SFG2540 V1 REV

BINH DINH PROVINCIAL PEOPLE'S COMMITTEE

COASTAL CITIES SUSTAINABLE ENVIRONMENT PROJECT (CCSEP)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

(Final Report)

Quy Nhon City Sub-Project

Hanoi, November 2016

BINH DINH PROVINCIAL PEOPLE'S COMMITTEE

COASTAL CITIES SUSTAINABLE ENVIRONMENT PROJECT (CCSEP)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

(Final Report)

Quy Nhon City Sub-Project

PROJECT MANAGEMENT UNIT **CONSULTING UNIT**

Hanoi, November 2016

CONTENT

LIST OF TABLES iv
LIST OF FIGURES vii
PREAMBLE……… 1
1. Subproject Background 1
1.1. Summary of Subproject Background 1
1.2. Approving Agency of the Feasibility Study 3
1.3. Related Projects and Master-Plannings 3
1.3.1. Related Master-Plannings 3
1.3.2. Related Projects 4
2. Legal and Technical basis for ESIA Preparation 6
2.1. Vietnam Legal Documents 6
2.2. World Bank’s Environmental and Social Safeguard Policies 9
2.3. Legal Documents of the Project 10
2.4. Documents and Data Prepared by the Project Owner 10
3. Organization of ESIA Preparation 11
3.1. ESIA Implementation 11
3.2. ESIA Preparation 11
4. Environmental and Social Assessment Methods 12
4.1. ESIA Method 12
CHAPTER 1. SUBPROJECT DESCRIPTION **14**
1.1. Subproject title: 14
1.2.Investor 14
1.3. Geographical Location of the Subproject 14
1.4. Objectives and Main Content of the Subproject 14
1.4.1. Objectives of Subproject 14
1.4.2. Item and Scope of Construction works 15
1.4.3. Construction method and technology 36
1.4.4. List of Construction Machines and Equipment 41
1.4.5. Subproject area of influence 41
1.4.5. Demand for Material 42
1.4.6. Subproject Implementation Schedule 44
1.4.7. Investment Capital 46
1.4.8. Subproject Implementation and Management 46
CHAPTER 2. NATURAL ENVIRONMENT AND SOCIO-ECONOMIC CONDITIONS...... .... **47**
2.1 Natural Environment Conditions 47
2.1.1 Geographical and Geological Conditions 47
2.1.2. Climatic and Meteorological Conditions 49
2.1.3. Hydrological/Oceanographical Conditions 50
2.1.4. Baselines of Physical Environment Components 51
2.1.5. Biological Resources 58
2.2. Socio-economic Conditions 63
2.2.1. Economic Condition 63
2.2.2. Social conditions 66
2.3 Current Infrastructure and Service 69
2.3.1. Traffic 69
2.3.2. Water Supply Condition 70
2.3.3. Drainage 70
2.3.4.Current flooding situation 71
2.3.5. Power Supply 72
2.3.6. Domestic wastewater treatment 72
2.3.7. Collection and Disposal of Solid Waste 72
2.3.8. Environmental Sanitation in the Subproject Area 73
2.3.9. Environmental and Social Conditions in Some of the Project’s Areas 73
CHAPTER 3. ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT **89**

3.1. Positive impacts 89
3.2. Potential negative impacts and risks 89
A. COMPONENT 1 92
A. 3.2.1. Pre-construction stage 92
A. 3.2.2. Construction Phase 93
A. 3.2.3. Operation Phase 114
B. COMPONENT 2 126
B. 3.2.1. Pre-construction Phase 126
B. 3.2.2. Impacts during Construction Stage 126
B.3.2.3. Operating Period of the Subproject 137
C. Site-specific Impact durding Construction Phase 140
D. Assessment of Cummulative Impacts 147
CHAPTER 4. ANALYSIS OF ALTERNATIVES 152
4.1. Environmental and Social Factors Considered in Feasibility Study 152
4.2. Analysis of Alternatives 154
CHAPTER 5. ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES......157
5.1. Measures to Be Integrated into the Detailed Technical Design 157
5.2. Mitigation Measures during Preparation Phase 159
5.2.1. Mitigation Measures for Land Acquisition Under Component 1 and 2 159
5.2.2. Mitigation of UXO risks 159
5.3. Mitigation Measures during Construction Phase 160
5.3.1. Mitigation Measures for General Impacts 160
5.3.2. Specific Mitigation Measures for the Specific Types of Works 160
5.3.3. Site-Specific mitigation measures during Construction Phase 167
5.4. Specific Mitigation Measures during Operation 177
5.4.1. Nhon Binh Wastewater Treatment Plant 177
5.4.2. Long My landfill 182
5.4.3. Other works 190
5.5. Measures to Mitigate Cumulative Impacts 191
5.6. Measures to Manage, Prevent and Respond to Risks and Incidents in the Subproject .192
5.6.1. Preparation Phase 192
5.6.2. Construction Phase 192
5.6.3. Operational Phase 193
CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN 197
6.1. Mitigation Measures for General Construction Impacts 197
6.2. Specific Mitigation Measures for the Specific Types of Works 213
6.3. Site-specific Impacts and Mitigation Measures 221
6.4. Specific Impacts and Mitigation Measures during Operation 245
6.4.1. Nhon Binh Wastewater Treatment Plant 245
6.4.2. Long My landfill 250
6.4.3. Other Works 257
6.4.4. Responsibilities for the implementation 259
6.5. Role and Responsibilities for ESMP Implementation 259
6.5.1. Implementation Arrangement 259
6.5.2. Environmental Compliance Framework 262
6.5.3. Estimated Costs for Each Work of Environmental Protection Measures 264
6.6. Environmental Monitoring Program 265
6.6.1. Monitoring Location, Parameters and Frequency 265
6.6.2. The estimated funding for environmental monitoring program 268
6.7. Capacity Building Program 269
6.8. Total Estimates 272
6.9. Grievance redress mechanism (GRM) 273
CHAPTER 7. PUBLIC CONSULTATION AND DISCLOSURE 277
7.1. Summary on the Implementation of Community Consultation 277
7.1.1. Summary on Community Consultation with Ward/Commune People's Committees 277

7.1.2. Summary the Process of Organizing Meeting for Advisory of Directly Affected Communities in the Project 277
7.2. Consultation Results 278
7.2.1. Local Authority's Opinions and Organizations to be Affected Directly by Project 278
7.2.2. Community's Opinions 279
7.2.3. Reply and Promise by the Subproject Owner 286
7.3. Information disclosure 288
CONCLUSION, RECOMMENDATION AND COMMITMENT 289
1. Conclusion 289
2. Recommendation 289
3. Committment 290
APPENDICES…… 291
Appendix 1. Assessment on material quarries' compliance with health and environment safeguard………… 292
Appendix 2. Due diligence of Nhon Binh WWTP 297
Appendix 3. Due diligence of Bau Lac WWTP 299
Appendix 4. Due diligence of Long My Landfill 301
Appendix 5. Sampling Location Map 304
Appendix 6. Dredging Material Management Plan (DMMP) 305

LIST OF TABLES

Table 0.1. Team members of ESIA Prepration 11
Table 1.1. Invested Construction Works of the Subproject 15
Table 1.2. Construction investment quantities for Phu Hoa canal 17
Table 1.3. Total investment volume of Hoc Ba Bep area 20
Table1.4.Investment quantity on Tran Hung Dao road 21
Table 1.5. Investment quantity on Bach Dang road 22
Table 1.6. Stormwater Drainage Systems 23
Table 1.7. Main parameters of input wastewater quality and treated wastewater quality 25
Table 1.8. Summary of the main components of the WWTP 25
Table 1.9. Quantity of leachate collection pipe 29
Table 1.10.Input and output parameters of leachate treatment station 30
Table 1.11. List of proposed schools for toilet construction 31
Table 1.12. Long My landfill liners 37
Table 1.13. Planned list of machineries and equipment 41
Table 1.14.Quantity of raw materials of the project 42
Table 1.15. Volume of excavated, dredged and backfilled soil 42
Table 1.16. Implementation plan for CCSEP – Quy Nhon city Subproject 45
Table 2.1. Maximum water level by annual cycle 51
Table 2.2. Monitoring Results of Ambinent Air Quality 53
Table 2.3. Results of Surface Water Quality 54
Table 2.4. Results of groundwater analyses 55
Table 2.5. Monitoring Results of Wastewater Samples 56
Table 2.6. Monitoring Results of Soil and Sediment Samples 57
Table 2.7. Current Land Use in the City 63
Table 2.8. Occupation of some households in the surveyed areas 64
Table 2.9.Living standards at survey areas by wards 65
Table 2.10. The population in the wards/communes of Quy Nhon city in 2014 66
Table 2.11. Cultural, historical and religious buildings in Quy Nhon city and its distance to the Project works 67
Table 2.12. Production, Trade and Waste Disposal (12/2014 - 5/2015) 73
Table 2.13.Sensitive locations along Phu Hoa canal to project’s construction item 76
Table 2.14. Sensitive locations on Tran Hung Dao street to project’s construction item 79
Table 2.15. Sensitive locations on Bach Dang Road to construction item of the project 82
Table 2.16. Sensitive locations on Bach Dang Road (part 2) to construction item of the project 83
Table 2.17.The current state of school toilet in Quy Nhon City 86
Table 3.1. Level of negative impacts to subproject’s works 90
Table 3.2. Forest land area and household’s name affected 92
Table 3.3. KPollution factor 93
Table 3.4. Load of pollutants from earthworks 93
Table 3.5. Meteorological data used forcalculating model 94
Table 3.6.The dust concentration generated in the process of digging and leveling 94
Table 3.7. Concentrations of pollutants generates from the digging and leveling activities 95
Table 3.8. Vehicle traffic 95
Table 3.9.Pollutants load generated from the excavated materials transportation process on each route 96
Table 3.10.Data sources used to calculate models 97
Table 3.11. Summary volume of transported materials 99
Table 3.12. Load of dust and exhause gases during transportation 100
Table 3.13. Level of noise caused by construction machines 101
Table 3.15. Noise level from construction machines to surrounded environment (dBA) 102
Table 3.15. Total noise level from construction vehicles(dBA) 102
Table 3.16. The special objects effected by noise, dust and gas pollutant 103
Table 3.17. Special objects impacted by noise pollution 103
Table 3.18. The mass of generated domestic waste and wastewater 104
Table 3.19. Pollutants load in domestic wastewater 105

Table 3.20. Pollutant from surface runoff during excavating, backfilling and levelling 106
Table 3.21. The volume of generated solid waste 107
Table 3.22. Amount of solid waste at each construction site.. 108
Table 3.23.Main subjects affected in traffic 112
Table 3.24.Noise levels from the operation of wastewater treatment plant spread around (dBA) 115
Table 3.25. The amount of solid waste generates from the wastewater treatment station................. 117
Table 3.26. The concentration of pollutants in untreated wastewater 118
Table 3.27. Load of pollutants discharged into Ha Thanh river 118
Table 3.28. Background environmental parameters to determine the capacity of receiving wastewater 119
Table 3.29. Maximum pollutant load of water sources 119
Table 3.30. Calculating pollutant load in wastewater... 120
Table 3.31. Calculating pollutant load in wastewater... 120
Table 3.32. Receiving capacity of the water sources.. 120
Table 3.33. Calculate the capacity of receiving wastewater of Ha Thanh River 120
Table 3.34.Air pollution emission coefficients of trucks.. 122
Table 3.35. Area and type of land to be acquired for theconstruction of Y-shaped bridge 126
Table 3.36. The total volume of construction supplies for road surface... 127
Table 3.37. The flow of material transportation vehicles for construction 02 bridges 127
Table 3.38. The volume of pollutants generated by the transportation process in each bridge 127
Table 3.39.The level of noise transferring from bridge construction equipment (dBA) 129
Table 3.40.Noise level caused by construction machineries (dBA) 130
Table 3.41.The pollutants concentration of wastewater in the construction of bridges...................... 131
Table 3.42.The pollutants concentration of wastewater bridge machine repairing and maintenance equipment 131
Table 3.43.Amount of pollutants cause by surface runoff in the area of construction bridge 132
Table 3.44. Main subjects affected in traffic 135
Table 3.45. Coefficient of environmental pollution due to transportation emission 137
Table 3.46. The volume of substances polluted by transportation in thebridge 138
Table 3.47.Forecast on pollutant concentration.. 138
Table 3.48.The average equivalent noise level of vehicle(L_{A7TC})... 140
Table 3.49. Particular noise levels at different distance from the noise source(dBA)........................ 140
Table 3.50. Site-specific impacts on key sensitive receptors.. 140
Table 3.51. Cumulative impacts in related to the proposed (sub)project 148
Table 3.52. Screening of cumulative environment impact of CCSEP.. 150
Table 4.1. The factors considered for selection of Nhon Binh WWTP's construction location......... 152
Table 4.2. Comparison for the cases "with" and "without" subproject 154
Table 4.3. Comparison for selection of Nhon Binh WWTP treatment techniques............................ 154
Table 4.4.Comparison for selection of Nhon Binh WWTP's treatment technologies....................... 155
Table 4.5. Comparison for selection of leachate treatment technologies 155
Table 5.1. Site-specific mitigation measures on key sensitive receptors.. 167
Table 6.1. Environmental Codes of Practices for addressing general construction impacts (ECOPs) 198
Table 6.2. Specific Mitigation Measures for the Specific Types of Works....................................... 213
Table 6.3. Specific Mitigation Measures for the Specific Types of Works....................................... 221
Table 6.4. Responsibilities for implementation of mitigation measures in operation phase 259
Table 6.5. Roles and responsibilities of key parties.. 260
Table 6.6. Regular Reporting Requirements 264
Table 6.7. Costs for environmental protection items 264
Table 6.8. Location, parameters and frequency of monitoring.. 265
Table 6.9. The total number of monitoring samples... 267
Table 6.10. The budget of monitoring 268
Table 6.11. Advanced training program on environmental monitoring management capacity.......... 271
Table 6.12. Estimated cost of EMP implementation (US $ million) 273
Table 6.13. Estimated costs of IEMC (Exchange rate: 1 USD = 22,230 VND)................................ 273
Table 7.1. Local authority's opinions and requirements... 278

Table 7.2. Community's opinions in 1st consultation 279
Table 7.3. Community's opinions in 2nd consultation 283

LIST OF FIGURES

Figure 0.1.Location of Quy Nhon city 1
Figure 0.2. Quy Nhon city Subproject investment items under the CCESP 2
Figure 1.1. Location of investment items in component 1 17
Figure 1.2. Investment scope of Phu Hoa canal 18
Figure 1.3. Current status of Phu Hoa canal 18
Figure 1.4. Investment scope of the upstream area of Bau Sen lake 19
Figure 1.5.The existing images of Bau Sen upstream ditch 20
Figure 1.6.Theinvestment scope of Hoc Ba Bep area 21
Figure 1.7.The investment scope and scale on Tran Hung Dao road 21
Figure 1.8. The investment scope of the sewers on Bach Dang road 22
Figure 1.9. Chart of household connection 24
Figure 1.10. The layout of the existing Nhon Binh WWTP and planned expanded area 26
Figure 1.11. Layout of the expanded Nhon Binh WWTP 27
Figure 1.12.The planning lay-out of Long My landfill 28
Figure 1.13. Bed lining structure of A-4 cell (A-4 cell) 29
Figure 1.14. Location of the pumping station at pile T50 31
Figure 1.15. The layout plan of Component 2 construction items 32
Figure 1.16. Current status of the existing Y-shaped bridge 33
Figure 1.17. Current status of location of future Huynh Tan Phat bridge 34
Figure 1.18. Long My landfill 36
Figure 1.19. Natural and Socio-economic Settings in the Subproject Area 40
Figure 1.20.Diagram of Subproject Management Organization 46
Figure 2.1. Map of Ha Thanh river basin in Quy Nhon city 50
Figure 2.2. Map of Sampling Location 52
Figure 2.3. Terrestrial species at Y-shaped and Huynh Tan Phat bridge areas 60
Figure 2.4. Terrestrial species around Nhon Binh WWTP areas 61
Figure 2.5. View at the New Cell of Long My landfill 61
Figure 2.6. Current drainage zoning of Quy Nhon city 70
Figure 2.7. Location of the 02 currently flooded area in Quy Nhon city 71
Figure 2.8. Diagram of Phu Hoa canal 75
Figure 2.9. Diagram of the drain upstream of Bau Sen Lake 77
Figure 2.10. Tran Hung Dao Street diagram 79
Figure 2.11.Hoc Ba Bep area current state 80
Figure 2.12.Route maps, the current status and socio-economic entities in Bach Dang street, section 1 81
Figure 2.13. Bach Dang Road diagram, part 2 from the intersection between Pham Hong Thai-Bach Dang Road to the intersection between Phan Dinh Phung-Bach Dang Road 82
Figure 2.14.Current status of Long My landfill surroundings 83
Figure 2.15. Current status of landfill site and leachate treatment pond-Long My landfill 85
Figure 2.16. Current state of Huynh Tan Phat Bridge’s construction area 87
Figure 2.17. Current status of construction area of future Huynh Tan Phat bridge 88
Figure 3.1. Average TSP concentration in the rainy season – Long My landfill (mg/m^3) 97
Figure 3.2. Average TSP concentration in the dry season – Long My landfill (mg/m^3) 98
Figure 3.3. Average TSP concentration in the rainy season – Nhon Binh WWTP WWTP (mg/m^3) .. 98
Figure 3.4. Average TSP concentration in the dry season – Nhon Binh WWTP WWTP (mg/m^3) 98
Figure 3.5. Average TSP concentration in rainy season – Tran Hung Dao road (mg/m^3) 100
Figure 3.6. Average TSP concentrationin dry season – Tran Hung Dao road (mg/m^3) 101
Figure 3.7. Average TSP concentration in the rainy season - Y-shaped bridge (mg/m^3) 128
Figure 3.8. Average TSP concentration in the dry season - Y-shaped bridge (mg/m^3) 128
Figure 3.9. Average TSP concentration in rainy season - Huynh Tan Phat bridge (mg/m^3) 128
Figure 3.10. Average TSP concentration in dry season-Huynh Tan Phat bridge (mg/m^3) 129
Figure 6.1. Organization chart for ESMP Implementation 260

PREAMBLE

1. Subproject Background

1.1. Summary of Subproject Background

Quy Nhon is a coastal city in Binh Dinh province in central Vietnam. It is 1,065km far from Hanoi in the North, and 650km from Ho Chi Minh City in the South. Quy Nhon is a political, economic, cultural, scientific, technical and tourist hub of Binh Dinh province in particular and of the Vietnam Central part in general. The location of Quy Nhon City is shown in Figure 0.1 below.

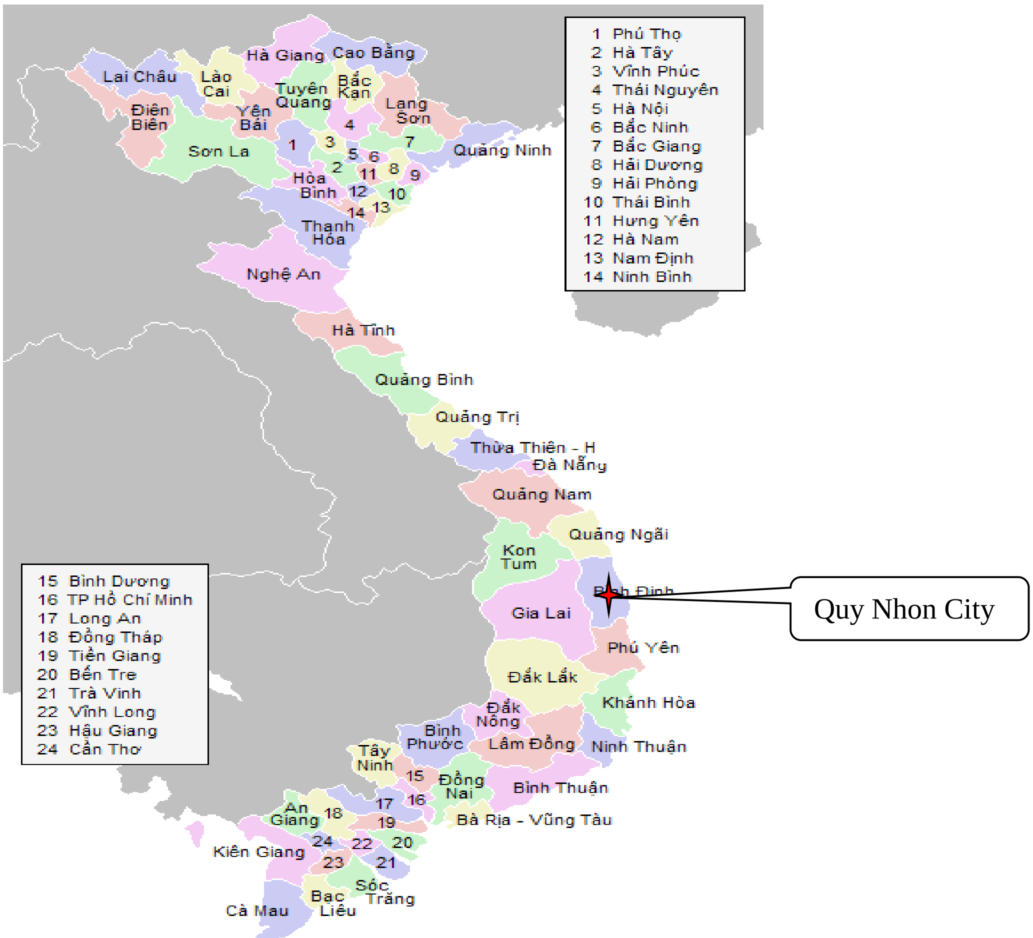


Figure 0.1.Location of Quy Nhon city

From 2006 to 2014, the Coastal Cities Environmental Sanitation Project (CCESP) funded by World Bank (WB) was implemented in the three coastal cities of Quy Nhon (Binh Dinh province), Nha Trang (Khanh Hoa Province), and Dong Hoi (Quang Binh province). The total investment for Quy Nhon subproject under the CCESP was USD 74.8 million. Quy Nhon subproject included 6 components: (1) Flood, drainage control and wastewater collection; (2) Construction of wastewater treatment plant; (3) Solid waste management; (4) Land compensation, clearance and resettlement; (5) Household revolving fund and school sanitation program; and (6) Capacity building and project implementation support.

The location of these components and items are described in Figure 0.2:

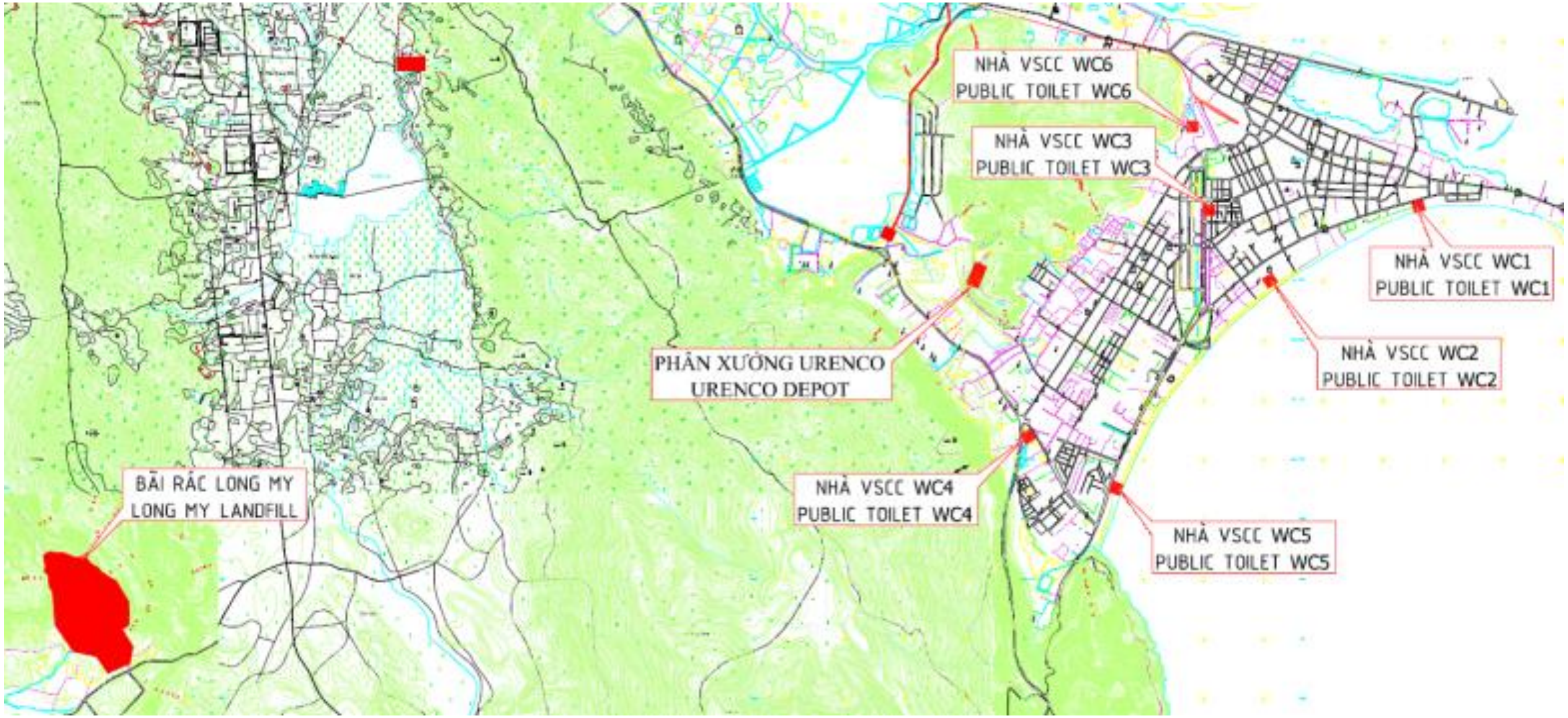


Figure 0.2. Quy Nhon city Subproject investment items under the CCESP

The Quy Nhon City Environmental Sanitation Subproject was completed in November 2014 and was highly evaluated by the WB. During its implementation, the subproject was downsized from its original design due to economic crisis and inflation, i.e. a scale-down of the area for installation of rainwater and wastewater collection system; reduced capacity of Nhon Binh wastewater treatment plant (WWTP) from 28,000m^3/day to 14,000m^3/day; Scaled down capacity of Bau Lac WWTP from 4,700m^3/day to 2,350 m^3/day; and reduced capacity of the solid waste landfill from 2.7 million m^3 to 0.92 million m^3.

To maintain the efficient investment and to strengthen institutional reform programs in the area of environmental sanitation of the participating coastal cities, the Goverment (GoV) has proposed to the WB a new project - Coastal Cities Sustainable Environmental Project (hereinafter referred to as the CCSEP). The Project will be implemented in the four coastal cities of Nha Trang, Dong Hoi, Quy Nhon, and Phan Rang - Thap Cham (NinhThuan province).

The lessons learnt as well as environmental good practices of CCESP will be described and incorporated in the chapters of this ESIA.

1.2. Approving Agency of the Feasibility Study

Approving agency: People's Committee of Binh Dinh Province.

Contact address: No. 1 Tran Phu Street, Quy Nhon City, Binh Dinh Province, Vietnam

Tel.: 056.3822294

Email: vpubbinhdinh@vpub.binhdinh.gov.vn

1.3. Related Projects and Master-Plannings

1.3.1. Related Master-Plannings

a.Adjusted Construction Master-plan of Quy Nhon city and its peripheral areas until 2035, vision to 2050

According to Decision No. 495/QD-TTg dated 14/04/2015 by the Prime Minister adjusting the construction master plan of Quy Nhon city and its peripheral areas until 2035, vision to 2050, covering an area of about 67,788 ha including the existing Quy Nhon City.

Given the orientation until 2025 that Quy Nhon city will become one of the major urban areas in the Vietnam Central Coastal Region, with a developed economy, based on industrialization - seaport - service - tourism; and by 2035 it will be one of the national coastal economic hubs; with its developed economy based on service - seaport - industrialization – tourism with a focus on service and sea port; infrastructure development and environmental quality assurance are essential to future sustainable development. Accordingly, the project will supports the general planning objectives of Quy Nhon City.

b. Quy Nhon City Drainage Planning up to 2020 and vision to 2050, taking into account of climate change impact.

The goals of the Quy Nhon City Drainage Planning up to 2020 and vision to 2050 are to control flooding and inundation, protect the environments, reuse water source and adapt to climate change. Open channels and ditches, and main culvert route will be installed to accommodate a 10-year flood and 5-year flood frequency, respectively. The Quy Nhon CCSEP Sub-project will construct stormwater drainage systems along Bach Dang, Tran Hung Dao, Hoc Ba Bep routes and the tertiary wastewater collection networks, thus ensuring environment sanitation and controlling inundation. Therefore, the implementation of the Sub-project completely matches with the planning goal of Quy Nhon city 2020, vision to 2050

c. Detailed planning of Phu Hoa Lake urban - tourism - culture - sport area at 1:500 scale.

The planned area borders with: (i) Ba Hoa mountain to the East; (ii) the residential area of Nhon Phu Ward and 48m planned road to the West; (iii) the 1D National Highway and Hoang Van Thu street and residential area of Quang Trung ward to the South; (iv) Hung Vuong street, Doi bridge and Ha Thanh River to the North.

The total area to be expanded is around 324.17 ha aiming at urban embellisment, ensuring environmental sanitation and contributing to a better living condition for people settling in the planning area. The CCSEP will construct twin box culvert system at Phu Hoa canal, lying in the planning of Phu Hoa Lake. Constructing dual box culvert system at Phu Hoa canal is to mitigate offensive odor spreading over the surrounding areas, thus reducing negative impacts for the urban area of Phu Hoa lake. Therefore, the implementation of the project completely matches with the planning goal of Phu Hoa Lake at 1:500 scale

d. Urban Solid Waste Management Master Plan in the province to 2020

The Urban Solid Waste Management Master Plan of the province up to 2020 includes 01 solid waste treatment station for each district, city and commune (including Phuoc My commune) to enhance solid waste management capcacity and ensure environmental sanitation. The subproject will expand A4 cell at Long My landfill, Phuoc My town with the area of 8.51 ha to treat domestic solid wastes within Quy Nhon City, thereby strengthening urban solid management capcacity, ensuring environmental sanitation. Thus, subproject completely matches with Urban Solid Waste Management Master Plan in the province to 2020.

1.3.2. Related Projects

a. Coastal Cities Environment Sanitation Project (CCESP)

This project continues the CCESP funded by WB which was implemented from 2006 to 2014 to solve inundation of Quy Nhon inner city to collect and handle domestic wastewater to mitigate water pollution, to collect and treat solid wastes, towards sustainable development in the future and maintaining the efficiency of environmental investment projects.

<u>Lessons learned from the project implementation:</u>

Quy Nhon City subproject under the CCESP was implemented in accordance with the planned progress and achieved almost all the subproject initial objectives. The subproject was highly evaluated in terms of implementation progress and environmental quality by the World Bank and the line ministries.

Belows are the key lessons learned from the CCESP implementation, in regard to the management of environmental and social issues:

- *The selection of construction locations:*
    - For the sewerage drainage section, it is necessary to follow the available routes for ease of construction and installation of pipelines. With respect to the WWTP construction, in associated with social, environmental and scalability criteria in the future, information disclosure and public consultation were adequately and timely provided during the stages of subproject preparation that played a very important role.

- The locations of Nhon Binh WWTP phase I were well considered with the isolation distance of 300m from residential areas to ensure the compliance with the government regulation. Further, preventive measures to mitigate environmental and social impacts and risks were mainstreamed into the technical designs and budgets of the subproject; due attention was paid to the green landscapes within and around the plant such as green corridors in order to elaborate the landscape and to separate the treatment zone from the outside land area.

▪ *The major environmental and social impacts* which occurred during the period of subproject implementation, the mitigation measures and lessons learned from the project implementation include:

- The Larssen sheet piling measure was applied for avoiding subsidence risk. Sheet piles were reused after the ground leveling to serve pile construction and walls retaining.
- Dust generated from the construction of sewer section, plants was significantly reduced by the deployed mitigation measures such as (1) immediate site cleanup and restoration upon the completion of construction; (2) adequate water spray during construction; (3) appropriate construction schedule to avoid affecting rest hours of the local residents; and (4) adequate personal protective equipment provided for workers.
- Dust generated from transportation vehicles was minimized significantly by the implementation of the following mitigation measures: (1) Cleaning of transport vehicles; (2) Spray water in the areas with densely transport routes and traffic activities; (3) Covering vehicles with canvas; (4) Controling vehicles speed in accordance with the regulations.
- Measures to ensure traffic activities for community safety: (1) Constructing section by section with the roadbed completion for residents‘ premises immediately upon the completion of constrution to ensure accessibility of residents to their houses; (2) Conducting side by side construction for roads where the sewer sections are on both sides; (3) Placing construction signs at the starting and ending points of the construction section; (4) Fencing-off sewer construction areas with ropes; (5) Preventing the spillage of soil and rock over roads and roadsides.
- Social impacts were mitigated by: (1) Bridging temporary planks or concrete plates to ensure residents' accessibility to their houses, and daily businesses, (2) Speeding up the construction of sewer sections to minimize the impacts on the daily life and business of the households near the construction area; (3) Coordinating with the local authorities to propagandize the importance of the project and the environmental benefits for which they will enjoy upon the completion of the project; (4) Performing mitigation measures to minimize environmental impacts on people's health, livelihoods and business activities in the construction areas.

▪ During the operation phase, periodical supervision mission was conducted for the landfill and WWTPs twice a year. Monitoring results were filed and reported to the relevant government authorities.

What can be done better in the new sub-project:

For the better implementation of the new subproject, apart from above-mentioned environmental and social impact mitigation measures as adopted by subproject under CCSEP, attention should be paid to the followings:

(1) The requirements of EMP performance should be an integral part of contract terms to ensure EMP compliance.

(2) It is necessary to select material supply sources which are nearest to the construction areas and which have obtained licenses to ensure the safety and performance of measures to mitigate negative impacts on the environments.

(3) Sludge and excavated soil need to be reused appropriately. Those can not be utilized should be disposed of at a proper site.

(4) Regarding the construciton of the pumping stations, it is worthy to note that construction sites should be fenced-off after the construction and while awaiting equipment and power systems installation to avoid dangers for local residents. In addition, environmental- friendly equipment and software application should be prioritized to save power and to ensure the sustainability of facilities.

(5) The site restoration of the sewer sections should be immediately implemented by Contractors to prevent dust especially in the dry season.

(6) The role of Construction Supervision Consultants (CSC) is very important because CSC is the daily supervisor and supporter of the Contractors. In case of arising environmental safeguard problems, the CSC and Contractors need to discuss the feasible and effective solutions, counter sign the incidence resolving minutes and report to the Project Management Unite (PMU). If the Contractors intentionally violate, the CSC should recommend the PMU apllying fine/punishment conditions, and impose stronger sanctions if the Contractors continue their violation.

b. Project on Technical Infrastructure of the Areas Along the Extended Hoa Lu Street

The goals of this project is to exploit the land resource along the extended Hoa Lu street to serve the demand for housing, create landscape, prevent land transgression and to arrange resettlement areas and beautify the areas along Ha Thanh river, within Dong Da ward. The progress timeline is from 2015 to 2017 with the following civil works: construction of road with 471.51 m in length, and auxiliary works such as power supply system, wastewater drainage system and domestic water supply system. The project will be implemented within Dong Da ward, Quy Nhon city, Binh Dinh province. The location of this project overlaps the construction areas of the Y-shaped and Huynh Tan Phat bridges within Quy Nhon subproject under the CCSEP.

2. Legal and Technical basis for ESIA Preparation

2.1. Vietnam Legal Documents

Administrative framework on Environmental Assessment

Law on Environmental Protection (No.55/2014/QH13) dated June 23, 2014 and Decree on Environmental Protection Planning, Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Plans (No. 18/2015/ND-CP) dated February 14, 2015 are key legal frameworks for environmental management in Vietnam. Law on Environmental Protection (LEP) provides statutory provisions on environmental protection activities; measures and resources used for the purpose of environmental protection; rights, powers, duties and obligations of regulatory bodies, agencies, organizations, households and individuals who are tasked with the environmental protection task. LEP is applicable to regulatory bodies, public agencies, organizations, family households and individuals within the territory of the Socialist Republic of Vietnam, including mainland, islands, territorial waters and airspace. LEP is on regulating strategic environmental assessment, environmental impact assessment and environmental protection commitment.

Furthermore, the law also indicated to consultation on, inspection and approval of the planning for environmental protection (Article 11, chapter II) as well as the list of entities subject to strategic environmental assessment in appendix I and II of the Decree No. 18/2015/ND-CP dated February 14, 2015 of the Government.

The Article 13 of the Decree (No. 18/2015/ND-CP) explains the requirement of the pertaining ESIA agencies. Clause 1: the project owner or the advisory organization conducting ESIA must meet all requirements – (a) there are staff members in charge of ESIA meeting requirements prescribed in Clause 2 of this Article; (b) there is specialist staff members related to the project obtaining at least Bachelor‘s degrees; and (c) there are laboratories, inspection and calibration devices eligible for performing measurement, sampling, processing and analysis of environmental samples serving the ESIA of the project; if there is not any laboratory with decent equipment for inspection and calibration, it is required to have a contract with a unit capable of carrying out inspection and calibration. Clause 2: the staff members in charge of ESIA must obtain at least Bachelor‘s degrees and Certificate in ESIA consultancy and Clause 3: the Ministry of Natural Resources and Environment shall manage the training and issuance of Certificates in consultancy of ESIA.

The project does not involve wetlands and natural protected areas, neither does it relate to emission of persistent organic pollutants or international trade in endangered species of wild fauna and flora. Therefore, no relevant international environmental agreements to which Vietnam is a party would apply.

- Law on Environmental Protection (LEP) No. 55/2014/QH13 ratified by the National Assembly of the Socialist Republic of Vietnam on June 23, 2014;
- Land Law No. 45/2013/QH13 dated 29 November 2013;
- Investment Law No. 67/2014/QH13 ratified by the National Assembly of the Socialist Republic of Vietnam on November 26, 2014;
- Construction Law No. 50/2014/ QH13 ratified by the National Assembly of the Socialist Republic of Vietnam on June 18, 2014;
- Law on Water Resources No. 17/2012/QH13 ratified by the National Assembly of the Socialist Republic of Vietnam on June 21, 2012;
- Law on Standards and Technical Regulations No. 68/2006/QH11 ratified by the National Assembly of the Socialist Republic of Vietnam on June 29, 2006;
- Decree No. 18/2015/ND-CP dated April 1, 2015 of the Government promulgating environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan;
- Decree No. 19/2015/ND-CP dated 14 May 02, 2015 of the Government detailing the implementation of some articles of the Law on Environmental Protection.

- Decree No. 201/2013/ND-CP dated November 27, 2013 of the Government detailing the implementation of some articles of the Law on Water Resources.
- Decree No. 127/2007/ND-CP dated August 1, 2007 of the Government stipulating the implementation of some articles of the Law on Standards and Technical Regulations.
- Decree No. 80/2014/ND-CP dated August 6, 2014 of the Government stipulating drainage and waste water treatment.
- Decree No. 03/2015/ND-CP dated 06 May 2015 of the Government on the environmental damage assessment.
- Decree No. 59/2015/ND-CP dated June 18, 2015 of the Government on construction project management.
- Decree No. 38/2015/ND-CP dated April 24, 2015 of the Government on the management of waste and scrap.
- Decree No. 179/2013/ND-CP dated December 30, 2013 of the Government on sanctioning of administrative violations in the field of environmental protection.
- Decree No. 43/2014/ND-CP dated May 15, 2014 of the Government detailing the implementation of some articles of the Law on Land.
- Decree No. 44/2014/ND-CP dated May 15, 2014 of the Government regulating land prices.
- Decree No. 45/2014/ND-CP dated 05/15/2014 of the Government providing the collection of land use levy.
- Decree No. 46/2014/ND-CP dated 05/15/2014 of the Government providing the collection of land and water surface lease.
- Decree No. 47/2014/ND-CP dated 05/15/2014 of the Government regulating compensation, support and resettlement upon land acquisition by the State.
- Decree No. 84/2013/ND-CP of the Government on management of housing development and resettlement;
- Decree No. 16/2016/ND-CP dated 03/16/2016 of the Government on the management and use of official development assistance (ODA) and preferential loans from donors;
- Circular No. 27/2015/TT-BTNMT dated May 29, 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plan.
- Circular No. 36/2015/TT-BTNMT dated June 30, 2015 of the Ministry of Natural Resources and Environment on hazardous waste management.
- Circular No. 36/2014/TT-BTNMT dated 06/30/2014 of MONRE on land pricing method; compilation of and adjustment to land price lists; determination of specific land prices and consultancy on land pricing.
- Circular No. 37/2014/TT-BTNMT 06/30/2014 MONRE detailing regulations on compensation, support, and resettlement upon land expropriation by the State.
- Decision No. 63/2015/QD-TTg of the Prime Minister dated 10/12/2015 on policy on assistance in vocational training and job search for workers whose land is acquired.

- Decision No. 1956/2009/QD-TTg of the Prime Minister dated 17/11/2009 approving the project on "Vocational training for rural workers by 2020".

Applicable standards and regulations:

- QCVN 05:2013/BTNMT: National Technical Regulation on Ambient Air Quality;
- QCVN 50:2013/BTNMT: National Technical Regulation on Hazardous Thresholds for Sludges from Water Treatment Process;
- QCVN 06:2009/BTNMT: National Technical Regulation Ambient Air Quality. Maximum allowable concentration of hazardous substances in ambient air;
- QCVN 26:2010/BTNMT: Acoustics – Noise in public and residential areas –Permissible noise levels.
- QCVN 08-MT:2015/BTNMT - National Technical Regulation on Surface Water Quality .
- QCVN 09-MT:2015/BTNMT - National Technical Regulation on Groundwater Quality.
- QCVN 03-MT:2015/BTNMT - National Technical Regulation on the allowable limits of heavy metals in the soils.
- QCVN 19:2009/BTNMT – National Technical Regulations on industrial emissions for dust and inorganic substances.
- QCVN 20:2009/BTNMT – National Technical Regulation on Industrial Emission of Organic Substances.
- QCVN 07:2009/BTNMT- National Technical Regulation on Hazardous Waste Threshold
- QCVN 14:2008/BTNMT- National Technical Regulation on domestic wastewater.
- Viet Nam Building Code QCXDVN 01: 2008/BXD compiled by Vietnam Institute for Urban and Rural Planning, approved by Science and Technology Department, issued under Decision No. 04/2008/QD-BXD dated 3 April 2008 by the Ministry of Construction.

2.2. World Bank's Environmental and Social Safeguard Policies

The environmental and social screening for the subproject according to the criteria defined by the Bank's safeguards policieshas been carried out, and the result shows that the WB policies on Environmental Assessment (OP/BP 4.01)[1], Natural Habitats (OP/BP 4.04)[2]; Physical Cultural Resources (OP/BP 4.11); and Involuntary Resettlement (OP/BP 4.12)[3] are triggered for this subproject. The subproject has also to comply with the WB's requirements on public consultation and disclosure of information required by the relevant safeguard

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

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

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

pocilices and in accordance with the Bank's Policy on Access to Information. The implementation of the policy on OP/BP 4.12 is addressed in details in the Resettlement Policy Framework (RPF) of the CCSEP project, and the Resettlement Action Plan (RAP) of this subproject. The subproject requires acquisition of 196,937m^2 of land area used for planting acacia in the landfill site. Although this land has been classified as forest land handed over to the local people for the exploitation and planting purposes, it does not maintain any natural forests. The subproject does not involve forest plantation or management and would not (i) have the potential to have impacts on the health and quality of forests; (ii) affect the rights and welfare of people and their level of dependence upon or interaction with forests; or (iii) aim to bring about changes in the management, protection or utilization of natural forests or plantations, whether they are publicly, privately, or communally owned. Therefore, the Bank's policy on Forests (OP/BP 4.36) is not triggered for this subproject.

The environmental and social screening and the detailed ESIA confirmed that the proposed subproject is classified as Category A because of its potential significant adverse environmental and social impacts.

World Bank Group Environmental, Health, and Safety Guidelines[4]

World Bank-financed projects should also take into account the World Bank Group Environmental, Health, and Safety Guidelines (known as the "EHS Guidelines"). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice.

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

2.3. Legal Documents of the Project

- Decision no. 582/QD-TTg dated 6 April, 2016 by Prime Minister regulating the approval of the sub-project portfolios of "Coastal cities' sustainable environment", financed by WB loan.

2.4. Documents and Data Prepared by the Project Owner

- Feasibility study of the project
- Resettlement Report of the project
- Socio-economic Report of the project
- Environmental impact assessment (EIA) reports already carried out for the sub project of Quy Nhon city includes: (1) EIA report of CCESP project – Quy Nhon city subproject (stage 1) approved by World Bank and Binh Dinh PPCs in May, 2006; (2) EIA report of CCESP project – Quy Nhon city subproject – components 1, 2 and 5 (stage 2) approved by the World Bank and Binh Dinh PPCs in June and November, 2010, respectively; (3) EIA report of CCESP project – Quy Nhon city subproject – component 3 (stage 3)

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

approved by World Bank and Binh Dinh PPCs in September and December, 2011, respectively

3. Organization of ESIA Preparation

The Consultant conducts ESIA: Vietnam Water, Sanitation and Environment Joint Stock Company (VIWASE).

In the course of ESIA preparation, the Consultant has closely coordinated with the investor representative, Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit (Binh Dinh CIW PMU)

3.1. ESIA Implementation

Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit signed the contract with the VIWASE for preparing ESIA.

– *The Investor :* Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit

Address: No. 379 Tran Hung Dao street, Quy Nhon city, Binh Dinh province.

Tel.: (84) 56 3822859; Fax: (84) 56 3817249

Representative: LE VAN LICH Position: Director of PMU

– *The Consultant preparing the EIA report:* Vietnam Water, Sanitation and Environment Joint Stock Company.

Address : No. 5, Thanh Street, Hoan Kiem District, Hanoi.

Tel. : 04.38242873 Fax: 04.38641564

Representative: LE VAN TUAN Position: General Director.

3.2. ESIA Preparation

The Environmental and Social Impact Assessment Report for Coastal Cities Sustainable Environmental Project (CCSEP), Quy Nhon city Subproject is carried out as follows:

Table 0.1. Team members of ESIA Prepration

No	Full name	Qualification	Position assigned
1	Mr. Tran Dong Phong	Environmental technical engineer	Team leader/ Environmental and/or social senior specialist
2	Mr. Nguyen Manh Khai	Ph.D in Environmental Chemistry	Environmental specialist
3	Mr. Le Truong Giang	Ph.D in Chemistry and Water Microbiology	Ecological specialist
4	Mr. Le Ba Viet Bach	Master in Environmental Engineering	Environmental modeling specialist
5	Mrs. Duong Thi Dien	Engineer in Environmental Technology	Chemistry/analysis specialist
6	Mrs. Ho Thi Huong	Master in Environmental Science	Resettlement specialist
7	Mrs. Nguyen Ngoc Huy	Master in Sociology	Social/community specialist

4. Environmental and Social Assessment Methods

The ESIA of the Sub-project is prepared in parallel with its feasibility study to identify, assess impacts and propose measures to prevent, reduce and control potential negative environmental and social impacts, which can occur during the project implementation. Environmental friendly solutions towards sustainable development are also considered during the preparation and implementation of the Subroject.

The ESIA is conducted in accordance with the Environmental and Social Safeguard Policies of the World Bank and the relevant policies of the Government of Vietnam .

The ESIA report is drafted on the basis of combining the following methods:

4.1. ESIA Method

The following methods were deployed to carry out the ESIA report:

- *Checklist*: is a behaviorally based approach to performance appraisal that requires raters to observe ratees' behavior and record performance-related judgments about these behaviors. In this approach to performance appraisal, a list of job-relevant behaviors is developed. Raters are asked to record whether or not each behavior has been performed by the ratee orthe degree to which each item describes the person being evaluated for economic-social investigation.
- *Matrix:* This method was applied to identify factors having impact on the environment and screen these factors; Factors under assessment are identified based on the understanding and screening of the various aspects of the affected areas, risks, causes and magnitude of impacts etc.
- *Modelling:* used to forecast the project impacts during the environmental impact assessment.
- *Rapid assessment:* use pollution co-efficients to assess rapidly the pollutant emission load
- *Expert Method:* utilize the knowledge of user experience professionals in evaluating environmental-economic-social issues as well as technology isues. Experts can also evaluate "difficult" materials such as product specifications or early prototypes with many technical problems. Basic problems can be avoided by conducting an expert evaluation before a more expensive user study.
- Statistics and data analysis; Data processing and analyzing method: used to collect and analyze hydrological, climate, environmental, geological and socio-economic data of the project area. Answers from the questionnaires (structured questionnaire) are processed by SPSS (Statistical Package for Social Sciences) and the qualitative information are analyzed via two ways: (i) by using directly the on-site technique as appropriate; (ii) The quotes and case studies are used to clarify further the quantitative information.
- *Public consultation and qualitative method:* The purposes of two methods are to generalize and gather the social-economic and environmental current status and collect opinions and suggestions with regards to the project design, impacts, and mitigation measures by the local authorities and people.
- *Sociological surveys:* conducted in 3 weeks from February 17-29, 2016 with 851 households in 8 out of 16 wards in Quy Nhon City. 6 wards where the main

construction will take place i.e. Dong Da, Tran Hung Dao, Quang Trung, Le Hong Phong, Nhon Binh and Phuoc My, and two wards i.e. Ngo May and Tran Quang Dieu were selected to carry out the survey. The two latter represented those wards where construction for only the tertiary sewer system connection will take place.

- *Site investigation and sampling:* applied to collect and analyze water samples (wastewater, surface water, groundwater); air, noise, vibration, and sludge. Environmental monitoring processes were carried out according to Vietnamese regulated standards to assess the current status of the environment in the project area.
- *Comparison:* used to assess environment impacts and current status by comparing environmental monitoring data and collected data with the Vietnamese standards and regulations.
- *Deskstop study:* The review and analysis of documents related to the project provided baseline information about the project and help explain why such changes or why not. On the other hand, it also helps to identify data gaps for further collection and assessment.
- *Quantitative method:* Survey questionnaires and tables for the local government in the project wards/communes, socio-economic survey for households were carried out via interviews using structured questionnaire.

CHAPTER 1. SUBPROJECT DESCRIPTION

1.1. Subproject title:

Subroject title: Coastal Cities Sustainable Environment Project – Quy Nhon City Subproject (CCSEP)

1.2.Investor

The Investor: Binh Dinh Province People's Committee

The Investor's Representative Agency: Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit (Binh Dinh CIW PMU)

The investor's Representative: Mr Le Van Lich – Position: Director of : Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit (Binh Dinh CIW PMU).

Correspondent address: No.379 Tran Hung Dao street, Quy Nhon city, Binh Dinh province.

Tel: (84) 56 3822859; Fax: (84) 56 3817249

1.3. Geographical Location of the Subproject

The Coastal Cities Sustainable Environment Project (CCSEP) – Quy Nhon City Subproject will be implemented in an area covering 16 wards and 4 communes including Phuoc My, Nhon Ly, Nhon Hai and Nhon Hoi of Quy Nhon city.

Project's geographical location

Quy Nhon city is geographically located at $13^0$46' North (latitude), $119^0$14' East (longitude) atthe Southern end of Binh Dinh Province. It borders Tuy Phuoc and Phu Cat districts to the north, Song Cau District, Phu Yen on the South, the East Sea on the East, and Tuy Phuoc district on the West. It is 1,065 km south of Hanoi, 650km north of Ho Chi Minh city.The National Highway No. 1 and trans-Vietnam railway go through the city and its airport has regular flights to Hanoi and Ho Chi Minh City.

1.4. Objectives and Main Content of the Subproject

1.4.1. Objectives of Subproject

The overall objectives of the subproject are to ensure the effectiveness and sustainability of environment project investment and to strengthen the institutional reform program related to environmental sanitation of the city.

Accordingly, the specific objectives of the subproject are: (i) Renovate stormwater drainage system of the city centre for flood control; (ii) Improve environmental sanitation conditions by constructing and development of wastewater collection system, enhancing connections from household septic tanks to the sewerage system; (iii) Solve environmental pollution caused by wastewater via expanded construction of WWTPs; (iv) Build waste collection and transportation capacity; (v) Minimize environmental pollution caused by solid waste by constructing sanitary solid waste landfill; (vi) Build capacity by providing with tools and equipment for the management of the sewerage system and WWTP, improving solid waste management capability, training operational staff to maintain and operate constructions effectively while consolidating organisatonal structure; (vii) Contribute to the completion and development of urban infrastructure and landscape in order to meet development needs of the city during 2010 - 2020; and (viii) Raise public awareness on environmental protection.

1.4.2. Item and Scope of Construction works

The sub-project consists of 4 components: Component 1 – Sanitation Infrastructure; Component 2 – Environmental Infrastructure; Component 3 – Resettlement and Site Clearance; and Component 4 – Technical assistance and Institutional Reform.

The investment works of the subproject are summarized in Table 1.1 below:

Table 1.1. Invested Construction Works of the Subproject

Civil Construction Works	Main Specification	Construction Location
Component 1: Sanitation infrastructure		
Renovating wastewater drainage ditch upstream of Bau Sen lake	Freestone ditch length of 1,076m with dimensions: B=1,000–1,400mm, B=1,500mm, B=1,400mm, Depth: 1.4m	Le Hong Phong ward and Ngo May ward
Constructing box culvert for stormwater drainage of Phu Hoa canal	Twin box culvert BxH = 2x3,000x1,800 mm and 2x3,000x2,200mm. L =1,193 m	Quang Trung ward
Constructing rain-water drainage culverts at Hoc Ba Bep area	Box culvert length 780m with size BxH=600x1,000mm;BxH=1,000x1,200mm; BxH=800x1,000mm	Dong Da ward
Constructing stormwater drainage culverts at Tran Hung Dao road	Stormwater sewer: Box culvert size 2,000x1,600mm; 3,000x1,600mm and pipe culvert D800-1,500mm with total length L=1,401m.	Tran Hung Dao road, Dong Da ward, Tran Hung Dao
Constructing stormwater drainage culverts at Bach Dang road	Box culvert B600x600mm and pipe culvert D600-800mm with total length L= 634.2m	Bach Dang road, Tran Hung Dao ward
Constructing tertiary culvert network[5]	Constructing tertiary culvert network B600x400 và D250-D300mm with total length L = 30,000 m	Wards and communes of Quy Nhon city
Upgrading capacity of Nhon Binh wastewater treatment plant	Increasing capacity of Nhon Binh wastewater treatment plant from 14,000m^3/day to 28,000m^3/day	Nhon Binh ward
Expanding Long My landfill	Constructing one cell (A-4) with an area of 8.51ha; internal road; stormwater drainage; leachate collection; gas collection system; equipment purchase; upgrading leachate treament station	Thanh Long Village, Phuoc My Commune
Constructing wastewater booster pumping station to Bau Lac wastewater treament plant	Including 04 submersible pumps, reinforced concrete air booster station, synchronous pipeline, valve, stopcock system at air booster. Construction area of leachate pumping station: 9.45m^2 and booster pumping station: 10.5m^2.	Phuoc My commune
Constructing school toilets	12 new school toilets	Phuoc My , Nhon Hai, Nhon Lyand Nhon Hoi commune, Le Loi, Dong Da, Bui Thi Xuan, Nhon Phu wards
Component 2: Environmental Infrastructure		
Constructing Y shaped bridge	Total length L= 88.98m with 4 spans, each span with length L_n = 20m and 68 piles.	Dong Da ward
Constructing Huynh Tan Phat bridge	Total length L= 90.25m with 5 spans, each span with length L_n = 20m and 85 piles.	Dong Da ward

[5] Culvert to collect domestic wastewater to the city's drainage system

Component 3: Resettlement and Site Clearance		
(no work items to be constructed under this Subproject)	The subproject will not build a separated resettlement site, but will acquire 196 937 m^2 forestry land of 6 households at Long My landfill (for the construction of A-4 cell)	
Component 4: Technical Assistance and Institutional Reform		
(including consulting services)	- Project implementation support through international consulting packages for construction supervision, independent environmental and social safeguards monitoring, auditing and independent technical assistance in accordance with the World Bank's requirements and through consulting and management assignments in accordance with the Government's regulations - Capacity building for the project owner and related regulatory agencies by conducting workshops, experience sharing and developing operational procedures - Community-based communication programs to raise the public awareness of environmental protection in project areas - Experience sharing with other participating cities/provinces in the management of ODA projects on drainage and environmental sanitation	

1.4.2.1 Component 1

The locations of construction works of the component 1 are presented in Figure 1.1 below:

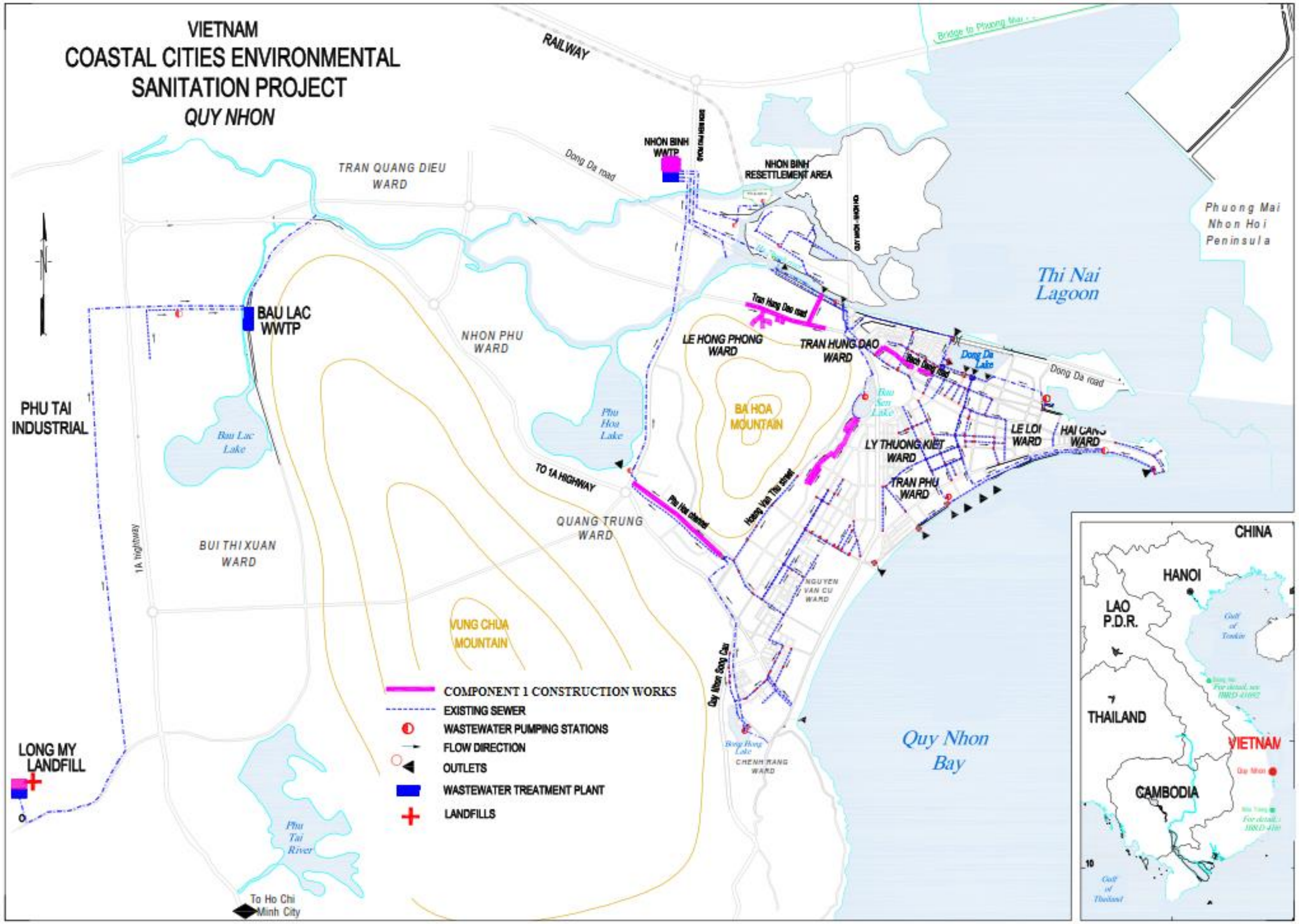


Figure1.1. Location of investment items in component 1

The work items in the Component 1 are described in details as following:

(1) Stormwater Drainage

Construction of box culvert to cover the open Phu Hoa canal with total length of 1192.5 m:

Construction of dual box culvert BxH = 2x3,000x1,800 mm and 2x3,000x2,200mm, Length L =1,193 m from Tran Van Ky Street to Dien Bien Phu Street, incl

Section 1.1: Building box culvert with its dimension of n x B x H = 2 x 3.0 x 1.8 from Tran Van Ky Street to Tran Quang Khai Street, 430 m long

Section 1.2: Building box culvert 2 x 3.0 x 2.2 (m) from Tran Quang Khai Street to Dien Bien Phu Street, 763 m long

The invested quantities of Phu Hoa canalare shown in the table 1.2 below:

Table 1.2. Construction investment quantities for Phu Hoa canal

No	Dimension	Amount (m)	Unit (no.)
I	**Dual box culvert**	**1,192.5**	
1	Culvert 2x3,000x1,800	429.7	
2	Culvert 2x3,000x2,200	762.8	
3	Manhole A x B = 2 x (2,0 x 3,0) (m)		37
II	**Northern endpoint sewer connection**		
1	D250, Polyvinyl chloride	238	
2	D300, Polyvinyl chloride	300	
3	Manhole BxH=800x800		13
4	Gully port with odor prevention		13
5	Sewer D400		20
6	Open channel with width of bottom 300	102	
7	Combined sewer overflow CSO[6]		7
8	Interceptor sewers D600		5
9	Interceptor sewers D800		60
10	Interceptor sewers D1000		5

- Table 1.2, No. I (1): An open canal system at the T-junction of Tran Van Ky and Xuan Thuy – an area of households located along the Ba Hoa mountain foot – will be constructed to collect stormwater and separate sand, stone before discharging into the box culvert system.

- Table 1.2, No. I(2): For sewers near the foot of the mountain which have included stormwater alley running alongside the houses into the canal, stilling-stair sewer will be constructed to connect the flow from the mountain alley to the box culvert.

- Table 1.2, No. II: For Northern residential area next to the box culvert, separate wastewater collection sewers will be constructed to collect the wastewater to the existing CSO on the southern bank. Polyvinyl chloride sewage pipe will pass through the top of Phu Hoa sewer. For residential areas which already shared a common sewer system: CSOs and interceptor sewers will be constructed to collect wastewater to the CSO) on the southern bank.

The investment scope of Phu Hoa canalis shownas belows:

[6] CSO: An sewer system used for collecting stormwater and overflow wastewater

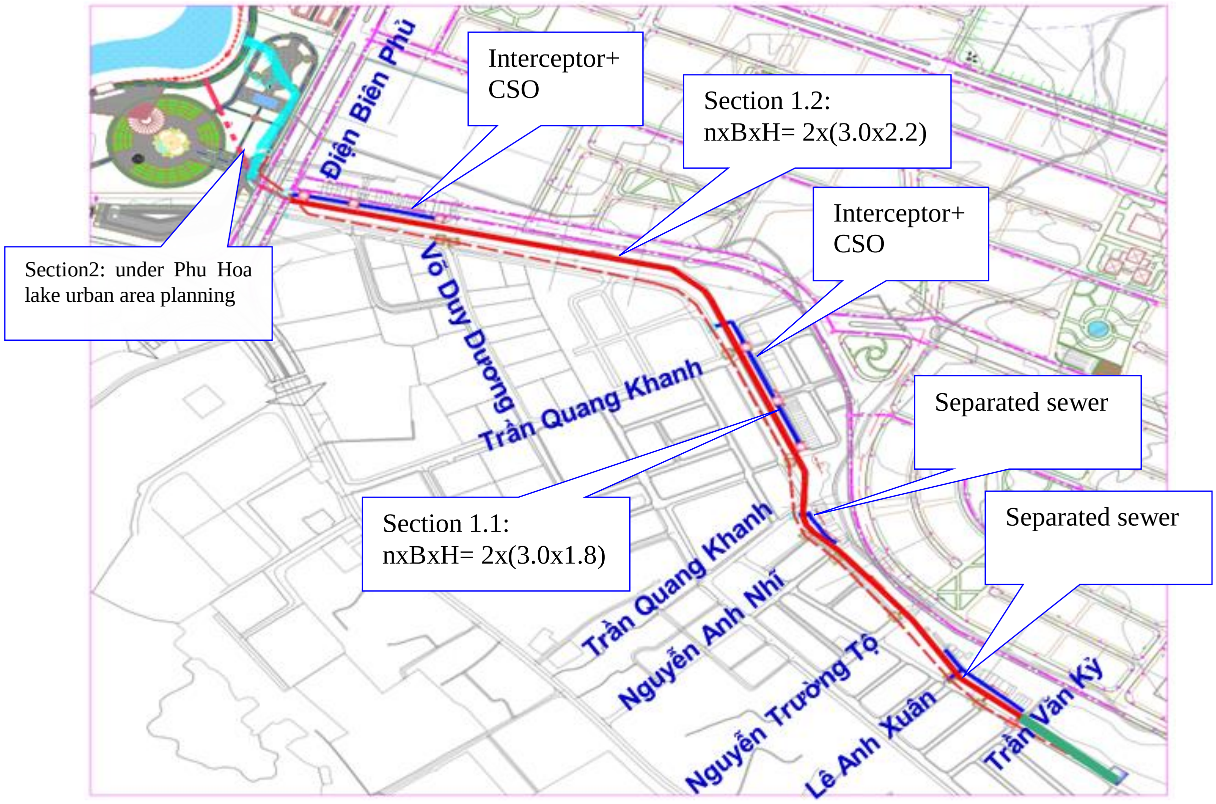


Figure 1.2. Investment scope of Phu Hoa canal

The current status of Phu Hoa canal is shown in Figure 1.3 below:

Figure 1.3. Current status of Phu Hoa canal

<u>Construction of upstream ditch of Bau Sen lake:</u>

The investment scope is from Vo Van Dung road to the CSO of Bau Sen lake (L=1076m) including thefollowing sewer sections:

- Section 1: Vo Van Dung road - Pham Ngu Lao road (Bau Sen lake CSO) - dimension of sewer B = 1,000-1,400mm, 800 m in length.
- Section 2: Vo Van Dung road: Dimension of sewer B=1500, 40 m in length

- Section 3: Regulation lake: Dimension of sewer B = 1400, 236 m in length

The investment scope and the existing views of Bau Sen upstream ditch are shown in Figure 1.4 and Figure 1.5 below:

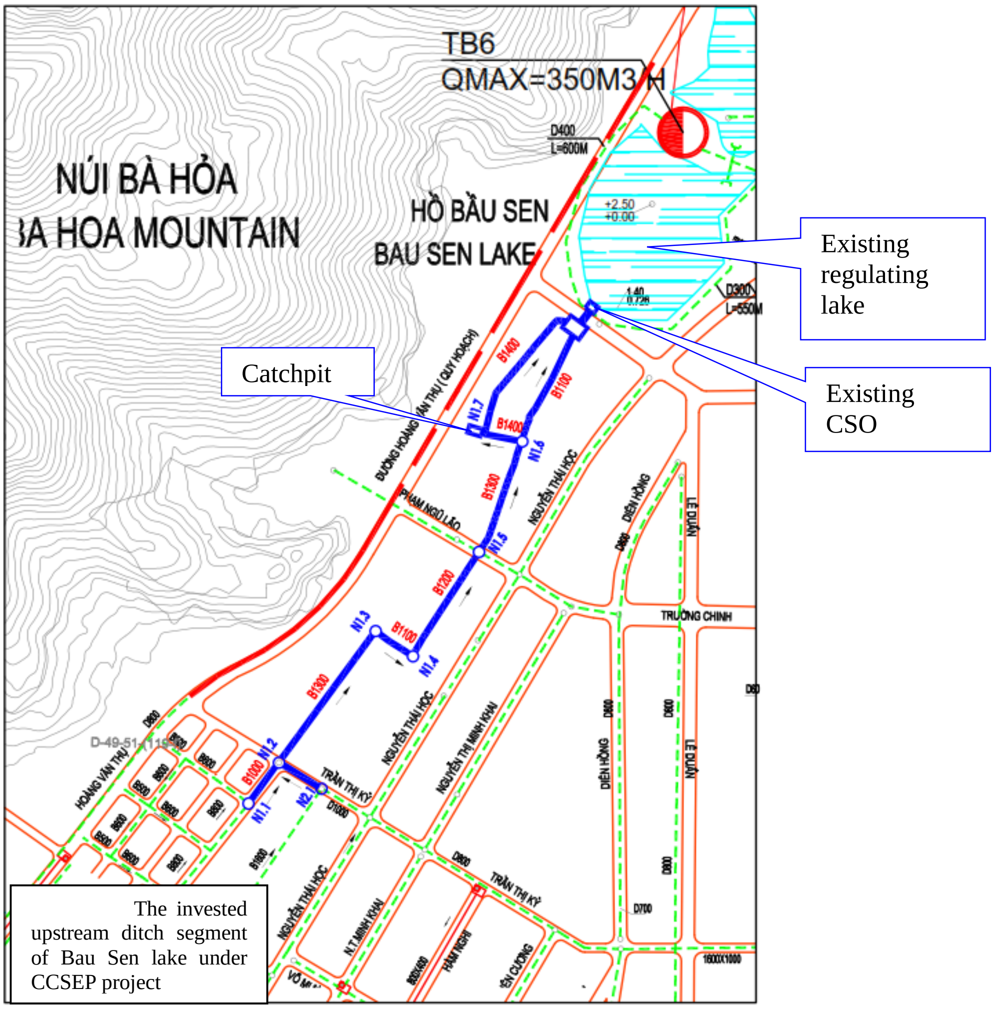


Figure 1.4. Investment scope of the upstream area of Bau Sen lake

Figure 1.5.The existing images of Bau Sen upstream ditch

<u>Hoc Ba Bep area</u>*:*

780 m of stormwater drainage sewer will be constructed along existing alleys to lead the water to water collection crossing points then discharge the water to manholes located on Tran Hung Dao road. 3 drainage points crossing the railway at D1, D2 and D3 points will be constructed. In parallel, to provide drainage for alley 1149, a box culvert line of 800x1000 from alley 1149 to manhole at point D1 will be constructed and connected to the manhole at the existing railway-crossing point. The total investment scope is described in the table 1.3 below:

Table 1.3. Total investment volume of Hoc Ba Bep area

No	Name of road	Dimension		
		length (m)	B (Dmm)	H (mm)
1	From the railway to the sewer on Tran Hung Dao road	144	800	1,000
2	From the railway to the sewer on Tran Hung Dao road	30	1,000	1,200
3	From the alley (inside alley 1083) to the railway	25	1,000	1,200
4	From the alley (inside alley 1083) to the railway	122	800	1,000
5	From the alley(inside alley 1083) to the railway	459	600	1,000

The investment scope of Hoc Ba Bep area is shown in Figure 1.6 below:

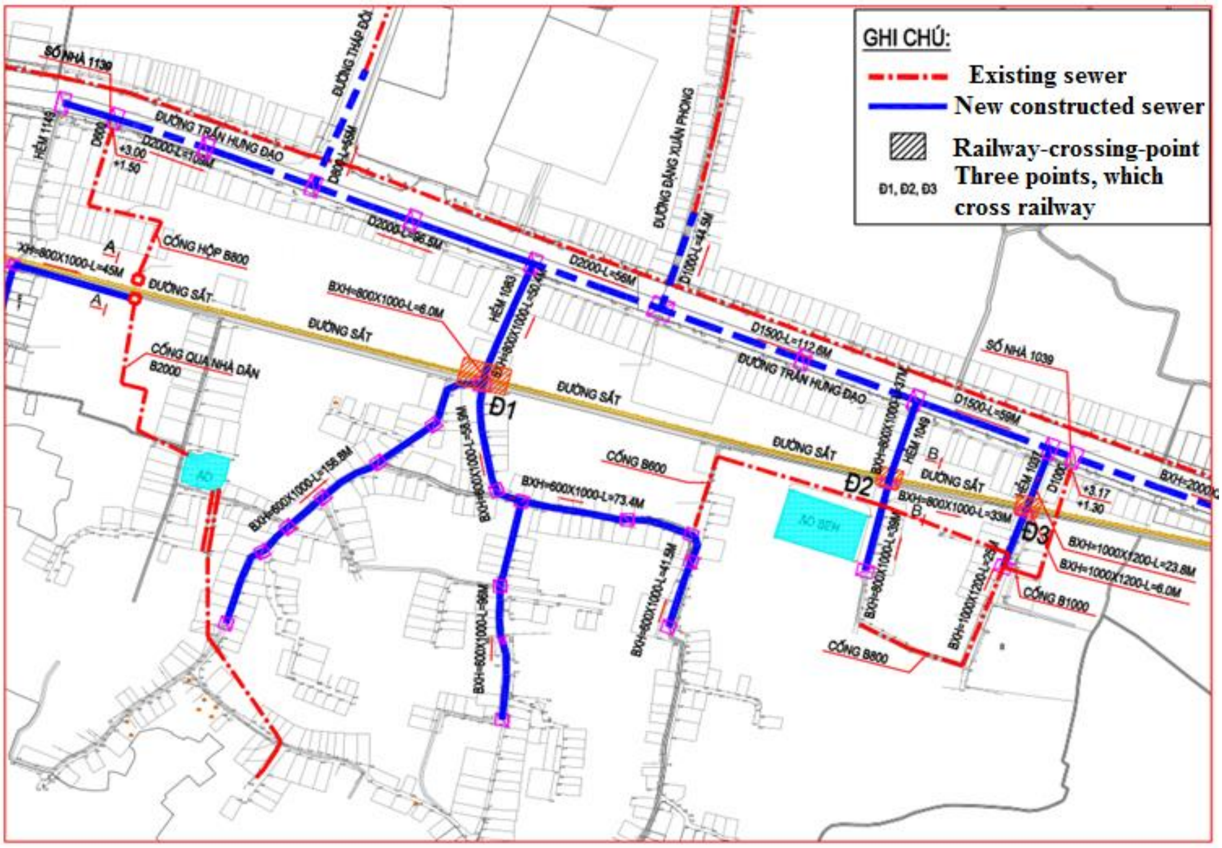


Figure 1.6.Theinvestment scope of Hoc Ba Bep area

<u>The stormwater sewer route on Tran Hung Dao road:</u>

Construction of a stormwater sewer route with the total length of 1401m, divided into 6 sections as follows:

- Section 1: Pipe sewer D1200mm, L=261.5m from lane 1149 Tran Hung Dao road to Phong Lan kindergarten. 02 road crossing points connecting to the existing sewer will be installed: (1) Sewer 800mm, L=55m connecting to sewer D800mm on the Thap Doi road; (2) Sewer D1000mm, L=44.5m connecting to the sewer on Dang Xuan Phong road;
- Section 2: Pipe sewer D1500mm, L=182 m from Phong Lan kindergarten (D2) to lane 1037 Tran Hung Dao road;
- Section 3: Box culvert 2000 x 1600, L = 184.0 m from lane 1037 Tran Hung Dao to Tran Quoc Toan intersection;
- Section 4: Pipe sewer D1500mm, L = 241 m from the existing manhole to Tran Quoc Toan intersection;
- Section 5: Box culvert 3000x1600mm, L = 368m from Tran Quoc Toan - Tran Hung Dao intersection to the outlet of Ha Thanh river on Hoa Lu – Tran Quoc Toan road

The scope and scale of investment on Tran Hung Dao road are described belows:

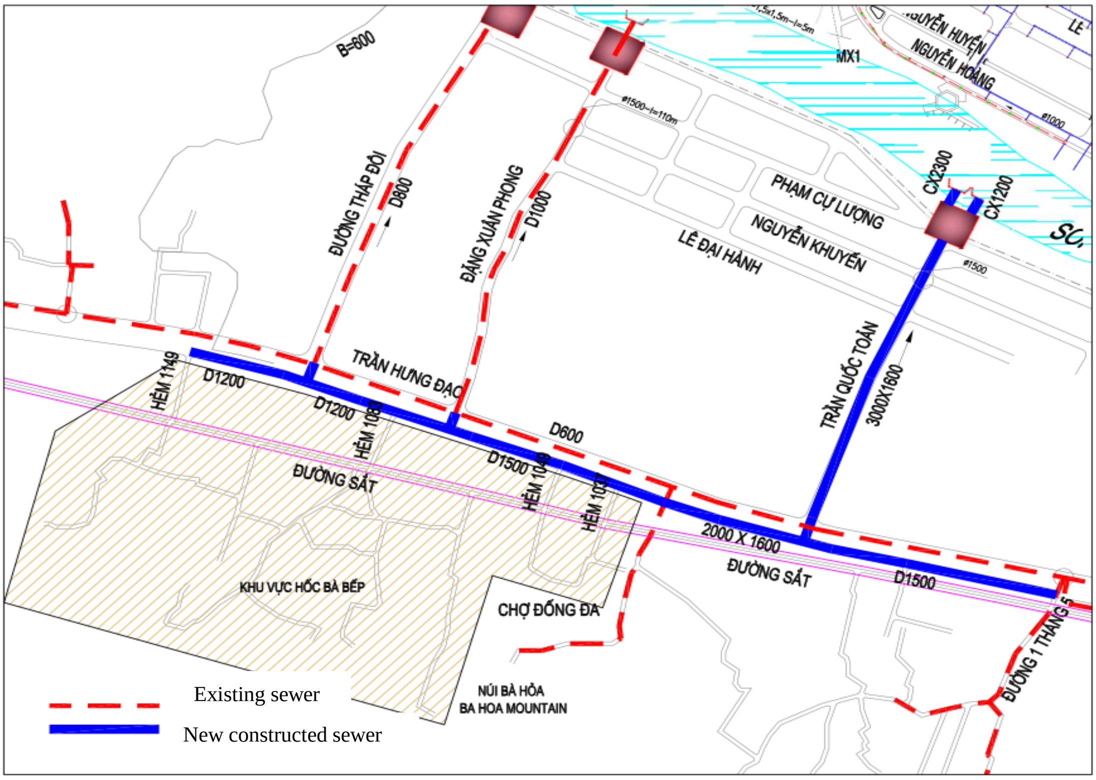


Figure1.7.The investment scope and scale on Tran Hung Dao road

Table1.4.Investment quantity on Tran Hung Dao road

No	Location	Dimension		
		Length (m)	B (D)	H (mm)

1	Tran Hung Dao road	120	(800	
2	Tran Hung Dao road	44.5	1000	
3	Tran Hung Dao road	261.5	1200	
4	Tran Hung Dao road	423	1500	
5	Tran Quoc Toan road	184	2000	1600
6	Tran Quoc Toan road	368	3000	1600
7	Outlet CX1		D1200	
8	Outlet CX2		D2000	

<u>Sewer system on Bach Dang road:</u>

The total length of the sewer route suggested for construction on Bach Dang road is 634.2m and is described in Figure 1.8 and Table 1.5 below:

Table 1.5. Investment quantity on Bach Dang road

No	Location	Dimension		
		Length (m)	B (D)	H (mm)
1	Doan Thi Diem road	114.6	600	600
2	Bach Dang road	172	600	600
3	Bach Dang road	168.8	600	
4	Bach Dang road	178.8	800	
8	Manhole type 1	20	1100x1000	
8	Manhole type 1	6	1300x1000	

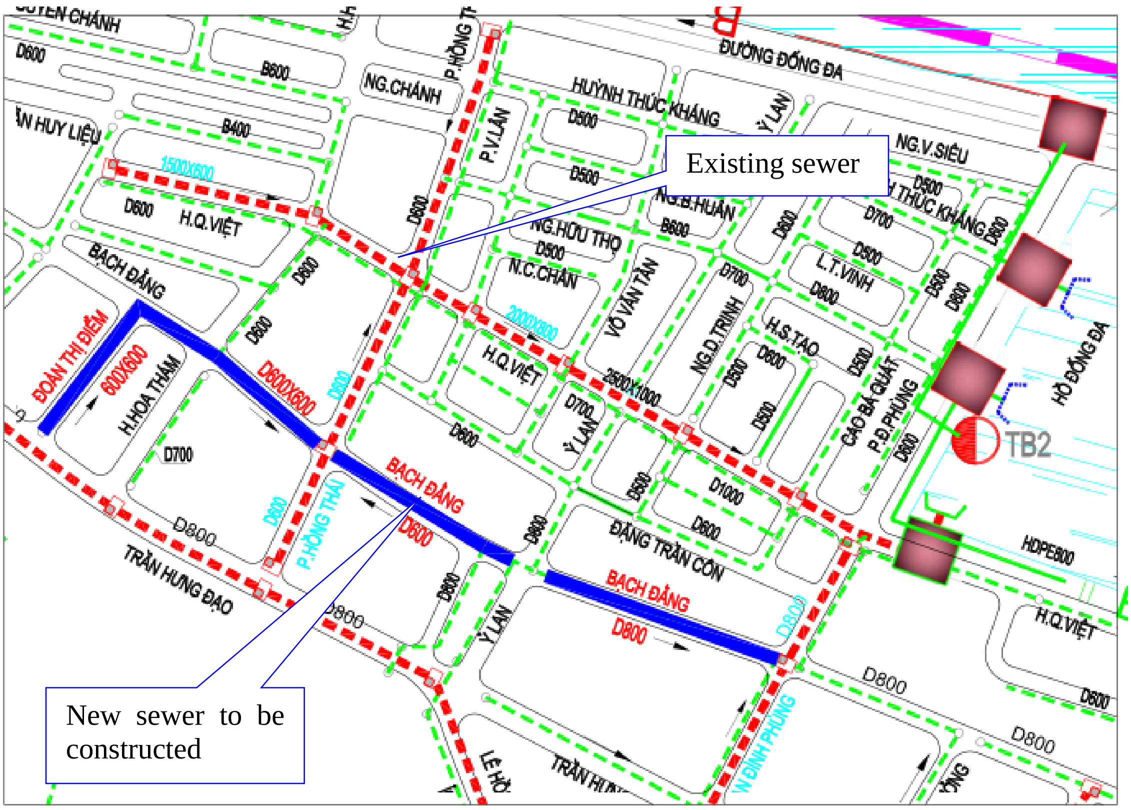


Figure 1.8. The investment scope of the sewers on Bach Dang road

The length and the installation depth of the stormwater drainage systems are shown in the Table 1.6 below:

Table 1.6. Stormwater Drainage Systems

No	**Installation location**	Dimension (mm)	Depth (m)	Length (m)
1	Phu Hoa canal	2x3000x1800 2x3000x2200	2.23 – 2.99	430 763
	Total			**1193**
2	Bau Sen upstream ditch	1000x1500 1100x1500 1200x1500 1400x1500 1500x1500	1.0 – 1.4	80 205 112 236 40
	Total			**1076**
3	Tran Hung Dao	D800 D1000 D1200 D1500 2000x1600 3000x1600	1.23 – 3.18	120 44.5 261.5 423 184 368
	Total			**1401**
4	Bach Dang	D600 D800 B600x600 B600x600	0.87 – 2.39	168.8 178.8 172 114.6
	Total			**634.2**
TOTAL				**4304.2**

(2) The tetiary sewer network: A 30 km of tertiary sewer is to be installed to connect with the 1st and 2nd grade sewers of Quy Nhon city:

The layout of household connection is described in the Figure 1.9 below:

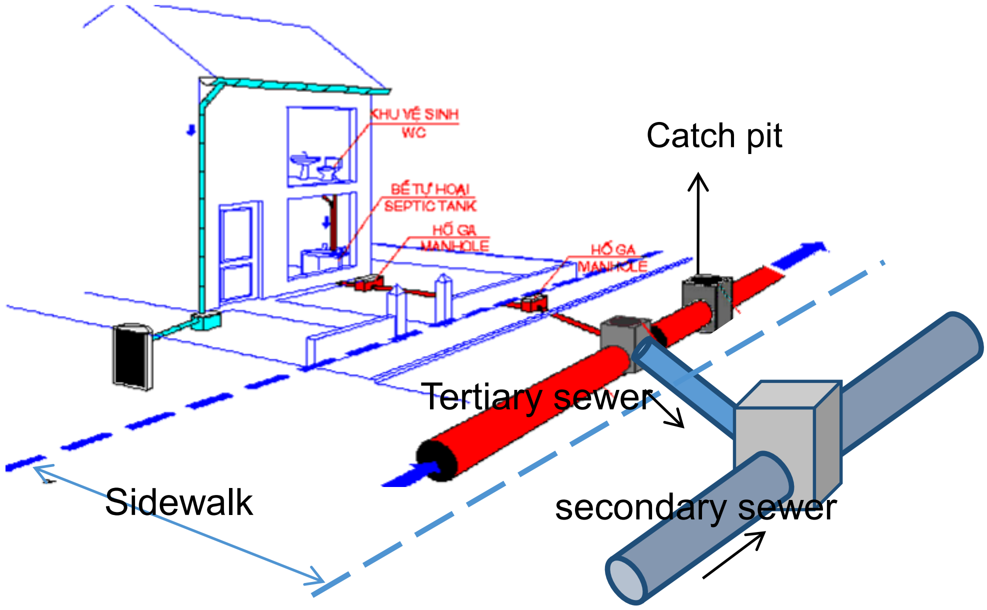


Figure 1.9. Chart of household connection

(3) Upgrading the capacity of Nhon Binh WWTP to 28,000 m^3/day:

Nhon Binh WWTP in Nhon Binh Ward is a domestic WWTP for the downtown of the city (except for Bui Thi Xuan and Tran Quang Dieu wards). Within the CCESP, one module with the capacity of 14,000 m^3/day was already completed. Due diligence of the existing Nhon Binh WWTP 14,000m^3 is presented at Appendix 2 in the report. The existing components of the plant include: wastewater collection network and 11 pumping stations, 01 flow division hole, 02 anaerobic preliminary sedimentation tanks, 01 air generation tower, 01 sencondary pumping station, 02 drip filters, 01 collecting and chemical enhancement works, 02 secondary sedimentation tanks, 01 concentrating tank, 01 disinfection tank, 01 operation house and some other ancillary works. The construction site occupies an area of 12.8 ha, approximately 800m away from the nearest point of Ha Thanh river. Dien Bien Phu road and Nhon Binh Industrial Park is located in the West side of the WWTP, which is surrounded by a 300m buffer zone. This buffer zone is in line with TCVN 7222:2002. The ESIA report of Nhon Binh WWTP was completed within CCESP and approved by the World Bank and Binh Dinh PPCs in June, 2010 and November, 2010, respectively. In this subproject, one more 1,4000 m^3/day module will be added to this WWTP to meet a large domestic wastewater volume caused by rapid population development of Quy Nhon city. For the current population growth rate (1.02 times), which compared with 2010 and 2014 according to Quy Nhon Statistical YearBook, On the other hand, CCSEP project will continue to invest in the tertiary network and household connection because the rate of willing connection is from 62.6% -89.9% in the developing wards and center wards. it is expected that Nhon Binh WWTP 28,000 m^3/day will meet demand of domestic wastewater treatment of Quy Nhon city till 2025. The construction site means an expansion to the north of the current plan with the total expanded area of 2.37 ha. The land is currently with rice fields and ponds with low terrain elevation. The average elevation of site is approximately -0.50 m. The wastewater after being treated will be discharged into Ha Thanh river via the existing drainage sewer of D1000 (the sewer was constructed under the CCESP, taking into account the increased capacity of the WWTP to 28,000m^3/day). The wastewater, after being treated, is supposed to meet permitted levels of Class B, QCVN 40:2011/BTNMT with the following main parameters:

Table 1.7. Main parameters of input wastewater quality and treated wastewater quality

No	Input parameter	Unit	Input wastewater as per phase 2 design	Output parameter QCVN 40:2011/BTNMT Column B (kq=0.9, kf=0.9)
1	BOD_5 (20^0C)	mg/l	150	40.5
2	COD	mg/l	250	121.5
3	Total suspended solid (TSS)	mg/l	150	81
4	Ammonia (by N)f	mg/l	25	8.1
5	TN	mg/l	60	32.4
6	TP	mg/l	14	4.86
7	Coliform	MPN/100ml	$1.0x10^6$	5,000

The input parameters of one new module 14,000 m^3 of Nhon Binh WWTP have been calcultaed based on consolidation of data from many information sources including the technical calculation basis for the input parameters of the existing Nhon Binh WWTP, the current standards/regulations, and those of other WWTPs with similar capacity. Summary of the main components of the WWTP is provided in Table 1.8.

Investment quantities:

Table1.8. Summary of the main components of the WWTP

No	Work	Unit	Quantity
I	**Construction works for main tanks**		
1	Chemical enhancement (coagulation, flocculation) + Dimension of coagulation tank: D x R x C (H) = 4.0 x 4.0 x 3.75(3.25) m + Dimension of flocculation tank: D x R x C (H) = 4.0 x 4.0 x 3.75(3.25) m x 2 tanks	cluster	1.0
2	Rehabilitation of existing chambers (areaL 7500 m2, holes' length: 5.5m) - Dimention of chamber 1: area of lakesurface: 1000m2, length of water level is 5.0m - Dimention of chamber 2: area of lakesurface: 6500m2, length of water level is 5.5m. Construct a 2m-retaining wall between two chambers and area to contain sludge	tank	2.0
3	Sludge pumping station	station	1.0
4	Biofilter Tank (Trickling filter) D x C (H) = 30.0 x 5.5(5.0) m x 2 Tanks	tank	2.0
6	Bio sedimentation Tank D x C (H) = 25 x 5.5 (4.9)m x 2 Tanks	tank	2.0
7	Gravity sedimentation tank D x C (H) = 9 x 4,2 m x 2 Tanks	tank	1.0
8	Septic sludge tank	tank	1.0

	A x B x H = 11,0 x 4,5 x 1,0 (m)		
II	**Ancillary items**		
9	House for compacting sludge A x B = 25,52 x 9,82 m	house	1.0
10	House for air blower A x B = 8,0 x 6,0 m	house	1.0
11	The cluster of reinforced concrete pedestal for odor treatment equipment	system	1.0
12	Yard, internal roads	system	1.0
13	Internal way	system	1.0
14	Gate, fence	system	1.0

The lay-out plan of Nhon Binh wastewater treatment plant:

Figure 1.10. The layout of the existing Nhon Binh WWTP and planned expanded area

The proposed layout of expanded Nhon Binh WWTP is described in Figure 1.11:

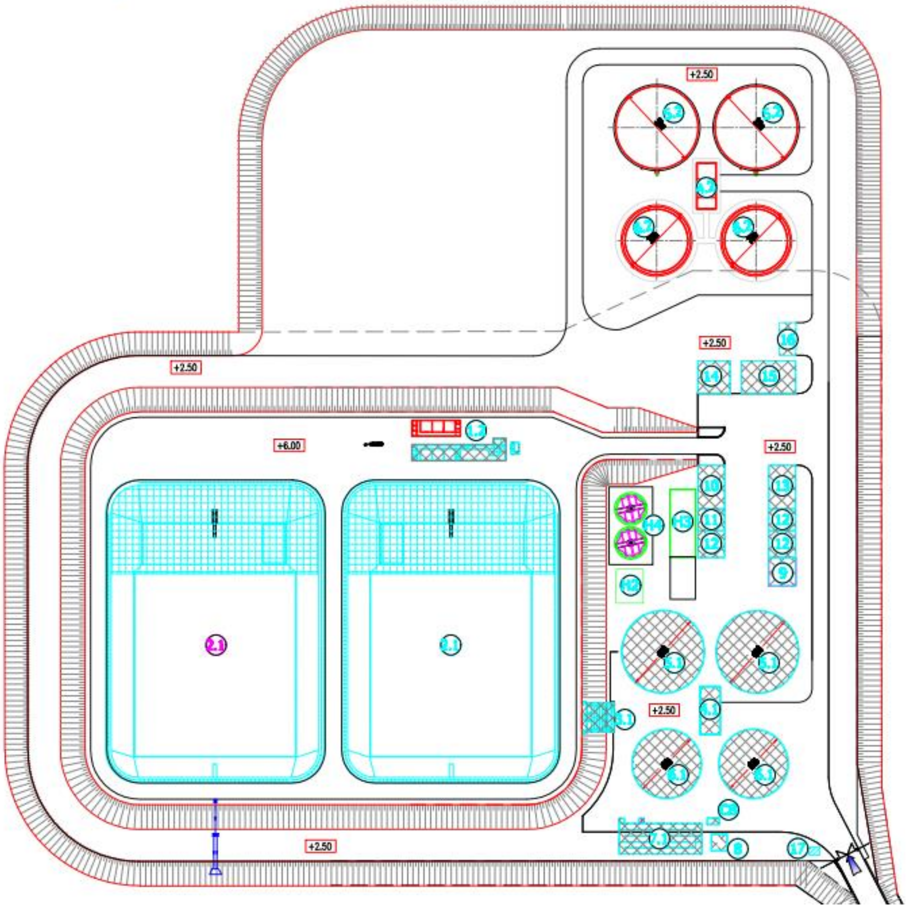


Figure 1.11. Layout of the expanded Nhon Binh WWTP

(4) Treatment of Solid Waste:

The subproject proposes to construct one more A4 landfill cell in Long My landfill. The due diligence of the existing Long My landfill is presented at Appendix 4 in the report.

The following items of A-4 cell:

- Area of A-4 domestic and non-hazardous waste landfill cell : 8.52 ha;
- Area of transportation road : 0.36 ha;
- Area of stormwater drainage system : 0.097 ha;
- Area of leachate treatment : 0.26 ha.

The average height of proposed A4 landfill cell is 17m, with the capacity of 1,462,515 m^3.

The proposed investment items of Long My landfill include: A-4 cell (8.52ha), internal road (0.36ha), stormwater drainage and leachate collection system (0.357ha), landfill gas collection system, equipment purchase and upgrading leachate treatment station (0.26ha).

The planning map of Long My landfill is shown in Figure 1.12 below:

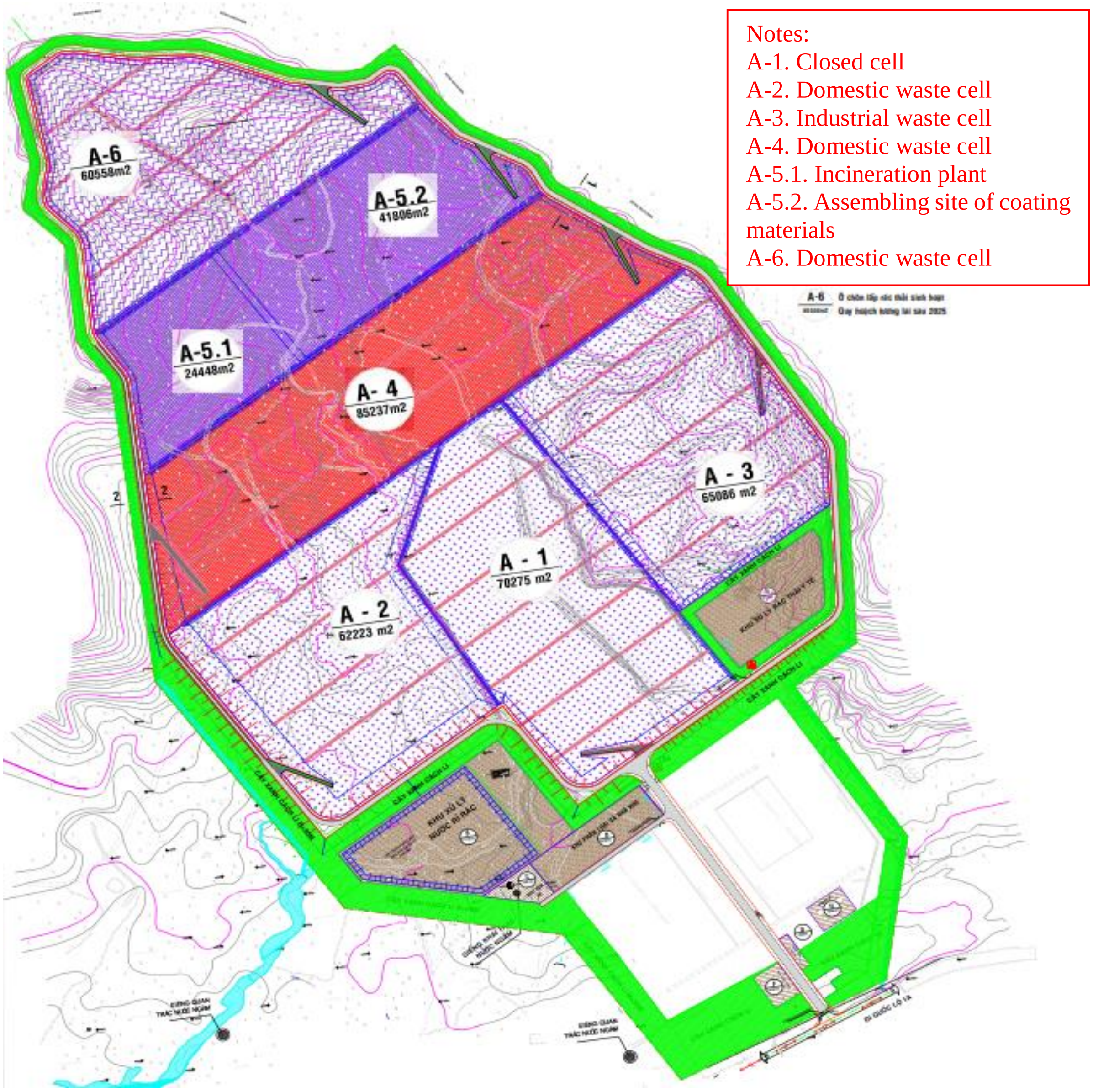


Figure 1.12.The planning lay-out of Long My landfill

Presently, cell A1 was already closed; A2 and A3 cells are in operation in which cell A2 (or named C3), invested in previous CCESP, now serves as the landfill cell for the entire Quy Nhon city and Tuy Phuoc district. Cell A4 (8.52 ha) will be constructed within this subproject. Cell A5 will be reclaimed and converted into a covering space when cell A4 enters operation. A6 cell is planned for future use, but land clearance and compensation have not taken place yet.

Collection of stormwater runoff during A-4 cell construction: The CCESP already constructed a concrete D800 sewer system with L=270m at A-3 cell to collect stormwater runoff. When constructing A4 cell, stromwater runoff will be collected and connected with the excisting concrete D800 sewer at A3 cell during the construction phase..

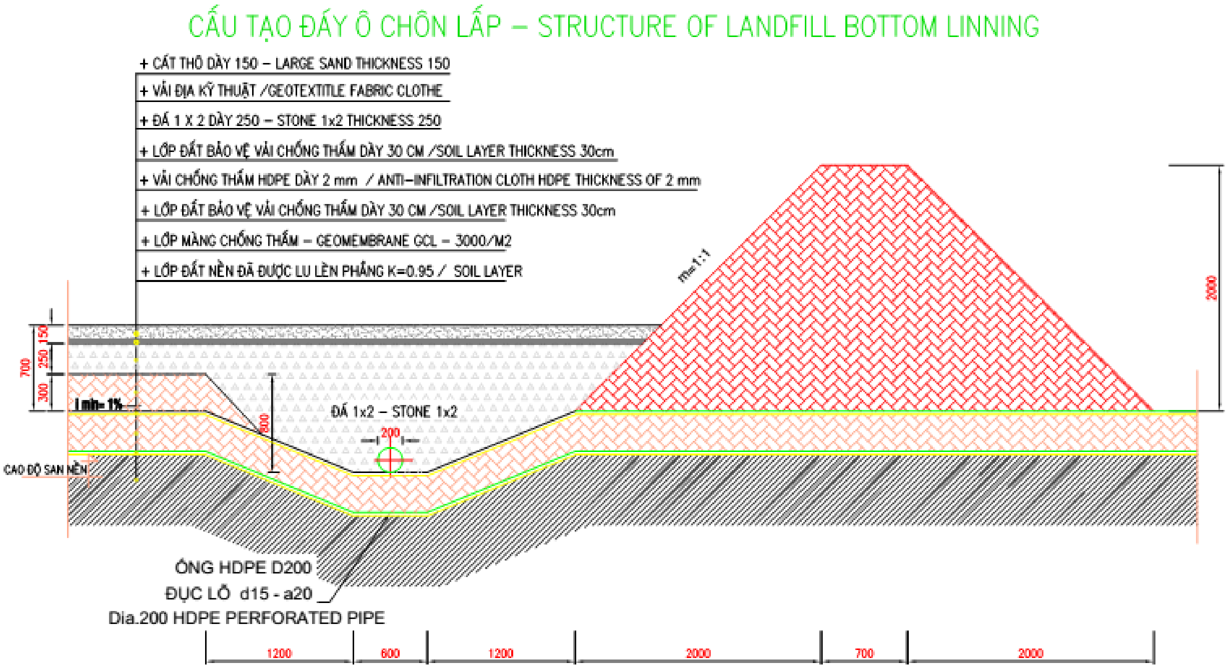
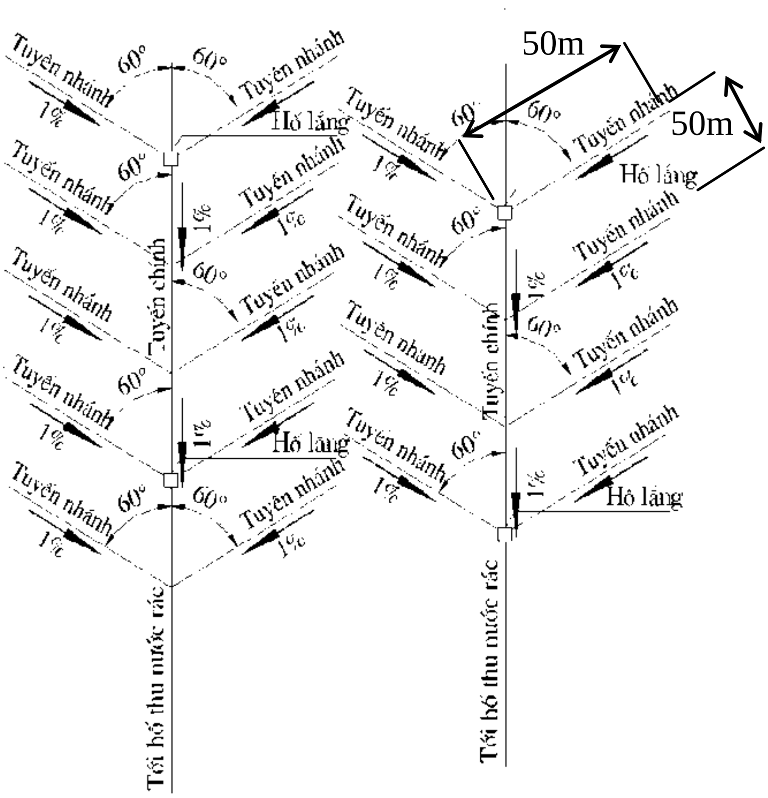


Figure 1.13. Bed lining structure of A-4 cell (A-4 cell)

Leachate collection: According to TCVN 261/2001, the leachate collecting pipeline at the bed of landfill cell will be constructed as fish bone shape:



The quantity of leachate collection pipes in the cell A-4 is summarized in Table 1.9:

Table 1.9. Quantity of leachate collection pipe

No.	Type	Quantity	Material
1	D200	2845	HDPE

2	D300	96	HDPE
3	D400	43	HDPE
4	Manhole	45	Manhole

Monitoring well: The landfill already has 03 existing monitoring wells, 01 in the upstream and 02 in the downstream of the landfill. The existing upstream monitoring well is located at the construction area of A-4 cell. Therefore, one new monitoring well will be placed at A-5 cell, which 100m away from the landfill cell embankment on North.

Leachate treatment plant:

The preliminary leachate treatment station, Bau Lac WWTP and the conveying pipeline (for conveying the leachate after treatment to Bau Lac WWTP) have already been constructed under the CCESP. Due diligence of Bau Lac WWTP is presented at Appendix 3 in the report. The subproject will upgrade the existing leachate treatment station to enhance its treatment efficiency. The whole station is now located within the current premises of Long My landfill. The capacity of preliminary leachate treatment station invested under CCESP was 200 m^3/d and it's capacity would be increased to 500m^3/day by the proposed subproject CCSEP.

The leachate at Long My Landfill is currently collected and preliminarily treated by adding lime before pumping to Bau Lac WWTP for further treatment. However, the leachate after preliminary treatment (through 4 sedimentation tanks and 02 leachate preliminary treatment lakes) has failed to meet the input effluent standard of Bau Lac WWTP. Therefore, the subproject proposes to install one more leachate treatment technology step following the existing preliminary treatment. The proposed technology for this leachate treatment plant is as follows: facultative anaerobic + preliminary treatment + primary physi-chemical treatment + biological treatment + secondary physi-chemical treatment + chemical treatment. The input influents and output effluents are described in Table 1.10 below:

Table 1.10.Input and output parameters of leachate treatment station

No	Parameter	Unit	Input designed	Output designed QCVN 25:2009/BTNMT (Column B1)
1	BOD_5 (20ºC)	mg/l	3200	100
2	COD	mg/l	5200	300
3	Amoni (by N)	mg/l	670	25
4	T-N	mg/l	824	32
5	T-P	mg/l	45	14

Construction and installation of the leachate treatment plant include:

- 01 cluster of lime separation tank: Liming tank (V=312 m^3), lime separation tank (V=396 m^3), aeration liming tank (V=354 m^3), lime sedimentation tank (V=125 m^3).
- 01 cluster of physi-chemical, sedimentation tank: 02 stripping towers (V=184 m^3), flocculation tank (V=12.7 m^3), coagulant tank (V=21.15 m^3), physi-chemical sedimentation tank 1 (V=125 m^3).
- 01 cluster of bio tank: 02 renovated SBR tanks (V= 932 m^3).
- 01 cluster of fenton tanks: mixing tank (V= 13.2 m^3), reaction tank (V=52.8 m^3), fenton sedimentation tank (V = 125 m^3).

- 01 sludge compression tanks: physi-chemical sludge compression.
- 01 foundation treatment system.

(5) Leachate pumping station to pump the leachate from Long My landfill to Bau Lac WWTP

Construction of a pumping station and installation of 4 submersible pumps at vacant land between Long My landfill and Bau Lac WWTP

+ Wastewater submersible pump: Q = 5.8 (l/s), H = 40 m, 4 pumps. Technical pipeline system, vavle, synchronization lock.

+ Leachate pumping station no. 3 (PS3): Reinforced concrete structure with dimension: A x B x H = 2.7 x 3.5 x 5.0 (m).

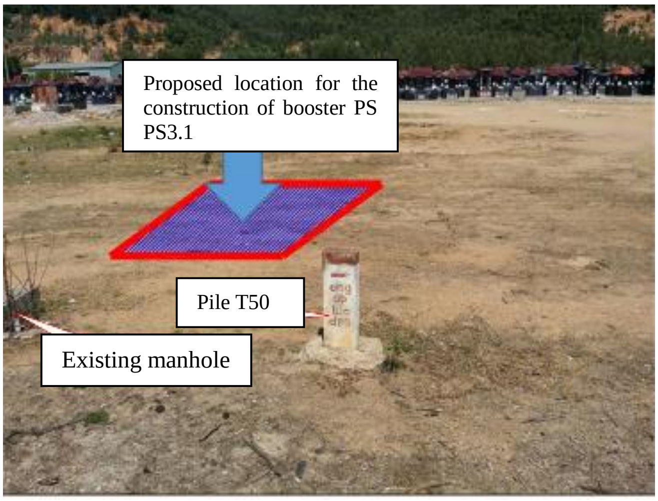


Figure 1.14. Location of the pumping station at pile T50

(1) School Sanitation Program

The subproject proposes to construct 12 toilets at primary and secondary schools in Quy Nhon city. The list of school toilets, addresses, education level, number of teachers and beneficiary pupils are presented in Table 1.11 below:

Table 1.11. List of proposed schools for toilet construction

No	Name of school	Address	Education level	Number of teachers	Number of pupils
1	Phước Mỹ Secondary school	Phuoc My commune-Quy Nhon city	Secondary	27	332
2	Bùi Thị Xuân Secondary school	Bui Thi Xuan ward-Quy Nhon city	Secondary	51	939
3	Bùi Thị Xuân Primary school	Bui Thi Xuan ward-Quy Nhon city	Primary	37	475
4	Nhơn Phú Primary school No.1 (branch 2)	Area 3-Nhơn Phú ward-Quy Nhon city	Primary	14	110
5	Nhơn Phú Primary school No.2	Nhơn Phú ward-Quy Nhon city	Primary	20	333
6	Hải Cảng Primary school	Hải Cảng ward-Quy Nhon city	Primary	43	754

No	Name of school	Address	Education level	Number of teachers	Number of pupils
7	Nhơn Hải Primary school (branch 2)	Nhon Hai commune-Quy Nhon city	Primary	30	250
8	Nhơn Hải Secondary school	Nhon Hai commune-Quy Nhon city	Secondary	28	345
9	Nhơn Lý Primary school (branch 2)	Nhon Lý commune - Quy Nhon city	Primary	15	420
10	Lê Lợi Primary school	Lê Lợi ward-Quy Nhon city	Primary	73	1161
11	Đống Đa Primary school (branch 2)	Đống Đa ward-Quy Nhon city	Primary	16	370
12	Nhơn Hội Secondary school	Nhon Hội commune - Quy Nhon city	Secondary	28	343

1.4.2.2. Component 2

This component will focus on the construction of the Y-shaped and Huynh Tan Phat bridges. The location of Y-shaped and Huynh Tan Phat bridges is shown in figure 1.15 below:

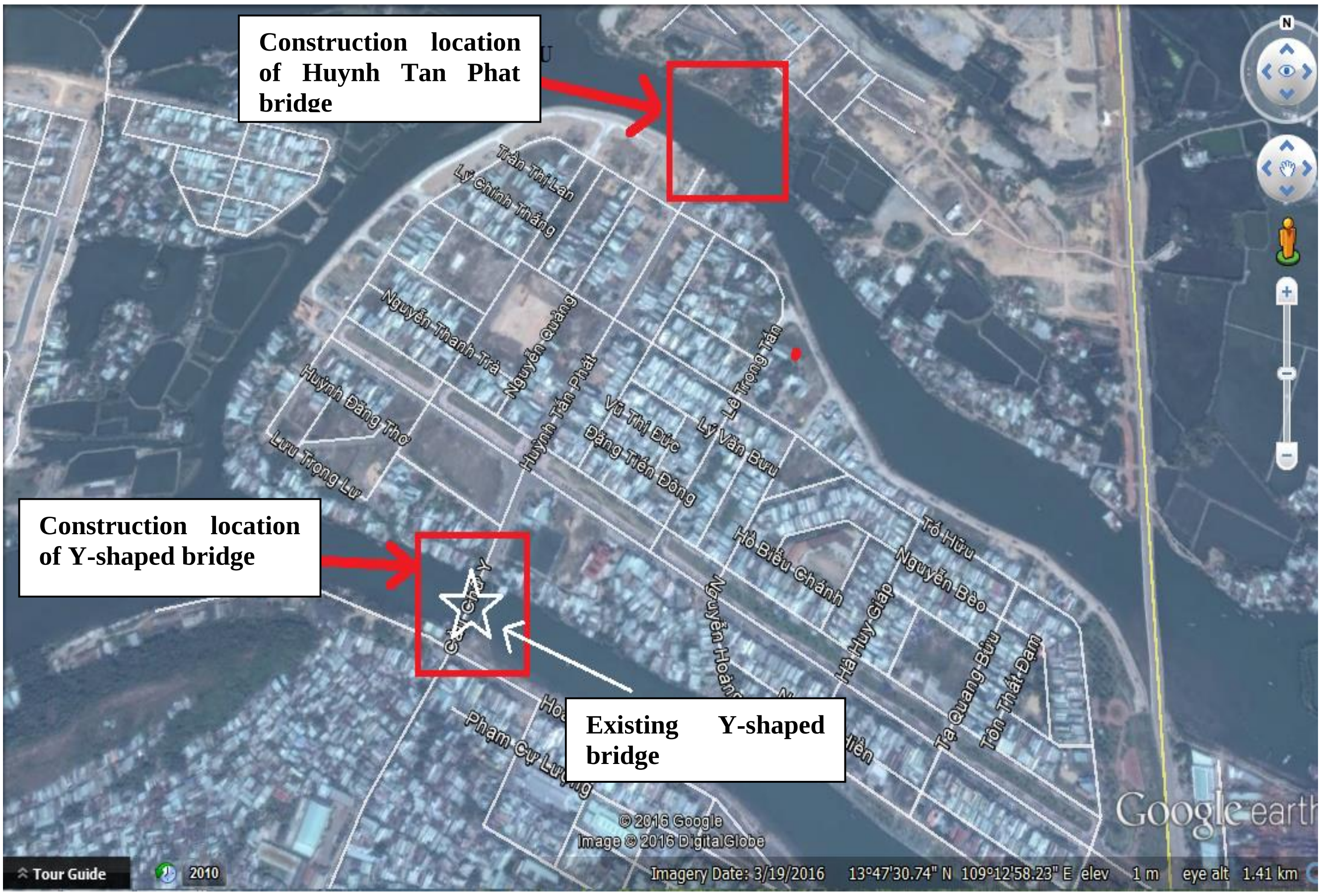


Figure 1.15. The layout plan of Component 2 construction items

<u>(1) Y-shaped bridge</u>: connecting Thap Doi road to the resettlement area of Quy Nhon city. The starting point (Thap Doi road – 15m right of way) to ending point (Huynh Tan Phat road – 36m right of way).

The scale of the bridge includes the entering pathways at the two ends of the bridge and the bridge itself:

- Entering pathways: The construction of entering pathways will follow the inner urban street standards (TCXDVN104-2007). The designed speed: V = 50Km/h, roadbed width: Bn = 1.5m + 12.0m + 1.5m = 15.0m (connecting to both sides of the road bed and the existing pavement).
- Loading capacity (HL93), the bridge's width B=15m; bridge aperture L=80m; the bridge length is L_c = 88.87m, comprising of 4 transverse spans and sixty eight (68) foundation piles, supported by 15 pre-stressed 35-Mpa RC main beams, main beam interval is 1 m and 0.65m in height each.
- Lighting system

Figure 1.16. Current status of the existing Y-shaped bridge

The existing Y-shaped bridge will be demolished and replaced by a new one. There is a wastewater pipeline, which could be seen at Figure 1.16. This waswater pipeline runs parallelly with the existing Y-shaped bridge and is located 2m from the existing Y-shaped bridge.

(2) Huynh Tan Phat bridge: As could be seen at Figure 1.15 and Figure 1.17, the subproject will build a completely new Huynh Tan Phat bridge, which is to connect 1B island residential area of Northern Ha Thanh river and the resettlement area of Quy Nhon city. The starting point (intersection of Huynh Tan Phat – Hoang Van Thai road) to ending point (DS2 road – 17.5m right of way). The ending point belongs to the resettlement area of Quy Nhon city.

The scale of construction includes entering pathways and the bridge itself:

- Entering pathways: The construction of entering pathways complies with the inner urban street standards (TCXDVN104-2007). The design speed is V = 50Km/h, the roadbed width is Bn = 1.5m + 12.0m + 1.5m = 15.0m (connecting to both sides of the roadbed and the existing pavement)

- Design loading capacity (HL93), bridge's width B=15m; bridge aperture L=100m; The bridge overall length is L_c = 111,9m, comprising 5 transverse spans and 85 foundation piles, supported by 15 pre-stressed 35-Mpa RC main beams, 1 m interval and 0.65m in height each.

- Stormwater drainage and lighting systems.

Figure 1.17. Current status of location of future Huynh Tan Phat bridge

1.4.2.3 Component 3

This component includes compensation for and relocation of the affected households, land clearance and the assurance of local livelihoods.

The total number of households affected by land acquisition for the subproject will be 6 households, all located in the expanded area of the Long My landfill, Phuoc My commune, Quy Nhon city. In addition, another 3 households will be affected by the construction of the Y-shaped and Huynh Tan Phat bridges. However, since this construction would take place within the land acquisition area of the Hoa Lu Road Infrastructure Expansion Project, the compensation and resettlement support for these 3 households will be implemented by Binh Dinh Land Development Center, before handing over the site to Binh Dinh's Key Project Management Board for implementation of the subproject. Since no households will loose their homes or need to relocate or resettle within the scope of the subproject, there will be no need for construction of any resettlement area.

1.4.2.4 Component 4

The main activities under Component will be:

- Supporting sectoral institutional reforms to enhance implementation efficiency and to ensure the sustainability of the subproject, and to share experience with other localities in the management of ODA funded projects in the field of urban drainage and environment sanitation.
- Building capacity for the project management board and other management agencies through workshops, sharing lessons learnt, setting up management procedures. Deploying public communication programs to raise environmental protection awareness for local people in the subproject area.
- Assisting the sub-project implementation through calls for international tenders in design, construction supervision and management, independent consultancy on social security – resettlement monitoring, environmental monitoring, auditing, independent consultancy on TA and project completion evaluation following the World Bank regulations and other tenders in the areas of inspection, verification, evaluation, management as regulated by the Government of Vietnam.

1.4.2.5. Auxiliary facilities

Power and water supply

- *Power*: High-voltage electricity will be supplied from 22 kV high-voltage network of the city managed by Binh Dinh Power Company.
- *Water supply*: Use water source at the construction sites (supplied by Dinh water supply and sewerage company) or water to be trucked to the construction sites.

b. Worker camps

- The subproject would mobilize about 540 workers at different construction sites. However, these workers would mainly be local labors, and therefore, the actual number of on-site staying workers would be approximately 100 workers, who would mainly stay at the sites of Phu Hoa canal and Nhon Binh WWTP. For other construction areas such as stormwater and wastewater sewer system, tertiary sewer, school toilets, Y-shaped and Huynh Tan Phat bridges, contractors and workers will rent local houses outside the construction areas.
- The warehouses will be set-up to materials and construction equipment storage and will be arranged on site. For the small sites, it is necessary to hire people houses or agency's offices for the storage of materials and construction equipment

c. Access roads

The existing road system is sufficient for construction activities, therefore, there is no need to build new access roads. The following road routes will be used during the construction of corresponding civil works of the sub-project:

- *Phu Hoa canal:* Xuan Thuy, Tran Quang Khanh, To Huy Hieu, Vo Duy Duong road and road no.24.
- *The upstream ditch of Bau Sen lake:* Nguyen Thai Hoc, Nguyen Tat Thanh, Vo Van Dung road.
- *Drainage culverts for stormwater on Tran Hung Dao road:* Tran Hung Dao street
- *Bach Dang Street:* Hoang Hoa Tham, Pham Hong Thai, Tran Hung Dao and Phan Dinh Phung streets.
- *Nhon Binh WWTP:* Tran Hung Dao, Dien Bien Phu, Nguyen Trong Tri, Lam Van Tuong, and Nguyen Man roads.
- *Y-Bridge and Huynh Tan Phat bridge:* Vo Nguyen Giap, Le Thanh Nghi, Thap Doi, Hoa Lu, Huynh Tan Phat, Nguyen Huu Hoang and To Huu road.
- *Long My landfill:* the existing road entering to Long My landfill (turning from NH 1A).

d. Location of disposal sites

There are 02 proposed disposal sites:

- Long My landfill, Thanh Long village, Phuoc My commune

- At the end of Dien Bien Phu Street (the City People's Committee is asking for the PPC's permission to plan for dumping construction debris): it is expected that this site will enter into operation at the beginning of 2017. This is a convenient location for dumping excavated soil of the subproject construction civil works. Excavated soil will be used for backfilling and planting.

As planned, the total capacity of Long My landfill is 2,164,253 m^3 on a total area of 61.61 ha. Phase 1 of this sub-project completed A-2 (or C3) landfill cell (with the total area of

62,223m^2 and a capacity of 902,233m^{3}of garbage) + preliminary leachate treatment station + treatment area of hazardous medical waste and other relevant auxiliary works.

Figure 1.18. Long My landfill

1.4.3. Construction method and technology

1.4.3.1. Construction method for ditch and sewer system

<u>Round culvert:</u>

All kinds of round reinforced concrete culverts are prefabricated by means of vibration or centrifugal casting plant. The box culverts would be casted or assembled in-situ, depending on the actual terrain and the capability of contractors.

Check-manholes, CSOs are constructed by direct on-site concrete casting method.

The trenches for installing culverts will be constructed by manual or mechanical open digging methods, using Larsen steel sheet piles or a separate section of steel pile..

<u>Box culvert:</u>

Box culvert, check-manholes are constructed by on-site casting method.

The trenches for installing culverts will be constructed by manual digging as for the route of wide construction limits. Larsen steel sheet piles or system of steel pile beams to separate sections are used in the case of narrow construction limits.

Tertiary culvert systems:

uPVC D250-D300 plastic pipes are used. The depth of pipe installation ranges from 0.8-1m. These connecting manholes are constructed in concrete and properly laid out to facilitate the connection by households to the domestic wastewater system.

1.4.3.2. Construction method for combined sewer overflows (CSO) and pumping station

- Combined sewer overflows (CSO) and pumping station are constructed by on-site casting.

- Trenches for installing box culverts, foundation trench of pumping station are constructed by larsen steel sheet pile or system of steel pile beams.

1.4.3.3. Construction method of Nhon Binh WWTP

<u>Reinforced concrete piles</u>:

- Re-inforced piles would be pre-fabricated , with mark 300, constructed by prestressing method.

- The pile joints must comply with Vietnamese standards.

Reinforced concrete:

- Construction by direct on-site concrete casting method

- Pits below 3m deep are constructed by open digging method

- Pits more than 3m deep are constructed by mechanical methods using steel sheet piles

Filling and leveling work:

- Soil is leveled in layers of 200mm in thickness, compacted at coefficient K = 0.95

- The main height of leveling isproposed at +2.50m, while the whole of power / mechanical works and all other buildings / offices at level +2.80m to avoid malfunctioning during event of even highest expected flood levels and to ensure the discharge of treated waste water by gravity.

1.4.3.4. Construction methods of Long My landfill construction methods

Long My landfill is designed and constructed following Vietnam construction standard (TCXDVN 261:2001 issued by the Ministry of Construction following Decision no. 35/2001/QD-BXD dated 26 December 2001.

- The material of lining bed and landfill cell must be of a waterproof or anti-leaked soil layer with permeability coefficient $K \leq 10^{-7}$ cm/s. If clay waterproofing material is used, its thickness should be not less than 60 cm. This clay waterproff layer can be replaced by a waterproof membrane GCL-3000/m2 with permeability coefficient 10^{-9} cm/s.

- The dike top should be extended at the natural elevation level and the dike bottom should be expanded at least 60cm into the clay base layer to form a dam. This will prevent water entering the cell from outside and prevent the spread of leachate below the embankment.

- The side steepness suggested for the embankments within the landfil cell is 1:1. This steepness will reduce the intrusion rate of water compared with the even layer.

- Lining materials must be durable and appropriate. It must be capable of resisting corrosive chemicals and mechanical stresses caused by the compaction force, squeeze, bendand ramming subsidence during and after the process of landfill operation.

- The constructioncom of the liner is desribed in Table 1.12 below:

Table 1.12. Long My landfill liners

Layer	Material	Thickness	Function
Solid waste landfill	Solid waste landfill		
Coarse sand layer		15 cm	Coarse sand layer
Absorbent cloth	Geotextile		Prevent spread of fine soil into rock
Rock layer filtering	Gravel 1x2mm	25 cm	Leachate collection
Protecting compacted soil (compaction coefficient K = 0.9)	Soil permeability coefficient> 10-4cm/s	30 cm	HDPE liner protection
Waterproofing layer	HDPE	2mm	Prevent leachate infiltration

Layer	Material	Thickness	Function
Waterproofing geomembrane GCL - 3,000/m2	Waterproofing geomembrane GCL - 3,000/m2		Prevent leachate infiltration
Natural surface soil	Land status quo		

1.4.3.5. Construction method for bridge

Construction of bridge:

The bridge is located in an area affected by tidal surge and salt intrustion, attention should be paid to the structural protective layer in the saltwater environment. The concrete structures such as piles, bridge beams can be precasted in the factory then shipped to construction site or casted on site. Piling construction will be performed by 3.5 ton diesel hammers and construction of pier cap beams, pillars on the spot on thefloor system, installation ofbeams by incremental push-launching method with specialized crane. Reinforced structure with pier foundation was used with reinforced pile with the dimension of 0.45x0.45m, in cyclinder column shape.

Detail on demolishtion activity of the existing Y-shaped bridge:

Contractor will contstruct a service road on the side of the bridge where the wastewater pipeline is not located. Demolish onto temporary access road and use a barge use for capturing debris on the river. After removal of the lights and signs, the deck and parapets were hammered or cut using a shear mounted on an excavator to cut right through steel and concrete. Use the grapple mounted on an excavator to pull piling and debris from the main footings. All debris materials need to be managed appropriately.

Technical solutions: The Y-bridge and Huynh Tan Phat bridge will be constructed under the National Standard 22 TCN 272-05 for bridge design, with the following technical parameters:

- Permanent bridge to withstand flood overtopping and to be constructed of RC and pre-stressed RC
- Design load: HL93 and pedestrians at 3.10^{-3}Mpa
- Bridge to withstand flood overtopping with design flood frequency at P = 1%
- Width of bridge deck: Bm = 1.5m + 12.0m + 1.5m = 15.0m
- Span layout and structure of abutment and pier foundations:
  - Y-Bridge: has an overall length of 88.87 m and a span length of 21 m, comprising four (4) spans, with abutment and pier foundations constructed of 25 Mpa RC piles measuring 45 x 45 cm, with a proposed length of 24 m and 1x2 stones. Piles to be sunk with a driver.
  - Huynh Tan Phat Bridge: has an overall length of 90.25 m and a span length of 20 m, comprising five (5) spans, with abutment and pier foundations constructed of 25 Mpa RC piles measuring 45 x 45 cm, with a proposed length of 42 m and 1x2 stones. Piles to be sunk with a driver

More details on Y-shaped bridge:

a. Main bridge

- Control elevation for the location of two (2) abutments.

- Elevation of two abutments: controlling the elevation at the intersection of Hoa Lu and Thap Doi roads at 1.59 m and 2.24 m at the location of stretching connection to Huynh Tan Phat road, which has been established under the development plan.
- Flood drainage elevation: The elevation of two abutments is 2.15 m and 2.94 m respectively ensures flood drainage with a frequency of H1% = 1.72m. At the position of the third span (from the southern abutment), the bridge deck has an elevation of 3.34 m and the static space under the bridge is 1.65m in height to ensure the search and rescue operation by exclusive-use speedboat in the rainy or flood season.

▪ Span structure:

- The bridge has an overall length of 90.25 m and its span length of 20 m, comprising four (4) transverse spans supported by 15 pre-stressed 35-Mpa RC main beams, 1 m apart and 0.65m in height each.

  Bridge deck slabs are made of cast-in-place (30-Mpa) RC, with 1x2 stones, 16 cm in thickness, covered with C12.5 asphaltic concrete 5 cm in thickness. The bridge has elastomeric bearing pads reinforced with steel plates; steel-rail expansion joints, anti-corrosive painted steel parapets and guard rails as have been used for urban bridges.

▪ Abutment and column structure:

- Constructed of driven foundation piles 45x45 cm, with a proposed length of 24 m, 30- Mpa RC and 1x2 stones.
- Abutment and column footings are made of cast-in-place (20-Mpa) RC, with 2x4 stones, whereas sterns and end dams, piers/columns, front walls and wing walls are constructed of 25-Mpa RC with 2x4 stones. Pad stones are constructed of 25-Mpa RC with 1x2 stones. The 25Mpa concrete casting with 2x4 stones is performed with abutment bottom sealing.
- Sidewalks construction: Sidewalks are laid out none-at-grade
- Sidewalks are paved with granite tiles 3 cm in thickness on a cement mortar layer 2 cm in thickness. Below the sidewalk is the system of technical trenches.

b. Road sub-grade

The sub-grade is filled with selected hill soil compacted to the density of K95, with the layer close to pavement surface being 50 cm thick and compacted to the density of K98. The slope of filled sub-grade is 1:1.5 and slope of excavated sub-grade is 1:1. For the filling of subgrade on residential land and soft ground, before performing the earthwork, the layer of organic soil needs to be cleared and soft soil needs to be replaced up to a depth of 0.5m, with a bank slope of 1:1.5.

c. Road pavement surface

The structure of design road pavement is of the type of high-grade A1 surface layer, with required value of elastic modulus Eyc >= 120 Mpa.

▪ **Pavement structure**

- Sub-grade constructed of soil aggregate, 50 cm thick, compacted to K98
- Sub-base course of crushed aggregate Grade 1 Dmax 37.5, 18 cm in thickness
- Base course of crushed aggregate Grade 1 Dmax 25, 18 cm in thickness

- Binder course of bituminous concrete C19, 7 cm in thickness
- Surface course of bituminous concrete C12.5 cm in thickness

d. Sidewalks

- Sidewalks to be soil-filled and compacted to the density of K95
- Sidewalks to be paved with granite tiles 3 cm in thickness on a cement mortar layer 2 cm in thickness.
- Kerbs to be 20 Mpa concrete cast with 1x2 stones

e Stormwater drainage

The drainage system in the project area has been fully constructed. Currently, at abutment 1, there exist two (2) pipe culvert outfalls 80 cm in diameter. It requires making a new design, involving the following elements:

- Joining the existing pipe culvert by adding a RC pipe 80 cm in diameter, 8 m in length;
- Culvert foundation to be reinforced with bamboo piles 3 m long each, at a rate of 16 piles per m2;
- Culvert foundation to be bedded with 4x6 stones and compacted properly.
- Culvert cutoff to be Grade 200 concrete cast with 2x4 stones
- Head wall and wing wall to be Grade 200 concrete cast with 2x4 stones

f. Lighting system

▪ Road lighting

Given that the roadbed is 20 m wide and sidewalks 8 m (Huynh Tan Phat road), it requires choosing lamp posts >=10m high and 150/250W lamps (2-mode type), setting up two-branch lamp posts on both sidewalks, shining in one direction, with yellow sodium vapor bulbs or metal halide bulbs.

▪ Bridge lighting

- The lighting system includes lighting provided to both sides of parapets;
- 10m-high lamp posts 10 to be set on both sides.

Construction of roads:

- The embankment of roadbed: gravel hill soil will be selected and a combination of excavators, graders, rollers will be used for roadbed embankment. The embankment will be carried out in layers, each layer will be tested as prescribed and then will be moved to the next layer embankment to reach the designed compactness.
- Before rolling, if the macadam is found macadam not to reach the best moisture then water can be added to CPDD for the best humidity. Preliminary rolling will be conducted with iron-wheel light rollers, rolling tightly with vibratory rollers or tire-wheel rollers, rolling to flatten with iron-wheel rollers weighing 8-10 tons.
- Construction of asphalt concrete pavement layer:asphalt concrete pavement is only constructed on days without rain, with dry road foundation.

1.4.4. List of Construction Machines and Equipment

List of construction machines and equipment are described in the Table 1.13 below:

Table 1.13. Planned list of machineries and equipment

No.	Equipment, means of construction	Unit	Quantity	Origin	Demand consumption of fuel (liter)	
					Diesel oil	Gasoline
1.	Automobile for transporting redundant stony ground and floor leveling sand	Machine shift	220.0	Vietnam	46	
2.	5m^3 watering automobile	Machine shift	150.0		23	
3.	10-ton dump truck	Machine shift	180.3		38	
4.	1.6 m^3 excavator	Machine shift	135.6	Japan	113	
5.	9-ton self-propelled pneumatic-tyred vibrator	Machine shift	128.6	Japan	34	
6.	Plate vibrator	Machine shift	123.2	Vietnam	2x10^{-3}	
7.	Needle vibrator	Machine shift	121.2		0.03	
8.	10-ton roller	Machine shift	128.3		26	
9.	600 m^3/h diesel motor air compressor	Machine shift	122.2	Japan		46
10.	108CV bulldozer	Machine shift	149.3	Japan	46	
11.	130-140CV spreader	Machine shift	124.3	China/ Japan	63	
12.	50-60 m^3/h spreader	Machine shift	121.3		30	
13.	108CV grader	Machine shift	19.8		39	
14.	500l concrete mixer	Machine shift	182.2	Japan	1.09	
15.	Excavator 2.3 m^3/shovel	Machine shift	167.2	Japan	138	
16.	Destruction drill	Machine shift	300.6	Germany	52	
17.	Concrete cutter	Machine shift	405.6	Germany		8

1.4.5. Subproject area of influence

- *Specific features of natural and socio-economic conditions within the Subproject Area*

In the process of assessing the environmental and social impacts of a project, it is very important to take into account scoping of the project influence area. The investment in of the CCSEP aims to ensure environmental sanitation, stormwater drainage, wastewater treatment, solid waste management and connection of traffic infrastructure for the whole Quy Nhon city. The investment will be implemented through installing stormwater and wastewater sewer systems; expanding Nhon Binh WWTP's capacity up to 28,000m^3/day; constructing a A-4 cell in Long My landfill; constructing Y-shaped bridge and Huynh Tan Phat bridge.

Specific features of natural and socio-economic conditions within the subproject area are shown in the following Table 1.19:

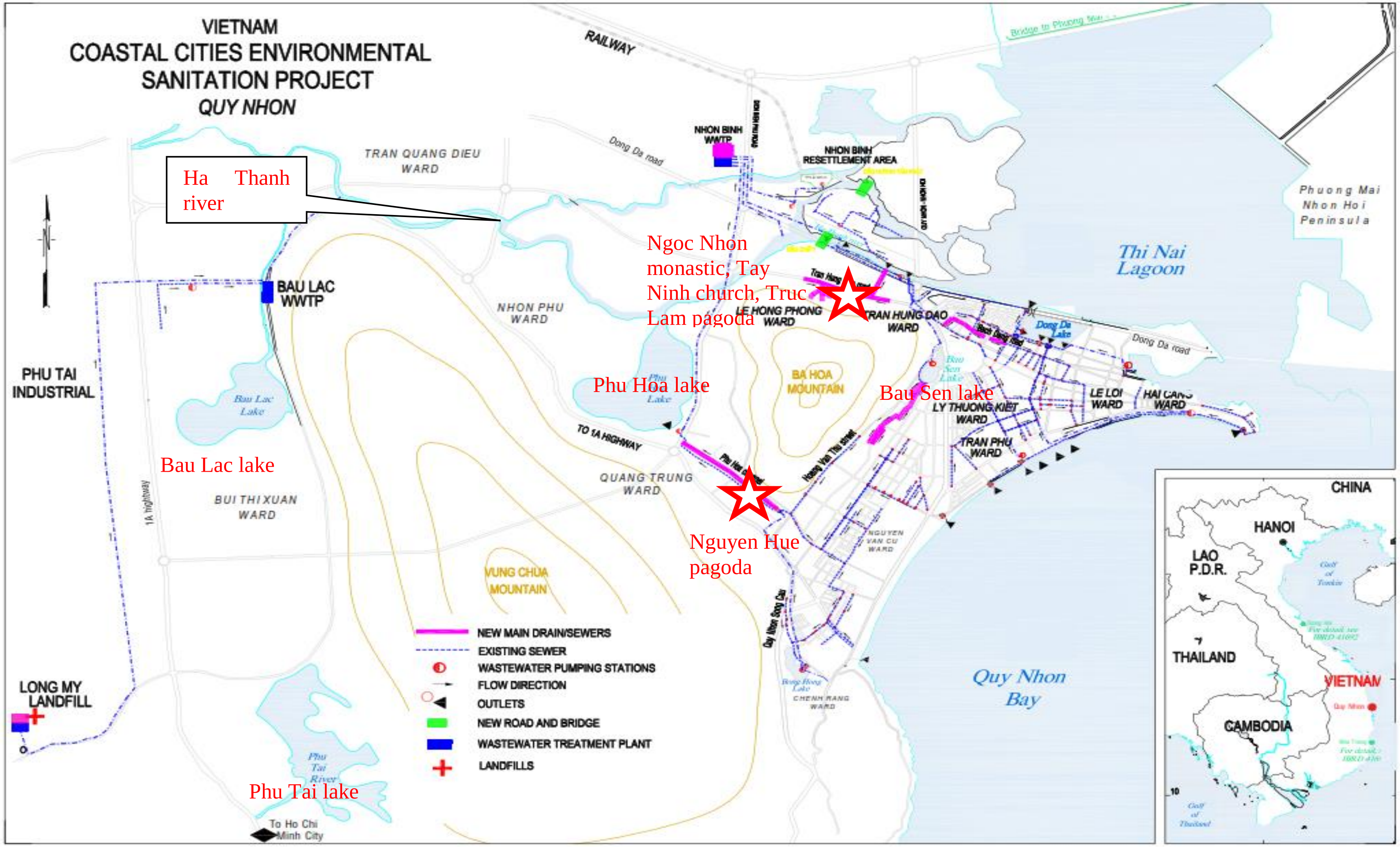


Figure 1.19. Natural and Socio-economic Settings in the Subproject Area

Natural - social objects near the works area of the project:

<u>Natural objects:</u>

Regarding transport: Tran Hung Dao Street and Hung Vuong Street connect the downtown of the city to 1D National Highway. This is the arterial road of Quy Nhon City – an area with high population density and heavy traffic flow (including medium and large load vehicles, wagon, container trucks, etc ..).

Regarding the river system, Ha Thanh river is the major river flowing through the city of Quy Nhon. Phu Hoa cannal in Quang Trung ward receives wastewater from the households living along its sides. The upstream ditch of Bau Sen lake collects domestic and cattle breeding wastewater discharged from households located in Le Hong Phong and Ngo May wards to Bau Sen lake.

<u>Socio – economic objects:</u>

Along Tran Hung Dao and Hung Vuong roads, there are major historical relics, temples and padogas within the project's construction area including: Twin Towers relics, Ngoc Nhon temple, Tay Ninh Holy See and Truc Lam pagoda. Besides, these are two arterial roads of Quy Nhon city so they are crowded and busy areas.

Along both sides of Phu Hoa canal are mostly households and Nguyen Hue pagoda is situated closely to the canal.

Other objects affected by the project includes Phong Lan semi-public kindergarten and Sen Hong kindergarten (Bach Dang Street).

The subproject area of influence includes the main construction routes such as Tran Hung Dao and Bach Dang, where are constructed stormwater sewer pipeline; the material and waste transport routes such as Tran Hung Dao (Nhon Binh WWTP, Long My landfill, stormwater sewer pipeline, Hoc Ba Bep area), Bach Dang (stormwater sewer pipeline), Xuan Thuy (Phu Hoa canal), Nguyen Thai Hoc (Upstream dich of Bau Sen lake), Thap Doi and Huynh Tan Phat (Y-shaped bridge and Huynh Tan Phat bridge). There are 19 wards/communes affected by subproject's activities, however, the impacts to those wards/communes are considered as negligible. The ecosystem areas are away 3-50km of distance from the subproject construction area (The nearest ecosystem area is Thi Nai lagoon away 3km to construction area of Y-shaped and Huynh Tan Phat bridge) therefore, impacts to ecosystem are considered as low.

1.4.5. Demand for Material

The quantity of raw materials used for the construction works are shown in Table 1.14 below:

Table 1.14.Quantity of raw materials of the project

STT	Construction Material	Unit	Phú Hòa Canal	Bau Sen Upstream ditch	Tran Hung Dao	Hoc Ba Bep	BachDang	Long My landfill	Y-shaped bridge	Huynh Tan Phat bridge
1	Sand	m^3	5,740	1,207.2	13,240.8	4,277.1	2,577.8	2,054.7	1,914	4,186
2	Crushed stone, frestone	m^3	12,105	2,117.2	8,408	5,539.2	1,563.6	1,876.6	33,676	53,374
3	Cement	ton	68.12	648.44	18.39	546.88	145.53	590.75	962,755	1,494,508
4	Iron, steel	ton	86.25	519.9	477.72	277.24	103.47	112.66	950	1,551
5	Wood	m^3	469.6	57.95	155.2	61.7	16.6	56.3	15	42.26

The volume of excavated, dredgedg and backfilled soil to be carried out is as follows:

Table 1.15. Volume of excavated, dredged and backfilled soil

No	Item	Volme of digging (m^3)			Volume of levelling (m^3)	
		Soil excavation (m^3)	Organic matter removal (m^3)	Foundation excavation (m^3)		
1	Phu Hoa canal			21,916	7,899.3	
2	Bau Sen upstream ditch	239.7	745	607.5	234	
3	Tran Hung Dao road	3,767		20,328	14,736	
4	Hoc Ba Bep area	244		5,428	4,527	
5	Bach Dang road	967		2,995	2,297	
6	Nhon Binh WWTP	10,560			4,280	80,380
7	Long My landfill	2,857				66,700
8	Y-shaped bridge	32.95	87.29	129.4	6,160.53	
9	Huynh Tan Phat bridge	258.71	1,084.62	531.34	12,606.45	4,439.03

- **Material sources**

Materials used for the construction works will be purchased from supply sources within the city itself or in the province (within radius of 30km from city downtown). Detail information on the material sources is describedas follows:

- **Rock quarry:** Rock is exploited at Giang mountain, Bui Thi Xuan ward, Quy Nhon city by VRG Binh Dinh Stone Granite Joint Stock Company under the licence no. 01/ /GP-UBND dated 04/01/2013, covering an area of 8.95ha, and with a reserve of 1,355,188 m^3in rock,and a capacity of 56,470 m^3/year over 27 years.
- **Sand mine:** Sand is exploited at Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district by Thanh Son company under licence no. 49/GP-UBND dated 15/9/2015, covering an area of 2.8ha, with a capacity of 10,000m^3/year, over 6.5 years.
- **Soil borrow pit:** Soil is exploited within the area of Bui Thi Xuan ward, Quy Nhon city, Binh Dinh province, by Phuc Loc Binh Dinh joint venture company, covering an area of 13.7ha, and with a capacity of 440,000m^3/year, term of 05 years. Soil mine was issued exploitation licence No. 12/GP-UBND dated 9/4/2015: area of 10ha, exploitation capacity under the design 495,000m^3/year over 05 years.

General comments on the material sources:

- Material sources have been granted with the exploitation licence issued by the Provincial People's Committee with plentifu reserves which can serve the need for materials by projects throughout the city.
- The environmental protection and recovery solutionsas well as environment deposit for the material sources have been fully implemented under the strict supervision and inspection of the Department of Natural Resources and Environment (DONRE) and the relevant agencies.
- The workers are fully equipped with equipment and labor protection tools. They are entitled to training sessions on labor safety.

The operation, the legal status, the technology to exploit, process and measures to mitigate enviornmental impacts by the mines owners will be presented in Appendix 1.

Material transportation routes:

- Rock quarry at Giang moutain, Bui Thi Xuan ward, Quy Nhon city: 1A Highway
- Sand mine at Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district: 638 Provincial Highway– 19C Highway
- Soil borrow pit at Bui Thi Xuan ward, Quy Nhon city: 19 Highway

Demand for electricity, chemicals:

Electricity: Nhon Binh WWTP consumes 2684 kWh per day; Leachate treatment plant at Long My landfill consumes 3,317 kWh per day.

Chemicals for Nhon Binh WWTP 28,000 m^3/day: $FeCl_3$ (38%): 142 kg/day; Polyme: 12.5 kg/day; NaOCl (10%): 7.5kg/day (with real capacity is about 25,000 m^3/day)

Chemicals for Long My landfill: EM solution: 0.6L/garbage ton.

Chemicals for Leachate treatment plant 200m^3/day: Lime: 500 kg/day

1.4.6. Subproject Implementation Schedule

Implementation period: 2017 - 2022.

The implementation plan of the subproject is presented as follows:

Table 1.16. Implementation plan for CCSEP – Quy Nhon city Subproject

No.	Work Items	No. of Month	LA signing		Phase 1 (30% loan value)						Phase 2 (70% loan value)														omple
			Year 2017				Year 2018				Year 2019				Year 2020				Year 2021				Year 2022		
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1	***Component 1 - Sanitation Infrastructure***	60			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1.1	Culvertilization of Phu Hoa Channel	18			1	1	1	1	1	1															
1.2	Rehabilitation of Bau Sen and Bach Dang combined sewers	18			1	1	1	1	1	1															
1.3	Construction of Long My leachate treatment plant, capacity phase 1 of	9			1	1	1																		
1.4	Supply, installation of automatic and odor removal equipment for PS, WWTP	9			1	1	1																		
1.5	Construction of school toilets	15			1	1	1	1	1																
1.6	Construction of drainage pipeline in Tran Hung Dao area	42									1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1.7	Construction of tertiary network and connection pits	42									1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1.8	Capacity upgrading for Nhon Binh WWTP to 28.000m3/day	42									1	1	1	1	1	1	1	1	1	1	1	1	1	1	
1.9	Construction, expansion of Long My landfill	18									1	1	1	1	1	1									
1.10	Construction of Long My leachate treatment plant, capacity phase 2 of	18									1	1	1	1	1	1									
2	***Component 2 - Environmental Infrastructure***	18			1	1	1	1	1	1															
2.1	Construction of Y-Bridge and Huynh Tan Phat Bridge	18			1	1	1	1	1	1															
3	***Component 3 - Site clearance and Resettlement***																								
4	***Component 4 - Implementation support, capacity building and institutional reform***	63			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

-

1.4.7. Investment Capital

The total investment for the subproject is US$**55.30** million, in which :

- ODA funding: US$ 50.36million
- Counterpart funding (allocated byBinh Dinh PPC from the provincial budget): US$ 4.94million

1.4.8. Subproject Implementation and Management

<u>Organizational structure:</u>

- Governing agency: Provincial People's Committee
- Employer: Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit
- Supervising agency: Binh Dinh Department of Planning and Investment;
- Implementation management unit: Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit (Binh Dinh CIW PMU);
- Donor: World Bank (WB).

<u>Management structure:</u>

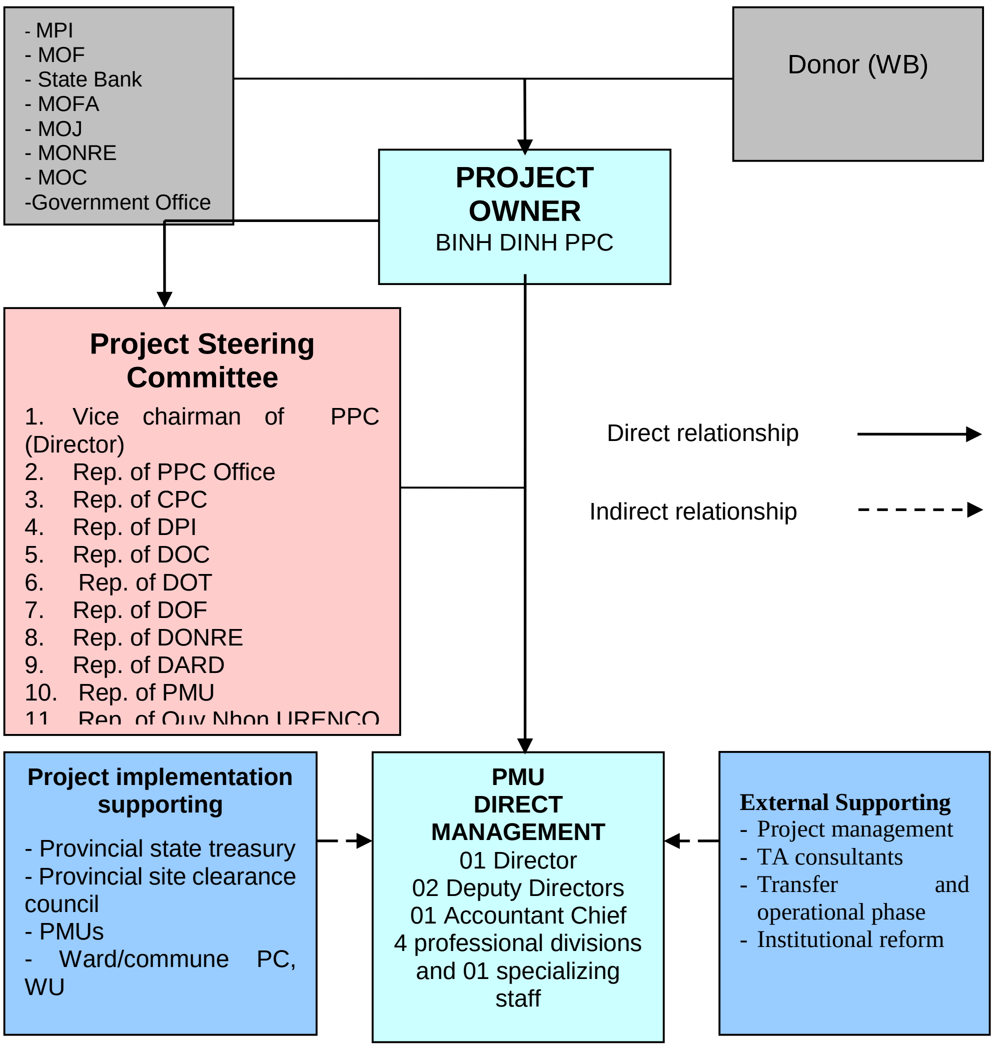


Figure 1.20.Diagram of Subproject Management Organization

CHAPTER 2. NATURAL ENVIRONMENT AND SOCIO-ECONOMIC CONDITIONS

2.1 Natural Environment Conditions

2.1.1 Geographical and Geological Conditions

Geographical conditions:

Quy Nhon city is situated in the southern end of Binh Dinh province with geographical location at $13^{0}46'$ North (latitude) and $119^{0}14'$ East (longitude). The city borders with Tuy Phuoc and Phu Cat districts on the North, Song Cau district of Phu Yen province on the South, the East Sea on the East and Tuy Phuoc district on the West. It is 1,065 km south of Hanoi and 650 km north of Ho Chi Minh City. The National Highway No. 1 and trans-Vietnam railway go through the city and its airport operates regular flights to Hanoi and Ho Chi Minh City. Quy Nhon, a coastal city, is the political, economic, cultural and scientific center of Binh Dinh province. Further, it is alsoan important route and marine transportation hub of the Southern-Central Vietnam, a key gateway of Central Highlands, Southern Laos, Northeast Cambodia and Thailand to the East Sea. Also, it is one of the nucleus urban areas of the Southern-Central Vietnam.

Terrain features:

Quy Nhon city consists of 2 areas: Area of old city and expanded area of Phuong Mai peninsulaa. Area of old city:

+ Inner city area:

The terrain is quite flat. The altitude varies from 1.5m to 4m. The slope directions are from the mountain to the sea and the river banks. The average slope ranges from 0.5% to 1% and areas with altitude below 2.0 m are often flooded from 0.5m to 1m (p=10%).

+ The area of Bui Thi Xuan – Tran Quang Dieu – Long My wards:

Located on both East and West sides of the National Highway 1A is a narrow valley clamped between Vung Chua mountain and Hon Cha mountain.

The west side of National Highway 1A has a high and relatively flat terrain. The lowest altitude is 5.5m and the average altitude is 8,0m. The slope directions are from the West to the East and from the South to the North with range from 0.5% to 1.5%, which is highly convenient for construction.

The east side of the National Highway 1A has low and hollow terrain, mainly covered with rice paddy fields. The lowest altitude is 1.1m and the highest altitude is 15.0m. Slope direction is from the South to the North ranging from 0.5% to 2% and areas with altitude below 3.0m are often flooded from 0.5m to 2.5m (p = 10%).

Long My area's terrain is quite flat with altitudes from 5.5m and above which are very convenient for construction.

b. Expanded area of Phuong Mai peninsula:

The area is a stable sand dune with the widest part is 4.5km, the narrowest part is 1km. The length of the peninsula is about 18km. The highest altitude is 315m; the average altitude is 15m and the lowest altitude is – 0.3m (the shrimp nursery area is in the west side of the peninsula).

The terrain slopes towards both the east and the west sides of the peninsula vary from 0.5% to 2%. There is no flood recorded in the peninsula and therefore, it is fairly convenient to construction.

Geological conditions

Geological conditions of the construction area in Quy Nhon city are as follows:

- The central area of the city: Layer 1 – the ground; Layer 2 – medium granulated coarse sand with the depth of more than 8 m; bearing intensity of R = 1.5kg/cm^2; Layer 3 – peat with bearing intensity of R = 0.4kg/cm^2 and Layer 4 - medium granulated sand containing seashells R = 1.8 kg/cm^2. This will be the construction area for the stormwater and wastewater drainage culverts at Tran Hung Dao road, Bach Dang road and Phu Hoa canal which will normally require shallow foundation of less than 2 meters deep.
- Ba Hoa – Vung Chua mountainside area: Layer 1 – 1.5m thick organic topsoil; Layer 2 - sand, deluvial and diluvial sand depth ranges from 4 to 4.5m, R = 1.2kg/cm^2; Layer 3 - medium sand, littoral deposit with R = 2.0 kg/cm^2, which are favorable for construction of the upstream ditch of Bau Sen lake and Hoc Ha Bep area.
- Phuong Mai peninsula has good geological structure, mainly consists of fine grained sand with relatively high bearing capacity > 1.8kg/cm^2 favorable for construction of the school toilet.
- Long My landfill: *Leveling topsoil layer:* consists of sand and clay mixed with broken stone, light yellow, solid state. This layer is distributed at the existing landfill embarkement area and over the buried garbage. The layer's thickness ranges from 3 to 5m; *O solid waste layer:* consists of polymer waste, dark gray, poor decomposition. This layer is distributed at the existing landfill embarkement area and underneath the buried levelling layer. The layer's thickness ranges from 1 to 5m. *SC layer*: main composition is yellow, light yellow sand, sticky to solid state with organic mixture. This layer is distributed mainly at the southwest and southeast areas around the existing surrounding area and stream bank areas; *SM layer:* consists of sand, ivory white colored sand, loose and broken stones mixed structure; *GW layer:* ivory white sand, loose and broken-coarse stones mixed structure, with thickness up to 2m; *CL layer*: clay, yellowish grey, white grey clay mixed with broken stones at solid state. This layer is distributed along mountain side or underneath SL and SM layer. *Argillit and siltstone 1A layer*: red brown, thickly stratificated siltstone and argillit. Rock is strongly weathered. This layer lies underneath the CL layer; *Granite stone layer*: white gray and yellow gray granite stone. Weathered rocks and unevenly fractured. According to survey results, at the cell construction site of Long My landfill changed considerably with various types of soil, inconsistent depth and distributed areas.
- Nhon Binh Wastewater area: *Site Levelling topsoil layer:* light yellow sand at solid state. This layer's thickness can be up to 1.7m at LK BHN3 area; *SM1 layer:*Medium to coarse sand, white gray, medium compaction state, partly mixed with little amount of organic material and small roots. The layer's thickness ranges from 1.8 to 6.5m; *SC1 layer*: Mixed sand, low stickiness, sticky state, dark gray coloured, partly mixed with little organic material and seashells, 2.9m thick and distributed at LK BHN3 area; *CH1 layer:* highly sticky clay, at fluid and fluidly sticky state, light blue grey colored, sometimes mixed with little amount of seashells. The layer's thickness is 24.0m to 24.6m; *CH2 layer*: Highly soft clay, soft and sticky state, light blue gray colored, sometimes mixed with little amount of seashells. The layer's thickness is from 7.5 to 9.5m; *SC2 layer*: Mixed sand, low stickiness, solid state, dark grey and yellow grey colored with some broken pebbles and conglomerate. The drilled thickness of this layer is 7.8m at BHN3; *SM2 layer*: medium to coarse sand mixed with gravel, white grey, compact state. The drilled thickness of this layer is 4.3m, at BHN3.

Hydrogeology:

- Water table ranges from 1.55m to 3.96m. Water table of the central city area is lower 3-4m from the ground surface.

Earthquakes:

- No record of earthquake or vibration has been found in Quy Nhon city.

2.1.2. Climatic and Meteorological Conditions

Quy Nhon city's climate in recent years is presented below:

a) Air temperature:

Quy Nhon air temperature fluctuates slightly by seasons/months within the year. The annual average temperature recorded during the period 2009-2014 was 27.2^{0}C. The highest average temperature is about 30.6^{0}C in June while the lowest temperature is about 23.3^{0}C in January.

b) Rain

Rainfall in Quy Nhon distributes unevenly across months within the year, the rainy season lasts from September to November and accounts for 80% of the total annual rainfall. The annual average precipitation in Quy Nhon during 2009-2014 was 1845.2mm. The november, 2010 has the highest rainfall with total rainfall is 2,812.1mm (from 2010-2014). Besides, the february, 2010 has the lowest rainfall with total rainfall is 0 mm (from 2010-2014).

c) Sunshine

The number of sunny hours in the city varies from 2,046 to 2,638 hours in the period of 2009-2014. The annual average number of sunny hours during 2010-214 was 2337.4 hours. The highest number of sunny hours was in May, 2014 with 319.9 sunny hours while the lowest number of sunny hours was in November, 2010 with 23.0 sunny hours.

d) Storm and flooding

Storms: often occur from September to December, and most frequently in October. There are about 1.13 storms per year and the number tends to increase each year. In recent years, storms tend to hit earlier and with greater intensity. In the year with La Nina and El Nino, there is 1 more storm than an average year and the number of storm in the period of La Nina is higher than the period of El Nino (3.4 compared to 2.1 storms). According to statistical data, storm is one of the natural disasters causing damages of houses, roads, infrastructure and agricultural production e.g. farming, cattle breeding, forestry, fishing and aquaculture. In 2009, after Marinea storm hit Phu Yen and Binh Dinh provinces, Quy Nhon city was the most heavily damaged area.

Flooding: Similar to the most of other central coastal regions, Quy Nhon city has to faced with the risk of high flooding becasue it's river system is narrow and sloping. In recent years, the frequency of flooding increases quickly, causing damage to human lives and their properties. The big floodings destroy roads, culverts, bridges, embankments, buildings and other infrastructures. This is the consequence of the rapid urbanization process and it is forecasted that the risks of flooding are unavoidable.

e) Drought

Hot sunlight and west wind in dry season, high temperature, extended large evaporation, together with sloping topography, short river can not store enough water during rainy seasons caused serious drought. The dry season lasts 8 months, drought often happened during summer-autumn crop and main crop every year.

f) Evaporation

The average annual evaporation amount of Quy Nhon city is 1,193 mm. Compared to rainfall amount, evaporation accounts for 60-70%. According to measurement result of Quy Nhon Meteorology Station, the highest evaporation amount was in July and August, with 156 mm while the lowest evaporation amount was in November and Demcember with 73 mm.

g) Wind regime

In winter, dominant wind direction is Northwest to North, in summer wind direction is East to Southeast but the dominant wind direction in the first half of summer is West to Northwest. The windy month was in May while the little wind month was in December. According to measurement result of Quy Nhon Meteorology Station, the average wind velocity in dry season is 3.95m/s, in rainy season is 3.8m/s. The highest wind velocity were 4 months: June, July, September and December.

h) Humidity

According to Statistical Yearbook of Binh Dinh province 2014, the annually average humidity at Quy Nhon city during 2010-2014 ranges from 64-85%. The highest humidity was in November, 2010 while the lowest humidity was in October, 2012.

2.1.3. Hydrological/Oceanographical Conditions

Hydrology:

Quy Nhon city central area situated at the South of Ha Thanh river, a 85km long river originated from an altitude of 1,100m at the Southwest of Van Canh district and flows at the Southwest - Northeast direction to Dieu Tri then split into 2 branches: Ha Thanh and Truong Uc. The river flows to Thi Nai lagoon through both Hung Thanh and Truong Uc gates then continues to Quy Nhon sea. The river basin area is 580 km2.

Currently, the rivers are often dry up due to insufficient flow in the dry season. In the rainy season, the water flow is strong and often causes flood from October to November with flooding time lasting from 58 to 75 hours.

The total annual flow discharge of Ha Thanh river is 0.6 billion m^3, the annually average discharge is 19.0 m^3 which peaks at 2,660 m^3/s and bottomed at 3,73m^3/s.

Figure 2.1. Map of Ha Thanh river basin in Quy Nhon city

Oceanography:

Maximum sea water level by repeated cycles at Quy Nhon is shown the Table 2.1 below:

Table 2.1. Maximum water level by annual cycle

Repeat cycle (Year)	2	5	10	20	25	50	100
H (cm) (National)	76.0	86.3	93.1	99.6	101.7	108.0	114.1

(Source:Calculation of maximum water level with rare frequency at Quy Nhon Station on the continental origin ‘0‘by oceanographical meteorology center).

Quy Nhon city is strongly affected by uneven diurnal tidal regime with the amplitude of tide ranging from 1.2 to 2.2m. The rainy season and rain event occured at the same time of tidal surge can create a difference of 0.4 - 0.6m. According to existing statistical data, from 1976 to present, the parameters of tidal level are as follows: average highest tidal level: + 1.04m; mean tidal level: +0,00m; and average lowest tidal level: - 0.12m. The expansion areas of Long My landfill and Nhon Binh WWTP are at the high elevation, particularly Long My landfill area is at an average elevation +118m above sea level, Nhon Binh WWTP is at an average elevation +37m above the sea level. Therefore, these areas will not be affected by tidal surge.

2.1.4. Baselines of Physical Environment Components

The sampling locations of physical environmental components, including soil, surface water, wastewater, and air are shown in Figure 2.2 below:

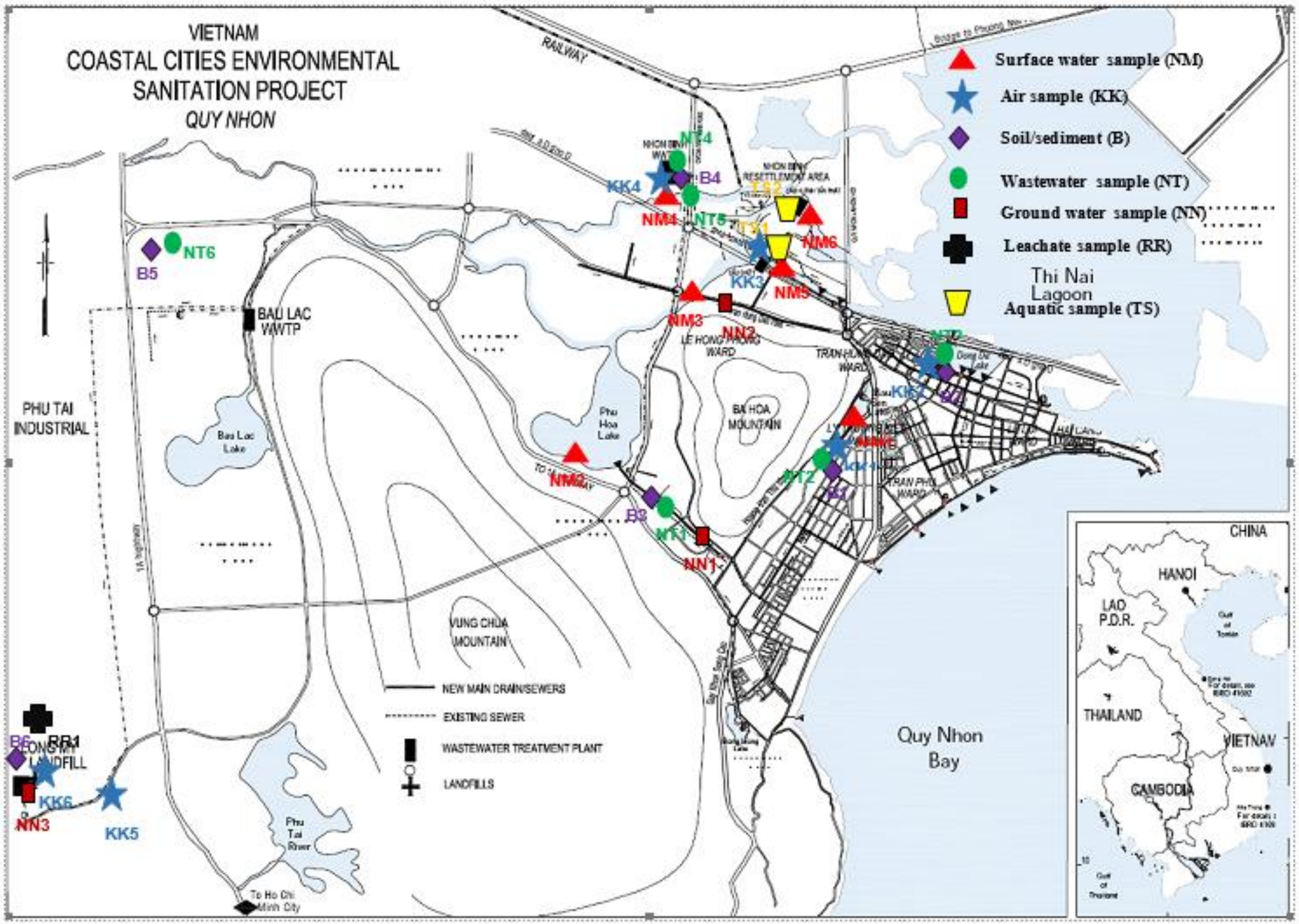


Figure 2.2. Map of Sampling Location

2.1.4.1. Ambient Air and Noise

Binh Dinh Department of Natural Resources and Environment (DONRE) monitored the quality of ambient air in some areas of Quy Nhon city from 26th to 27th February 2016. The monitoring results are shown in Table 2.10 and compared to the following standards:

- QCVN 05:2013/BTNMT: National technical regulation on ambient air quality (hourly average).
- QCVN 06:2009/BTNMT: National technical regulation on maximum concentration allowance of some toxic substances in ambient air.
- QCVN 26: 2010/BTNMT: National technical regulation on noise in residential areas.

Table 2.2. Monitoring Results of Ambient Air Quality

	Parameters	**Unit**	**Analysis Method**	**Result**						**QCVN05:2013/ BTNMT**
				KK1	**KK2**	**KK3**	**KK4**	**KK5**	**KK6**	
1	Temperature	^0C	QCVN 46:2012/BTNMT	21.5	21.6	21.8	22.1	22.2	22.4	**-**
2	Humidity	%	QCVN 46:2012/BTNMT	79.8	79.7	79.7	79.4	79.3	79.1	**-**
3	Wind velocity	m/s	QCVN 46:2012/BTNMT	1.3	1.2	1.9	2.5	1.6	2.1	**-**
4	Noise	dBA	TCVN7878-2:010	52.3	61.5	62.1	60.31	60.7	53.5	**70***
5	TSP	µg/m^3	HAZ-DUST portable meter	44	96	85	87	78	69	**300**
6	NH_3	µg/m^3	TCVN5293:1995	18	5	8	16	9	25	**200****
7	CO	µg/m^3	52TCN352-89	2205	2316	2271	2264	2259	2219	**30,000**
8	NO_2	µg/m^3	TCVN6137:1996	30	33	32	32	30	29	**200**
9	SO_2	µg/m^3	TCVN5971:1995	61	69	67	66	65	68	**350**
10	H_2S	µg/m^3	TQJT_YHLĐ& VSMT1993	6	1	2	7	4	14	**42****

Note:
**: QCVN26:2010/BTNMT: National technical regulation on noise*
***: QCVN06:2009/BTNMT: National technical regulation some toxic substances in ambient air*
Sampling location and coordinates:
- ***KK1**: Renovation area of the ditch upstream of Bau Sen lake on 26/02/2016*
- ***KK2**: Central city area at Bach Dang - Phan Dinh Phung crossroad on 26/2/2016.*
- ***KK3**:Y shaped bridge construction area on 26/2/2016.*
- ***KK4**:Residential area adjacent to Nhon Binh wastewater treatment plant on 26/2/2016.*
- ***KK5**: Residential area adjacent to Long My landfill, Thanh Long village, Phuoc My commune on 26/2/2016*
- ***KK6**: Long My landfill,Thanh Long village, Phuoc My commune on 26/2/2016.*

Comments: The monitoring results showed that all the measured parameters of ambient air quality and noise level meet the permitted levels of QCVN 05:2013/BTNMT; QCVN 06:2009/BTNMT and QCVN 26:2010/BTNMT.

2.1.4.2 Surface Water Quality

The environmental consultants also conducted surface water sampling at 7 locations in Quy Nhon city from 26 to 27 February 2016. The measured results are shown in Table 2.14 and compared to QCVN 08-MT:2015/BTNMT (column A2 - National technical regulation on surface water quality for domestic water supply but must apply appropriate treatment technology):

The results of surface water quality are presented in the following tableThe results of surface water analysis are presented in the following table 2.3:

Table 2.3. Results of Surface Water Quality

	Parameters	**Unit**	**Analysis Method**	**Result**							**QCVN 08-MT:2015/ BTNMT Column A2**
				NM1	**NM2**	**NM3**	**NM4**	**NM5**	**NM6**	**NM7**	
1	pH	-	TCVN 6492:99	7.29	7.02	7.64	7.58	7.25	7.25	6.92	**6 – 8.5**
2	Temperature	^{0}C	SMEWW 2550B	23.2	22.1	24.6	23.5	23.9	23.4	24.2	–
3	Salinity	‰	SMEWW 2520B	0.37	2.81	3.96	4.55	5.70	4.15	0.01	–
4	TSS	mg/l	SMEWW 2540D	52	< 5	8	5	13	7	< 5	**30**
5	BOD_5	mg/l	TCVN 6001:95	32	10.12	5.19	6.9	5.0	6.22	11.6	**6**
6	NH_4^+- N	mg/l	TCVN 6179-1:96	3.8	3.47	1.07	1.42	1.39	1.31	3.8	**0.3**
7	Cl^-	mg/l	TCVN 6194:96	56.72	1368	1949	2091	4101	3806	69.5	**350**
8	T-N	mg/l	TCVN 5987:95	7.63	6.72	6.53	6.58	7.43	6.48	7.68	–
9	T-P	mg/lP	TCVN 6202:96	2.8	1.58	0.42	0.83	1.97	0.64	0.22	–
10	Fe total	mg/l	TCVN 6177:96	1.14	1.51	0.64	0.55	0.63	0.50	2.64	**1**
11	As	mg/l	SMEWW3500-As	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.02**
12	Mn	mg/l	TCVN 6002:95	< 0.05	< 0.05	0.5	< 0.05	0.3	< 0.05	0.1	**0.2**
13	Total oil	mg/l	SMEWW5520D	18160	120	250	160	40	85	123	**0.5**
14	Coliform	MNP/100ml	TCVN6178:1.2:96	5700	1200	2100	3500	46	1350	670	**5000**

Sampling location and coordinates:

- ***NM1***:*Surface water samples at the receiving water body in the upstream ditch of Bau Sen lake on 26 Feb 2016.*
- ***NM2***: *Surface water samples at Phu Hoa* canalon *27 Feb 2016.*
- ***NM3***:*Surface water samples adjacent to Doi bridge on Ha Thanh river on 27 Feb 2016*
- ***NM4***: *Surface water samples at the receiving water body of Nhon Binh WWTP on 26 Feb 2016*
- ***NM5***:*Surface water samples at Y shaped bridge construction area on 26 Feb 2016.*
- ***NM6***:*Surface water samples at Huynh Tan Phat bridge construction area on 26 Feb 2016.*
- ***NM7***: *Surface water samples at the irrigation channels behind Long My landfill, on 26 Feb 2016.*

Comments: In comparison with QCVN 08-MT:2015/BTNMT (Column A2: for domestic water supply but requires applying appropriate treatment technology) and the analysis results of 7 surface water samples shown that:

- The concentration of TSS of NM1 sample exceeds the allowable value of QCVN 08-MT:2015/BTNMT, 1.73 times

- The concentration of BOD5 of 05 samples NM1, NM2, NM4, NM6 and NM7 exceeds the regulated level of QCVN 08-MT:2015/BTNMT, from 1.03 to 5.3 times

- The content of ammonia (NH4+-N) of all 7 samples is higher than the permitted level of QCVN 08-MT:2015/BTNMT, from 4.4 to 12.7 times.

- The content of chloride (Cl-) of samples NM2, NM3, NM4, NM5 and NM6 exceeds the permissible limit from 3.9 to 0.9 times.

- The concentration of Fe of the samples NM1, NM2 and NM7 is higher than the allowable level of QCVN 08-MT:2015/BTNMT (column A2).

- Mn concentration of samples NM3 and NM5 is 1.5 – 5 times higher than the permitted value of QCVN 08-MT:2015/BTNMT (column A2).

The concent of Coliform of sample NM1 exceeds 1.14 times the regulated level in comparison to QCVN 08-MT:2015/BTNMT (column A2).

The reason for the degradation of surface water is the domestic wastewater which is being discharged directly into the receiving water bodies causing water pollution.

2.1.4.3. Ground-water Quality

Groundwater samples were collected on 26 and 27 Feb 2016. The quality of groundwater samples is compared to QCVN 09-MT:2015/BTNMT as follows:

Table 2.4. Results of groundwater analyses

	Parameters	Unit	Analysis Method	Result			QCVN 09-MT:2015/ BTNMT
				NN1	NN2	NN3	
1	pH	-	TCVN 6492:99	7.67	6.91	6.71	**5.5 – 8.5**
2	TSS	mg/l$CaCO_3$	TCVN 6224:96	280	208	300	**500**
3	TDS	mg/l	SMEWW 2540C	584	469	1281	**1500**
4	COD	mg/lO_2	TCVN 6491:99	4.8	5.6	4.8	**4**
5	Cl^-	mg/l	TCVN 6194:96	85	81	333	**250**
6	NH_4^+ - N	mg/l	TCVN 6179-1:96	3.82	1.82	3.77	**1**
7	SO_4^{2-}	mg/l	TCVN 6200:96	281.8	54.9	15.3	**400**
8	Total Fe	mg/l	TCVN 6177:96	14	0.15	4	**5**
9	Mn	mg/l	TCVN 6002:95	0.75	0.07	2.854	**0.5**
10	As	mg/l	SMEWW3500-As	<0.001	<0.001	<0.001	**0.05**
11	Coliform	MNP/100ml	TCVN6178:1.2:96	3	0	1	**3**

Sampling location and coordinates:
- ***NN1****: Residential well, group 46, area 5(Quang Trung ward – next to Phu Hoa* canal*) on 27/2/2016.*
- ***NN2****: Mr. Nguyen Van Tien's house, no. 1203 Tran Hung Dao, Tran Hung Dao ward on 27/2/2016.*
- ***NN3****: Observatian well at Long My landfill, Thanh Long village, Phuoc My commune on 26/2/2016.*

Comments: In comparison with QCVN 09-MT:2015/BTNMT – National technical regulation on groundwater quality, the monitoring results of 3 groundwater samples shown that:

- COD at 03 ground water samples exceeded the allowed limits of QCVN 09-MT:2015/BTNMT.

- Cl^- conentration of sample NN3 exceeded 1.3 times the allowed limits of QCVN 09-MT:2015/BTNMT

- All 03 ground water samples have NH_4^+ concentration exceeded the allowed limits of QCVN 09-MT:2015/BTNMT by 1.82 to 3.82 times.

- Fe conentration of sample NN1 and Mn result of sample NN3 are higher than the remaining samples.

According to Binh Dinh Construction Department reports in recent years, due to over extraction, the ground water of Binh Dinh province appears to diminish in quality and quantity with significant increased Fe and Mn levels. This result is relevant to the analytical result of the ground water samples.

2.1.4.4. Domestic Wastewater Quality

Domestic wastewater samples were collected on 26 and 27 Feb 2016. The monitoring result of wastewater samples in the city compared to QCVN14:2008/BTNMT as follows:

Table 2.5. Monitoring Results of Wastewater Samples

	Parameters	**Unit**	**Analysis Method**	**Result**								**QCVN 14:2008/ BTNMT Column B**
				NT1	**NT2**	**NT3**	**NT4**	**NT5**	**NT6**	**RR1**	**RR2**	
1	pH	-	TCVN 6492:99	7.05	6.97	7.28	7.26	7.60	7.15	7.45	7.53	**5 - 9**
2	TSS	mg/l	SMEWW 2540D	25	8	354	154	97	75	271	120	**100**
3	BOD_5	mg/l	TCVN 6001:95	40.5	59.6	156	62.4	15	6.2	612	224	**50**
4	COD	mg/l	TCVN 6491:99	85	107	384	120	50	12	1252	780	**-**
5	NH_4^+ - N	mg/l	TCVN 6179-1:96	10.6	36.4	36.18	20.24	4.37	4.9	252.4	165.8	**10**
6	T-N	mg/l	TCVN 5987:95	72.8	61.2	63.6	36.2	8.11	35.2	382.2	213.5	**-**
7	T-P	mg/l	TCVN 6202:96	7.2	9.4	13.8	14.3	7.73	1.6	41.86	36.0	**-**
8	Cr^{6+}	mg/l	SMEWW3500B-Cr	0.09	0.06	0.094	0.03	0.02	0.04	3.6	2.4	**-**
9	Cr^{3+}	mg/l	SMEWW3500B-Cr	0.08	0.03	0.062	0.01	0.001	0.01	1.64	1.5	**-**
10	Cu	mg/l	SMEWW3500B-Cu	0.42	0.25	0.63	0.12	0.06	0.08	1.09	0.83	**-**
11	Pb	mg/l	SMEWW3500B-Pb	0.0008	0.0002	0.0009	0.0001	<0.0001	<0.0001	0.5	0.2	**-**
12	Zn	mg/l	SMEWW3500D-Zn	0.25	0.14	0.37	0.09	0.04	0.02	5.8	3.6	**-**
13	Total Fe	mg/l	TCVN 6177:96	1.35	0.6	4.38	2.18	0.73	4.9	3.12	1.9	**-**
14	As	mg/l	SMEWW3500B-As	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**-**
15	Total oil	mg/l	SMEWW5520D-C	27	15	86	140	10.5	1	37920	200	**20**
16	Coliform	MNP/100ml	TCVN6178:1.2:96	19400	92000	60000	45500	3400	330000	430000	180000	**5000**

Sampling location and coordinates:

- **NT1**: Wastewater at Phu Hoa canalon 27 Feb 2016.
- **NT2**: Wastewater at upstream ditch of Bau Sen lake on 26 Feb 2016.
- **NT3**: Wastewater nearby Dam market area, Bach Dang - Phan Dinh Phung crossroad (construction area of culvert network on Bach Dang road) on 26 Feb 2016
- **NT4**: Input wastewater of Nhon Binh wastewater treatment plant on 26 Feb 2016
- **NT5**: Output wastewater at Nhon Binh wastewater treatment plant (inside the plant) on 26 Feb 2016
- **NT6**: Wastewater at pumping station BS10, Tran Quang Dieu ward (constructs collection network level 3) on 27 Feb 2016
- **RR1**: Input leachate samples at Long My landfill, Thanh Long village, Phuoc My commune on 26 Feb 2016.
- **RR2**: Output leachate samples at Long My landfill, Thanh Long village, Phuoc My commune on 26 Feb 2016

Comments: In comparing with QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater quality (column A), the monitoring results of 06 wastewater and 02 leachate samples showed that:

- TSS result of 04 wastewater samples NT3, NT4, NT5, NT6 and 02 leachate sample exceeded the allowed limit of QCVN 14:2008/BTNMT, column A by 1.5 to 7.08 times.

- BOD_5result of 04 wastewater samples NT1, NT2, NT3, NT4 và 02 leachate sample exceeded the allowed limit of QCVN 14:2008/BTNMT, column A by 1.35 to 20.4 times.

- $NH4^+$result of 04 wastewater samples NT1, NT2, NT3, NT4 and 02 leachate samples exceeded the allowed limit of QCVN 14:2008/BTNMT, column A by 2.12 to 50.48 times.

- Total oil result of 05 wastewater samples NT1, NT2, NT3, NT4, NT5 and 02 leachate samples exceeded the allowed limit of QCVN 14:2008/BTNMT, column A by 1.05 to 3.792 times

- Coliform result of all 06 wastewater samples and 02 leachate samples exceeded the allowed limit of QCVN 14:2008/BTNMT, column A by 1.13 to 143.3 times.

According to the above-mentioned results, wastewater samples NT1 to NT6 are heavily polluted with high concentrations of organic matters. The causes for this exceeding permissible levels are attributed to the reason that untreated domestic wastewater is directly discharged into the channels, ditches and receiving water bodies. Therefore, it is necessary to construct wastewater collecting culvert system and upgrade Nhon Binh WWTP which will contribute to minize pollution situation..

2.1.4.5. Soil and Sediment Quality

Soil and sediments were sampled from 27 to 28 Feb 2016. The monitoring results shown in Table 2.17 indicated that all soil and sediment samples in the subproject area are satisfactory to the permitted levels as regulated by QCVN 03-MT:2015/BTNMT - National technical regulation on the allowable limits of heavy metals in the soils.

Table 2.6. Monitoring Results of Soil and Sediment Samples

	Parameters	**Unit**	**Analysis Method**	**Results**						**QCVN03-MT:2015/ BTNMT Residential land**
				B1	**B2**	**B3**	**B4**	**B5**	**B6**	
1	pH	-	SMEWW2520B	6.38	6.24	6.08	6.02	6.18	6.58	**-**
2	As	mg/kg	TCVN6180:96	6.2	5.6	4.82	4.98	5.16	7.12	**15**
3	Hg	mg/kg	TCVN8882:2011	0.004	0.008	0.002	0.004	0.006	0.001	**-**
4	Cd	mg/kg	TCVN6202:96	1.06	0.89	1.26	1.24	1.39	1.14	**2**
5	Cr	mg/kg	TCVN6496:2009	12.8	11.3	12.8	13.4	14.2	9.6	**200**
6	Cu	mg/kg	TCVN6001:95	35.4	32.7	35.8	35.2	36.4	43.5	**100**
7	Pb	mg/kg	TCVN6178:96	45.7	40.8	40.7	38.4	42.8	46.2	**70**
8	Zn	mg/kg	TCVN6179-1:96	136	125	129	142	151	168	**200**
9	Salinity	‰	SMEWW2520B: 2012	0.63	0.59	0.65	0.71	0.68	0.62	**-**

Sampling location and coordinates:
- ***B1****: Sediment sample from ditch upstream of Bau Sen lake on 26 Feb 2016*
- ***B2****: Sediment sample near Dam market area, Bach Dang - Phan Dinh Phung crossroad (construction area of culvert system on Bach Dang road) on 26 Feb 2016*
- ***B3****: Sediment sample of Phu Hoa* canal*on 27 Feb 2016*
- ***B4****: Sediment sample of Nhon Binh wastewater treatment plant on 27 Feb 2016*
- ***B5****: Residential area next to Long My landfill, Thanh Long village, Phuoc My commune on 26 Feb 2016*
- ***B6****: Soil sample at Long My landfill, Thanh Long village, Phuoc My commune on 26 Feb 2016*

Comments: In compared to QCVN03-MT:2015/BTNMT, the monitoring results showed that all the 06 collected soil and sediment samples meet the requirement of the national technical regulation.

2.1.5. Biological Resources

2.1.5.1. Biological Resources in Binh Dinh Province

a. Flora

Vegetation coverage of Binh Dinh province is rich and diverse in terms of species quantity. Tropical plants grow throughout the year because the area is unaffected by Northeast seasonal winds. The province's vegetation cover includes:

- Natural thick forest: concentrate on the west side of the province - at the areas of Vinh Thanh, An Lao, Hoat An, Tay Son and Van Canh districts. This type of forest grows at high mountain, contains mainly broad-leaf tree plants and woods with various rare types such as *Spondias cytherea*, *Dipterocarpaceae*, *Parashorea*,*Shorea roxburghii* ... This is the popular forest type of Binh Dinh province.
- Bush forest: this type concentrates at sliding area and low hills. Its characteristics include specific creeper *Embelia pulchella(Myrsinnaceae)*, *MelinilahọMua (Melastomaceae)* and pepper (*Piperaceae*). The bush layer is quite developed, covering 15% of the forest surface. There are also many grass-type plants e.g. *Chirita cf.annamensis*, *Slackia tonkinensis*, *Pentaphragma gamopetalum; Selaginella species;Litsea cubeba*and*Schefflera dongnaiensis var. langbianensis*.

In addition, there are other types including fern, moss and spermatophyta distributed at the area of An Lao, Hoat An, Hoat Nhon and Tay Son districts.

b. Fauna

There are 330 species of terrestrial vertebrate animals including 84 species of mammals, 163 species of birds and 83 reptilia - amphibia species in the province' area. 46 of these species are rare and endangered species listed in Vietnam Red List (2007), 2015-IUCN Red List of Threatened Species and appendices of Decree 32/2006/NĐ-CP. However, these rare species do not live within the subproject area of influence. They only concentrate at the An Toan natural reserve area (An Toan commune, An Lao district) which is 93 km from the subproject area.

c. Marine Ecosystem

Mangrove forest ecosystem:

Thi Nai Lagoon covers an area of 1,200 ha. The lagoon has 116 fish species in which 25 species are of highly economic value: red snapper, grouper, cobia, sea bass, pompano, flying fish...; 14 shrimp species with 3 species of which are considered as high economic value species: giant tiger shrimp, white shrimp and prawn; over 100 seaweed species, especially large *gracilaria verrucosa*. The mollusca living in the lagoon include 100 species with some high economic valuable species. The details of current status of natural biological resources in Thi Nai lagoon are presented in the section 2.1.5.2.

Coral reef and aquatic species:

Coral reef distributes mainly at the embankment areas at the south of Nhon Hai commune, Hon Dat island and Xanh island (west and south sides) which is 14km from the project's construction area. The reef's main composition is alcyonaria, except the reef at west side of Xanh island with hard coral reef. Recognized aquatic species at the coral reef includes:

- 61 seaweed species of 4 divisios: Cyanophyta, Phaeophyta, Rhodophyta and Chlorophyta has been recognized. Cyanophyta has 3 species (accounts for 4.9%), Rhodophyta has 30 species (accounts for 49.1%), Phaeophyta has 13 species (accounts for 21.3%) and Chlorophyta has 15 species (accounts for 24.7%). Especially, there are seaweed species having high economic value such as *Gracilaria eucheumoides*, *Gelediella acerosa*, *Hypnea pannosa* and *Sargassum* spp.

- 111 species of 61 genus and 34 family of fish at the coral reef, with a number of species having high economic and export value. *Pomacentridae* family has 19 species (17.11%), *Labridae* has 17 species (15.31%), *Chaetodontidae* has 10 species (9%), *Acanthuridae* has 10 species (9%). Next, *Serranidae* has 5 species (4.5%), *Lutjanidae* has 4 species (3.6%), *Siganidae* has 4 species (3.6%) and other remaining families has 1-3 species each. The families which has more than 10 species includes *Chaetodontidae*, *Pomacentridae*, *Labridae* and *Acanthuridae*.

In addition to the mentioned main species, there are also many different *mollycoddle* species (*Tectus niloticus, Conus, Lambis chiragra, Naticidae and abalone*, etc.), black sea cucumber and baby lobsters. Although these species do not bring major benefits, their existence increases the reef's diversity.

2.1.5.2. Biological Resources at Thi Nai Lagoon

Thi Nai lagoon is about 4km from subproject area. The World Conservation Monitoring Centre has listed the mangrove area of Thi Nai lagoon is located on the coastal area at the north of Quy Nhon. The mangrove area is 5,000 ha at high tide and 3,200 at low tide period, with a 700m wide canal flowing to the sea. A number of rivers like Ha Thanh, An Phu and Dai An flow to the flooded area with average depth of 1-2m and highest depth of 7-10m. There are several small islands with mangrove forests in the north side of the flooded area.

*Phytoplankton: R*esearch result [9] on phytoplankton of Chim island and Thi Nai lagoon areas showed that: there are 75 species including 20 dinophyta species, 49 bacillariophyceae species, 02 chlorophyceae species and 01 cyanobacteria species. Small sized bacillariophyceae species which are often seen at the observation station are *Chactoceros, Coscinodiscus, Bipartitus, Coscinodiscus Sp. Cylindrotheca, Closterium, Nitzschia Sp.,Odontella Mobiliensis* and *Thalassionema Nitzschioides.* Commonly seen dinophyta species are *Ceratium, Furca,* algae species of *Gonyaulax, Prorocentrum, Protoperidinium.* The density distribution of phytoplankton is on average 13,500 cells/liter at high tide and 17,500 cells/liter at low tide.

Zooplankton: This is an important link in the aquatic food chain, the main foundation to assess the richness as well as the environmental pollution level of the researched area. According to the research findings [10] on the characteristics and composition of species in the analytical result of 14 zooplankton samples collected from April to November 2013 at the Chim island - Thi Nai lagoon area, 53 species initially identified. *Copepoda* dominates in number of species (64% of the total species) and individuals (81.67% of the total number of individuals). The species composition is quite abundant but complicated because in addition to brackish water and sea water species, there are also a number of fresh water such as: *Psendodiaptomus incisus, schmackeria dub.* This suggests that the studied area is not only affected by sea water but also by fresh water from the continent.

The abundance of phytoplankton and zooplankton at Thi Nai lagoon show that there is an abundant food source for fish and aquatic species which feed on plankton. Plankton is a key link in the aquatic food chain and demonstrates the fertility of the environment. Therefore, considering on the basis that plankton is a food source, Thi Nai lagoon can be considered as a highly nutritious area.

Fish species composition: There are 75 fish species of 40 families and 12 ordos in Chim island - Thi Nai lagoon area, including 46 species in dry season and 50 species in rainy season. A number of species are often seen in both dry and rainy seasons. These species can live in both bracklist water and sea water even in fresh water such as Elops Saurus Linaeus, Hypurhamphus limbatus, Leiognathus equulus, Gerres Filamentosus, mullets and a number of Saurida umeyoshii and goby. 25% of the species is considered as having high economic value, confirming that fishing area in Chim island - Thi Nai lagoon plays a key role in the area's fishery.

Bird species: The number of bird species such as storks and duck... gathering at Thi Nai lagoon has been increasing in both number of species and individuals but this is still not researched yet.

Vegetation coverage: Low coverage has 139 species, accounts for 53% of total species, and distributed at areas which was affected by incidents or used to be densely populated. Average coverage has 86 species, accounts for 33%. These species are mixed groups in the population. Therefore, they has characteristics of the dominant species. High coverage has 37 species, accounts for 14% total species. These are dominant species with characteristics of riverside forest. Among these species,*Rhihizophora apiculata* is the prevailing vegetation species and the main component of the coverage structure. The mangrove forest distributes at areas with plenty of channels/canals and flooded areas caused by semidiurnal tide regime. Trees in the mangrove forest are normally re-planted trees or wild vegetation distributed at fertile lands.

2.1.5.3. Biological Resource in the Subproject area

There has not been any specific quantitative research on animal and vegetation of the city. However, according to field research results of the ESIA study team and information provided by local residents, the characteristics of terrestrial species within the city area are as following:

a. Terrestrial Flora and Fauna

<u>Construction area of Y shaped and Huynh Tan Phat bridges</u>

On both sides of the construction area of Y-shaped bridge, there are mainly residences of North Ha Thanh river and South Ha Thanh river. Therefore, this area has only a few trees and mostly residential animal like dogs, cats, chicken and ducks.

Huynh Tan Phat bridge construction area has only a small population so there are many trees and vegetation coverage grown along both sides of Ha Thanh river. Moreover, during survey process, there were not any wild animals detected.

Figure 2.3. Terrestrial species at Y-shaped and Huynh Tan Phat bridge areas

<u>Nhon Binh WWTP Area</u>

Nhon Binh WWTP is surrounded by paddy rice fields and local irrigation canals, so the main terrestrial biological resources are rice crops and other invasive species such as grass, shrubs and Mimosa (Figure 2.4). Especially this area has a lot of Mimosa, which is harmful to soil and other species. Main animal species are geese, ducks, dogs and cats. Overall, Nhon Binh WWTP's vegetation is poor.

Figure 2.4. Terrestrial species around Nhon Binh WWTP areas

<u>The Expansion Area of New Landfill Cell in Long My landfill</u>

Around the new waste buried cell of Long My landfill, there are timber trees such as Chinese banyan, Acacia and bushes growing on hills. Main animals here are bird species like crows, storks and some small birds gathered to feed at waste burying cells but there is no pets of local residents appeared in this area.

Figure 2.5. View at the New Cell of Long My landfill

b. Aquatic species

Phytoplankton

Species Composition: Phytoplankton samples were taken at Ha Thanh river (about 300m downstream from the discharge point of treatment station) in May 2016. The analytical results show that the area has 22 phytoplankton species of 4 divisia: Dinophyceae has 10 species, Bacillariophyceae has 8 species, Euglenophyceae has 2 species and Cyanobacteria has 2 species. It can be seen that Bacillariophyceae and Dinophyceae dominate because this is a brackish basin area. The samples and research at lakes and lagoon of Quy Nhon city showed that the area has 166 phytoplankton species, including: i) *Chlorophyta* with 61 species, accounting for 37% total species; ii) *Cyanophyta* with 41 species, accounting for 24,8%; and iii) *Bacillriophyta* with 41 species, accounting for 24,8%. In fresh water basin, Chlorophyta always dominates, next is Cyanophyta then Bacillriophyta. On the other hand, Bacillriophyta dominates in brackish water. Pond has the most number of phytoplankton species, followed by reservoirs, natural lagoons/lakes and springs. Different types of water body in Binh Dinh has the following species compostion characteristics: in pond, Chlorophyta has the most species then followed by Cyanophyta and Bacillriophyta. In lagoon, Bacillriophyta has the most species then followed by Chlorophyta and

Cyanophyta. In natural lakes, Cyanophyta developed quickly, indicating that lake is poor in nutrition. Phytoplankton species obtained in body of water inside Binh Dinh are broadly distributed species: *Surirella, Synecdra, Melosira, Ceratium, Nijchia, Navicula, Cymbella, Sicnedesnus cloterium, Periclinium, Skiletonema*.

- **Quantity and Characteristics of Dominant Phytoplankton Species**

The number of phytoplankton cell is quite high, on average 22,215,4 x10^{-3} cells/l, in which Pond: 83,700 x 10^{-3} cells/l, reservoirs: 22,773.9 x 10^{-3} cells/l, Lagoon: 3,173.4 x 10^{-3} cells/l, Natural lake: 860 x 10^{-3} cells/l, Spring: 510 x 10^{-3} cells/l. Average phytoplankton mass in lagoon is 0.0704mg/l, in pond is 10.96 mg/l, in reservoir is 2,704 mg/l, in entire body of water is 2,186 mg/l. Moreover, the mass of 59 phytoplankton species have been identified including 23 Chlorophyta species, 18 Bacillriophyta species, 7 Euglenophyceae species, 6 Dynophyta species and 5 Cyanophyta species. Overall, the mass of algae varies a lot: the largest species reach 1,858 x 10^{-6} mg and the smallest species reach 0.020 x 10^{-6} mg

Zooplankton

Species Composition: Zooplankton sample was taken at Ha Thanh river (about 300m downstream from the discharge point of treatment station) in May 2016. The analytical results detected 15 species of 8 groups (2 larva types of Larvae group). Zooplankton fauna in the area has poor typical tropical characteristics. Species composition more or less is affected by the characteristics of animal species which are typical to the water area affected by sea water, is part of the zooplankton fauna of Central coastal plain and there are similarities to the zooplankton fauna in the Northern delta and midland.

Quantity and Characteristics of Dominant Zootoplankton Species: The number of zooplankton varies from 1 to 5,000 individuals/m^3, the highest quantity is Naupli larva with over 5,000 individuals/m^3.

Benthos

Species Composition: 15 obtained species were divided into 3 phyla of which Mollusca has 7 species; Annelida has 6 species and Anthropoda has 2 species. The water environment characteristics of the studied area are sea and salty brackist water, all the species obtained in this area are typical species of the coastal water environment.

Quantity and Characteristics of Dominant Species: The obtained invertebrate density varies from 3 to 633 individuals/m2. *Neanthes sp.*dominates at sample collection station.

<u>Evaluation:</u> Ha Thanh river possesses a large amount of benthos and zooplankton, which are the food source for most of the fish and eel species, therefore this area always maintain a stable volume of seafood for local residents. Fish species in river and sea gate areas are mainly fresh water species (carp, catfish, snakehead fish, eel and bund) and brackish water species (bango, mullet, gerreidae and siganus gustatus). However, the project area does not have any endemic species or species listed as under protection in the Red List. Fish and eel species in Ha Thanh river are local species living here permanently and do not migrate. Moreover, there is no aquaculture activity happening at the construction area of Y-shaped and Huynh Tan Phat bridges on Ha Thanh river. The project activities also do not affect these species.

Besides, Binh Dinh has An Toan natural reservation area (An Toan commune, An Lao district) which is 93 km away from the project area, three landscape protection areas: Nui Ba landscape protection area (Phu Cat district, 30km away from subproject area; Nguyen Hue orange garden landscape protection area (Vinh Son commune, Vinh Thanh district) 50km from subproject area and Quy Hoa – Ghenh Rang landscape protection area (Ghenh Rang ward, Quy Nhon city), 10 km from project area. These locations are quite far away from the project area,Quy Hoa – Ghenh Rang landscape protection area does not have any remaining natural forest, current land usage of this area includes 1,527 ha of planted forest, 2,574 ha of spare land, 207 ha of agricultural land and 186 ha of lands for other purposes, therefore this area does not have any natural habitat and almost no value on biodiversity.

2.2. Socio-economic Conditions

2.2.1. Economic Condition

2.2.1.1. Economic Structure and Growth

According to the Report on performance of the 5 year socio-economic development task, period 2010-2015 of Quy Nhon city: gross regional domestic product (GRPD) increases on average 11% annually; in which industrial – construction field increases 10.3%, services increases 12.4% and agriculture – forestry – aquaculture increases 5.5%.

Industry: Production value is estimated at 7,371.8 billion VND (US$ 345,245,901) including the main industry sectors such as production of construction materials, processing of leather, plastic, rubber and aquaculture.

Trade and service: Total retail sales of goods and service revenue on average increase 14.3% annually. Export value in 2014 reached 530.4 millions USD, 1.4 times compared to the value in 2010. The main products of trade and service sectors are exchange and commodities trading, transport services and payment services.

Production in agriculture – forestry – aquaculture: Production value of agriculture, forestry, aquaculture increased 3.6% annually. In which, production value of aquaculture increased 7.9% and production value of forestry and agriculture decreased respectively 1.3% and 1.6%. According to statistical results of Departmen of Planning and Investment of Binh Dinh province, the agriculture-forestry-aquaculture sector accounted for 22% of Binh Dinh provincial economy in 2015.

Tourism: According to data from the Provincial Tourism Operation Department,during the first 9 months of 2015, there were nearly 1.85 million tourists visited Quy Nhon, increased by 22.7% of visitors and 28% of revenue compared to the same period in 2014. In 2015, the number of hotels in Binh Dinh province is 70, of which 40 hotels are in Quy Nhon city.

2.2.1.2. Land Use

According to the 2014 statistical yearbook of Quy Nhon Department of Statistics, the city has a total land area is 28,552.9 hectares by 2013. In which, agricultural land accounts for 63.7%; Non-agricultural land accounts for 29.8%; the remaining portion of 6.5% is unused land. Details on the current land utilization are presented in the table 2.7 below:

Table 2.7. Current Land Use in the City

(Unit: Ha)

ID	Land type	Area (ha)	Proportion (%)
Total		**28,553**	**100**
Agriculture		**18,184**	**63.7**
1	Agricultural production land	2,926	10.2
2	Land for cultivation of annual crop	1,960	6.9
3	Land for cultivation of perennial crop	967	3.4
4	Forestry land	14,898	18.2
5	Aquaculture land	349	1.2
6	Salt production land	-	-
7	Other agricultural land	11.9	
Non- agriculture		**8,525**	**29.9**
1	Land for living	1,037	3.6
2	Urban land for living	884	3.1

3	Land for specific use	154	0.5
4	Land for headquarter of agency. public building	4,367	15.3
5	Land for national defense and security	63	0.2
6	Non-agricultural production land	409	1.4
7	Land for public purpose	2,563	9.0
8	Land for religion	1,333	4.7
9	Cemetery land	35	0.1
10	Stream. surface water land	203	0.7
11	Other non-agricultural land	2,856	10.0
Unused land		**1,845**	**6.5**
1	Unused land	295	1.0
2	Unused hill land	1,046	3.7
3	Mountain	504	1.8

(Source: Statistical Yearbook 2014 of Quy Nhon Statistics Department)

The current status of land use in subproject area mainly are urban land for living and public land. However, there are two types of land affected by the construction of subproject including: Area of agricultural land affected by the project is the area used to upgrade the capacity of Nhon Binh Wastewater Treatment Plant; Land of planted forest is affected by the expansion of Long My landfill cells (land of industrial crops such as ficus microcarpa, acacia...)

2.2.1.3. Labour and employment

✓ Labour

By 31/12/2014, the total number of employees in businesses is approximately 78,273 people, including in 6,798 people in the state-own-enterprises, 69,819 people in the non-state-enterprises, and 1,656 people in the FDI enterprises. The workforce in enterprises of processing industries is largest with about 36,283 people, 16,997 people in construction, 8,031 people in wholesale and retail, and 6,124 people in transportation and storage. For non-agricultural, non-forestry and non-fishery sectors, the total workforce is about 32,350 people, including about 3,398 people in the processing industry sector, 13,053 people in the wholesale, retail, repair of automobile, motorcycle, motor vehicles sectors, and 10,339 people in the catering business services.The number of workers in other sectors accounts for small quantities.

✓ Employment

Most of the households belong to the state-paid-salaried group (including public officials currently in office and retired) and the business households are those with relatively stable income and life. The poor households often have no job or unstable employment, uncertain income and unstable life.

Occupations of some households in the subproject areas answered interview are presented in Table 2.8 as below:

Table 2.8. Occupation of some households in the surveyed areas

(Unit: Households)

ID	Survey area	Public official		Army/ Police		Business/ Service		Agriculture		Housewife		Unstable employment		Total	Ratio (%)
		Freq.	ratio (%)	Freq.	ratio (%)	Freq.	ratio (%)	Freq.	ratio (%)	Freq.	ratio (%)	Freq.	ratio (%)		
1	Dong Da	5	0,6	13	1,5	99	11,6	35	4,1	25	2,9	86	10,1	86	10,1
2	Le Hong Phong	2	0,2			26	3,1	3	0,4	10	1,2	14	1,6	55	6,5
3	Ngo May	7	0,8	3	0,4	20	2,4	5	0,6	5	0,6	13	1,5	53	6,2
4	Nhon Binh	12	1,4	4	0,5	54	6,3	27	3,2	9	1,1	24	2,8	130	15,3

5	Phuoc My					3	0,4	16	1,9			11	1,3	30	3,5
6	Quang Trung	2	0,2	2	0,2	35	4,1	17	2,0	15	1,8	43	5,1	114	13,4
7	Tran Hung Dao	10	1,2	8	0,9	52	6,1	20	2,4	22	2,6	32	3,8	144	16,9
8	Tran Quang Dieu	3	0,4	1	0,1	14	1,6	18	2,1	7	0,8	19	2,2	62	7,3
	Total	**41**	**4,8**	**31**	**3,6**	**303**	**35,6**	**141**	**16,6**	**93**	**10,9**	**242**	**28,4**	**851**	**100**

(Source: Investigation Report on socio-economic and housholds connectors in Quy Nhon city 2016)

According to the survey data in wards implementing construction investment work items, the primary occupation is service business in 303 households (35.6%), agriculture in 141 households (16.6%) and unstable employment in 242 households (28.4%).

2.2.1.4. Income

Quy Nhon city's economy has grown continuously for 10 years from 2005 to 2014 with the average GDRP growth rate of 12.15% per annum; the city's income per capita increased by 4.5 times, currently at VND65 millions/person/year (equivalent to US$,3,045/person/year) which is 1.5 times higher than the average level of Binh Dinh province. The living standards of some surveyed households are presented in the table below:

Table 2.9.Living standards at survey areas by wards

(Unit: Households)

ID	Survey areas	Above average households		Average households		Poor households		Total	Ratio (%)
		Freq.	Ratio (%)	Freq.	Ratio (%)	Freq.	Ratio (%)		
1	Dong Da	19	24.4	235	33.9	9	11.7	263	31.0
2	Le Hong Phong	2	2.5	51	7.4	2	2.6	55	6.5
3	Ngo May	6	7.6	35	5.1	10	13.0	51	6.0
4	Nhon Binh	16	20.3	90	13.0	24	31.2	130	15.3
5	Phuoc My	3	3.8	25	3.6	2	2.6	30	3.5
6	Quang Trung	13	16.5	96	13.9	5	6.5	114	13.4
7	Tran Hung Dao	17	21.5	114	16.5	13	16.9	144	17.0
8	Tran Quang Dieu	3	3.8	47	6.8	12	15.6	62	7.3
	Total	**79**	**100**	**693**	**100**	**77**	**100**	**849**	**100**

(Source: Investigation Report on socio-economic and housholds connectors in Quy Nhon city 2016)

With the current household economic development, the current economic model of household is often a mixed model (agriculture combined with some other occupations), leading to various sources of income. Some work such as seasonal employees has low stability but account for a significant source of income in the household economy.

2.2.1.5. Housing

Current housing conditions have changed significantly from 2005 to 2014, the level 4 houses in the outside and bordering areas of the city center have been replaced by multi-floor buildings with good planning, ensuring living and business conditions for households. The city centrehas clean and beautiful landscape, many well constructed buildings and achieved the Class I urban standards of Binh Dinh Province.

The survey results show that of the 851 households the general trend of the households is semi-strong houses is 51.4%, 48.2% of households have strong houses. In the survey only 0.5% of households(4 households) currently stay in temporary houses. Among the households with good earnings, there are up to 57.0% of households having strong houses and 43.0% having semi-strong houses, none of them living in temporary houses. Among the medium earning household group, 57% of households having strong houses, 49.1% having semi-strong houses and only 0.4% (3 households) having temporary houses. Among the poor households, 14% have strong houses, 62.0% have semi-strong houses and 1 household living in a temporary house.

2.2.2. Social conditions

2.2.2.1. Population

The population of Quy Nhon City as of 2014 was 285,543 people with the fairly balanced genders (male/female is 0.94%). Approximately 91.09% of the population concentrates in urban areas, mainly living in the six wards, i.e. Nhon Binh, Nhon Phu, Dong, Da, Quang Trung, Ngo May and Nguyen Van Cu. Overall, population in the wards are quite evenly distributed, the distribution of population in wards is presented in the following Table 2.11:

Table 2.10. The population in the wards/communes of Quy Nhon city in 2014

(Unit: Person)

No	Ward/commune	Population 2014	Rate	
			Male	Female
1	Nhon Binh Ward	18,712	9,070	9,642
2	Nhon Phu Ward	20,429	9,918	10,511
3	Dong Da Ward	29,550	14,342	15,208
4	Tran Quang Dieu Ward	17,115	8,314	8,801
5	Hai Cang Ward	17,765	8,606	9,159
6	Quang Trung Ward	22,235	10,763	11,472
7	Thi Nai Ward	11,215	5,427	5,788
8	Le Hong Phong Ward	14,427	6,974	7,453
9	Tran Hung Dao Ward	9,240	4,473	4,767
10	Ngo May Ward	23,115	11,202	11,913
11	Ly Thuong Kiet Ward	5,551	2,694	2,857
12	Le Loi Ward	12,974	6,293	6,681
13	Tran Phu Ward	11,333	5,521	5,812
14	Bui Thi Xuan Ward	15,647	7,584	8,063
15	Nguyen Van Cu Ward	20,098	9,722	10,376
16	Ghenh Rang Ward	10,702	5,195	5,507
17	Nhon Ly Commune	8,370	4,098	4,272
18	Nhon Hoi Commune	3,704	1,811	1,893
19	Nhon Hai Commune	6,043	2,949	3,094
20	Phuoc My Commune	5,335	2,602	2,733
	Total	**283,560**	**137558**	**146,002**

(Source: Statistical Yearbook 2014 of Quy Nhon Statistics Department)

2.2.2.2. Education

According to the Statistical Yearbook 2014, Quy Nhon Department of Statistics, the city currently has 102 preschools with 435 classrooms and 387 classes (including 218 public classes; 169 private classes). The number of pre-school teachers in 2014-2015 was 699 people; and the number of children in pre-school are 11,393 children. The number of secondary teachers is much larger than that of pre-schools, with a total of 2,053 people, taught at 57 schools (primary, secondary and high school); The number of students at all levels in the whole city is 47,693 including 23,122 primary school students, 15,548 secondary school students and 9,023 high school students.

Interview data of 851 households in the subproject area including 8 wards (Dong Da, Le Hong Phong, Ngo May, Nhon Binh, Phuoc My, Quang Trung, Tran Hung Dao and Tran Quang Dieu) showed that 52 households (6.1%) have not completed primary school; 89 households (10.5%) at primary education; 264 households (31%) at secondary school level, 299 households (35.1%) at high school level and 147 households (17.3%) at the level of college/university or higher.

The total number of toilets invested by the World Bank in the CCESP project are 37school toilets and the CCESP project is planned to deliver 12 toilets, accounting for 71.1% of toilets invested by the World Bank in Quy Nhon city. According to the survey results of school's toilets, there were 16 primary schools, 13 secondary schools and 10 high schools, which are achieved good hygienic condition and using clean water sources, accounted for 57.3% of total school's toilets on Quy Nhon city area.

2.2.2.3. Medical

By 2014, Quy Nhon city had 10 hospitals (with 2,540 hospital beds), 1 polyclinic department and 21 commune health stations. In terms of medical staff, according to statistics in 2014, there are 556 doctors, 205 physicians, 1,008 nurses and 129 midwives in the city; Pharmaceutical industry: 148 pharmacists (with education level of doctor, master andpostgraduate junior), 360 intermediate pharmacists and 188 druggists.

HIV/AIDS is a sexually transmitted disease and relates to the sub-projects in some issues such as: (i) the existing popularity and transmission rates; (ii) the knowledge of the community on transmission and prevention methods; and (iii) the presence of the construction workforce including mainly those from outside or foreigners could exacerbate the current situation. According to statistics of the Provincial Center of HIV/AIDS control and prevention, in the first 11 months of 2015, Quy Nhon city recorded 262 cases of HIV/AIDS.

There are some popular diseases in the area, such as flu (39.7%), headache (57.3%), diarrhea (2.8%), dysentery (0.9%), cholera (0.8%), itching and rash, allergy (19.3%), gynecological diseases (6.0%), parasites (10.1%), hepatitis A (1.8%), stomach (17.4%) and a number of unknown diseases (accounted for 15.0%).

Regarding school toilets, it is necessary to propagate the awareness of hand washing after going to the toilet to the pupils in order to avoid diseases which can be transmitted via water and related to hygiene.

2.2.2.4. Cultural, historical and religious works

Cultural, historical and religious works in Quy Nhon city are shown in the Table 2.11 below:

Table 2.11. Cultural, historical and religious buildings in Quy Nhon city and its distance to the Project works

No	Name	Location	Distance to the Project works (m)
1	Son Long pagoda	Nhon Binh Ward, 700m from Truong Uc bridge to the east	5000
2	Long Khanh pagoda	141 Tran Cao Van	800
3	Truc Lam pagoda	Located on Tran Hung Dao Street, Dong Da Ward	2
4	Ngoc Nhon Vihara	999 Tran Hung Dao Street, Dong Da Ward	5
5	Tay Ninh Holy See (its old name is Kham Chau Đao)	1093A Tran Hung Dao Street, Dong Da Ward	5
6	Tran Hung Dao monument	Hai Minh Hill (Phuong Mai Peninsula, Quy Nhon city)	10000
7	Tran Temple	Thi Nai Ward, Quy Nhon city	680
8	Quy Nhon Twin Tower	Tran Hung Dao Street, Dong Da Ward	5

9	Mr. Nhieu pagoda	Khanh Vinh village, Tuy Ha commune, Tuy Phuoc district, An Nhon province (currently 253 Bach Dang, Tran Hung Dao Ward, Quy Nhon city)	550
10	Cam Thuong temple	Cam Thuong temple was built in the late nineteenth century early twentieth century by Mr. Le Van Truyen being Language Prime, in charge of Thi Nai port formed by the Le, previously belonged to the ancient village of Thi Nai and he also founded Cam Thuong village..	350
11	Nhon ChauLighthouse	Nhon Chau Island (Green Island)	10000
12	Cathedral of Quy Nhon (Nhon church)	122 Tran Hung Dao Street, Quy Nhon city	880
13	Nguyen Hue pagoda	Tieu village, Quy Nhon city	2

Most of these works are located far from the construction site, some of them are located in the construction area of the project and can be affected by smoke and dust including Quy Nhon Twin Tower, Ngoc Nhon Vihara, Tay Ninh Church, Truc Lam pagoda and Nguyen Hue pagoda. Details on the PCRs to be affected by the subproject are provided below:

Quy Nhon Twin Tower: Through long periods of time, the mysterious Quy Nhon Twin Tower (Cham Towers), some of which are a thousand years old, still remain in Binh Dinh as vivid evidence of the Champa kingdom that flourished in the region during the 10th-15th centuries. Quy Nhon Twin Towers was built in the Hindu Ba La Mon architectural style that represents the symbolic legendary Meru Mountain where Hindu genies and spirits dwell. Historical researchers say that the Cham Towers in Binh Dinh are the biggest in Southeast Asia. They are located mainly in Quy Nhon city and Tuy Phuoc, An Nhon and Tay Son districts in the area of the Do Ban Citadel, which was part of the ancient kingdom of Champa.

Ngoc Nhon Vihara: In 1958, Buddha's Footsteps went to Quy Nhon city. Mrs. Nguyen Thi Tam – a local Buddhist woman has voluntarily devoted a plot of 2,500 m^2 area to build the Vihara. Ngoc Nhon Vihara is the place where Buddhist monks gather to lead a religious life in the Central Region. In 1995, Ngoc Nhon Vihara was renovated and completed in 1999 and still hold up its historical beauties. Currently, Ngoc Nhon Vihara located at no. 999 Tran Hung Dao street, Dong Da ward and it is the belief place of Vietnam Buddhist Church organization.

Tay Ninh Church: is a religious works of the Cao Dai religion, located at no.1039A Tran Hung Dao street, Dong Da ward, Quy Nhon city. This location focuses on the implementation of the rites of Cao Dai religion.

Truc Lam pagoda: This pagoda is located at Tran Hung dao street, Dong Da ward. It is a local worship place of people living around the area. The holidays in Truc Lam pagoda are 1st day and 15th day of the lunar month.

Nguyen Hue pagoda: The pagoda is located at Tieu village, Quy Nhon city. It is a local worship place of people living around the area. The holidays in Nguyen Hue pagoda are 1st day and 15th day of the lunar month.

2.2.2.5. Gender Issues

Gender issues in the province has improved since the issuance of Law on Gender Equality, for instance in the wards/communes there is hardly an occurrence of severe family violence, women were more involved in resolving family issues, as well as participate in social activities, there is no gender discrimination in education and health care.

<u>Gender issues in political participation:</u>The statistics collected by the commune/ward in the sub-project area and the results of qualitative research in consultation with representatives of local authorities in the sub-project area showed that currently women participation in politics has been

improved. However, these are only improvements in quantity; in fact, local women still hold positions with less decision making power than men which affects their participation in the decision-making process as well as their opportunity to benefit.

Gender issues in family: Survey results on labor allocation in families showed that women are the main labour doing house choirs, cooking and house cleaning tasks. In the sub-project area, there is an equality between males and females when 93.2% of both men and women of households responded that both husbands and wives work together to make decisions to buy cars and houses; 97.2% in applyingfor bank loans, investing in business; especially in the matter of property ownership, up to 81.7% of households responded that the couple jointly owned property of the family. The detail is as following:

Gender issues in community activities participation:Survey results showed a difference between males and females in participating in local organizations. Specifically, 46.8% of males participate in local organizations, while this percentage is only 28.7% for females; 48.2% of males engage in community activities, while this percentage is only 40.8% for females.

Overall, in the sub-project area, males and females are equal in the decision making process of major matters in the family, the status and role of women has been increasingly enhanced and respected but the participation of women in community activities in the area is still lower than men

2.3 Current Infrastructure and Service

2.3.1. Traffic

- **External traffic**

Railways: North-South railway passes through the west the national highway 1A (NH1A) in Tuy Phuoc district territory. The Dieu Tri-Quy Nhon route is 12 km long, Quy Nhon station is a dead-end station. Due to the small volume of goods and passengers, this route is ineffective in bussiness.

Road: The NH 1A passes Phu Tai Industrial Zone, Tran Quang Dieu Ward and Bui Thi Xuan Ward at the west of the city. This route is both external roads and main urban roads. The NH 1D goes from Phu Tai junction to the southeast of the city, it also plays both roles of external roads and main urban roads.

Waterway: The group of ports in Quy Nhon includes: i) Quy Nhon port, the main general port of the South Central port group, capacity of 1.5 million tons/year, for ships with capacity of 10,000 tons; ii) Thi Nai local general port, the capacity of 0.2 million tons/year, for ships with capacity of 5,000 tons; iii) Petroleum port of 0.2 million tons/year, for ships with capacity of 5,000 tons.

Ha Thanh river waterway: Activities on Ha Thanh river are quite busy especially in the area of Y-shaped bridge. Since the current Y-shaped bridge is only about 3.5m high from the river surface, mainly small-sized vessels pass though here. The fishing boats and cargo ships also regularly pass from Thi Nai lagoon to river branches to trade.

Airway: Phu Cat Airport is 37km away from Quy Nhon to the northwest, with a runway of 3.2 km long, 45m wide. There are daily flights to Ho Chi Minh and Hanoi.

- **Internal traffic**

The network of roads in old urban areas has the average width of 15 - 20m (pavement of 6-10m, pavement of 3-4m). The total length of main and area roads is 99.8 km, including 41.7km asphaltic concrete road, 34.8km asphaltic penetration road, 4.1km cement-concrete road and 19.2km earth roads.

In recent years, the network of internal urban roads of Quy Nhon city is invested synchronously, ensuring basic transportation requirements of people. Structure of urban roads is varied, including:

asphaltic concrete road, asphaltic penetration road and cement-concrete roads. However, there are still some routes of earth roads.

It can be said that the quality of roads in the city in general and in alleys in particular was invested and upgraded quite synchronously, enabling convenient transportation for the people. However, only some of the roads are earth roads, concentrated in the wards/communes bordering the center, with low population density such as Tran Quang Dieu, Phuoc My...

2.3.2. Water Supply Condition

Wells pumping stations: There are 23 well pumping stations along the Ha Thanh River, each well's flow is about 125 - 200 m^3/h, with the depth from 18.5 to 25 m. The total volume of water extracted is 38,591 m^3/day, in which Quy Nhon city's volume is 23,288 m^3/day, Phu Tai water supply company's volume is 15,303 m^3/day. The water quality is good and meets the requirement of QCVN 01:2009/BYT.

Distribution Network: The city has about 530,061m pipes with diameter from 400 mm to 500 mm. The water supply system currently covers all urban wards in Quy Nhon city and Dieu Tri town of Tuy Phuoc district. The total number of customers using tap water is over 55,203 households.

Research result showed that the main source of water used by households in the sub-project area is tapwater (98.4%), only a small percentage of households have no access to the city's tap water. However, research shows that only 60.5% of households in the sub-project area use the city's tap water as the only single source of water and up to 39.5% of households use 2 and above sources of water (normally tap water combined with drilled-well water), concentrate mainly in households at Tran Hung Dao, Quang Trung and Le Hong Phong wards etc. These households tend to use tap water for domestic use and well water for vehicles cleaning and plant watering.

2.3.3. Drainage

The current drainage status of Quy Nhon city is shown in Figure 2.6 below:

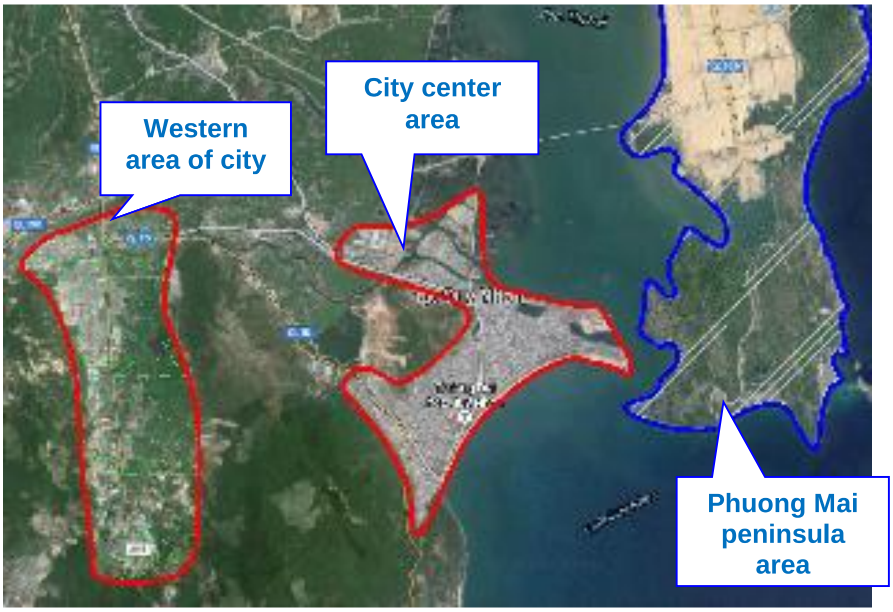


Figure 2.6. Current drainage zoning of Quy Nhon city

<u>Drainage organisation:</u>

The city center area has built the combined drainage system, wastewater and rainwater is collected by the tertiary (level 3) and secondary (level 2) culvert systems to transfer to level 1 culvert routes then wastewater would be separated through separating wells and led to WWTP. The rainwater would be discharged directly into the lake or water receiving sources. The main receiving sources are: Ha Thanh river, Thi Nai lagoon, Dong Da lake, Phu Hoa lake and Quy Nhon bay.

Phase 1 and 2 of the CCESP project focused investment in city central areas to deal with the flooding spots and enhance the capacity tocollect wastewater, transfer wastewater WWTP in order to prevent discharging of wastewater directly into the sea.

<u>Drainage system:</u>

The old drainage system of Quy Nhon city is common drainage system, including stormwater and wastewater till CCESP project invests in Quy Nhon city, it was separated into 02 drainage system. Currently, stormwater and wastewater are leaded to the nearest receiving source (rivers, lakes or sea) without assessing load capacity of reciving sources (especially lakes) and separating drainage catchment. After finishing 2 stages of CCESP project, stormwater and wastewater have already colellected and separated through CSO. The old drainage culverts are replaced by new box culverts and wastewater collecting culvert system. Stormwater is collected and leaded to the nearest receiving source (rivers, lakes or sea), wastewater is collected and pumped to WWTP.

2.3.4.Current flooding situation

Previously, local floods occur regularly during the rainy season (from September to November) with large flow because water from the mountains flows into the city.

After the project phase 1, 2 are in operation, the majority of the previously flooded areas had been fixed. However, the city still has 02 frequently flooded points remain not invested, which are Hoc Ba Bep area and Bau Sen upstream area. These areas are located at the base of Ba Hoa Mountain, with large rainwater flows, road/alleys in narrow areas, low altitude so flooding time often lasts long, causing frustration in local people. Therefore, they need to be researched for investment in this phase of the project. Locations of 02 flooding points are shown in Figure 2.7 below:

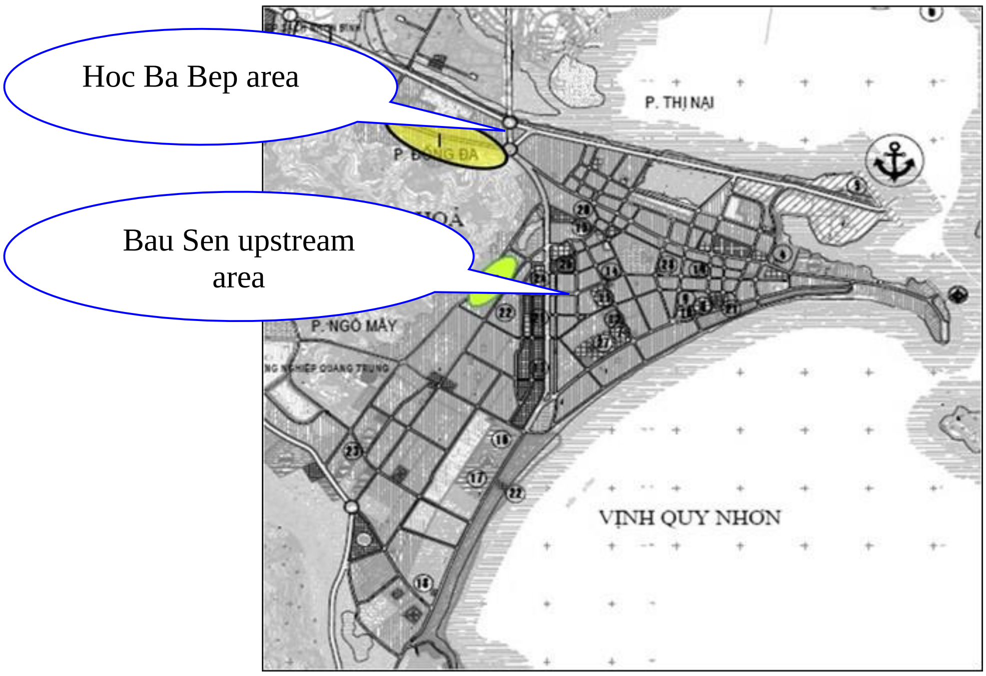


Figure 2.7. Location of the 02 currently flooded area in Quy Nhon city

<u>Area 1: Hoc Ba Bep</u>

Hoc Ba Bep is a low area at the base of Ba Hoa Mountain in Dong Da Ward. Rainwater from Ba Hoa Mountain flows into this area. Railway (with high subgrade altitude) causes difficulty to collect rainwater and drain to Ha Thanh River. Floods regularly occur in the rainy season. The level of inundation is about 40-50 cm, lasting for about 5-6 hours after the end of the rain.

<u>Area II: Upstream of Bau Sen</u>

Bau Sen upstream area from Vo Van Dung street to Bau Sen Lake is regularly flooded due to rainwater from the Ba Hoa Mountain. The inundation often takes place in the rainy season, lasting for about 5-6 hours after the end of the rain.

According to the survey result of the Social Assessment (SA) in 2016 in Quy Nhon city, 35.4% of the surveyed households said that in recent years their local area is still inundated, in particular, the wards regularly flooded in the rainy season are Dong Da, Nhon Binh, Phuoc My, and Tran Quang Dieu wards..

Regarding the cause of inundation in sub-project areas, in addition to heavy rain, the local channel system that cannot sufficiently drain water during wet season is also a reason which many residents and local leaders mentioned.

Quy Nhon city is on average +29m high compared to water surface, so the location to construct canal routes and drainage culverts would not be affected by flood or possibly local flood in Hoc Ba Bep area and upstream ditch of Bau Sen lake (as mentioned above) because these locations are at the base of Ba Hoa mountain. Especially, construction areas of Long My landfill and Nhon Binh wastewater treatment plant are at high ground so there is no thread of flood. The average height of these locations were presented in 2.1.3 Hydrological/Oceanographically conditions

2.3.5. Power Supply

Binh Dinh province and Quy Nhon City are supplied with electricity from the national power grids of 110KV and 220KV. In Phu Tai area (of Quy Nhon City), the 220/110KV-1x125MVA station is powered by Playku-Phu Tai 220KV electric conduit, with the ACO300 wire of 140km long, the 110KV side of this station is connected to the Vinh Son hydroelectric power plant (capacity of 66MW). For the local power sources, Qui Nhon has Nhon Thach diesel power plant, with an installed capacity of 27,78MW and available capacity of 18,72MW. The plant only works for contingency purpose.

2.3.6. Domestic wastewater treatment

Nhon Binh WWTP with capacity of Q = 14,000m^3/day night includes the collecting works and chemical strengthening, 02 preliminary anaerobic sedimentation ponds, 02 trickling filters, 02 secondary clarifiers, secondary pump station, disinfection tank, the chlorine contact chamber and other supplemental facilities. Nhon Binh WWTP was completed in2014 and collects wastewater in city center, ensuring collection capacity and treatment meeting standards before discharging into the receiving sources. 2A wastewater treatment plant (Bau Lac), with a capacity of Q = 2,350 m^3/day, collects wastewater in Tran Quang Dieu Ward.

Wastewater collection:

- Collecting wastewater to Phu Hoa Lake: collect wastewater from the basin in the west of the center area, from Nguyen Tat Thanh Street to the base of Ba Hoa Mountain then to Nhon Binh wastewater treatment plant to process.

- Collecting wastewater to Thi Nai Lagoon: Wastewater of the area in the north of the city from Nguyen Hue Street and the east of Nguyen Tat Thanh Street to Dong Da Street, then lead along Ha Thanh River to Nhon Binh wastewater treatment plant to process.

- Bui Thi Xuan, Tran Quang Dieu area: wastewater is collected to PS10 pump station and then taken to the 2A wastewater treatment plant to process.

2.3.7. Collection and Disposal of Solid Waste

Domestic solid waste from residential areas, offices and other sources in the cityis collected daily and transported to temporary collection pointsin each geographical area by workers of the Quy Nhon Urban Environment Company (URENCO). Meanwhile, solid waste from the city’s markets is collected and transported to temporary collection points by the markets’ management boards.

At present, Quy Nhon City has about 64 domestic solid waste collection points. After being moved to designated zones, the collected waste is transferred by URENCO's trucks to Long My Landfill, which is about 20km southwest of the city center. Transporting time frames daily are between 3-5am in the morning and 3-5pm in the afternoon. The waste is thenburied within the landfill.

Long My Landfill has a planned total area of 61.61 hectares. In Phase 1 of the project, several components have been completed including the construction of the Landfill Cell C3, the primary leachate treatment station, the hazardous medical waste treatment area and other related subsidiaries. Total capacity of Long My landfill is 2.7 million m^3 and it is expected that Long My landfill can receive Quy Nhon city's waste in 20 years (2010 – 2030). The maximum volume of waste of Long My landfill, which could be received in one day is about 205 tons. The production, trade and waste disposal of Long My landfill in 6 months (12/2014-5/2015) is shown in the following Table 2.12:

Table 2.12. Production, Trade and Waste Disposal (12/2014 - 5/2015)

No.	Items	Composting		Landfilling	
		Current 6-month	Previous 6-month	Current 6-month	Previous 6-month
1	Production capacity				
	Disposed waste (tons)	482.59	1,663.81	41361.035	30,737.17
	Compost (tons)	78.94	186.02		
2	Production time (hours)	208	364	1,800	1,800
3	Number of workers (persons)	2	2	8	6
4	Fuels (Diesel) (liters)	325	1,776	11,879	7,802
5	Water (m^3)	38	72.59	1221	1013.31

For daily landfill operation,at night, solid waste is dumped and compacted. During daytime, the waste is received at the Landfill from 9am to 10am and from 4pm to 5pm. Other daytime activities include deodorizer spraying, waste compacting and covering, all of which takes an average of 10 hours per day. At this moment, the composting area of the Long My Landfill has been shut down because product quality is unable to meet the demand of market.

According to the Report on Socio-Economic Survey of Quy Nhon City in 2016, the results from consultations with representatives of local governments in the sub-project area show that, up to now, the collection of solid waste in Quy Nhon City was conducted in all of the wards in-land with the collection rate of 95%. In the four islands and peninsulas of the city,the rate reaches 80%. On aggregation, the whole city's collection rate isat 85%.

2.3.8. Environmental Sanitation in the Subproject Area

The survey results show that the majority of households have private toilets, in which toilets with septic tanks accounts for the highest proportion of 58.7%, semi-septic tanks contribute 41.6% and temporary toilets only account for 0.7%. Most of low-income households in the subproject areastill have not considered building` proper toilets. However, owning standard toilets has become a necessity in a modern and civilized society.

Out of 851 households surveyed, 228 (26.8%) thought that their surrounding environmentsare polluted. In particular, Le Hong Phong, Phuoc My, Tran Quang Dieu, and Nhon Binh wards received the most amounts of feedbacks from residents with regards to environmental pollution. Most of these feedbacksconcerned witha few common types of pollution, for example: noise pollution (61.4% of the feedbacks about environmental pollution), dust (59.6%). These are followed by other sources of pollution from rainwater, sewage and waste: stagnant wastewater (39.8%), industrial wastewater (12.5%), garbage odor (9.3%) and sewer odor (27.3%).

2.3.9. Environmental and Social Conditions in Some of the Project's Areas

- **Component 1 includes:**

- ✓ Rainwater drainage systems: construction of the box culvert on Phu Hoa Canal, the renovation of drainage system on Bau Sen Lake's upstream, construction of the sewer system on Tran Hung Dao Street and the drainage system in the Hoc Ba Bep and Bach Dang Street area.
- ✓ Strengthening of the tertiary network including the sewer system of BxH=600x400 and D250-300-PVC with a total length of 30,000m
- ✓ Capacity upgrade at Nhon Binh wastewater treatment plant and treatment of the odor in the plant area.
- ✓ Expansion of Long My Landfill and renovation of the leachate treatment station

➢ **Route maps, the current status and socio-economic entities of Phu Hoa Canal*:***

Figure 2.8. Diagram of Phu Hoa canal

Notes:
1. Phu Hoa canal's beginning point
2. Current status of the canal
3. High-voltage power pole
4. Dong Hai Mechanic Ltd
5. Nguyen Hue Pagoda
6. The Communist Youth Union of Binh Dinh Province
7. Phu Hoa canal's ending point

At present, the southern bank of Phu Hoa Canal already has an interceptor sewer system, HDPE DN630, which brings wastewater from the combined sewer at the Nguyen Phong Sac and Tran Van Ky Junction to the pumping station PS5. Besides, on the southern bank of the canal, wastewater from residential areas is collected through current combined sewers. However, on the northern bank of Phu Hoa canal, where there are currently four residential areas, rainwater and wastewater still flows directly into the canal. Wastewater which is released into the canal creates odors that negatively affect the environment and landscape of the area.

- Along the two sides of Xuan Thuy Road, there are mostly residential areas and industrial parks, which have a relatively high population density. In this area, the canal is 1.2m wide; along the two banks of the canal, hillside embankments are already constructed (although the end of Phu Hoa Canal which connects to Phu Hoa Lake still has earth embankments. Field surveys show that the pollution in the area of Phu Hoa canal is very serious: A large amount of domestic solid waste is accumulated both onshore and underground of the canal. This is a result of a number of residents not maintaining environmental sanitation. Notably, there are several high-voltage power poles along the canal.

- In terms of religious and cultural places along the open canal, there is Nguyen Hue Pagoda, which is located opposite the mechanical limited liability company Dong Hai. The pagoda, which is situated adjacent to an open drain and in the middle of a residential area, receives many regular worshippers. Along the canal, besides Nguyen Hue Pagoda, there is not any other 'sensitive' structures, such as schools, hospitals, markets, and cultural and religious places.

Surroundings of Phu Hoa Canal include:

- *Transportation*: There is Xuan Thuy Road, which facilitates the transport of materials and dredged sediments. The traffic in the area is quite relaxed.

- *Vegetation cover*: There are few trees. Most of existing plants are shrubs, Lagerstroemia, Spondias lakonensis.

- *Aquatic ecosystems*: Because Phu Hoa Canal is heavily polluted, there is practically no living aquatic species.

The current status of the area's environmental sanitation and waste disposal practices:

- Residents on two sides of the canal still dispose trash directly into the canal.

- The canal water is very dark and produces unpleasant odors.

'Sensitive' locations:

- Nguyen Hue Pagoda

- The Mechanical LLC. Dong Hai

- The Ho Chi Minh Communist Youth Union of Binh Dinh Province – Youth Activity Center

Table 2.13.Sensitive locations along Phu Hoa canal to project's construction item

No.	Sensitive location	Construction item	Distance from construction item to sensitive area (m)
1	Nguyen Hue Pagoda	Replacing Phu Hoa canal with sewage pipeline	2
2	Dong Nai Mechanic Ltd		20
3	Ho Chi Minh Communist Youth Union of Binh Dinh Province		45

- **Route maps, the current status and socio-economic entities of the drain on the upstream of Bau Sen Lake:**

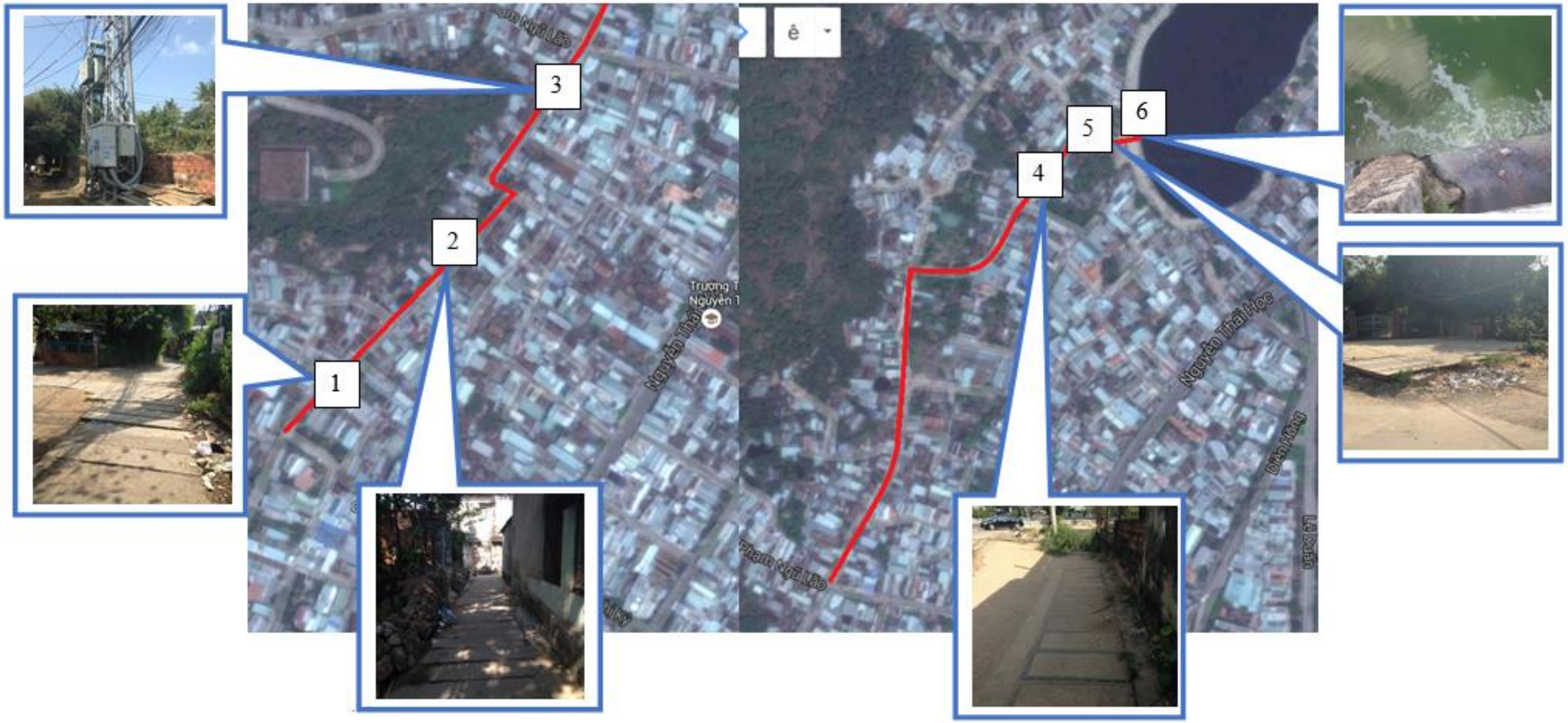


Figure 2.9. Diagram of the drain upstream of Bau Sen Lake

Notes:

1. Renovation beginning point of the drain upstream of Bau Sen lake
2. Current condition of the drain
3. Power pole near the drain
4. Drain running alongside houses' walls
5. Main sewer collecting wastewater before being discharged into Bau Sen lake
6. Discharing point at Bau Sen lake

Since 1992, the drain route on the Bau Sen Lake's upstream has been constructed with rubble as the the main material. At present, this system has seriously degraded: few sections have been eroded which reduces the drainage capability of the Bau Sen area. This area frequently suffers from prolonged waterlogging. Therefore, it is necessary to renovate the drain route on the Bau Sen Lake's upstream to enhance the water collection capability and prevent odor. The drains starts at Ngo May Ward and runs along Pham Ngu Lao Road towards the final discharge point of Bau Sen Lake. The drain is covered with concrete slabs with an average length of about 1.5 m. However, the drain still smells unpleasant. In addition, the discharge of waste from animal-raising activities of several households (direct discharge of waste to the drain) has made the surrounding environment more severely contaminated, especially in summer. Unpleasant odors from the drain have affected the living environment of residents around the upstream area of Bau Sen Lake. Along the drain, there is not any public structures, such as schools, markets, hospitals or cultural and religious places.

Surroundings of the drain on the upstream of Bau Sen Lake includes:

- *Transportation*: Narrow access roads, which are surrounded by houses, create difficulty for travels and transports of construction materials.

- *Vegetation cover* : There is almost no trees.

- *Aquatic ecosystems*: The drain on the upstream of Bau Sen Lake is mainly for wastewater drainage. Therefore, the drain is severely polluted and not liveable for aquatic species.

The current status of the area's environmental sanitation and waste disposal practices:

- Along the drain, a lot of people still leave garbages in front of their houses that contribute to environmental pollution of the area.

'Sensitive' locations:

- Households residing along the renovated drain.

➢ **Route maps, the current status and socio-economic entities of the drain on Tran Hung Dao Road:**

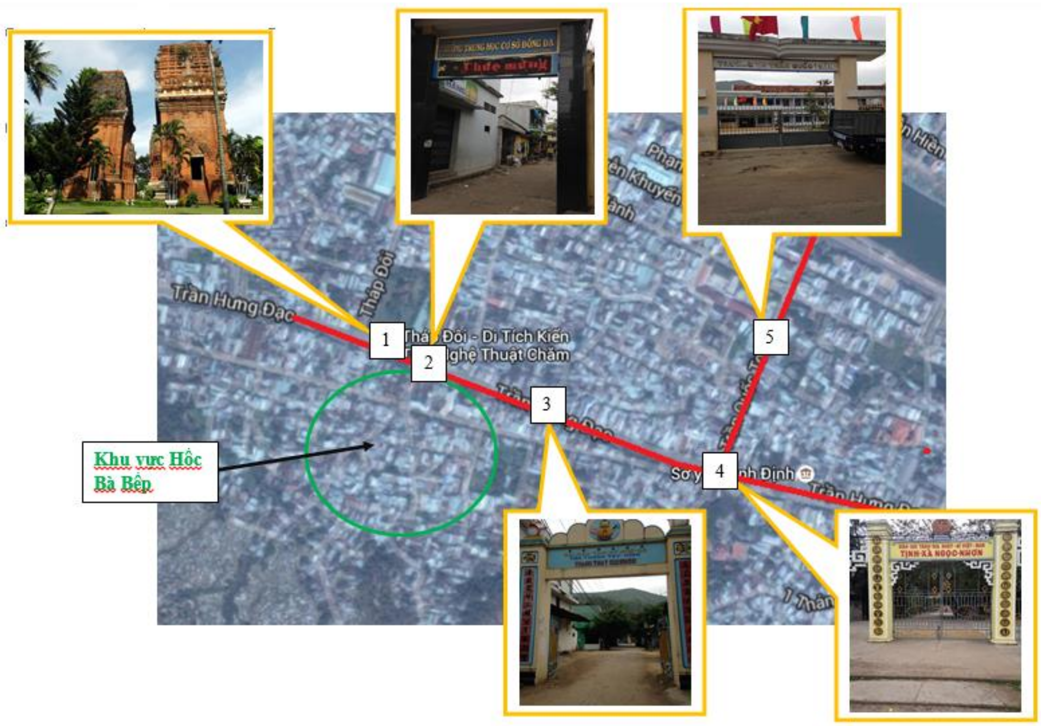


Figure 2.10. Tran Hung Dao Street diagram

Notes:
1. Quy Nhon twin tower
2. Dong Da Secondary school
3. Tay Ninh Holy See Temple
4. Ngoc Nhon monastic
5. Tran Quoc Toan primary school

Tran Hung Dao Road is one of the most important roads of the Quy Nhon City because the road is connected to National Highway 1A. The location near the foot of Ba Hoa Mountain gives the road a distinct terrain. This terrain which combines with the existing small culverts D600 makes Tran Hung Dao Road unable to drain water water during heavy rains, creating a huge impact on people and traffic in the area. Therefore, the construction proposal of collecting culverts from May 1st Road to 1149 Alley of Tran Hung Dao Road, is very necessary.

- 'Sensitive' infrastructures on the route from 1149 Alley of Tran Hung Dao Road to May 1st Road include Dong Da Middle School, Phong Lan Semi-public Kindergarten, Quy Ngon Twin Towers, Residential area No. 4 of Dong Da Ward, Tay Ninh Holy See and Ngoc Nhon Viharas. Besides, there is also Tran Quoc Toan Primary School, which is situated on Tran Quoc Toan Road.

Surroundings of Tran Hung Dao Road includes:

- *Transportation*: Tran Hung Dao Road is one of the most key roads of Quy Nhon City. Lots of trucks and semi-trailers trucks run 24 hour/day on Tran Hung Dao Road. The road traffic is heavy, especially in rush hours, from 7.30 am to 8.30 am and from 5 pm to 7 pm.

- *Vegetation cover*: Very few trees.

The current status of the area's environmental sanitation and waste disposal practices:

- There are still people who litter on the roadsides and pollute the environment.

'Sensitive' locations:

- Phong Lan Semi-public Kindergarten
- Residential area No. 4 of Dong Da Ward
- Dong Da Middle School
- Quy Ngon Twin Towers
- Tay Ninh Church
- Ngoc Nhon Viharas

Table 2.14. Sensitive locations on Tran Hung Dao street to project's construction item

No.	Sensitive location	Construction item	Distance from construction item to sensitive location (m)
1	Phong Lan semi-public kindergarten	Construction of stormwater drainage system	4 - 5
2	Quy Nhon twin tower		4 - 5
3	Tay Ninh Holy See temple		4 - 5
4	Ngoc Nhon Monastic		4 - 5

➢ **Route maps, the current status and socio-economic entities in Hoc Ba Bep area:**

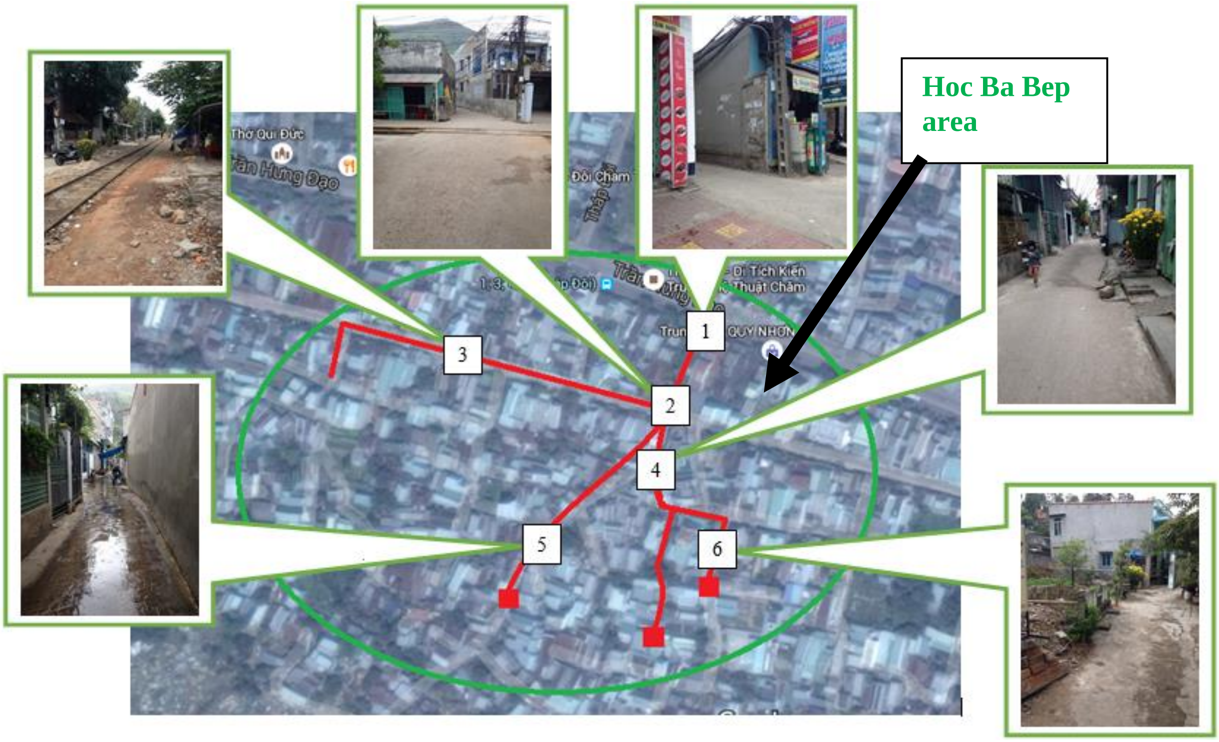


Figure 2.11.Hoc Ba Bep area current state

Notes:
1. Hoc Ba Bep area entrance (1083 alley)
2,3.The railway passing through Hoc Ba Bep
4, 5, 6. The current status of the alleys along the construction of stormwater drainage system

- The construction area of the drainage system Hoc Ba Bep (Alley 1083) is a lowland area, which is located on foothills and lower than Tran Hung Dao Road. Hoc Ba Bep Area is the area that suffers the most from floodings. In this area, floodings are quick to happen and slow to vanish. Deep and prolonged inundation makes it difficult for people living in the area. Therefore, in this period of time, the proposal for research on investment on the drainage system is very necessay and receives strong support from residents as well as the local government of Dong Da Ward. Currently, there is one railway line passing through this area. The drainage system of Alley 1083 is a small type of sewers, which is also in unfahsioned conditions. This setback leads to poor drainage conditions and frequently severe floodings.

Surroundings of Hoc Ba Bep Area includes:

- *Transportation*: There are mostly motorbikes and bikes. The construction space is very limited.

- *Vegetation cover*: There are mostly shrubs.

The current status of the area's environmental sanitation and waste disposal practices:

- There are still people who litter in the Alley and pollute the environment.

Sensitive locations:

- The railway line passing through Hoc Ba Bep Area.

This railway line is located on the construction zone of the drainage system of the Alley 1083 (Hoc Ba Bep Area)

- **Route maps, the current status and socio-economic entities on Bach Dang Road:**

Figure 2.12.Route maps, the current status and socio-economic entities in Bach Dang street, section 1, starting point: junction of Doan Thi Diem – Tran Hung Dao, ending pointPham Hong Thai street

Notes:

1. *Truc Lam pagoda located on Doan Thi Diem Road-construction area of Bach Dang Road stormwater drainage system*
2. *Current status of the t-junction between Bach Dang-Doan Thi Diem*
3. *Current status of the intersection between Hoang Hoa Tham-Bach Dang*
4. *Dam market picture (100m away from the stormwater drainage)*
5. *Current status of the intersection between Bach Dang-Pham Hong Thai*

The current pipeline on Bach Dang Road is consisted of round culverts BTCT D600mm, which were built along the road a long time ago and has seriously degraded. The drainage capability is not adequate. In addition, a number of existing culverts lie beneath yards or houses of local households. The gates of drainage manholes are blocked and some manholes have dysfunctional odor-prevention compartment or do not even have one. As a result, the unpleasant odor is released to the environment from the drainage system and seriously affects local people's lives. Investing in new culverts and manholes is necessary to prevent odor.

Section 1: The starting point is at the Junction of Doan Thi Diem Road and Tran Hung Dao Road. The ending point is at Pham Hong Thai Road.

- Bach Dang Road is a very important road of the city and the surrounding area has a high population density. Therefore, the traffic of this road is massive. On the planned construction route of the sewer line, there is Truc Lam Pagoda, which is located at the Junction of Doan Thi Diem Road and Tran Hung Dao Road. Along the construction route, there are also a large number of households living and running business. 100m away from the ending point of the sewer route at the intersection between Pham Hong Thai Road and Bach Dang Road, there is a large market at the intersection between Pham Hong Thai Road and Hoang Quoc Viet Road. However, construction activities would not affect too much the operations of market area because there are many other roads to access this market.

Surroundings along Bach Dang Road, specifically from Junction of Doan Thi Diem Road and Tran Hung Dao Road to the intersection between Pham Hong Thai Road and Bach Dang Road:

- *Transportation*: On the two sides of Bach Dang Road, there are lots of businesses, such as convenient stores, tailor shops, wet markets, to name a few. Therefore, the traffic is quite crowded.

- *Vegetation cover*: There is few trees, which are mostly African mahogany, Tamarind tree, Lagerstroemia and Flamboyant.

The current status of the area's environmental sanitation and waste disposal practices:

- In general, the local residents are quite good at maintaining the environment and sanitation. There is hardly anyone who litters onto the roads or on the pavements.

'Sensitive' locations:

- Truc Lam Pagoda

- Dam Market, which is situated at the intersection between Pham Hong Thai Road and Hoang Quoc Viet Road – 100m away from the construction area

Table 2.15. Sensitive locations on Bach Dang Road to construction item of the project

No.	Sensitive location	Construction item	Distance from construction item to sensitive location (m)
1	Truc Lam Pagoda	Construction of stormwater drainage system	2
2	Dam market (intersection between Pham Hong Thai – Hoang Quoc Viet)		100

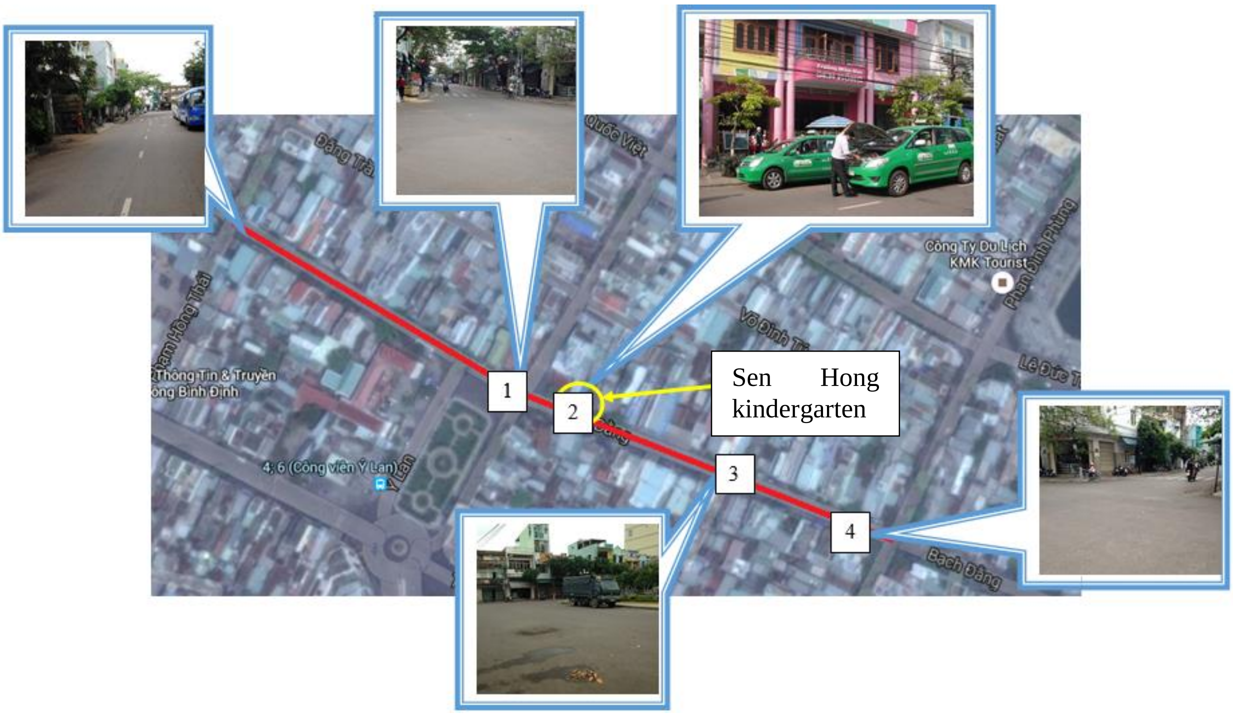


Figure 2.13. **Bach Dang Road diagram, part 2 from the intersection between Pham Hong Thai-Bach Dang Road to the intersection between Phan Dinh Phung-Bach Dang Road**

Notes:

1. *Intersection between Y Lan-Bach Dang Road*
2. *Sen Hong kindergarten located on Bach Dang Road*

3, 4. Images of the current status along Bach Dang Road

Section 2: The starting point is at the intersection between Pham Hong Thai Road and Bach Dang Road and the ending point is at the intersection between Phan Dinh Phung Road and Bach Dang Road.

- On the two sides of this section of Bach Dang Road, there are mostly households. Besides, there is a kindergarten (Sen Hong Kindergarten) at 351 Bach Dang Road. Otherwise, there is not any ‘sensitive’ public structures, such as markets, hospitals, cultural and religious places.

Surroundings along Bach Dang Road, from the intersection between Pham Hong Thai Road and Bach Dang Road to the intersection between Phan Dinh Phung Road and Bach Dang Road:

- *Transportation*: On the two sides of Bach Dang Road, there are lots of businesses, such as convenient stores, tailor shops, wet markets, to name a few. Therefore, the traffic is quite crowded.

- *Vegetation cover*: There is few trees, which are mostly African mahogany, Tamarind tree, Lagerstroemia and Flamboyant.

The current status of the area’s environmental sanitation and waste disposal practices: - In general, the local residents are quite good at maintaining the environment and sanitation. There is hardly anyone who litters onto the roads or on the pavements.

‘Sensitive’ locations:

- Sen Hong Kindergarten

Table 2.16. Sensitive locations on Bach Dang Road (part 2) to construction item of the project

No.	Sensitive location	Construction item	Distance from construction item to sensitive location (m)
1	Sen Hong kindergarten	Construction of stormwater drainage system	2

- **The current status and socio-economic entities in the area of the Nhon Binh Wastewater Treatment Plant:**

Figure 2.14.Current status of Long My landfill surroundings

The eastern and western parts of the plant border paddy fields, ponds, irrigation drains, the southern part is next to industrial parks and residential areas; the northern part is the entrance gate of the Nhon Binh Plant. Several households still live within the buffer zone (radius of 300m) of

Nhon Binh Wastewater Treatment Plant. These households, which are only about 200 meters from the plant, fill complaint about the relocation compensation and do not agree to move out yet. Trees around the plant are mostly small plants in small quantities, which are not enough to prevent odors from the wastewater treatment plant. In summer, the odors from Nhon Binh plant are carried by the winds to neighboring residential areas (there have been several complaints). The average capacity of the plant ranges from 10,000 - 11,000 m3/day; and 13,000 m3/day on peak days.

Surroundings of Nhon Binh Wastewater Treatment Plant:

- *Transportation*: Roads which lead to Nhon Binh Plant include Dien Bien Phu, Nguyen Trong Tri, Lam Van Tuong and Nguyen Man Roads. All of them are large roads, yet have light traffic. Therefore, the roads are convenient for the transport of construction materials.

- *Vegetation cover*: On the two sides of Bach Dang Road, there are mostly shrubs and empty spaces.

The current status of the area's environment and sanitation:

- Because there are few people living in this area, the surrounding environment is in relatively good condition.

- In summer, some households complain about the unpleasant odor from the wastewater treatment plant.

'Sensitive' locations:

- The several households that have not relocated from the buffer zone of the Nhon Binh WWTP.

The survey contains the information about the eleven households that have complaints relating to compensation, support, site clearance and resettlement. The current result is as following:

- 07 households have already received either compesation cash or resettlement plot without complaints, including Ms. Ngô Thị Hường, Mr. Võ Thị Kiên, Mr. Trần Văn Mai, Mr. Trần Đình Sang, Mr. Phạm Văn Bá, Ms. Nguyễn Thị Thao, Mr. Đăng Văn Hớn. Currently, those households are building their houses at resettlement area of the CCESP project. They will move to resettlemt area after their houses completing.
- The four remaining households still are complaining including: Ms. Lê Vui, Mr. Lê Văn Hải, Ms. Lê Thị Hiếu and Ms. Lê Thị Huệ. Those 4 households are a one family with headed-households Lê Văn Hải. On 15 June, 2016, the PPC set up a dialogue with Mr. Lê Văn Hải and all the members in his family. The participants include: Government Inspectorate, the Board of Central Citizen Receiption and the authorities of the province of Binh Dinh. However, Mr. Lê Văn Hải and the members in his family absent. On July 19, 2016, the Government Office organized a meeting to resolve lawsuit of Mr. Le Van Hai his family members. This meeting chaired by the Deputy Prime Minister Truong Hoa Binh and attended by Ministry of Natural Resources and Environment, the Government Inspectorate, Binh Dinh Province People's Committee, and the Board of Central Citizen Receiption. The Deputy Prime Minister Truong Hoa Binh assigned the Ministry of Natural Resources and Environment to recheck Mr. Lê Văn Hải's lawsuit before submitting Government for review and resolve..

The current status and socio-economic entities of Long My Landfill:

Figure 2.15. Current status of landfill site and leachate treatment pond-Long My landfill

Long My landfill, Thanh Long hamlet, Phuoc My commune, has a total area of 61,6ha over a hilly terrain, including the Landfill Cell or C3 (6,12ha), the leachate treatment station (2,01ha), medical waste incinerators (200 kg/h), the stone powder waste cell (2,18ha) and the compost processing plant Long My (6,6ha) which has been closed down due to the unsatisfactory quality of finished products. With regards to the current drainage situation, the CCESP has invested to build an open ditch along the eastern edge of the landfill and a protective trench upstream to intercept rain water flowing down from the mountain slopes. In addition to that, the CCESP also built a drainage pipe in the lowlands to carry rain water away from the protective trench of the landfill. The supply water source for the landfill use is groundwater taken from the monitoring wells. Currently, the compost production area is shut down, other areas such as medical waste incinerators, landfill cells, etc .. are still in operation. Long My Landfill has completely closed the old cells and is in the process of diposing waste in the new ones (the locations of the new landfill cells are higher than the old ones). The landfill has a 300m buffer zone, mainly used for plants such as Chinese Banyan, Wattle. The vegetation in construction area of new cell is covered by Chinese Banyan, Wattle and some kinds of scrub. The site is the planted forest land, which is handed over to the people for the exploitation and planting purposes. Furthermore, the site also the feeding ground of birds and small animals such as crows, doves, storks etc. Currently, households are exploiting their planted forest including construction area of new cell of the project. The area around the site is uninhabited due to its uphill location. Under the provisions of Long My landfill, scavengers and waste pickers are not allowed to the site.

Other features of the current Long My Landfill:

- *Transportation route:* the route approaching Long My Landfill is also the route that leads to Long My Industrial Park (off National Route 1A), which is currently un-named. The vehicles on this road mainly are trucks and containers, which make for a crowded traffic route.
- *Vegetation cover:* many trees, mainly Chinese Banyan, Wattle.

The current state of the area's environmental sanitation and waste disposal practices:

- Because there are no people living in this area, there are no household waste that can affect the environment.

Sensitive location:

- Due to the landfill's uphill location, away from residential areas and other education, heathcare and welfare buildings, there are no sensitive infrastructure within the area. During the expansion of landfill cells, it is possible that some household trees will need to be cut down.

During the field investigation, the Consultant observed that wastes from the transfering trucks might fall out on the street, and these will need to be picked up by someone and brought into the landfill.

- **The current state of school toilet**

The current state of school toilet is descripted in the following table:

Table 2.17.The current state of school toilet in Quy Nhon City

No.	School name	Current state
1	Le Loi Primary School	01 simple toilet facility for all the students in the school, which has been built a long time ago (before 1995) and in seriously deteriorated condition.
2	Hải Cảng Primary School	01 simple toilet facility for all the students in the school, which has been built a long time ago (before 1995) and in seriously deteriorated condition.
3	Đống Đa Primary School (2nd branch)	01 toilet facility for students in the school, which has been built from 1990, in seriously deteriorated condition and could not meet the school's needs. Currently the school has no toilet facility for teachers so the teachers have to use the same toilet as the students.
4	Phước Mỹ Secondary School	01 toilet facility for students built before 2000 in a state of deterioration, cracked walls, broken drainage systems causing flooding in the toilet
5	Bùi Thị Xuân Secondary School	01 toilet facility for all the students in the school, which has been built before 1990 and in seriously deteriorated condition.
6	Bùi Thị Xuân Primary School (Military School branch)	The whole school has 01 toilet facillity for students, built before 1990 and in a state of deterioration. Teachers' toilets are put right next to the students' facility, which include 01 for male teachers (01 flush toilet + 01 wash basin + 01 urinal) and 01 for female teachers (01 flush toilet + 01 wash basin)
7	Nhơn Phú 1 Primary School (2nd branch)	The whole school has 01 toilet facility for students which has been built before 2004 and currently the school still hasn't had facility for teachers, who have to share the facility with the students.
8	Nhơn Phú 2 Primary School	01 simple toilet facility for all the students in the school, which has been built before 1995 and in seriously deteriorated condition.
9	Nhơn Hội Secondary School	The school has 01 simple toilet facility for students, built in 2010, together with 02 facilities for teachers under the staircase.
10	Nhơn Hải Secondary School	The school has 01 toilet facility for students, built in 2001 and in a state of deterioration and 01 facility for teachers, built right next to the students' toilet.
11	Nhơn Hải Primary School (2nd branch)	The school has 01 toilet facility for students, built in 2000 and in a state of deterioration. Staffs and teachers share this facility with the students.
12	Nhơn Lý Primary School (2nd branch)	The school has 01 toilet facility, built in 2003 and in a state of deterioration. Teachers' toilet facility was built right next to the students' and this toilet is used by both male and female teachers (01 toilet with no seperation).

- **Phase 2 includes**
  - ✓ Construction of a new Y-shaped bridge, which is replaced the existing one
  - ✓ Construction of a completely new Huynh Tan Phat bridge
- **Current state and the socio-economic entities at the Y Bridge:**

Figure 2.16. Current state of Huynh Tan Phat Bridge's construction area

- Parallely with the existing Y-shaped bridge is a wastewater pipeline (away 2m of distance) of South residential area of Ha Thanh river. The current situation of Ha Thanh river near Y-shaped bridge, a part of Ha Thanh riverbank forward South residential area of Ha Thanh river has been already fortified, the remaining part of Ha Thanh riverbank has not fortified. The situation of people encroaching riverbank for the construction of their housing is quite common. According to people's reflection, in the summer Ha Thanh river segment reeks the offensive odor because of the indiscriminate littering of households living both sides of Ha Thanh river. The waterway traffic activities are not busy on this river segment.

Other features at the construction site of Y-shaped bridge:

- *Transportation*: Mainly motorcycles and bicycles.

- *Vegetation cover*: Mainly shrubs on both sides of Ha Thanh river

- *Aquatic ecosystems*: Poor ecosystem with little or virtually no aquatic species found.

- The current state of the area's environmental sanitation and waste disposal practices: Households in Residential Area 1B are mindful of environmental sanitation, waste littering activities on Ha Thanh river do not exist.

Sensitive location:

-Business households living near project construction item;

- Wastewater pipeline is parallel with the existing bridge;

- Infrastructure such as access road, water supply and electrical system

Current state and the socio-economic entities at Huynh Tan Phat Bridge:

Figure 2.17. Current status of construction area of future Huynh Tan Phat bridge

- Infrastructure on both sides of the river mainly includes houses (Residential island 1B) and empty land. Both sides have been fortified and in the process of finishing the embankment. The surface water of Ha Thanh river branch in this area is not clean. The empty lands in the area can be used to stock construction materials for the project. The waterway traffic activities are not busy on this river segment.

Other features at the construction site of Huynh Tan Phat bridge:

- *Transportation*: Mainly motorcycles and bicycles.

- *Vegetation cover*: Mainly shrubs on both sides of Ha Thanh river

- *Aquatic ecosystems*: Poor ecosystem with little or virtually no aquatic species found.

- The current state of the area's environmental sanitation and waste disposal practices: Households in Residential Area 1B are mindful of environmental sanitation, waste littering activities on Ha Thanh river do not exist.

Sensitive location:

- Business households living near project construction item;

- Infrastructure such as access road, water supply and electrical system

CHAPTER 3. ENVIROMENTAL AND SOCIAL IMPACT ASSESSMENT

3.1. Positive impacts

- The subprojet would involve construction of the interceptor sewer, wastewater treatment plant, stormwater collection and bridges. These components, together with the components of improved roads and stormwater drainage, would enhance traffic condition in the construction area of Y-shaped bridge and Huynh Tan Phat bridget.

- The drainage system is renovated and upgraded, therefore, the flood-prone area in Quy Nhon city would be solved absolutely.

- Constructing stormwater drainage system would help reduce flooding in some areas such as Hoc Ba Bep, Bach Dang, Tran Hung Dao, Hung Vuong, around Bau Sen lake, Phu Hoa canal, etc. Besides, the drainage system also help strengthen drainage capacity; avoid, protect and prevent outside flood from entering the city center as well as solve environmental pollution.

- The collection and treatment of domestic wastewater for Sub-project area would minimize the volume of wastewater discharged directly into natural water bodies such as canals, lakes, then reduce significantly pollutants for the lakes in the area.

- The technical assistance given to the subproject owner, management agencies and sectors' institutions would help bringing about efficiency in the operation promotion the subproject sustainability.

- The subproject would improve sanitation conditions in the area, contributing to the better local people's living environment, reducing pollution and water related diseases, and hence enhancing their health. Communication on hygienic water and sanitation would help the school children change their behavior toward healthy water and sanitation habits for the better health and development.

3.2. Potential negative impacts and risks

Risks and potential negative impacts of dust, noise, vibration, esmission… would be arised through several construction activites of the subproject such as: (1) Removal of the top soil; (2) Mobilization of workers and machineries; (3) Transportation, gathering materials and fuel at construction sites, excavation, dredging canals; (4) Casting sewers and piles; (5) Construction or installation of equipment items; (6) Backfilling, finishing, and site reinstatement; and (7) Waste disposal.

The types and scale of impacts may change significantly in conformity with the characteristics and the scale of activities, locations and environmental and social conditions, human habits and time. However, those impacts could be mitigated through the application of good engineering and construction management practices and with strict supervision and monitoring of contractors' performance and consultation with local communities.

The levels of impacts are assigned as follows: None (N)-no impact; Low (L)-Small works with minor impacts, localized, reversible, temporary; Medium (M) -Small /medium scale works with moderate impacts of which most are reversible, reducible and manageable, localized, temporary; High (H)-Medium scale works or large scale works with significant impacts (socially and/or environmentally) of which some are irreversible and require compensation..

Table 3.1. Level of negative impacts to subproject's works

Work items	Physical elements			Biological elements		Social elements				Others		Notes
	Air, noise, vibration	Soil, water	Solid waste, dredged sludge	Forest, natural ecosystem	Fish, aquatic species	Land acquisition, resettlement	Native ethnic groups	Tangible culture resources	Livelihood, disturbance to residential community	Localized flooding, traffic, safety	Impacts from outside subproject area	
COMPONENT 1												
Culvert installation of Phu Hoa canal and upstream canal of Bau Sen lake												
Preparation	L	L	L	N	N	N	N	N	N	N	N	- Small and medium scale works with small impacts (see Notes (2) below for further information)
Construction	M	M	M	N	N	N	N	L	M	M	L	
Operation	N	N	L	N	N	N	N	N	N	N	N	
Stormwater and wastewater drainage route												
Preparation	N	N	N	N	N	N	N	N	L	N	N	- Small and medium scale works with significant impacts (see Notes (2) below for further information)
Construction	M	M	L	N	N	N	N	L	M	M	L	
Operation	N	N	L	N	N	N	N	N	N	L	L	
Capacity expansion of Nhơn Bình wastewater treatment plants												
Preparation	L	L	L	L	N	N	N	N	L	N	N	- Large scale works with medium impacts (see Notes (2) below for further information)
Construction	M	M	M	N	N	N	N	N	M	N	N	
Operation	N	N	L	N	N	N	N	N	N	N	L	

Construction of new A-4 cell in Long My landfill												
Preparation	L	L	L	N	N	M	N	N	N	N	N	- Large scale works with medium impacts (see Notes (2) below for further information)
Construction	M	M	M	M	N	M	N	N	L	L	L	
Operation	N	N	L	N	N	N	N	N	N	M	L	
Closure phase at landfill cell	L	L	L	N	N	N	N	N	L	M	N	
COMPONENT 2												
Construction of Y shape and Huynh Tan Phat bridge												
Preparation	L	L	L	N	N	N	N	N	L	L	N	- Large scale works with medium impacts (see Notes (2) below for further information)
Construction	M	M	M	N	L	N	N	N	M	M	L	
Operation	L	L	L	N	N	N	N	N	L	L	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.												

A. COMPONENT 1

A. 3.2.1. Pre-construction stage

A. 3.2.1.1. The impacts of land acquisition and site clearance

- Impacts of land acquisition:

6 households would be affected with total forest land area of 196,937 m2, in which those 6 households are seriously affected by acquisition of planted forest land. However, None of them would be affected with residential land, housing, or architectural works which must be relocated. Details of affected land area are listed in Table 3.2 below:

Table 3.2. Forest land area and household's name affected

No	Name	Forest land			
		Total area*(m^2)*	Affected area*(m^2)*	% AH *(m^2)*	Affected tree/crop
1	Quàng Văn Bình	21.250	13,000	61	Acacia, eucalyptus
2	Nguyễn Bá Ngụ	30.000	27,146	90	Acacia, eucalyptus
3	Trần Kim Phụng	94.600	49,000	52	Acacia, eucalyptus
4	Phạm Tấn Toàn	30.000	15,000	50	Acacia, eucalyptus
5	Đào Thiên Thạo	70.000	37,000	53	Acacia, eucalyptus
6	Lê Xuân Văn	88.000	55,791	63	Acacia, eucalyptus
TOTAL		**333.850**	**196.937**		

According to the socio-economic survey report of Quy Nhon city in 2016, of the 25 members of the six affected households, 6 people are in school age; 5 people work in agriculture sector and animal husbandry, the remaining 10 people are children and the elderly, 10 people are labor and business. As such, the major professional occupation of the members of the 6 AHs are famers and businessmen, contributing to the main income of their families. The acquisition of 196,937 m^2 of agricultural land area (mainly planted eucalyptus, black acacia) in the Long My landfill area, corresponding to 196,937 trees (a tree/1m^2) for compensation price regulated under Decision 40/2013 of the People's Committee of Binh Dinh Province is VND16,500/ tree for eucalyptus, acacia which diameter is 4 - 6 cm. As such, the compensation cost for acquiring trees by the subproject is: VND 1,894,051,500. In general, the impact on land acquisition under component would be moderate.

A. 3.2.1.2. Safety risks related to unexploded ordnance (UXOs)

The construction sites located in Quy Nhon city have been much affected by human activities, and UXOs detection and mine clearance have been already conducted before. Experience in implementation of the CCESP in Quy Nhon city shows that no remaining UXOs have been detected, and during the construction no UXOs were found. However, this is a risk to be considered as this kind of hazard, once taking place, may cost human lives and properties. The current construction sites located in Phu Hoa canal, Bau Sen river's upstream canal, Tran Hung Dao, Bach Dang already had construction, or used land. Therefore, risk due to UXOs in these areas is quite low. The areas for expansion of Long My landfill and Nhon Binh WWTP are at risk of UXOs left from the war; therefore, it should have been cleared before commencement od construction.

A. 3.2.2. Construction Phase

A. 3.2.2.1. Impacts on Ambient Air Quality

a. ***Dust and exhaust gases***

***Impacts during site clearance*:**

There would be no demolition required for the construction of Phu Hoa canal, upstream ditch of Bau Sen lake, Tran Hung Dao, Bach Dang road and Hoc Ba Bep area. Similarly, the activities of site clearance would also not be required for the construction of A4 Cell of Long My landfill. For the WWTP, the activities of site clearance will demolish approximately 200m of Nhon Binh WWTP's barbed wire fence. The volume of barbed wire fence is small, and therefore, the impact of site clearance in Nhon Binh WWTP could be assessed as low. As for the construction of school sanitation blocks, the activities of site clearance would demolish the existing toilets and the new toilets would be built on the ground of the existing toilets. Therefore, the overall impact could be assessed as low.

Impacts during construction:

For construction activities, road digging, connecting and ground leveling

The earthworks, roadbed leveling, and construction of the drainage system would affect the ambient air. The sources of emissions during construction are primarily from roadbed earthworks.

The equipment used in roadbed earthworks would be 110CV bulldozers, excavators bucket 1,25m^3 and tipper trucks 10 tons. The load of pollutants generated is determined by the formula:

$$E = B \times K$$

Where:

E – Pollutants load (g/s).

B – The amount of fuel consumed by the device (kg/h).

K – Pollution coefficient equivalent withfuel consumption (kg/ton NL):

Table 3.3. KPollution factor

Machinery	Pollution factor (kg/ton NL)				
	TSP	CO	SO_2	NO_2	HC
Bulldozer110CV	16	9	6	33	20
Excavator 1,25m^3	16	9	6	33	20
Tipper truck 10T	2	21	2	20	34

<u>Source:</u> *Assessment of Sources of Air, Water and Land Pollution –Part 1: Rapid Inventory Techniques in Environmental Pollution, WHO, 1993)*

Table 3.4. Load of pollutants from earthworks

Devices	Fuel (kg/h)	Load of pollutants (kg/h)				
		TSP	CO	SO_2	NO_2	HC
Bulldozer110CV	42l/hx2x0.8=67.2	1.08	0.6	0.4	2.22	1.34
Excavator 1.25m^3	42l/hx2x0.8=67.2	1.08	0.6	0.4	2.22	1.34
Tipper truck 10T	21l/hx4x0.8=67.2	0.13	1.41	0.13	1.34	2.28
Total (kg/h)		2.29	2.61	0.93	5.78	4.96
Total (g/s)		0.636	0.725	0.258	1.606	1.378

<u>Notes :</u>*Density of diesel is 0,8g/cm^3= 0,8kg/l*

Using Gifford & Hanna model to identify average concentrations of contaminants during digging and leveling the roadbed as follows:

$$C = Co + \frac{10^3 El}{uH}, \text{ mg/m}^3$$

Where:

C – The concentration of pollutants, mg/m^3.

Co – The concentration of pollutants in the air of the calculated area, mg/m^3.

E – Pollutant load, g/m^2.s

l – The length of the calculated area, m (length of routes).

u – The average wind speed in the area, m/s.

H – the mixing height of the atmosphere, m.

From dust load arising during digging and leveling the roadbed is calculated in the table above with the mixed height of the atmosphere of Binh Dinh in the area of 10 meters. The average wind speeds in the area in the rainy season and the dry season are shown in Table 3.5 below:

Table 3.5. Meteorological data used forcalculating model

Area	Rainy season			Dry season		
	Wind direction	**Average wind speed**	**Wind direction**	**Wind direction**	**Average wind speed**	**Wind direction**
Quy Nhơn	SE	3.95m/s	30°C	NW	3.8m/s	27°C

Notes : - Meteorological data used from chapter 2

Table 3.6.The dust concentration generated in the process of digging and leveling

Calculation mode	Parameters					Concentration of dust(mg/m^3)	TCCP (mg/m^3)
	Co (mg/m^3)	**E (g/m^2.s)**	**l (m)**	**u (m/s)**	**H (m)**		
Tertiary sewer							
Rainy season	0.094	6.88x10^{-6}	28,854	3.8	10	5.318	6
Dry season	0.094	6.88x10^{-6}	28,854	3.95	10	5.12	6
Nhon Binh wastewater treatment plant							
Rainy season	0.087	4.96x10^{-6}	685	3.8	10	0.176	6
Dry season	0.087	4.96x10^{-6}	685	3.95	10	0.173	6
Long My landfill							
Rainy season	0.069	7.47x10^{-6}	450	3.8	10	0.157	6
Dry season	0.069	7.47x10^{-6}	450	3.95	10	0.154	6

Note: TCCP – QĐ 3733/2002/BYT Occupational health standards of the Ministry of Health, 2002

Based on the calculated data in the table above, theconcentration of dust generated in the process of roadbed digging and leveling in the rainy season and the dry season are within permissible limits regulated by the occupational health standards of Health Ministry (QD 3733/2002/BYT).

The spread of dust (TSP) and gases from roadbed earthwork opearation is determined by the concentration of pollutants downwind:

$$Cx = \frac{2E}{(2\pi)^{1/2}\sigma_z u}, \text{ mg/m}^3$$

Where:

E – Load of pollutants per unit length of discharge sources, g/ms.

σ_z – Diffusion coefficient pollutants under the z, m.

u – The average wind speed in the area of subproject, m/s.

From the load of pollutants identified in Table 3.6, the concentrations of toxic substances at a distance of 20m, 40m, 60m and 80m with downwind are defined in Table 3.7:

Table 3.7. Concentrations of pollutants generates from the digging and leveling activities

Calculation mode	Distance (m)	Coefficient sz (m)	Load (g/m.s)/ Concentrations of pollutants (mg/m3)				
			TSP	**CO**	**SO2**	**NO2**	**HC**
Rainy season	20	9.5	0.032	0.036	0.013	0.08	0.069
			0.64	0.72	0.26	**0.6**	1.38
	40	10.1	0.016	0.018	0.006	0.04	0.034
			0.3	0.34	0.11	0.15	0.64
	60	11.1	0.011	0.012	0.004	0.027	0.023
			0.188	0.205	0.068	0.102	0.394
	0	12.5	0.008	0.009	0.003	0.02	0.017
			0.122	0.137	0.046	0.084	0.258
Dry season	20	9.5	0.032	0.036	0.013	0.08	0.069
			0.727	0.817	0.295	**1.24**	1.567
	40	10.1	0.016	0.018	0.006	0.04	0.034
			0.342	0.384	0.128	**0.854**	0.726
	60	11.1	0.011	0.012	0.004	0.027	0.023
			0.214	0.233	0.078	0.147	0.447
	80	12.5	0.008	0.009	0.003	0.02	0.017
			0.138	0.155	0.052	0.125	0.293
QCVN 05:2013/BTNMT			0.3	30	0.35	0.2	5

Based on the calculated data in Table 3.7 above, the concentration of toxic gases generated from the roadbed digging and grading equipment in the rainy season at a distance of 60m and in the dry season at a distance of 80 meters (under downwind) within the allowable limits for ambient air quality regulated by QCVN 05:2013/BTNMT. In distances of 20-40m, there are dust and SO_2 that its concentration exceeds allowable limit according to QCVN 05:2013/BTNMT. Based on calculated results for (1) 20-40m of distance; (2) dry and rainy seasons; (3) QCVN 05:2013/BTNMT: TSP content exceeds allowable limit from 1.14 to 2.14 times. SO_2 concentration exceeds allowable limit from 3 to 6.2 times. Overall, impacts of dust and emission are assessed as low to medium.

Impacts due to transportion of excavated materials

For activities of transporting of excavated materials, the sources of emissions generated mainly from the transportation of the construction spoils to the disposal sites. The volume is calculated by the volume of excavated materials minus the volume of soil used to fill up. The amount of traffic needed to transport the excavated materials (average 10 tons per vehicle, use diesel fuel) is defined in Table 3.8 as follows:

Table 3.8. Vehicle traffic

No.	Items	Disposal volume(tons)	Traffic (vehicle)	Time (day)	Traffic (vehicle/hour)
1	Phu Hoa canal	29815.3	2981.5	180	2.07
2	Bau Sen upstream drains	1824.2	182.4	180	0.12
3	Tran Hung Dao road sewer	38831	3883.1	360	1.35
4	Bach Dang road sewer	10199	1020	180	0.71
5	Sewer level 3	6259	626	180	0.43
6	Nhon Binh wastewater treatment plant	95220	9522	360	3.31
7	Long My landfill	69557	6955.7	180	4.83

Note: Working time in the construction schedule depends on each package, the number of days. The number of working hours is 8 hours per day.

The level of pollution caused by gas emissions from vehicles in the area of the subproject depends on the quality of roads, traffic density, technical quality of the vehicles on site and the amount of fuel consumption. Load of pollutants is calculated on the basis of "pollution factor" established by the United States Environmental Protection Agency (US EPA) and the World Health Organization (WHO) for the trucks using diesel oil with load of below 16 tons. The pollution loads of dust, CO, SO_2, NO_2 by vehicles are: Dust: 0.9 kg/1000km per vehicle; CO: 2.9 kg/1000km per vehicle; SO_2: 4,15S kg/1000kmper vehicle; NO_2: 14.4 kg/1000kmper vehicle; and VOC: 0.8 kg/1000 km per vehicle.

Load of pollutants generated from the transporting excavated materials with vehicle traffic on each route is indicated in Table 3.9.

Table 3.9.Pollutants load generated from the excavated materials transportation process on each route

Routes	Load of TSP (mg/ms)	Load of CO (mg/ms)	Load of SO_2 (mg/ms)	Load of NO_2 (mg/ms)	Load of VOC (mg/ms)
Phu Hoa canal	0.52	1.67	0.72	8.28	0.46
Bau Sen upstream ditch	0.03	0.1	0.41	0.48	0.02
Sewer construction on Tran Hung Dao road	0.33	1.09	0.46	5.40	0.30
Sewer construction on Hốc Bà Bếparea	0.18	0.56	0.24	2.8	0.16
Sewer construction on Bach Dang road	0.11	0.35	0.18	1.72	0.09
Nhon Binh wastewater treatment plant	0.83	2.66	1.142	13.21	0.73
Long My landfill	1.21	3.89	1.67	19.34	1.07

Note : S=0,3% in DO

The transportation process for excavated materials would generate pollutants. The greatest impact of this process is dust pollution along transporting routes. From the calculation above, the Sutton model is used to define the average concentration of TSP dust:

$$C = \frac{0{,}8E.\left\{\exp\left[\frac{-(z+h)^2}{2\sigma_z^2}\right] + \exp\left[\frac{-(z-h)^2}{2\sigma_z^2}\right]\right\}}{\sigma_z.u} \quad (mg/m^3)$$

Where:

C - The concentration of pollutants in the air (mg/m^3).

E - Pollutants load from waste source (mg/ms).

z - The height of the calculation point (m).

h - The height of the road surface from the surrounding ground (m).

u - The average wind speed in the area (m/s).

σz - Diffusion coefficient of the pollutants under the z (m).

Dispersion coefficient σz will be subject to atmospheric dispersion. The value of the dispersion coefficient in horizontal directions is calculated with Slade model, with atmospheric stability B and distance X(m) between the calculation point and the emission point, taking into account wind direction, and is calculated with the following formula: $\sigma z = 0.53\ x^{0.73}$ (m). From the calculated pollutant loads in the table above, the highest concentrations of the generated dust would be at the sites for construction of Long My landfill (1.21mg/ms) and Nhon Binh WWTP (0.83mg/ms). Data source is used to forecast the dust pollution during transporting of material for backfilling above are presented in Table 3.10.

Table 3.10.Data sources used to calculate models

Construction items	E_{TSP} (mg/ms)	Z (m)	h (m)	X_1 (m)	X_2 (m)	X_3 (m)	X_4 (m)	X_5 (m)	X_6 (m)	X_7 (m)	X_8 (m)	X_9 (m)
Phu Hoa canal	0.52	0.5	0.2	20	40	60	80	100	120	140	160	180
Bau Sen upstream ditch	0.03	0.5	0.2	20	40	60	80	100	120	140	160	180
Tran Hung Dao road	0.33	0.5	0.2	20	40	60	80	100	120	140	160	180
Hoc Ba Bep area	0.18	0.5	0.2	20	40	60	80	100	120	140	160	180
Bach Dang road	0.11	0.5	0.2	20	40	60	80	100	120	140	160	180
Nhon Binh WWTP	0.83	0.5	0.2	20	40	60	80	100	120	140	160	180
Long My landfill	1.21	0.5	0.2	20	40	60	80	100	120	140	160	180

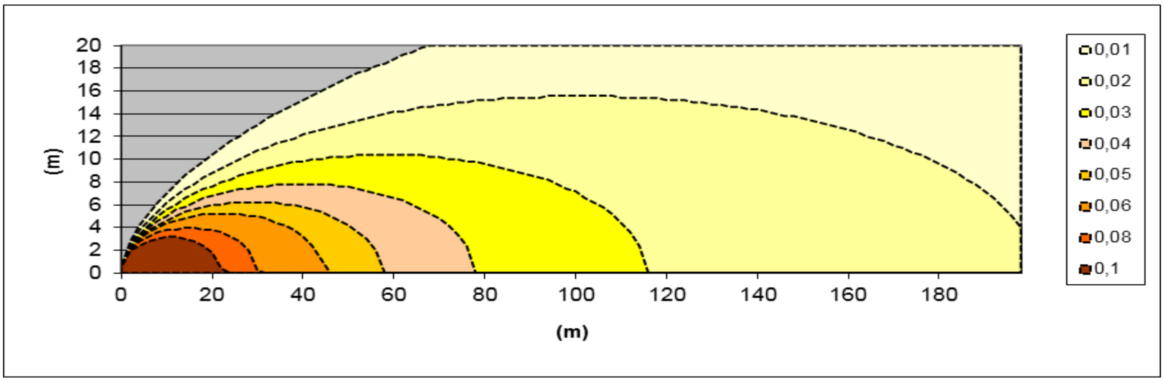


Figure 3.1. Average TSP concentration in the rainy season – Long My landfill (mg/m^3)

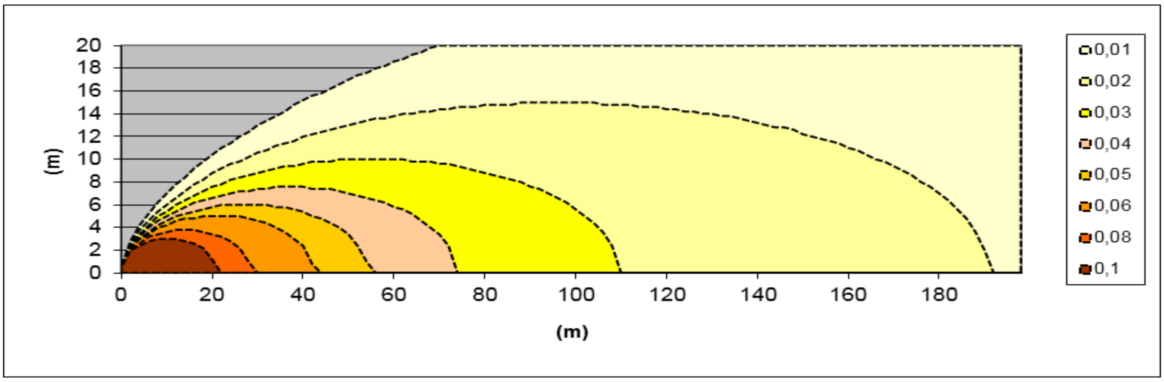


Figure 3.2. Average TSP concentration in the dry season – Long My landfill (mg/m³)

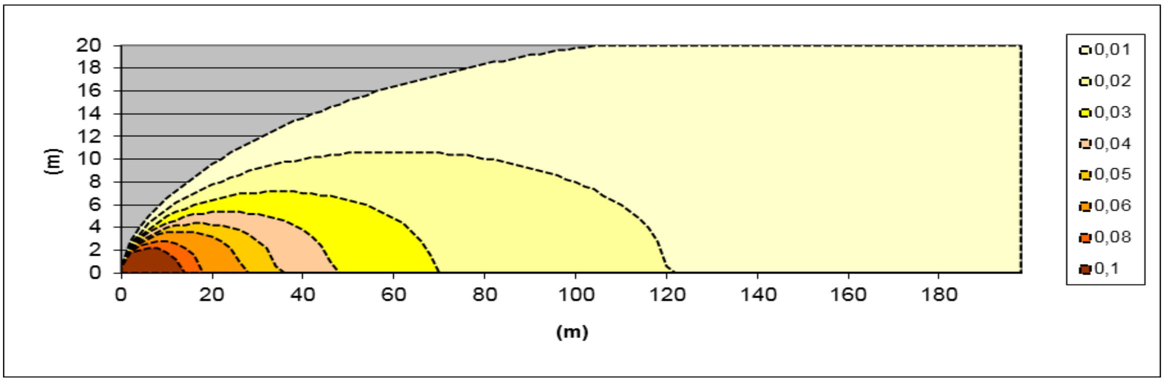


Figure 3.3. Average TSP concentration in the rainy season – Nhon Binh WWTP WWTP (mg/m³)

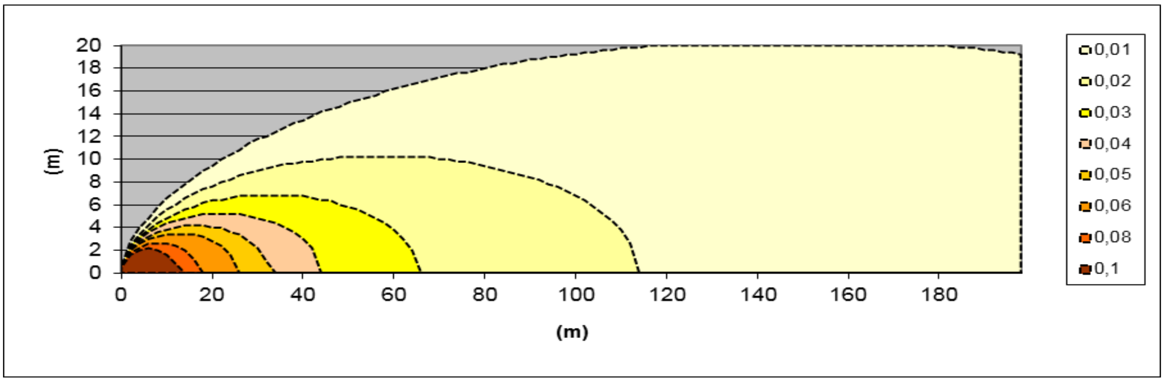


Figure 3.4. Average TSP concentration in the dry season – Nhon Binh WWTP WWTP (mg/m³)

The calculation results and models show that:

- The concentration of generated dust from Nhon Binh WWTP and Long My landfill (20-180m) during the rainy and dry seasons rangers from 0.1 to 0.01 mg/m³ and the concentration of generated dust does not exceed allowable limit according to QCVN 05:2013/BTNNT - *National Technical Regulation on Ambient Air Quality* (Figure 3.1 through 3.4).

- Overall, during construction process, the average concentration of generated dust caused by excavated earth transporting vehicles in the rainy and dry seasons would not exceed the permissible standards according to QCVN 05:2013/BTNMT. However, in construction phase, there would be the times and frequency of the demand for using machineries and construction vehicles would increase significantly. Therefore, concentration of generated dust would expect to exceed the allowable limit according to QCVN 05:2013/BTNMT. The negative impact of generated dust would affect the daily life, health of the community in densely populated areas of Phu Hoa canal, Upstream canal of Bau Sen lake, Hoc Ba Bep area. The loads of dust generated by transporting excavated soils, materials are predicted as temporary and being not substantial.

Transportation routes of construction equipment and materials

As previously stated in Section 1.4.2.5 of Chapter 1, the transportation activities of construction equipment and materials may occur on several routes as below:

- *For construction of Phu Hoa canal:* Xuan Thuy, Tran Quang Khanh, To Huy Hieu and Vo Duy Duong roads.
- *For construction of the upstream ditch of Bau Sen lake:* Nguyen Thai Hoc and Nguyen Tat Thanh roads.
- *For construction of the stormwater drainage culverts on Tran Hung Dao road:* Tran Hung Dao street
- *For construction of the stormwater drainage culverts on Bach Dang Street:* Hoang Hoa Tham, Pham Hong Thai, Tran Hung Dao and Phan Dinh Phung streets.
- *For construction of Nhon Binh WWTP:* Dien Bien Phu, Nguyen Trong Tri, Lam Van Tuong, and Nguyen Man roads.
- *For construction of A-4 Cell at Long My landfill:* The existing road entering to Long My landfill (turning from NH 1A).

The residential areas along those routes would be affected by material and equipment transportation activities. Major negative impacts would be dust, exhaust gases, and noise.

Transportation of construction equipment and materials

The construction activities would require operation of vehicles and construction machines. Besides, the presence of trucks/vehicles transporting raw materials (including iron, steel, sand and construction gravel) and technical equipment would also increase the traffic flow in subproject area. The impacts causing air pollution from this activity include dusts and exhaust gases from vehicles and construction machines.

The main air pollutants emitted from construction activities are dusts, gases of CO, SO_2, NO_2, and volatile organic compounds (VOCs) from construction machineries (excavators, concrete mixers) and vehicles. The amount of main equipment and materials needs to be transported is presented in Table 3.11 below:

Table 3.11. Summary volume of transported materials

No	Item	Volume (ton)	Construction time (quarter)	Vehicle trip (vehicle trip/day)	Vehicle trip (vehicle trip/hour)
1	Phu Hoa canal	25644.9	12	7.1	0.9

No	Item	Volume (ton)	Construction time (quarter)	Vehicle trip (vehicle trip/day)	Vehicle trip (vehicle trip/hour)
2	Bau Sen lake upstream canal	5859.5	12	1.6	0.2
3	Tran Hung Dao sewer	27746.8	12	7.7	1.0
4	Hốc Bà Bếp area	14199.2	12	3.9	0.5
5	Bach Dang road	5423.2	12	1.5	0.2
6	Long My landfill	5880.9	12	1.6	0.2

Load of dust TSP and gases of CO, SO_2, NO_2dischargedfrom daily transport vehicles are determined as below (S=0.3%):

Table 3.12. Load of dust and exhause gases during transportation

Sections	Load of dust TSP (mg/ms)	Load of CO (mg/ms)	Load of SO_2 (mg/ms)	Load of NO_2 (mg/ms)	Load of VOC (mg/ms)
Construction of culvert system on Phu Hoa canal	0.23	0.7	0.3	3.6	0.2
Construction of Bau Sau upstream ditch	0.05	0.16	0.07	0.8	0.04
Construction of culvert system on Tran Hung Dao road	0.25	0.81	0.35	4.00	0.22
Construction of culvert system on Hoc Ba Bep area	0.12	0.4	0.17	2.00	0.11
Construction of culvert system on Bach Dang road	0.05	0.16	0.07	0.8	0.04
Expansion of Long My landfill	0.05	0.16	0.07	0.8	0.04

- Environmental impact assessment to the atmosphere:

The Sutton computational model was applied, using the load of pollutants calculated above, to determine the average concentration of TSP dust on the routes to the subproject sites during the construction as presented in the section of impact assessment on the transportation of ground leveling. The Sutton model was applied for the road having the highest dust load which is 0.25 mg/ms on Tran Hung Dao road respective to the different time frames in the rainy and dry season.

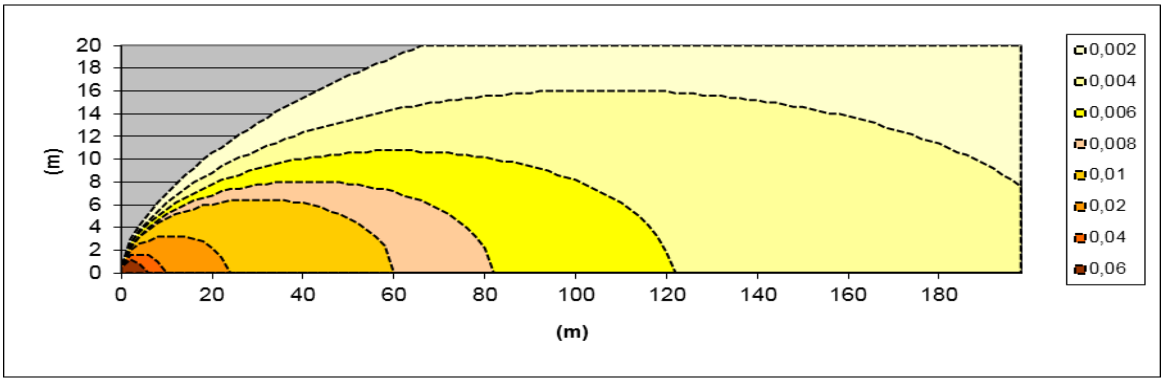


Figure 3.5. Average TSP concentration in rainy season – Tran Hung Dao road (mg/m^3)

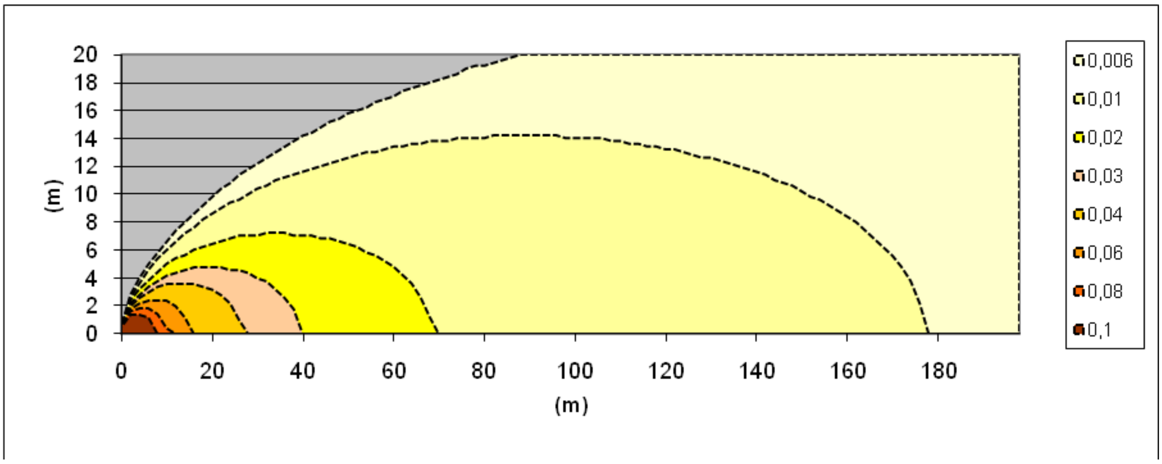


Figure 3.6. Average TSP concentrationin dry season – Tran Hung Dao road (mg/m^3)

The calculation result and models show that the highest concentration of TSP caused by the means of transporting materials and equipment's in the rainy and dry season at 10 meters from the center of the road is 0.1 mg/m^3 (Figure 3.5 and 3.6), which is lower than the permissible levels indicated by QCVN 05:2013/ BTNMT for all construction items of Component 1.

According to survey results, the householders located along streets Tran Hung Dao, Bach Dang, Xuan Thuy, Tran Quang Khanh, Vo Duy Duong, Nguyen Thai Hoc, Vo Nguyen Giap, Le Thanh Nghi where transportion of the construction materials and excavated earth would be affected by dust and exhaust gas. Visitors at Nguyen Hue pagoda area (next to Phu Hoa canal), Tay Ninh church, Ngoc Nhon monastic (Tran Hung Dao street), Truc Lam pagoda (Doan Thi Diem – Tran Hung Dao intersection) would also be affected by dusts and exhaust gases. The degree of impact is assessed as medium.

b. Impacts caused by noise pollution

Noise would impact directly construction workers on site and residents near or along the construction route. According to calculations, within 15 meters, noise intensity is evenly over 85dB. As this is the noise threshold, if humans are continuously exposed to such intensity, they will suffer from fatigue and unpleasant feelings. If noise exceeds 90dB, it will adversely affect hearing.

The trucks, rod vibrators, and paving machines would be the noise pollution sources impacting the environment during construction process. These noise pollution sources and their associated noise levels are presented in Table 3.13 below.

Table 3.13. Level of noise caused by construction machines

Construction machine	Noise level at 1 m distance
Trailer	78
Roller	73
15 ton Truck	88
Rod vibrator	87.7
Paving machine	86.5
Watering machine	57.7
2HP Water pump	75.4
Concrete mixer	81.5
TCVN 3985-1999	*85*

Note: TCVN 3985-1999 :Allowable noise levels at workplace

Noise pollution transfer from construction area to the surrounding environment is determined as below:

$$Li = Lp - \Delta L_d - \Delta L_c, \text{ dBA}$$

Where :

Li –Noise level at determined points at distance of r_2 from noise source, dBA

Lp–Noise level measured nearby noise source, at distance of r_1 from noise source, dBA

ΔL_d–Noise level reduction at distance of $r_2$at frequency of i

$\Delta L_d = 20 \lg[(r_2/r_1)^{1+a}]$, dBA

r_1–Distance from noise source, corresponding to Lp, m

r_2–Distance used to calculating noise reduction, corresponding to Li, m

a –Coefficient accounting to the noise absorption of soil (a=0).

ΔL_c–Noise level reduction by sound proof things. At subproject area ΔL_c=0.

From the formula above, the total noise level generating from all machineries and construction equipment within the radius of 50m and 100m are calculated in Table 3.15:

Table 3.14. Noise level from construction machines to surrounded environment (dBA)

No.	Construction machine	Noise level at 1m distance	Noise level at 50m distance	Noise level at 100m
1	Trailer	78	59.3	56
2	Roller	73	54.3	51
3	15 ton Truck	88	69.3	66
4	Rod vibrator	87.7	69	65.7
5	Paving machine	86.5	67.8	64.5
6	Watering truck	57.7	39	35.7
7	2HP Water pump	75.4	56.7	53.4
8	Concrete mixer	81.5	62.8	59.5
TCVN 3985-1999 QCVN 26-2010/BTNMT		*85*	*85*	*70*

Note : - TCVN 3985-1999 is noise pollution standard for manufacture area
- QCVN 26-2010/BTNMT is National Technical Regulation on Noise

Thus, noise arising from machineries, construction equipment is the main source affecting an area within 50m from the source.

Total noise level raising from all machineries and construction equipment is calculated as following:

$$L_\Sigma = 10 \lg \sum_1^n 10^{0,1Li}, \text{ dBA}$$

L_Σ - Noise level at the calculation time, dBA.

L_i–Noise level at the callculation of noise source no. I, dBA.

From the formula above, the total noise level generating from all machineries and construction equipment within the radius of 50m and 100m are calculated in Table 3.15.

Table 3.15. Total noise level from construction vehicles(dBA)

No	Construction machineries	Noise level at 1m distance	Noise level at 50m distance	Noise level at 100m
1	Trailer	78	73.8	70.5
2	Roller	73		
3	15-tons truck	88		
4	Rod vibrator	87.7		
5	Paving machine	86.5		
6	Watering truck	57.7		
7	2HP Water pump	75.4		
8	Concrete mixer	81.5		
TCVN 3985-1999		*85*		
QCVN 26-2010/BTNMT			*70*	*70*

Ghi chú : - TCVN 3985-1999 là Tiêu chuẩn tiếng ồn đối với khu vực sản xuất.
- QCVN 26-2010/BTNMT là Quy chuẩn kỹ thuật quốc giá về tiếng ồn

The calculation results show that, the total noise level generated from all raw material transport vehicle and construction machine and equipment in subproject area is more than the permitted standard for construction and residential area at distance of more than 50 m, as regulated by QCVN 26-2010/BTNMT.

The Tables 3.16 and 3.17 below list the areas which can be impacted by the noise, dust, and gas pollutants:

Table 3.16. The special objects effected by noise, dust and gas pollutant

Stt	Affected object	Construction activities
1	Household along Xuan Thuy street	Construction of Phu Hoa canal
2	Household along Vo Van Dung road to Bau Sen lake	Construction of Bau Sen lake upstream ditch
3	Household along Tran Hung Dao street	Construction of stormwater drainage sewers
4	Household along Bach Dang street	Construction of stormwater drainage sewers
5	Staff and workers in wastewater treatment plant, landfill	Extension of Long My landfill, capacity increase of Nhon Binh wastewater treatment plant

In the daytime, this area would be affected by noise pollution due its close proximity to the construction area. In the night-time, if construction activities occur in this area, all the noise level would be more than permitted standards.

Table 3.17. Special objects impacted by noise pollution

Stt	Subjects affected	Construction items
1	Nguyen Hue pagoda	Construction of Phu Hoa canal
2	Tay Ninh castle, Ngoc Nhon monastic	Construction of sewer in Tran Hung Dao street
3	Semi-public kindergarten Phong Lan, primary school Tran Quoc Toan	Construction of sewers in Tran Hung Dao street
4	Railway	Construction at Hoc Ba Bep area
5	Truc Lam pagoda	Construction of sewers in Tran Quoc Toan street
6	Dam market at intersection Pham Hong Thai – Hoang Quoc Viet	Construction of sewers in Bach Dang street (at distance of 100 m)
7	Sen Hong kindergarten	Construction of sewers in Bach Dang street

The special receptors (Table 3.17) located within the radius of 50 m from noise source would be affected during the day time, however, the construction activities of wastewater and stormwater drainage culvert system on Phu Hoa canal, upstream ditch of Bau Sen lake, Tran Hung Dao, Bach Dang road and Hoc Ba Bep area do not require heavy construction machineries, which are mentioned in the Figure 3.16 so impacts of noise to the those special receptors are neglilible. For the schools, the construction of toilet would occur in the school area, and thus the noise would affect school children. The level of impact is assessed as medium.

c. Impacts caused by vibration

The construction activities may cause vibration as a result of operation of the construction machines and equipment. The construction of sewers, canal, and ditches in the city would not require heavy construction machine and equipment. Therefore, the impacts caused by vibration would be insignificant. The area of Long My landfill and Nhon Binh WWTP are located far away from the residential areas, thus if vibration appears during the construction process, its impacts would be at medium level for the workers at the sites but would be small for the residential areas. Besides, according to site survey, assessment and data analysis if the vibration occurs during construction of the new cell A-4, it would not cause negative impacts to the leachate waterproof lining HDPE of the existing cells in Long My landfill.

d. Odor pollution

Offensive odors would appear mainly from construction and improvement of stormwater drainage sytems and wastewater collection sewers. Offensive odors would last for long time if cut sewers are not covered quickly. This impact is only localized, temporary, and stopped right after the sewers are covered and completed.

Nuisance odors would affect the households when constructing the Phu Hoa canal, Bau Sen lake upstream ditch because these channels are highly polluted, always produce very unpleasant odor. Dredging the ditch and opening the channel lids at Bau Sen lake site would cause odor diffusion and impact to the households living in the area.

At Long My landfill area, the offensive odor from operation the landfill would impact directly the workers in the construction area. The typical gases making odors at the landfill are H_2S, CH_4, CO_2, hydrocarbons. The level of impact is assessed as moderate.

A. 3.2.2.2. Impacts on the Water Environment

a. Impacts caused by domestic wastewater

The total number of workers expected for all construction sites would be about 390 workers (Table 3.18). However, they will work at 9 construction sites under Component 1 with the largest number of workers anticipated to be allocated at the Long My landfill site. During excavation and ground leveling, the sources of wastewater would mainly be domestic wastewater of workers operating bulldozers, excavators, and trucks. Because workers would not stay at the site, the amount of water actually used at the construction sites would not be much, around 20-25 liters/person estimatedly. The flow of domestic wastewater and the load of pollutants released daily to the environment by one person (without treatment) would be as indicated in Table 3.18:

Table 3.18. The mass of generated domestic waste and wastewater

No	Item	Number of worker (person)	Wastewater (m3/day)
1	Long My landfill	100	2.5
2	Wastewater treatment plant	40	1
3	Phu Hoa canal	40	1
4	Bau Sen Lake upstream channel	40	1

No	Item	Number of worker (person)	Wastewater (m3/day)
5	Tran Hung Dao sewer	40	1
7	Bach Dang road	40	1
8	Tertiary sewerage system	80	2
9	Leachate pump station	10	0.25
Total		390	9.75

Table 3.19. Pollutants load in domestic wastewater

Load for one person

Pollutants	Mass (g/ person/ day)
BOD_5	45 – 54
COD	72 - 102
SS	70 - 145
∑N	6 - 12
∑P	0,8 - 4,0
Coliform	10^6 – 10^9 MPN/100ml

The total volume of domestic wastewater generated would be about 9:25 m^3/day. Domestic wastewater would affect aesthetics of the site, pollution of land, water, atmosphere, and create favorable conditions for the development of pathogenic vectors. These factors would adversely affect the health of the communities and workers. The construction time for each work item is expected round 3-14 quarters, the total volume of wastewater generated at all the construction sites is between 22.5 m^3 – 1,260 m^3 for the whole construction period. Wastewater mainly contains impurities, suspended solids (SS), organic matters (BOD/COD), nutrients (N, P), and micro-organisms. Therefore, this amount of wastewater should be treated before being discharged into the receiving water. The impact of pollution arising from waste water in the process of construction of items are expected medium level.

b. Impacts caused by stormwater runoff

Stormwater runs off solid surfaces such as roads in construction areas and collects pollutants such as sediments, sands, trashes, oil and grease, and bacteria, and then deposits them into ponds, channels, and rivers in the area. If the stormwater runoff is poorly managed, it would cause negative impacts to nearby areas, especially to the aquatic environment. According to the statistical data of World Health Organization (WHO), the concentrations of pollutants in stormwater runoff range from 0.5 – 1 mgN/l; 0.004 – 0.03 mgP/l; 10 – 20 mgCOD/l and 10 – 20 mgTSS/l. The runoff flow over the catchment is calculated by intensity limits:

$$Q = q.F.\varphi = 0,1/3600 m/s \times F \times \varphi$$

Where :

Q – rate of runoff m^3/s

q - rainfall intensity (l/s.ha)

F – catchment area (m^2)

φ - runoff coefficient, estimate to be 0.7 averagely

Rainfall intensity is determined by formula:

$$q = \frac{(20+b)^n . q_{20}(1 + C \lg P)}{(t+b)^n}$$

Where:

q – rainfall intensity, l/s.ha

p – return period (p = 1 year)

q_{20}, b, c, n – parameters depend on local meteorological conditions of subproject area, for Binh Dinh Province, (q_{20}=156,4 l/s.ha, b=12,9, c=0,2738, n=0,8768);

t – time of concentration (minutes): $t = t_0 + t_1 + t_2$

t_0 - overland flow time for runoff to reach pavement channels: t_0 = (5 – 10) minutes

t_1 – runoff flow time in pavement channels (minutes): $t_1 = 0.021 \times (l_1/v_1)$

l_1 – length of pavement channels (m)

v_1 – runoff velocity at the end of pavement channels (m/s)

t_2 – runoff time in sewer (minutes) $t_2 = 0{,}017 \times \Sigma(l_3/v_3)$

l_3 – length of designed sewer (m)

v_3 – equivalent velocity of runoff in sewer (m/s)

The first stormwater flush often contains high load of pollutants accumulated in surface such as oil and grease, dust etc. from dry days. The mass of accumulated pollutants in the period of time is determined as following:

$$G = M_{max} [1 - \exp(-k_z.T)]. F, \text{kg}$$

Where:

Mmax – Maximum mass of accumulated dust, Mmax = 220 kg/ha

k_z - Kinetic coefficient of accumulated pollutants, k_z = 0,3ng^{-1}
T – pollutant accumulation time, T = 15 days

F – Stormwater drainage catchment area, ha.

$$G = 220 [1 - \exp(-0{,}3 \times 15)]. F$$

Table 3.20. Pollutant from surface runoff during excavating, backfilling and levelling

No.	Parameter	Unit	Phu Hoa canal	Bau Sen Lake upstream dtich	Tran Hung Dao Sewer	Bach Dang road	Tertiary sewerage system	Nhon Binh WWTP	Long My landfill
1	Rainfall intensity(q)	m/s	0.1/3600	0.1/3600	0.1/3600	0.1/3600	0.1/3600	0.1/3600	0.1/3600
2	Catchment area (F)	m^2	7865	4680	17480	1950	57708	128000	85100
3	Runoff coefficient(φ)	-	0.7	0.7	0.7	0.7	0.7	0.7	0.7
4	Rate of runoff (Q)	m^3/s	0.153	0.091	0.34	0.038	1.122	2.489	1.655
5	Maximum mass of	kg/ha	220	220	220	220	220	220	220

	dust(Mmax)								
6	Accumulation coefficient (k_z)	ng^{-1}	0.3	0.3	0.3	0.3	0.3	0.3	0.3
7	Accumulation time (T)	ngày	15	15	15	15	15	15	15
8	Stormwater drainage area	ha	0.79	0.47	1.75	0.2	5.77	12.8	8.51
9	Waste mass (G)	kg	**171.9**	**102.3**	**380.7**	**43.5**	**1255.3**	**2784.7**	**1851.4**

Table 3.20 shows that the accumulated pollutants in about 15 days on the road sections during excavating, backfilling and levelling is quite high, the amount of contaminants from stormwater runoff containning suspended solid would affected the receiving water. For the construction area of Phu Hoa canal, Bach Dang street, and the construction areas for tertiary culverts, the runoff can carry with it contaminants to flow down the canal, causing pollution and stagnant status on the drainage sewers. For the Nhon Binh WWTP, the possibility of accumulated contaminants would likely be sediments causing sedimentation on the site and the receiving water bodies. Regarding the A-4 cell at Long My landfill, the runoff with contaminants can flow down stormwater drainage system obstructing the drainage system in Long My landfill. The level of impact is anticipated to be medium.

A. 3.2.2.3. Impacts caused by Solid Wastes

Solid waste generated during site clearance

Solid wastes generated in this stage are mainly trees, wood and other materials (rubbish, plastic bags, plastic etc.). Materials such as purlins, bamboos, wood, corrugated iron would be collected by people for reusing. Therefore, the ground preparation does not generate solid waste. The expandsion activities of Nhon Binh WWTP would generate solid wastes due to the removal of a part of the barbed wire fence around existing Nhon Binh WWTP.

The vegetation biomass cleared at the new cell in Long My landfill site is about 19,6,937 tons based on the forestry land clearance area of 196,937 m^2 (with estimated biomass of 0.1 ton/m^2). The volume of vegetation biomass is concentrated in a area of 20 hectares and mainly are grass, therefore, the impact level is assessed to be low.

During construction:

Domestic solid waste

Domestic solid waste is generated mainly by workers at the construction sites. It is estimated that about 390 workers will be mobilized to works on all the construction sites. It is commonly accepted that domestic solid waste generated by a person is about 0.5 kg/person/day. Therefore, the amount of domestic solid waste can be calculated in Table 3.21 below.

Table 3.21. The volume of generated solid waste

No.	Item	Number of workers (person)	Solid waste (kg/day)
1	Long My Landfill	100	50
2	Nhon Binh WWTP	40	20
3	Phu Hoa canal	40	20
4	Bau Sen lake upstream channel	40	20
5	Tran Hung Dao sewer	40	20
6	Bach Dang road	40	20

No.	Item	Number of workers (person)	Solid waste (kg/day)
7	Tertiary sewerage system	80	40
8	Leachate pump station	10	5
Total		390	195

Since the local people would be hired, fewer workers would stay on the site resulting in a smaller amount of household wastes renerated which would account for only about 1/5 of the estimated volume (approximately 40kg/day). This means that only about 1-8kg/day of domestic solid waste would be generated for each construction site. With construction time from 3 to 14 quarters, the amount of solid waste would be around from 90kg to 5 tons on each site for the whole construction period. Without proper management, such amounts of domestic waste would become a pollutant source, giving rise to bad smells and pathogenic factors from microorganisms. Therefore, it should be contracted with the functional units to collect and transport the solid waste to Long My landfill. The impacts due to solid waste are assessed as medium.

Soil/mud waste from the excavation and backfilling

Solid waste arising from excavating and levelling activities will mainly be excessive soil. Because mechanical properties of this type of soil is relatively good, it can be used for backfilling and gound levelling of the subproject sites. For the soil that is not suitable for subproject activity would be disposed at appropriate areas to avoid negative impacts to the environments.

Table 3.22. Amount of solid waste at each construction site

No.	Item	Waste volume (m^3)
1	Phu Hoa canal	21,916
2	Bau Sen upstream ditch	1,592
3	Tran Hung Dao road Sewer	24,095
4	Bach Dang road Sewer	3,962
5	Tertiary sewerage system	895
6	Nhon Binh wastewater treatment plant	10,560
7	Long My landfill	87,957

The analysis result of soil sample, indicated in Chapter 2, Section 2.1.4.5 on Soil and Sediment Quality, shows that the concentrations of heavy metals in sample B6: Soil sample at Long My landfill, Thanh Long village, Phuoc My commune are within allowable limits of QCVN 03-MT:2015/BTNMT. Thus, the 87,957 m^3 of excavated soil at Long My landfill can be reused as coating materials at the landfill or stored at the disposal site. The A-5 cell can be used as a storage area for the excavated soil during excavation of the A-4 cell. According to detail design, the thickness of each covering ground layer for each garbage layer is 20cm, accounting for 7% (59,570m^3) of disposal cell volume, the entire excavated soil left would be used for the embankment of the A-4 cell and coverage of the on-going cell A-3. The impact level of excavated soil is assessed to be low.

Similar to the analysis result of soil sample in Long My landfill, the soil samples from construction of Phu Hoa canal, upstream ditch of Bau Sen lake, sewers, Nhon Binh WWTP, indicated in Chapter 2, Section 2.1.4.5 on Soil and Sediment Quality. The concentrations of heavy metals in those samples are within allowable limits of QCVN 03-MT:2015/BTNMT. The volume of excavated soil from the construction of canals, ditches, sewers, WWTP are around 63,0202 m^3, approximately 50% of which can be reused for embankment and ground levelling. The remaining amount would be transported to a disposal sites at the end of Dien Bien Phu street for the purpose of urban tree plantation and surrouding the WWTP. It is necessary for the contractor to have plan for disposal of the excavated soil in accordance with law and should incorporated into the bidding document. The impact level is assessed to be low.

Construction waste

Construction waste from the construction process would include cement bags, residual iron bars and steel scraps, wood chips, empty cartons and boxes, etc. Without proper collection and recycling, these would have negative on the environment and be wasteful. This type of waste is composed of inert and non-toxic substances, some of which can be recycled or re-used for other purposes. The amount of waste is as follows:

	Long My land fill	Phu Hoa cannal	Upstream ditch of Bau Sen lake	Sewer on Tran Hung Dao road	Sewer on Bach Dang road
Construction waste (m^3/day)	6.75	1.4	0.85	3.19	0.36

Level of impact is from low to medium.

A. 3.2.2.4. Hazardous Waste

Oil and grease is classified as hazardous waste according to hazardous waste management regulations. The amount of oil and grease waste generated during construction is based on the following factors: i) The number of construction equipment and vehicle on the site; ii) The amount of oil/grease discharged from the construction equipment and vehicles; and iii) The schedule of oil change and equipment/machine maintenance.

The average amount of grease and oil discharged from machinery and equipment is 7 liters/each change. Oil change and maintenance of machines-equipment are scheduled every 3 months at maximum. The number of vehicles and construction means needing oil changes and mainly used in the subproject is 45 vehicle (including 14 trucks and 35 construction vehicle). So the average amount of waste oil generated on site is: (45 vehicles x 7 liters/time. Vehicle) / 3 months = 105 liters of oil per month.

In addition to that, it is also expected to generate waste grease rags and grease containers during contruction. Without appropriate management, these types of construction waste would have negative impacts on the soil, water, and air environment; residual grease and oil in containers can penetrate into the ground, causing soil pollution.

The impact level is assessed to be medium.

A. 3.2.2.5. Impact on Aquatic and Terrestrial Ecosystem

Impacts on aquatic species:

There is no aquatic ecosystem within the area of influence of Component 1. Based on the assessments, site survey of Chapter 2, Section 2.3.9. on environmental and social conditions in Some of the subproject areas show that Phu Hoa cannal and Bau Sen lake areas are seriously polluted by local people’s littering activities. The Phu Hoa canal and Bau Sen lake ditch serve as open wastewater conduits in the area in which water is heavily polluted by domestic wastewater; therefore natural aquatic ecosystem is non-existent. Thus, the construction would not affect any aquatic ecosystem.

Impacts on terrestrial flora and fauna:

Long My landfill area: There has the existence of Mimosa Pigra in Long My landfill, a strongly invasive species, affecting the habitat of plants and some animals, thus, after cut down, they must be collected and burned to avoid the rebirth of this harmful plant. In regard with animals there is the appearance of some species of birds, crows. Therefore, during construction time, contractors and landfill management units should pay attention to the workers' behaviors, prohibit any hunting actions, purchasing or selling the animals in the area.

Area of the WWTP: The expansion of the plant will be carried out within the boundary of the existing plant and would impact on a small number of trees, bushes, crops, and paddy rice fields. There area has no native flora and fauna of value. Therefore, construction activities would be expected to have insignificant impacts on the terrestrial flora and fauna in the area.

The areas for the construction of the drainage system are mainly urban land, and hence, construction activities would not have any impact on the flora and fauna in these areas.

Important natural habitats: There are critical natural habitats in Quy Nhon such as An Toan Natural Reserve Zone (An Toan commune, An Lao district), Nui Ba landscape protection zone (Phu Cat district); Vuon Cam Nguyen Hue landscape protection zone (Vinh Son commune, Vinh Thanh district) which are located within 30-90km from the subproject area; therefore, they should not be affected by the activities of the subproject. Quy Hoa landscape protection zone - Ghenh Rang (Ghenh Rang Ward, Quy Nhon City) at about 10km far from the subproject area is no longer a natural forest. The current land use in this area includes 1,527 ha of plantations, 2,574 ha of vacant land, 207 ha of agricultural land, and 186 ha of land used for other purposes and no natural habitats, virtually having no value on biodiversity. Hence, there would be no effect on the critical natural habitats and other non-critical natural habitats.

A. 3.2.2.6. Impacts on Urban Aesthetics and Landscape

Construction activities would require soil excavation, road excavation, and the setting up of the fences for the sewer construction sites on Tran Hung Dao road, Bach Dang road, Hoc Ba Bep area, Phú Hòa canal, and upstream canal of Bau Sen lake. These would temporarily change the landscapes and affect urban beauty of Quy Nhon city.

Long My landfill area is about 15-20km from the inner city, and construction of the A-4 cell will take place within the existing landfill, and thus would not affect the urban aesthetics and landscape.

The level of impact is low.

A. 3.2.2.7. Impacts on Water Quality

Long My landfill area: During construction the runoff water can overflow the area bringing with it suspended solids, domestic and construction wastes, and hazardous wastes from the construction site to drainage system of the landfill to the receiving area, leading to the increase in the quantity of suspended solids in the receiving area. However, these is no natural water bodies in the landfill area, and thus no impacts on water quality is expected.

Other Component 1 construction sites: The domestic wastwater contain organic pollutant (BOD, COD) and construction wastewater discharged directly to Phu Hoa canal\and Bau Sen lakeand the other receiving waters without treatment, would affect water quality at those waterbodies.

Overall, the level of impact on water quality of construction of component 1 is medium level.

A. 3.2.2.8. Impacts of Flooding on Construction Sites

During the construction of the drainage system, localized flood may occur, especially when there are heavy rains, due to the lack of measures to divert the flows and washout of materials from the construction sites into the drainage system. Given the nature and scale of the construction, this effect would be temporary.

Hoc Ba Bep construction area is low lying area which is likely to be flooded during heavy rains. Heavy rains can also flush the solid waste, construction waste into the existing channels, ditches and channels which are being stagnant reducing the drainage capacity of Phu Hoa channel, Bau Sen upstream channel, sewer on Tran Hung Dao, Bach Dang street. These drainage canals are also the main drainage system of the city. Therefore, the construction can affect the drainage capacity of the channels, probably causing temporary flooding problem, particularly during heavy rains.

In the construction area of, Long My landfill, there is needs to excavate inside of landfill plots deeply, leading to the possibility of stormwater stagnancy.

Overall the level of impact would be moderate.

A. 3.2.2.9. Traffic Disturbances and Traffic Safety

Traffic safety can be violated by the following reasons: (1) Traffic jams caused by construction activities; (2) Unsafe means and methods of construction on and near the traffic, (3) Operation of mechanical vehicles at the subproject site during construction; (4) Traffic jams at the intersections; (5) Lack of facilities, signboards, signal lights instructing transportation.
As estimated, during the construction in the urban area, an increase in the total vehicle trips transporting construction materials and wastes is estimated at 126 trips/day on average. The increased traffic would raise the risk of traffic accidents and traffic jams in city center areas.

Along Tran Hung Dao and Bach Dang road, the population and traffic are quite crowded, and thus there would be potential substantial risks of accidents by the contruction vehicles and construction activities. These adverse impacts may include traffic jams and traffic accidents for travelers and workers. During the construction of the drainage sewer systems, management of traffic safety needs to be taken by the contractors and the subproject owner.

Construction of twin box culvert on Phu Hoa canal: The material, equipment and waste transporation route is Road no.24. The width of this route is about 10m, and there is a sensitive location, the Dong Hai Mechanical L.t.d located near Road no.24.

Construction of freestone ditch at upstream ditch of Bau Sen lake: The material, equipment and waste transporation route is Nguyen Thai Hoc road. The population and traffic on this route are quite crowded. The sensitive reseptors are households living along this route.

Expansion of Nhon Binh WWTP; stormwater drainage system on Tran Hung Dao road and Hoc Ba Bep area: The material, equipment and waste transporation route for the 3 construction works is Tran Hung Dao road. The sensitive locations on Tran Hung Dao route are Phong Lan kindergarten, Dong Da secondary school , Quy Nhon Twin Towers, Tay Ninh church and Ngoc Nhon temple.

Stormwater drainage system on Bach Dang road: The material, equipment and waste transporation route is Bach Dang road. The sensitive loction on Bach Dang route is Truc Lam pagoda, Sen Hong kindergarden and Dam market area.

The construction of new A-4 cell at the Long My landfill: would not significantly affect the traffic because this area is located quite far from the city (15 km), and the construction will take place within the landfill area. This increase in vehicle volume only affects local traffic in Long My landfill area which is very light. The material, equipment and waste transporation route for construction of new A-4 cell in Long My landfill is the existing road entering to Long My landfill (turning from NH 1A).

Railway traffic safety in Hoc Ba Bep area: The Hoc Ba Bep areas are narrow alleys, the stormwater drainage lines to be constructed would cut across the railway line where the trains run every day. The potential negative impacts may include interference with the train schedules, unsafety for the trains due to inappropriate construction methods, and risks of train accidents for the workers. Therefore, attention should be paid to the issue of traffic safety, and safety measures should be implemented to avoid the risk of railway traffic accidents. Construction of the sewer underpassing the railway would be carried out using tunneling method in oder to limit the area of excavation and to minimize the negative impacts to railway. The potential impacts could be significant.

General assessment of road traffic safety: The streets and roads in the Quy Nhon City center are often narrow, therefore, the construction would need to be carried out on the carriage way, significantly narrowing the width of the travel lane, causing potential traffic jams and traffic accidents to travellers. The significance of the potential impact can be assessed as moderate.

The areas with the traffic and traffic safety that would be potentially significantly affected during the construction of Component 1 are indicated in Table 3.23 below:

Table 3.23.Main subjects affected in traffic

Stt	Subjects affected	Transportation route	Construction items
1	Xuan Thuy, Tran Quang Khanh, To Hieu, Vo Duy Duong and No.24 road	No.24	Phu Hoa canal construction
2	Area on Tran Thi Ky, Nguyen Thai Hoc, and Nguyen Tat Thanh road	Nguyen Thai hoc	Bau Sen upstream ditch construction
3	Tran Hung Dao road	Tran Hung Dao	Construction of storm water drainage line on Tran Hung Dao road
4	Bach Dang, Hoang Hoa Tham, Pham Hong Thai, Phan Dinh Phung road	Bach Dang	Construction of storm water drainage line on Tran Hung Dao road
5	Railway	Tran Hung Dao	Construction of Hoc Ba Bep drainage system which has 03 intersections with railways

A. 3.2.2.10. Social Impacts Related to Construction Activities

Impacts on community relations and social structure

The concentration of the workforce in the locality during the construction stage at Quy Nhon city (about 100 people at the Long My landfill, 40 at the WWTP, 40 people at Phu Hoa canal, upstream ditch of Bau Son lake, Tran Hung Dao sewer, Bach Dang sewer, 10 people at pumping stations, 80 people at the tertiary sewer lines) would increase the risks and give rise to the issues related to security, social evils, diseases and epidemics, as well as other social problems such as prostitution and drug use.

Besides, temporary utilization of the residents' land to store materials, or the inconvenience of dust and exhaust gases generated during the construction in living areas (construction of tertiary sewers, Bau Sen upstream channel range, sewer section of Tran Hung Dao, Bach Dang Street) can lead to conflicts arising between construction workers and local residents.

The level of impact is medium.

Impacts on household properties

Transportion of construction materials and wastes and construction activities can also pose the risk of accidents or damages to the local people' properties. Aciticities of the digging to install the big-size-stormwater sewers on Tran Hung Dao road may cause cracking, vibration and subsidence to the people's housing. However, this impact is only temporary and in medium level, during construction phase, the contractors would negotiate with the people about the rented land area for garthering construction material or building approaching routes purposes. At the end of the construction process, road works must be reverted as before, any damage to residents' properties would have to negotiated and adequately compensated in order to avoid conflicts arising with the residents. The households living near or along Tran Hung Dao road could be affected by this impact.

Impacts on household's income

The along Tran Hung Dao, Bach Dang, 1A, Xuan Thuy streets, where construction activities will be implemented, there are many small businesses and restaurants. The construction activities may limit customer access to these businesses. In addition, dust and exhaust gases may hinder service business activities because the customers would choose a cleaner place to eat instead of dirty one, leading to reduction in customer visit affecting income of these businesses. The impact level is assessed to be medium.

However, to minimize and reduce the impact, the local investor would closely cooperate with the authorities to assess the impact level to have the appropriate support. In addition, during the construction, contractors should have to plan and organize the construction to ensure minimizing the impact to these affected households. The implementation of compensation and assistance in consistency with the policies stated in the RAP, to ensure the business and livelihood situation of affected households is not worsen.

A. 3.2.2.11. Risks on Health and Safety for Workers and Community

a) Health and safety risks to communities

During the site clearance:

Site clearance can generate the risk of accidents to local people as well as workers. However, there would not need to carry out the site clearance at construction areas such as Phu Hoa canal, upstream ditch of Bau Sen lake, Bach Dang, Tran Hung Dao road, Hoc Ba Bep area and Long My landfill. For the expansion of Nhon Binh WWTP, a part of barbed wire fence of the existing Nhon Binh WWTP would be demolished for the construction of new module. Therefore, impacts on the communities is assessed as low.

During construction phase:

During the construction stage, with more workers (about 100 workers at the Long My landfill, 40 at the WWTP, 40 at Phu Hoa canal, upstream ditch of Bau Son lake, Tran Hung Dao sewer, Bach Dang sewer, 10 at pumping stations, and 80 at the tertiary sewer lines) and free migrants participating in construction or other services, the local health centers may face with more difficulties in diagnosing and treating diseases and providing healthcare for the communities in case of arising diseases and epidemics.

Due to the narrow room of construction area in Bau Sen, Hoc Ba Bep, the odor, noise, dust may affect to the local people. Other health risks to the communities may be traffic accident, source of infection arising from wastewater, solid and construction waste during construction. However, these impact would be localized and temporary. As such, the level of impact is medium.

b) Health and safety risks to workers

Dredging of Phu Hoa channel, Bau Sen lake's upstream ditch, and construction of the Long My landfill expansion would expose the workers to offensive odors that may affect worker health. In addition, workers would be affected by dust, noise, exhaust gases at the construction site. They may also get sick because of unsafe living conditions, unsafe food, and inappropriate personal protective equipment (PPE). The level of impact is at low to medium.

A. 3.2.2.12. Impacts on Existing Infrastructure

Road infrastructure: To construct the stormwater and wastewater sewers, tertiary sewer, many routes such as Tran Hung Dao, Bach Dang road, internal traffic routes in wards would be dug or affected by activities of gathering, transporting the construction materials and wastes. In addition, the transportation of raw materials can also damage the roads. However, given the scale of the civil works, this impact could be assessed as low to moderate.

Water supply system: The current water pipelines mainly go along the sidewalk on the roads. Therefore, construction of drainage system may affect water supply infrastructure in the area.

Power infrastructure: The area which is along the Phu Hoa channel has some high voltage power lines, therefore, there is a risk in which construction machineries such as excavators, cranes can cause wire cut or damages to power poles affecting the power supply and causing electricity safety risks.

The impacts affecting the existing infrastructure during construction under Component 1 can be assessed medium.

A. 3.2.2.13. Impacts on Physical Cultural Resources

The construction activities under Component 1 would not infringe upon the physical cultural resources (PCRs) in the area such as Nguyen Hue pagoda near Xuan Thuy street, Truc Lam pagoda near Bach Dang street, and the Twin tower near Tran Hung Dao street. However, the construction activities may cause some negative impacts on their visitors and religuos events, including dust, noise, exhaust gases, wastes, and community safety. Beside, the construction of the big-size stormwater drainage culvert lines on Tran Hung Dao road may cause risk of subsidence because geological condition of this area is weak. These PCRs' detailed location, distance to the construction sites, and associated site-specific impacts are described in Table 3.50. The level of impact on the PCRs is moderate.

A. 3.2.3. Operation Phase

A. 3.2.3.1. Nhon Binh Wastewater Treatment Plant

Positive impacts: In general, operation of Nhon Binh WWTP will have a positive environmental impact on the city and the immediate residential areas. It is expected to produce a long-term improvement in public health of the city's dwellers of Quy Nhon as well as to significantly reduce a source of chronic water pollution. Specifically, the plant will help improve quality of surface water in Ha Thanh river and subsequently improving water quality in Thi Nai lagoon, reclaim the cultivated land using sludge from the plant if it is satisfied the requirements of the standard of sludge quality, and provide job opportunities for the local people. Specific impacts that are anticipated or forecasted for the WWTP including the expansion modul are discussed in greater detail below.

Odors and Air Pollution

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. odors are likely to adversely affect the health of operators. Those units which possibly generate odors include the screener, the anaerobic tank, and oxidation ditch. Main source of odor of these units are wastewater, sludge, floating on the surface, biofilm, chemicals. Most of the odor-causing compounds in wastewater and wasted from biological anaerobic process are organic matter, sulfur and nitrogen.

The experience from the first phase of Nhon Binh WWTP under the CCESP indicates that the offensive odors are mainly generated from the two preliminary sedimentation tanks. Drawing on this lesson the two Imhoff sedimentation tanks will be used for the expansion module of the plant instead of the two preliminary sedimentation tanks. A separate odor treatment facility, the Stripping tower, will also be constructed for treating odors of the existing plant and its expansion module. Therefore, any odors that are produced by the proposed expansion of the WWTP and the existing plant are likely to be significantly reduced. There are few households living within 200m of the palnt, but they have been compensated and will be resettled in a new resettlement area. The other households are located within 500m radius of the plant and within the prevailing northwesterly winds. Therefore, they will be affected by the odors.

Sludge from the aerobic lagoons will be removed in every 2-3 years, spread in sludge drying lagoons, and allowed to drain in the sun. There is a potentially small odor problem from this operation, because the sludge will be stabilized by natural processes in the aerobic lagoons. However, the site's relatively isolated location should further reduce the low probability of adverse impact on the local population. Once the sludge is dry, it is relatively inert and odorless.

Overall, the impact by odors is anticipated to be medium.

Air emissions from wastewater treatment operations may include hydrogen sulfide, methane, gaseous or volatile chemicals used for disinfection processes (e.g., chlorine), and bioaerosols. Given the scale of the WWTP, this impact is localized and minor.

Infiltration to soils, groundwater and water supply

Impacts on groundwater only happen in facultative ponds. In case these ponds are not bottom-lined, sewage with high organic and micro organic concentration will penetrate into soil and causing pollution to the groundwater. Event though, groundwater in this area is not use for agriculture and cannot be used for domestic use due to salinity intrusion, the discharge of organic substance into this water resources will cause a long term impacts upon the water resources in the area, especially to the areas having complicated changes in term of hydrogeology. The provision of proper wastewater treatment facilities will reduce or eliminate any significant potential for infiltration of sewage into the soil and groundwater. Therefore, a potential adverse impact due to infiltration is anticipated and assessed as moderate.

The impacts of noise

WWTPs may cause elevated noise levels. This may be a nuisance for workers and for residents in the close vicinity. During the operation of the WWTP, noise is mainly associated with pumps, stirrers, aration machines and transportation vehicles going in and out the plant. The levels of noise calculated for the WWTP are specified in the Table 3.24 below.

Table 3.24.Noise levels from the operation of wastewater treatment plant spread around (dBA)

No.	Equipment	Noise level 1.5m from equipment	Noise level 40m from equipment	Noise level 100m 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
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-existant. However, this noise will have the negative long term impact on the workers working at the plant. The significance of the impacts can be assessed as low.

Impacts of domestic wastewater

Domestic wastewater may generate from the staff and workers who are operating in the wastewater treatment plant. In the WWTP, there are about 15 workers and they may use about 100 liter/person/day. Wastewater accounts for 80 % of the supplied water. The amount of domestic wastewater from these workers will be 1,6 m^3/day. In general, the amount of domestic wastewater is small and within the location of WWTP. As such, its impacts is low.

Impacts of stormwater 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 2.8kg of different contaminants.

Because the surface area of the wastewater treatment plant is 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.

Impacts of domestic solid wastes

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. Therefore, the total amount of domestic solid waste would be about 7.5kg/day. This impact can be considred low.

Impacts of solid wastes and sludge of the WWTP

Solid wastes discharged from the treatment processes of the plant may include: Sand and wastes from sand sedimentation tanks; Garbage from the bar screens and fine screens; Sludge from the anaerobic sedimentation lake; and Biological sludge from final sedimentation tanks. The amount of solid waste generated during wastewater treatment and sludge treatment are provided in Table 3.25 below.

Table 3.25. The amount of solid waste generates from the wastewater treatment station

Location	Discharge factor	Nhon Binh waste water treatment plantQ_{1B} = 28,000 m^3/day-night
Sand sedimentation tanks	0,005 m^3/ 1.000 m^3	0.14 m^3/day
Screens/ Grids	50l / 1.000 m^3	1.4 m^3/day
Preliminary anaerobic sedimentation lake:		
- Rough garbage	+ Input SS concentration: 300 mg/l + Efficiency: 50%	4,200/day
- Aluminum and remaining polymer	17 g/m^3	476 kg/day
Sedimentation tanks	+ BOD_5 input: 150 mg/l + BOD_5 output: 30 mg/l +The production coefficient: 0,3 gVSS/gBOD_5.gSS + Ratio VSS:SS = 0,8	1260 kg/day
The amount of sludge dredging from the anaerobic sedimentation after 2-3 years		
- Dry sludge	20 tons/1.000.000 m^3wastewater	408 tons
- Wet sludge	Humidity: 40%	1020 tons

The solid wastes separated from the screens and grids are relatively large size and non-hazardous. The quality of sludge could be referenced to that of the existing Nhon Binh WWTP because of the same treatment technology. Characteristics of sludge from the Nhon Binh WWTP in 2016 are presented in Table 2.6. The sludge as indicated in Table 2.6 does not contain heavy metals and other hazardous substances, and thus is considered a normal waste. Suitable sludge disposal sites will be need to be considered. Sanitary means of sludge disposal such as landfills will reduce adverse environmental impacts associated with the sludge. If the sludge disposal to agricultural uses or composting will be carried out, sludge quality will need to be monitored to ensure that human health is protected. The absence of significant quantities of heavy metals or toxic compounds in Nhon Binh WWTP's wastewater indicates that pathogens and nematodes will likely be the major health concern. The health impact is likely to be slight to non-existent if proper sludge stockpiling, handling and soil conditioning procedures are followed. All the solid wastes and sludge will be collected by Quy Nhon Urban Environmental Company and discharged at Long My landfill.

Impacts of hazardous wastes

Hazardous waste generated from the operation of the WWTP is mainly composed of filter material, waste oil, oily rags from maintenance, broken fluorescent light bulbs. Lubricant may arise from the preparation and maintenance of machinery and equipment. If the strict management measures for the collection and removal of waste are not applied, it can be potential pollution source for soil and groundwater. Chemical bags, which are used in treatment processes, have to be collected and stored under safety standards, and periodically disposed. The total amount of these hazardous wastes expetect to be generated a year is about 50kg. The total amount of chemicals using for wastewater treatment at Nhon Binh WWTP is about 162kg . This impact is assessed as moderate.

Impacts on the surface water environment

The ESIA of the CCESP for Nhon Binh WWTP has indicated that water quality of Ha Thanh river is being contaminated and getting close to the limit of column B1, QCVN 08-MT:2015/BTNMT. Besides, the population of Quy Nhon city has rapidly increased in recent year resulting the increase of domestic wastewater, creating more pressure on the water environment. Therefore the construction of one more unit to increase capacity from 14,000 m^3/day to 28,000 m^3/day is necessary. Collection and treatment of wastewater in the area would minimize significantly amount of pollutants discharged into the Ha Thanh river, and subsequently the Thi Nai lagoon. With an increase of treatment capacity to 28,000 m^3/day, the amount of BOD5, COD, Ammonia (N), Total nitrogen (T-N) and Total phosphorous (T-P) would be reduced 2.8 tons, 2.8 tons, 0.42 tons, 0.56 and 0.224 tons per day, respectively.

The Thi Nai lagoon is a wetland with intensive aquaculture and fisheries. It could be confirmed that the subproject will not have significant impacts on the sensitive ecological systems in Thi Nai lagoon because: i) When the plant is constructed, it will improve the quality of the water receiving bodies because the total contaminant loading will be decreased; ii) The ecological systems locate in the north of the lagoon which is upstream of the lagoon, 3 km far from the Ha Thanh river outfall; and iii) The assimilation capacity of the lagoon is very huge because of its large area (3,200ha at low tide and 5,000ha at high tide, which are about 32,000,000 m^3 at low tide and 60,000,000 m^3 at high tide). Provided the declined pollution loads from the current outlets of untreated wastewater from elsewhere in the catchment, to predict quality improvement of the lagoon water quality quantitatively, a regular monitoring of water quality in the lagoon would be needed. This impact would be largely positive.

Operational incidents

Emergency discharge from the WWTP:

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 discharege to Ha Thanh river, increasing levels of organic matter in river and Thi Nai lagoon; increasing algal development or eutrophication status of these water resources; increase harmful bacteria to aquatic life living in the river and lagoon, causing spread of cholera to the people living along the river. Therefore, this impact can be significant. 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 inoperation of the WWTP.
- 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. Based on the concentration of the pollutants in the wastewater of Qui Nhon city and the treatment capacity of the plant, the amount of pollutants to be discharged in to Ha Thanh river in emergencies is calculated in Table 3.26 based on the pollutant concentrations of the untreated waste water.

Table 3.26. The concentration of pollutants in untreated wastewater

Indicators	Unit	Quy Nhon city areas
BOD5	mg/l	150
TSS	mg/l	100
Tổng N	mg/l	60
Tổng P	mg/l	14

Table 3.27. Load of pollutants discharged into Ha Thanh river

Indicators	Unit	1 unit 14000m^3	2 units (28000 m^3)

BOD5	kg/day	2100	4200
TSS	kg/day	1400	2800
Tổng N	kg/day	840	1680
Tổng P	kg/day	196	382

To assess the risk of contamination by untreated wastewater on Ha Thanh 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 Ha Thanh river. (According to the guidance in 02/2009/TT-BTNMT 19/3/2009 regulatory assessment of wastewater receiving water).

Wastewater receiving capacity of the Ha Thanh 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 the table 3.28:

Table 3.28. Background environmental parameters to determine the capacity of receiving wastewater

Indicators	Unit	Quality of input wastewater (Ct)	Receiving source: Ha Thanh river (Cs, max)*	Prescribed standards limits	
				QCVN 08:2015 (B2)	Safety factor (Fs)
BOD_5	mg/l	150	6.9	25	0.4
COD	mg/l	250	39.2	50	0.4
TSS	mg/l	150	5	100	0.4
NH_4^+	mg/l	25	1.42	0.9	0.4
Fe	mg/l	2.2	0.64	2	0.4

Capacity of 1 unit of the wastewater treatment plant is 14,000 m³/day (0.16 m^3/s), 2 units is 28,000m^3/day (0.32 m^3/s).

The smallest flow of the receiving Ha Thanh river is Qs = 3.73 m^3/s.

a) The formula for calculating the maximum pollution load is:

$$L_{tđ} = (Q_s + Q_t) * C_{tc} * 86,4$$

Where:

- $L_{tđ}$ (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 3.29. Maximum pollutant load of water sources

Indicators	BOD_5	COD	TSS	Amoni	Fe
$L_{tđ}$ (kg/day) – 14000 m^3	8,402	16,805	33,610	303	672
$L_{tđ}$ (kg/day) – 28000 m^3	8,748	17,496	34,992	315	700

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 3.30. Calculating pollutant load in wastewater

Indicators	BOD_5	COD	TSS	Amoni	Fe
L_n (kg/day)	2224	12633	1611	458	206

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

The load of pollutants from the WWTP discharged into water sources will be as follows:

Table 3.31. Calculating pollutant load in wastewater

Indicators	BOD_5	COD	TSS	Amoni	Fe
L_t (kg/day)-14000m^3	2074	3456	1382	346	30
L_t (kg/day)-28000m^3	4147	6912	2765	691	61

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 3.32. Receiving capacity of the water sources

Indicators	BOD_5	COD	TSS	Amoni	Fe
Ltn (kg/day)-14000m^3	1,642	286	12,246	-200	174
Ltn (kg/day)-28000m^3	951	-820	12,246	-334	173

Therefore, if the incidents occur in 1 day, 14,000 m^3 of untreated wastewater (1 unit) would be discharged into Ha Thanh river. Ha Thanh river is still able to receive more wasterwater for parameters: BOD_5 , TSS, COD, Fe but not ammonium. In the case of 28,000 m^3 of untreated wastewater is discharged into Ha Thanh river, it is still capable of receiving for the parameters BOD_5, TSS, Fe but no more COD, ammonia. The receiving capacity of the Ha Thanh river over time is calculated as follows:

Table 3.33. Calculate the capacity of receiving wastewater of Ha Thanh River

Indicators	BOD_5	COD	TSS	Amoni	Fe
Ltn (kg/day)	1,642	286	12,246	-200	174
L_t (kg/day)	2,074	3,456	1,382	346	30
Incident (day)	0.8	0.1	8.9	-	5.8

Based on the data on the amount of pollutants from the wastewater discharged into Ha Thanh river, if the incident happen the number of days Ha Thanh river is still capable of receiving the pollutants will be 0.8 days for BOD5, 0.1 days for COD, 8.9 days for TSS, and 5.8 days for Fe.

Although the frequency of thes occurrences is very low. An emergency contingency plan needs ro be formulated to minimize its impact and facilitate subsequent management of the emergency. The significance of impact is assessed as medium.

The chemical leakage:

Common reasons causing chemical leakages in WWTP are: the barrel contains leaks due to defects in the cap or not-tight covering; carelessness in the transport, chemical spills when moving containers. The chemical leakage will affect directly to the workers by inhalation or dermatological adsorption. Thi impact could be moderate.

Explosion/Fire incidents:

In the WWTP, the causes of fire/explosion could be:

- Fire and inflammable materials in fuel storage, storehouses; pumps, air blowers, clogged pipes or continuous operation for a long time.
- Carelessness of staff and technicians such as smoking and cigarette ash.
- Open spaces in the storehouses is not designed improperly; electrical overloading.

Working accidents:

The probability of these risks depends on the awareness of workers on labor safety. 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; however the plant will also need a number of preventive measures of this problem.

A. 3.2.3.2. Long My Landfill

The domestic solid wastes to be disposed at Long My landfill are extremely variable in composition, including household refuses, institutional wastes, street sweepings, commercial wastes, as well as construction and demolition debris. They include paper and packaging materials; foodstuffs; vegetable matter such as yard debris; metal; rubber; textiles; and potentially hazardous materials such as batteries, electrical components, paint, bleach. They also contain varying amounts of wastes from small industries, as well as dead animals and fecal matter. Environmental impacts associated with operation of the landfill are described below.

Leachate:

The characteristics of leachate depends on various factors such as landfill age, climate, season, landfill moisture, level of dilution with stormwater and type of solid waste, etc. The level of waste compaction and thickness of cover material also affect leachate composition. During Long My landfill's operation, leachate is one of the main factors polluting surface water and groundwater environment because of its high content of organic matter such as BOD, phenol, nitrit, nitrat, photphorous, heavy metals, virus, pathogens, and other pollutants. The leachate of the existing landfill has BOD, COD, Ammonia (N), Total nitrogen and Total phosphorus concentrations of up to 612 mg/, 1252 mg/L, 252.4 mg/L, 382 mg/L and 41.8 mg/L, respectively. The leachate volume of Long My landfill is about 500 m^3/d. Therefore, in case that the leachate treatment plant has problems, untreated leachate from landfill would affect the raw water source quality of Bau Lac plant, indirectly cause pollution to other downstream catchments.

The technical design of subproject has already contained the facilities of leachate collection and treatment, after being preliminary treated, the leachate will be conveyed to Bau Lac wastewater treatment plant for further treatment to meet QCVN 14: 2008/BTNMT, thus the potential impact of leachate would be well-controlled. The level of impact is moderate.

The wastewater from washing of garbage truck before leaving the landfill:

In order to ensure the environmental sanitation, all garbage trucks are required to be washed before leaving the landfill to minimize dusts, soils and trash attached on the tires. This washing water contains solids (soil, sand), organic matter (trash pieces etc.) and many kind of microorganism from solid waste. There are averagely 300 garbage trucks coming in and leaving out the landfill per day. The water volume used for washing is 15 m^3/d. This amount of washing water is not much thus the environmental impact is insignificant. Treated washed washing water can be reused for landfill spray irrigation.

Surface runoff:

Leachate from waste piles caused by exposure to precipitation and from residual liquids in the waste itself may contain organic matter, nutrients, metals, salts, pathogens, and hazardous chemicals. If allowed to migrate, leachate can contaminate soil, surface water, and groundwater potentially causing additional impacts such as eutrophication and acidification of surface water and contamination of water supplies. The surface runoff is collected by concrete sewer with dimension of 800 mm (D800) then discharges to channel behind the landfill (the channel then discharges to Ha Thanh river). Therefore, impacts caused by surface runoff to local surface water in place is insignificant. The level of impact is medium.

Domestic wastewater:

With 10 persons including staff and operators of landfill, water supply for domestic usage currently is about 1 m^3/d. Domestic wastewater is about 0.8 m^3/d. The landfill has already constructed administration buildings with toilet and septic tanks, domestic wastewater would be well-controlled. Therefore, the impact would be insignificant.*Air pollutants from landfill:*

The cell of landfill can be considered as the bio-chemical reactors with main inputs are solid waste and water and main outputs are gases and leachate. The dumbed solid waste consists of biodegradable organic substances and other inorganic matters. Gases control system is used to avoid unintentionally spreading out of gases into the atmosphere and soil/stone layers. Gases from landfill can be reused to produce energy or burn under control to avoid air pollution.

The major gases produced from landfill during the decomposition of domestic organic waste and reactors are: H_2S, NH_3, SO_2, NO_2, CO etc, with CH_4 and CO_2 accounting for more than 90% of all the gases. Direct air emissions can include bioaerosols, particulate matter/dust, ammonia, amines, volatile organic compounds (VOCs), sulfides, odors, etc. Some trace gases, although exist at low concentration but are able to be toxic and highly adverse potential impacts to public health. Since the landfill is isolated and located far from resitential areas this impact is anticipated small. However, people working at the landfill could be moderately be affected.

The operation of landfills can generate flammable gases such as CH4, posing fire risks and damages to properties and human health risks. A number of environmental risks can happen. Heavy rain may cause a great amount of rain water get into the landfill if not properly designed. The risk of flooding when extreme weather incidents such as storm leads to leachate leaking into the environment causing environmental pollution and diseases spread. These risks are anticipated to be moderate.

Air pollutant from operating machines and transport vehicles:

During operation, averagely there are 300 garbage truck trips per day coming in and out the landfill to transporting domestic waste from municipal area to the landfill mostly at night. In order to implement waste placement, compaction and dumping, there are 3 heavy compactors operating on the landfill.

Table 3.34.Air pollution emission coefficients of trucks

Type of truck	Unit (U)	SO2 (kg/U)	NOx (kg/U)	CO (kg/U)	TSP (kg/U)	VOC (kg/U)
Truck load 3.5 - 16 Tons	1000 km	4.15S	14.4	2.9	0.9	0.8
Truck load over 16 tons	1000 km	7.43S	24.1	3.7	1.6	2.6

Source: Rapid assessment of WHO, 1993.
Bote: S- percentage of sunfua in DO, S = 0,2%-0,5%.

The maximum dust concentration apart from road centerline of 34 m in rainny season and of 30 m in the dry season is 0.5 mg/m^3, higher 2.5 times than average level within 24 hours according to QCVN 05 – 2013/BTNMT. The landfill area is located far from residential area, surrounded by buffer zone 300 m in width of agriculture planting acacia, thus the impacts to householders and residential area are insignificant. Overall, the level of impact is medium.

Dust, Bio-aerosols, and Odors:

Dust can include nuisance dust, hazardous dust (e.g., containing asbestos or silica), and bioaerosols (i.e., particles in the air consisting wholly or partially of microorganisms). Bioaerosols are of particular concern to the health of waste workers and have been show to be the source of reduced pulmonary function and increased respiratory disease for those in immediate proximity to waste sweeping and collection activities. The impact is considered as moderate.

Domestic solid waste and hazardous waste:

Domestic waste generated from landfill operation processes are mainly waste from staff and operators of the landfill. They are mostly papers, waste food, cartons with the amount of 15kg/month. Hazardous waste generated from administrative office area are mainly neon lights, printer inks, batteries from electrical equipment etc. but limited amount and mass. It is estimated that about 15 neon light and 4 printer ink box would be generated per year.

Workplace and traffic safety:

Workplace and traffic safety is one of the potential issues which might happen during landfill operation. Since most of works are implemented in the evening and night, the vision is limited and furthermore there are many garbage trucks operating in the landfill. Thus the traffic accident may happen in the landfill as well as surrounded transport roads in residential areas. Hence, it is necessary to implement the landfill regulations to ensure workplace and traffic safety. The operation of transport vehicle for landfill works inevitably increases the pollutant loads, decreases air environmental quality. The level of impact is medium.

Impacts to water environment:

The trashs dropped off from transport vehicle combined with stormwater runoff would carry the surface pollutants and adversely affects to water environment in the area.

There is a risk that leachate would infiltrate through soils layers and affect to shallow groundwater aquifer, causing water pollution. However, the operation of landfill- leachate treatment plant and non-permeable layers at the bottom of landfill would minimize the potential groundwater pollution. Besides, the solid waste, oil and grease also increase the potential groundwater pollution if they are not treated appropriately and timely. The level of impact is low to medium.

Offensive odors

Odors from the landfill is generated from the main following sources:

- Solid waste dumpling: Under the decomposition of aerobic microorganism, some fast degradable organic compounds and amino-group compound in trash, especially in food, would be degraded biologically to produce the odors such as NH_3, fat acid etc. In addition to raw solid waste, offensive odors are also generated from leachate because it contains many fast degradable organic compounds.
- Decomposition of dumped waste: Due to the main impacts of anaerobic microorganism, the anaerobic decomposition occurs in long period of time and produce massive gases. These odor compounds contain many substances and mainly are 4 groups mentioned above. The odor emission in this stage is highly dependent on the dumping activities and covering method.
- Leachate: the odor generated from decomposition of leachate is dependent on surface area of leachate storage ponds, treatment method, climate conditions in each season etc.

The level of impact is medium.

Impacts on soil environment

The soil environment in the landfill area is considerably impacted due to topographical change in landfill cells, increasing the likelihood that stormwater infiltrates into operating landfills. The soil environment is also impacted significantly due to the composition of the solid waste and leachate, causing soil pollution in terms of organic concentration. The level of impact is medium.

Impacts on public health and workers

Landfill operator's health: In general, the landfill operators contact directly with solid waste resulting in high exposure to potential pathogens, fungi, cysts, odor and toxic gases than waste collectors. The negative impacts to operator's health would be minimized by obeying the sanitation regulation and workplace safety.

Public health: Because the landfill is located far away from residential area (400 m) and surrounded by a buffer zone of trees (300 m), the effect of the landfill to the public health is insignificant. The issue of odor from operating landfill to people health is also gradually controlled by spraying EM solution.

The risk of landfill plot collapse: When organic garbages decompose partly turning into gas and leachate, their volume will be diminished posing a risk of landfill susidence. Collapse also occurs due to the increase of garbage layers in the landfill, and when the wastewater enters or exits the landfill. Collapse would break the cover of the landfill, affecting gas recovering system, surface water drainage capacity and landfill ground reuse activities after closure. The range of collapse of landfill plots depends on the initial degree of compaction, waste characteristics, decomposition degree, the adhesion when water and air are pushed out of the compressed solid waste, and the depth of landfill plot. The studies show that the final collapse occurs in the first 5 years and fluctuates from 20-40%. Therefore, repair scheme and plan of subsided landfills must be always ready. The compensation for this height can be the continuance to add soil to facilitate plantation. Level of impact is medium.

Impacts on terrestrial and aquatic flora and founa

The landfill is located entirely within a disturbed and developed area that does not contain suitable habitat for any ground dwelling wildlife species. There would be no impact to ground dwelling wildlife species, and no mitigation is required. All proposed landfill activities would occur within the existing footprint of the existing landfill. Therefore, there would be no impact.

Closure phase of landfill cell

When a landfill cell is full, it will be closed, and site restoration in the landfill area will be carried out. In general, during the closure generation of leachate and gases will be reduced; however, this process continues. The final cover may be damaged due to erosion, and the potential causes might include the length and steepness of slopes, insufficient vegetation growth due to poor planting, or uneven settlement of the waste. This may cause potential negative impacts on the water, soil, and air environment. The level of impact is medium.

Impacts during operation of the stormwater drainage and wastewater collection system

Leaks and Overflows:

The leaks and overflows from the sewerage system can cause contamination of soil, groundwater, and surface water. Depending on the elevation of groundwater, leaks in gravity mains may also allow groundwater into the sewer system, increasing the volume of wastewater requiring treatment and potentially causing flooding and treatment bypass. Substantial leaks due to breakage or joint disconnection of the wastewater interceptors may trigger land subsidence causing damages to roads and other properties. Overflows occur when the collection system can not manage the volume of wastewater, for example due to high flows during rain events or as the result of power loss, equipment malfunctions, or blockages. The excess flows may contain raw sewage, industrial wastewater, and polluted runoff. Since the groundwater is used for water supply of the city the risks of groundwater pollution and land subsidence due to leaks and overflows are assessed as moderate.

Offensive odors:

Another impact of the stormwater drainage and wastewater collection systems is the offensive odors. Moreover, wastewater collection system in sewer, canal route would generate a large amount of sludge during operation, hence these systems need to be dredged periodically. The odor from school toilets is mainly NH_3, affecting students and teachers. The impacts of odor can be controlled through some measures combined with design and regular clean in operation. Given the scale and location of the drainage and sewer systems, the level of impact is anticipated to be low.

A. 3.2.3.4. Induced Impacts

The proposed subproject is limited to construction and rehabilitation of the drainage and sewer system, construction of a new module of the Nhon Binh WWTP, and construction of a new cell in the existing Long My landfill. The proposed subproject would not involve construction of housing or commercial development that would directly affect the number of residents or employees within the area. The proposed project would not directly contribute to the creation of additional housing or jobs in the subproject areas and thus would not result in direct or indirect growth inducement. Given the scale of the subproject interventions, their locations, and planning of the city, it is anticipated that there would be potential induced social impacts of land use changes as a result of the subproject such as increase in land prices, triggering significant land speculation and potential dislocation of poor people leaving along the subproject roads. The new module of the WWTP and the landfill would have sufficient capacity to treat future effluent flows and urban domestic solid waste stream.

B. COMPONENT 2

B. 3.2.1. Pre-construction Phase

B. 3.2.1.1. The Impacts of Land Acquisition and Site Clearance

Impacts of land acquisition:

According to investigation result of RP report 2016 of Quy Nhon city, the construction area of Huynh Tan Phat bridge would not affect land acquisition. However, the construction area of Y-shaped bridge would acquire 273.1m^2 land of one household. Details of land acquistion are shown at the Table 3.35 below.

Table 3.35. Area and type of land to be acquired for theconstruction of Y-shaped bridge

Item	Total affected area (m^2)	Affected land		Affected plant		Affected works		Total affected HHs (hh)	Displaced HH (hh)
		Residential land (m^2)	Garden land (m^2)	Fruit trees (tree)	Bonsai (pot)	Housing (m^2)	Other structure (m^2)		
Construction of Y-shaped bridge	273.10	172.67	100.43	49	72	278	550	1	1
TOTAL	273.10	172.67	100.43	49	72	278	550	1	1

The CCSEP would not construct a new resettlement area. There is only one household resettled by CCSEP subproject therefore, the subproject would arrange two resettlement plots at the residential planning area along extended Hoa Lu road for the displaced household. The residential planning area is next to land of the affected household. Utiliy services (electricity and water supply infrastructure, hospital, market…) and social relations of the resettled household would not be affected by land acquisition of the subproject.

B. 3.2.1.2. Safety Risks Related to Unexploded Ordnance (UXOs)

The current construction sites located Y-shaped bridge, Huynh Tan Phat bridge already had other construction works, or used land. Therefore, risk due to UXOs is quite low. However, the activities of mine clearance and unexploded ordnances still would be needed.

B. 3.2.2. Impacts during Construction Stage

B. 3.2.2.1. Impacts to Air Environment

The activities of bridge construction will include: i) Construction of macadam roadbed foundation; ii) Application of prime coat and tack coat; iii) Construction of asphalt concrete pavement and roadside; iv) Transportation of the materials: sand, stone, cement and steel for construction; v) Construction of abutments: excavating for ground, drilling to pour concrete piles, construction of abutment, constructing abutment bodies, head walls and wing walls; vi) Construction of piers: pile construction, pit excavation, concrete pour to cover floor, cylindrical pedestal and body construction; and vii) Construction of the bridge: installing girders, railings, covering asphalt and finishing.

a. Dust and emissions

<u>During demolition process:</u>

The house dismantlement at Y-shaped bridge and Huynh Tan Phat bridge sites will generate dust which may affect households in neighboring areas:

- For Y-shaped bridge area: impacting on the local community leaving next to the bridge at the Twin Towers, 1B Island residential area in the north of Ha Thanh river.
- For Huynh Tan Phat bridge: 1B Island residential area in the north of Ha Thanh river, Urban-Trade in the north of Ha Thanh river also temporarily affected.

Overall, the local communities in the construction areas of Y-shaped bridge and Huynh Tan Phat bridge would be affected by elevated dust and exhaust gases, risks of traffic accidents, and safety due to the demolition and transportation of the wastes.. The demolished works under implementation of CCSEP is only the existing Y-shaped bridge. However, this will be an activity of limited scale and temporary. Therefore, the significance of the impacts is anticipated to be low.

During construction process:

During the construction of road surface, construction vehicles and machinery may be mobilized. The machinery and equipment, transport vehicles operating on roads would cause negative impacts on regional air environment, specifically pollution caused by dust and pollution caused by emissions from vehicles and mechanical construction.

In the process of road surface construction, the volume of materials transported would be as follows (Table 3.36):

Table 3.36. The total volume of construction supplies for road surface

No	Equipments	Volume (ton)	
		Y-shaped bridge	Huynh Tấn Phát bridge
1	Sand	1,971	4,312
2	Chippings, free stone..	53,883	85,398
3	Cement	962,755	1,494,508
4	Iron, stell	950	1551
5	Wood	16	44
6	Excavating soil	350	2,622
7	Backfilling soil	8,625	17,649
	Total	1,028,547	1,606,086

In the construction process of foundation and road surface, dust generation is calculated for each route. The traffic volume for transporing materials is indentified in the following table 3.37:

Table 3.37. The flow of material transportation vehicles for construction 02 bridges

Item	Volume of transportation (tons)	Volume (the)	Time (day)	Volume (turn/h)
Y-shaped bridge	1,028,547	102,854.8	540	15.9
Huynh Tan Phat bridge	1,606,086	160,608.6	540	24.8

Note: Working time follows construction progress of each package. 8-hour working per day.

The volume of pollutants generated by the transportation process of the main supplies and the volume of vehicles is provided in Table 3.38 in each line.

Table 3.38. The volume of pollutants generated by the transportation process in each bridge

Section	TSP load (mg/ms)	CO load (mg/ms)	SO_2 load (mg/ms)	NO_2load (mg/ms)	HC load (mg/ms)
Y-shaped bridge	3.98	12.82	5.50	63.65	3.54
Huynh Tan Phat bridge	6.2	19.99	8.58	99.2	5.51

The impacts on air quality:

From the load of pollutants calculated in the above table, the Sutton computing model was used to determine the average concentration of TSP dust at any point on the bridges. Because Huynh Tan Phat bridge has high emission load, it should be chosen to run computing model. The calculation results are shown in Figure 3.7 through Figure 3.10 below.

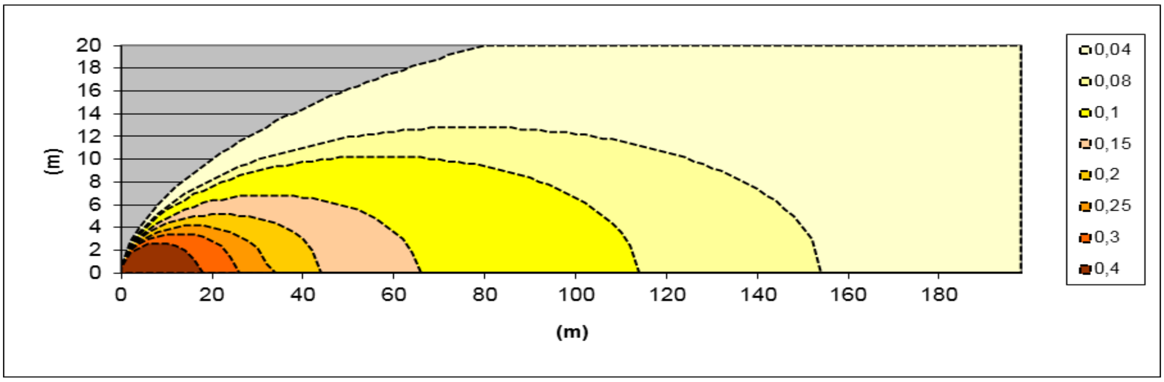


Figure 3.7. Average TSP concentration in the rainy season - Y-shaped bridge (mg/m³)

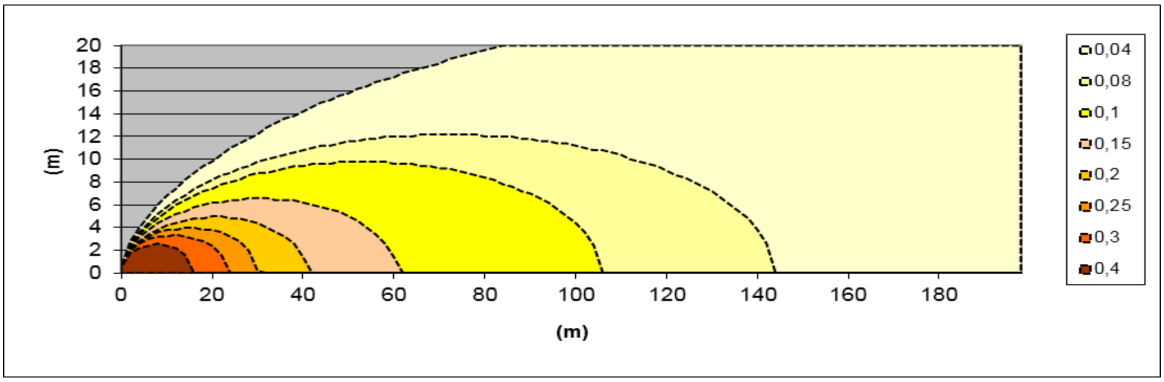


Figure 3.8. Average TSP concentration in the dry season - Y-shaped bridge (mg/m³)

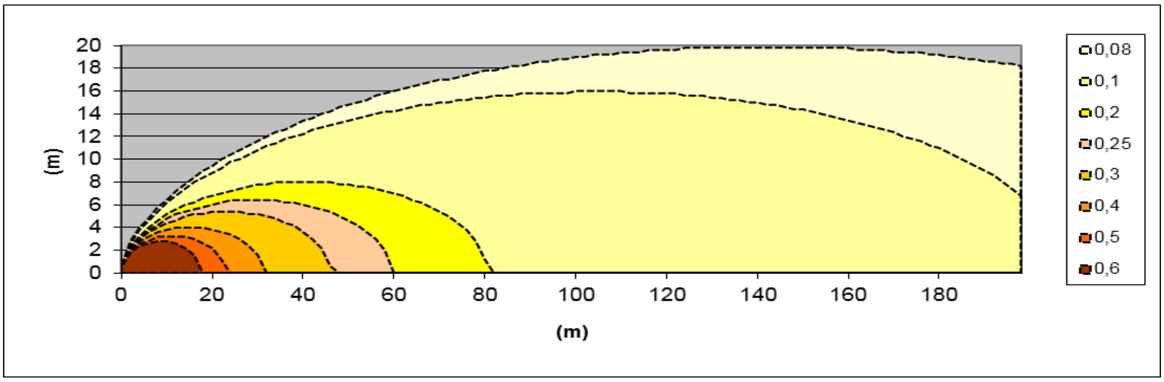


Figure 3.9. Average TSP concentration in rainy season - Huynh Tan Phat bridge (mg/m³)

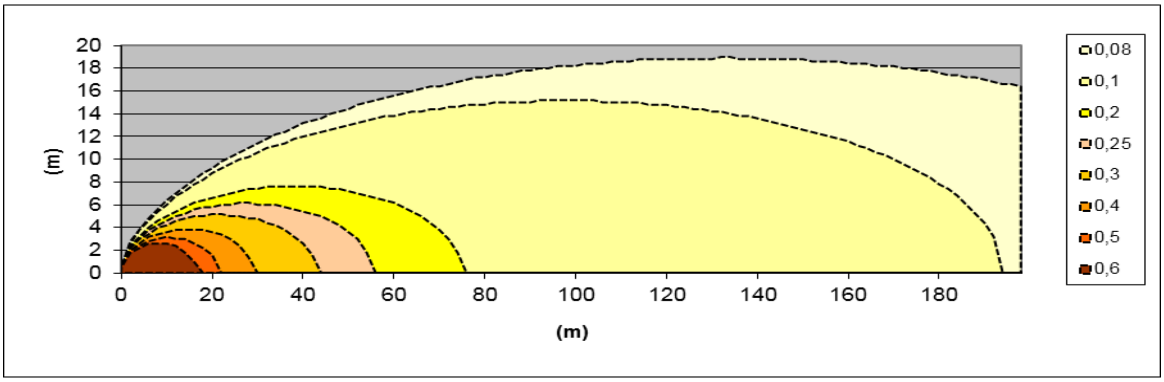


Figure 3.10. Average TSP concentration in dry season-Huynh Tan Phat bridge (mg/m^3)

The calculating results and models show that:

- The highest concentration of road surface dust caused by the means of transporting construction materials on Y-shaped bridge are 0.4 mg/m^3 at the distance of 16m from the bridge which are over the permissible standard under the regulations of QCVN 05-2013 BTNMT. The negative impacts of dust during construction of Y-shaped bridge is presented in Table 3.50.
- The highest concentration of dust on the road surface caused by the means of transporting construction materials on Huynh Tan Phat bridge are 0.5 mg/m3 at distance of 22m from the bridge over the permissible standard under the regulations of QCVN 05-2013 BTNMT. Therefore, the residential area B, Island 1 in the North of Ha Thanh river, and the resettlement area of Quy Nhon City can be affected by the dust from the means of transporting construction materials. The negative impacts of dust during construction of Huynh Tan Phat bridge is presented in Table 3.50.

b. The impacts of noise

In the process of bridge construction, the noise would be caused mainly by means of bridge construction machinery and equipment. The calculating results of noise transferring levels from the bridge construction equipment to the surrounding environment are shown in Table 3.39 below:

Table 3.39.The level of noise transferring from bridge construction equipment (dBA)

No	Construction machinery	Noise level at 1.5m distance	Noise level at 50m distance	Noise level at 100m distance
1	110CV motor grader	93	67	61
2	Harrow	97	71	65
3	Crane	93	67	61
4	Concrete mixers	84	58	52
5	Concrete pumps	82	56	50
6	Vibration machine	74	48	42
7	Compactor 8-10T	81	55	49
8	Plastic concrete paver	82	56	50
9	18T Trucks	76	50	44
TCVN 3985-1999		*85*	*85*	
QCVN 26-2010/BTNMT				*70*

Note: - TCVN 3985-1999 is the noise standard for production area
- QCVN 26-2010/BTNMT is the national technique standard on noise.

Therefore, the noise generated by the construction equipment and vehicles would be the source of impact at a distance of up to 100m.

The total of noise level from the bridge construction equipment is calculated as follows:

$$L_{\Sigma} = 10 \lg \sum_{1}^{n} 10^{0,1L_i}, \text{ dBA}$$

Where:

- L_{Σ} - The volume of noise at calculated site, dBA.
- L_i - The volume of noise of i source, dBA.

By the above formula, the total volume of noise level from the construction equipment to the surroundings at 50m and 100m distances is calculated in Table 3.40 below.

Table 3.40.Noise level caused by construction machineries (dBA)

No	Construction machinery	1.5m of distance	50m of distance	100m of distance
1	110CV motor grader	93	73.8	67.8
2	Harrow	97		
3	Crane	93		
4	Concrete mixers	84		
5	Concrete pumps	82		
6	Vibration machine	74		
7	Compactor 8-10T	81		
8	Plastic concrete paver	82		
9	18T Trucks	76		
TCVN 3985-1999		*85*		
QCVN 26-2010/BTNMT			*70*	*70*

Note: - TCVN 3985-1999 is the noise standard for production area
- QCVN 26-2010/BTNMT is the national technique standard on noise.

The calculation results showed that the total volume of noise level generated by the construction machinery and equipment on the bridge meets the permissible level for the construction area and within the permissible value for residential areas at a distance of 100m or more as required by the national standard (QCVN 26:2010/BTNMT). The residential area away 70m of distance from construction area of Huynh Tan Phat would not be affected by noise. The impact of noise would be low.

c. The impacts of vibration

In the construction process of the two bridges, the pile driving process would create vibration affecting the safety of the existing buildings around the two bridges, especially the current sewage pipeline in the Y-shaped bridge area. Vibration can damage the joints of pipeline resulting in leakage risk of wastewater into Ha Thanh river causing pollution by BOD, TN, TP, SS to the river as well as impact on aquatic life. Wastewater piple's diameter is about 40 cm^2 and away 2m of distance from the existing Y-shaped bridge. Vibration capacity affecting wastewater pipeline assessed as medium. The site-specific impacts for wastewater pipeline are presented in the Table 3.50

Because the residential houses are far from the construction site of Y-shaped bridge (30m) and Huynh Tan Bridge (70m), they would be less affected by vibration created by the construction. The vibration impact on the existing drainage system is low if the constractor abide with the mitigarion measures during the construction of Y-shaped bridge. The impact of construction of two bridges would be low in term of vibration.

Sensitive locations to be affected by vibration are wastewater pipeline and households living near construction of Y-shaped and Huynh Tan Phat bridge.

B. 3.2.2.2. Impacts to Water Environment

a. Impacts caused by domestic wastewater

The demand for water of workers is estimated normally about 20-25 litres/person/day. Therefore, the wastewater flow at construction sites would be:

- The amount of domestic wastewater from Y-shape Bridge construction site where there are 60 workers is around 1.5 m^3/day.
- The amount of wastewater from Huynh Tan Phat Bridge construction site where there are 60 workers would be 1.5 m^3/day.

If domestic wastewater is not well-managed, it would cause negative impacts on the environment in terms of BOD, N, P, TSS, odor, promote the development of pathogens vectors. All these factors would affect directly to the health of not only the workers but also the entire community. The impact level is assessed to be medium.

b. Impacts caused by wastewater in construction sites

During the construction of bridges, wastewater is mainly produced from the washing of materials, cleaning of construction equipment and curing of concrete girders, abutments and piers. Normally, this type of wastewater composes a high concentration of suspended substances and organic matters which can pollute the receiving sources. The pollutants of waterwater in the constructio of the briges are shown in Table 3.41.

Table 3.41.The pollutants concentration of wastewater in the construction of bridges

Type of wastewater	Standard (m^3/day)	Equipment (number)	Flow m^3/day	Pollutants concentration			
				COD (mg/l)	Oil (mg/l)	TSS (mg/l)	TN (mg/l)
Concrete curing	10	1	10	100–150	-	250–400	-
cleaning of equipment and washing of materials	12,5	2	25	50–80	1.0–2.0	150–200	41.5-42.9
QCVN 40-2011/BTNMT (A)				*75*	*5*	*50*	*20*
QCVN 40-2011/BTNMT (B)				*150*	*10*	*100*	*40*

Sources: QCXDVN 2005.

According to the results mentioned in the table above, the concentration of TSS in the wastewater discharged from the construction of the bridges is 2.5 to 4 times higher than the permissible values determined in the national standard QCVN 40:2011/BTNMT (for Colum B). The total nitrogen content is also greater than 1.1 times.

The wastewater discharged from machine repairing and maintenance is classified into 3 levels of construction and presented in Table 3.42 belows:

Table 3.42.The pollutants concentration of wastewater bridge machine repairing and maintenance equipment

Size of bridge	Type of wastewater	Flow (m^3/ngày)	Pollutants concentration (mg/l)		
			COD	Oil &Grease	TSS
	Repairing and	1	20 - 30	1.0 – 2.0	50 - 80

Bridges >200m	maintenance				
	Cleaning of equipment	3	50 – 80	1.0 – 2.0	150-200
	Washing of transport	3	10 - 20	0.5 – 1.0	10 – 50
Bridges 100-180m	Repairing and maintenance	1	20 – 30	1.0 – 2.0	50 – 80
	Cleaning of equipment	2	50 – 80	1.0 – 2.0	150-200
	Washing of transport	2	10 - 20	0.5 – 1.0	10 – 50
Bridges <100m	Repairing and maintenance	0	20 – 30	1.0 – 2.0	50 – 80
	Cleaning of equipment	1	50 – 80	1.0 – 2.0	150-200
	Washing of transport vehicles	2	10 - 20	0.5 – 1.0	10 – 50
QCVN 40-2011/BTNMT (A)		-	*75*	*5*	*50*
QCVN 40-2011/BTNMT (B)		-	*150*	*10*	*100*

The data in the table above show that, wastewater from machine repairing and maintenance at the bridge construction sites contains suspended considerable amount of solids and oil and grease. This wastewater would cause water pollution to receiving water bodies.

The runoff flow over the area of the bridge construction sites (2 rivers bank) is determined as follows:

$$Q = qxFx\varphi = 0.1/3600m/s \text{ x } F \text{ x } 0.3 \ (m^3/s)$$

Where :

q - rainfall intensity, l/s.ha.

F - catchment area (2 rivers bank).

φ - runoff coefficient (φ_{tb}=0,3).

The first stormwater flush often contains high load of pollutants accumulated in the surface such as oil and grease, dust etcfrom dry days. The mass of accumulated pollutants is determined as following:

$$G = M_{max} [1 - \exp(-k_z.T)]. F \text{ (kg)}$$

Where:

- M_{max}- Maximum mass of accumulated dust, M_{max}=220 kg/ha
- k_z- Kinetic coefficient of accumulated pollutants, k_z=0,3ng^{-1}
- T- Pollutant accumulation time, T=15 day
- F - catchment area, ha (2 rivers bank)

Table 3.43.Amount of pollutants cause by surface runoff in the area of construction bridge

No.	Item	The mass of accumulated pollutants (kg)	Mass of accumulated pollutants (kg) daily
1	Y-shaped bridge	80.3	0.06
2	Huynh Tan Phat bridge	105.8	0.08

As can be seen that the dust accumulation in 15 days at the bridge construction areas (at the 2 river banks) is high. This amount of pollutants would follow the runoff and flow over the construction area, and then adversely affect the aquatic organisms living in receiving sources.

According from the above table, the amount of pollutants generated in the Y-shape and Huynh Tan Phat bridge construction sites are 0.06kg/day and 0.08kg/day, respectedly. As such, the level of impact is low.

B. 3.2.2.3. Impacts caused by Solid Waste

Solid waste generated during site clearance :

Solid waste generated in this stage is mainly concrete, soil and rocks from the demolition of the existing Y structure bridges. For the domestic waste of the workers, since the site clearance works are not much, there's no need to set up construction site during this phase. Therefore, the domestic waste of the workers is not significant. The construction waste arising from demolition of the existing Y-shaped bridge would be disposed at Long My landfill. The level of impact is low.

During construction:

Volume of excavated materials: Volume of the dredged soil at construction area of Y-shaped and Huynh Tan Phat bridge respectively are 249.64 m^3 and 1,874.67 m^3.

Volume of levelling: Volume of levelling soil at construction area of Y-shaped and Huynh Tan Phat bridge respectively are 6,160.53 m^3 and 17,045.48m^3.

The construction activity of Y-shaped and Huynh Tan Phat bridge only carry out the soil digging without mud dredging. All the volume of the excavated soils would be used for on-site levelling.

Construction waste: If the construction phase of Huynh Tan Phat bridges lasts about 1,5 years, the amount of construction waste would be: 0,1x3750x= 375 m^3=0.68m^3/day. If the construction phase of Y- shape bridge lasts about 1,5 years, the amount of construction waste would be: 0,1x4772,6 = 477 m^3=0.87m^3/day.

Domestic solid waste: With 120 workers at the Y-shape and Huynh Tan Phat bridge construction site, the amount of generated domestic solid waste is 12kg/day.

Overall, the impact of domesctin solid waste during the construction time is low.

B. 3.2.2.4. Hazardous Waste

Bridge construction process would generate a small amount of hazardous wastes of about 10-15 liters of oil/grease waste per month, and about 2-3kg of oil/grease rags per month. The amount of waste generated is small and manageable if mitigation measure would be applied. The impact is therefore would be low.

B. 3.2.2.5. Impact on Aquatic and Terrestrial Ecosystem

Impacts on aquatic species:

Ha Thanh river: Construction activities of the two bridges on Ha Thanh river cause loss and disturbance of benthic habitats due to construction of the bridge foundations and an increase in suspensed solids in the water column due to dredging. Increased water turbidity results in a decrease in light penetration, adversely affecting phytoplankton productivity. The zoobenthos at the bridge foundatations will be revoved due to dredging, and their habitats will be lost. These impacts in turn will affect food availability for other secondaty consumers in the areas such as fish. However, dredging and construction of the bridge foundations will be conducted in temporary steel coffer dams which limit habitat loss and reduce suspended solids in water. This habitat loss and disturbances would be very small compared to the whole natural benthic habitats in the area. The zoobenthos can recolonize in 3 months[7] after the construction phase. There are no rare or protected species listed in the Red Book living in this area. In fact, the section of Ha Thanh river passing through Y-shaped bridge is heavily polluted due to direct waste and wastewater discharge from the residential areas. Therefore, the level of impact on the aquatic organism is low.

Thi Nai Lagoon: The lagoon is located 3km from the bridge construction areas. Therefore, the impact on the aquatic species of the lagoon is expected to be insignificant. Nevertheless, wastewater, solid waste, and cosntruction spoil should be controlled to avoid pollution to surface water sources and adverse impacts on aquatic life.

Terrestrial species:

There are only wild plants such as grass, duckweed, etc. and some normal animals such as mice, frogs and some kinds of birds in the construction areas of Y-shaped and Huynh Tan Phat bridges. Thus, the effect on terrestrial species is almost negligible.

B.3.2.2.6. Impacts on Surface Water Quality and River Flow

Water quality: The construction of the Y-shaped and Huynh Tan Phat bridges would mainly increase the amount of suspended solids in the Ha Thanh River. The stormwater runoff through the construction area together with pollutants such as construction materials, dirt, oily waste flows into the river, affecting the water quality of Ha Thanh river. In addition, if domestic wastewater and wastewater from construction activities would not be managed appropriately, pollution would occur to the water environment surrounding construction site, especially Ha Thanh river water due to increasing T-N, T-P and BOD concentration. However, the volume of the wastewater is anticipated to be about 1-1.5m^3/day. Therefore, the impact would be low.

River flow: During the construction of the bridges, building the coffer dams around the bridge foundations may limit the width of the flow, causing the flow velocity to increase and subsequent river bank erosion. However, this effect is negligible because the enclosure zone would only occupy an area of 6m wide on the river while the river is 70m wide. Therefore, the impact on the river flow can be expected to be low.

B.3.2.2.7. Impacts of flooding on construction sites

In the construction process of Y-shaped and Huynh Tan Phat bridges, there is likely localized flooding, especially in heavy rain. However, the area has flat terrain and relatively high and flooding is not likely occuring. The impact is temporary and localized and is assessed to be low.

B.3.2.2.8. Traffic Disturbances and Safety

Traffic safety can be violated by the following reasons: i) Traffic jams caused by constructing activities; ii) The insecurity of means of construction while traveling; iii) The operation of mechanical vehicles at the construction sites; iv) Traffic jams at the intersections; and v) The lack of facilities, signboards, signal lights instructing transportation.

As estimated, during the construction in the urban area, an increase in the volume of vehicles transporting raw materials and wastes is estimated to be 90 trips/day on average. Since construction of Y-shaped bridge and Huynh Tan Phat bridge would be implemented within the center it will

[7] Bolam,S.G., Schratzberger, M. and Whomersley, P. (2006). Macro- and meiofaunal recolonization of dredged material used for habitat enhancement: Temporal patterns in community development. Mar. Pollut. Bull. 52: 1746-1755

affect the city inner traffic. The increased traffic would give rise to the risk of traffic accidents and traffic jams in city center areas.

The roads and streets in the Quy Nhon City center are often narrow, so the construction would be taken place on the travel lane. Although it would restrict the impact on the surrounding houses, it would reduce the road width and result in traffic jams.

Y-shaped and Huynh Tan Phat bridge: The transportation activities of the material, equipment and waste for construction of the two bridges would be completely carried out by road instead of waterway. These main roads are Thap Doi, Hoa Lu, Le Thanh Nghi and Huynh Tan Phat roads. The sensitive location is the households living along those routes.

The areas significantly impacted on traffic during the construction subproject works are described in Table 3.44:

Table 3.44. Main subjects affected in traffic

Stt	subjects affected	construction items
1	Vo Nguyen Giap, Le Thanh Nghi, Twin Towers and Hoa Lu	Y-shaped bridge construction
2	Vo Nguyen Giap, Le Thanh Nghi, Huynh Tan Phat, Nguyen Hoang and To Huu Street	Huynh Tan Phat bridge construction

Impacts on road traffic: The main roads for construction and material transportation for the Y-shaped and Huynh Tan Phat bride are: Vo Nguyen Giap, Le Thanh Nghi, Thap Doi and Hoa LY roads (for Y-shaped bridge); Vo Nguyen Giap, Le Thanh Nghi, Huynh Tan Phat, Nguyen Hoang, and To Huu roads (for Huynh Tan Phat bridge). Besides, the demolition of the existing Y-shaped bridge for construction of the new bridge would increase traffic density on the surrounding roads, resulting in higher risk of traffic congestion and accidents. The impact on the road traffic and safety is expected to be moderate. Details on those main roads would be presented in the Table 3.44

Impacts on waterway traffic: It should be paid attention at the construction area of the two bridges because there are fishing boats crossing those areas so the issues of waterway traffic safety must be guaranteed. According to assessment, the impacts on the waterway traffic and safety would be medium.

B.3.2.2.9. Impacts on Urban Aesthetics and Landscape

The construction of the Y-shaped and Huynh Tan Phat bridges would change the landscape of this area. However, there are only shrubs and vacant land in this area. Construction activities would require soil excavation, road demolition, and the setting up of fences for the bridge construction sites leading to temporarily changes in landscapes and afftecting the urban beauty of the city. Therefore, compliance with mitigation measures during construction process is necessary. The significance of the impact is anticipated to be low.

B.3.2.2.10. Social Impacts related to Construction Activities

The impact of social influence from Component 2 of the subproject is low because the number of workers at the construction area (in Ward Dong Da) are concentrated, not scattered like Component 1. In addition, construction activities of the two bridges might cause disturbances to the boat tranportation on the river, which can result in social conflicts. During the construction process, the contractor, the construction company would have to apply the mitigation measures and management workers measures to avoid affecting the people around the construction area of the subproject. The level of the impact is considered to be low.

There are several small business households living near the construction area of Y-shpaped bridge and Huynh Tan Phat bridge. Land acquisition and construction would cause impact on the livelihoods and business of the people in the construction areas. Dust pollution would hinder service business activities due to customers' would choose a cleaner place to eat instead of dirty one, leading to reduction in customer visits. The degree of negative impact to the business operations depend on the following factors:

- Traffic access to business shops: The establishment of the temporary sidewalk is essential. However, some projects have ignored this requirement and made the business shops isolated.
- Construction time: The more prolonged, sluggish construction time, the more the impact on the activities of people living along sewer lines.
- The materials gathered and the temporary excavation on the pavement.
- Weak ground re-establishment.
- Dust diffusion during construction affecting product quality, especially for the food industry.

To minimize and reduce the impact, the local investor would need to closely cooperate with the local authorities to implement mitigation measures. In addition, during the construction, contractors should have to plan and organize the construction to ensure minimizing the impact to these affected households. Since the construction area is limited, the impact is assessed to be low.

B.3.2.2.11. Risks on health and safety

During site clearance process:

The demolition of existing works at the site can generate the risk of accidents to local people as well as demolition workers. The potential risk areas are construction area of Y-shaped and Huynh Tan Phat bridges. Impacts on health and safety to worker and community during the land area demolition process are assessed to below.

During construction process:

Risks on health and safety to workers*:* The bridge construction site would across the Ha Thanh river resulting in the risk of occupational safety for construction workers, especially in flood season. The rainny season normally occurs from September to December, especially in October. Therefore, the construction of the bridge at this time can be a disadvantage, increase the risk of occupational accident. The contractors need to be aware of this issue to have appropriate construction schedule

Risk on the community's health: The issue of dust and noise during construction would cause health impacts and nuisance to the local people. However, these impacts are localized and temporary.

Impacts on health and safety to worker and community during the two bridge construction are assessed to be medium.

B.3.2.2.12. Impacts on Existing Infrastructure

Road infrastructure: Construction area of Y-shaped bridge and Huynh Tan Phat bridge would be affected by activities of gathering, transporting the construction materials and waste. In addition, the transportation of raw material can also damage the roads. Right after the completion of bridge construction, the road would be restored, the restoration cost has been included into the cost estimation. The routes, which would be affected by activities of gathering, transporting the materials and waste including Thap Doi, Hoa Lu, Le Thanh Nghi and Huynh Tan Phat roads. The level of impact assessed as low.

Water supply infrastructure: In the process of new Y-shaped bridge construction, special attention should be paid to a wastewater sewer running about 2m in parallel with the existing Y-shaped bridge. The construction activities of new Y-shaped bridge can damage the joints of sewer resulting in leakage of wastewater into Ha Thanh river causing pollution by BOD, TN, TP, SS to the river as well as impact on aquatic life. According to site survey, there are no water supply infrastructures around the construction of the two bridges

Impacts on the power infrastructure: Similar to Phu Hoa channel area, Y-shaped bridge also has some power lines running parallelly. In the construction process the contractor should pay attention to the problem that construction machinery could make the wire severed.

The impacts to the existing infrastructures (water supply, electricity and traffic infrastructure) in construction process of Component 2 are expected to be medium.

B.3.2.2.13. Impact Assessment to Ha Thanh River in terms of Hydrology, Bank Rrosion and Sediment Deposition

The bridge construction would impact directly the flow pattern, hydrology, bank erosion. As the river flow of Ha Thanh river is narrowed down by the bridge construction, the water level would rise in the front of the bridge and the highest level position is located a distance from the bridge. The phenomenon of slower flow in the upstream then accelerating downstream of the bridge would cause bank erosion. Further downstream of the bridge, the slower flow would decrease the sand movement and then cause sediment deposition on the river bed. The reinforced embankment don stream of Y-shaped bridge would not be affected by erosion. However, at the Huynh Tan Phat bridge site the river embankment may be affected because the river bank has not been reinforced.

The placement of bridge's pillars would change the hydrological and hydraulic regime of the river and cause bank erosion, increase the general and local erosion etc. However, the bridge design meets the safety factors for not causing significant change in the water level, direction and velocity, and would not cause bank erosion compared to existing situations. Therefore, the impacts caused by bank erosion are anticipated to be low, and abutment protection by embankment would not be necessary during construction for preventing bank erosion.

B.3.2.3. Operating Period of the Subproject

B.3.2.3.1. Y-shaped Bridge and Huynh Tan Phat Bridge

Exhaust gas Emission sources

When the subproject come in operation, means of transportation on the route would cause air pollution. The vehicles with main fuel which is gasoline and diesel. would release into the environment an amount of exhaust gases containing the pollutants such as dust, NO_2, SO_2, CO, HC ... Using the pollution coefficient set up by US EPA and WHO to determine the volume of pollutants in the emission of vehicles on the route as follows:

Table 3.45. Coefficient of environmental pollution due to transportation emission

Types of vehicles	Unit (U)	TSP (kg/U)	SO_2 (kg/U)	NO_X (kg/U)	CO (kg/U)	HC (kg/U)
1. *Coach*						
- Small coach (engine < 1400cc)	10^3 km tons of gasoline	0.07 0.80	1.74S 20S	1.31 15.13	10.24 118.0	1.29 14.83
- Huge coach	10^3 km	0.07	2.35S	1.33	6.46	0.60

(engine > 2000cc)	tons of gasoline	0.06	20S	9.56	54.9	5.1
2. *Truck*						
- Gasoline truck > 3,5 ton	10^3 km tons of gasoline	0.4 3.5	4.5S 20S	4.5 20	70 300	7 30
- Small truck, diesel engine < 3,5 tons	10^3 km tons of gasoline	0.2 3.5	1.16S 20S	0.7 12	1 18	0.15 2.6
- Huge trucks, diesel engine 3,5 -16 ton	10^3 km tons of gasoline	0.9 4.3	4.29S 20S	11.8 55	6.0 28	2.6 2.6
- Huge trucks, diesel engine > 16 tons	10^3 km tons of gasoline	1.6 4.3	7.26S 20S	18.2 50	7.3 20	5.8 16

Sourced: WHO, 1993. (Oil containing S=0,3%).

When the subproject put into operation, the large number of vehicles would go in and out on the route.The volume of substances polluted by transportation in the subproject route, is shown in the table below:

Table 3.46. The volume of substances polluted by transportation in thebridge

Means of transportation		Number (Vehicles trip / day)	The pollution load (kg/day)			
			Dust	SO_2	NO_2	Dust
Car		215	0.11	0.85	2.14	16.76
Passenger car	113	0.09	0.69	1.75	13.66	Passenger car
	152	0.16	1.6	3.03	14.7	14.7
Truck	168	0.49	0.85	1.72	15.84	Truck
	224	0.76	1.33	2.68	24.7	24.7
	65	2.65	1.03	2.06	2.95	2.95
	35	2.33	3.33	30.5	2.59	2.59
Total		*972*	*6.59*	*9.68*	*48.88*	*91.2*

The receptors to be affected are those who transporting on the two bridges and households living and doing businessin the neighbouring area. The level of impact is low.

Impacts on air quality

When the bridge put into operation, the increase of traffic flow would increase the amount of pollutants such as noise, dust, concentration of toxic gases including CO, NO_2, SO_2, VOC and TSP, dust PM10. Based on the Vietnamese National Technical Regulation on ambient air quality QCVN 05:2013/BTNMT and QCVN 26:2010/BTNMT, the Sutton model for air pollutant and the calculation results are shown in tables below:

Table 3.47.Forecast on pollutant concentration

Parameters	Meteorological season	Distribution of concentration according to distance (mg/m^3)					QCVN 05-2013
		5m	10m	25m	50m	100m	
TSP	Rainy	0.021	0.017	0.011	0.007	0.004	0.3 mg/m^3 *(0.2 mg/m^3)*
	Dry	0.05	0.012	0.008	0.005	0.003	
SO_2	Rainy	0.028	0.023	0.015	0.009	0.006	0.35 mg/m^3 *(0.125 mg/m^3)*
	Dry	0.020	0.017	0.011	0.007	0.004	
NO_2	Rainy	0.130	0.106	0,.067	0.043	0.026	0.2 mg/m^3

	Dry	0.095	0.078	0.049	0.032	0.019	*(0.1 mg/m³)*
CO	Rainy	0.264	0.214	0.135	0.087	0.054	30 mg/m³
	Dry	0.193	0.156	0.099	0.064	0.039	*(5 mg/m³)*

Note: permitted valued of QCVN 05-2013/BTNMT (Italic letters or in brackets and normal letters are average concentration in 24 hours and in 1 hours, respectively, or air pollutant).

According the calculation in the table abve and compared with the permissible standard of QCVN 05-2013/BTNMT with concentration in 1 hour and 24 hours, it can be seen that:

- Dust (TSP): with the distance of 5 m from the roadside, the average dust concentrations in 24 hours discharged from vehicles within the subproject area in 2020, 2030 and 2040 are lower than limited values.
- NO_2 gas: with the distance further than 10 m from the roadside, the average NO_2 gas concentrations in 24 hours discharged from vehicles in 2020, 2030 and 2040 are lower than limited values. With the distance less than 5 m from the roadside in rainy season in 2040, the average concentrations of NO_2in 24 hours are higher than permitted values.
- SO_2 gas: With the distance of 5 m from the roadside, the average SO_2 gas concentration in 24 hours and in 1 hour discharged from vehicles in 2020, 2030 and 2040 are lower permitted values.
- CO gas: the average CO gas concentration in 1 hour and 24 hours in all projected years are both lower then permitted values at any location from the roadside

Noise effects

During the operation, the noise level of from vehicles is often unstable and depends highly on many factors such as vehicles flow, vehicles type, surface road conditions, surrounded environment etc. Thus, the average equivalent noise level value in period of time is used to evaluate the noise from continuously moving vehicles. In order to estimate the noise level from moving vehicles, this formula is used (Pham Ngoc Dang – The air environment, Science and technology Publisher, 2003):

$$L_{A7} = L_{A7\,TC} + \sum\triangle L_{Ai}\ , (dB)$$

Where:

- L_{A7} :the average equivalent noise level of vehicles (at the height of 1.5 m and distance of 7.5 m from vehicle flow central line)

- $L_{A7\,TC}$:The average equivalent noise level of vehicle at the height of 1.5 m and distance of 7.5 m from vehicle flow central line under standard conditions which vehicles moving straight on flat road, 60% of vehicles are trucks and buses with average velocity is 40 km/h

- $\sum\triangle L_{Ai}$:Summary of all adjusted coefficients applied in different case from standard condition. For this subproject, the coefficient $\sum\triangle L_{Ai}$ are calculated as below:

+ If the trucks and buses in actual condition are 10% increase or decrease of standard condition, $\sum\triangle L_{Ai}$ = ± 0,8 dBA

+ If average velocity is more or less 10 km/h from those in standard condition, $\sum\triangle L_{Ai}$ = ± 1,5 d BA

From data of vehicle flow and the average equivalent noise level of vehicle in standard condition as displayed above, the projected noise level from vehicles at the height of 1.5 m and distance of 7.5 m from vehicle central line are below:

Table 3.48.The average equivalent noise level of vehicle(L_{A7TC})

Vehicle flow (trip/h)	**40**	**50**	**60**	**80**	**100**	**150**	**200**	**300**
Noise level L_{A7TC}(dB)	68	68.5	69	69.5	70	71	72	73
Vehicle flow (trip/h)	**400**	**500**	**700**	**900**	**1000**	**1500**	**2000**	**3000**
Noise level L_{A7TC}(dB)	73.5	74	75	75.5	76	77	77.5	78.5
Vehicle flow (trip/h)	**4000**	**5000**	**10000**					
Noise level L_{A7TC}(dB)	79	80	81					

Source : Pham Ngoc Dang, 2003. The air environment, Science and technology Publisher

Impact assessment caused by noise

The potential of noise transfer to the surrounding environment along the bridge has been identified by the formulas above, the particular noise levels at different distance from the noise source are below:

Table 3.49. Particular noise levels at different distance from the noise source(dBA)

Item	**Distance**				
	0m	**10m**	**25m**	**50m**	**100m**
Bridge	75.5	73.5	65.6	59.5	53.5

The calculation results in table above show that, the noise level caused by transport activities on the entire bridge in distances of more than 10 m from the noise source is lower than the permitted values required by the national regulation (QCVN 26-2010/BTNMT).

Impacts of storm water runoff

When the bridge comes into operation, there would be some processes of corrosion and degradation of asphalt concrete, abrasion of tires, oil and oil and grease leakage, deposition of metals from the atmosphere, which lead to adverse impacts on surface water quality by factors such as heavy metals, mineral oil However, given the limited lengths of the bridges and the moderate vehicle trips to be expected on the bridges, this impact is expected to be low.

C. Site-specific Impact durding Construction Phase

Table 3.50. Site-specific impacts on key sensitive receptors

No	**Sensitive receptors and their relation to subproject activity**	**Site-specific impacts**
	Component 1	
1	**Phu Hoa canal – Construction of twin box culvert**	
	 Nguyen Hue pagoda located on the local unnamed road, 2m From Phu Hoa canal	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Potential risk of land subsidence during culvert installation causing damages to the pagoda. - Increased traffic congestion and risks of traffic accidents due to construction and transportation.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
		- Interference with religious events at the pagoda due to construction activities.
	 Dong Hai Mechanical Limited Company located on Road no.24, 20m from Phu Hoa canal	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation.
	 Binh Dinh provincial Youth Union Center located on Dien Bien Phu road, 45m from Phu Hoa canal	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation.
	 Some high-voltage power poles on Road no.24, along the Phu Hoa canal	- Risks of damage to the high voltage power line causing loss of property and power outage. - Risk of electrical accidents to the workers and communities.
2	***Upstream ditch of Bau sen lake – Construction freestone ditch***	
	 The households living along ditch	- Inundated when occurring downpour - Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Potential traffic accidents and community safety risks due to construction and transportation. - Risk of subsidence of people's housing due to dredging activity. - Clogging of household wastewater drainage due to construction excavation. - Interference with the daily living activities of local people due to construction activities. - Potential conflict between local people and the workers.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
3	**Tran Hung Dao road – Construction** of **stormwater drainage culvert**	
	 Tay Ninh church located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Potential traffic congestion and accident on Bach Dang street, especially night. - Potential localized flooding due to construction. - Hindering of access to the church due to construction activities directly on the road. - Interference with religious events at the church due to construction activities.
	 Ngoc Nhon monastic located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with religious events at the monastery due to construction activities.
	 Phong Lan kindergarten located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with school children learning hours due to nose and vibration.
	 Dong Da secondary school located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with school children learning hours due to nose and vibration.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
	 Quy Nhon Twin Towers located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access to PCR by tourist visitors due to construction activities. - Temporary disturbance of the beauty of the site.
4	**Hoc Ba Bep area - Construction of stormwater drainage culvert**	
	 Railway passing through the construction area of Hoc Ba Bep area (alley 1083)	- Inundated when occurring downpour - Potential land subsidence due to excavation activities negatively affecting the raiway. - High risks of railway traffic accidents for the construction vehicles workers due to busy construction activities, especially at night. - Potential interference with the rainway schedule.
5	***Bach Dang road – Construction of stormwater drainage culvert***	
	 Truc Lam pagoda located on Doan Thi Diem road, 2m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with religious events at the church due to construction activities - Hindering of access to the pagoda by tourist visitors due to construction activities. - Temporary disturbance of the beauty of the site.
		- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting the market foods and product for the local people. - Clogging of local drainage canal leading to localized flooding.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
	Dam market located on Hoang Quoc Viet road, 100m from the stormwater drainage culvert	- Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.
	 Sen Hong kindergarten on Bach Dang road, 2m from the stormwater drainage culvert	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents for the school children due to construction and transportation. - Interference with school children learning hours due to nose and vibration.
6	School children and teachers of the 12 primary and secondary schools: Le Loi Primary School; Hai Cang Primary School; Dong Da Primary School; Phuoc My Secondary School; Bui Thi Xuan Secondary School; Bui Thi Xuan Primary School; Nhon Phu 1 Primary School; Nhon Phu 2 Primary School; Nhon Hoi Secondary School; Nhon Hai Secondary School; Nhon Hai Primary School; Nhon Ly Primary School.	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with school children learning hours due to noise and vibration.
7	Alley no. 1083 is a narrow alley and related to construction of stormwater sewer in Hoc Ba Bep area	- hindering access to households living at Hoc Ba Bep area - Dredging and culvert installation may cause wall sluming of the households - Risks of traffic accidents - Dust, waste, damaged landscape - Affecting drainage capability
8	Vo Van Dung road is a small road and related to construction of upstream ditch of Bau Sen lake	- hindering access to households living at Bau Sen lake area - Dredging and culvert installation may cause wall sluming of the households - Risks of traffic accidents - Affecting drainage capability - Dust, waste, damaged landscape
9	Tran Hung Dao road related to the construction of stormwater and wastewater drainage lines and related to material transport route for the entire construction items of the subproject (except construction item of Phu Hoa canal)	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction materials during construction ;

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
		- Traffic risks: at the starting and ending points junction with Thap Doi and Tran Dung Dao road; - Inconveniences to locals' business activities as access to business establishments will be obstructed; - Affecting drainage capability; - Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench; - Safety risks to vehicles and community, especially at night when excavation is performed to depths of 2 m
10	Bach Dang road related to the construction of stormwater and wastewater drainage lines and related to material transport route of the subproject	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction materials during construction ; - Risks of traffic accidents; - Inconveniences to locals' business activities as access to business establishments will be obstructed; - Affecting drainage capability; - Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench
11	Road no.24 related to the construction of Phu Hoa canal and related to material transport route of the subproject	
12	National highway 1A related to the construction of Long My landfill and related to material transport route of the subproject	
	Componen 2	
13	***Construction of Y bridge***	
	 Wastewater pipeline running parallel with the existing Y-shaped bridge	Impact on water quality and aquatic species: - Negative impacts on water quality due to construction, domestic, and hazardous wastes. - Negative impacts on aquatic species and bentic community due to limited loss of habitats and potential increased total suspended solids and wastes in the river due to construction. Impact on the wastewater sewer: - Risk of damage to the wastewater sewer such as break or crack affecting wastewater collection and pollution to the river. Impact on road transport and connectivity between the two bank of the river: - Temporaty disconnection of the traffic connecting the two bank of the river affecting people and vehicles that have to cross the river at this site.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
	 Boats moving under Y-shaped bridge	- Loss of moring place for the local fishing boats. - Risk of waterway accidents for the local fishermen due to construction activities.
	 Business households living along Ha Thanh river	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting daily life of the local people. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Temporary hindering of customers' access to the business households and restraurant along the river due to demolition of the bridge negatively affecting their income.
14	***Construction of Huynh Tan Phat bridge***	
	 1B residential area located on Huynh Tan Phat road, 70m from the construction area of the bridge	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting business activities of the 1B residential are. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.
	 Small business households located on Huynh Tan Phat road	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting the market foods and product for the local people. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts
15	Thap Doi road related to the construction of Y-shaped bridge and related to material construction route of the 2 subproject	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction materials during construction ; - Risks of traffic accidents; - Inconveniences to locals' business activities as access to business establishments will be obstructed; - Affecting drainage capability; - Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench
16	Huynh Tan Phat road related to the construction of Huynh Tan Phat bridge and related to material construction route of the 2 subproject	

D. Assessment of Cummulative Impacts

This section discusses the cumulative impact of the subproject. In this regard, the cumulative impact under consideration is defined as two or more individual effects that, when considered together, are considerable or which compound or increase other environmental impacts. The cumulative impact from several projects result from the incremental impacts of the proposed project when added to other closely related, and reasonably foreseeable, future projects. The impacts that do not result in part from the subproject will not be discussed.

The discussion of impact severity and likelihood of occurrence need not be as detailed as for effects attributable to the subproject alone. The analysis of cumulative effects in this ESIA focuses on the effects of concurrent construction and operation of the proposed project with other spatially and temporally proximate projects as described below. As such, this cumulative analysis relies on a list of related projects that have the potential to contribute to cumulative impacts in the subproject area.

Geographic Scope

Cumulative impacts are assessed for 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. Geographically, the proposed subproject is located in the Quy Nhon City. For the purposes of this analysis, projects in and around the subproject area are considered when evaluating potential cumulative impacts due to construction and operation of the proposed subproject. These projects are: 1) Coastal Cities Environmental Sanitation Subproject (CCESP) – Quy Nhon subproject; 2) Extended Hoa Lu road technical infrastructure project. They are listed in Table 3.51.

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 avialable information on the projects completed, being impplemented, and to be executed in the City. Table 3.52 lists the major capital improvement projects between 2006 and 2022 that are included in the analysis of cumulative construction-related impacts.

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:

i) Water quality in Ha Thanh river: Given the bridge construction and expansion of Nhon Binh WWTP's capacity under the subproject, concurrent construction activities could result in increased erosion and subsequent sedimentation, with impacts to local drainages and/or storm drain capacity. Additionally, surface water quality could be affected by construction activities that result in the release of fuels or other hazardous materials to stream channels or storm drains.

ii) Aquatic bio-diversity in Ha Thanh River and Thi Nai lagoon: Although there would be some negative impacts during construction of different projects, operation of the proposed project, together with the identified related projects in the area, would improve the quality of water discharged to Ha Thanh River as well as Thi Nai lagoon. The proposed subproject would not have a cumulatively considerable impact to the aquatic ecosystem located in freshwater and marine environments.

iii) 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 subproject area. Construction of the subproject would exceed the national standard' thresholds, and therefore would be expected to be cumulatively considerable.

iv) 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 enhanced flood control and provision of basic services including collection of wastewater and wastewater treatment.

Assessment of cumulative impacts:

In case all construction works are implemented simultaneously, the subproject would generate approximately 82.5 kg/d of domestic waste, 12.25 m^3/d of domestic wastewater, 52 kg/d of dust, 176,537 ton of excavated soil; about 490 workers and 446 truck trips per day.

If not properly managed, it would cause adverse impacts to city aesthetic landscape, solid waste, wastewater and dust would impact to householders and visitors. The highest potential suffered areas are Tran Hung Dao street, Bach Dang Street and Hoc Ba Bep due to relatively high population density and many visitors visiting Twin tower relics, Ngoc Nhon temple, Tay Ninh citadel (Tran Hung Dao street) and Truc Lam pagoda (Tran Thi Ky road).

❖ Details on the cumulative impacts of the subproject is described in the tables 3.51 below:

Table 3.51. Cumulative impacts in related to the proposed (sub)project

1. Project name	**Coastal Cities Environmental Sanitation Subproject (CCESP) – Quy Nhon city Subproject**

Project description	The subproject is funded by the WB with an investment of 229.5 million USD, including 6 components: (1) Component 1: Drainage, flood control and wastewater collection, consisting of 2,598m of combined sewer lines for Northern Nha Trang, 9,166m of combined sewer lines for the Southern part of Nha Trang and the central area of the City, 8,175m of sewerage lines for Northern Nha Trang, 11,782m of sewerage lines for Southern Nha Trang and the Central area, 30,638m of tertiary sewer lines, 10 pumping stations, 19 CSOs, 2,679 manholes; (2) Component 2: Wastewater Treatment Plants (WWTPs) including the Southern wastewater treatment plant in Phuoc Dong ward with a capacity of 40,000m3/day and the Northern wastewater treatment plant in Vinh Ngoc commune with a capacity of 14,000m3/day; (3) Component 3: Solid waste management; (4) Component 4: Resettlement and site clearance; (5) Component 5: Revolving Fund and School Sanitation Program; and (6) Component 6: Capacity building and Subproject implementation assistance.
Current status of the project	The Subproject has been completed in the 2006-2014 phase. However, as there was a lack of budget during implementation, a number of work items were eliminated from the Subproject, including the Nhon Binh wastewater treatment plant and several wastewater collection and drainage lines in Quy Nhon city area.
EIA/EMP status	EIA/EMP reports of the Subproject have been approved by Binh Dinh Department of Natural Resources and Environment and received the No-Objection Letter from the WB. All of the social and environmental management issues have conformed to EIA/EMP reports throughout the subproject implementation.
Assessment on cumulative impacts	The CCESP was completed in 2014, so the construction process will not have cumulative impacts. However, the CCSEP is the subproject following the CCESP and has some related work items in order to thoroughly solve the outstanding environmental issues and guarantee sustainable development in the future: - The investment in the construction stormwater drainage system, wastewater treatment and collection system and tertiary sewer lines on Tran Hung Dao, Bach Dang road, Hoc Ba Bep area, Phu Hoa canal and upstream dich of Bau Sen lake will help to improve environmental sanitation condition at the entire city; and thoroughly solve the flooding situation in Hoc Ba Bep area and Upstream dich of Bau Sen lake. - The Subproject will also implement the construction of one more module 14,000m^3 at Nhon Binh wastewater treatment plant (WWTP) due to the lack of budget under CCESP project. Constructing one more module will help to thoroughly solve the pollution caused by wastewater of Quy Nhon city, improve the water quality of Ha Thanh river, guarantee the ecosystem quality on catchments of this river and in the whole city, and ensure the target of sustainable development. - Besides, CCSEP will carry out the construction of new A-4 cell in Long My landfill to meet the capacity of solid waste management and collection till 2025. - The CCSEP also invests on the construction of two (02) bridges Y-shaped bridge and Huynh Tan Phat bridge, thereby enhancing traffic infrastructure connection for the entire Quy Nhon city. - The negative cumulative impacts would result from the more sludge and treated wastewater discharged to the landfill and Ha Thanh River. Construction of one

	more cell in Long My landfill on the one hand would help treat more solid wastes, however, on the other hand would also create more pressure on the environment around the landfill areas. - Therefore, it can be seen that the resonant impacts of the 2 subprojects are long-term beneficial impacts, guaranteeing the target of sustainable development in the future..

2.Project name	**Extended Hoa Lu Road Technical Infrastructure Project**
Project description	The objective of the project is to connect the urban infrastructure, creating environmental landscapes and ensuring sustainable economic development. The Project has a total investment of 13,353,589,000 VND funded by the State Budget and other other legal Budgets. The construction location is in Dong da ward. The implementation duration is 2015 – 2017. The Subproject will construct a road with 471.51m in length, and auxiliary works such as power supply system, wastewater drainage system and domestic waste supply system with the total area of 9.97ha
Current status of the project	The Project has completed the Feasibility Study Report and is expected to be implemented from 2015 to 2017 at the same time as the implementation of the CCSEP.
EIA/EMP status	The EIA Report of the Subproject has been prepared and approved by Binh Dinh Provincial People's Committee
Assessment on cumulative impacts	The Project is completed in 2017, there will be few resonant impacts with the CCSEP. The resonant impacts at this point of time are mainly the increased quantity of travelling vehicles on Dong Da ward and generation of exhaust gases and dust on this area. However, if the Hoa Lu project lasts longer, the construction of Y-shaped and Huynh Tan Phat bridge is also carried out in Dong Da ward. Then, the cumulative impacts of the 2 subprojects will include: - Increased amount of exhaust gases and dust affecting residential area 1B island - Increased quantity of transport vehicles in the ward; - Increased risk of accidents due to transportation vehicles for construction; - Increased amount of domestic wastewater and solid waste in the ward; - Affected Ha Thanh river water quality - Security and order issues due to the high concentration of labors in the ward.

The assessment of the significance of the cumulative effects of projects on the VECs, by order of magnitude, is presented in the Table 3.52 below :

Table 3.52. Screening of cumulative environment impact of CCSEP

Key factors	**Development activities in Project area**			**Overall score**
	2006-2014 (completed)	**2015-2017 (On-going)**	**2017-2022 (On-going)**	
	CCESP project	Extended Hoa Lu road technical infrastructure proejct	CCSEP project	
Water quality in Ha Thanh river	+3	0	-1	+2

Aquatic bio-diversity in Ha Thanh River and Thi Nai lagoon	+3	0	-1	+2
The quality of people life in subproject area	+2	+1	+1	+3
Air pollution	+2	-1	-1	0

Note: “+” and “-“ respectively stand for positive and negative impacts

“0,1,2,3” indicate the levels of impact, respectively negligible, minor, medium and high

b. Cumulative Social Impacts

Due to the fact that Project of technical infrastructure along extended Hoa Lu street is at the location where two Y-shape and Huynh Tan Phat bridges are built, the land compensation, resettlement of householders living within project area would be done by the Project of technical infrastructure along extended Hoa Lu street. The completion of land compensation and resettlement actions would facilitate the construction of Y-shape and Huynh Tan Phat bridges, otherwise the Project extension would affect the progress of CCSEP project and also disturb psychologically the householders.

Remarks: Based on analysis of accumulative environmental and social impacts as above-mentioned, these accumulative impacts are mainly positive. After CCSEP project is put into operation, stormwater drainage system and; wastewater treatment and collection system on Quy Nhon city area will be completed, thereby improving environmental sanitation condtion, Ha Thanh river water quality and reducing flooding as well as enhancing traffic infrastructure connection. The negative accumulative impacts would be minimized by the management and supervision activities and full compliance with the environmental and social safeguard policies..

CHAPTER 4. ANALYSIS OF ALTERNATIVES

4.1. Environmental and Social Factors Considered in Feasibility Study

Quy Nhon city focuses on industry – seaport – services – tourism development. Development process would cause environmental issues that need to be solved to ensure a sustainable development. Strengthening the traffic infrastructure, stormwater drainage system, wastewater treatment would be the ground for the economic, social, environmental development in a sustainable way. Other issues were also considered and reviewed during the Feasibility (FS) planning for identification of the proposed investment works in Quy Nhon city area.

The factors considered for upgrading treatment capacity of Nhon Binh WWTP

CCSEP subproject would boost Nhon Binh WWTP's capacity up to 28,000m^3/day. The main reason for boosting Nhon Binh WWTP's capacity up to 28,000m^3/day are to meet a large domestic wastewater volume caused by rapid population development of Quy Nhon city. The factors considered for Nhon Binh WWTP's construction location include: (1)Wastewater treatment demand; (2)The area of land used; (3) Entrance; (4) Land use; (5) Terrain; (6) Geology; (7) Flooding; (8) Atmosphere; (9) Biology; (10) Culture resources; (12) Interruption of other activities in the area.

Table 4.1. The factors considered for selection of Nhon Binh WWTP's construction location

Factors	Characteristic	Assessment
Wastewater treatment demand	- Expansion of the WWTP will help meet the demand of wastewater treatment in Quy Nhon city area. - The WWTP will help improve quality of Ha Thanh river water.	+++
The area of land used	- The area is about 15.17ha (excluding the buffer zone), which is sufficient size for the construction of Nhon Binh WWTP 28,000m^3.	+++
Entrance	- Ensure transportation in all weather conditions, enough to prevent traffic jam.	+++
Land use	- No conflict with the current land use in the area.	+++
Legacy issue	- No problems or disputes arisen because of land clearance and compensation for land acquisition.	++
Terrain	- Favorable nature conditions	+++
	- Low terrain which is easy to flood. - However, subproject designed to lift foundation to +2,5m to prevent flooding in the period of 20 years.	++
Geology	- Carrying capacity of muddy sand layer is weak under surface, 5-7m depth, followed by soft clay layer with a thickness of 23 – 30m, high ductility and finally sandstone layer or thick layer which suitable for bearing pile.	++
Flooding	- Prevent flooding risk thanks to high foundation to +2,5m	++
	- Technique design is considered to prevent flooding	++
Atmosphere	- Limit the impacts of odors and emission evaporation thanks to about 300m wide buffer	+++

Biology	- No special ecosystem in the area where the plant is built, the rare creatures are endangered - Poor ecosystem					+++
Culture resources	- No architecture and culture works and sensitive constructions.					+++
Interruption of other activities in the area	- Plant construction has almost no impact on other operations in the region					+++
Note: +++ Very good	++ quite good	+ good	0 No affect	- Bad	-- quite bad	--- very bad

The factors that need to be considered for expanding Long My landfill

- Due to requirements of socio-economic development, attracting investment, tourism development, demands of people of the City on a clean, safety living environment, and achieving the goals set out in Solid waste management, expansion for Long My landfill is very essential and urgent
- The land fund of Long My landfill is huge so it is suitable for the expansion of new cells instead construction of a new landfill at other location
- The biological resources in Long My landfill is poor and without special ecosystem as well as rare creatures
- Long My landfill located at the high terrain so it is capable of the prevention of flooding risk
- CCESP subproject invested several works such as adminstrative buildings, landfill cells, drainage system in Long My landfill
- The landfill is located in a suitable location: mountainous area where there is no people living around so negative impacts to the people would be minimized significantly.
- Site clearance only affects plants such as Acacia... in addition, it does not impact to household resettlement thereby reducing maximum to compensation cost.

The factors that need to be considered for constructing Y-shaped bridge and Huynh Tan Phat bridge:

- In order to meet rapid population growth accompany with the increase of traffic infrastructure demand
- The construction of bridge will promote comprehensive socio-economic development so as to meet the growing need for urban development of Quy Nhon City and the growth of Nhon Hoi Economic Zone.
- Reduce traffic flow to the routes: Hung Vuong, Thap Doi and Tran Hung Dao.
- The quality of existingY-shaped bridge is degraded with narrow width (2m including the sidewalk), difficult transportation that cars are not able to go through
- Construction area of a completely new Huynh Tan Phat bridge is convenient for traffic participants and this location is far from residential area so negative impacts to the local people are neligible
- Less impact of site clearance

4.2. Analysis of Alternatives

The development of the subproject is fully consistent with the "Quy Nhon city Drainage Plan by 2020 and vision to 2050, taking into account climate change**"** and **"**Resettlement area for Northern Ha Thanh River Urban and Commercial Area Construction Project, Quy Nhon city"

During the impact assessment of the subproject, the analysis of alternatives is an important stage in the assessment. The main objective of the analysis of alternatives is to identify location/design/technology applicable for a particular project component in order to minimize adverse impacts and maximize positive impacts.

The analysis of alternatives is conducted for "with" and "withouth" the subproject alternatives, wastewater technologies for Nhon Binh WWTP, and leachate wastewater treatment technologies for Long My landfill. The results of analyses are presented in Table 4.3, 4.4, and 4.5 below.

Table 4.2. Comparison for the cases "with" and "without" subproject

Case	Without subproject	With subproject
Advantages	No adverse environmental and social impacts due to construction activities such as dust, noise, air pollution and short-term influence to local economy	Many people will benefit from the subproject activities including: i) people who are living in inundation region under Component 1 of the subproject; ii) improved traffic in the area under Component 2 of the subproject
Disadvantage	Environmental sanitation condition will continue degrading, especially in densely populated areas. These problems include: - Pesistent flooding and inundation - Decrease in surface and ground water quality - Poor sanitation condition Poor landscape	Adverse environmental and social impacts related to land acquisition and construction activities. However, no household would have to be relocated, and the impacts on the local people who would lose their land is small to modereate and could be megigated. The environmental adverse impacts during construction and operation would be localized and and manageable.

<u>*Wastewater treatment technology alternatives of Nhon Binh wastewater treatment plant:*</u>

Table 4.3. Comparison for selection of Nhon Binh WWTP treatment techniques

Analysis	Option 1 (Preliminary treatment + chemical enhancement + Imhoff sedimentation+ Biofilter Tricking filter + Secondary sedimentation + Disinfection)	Option 2 (Preliminary treatment + chemical enhancement + Primary sedimentation + Forced air treatment + Biofilter Tricking filter + Secondary sedimentation + Disinfection)
Treatment efficiency	High treatment efficiency	High treatment efficiency, especially for ammonia and phosphorus treatment process, as well as for meeting the future discharge standards.
Economic	Investment cost is low because of using the existing works	- High investment cost: o Adjust technology and renovate anaerobic preliminary sedimentation of phase 1 for both phases.

		o Invest sludge treatment for phase 2.
Environmental	Applied for most kinds of wastewater polluted by organic substance	-Applied for most kinds of wastewater polluted by organic substance - Environmentally friendly technology
Social	Does not generate much noise affecting the people living around	Does not generate much noise affecting the people living around
Operation	- Complicated operation and requirement of the high qualified operators in the whole monitoring process of the Biofilter tricking filter - It is synchronized with the technology of phase 1 allowing the two phases to operate comparably and resulting in a reduced number of operators	- Simple to operate without high qualified operators - It is not synchronized with the technology of phase 1 so it requires the more operators.

Through the analysis above, option 2 (Preliminary treatment + chemical enhancement + Primary sedimentation + Forced air treatment + Biofilter Tricking filter + Secondary sedimentation + Disinfection) is the proposed technology for Nhon Binh wastewater treatment plant, phase 2.

Odor treatment technology alternatives of Nhon Binh wastewater treatment plant:

Table 4.4.Comparison for selection of Nhon Binh WWTP's treatment technologies

Analysis	Option 1 - Odor treatment by Stripping tower	Option 2 - Odor treatment by bio-technology
Treatment efficiency	- High treatment efficiency	- High treatment efficiency
Economic	- Low investment cost	- Investment cost is higher than that of option 1
Environmental	- Demand of energy use is low so it is able to decrease green house gas emission	- Demand of energy use is low so it is able to decrease green house gas emission
Social	- Does not generate offensive odors, which affect people around	- Does not generate offensive odors, which affect people around
Operation	- Simple to operate	- Require a completely automatic system with the proficient operators. The operators must controll operation tighly as well as ensure appropiate pH, humudity for microorganism's development

Through the analysis above, Option 1 – Odor treatment by Stripping tower is the proposed technology because of: simple operation, low investment cost, easy control the treatment process

Leachate treatment technology alternatives of Long My landfill:

Table 4.5. Comparison for selection of leachate treatment technologies

Analysis	Option 1 (Anaerobic biological treatment, discretionary + primary Treatment + physical chemistry level 1+Biotreatment+	Option 2 (Anaerobic/facultative biological treatment, Primary Treatment + physical chemistry Level 1 +Biotreatment+ Crop filter area)

	physical chemistry 2 + Chemical treatment)	
Treatment efficiency	High treatment efficiency	High treatment efficiency
Economic	- High investment cost High maintenance cost	Low investment cost
Environmental	- Efficient processing of organic matter such as COD, BOD_5, NH_4^+ in leachate - Demand of energy consumption is stable so it is able to decrease green house gas emission	The pollutants will increase its pollution load because biological treatment is not handled thoroughly. Biological treatment process only carries out on RO membranes
Social	Efficient processing of leachate odor and does not affect worker's health	- Efficient processing of leachate odor and do not affect worker's health - Require a huge construction area
Operation	- Complex operation and requires highly qualified operators	- Simple and efficient operation without highly qualified operators because of having Peroxon tank - Efficient operation in each case of wastewater characteristic (low pollution load in rainy season and high pollution load in dry season)

Through analysis above and assessing the management capacity of Quy Nhon WWTP's operating unit, Option 2 (Anaerobic/facultative biological treatment, Primary Treatment + physical chemistry Level 1 +Biotreatment+ Crop filter area) is the chosen one for Long My leachate treatment plant..

CHAPTER 5. ENVIRONMENTAL AND SOCIAL MITIGATION MEASURES

In order to minimize adverse environmental impacts, many measures haven been proposed since the preparation stage of the subproject. Surveys and design activities have been prepared with many alternatives to minimize the project's impacts during construction and operation processes. During the preparation of the project, effort has been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the project investment. In developing the mitigation measures the strategies to minimize and/or rectify the impacts have been applied and where appropriate compensation has been incorporated. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RP. The following principles have been adopted in devising the mitigation measures:

- Disturbance to the life and transportation of the local people must be minimized.
- The proposed measures must be environmentally and socio-economically feasible.
- Technical standards and regulations must be abided by.
- Construction equipment and methods must be environment-friendly.
- Monitoring activities must be conducted on a regular basis.

This chapter identifies mitigation measures of the key subproject impacts during the pre-construction and construction (including measures integrated into detailed techinical design, site clearance, ground leveling, construction, and restoration) and operation phases. Given that most of the key impacts will occur due to civil works and transportation of construction/waste materials, many of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction projects to minimize impacts such as noise, dust, water, waste, etc. Since there are specific impacts, this chapter also address the site-specific measures both during the construction and operation phases.

5.1. Measures to Be Integrated into the Detailed Technical Design

The following measures will need to be included in the detailed technical designs of the works items during subproject implementation.

(i) Phu Hoa canal, upstream ditch of Bau Sen lake and sewerage system

- The sewer system would be designed based on surveys on the local hydrological regime (such as flood level, flow regime etc.), topography and geology to ensure effectiveness.
- The sewer system would be proposed to be designed with box culverts, CSO and anti-odor manholes where it comes across residential areas.
- Trees would be planted along Phu Hoa canal to improve the landscape.
- The open ditches are designed to collect surface water along the sewer system to remove sand and stones before allowing the water flow into the box culverts.

(ii) Waste water treatment plant

- Designing the plant and the site plan that guarantees a buffer zone distance of 300m from the nearest residential area in conformity with Vietnamese Code QCVN 01:2008/BXD applied to WWTPs without sludge-drying beds and with odor treatment works.

- Designing a corridor of green trees surrounding fences to create green landscapes and a grass bed in the plant premises among concrete structures so as to mitigate temperature inversion effects from concrete; planting shade trees around the administrative building (so as to cut down electricity consumption for air conditioners in sunny weather).
- The plant would be designed with 2 pools, 2 replacement shells and 2 anaerobic tanks to reduce odor generated in the plant area. The Stripping towers are designed to treat odor generated from operation.
- Arranging an in-house system of automatic monitoring machine for the parameters of temperature, pH, COD, TSS/SS, Total-N, Total-P.
- Arranging adequate safety equipment in the WWTP: ventilators, firefighting equipment, other safety equipment, bathrooms with sinks and showers for workers' use after handling chemicals or finishing their shifts..

(iii) Long My landfill

- Bottom layer and surrounding walls are waterproofed.
- Emission gases system as well as landfill leachate collecting system are installed to prevent pollution.
- Maintain a 300-meter vegetated buffer zone.
- Stormwater collecting system around landfill plots are designed.

(iv) School toilets

- School toilets should be designed to ensure aesthetic beauty, friendliness, and safety for the school children including children with disabilities. The school toilets will be designed to ensure aesthetic beauty, friendliness and safety for the pupils, and for children with disabilities and include: i) separate toilets for girls and boys; ii) inside locks; iii) antisloppy floor; iv) enough light; v) separate toilets for children with disability which include safe wheel chair access and wall mounted grab rail.
- Toilets should have roofs and should be connected to classrooms with cement paths. To this end, slogan signs saying "Wash hands before and after using the toilet" are displayed, the toilet are roofed and connected with class area by cement pathways.
- School sanitation blocks should be beautifully designed. The floors should be lined with anti-slip bricks which must also be cleaned easily during use. Power and water devices should be of energy-saving types. Handwash sinks should be available. Internal and external walls of the toilets should be decorated with images containing advice on hand washing after using toilets. Trees and flowers should be planted around these school sanitation blocks.
- The toilet should be designed to take advantage of natural light and equipped with air ventilation system. Exhaust pipe from septic tank should be directly connected to the sewage collecting pipe. Adobe bricks are used as much as possible and hazardous materials would bed avoided.

(v) Pumping stations and sewers

- The pump stations located at public places would be designed to ensure safety and landscape beauty, with fences and warning signs.

- Different alternatives concerning the alignment and scope of the work items have been considered, and priority is given to those alignments which are likely to exert fewer or negligible impacts such as crossing uncultivated land, agricultural land or public land with few residents, or those running along existing roads. At intersections with residential areas, different options have been considered, and necessary adjustments have been made so as to minimize the number of displaced people. The alternatives of reducing the designed width of roads or intersections have been introduced for analysis and consideration..

(vi) Bridges system:

- Surface water drainage system, street lighting system and traffic signs would be designed to meet relevant requirements. The traffic systems and intersections with the existing streets are designed with proper width so visibility and traffic safety are ensured when the bridges are put into operation.

5.2. Mitigation Measures during Preparation Phase

5.2.1. Mitigation Measures for Land Acquisition Under Component 1 and 2

During detailed design, PMU will study carefully the scale and scope of the subproject implementation to minimize land acquisition impacts. At the same time, the PMU will closely coordinate with the local authorities to carry out dissemination activities so that the local communities understand the roles and significance of the subproject thus cooperate and supervise the contractors' performance during the project implementation process.

As presented in Chapter 3, total acquired land area within the subproject are 196,937 m^2 land of planted forest, affecting 06 households residing in the constructed area of A-4 plot of Long My landfill. Besides, there is only 01 household affected by land acquisition of the subproject in the construction area of Y-shaped bridge. The household would be resettled at the residential planning area along extended Hoa Lu road.

The estimated cost for the Resettlement Action Plan of the subproject is approximately 13,860,231,000 VND (equivalent to 620,839 USD at the exchange rate of 22,325 VND = 1 USD). The estimated cost are: 196,937 m^2 forestland area (1,280,090,500 VNĐ); crops (896,077,000 VNĐ); temporary impact (5,000,000,000 VNĐ); assistance for job changes and life stabilization, (3,322,181,000 VNĐ); communication (50,000,000 VNĐ); independently monitoring (34,990,645 VNĐ); contigency cost (325,400,000 VNĐ).

The estimated cost for land clearance and resettlement is calculated based on provisions set by People Committee of Binh Dinh province and the policies determined by the World Bank. The Detailed mitigation measures for land acquisition under Component 1 are provided in the RAP of the subproject..

5.2.2. Mitigation of UXO risks

The subproject owner (the subproject PMU) will sign a contract with the military civil engineering agency or Binh Dinh Provincial Military Base for UXO detection and clearance at the construction site. UXO clearance will be executed right after the completion of site compensation and before the implementation of demolition and ground leveling. The estimated cost is approximately 50 million VND/ha. No construction activity will be allowed until the UXO clearance is compeletd.

5.3. Mitigation Measures during Construction Phase

5.3.1. Mitigation Measures for General Impacts

As part of the Environmental and Social Management Plan (ESMP) for the subproject these general measures have been translated into a standard environmental specifications to be incorporated into the bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs), and they will be applied to mitigate typical impacts of the subproject's civil works under Component 1 and 2. Section 6.1 briefly explains the scope and content of the ECOPs, which are presented in the next Chapter 6

The ECOPs describe typical requirements to be undertaken by contractors and supervised by the construction supervision consultant during construction. The ECOPs will be incorporated into the bidding and contract documents (BD/CD) annexes. The scope and content of the ECOPs is as follows:

Scope: Construction activities for civil works governed by these ECOPs are those whose impacts are of limited extent, temporary and reversible, and readily managed with good construction practices.

The measures identify typical mitigation measures for the following aspects:

- ✓ Dust generation, emission, noise and vibration
- ✓ Wastewater management
- ✓ Solid waste management
- ✓ Hazardous waste management
- ✓ Water pollution
- ✓ Plants and aquatic species
- ✓ Urban landscape and beauty
- ✓ Sedimentation, erosion, flooding subsidence and landslide
- ✓ Traffic management
- ✓ Existing infrastructure and services
- ✓ Social impacts
- ✓ Cultural works
- ✓ Community's safety and health
- ✓ Workers' health safety
- ✓ Management of warehouses and borrow pits
- ✓ Communication to local community

5.3.2. Specific Mitigation Measures for the Specific Types of Works

<u>Component 1:</u>

(1) Mitigation Measures for Construction of the Box Culverts at Phu Hoa Canal and Upstream Ditch of Bau Sen Lake

- 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.

- Excavation for pipeline installation will be implemented in stages, following the rolling method:
  - ✓ For sewers, pipe trenches shall be excavated along the street at 50m long for each section. After the pipes are installed, the contractor shall proceed with refilling the trench and making temporary road surface instatement immediately, before moving to the next section. Each 50 m long section will be implemented within 24 hours. For asphalt road, final road surface reinstatement will take place within three weeks from excavation.
  - ✓ For storm water drainage, each section up to 300 long should be excavated at one time. After installation is completed, refilling should be carried out immediately as per technical specifications before moving to the next 300 m section. Avoid excessive excavation and prolonged construction on any street in order to minimize the negative impacts on daily life of the households living along the roads. The excavated soil shall be transported out of excavated areas to the landfill as soon as possible and within 24 hours
- Train workers on how to respond to landslide:
- Do not store the materials along the ditch. Cover construction site carefully.
- Set up 2 meters fence in height surrounding construction site.
- Carry out the construction activities carefully in order to avoid all the concrete slabs are removed at the same time which causes odor spread.
- Immediately remove dredging material to avoid giving rise odor.
- Cover the ditch with woven sheets to decrease the odor after each working day when no construction is being carried out. Clean up the site after each construction session.
- Encouraged to use low-noise equipment and adopt proper construction methods.
- Suspend the construction activities during the local's break time (during noon and from 6 pm to 6 am).
- Collect wastes and tidy up the construction sites at the end of a working day/shift; transport the wastes out of the construction sites as soon as possible. If dredged materials would to be temporarily stored, necessary measures must be applied to control pollution such as gathering them within enclosures, under coverings, within fenced areas, etc. with warning signs being set up.
- Use specialized tank truck to transport sludge or fully covered vehicles while transporting sludge in a way that do not drop sludge on public roads.
- Sign the contract with URENCO unit for transportation and disposal as well as sludge treatment at the Long My landfill.
- Use the mobile toilet to avoid polluting the surrounding environment.
- Stormwater runoff: Use drains combined with sand sedimentation holes before discharge into the sewer system.
- Provide training on occupational safety for workers.
- Post internal rules and safety signs at site.
- Regularly check the safety of equipment and construction machineries.

- Place the healthcare tools and addresses to look for in case of accident, such as medical cabinets, emergency eyewash and shower equipment, addresses and phone numbers of hospitals would be clearly informed.
- Conduct traffic diversion, diversion signs, speed signs and erect warning signs.
- Strictly prohibit the use of air horn when crossing residential area.
- Only implement the construction within the cleared ground area.
- Inform migrant workers of local culture and norms.
- Perform tanagement of construction workers who are temporarily residing at the locality would be performed in close coordination through relevant authorities.

  Arrange construction plans and schedules to avoid in festival/holidays on the 1st and 15th of each lunar month. Regularly clean up materials, wastes gathering sites near Nguyen Hue pagoda on Phu Hoa canal, Ngoc Nhon temple, Truc Lam pagoda (Tran Hung Dao road).

(2) Stormwater Drainage Culverts on Tran Hung Dao and Bach Dang Streets, in Hoc Ba Bep Area, and Tertiary Culvert Networks:

- Erect and maintain the bulletin boards at the site, containing the following information: full name and phone number of the Site Manager, Supervision Consultants and Owner, duration and scope of work.
- Devise and carry out a plan for successive construction, with each section of a length of 50m for wastewater sewers and 300 m for stormwater sewers. The site of each completed construction would be reinstated within 24 hours. In sections to be asphalted, asphalting must not exceed 3 weeks from the date of site reinstatement. After stormwater drainage lines are installed, backfilling must immediately be carried out in accordance with technical requirements before excavation for the next section can be started.
- Erect fences, sign boards, warning boards, beacons, and barriers along ditches and roads under construction in accordance with current regulations. "Sorry for any conveniences caused" signs during construction must be placed in densely populated areas with many restaurants, hotels, etc.
- During construction, staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste.
- Neatly garther materials and wastes to avoid the encroachment on existing roadways, sewers, and drainage manholes. Thoroughly collect xxcavated soil falling in existing stormwater manholes and drains.
- Before the construction of street crossing sewers, relevant authorities must be coordinated to make arrangements for traffic channelization if necessary. In case the construction area takes up only 50% of the road width, construction is to be carried out in one half of the pavement, with the other half reserved for vehicle circulation. Construction would only be carried out in this other half after the pavement of finished first half has been temporarily reinstated. The construction of road-crossing sewers should be carried out at times of light traffic as at night, during which lighting must be properly provided.

- Do not allow construction activities from 12:00-13:00pm, before 7:00am, and after 6:00pm to not disrupt rest time of the local peoples. If construction needs to be carried out at night, inform the community least 2 days in advance.
- Install temporary bridges to give access to roadside houses, and shops, affected by ditch excavation.
- Clean and tidy up construction sites after every construction session.
- Use wall piles in excavated pits and ditches with a depth of 2.5m and over. Check and reinforce bearing walls to ensure the stability of excavated pits
- Backfill excavated ditches, pits, reinstate pavements in the soonest possible time.

(3) Wastewater booster pumping station to Bau Lac wastewater treament plant

- 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;
- Put corrugated iron enclosures with a minimum height of 2m around the construction site.
- Fence off the construction sites by iron sheet of 2m high to ensure safety for people.
- Put warning signs of construction site, deep pits, and speed limits on the section passing the construction site.
- Use Larsen sheet piles to prevent wall slumping.
- Gather materials and excavated soils around foundation pits and properly monitored to ensure minimum scope of disturbance.
- Collect wastes and construction materials within 20m around pumping stations every day.
- Provide ladders to the workers for safe operations in deep pits

(4) Nhon Binh wastewater treatment plant

- 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.
- Put corrugated iron fences with a minimum height of 2m.
- Locate the places for washing vehicles at the entrance to the sites. Channel wastewater from vehicle washing to a settling pond before discharging into the environment.
- Excavate and maintain the ditches and canals which collect and direct stormwater to mud pits before stormwater could overflow from the plant site to the outside.
- Make macadam on the service roads in the plant premises to limit dust and prevent materials from being washed off by stormwater.
- Spray water onto the site within 20 m from the gate of the plant and local roads at least three times a day on dry days.
- Carefully cover bulk materials and keep in temporary storehouses.
- Restore the road for community travel in the WWTP area upon completion of the construction.

- Store or cover construction materials such as sand and cement in the designated palce to prevent spreading to the surrounding environment. Do not storeb construction materials near the management building and administrative building of the existing WWTP to avoid affects on the staff.
- Utilize the toilet of the existing WWTP to avoid the discharge of untreated wastewater
- Prioritize the hiring of local worker to minimize the discharge of domestic wastewater.
- Collect and gather all the waste from the worker camp into the 200-liter-containers and hire URENCO to dispose of at Long My landfill.
- Collect 100% of the oil and grease waste and rags into the separate containers and put in a closed roofed area at the landfill. The containers would be located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills.
- Collect hazadous waste in the separated bin and then label and stored in the roofed area and hire URENCO to periodically collect and treat at the harzadous waste treatment facility.
- Arrange and maintain the drainage ditches around the construction area. These ditches would ensure the water drainage for the area and avoid localized flooding when it rains.
- Restore infrastructure restoration: access road, traffic roads, the other infrastructure works which affected by the subproject construction before handing over for the Investor, which is considered as a prerequisite for the Investor to sign for certification

(5) Long My landfill

- Cover the material transport vehciles (soil, sand, rock, cement, etc.) in order to prevent dispersal of dust into the surrounding environment in the transportation process. This measure would decrease by 90- 95% of the dust generation compared without covering.
- Frequently clean up the transportation vehicle before leaving the landfill. Places for washing vehicles should be located at the entrance of the sites.
- Comply with the procedures and norms of construction in the landfill, avoid the impact to the crop of local people.
- Utilize the existing sanitation system in the construction areas of Long My landfill.
- Prioritize the use of local workers in order to minimize the amount of wastewater from bathing and hygiene in the construction area because most of these workers come back their homes after work, which would partly reduced the amount of domestic wastewater.
- Collect wastewater from vehicle washing and left to settle in a settling pond before discharging into the environment.
- Arrange the garbage containers in the construction site and use the service of garbage collection and treatment at Long My landfill.
- Collect 100% of the oil and grease waste and rags into the separate containers and put in a closed roofed area at the landfill. The containers would be located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills.
- Prepare the backup pumps in the construction areas for heavy rains risk at the landfill area.
- Cover and reinforce the roof of the adjacent ceel of the landfill to prevent any landfill collapse.

- Equip fire fighting equipment such as fire extinguishers for timely rescue when the incident occurs. Because the landfill is in operation, the flammable landfill gas would be high risk of fire.
- Periodically check the workers' health at the construction site need to determine the health status of each person so as to arrange their work appropriately.
- Upon completion of the construction remove the worker camps and collect the waste materials on the construction site to discharge into the landfill.
- Restore roads, works in the landfill area if the construction process damages these works.

Component 2:

(1) Construction of Y-shaped bridge and Huynh Tan Phat bridge

- Inform the local authorities and communities of the construction plan and schedule, block off and demolition of the existing bridge, or any temporary disruption of services at least one month before start of the construction.
- 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.
- The Contractor shall be required to prepare specific Environmental, Health and Safety Plan (EHSP) before the demolition of the existing bridge and construction of the new bridge. At minimum, the EHSP shall satisfy the following requirements: Descriptions on measures for spill prevention, and sedimentation control, surface water flow diversion, reinstatement, etc.
- Install signboard directing the traffic diversion 600m from the Y-Shape bridge before the existing bridge is blocked off for demolition and reconstruction.
- Signboards and fences shall be placed and maintained to safely block off access to the two ends of the existing bridge. Allocate staff to guard the site 24 hours per day. Ensure adequate lighting at night time.
- The bridge works shall be scheduled to avoid the high river flow season.
- Place warning signs of "Authorized personnel only", restrict the access of unauthorized subjects to the bridge construction site. Arrange the float on the Ha Thanh river to warn the crossing boat.
- Coordinate with the local waterway transport authority to regulate the waterway transport at the river section where construction of the bridge is ongoing.
- Provide fife vests and protective equipment to the workers and enforce the use when working in or above water surface, especially during construction of bridge abutments (2-3m high above the water surface).
- Prohibit discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the Ha Thanh River. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly.
- Use the construction method that include close coffer dam with steel sheet piles to limit disturbances of the benthic community and sedimentation from the construction.

- Concrete mixing directly on the ground shall not be allowed and shall take place on impermeable surfaces and at lease 500m from Ha Thanh River.
- All runoff from batching areas shall be strictly controlled, and cement-contaminated water shall be collected, stored and disposed of at the approved site.
- Unused cement bags shall be stored out of the rain where runoff won't affect it; Used (empty) cement bags shall be collected and stored in weatherproof containers to prevent windblown cement dust and water contamination.
- All excess concrete shall be removed from site on completion of concrete works and disposed of. Washing of the excess into the ground is not allowed. All excess aggregate shall also be removed.
- Install the stormwater drainage ditch in the construction site. Set up sedimentation ponds to remove the solid before discharging into the Ha Thanh river.
- Prohibit Workers to discharge garbage into the Ha Thanh river.
- Equip from 1 to 2 oil and grease container with capacity of 150 liters and locate at the subproject site. The containers are located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills.
- Use the mobile toilets to avoid polluting the surrounding environment, especially the Ha Thanh river.
- During the construction phase, the contractor would arrange the marker posts, construction site signs, speed limit signs at the proper distance that easily visible of traffic participants. Staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste.
- Reasonably arrange time for materials transportation that avoid the peak hours from 6am to 8am and from 16 pm to 18 pm.
- Regularly maintain, repair roads used for transporting the construction materials.
- Request drivers to control the speed as prescribed: maintain vehicle speed to ensure the safety in accordance with regulations for the vehicles on the road when crossing the localities.
- Strictly prohibit to use the air horn when crossing through the residential areas.
- Restrict the construction activities at night. If the construction activities at night are unavoidable or disrupt services (supplying electricity, water, etc.), the community must be informed at least one week in advance.

Mitigation measures for access to street household businesses:

- ✓ Inform the street household businesses of the construction activities and their potential impacts such, waste, dust, and noise, traffic, and construction schedule at least 02 weeks before start of the construction.
- ✓ Set up construction and traffic warning signs at the construction site.
- ✓ Provide safe and easy acces to the household businesses putting clean and strong thick wood panels or steel plates over the open ditches.
- ✓ Do not gather materials and wastes within 20m from household businesses and shops.

- ✓ Do not use machines generating loud noise and high vibration levels near the businesses.
- ✓ Spray sufficient water to suppress dust during dry and windy days at least three times a day at site.
- ✓ Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations.
- ✓ Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session.
- ✓ Cleaning up construction areas at the end of the day, especially construction areas in front of business shops.
- ✓ Providing night lighting system with luminously painted fence and night lamp.
- ✓ Manage the worker force to any avoid the conflict with the local people and traders.
- ✓ Compensate goods, products damaged by construction activities of the subproject.
- ✓ Immediately address any issue/problem caused by the construction activities and raised by the local household traders.

5.3.3. Site-Specific mitigation measures during Construction Phase

Table 5.1. Site-specific mitigation measures on key sensitive receptors

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	Component 1	
CONSTRUCTION PHASE		
	Component 1	
1	**Phu Hoa canal – Construction of twin box culvert**  Nguyen Hue pagoda located on the local unnamed road, 2m From Phu Hoa canal	- Inform the pagoda 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. - Prohibit gathering of construction materials within 100m in front of the pagoda. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as pagodas. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the temple. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
		- Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the pagoda.
	 Dong Hai Mechanical Limited Company located on Road no.24, 20m from Phu Hoa canal	- Inform the company and the You Union 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. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Sprey water at least three time during dry and sunny days. - Tidy site after every working session - Installing night lighting at site to ensure safety for road users. - Reinforce steel piles to avoid subsidence. - Clean up the site daily. - Immediately addess any issue/problem caused by the construction activities and raised by the company.
	 Binh Dinh provincial Youth Union Center located on Dien Bien Phu road, 45m from Phu Hoa canal	
	 Some high-voltage power poles on Road no.24, along the Phu Hoa canal	- Do not carry out the construction activities within 7m at any direction near the high-voltage power line. - Prohibit construction activities within 20m of the power line during rainy days. - Provide workers with personal protective equipment and enforce them to use. - Deploy qualified technical staff to supervise construction activities near the power towers and lines. - Set up night ligting system.
2	**Upstream ditch of Bau sen lake – Construction freestone ditch**	- Provide a standby pump in case of localized flooding at upstream ditch of Bau Sen lake - Inform the community 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. - Ensure a drainage ditch at the site and clean any clogs to ensure household drainage system, provide alternative dranaige for them if needed.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	 The households living along ditch	- Reinforce steel piles to avoid subsidence. - Provide a standby pump in case of localized flooding at the site. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk construction activities. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at day's end. - Providing night lighting system with luminously painted fence and night lamp. - Manage the worker force to any avoid the conflict with the local people and immediately addess any issue/problem caused by the construction activities and raised by the local people.
3	**Tran Hung Dao road – Construction** of **stormwater drainage culvert**  Tay Ninh church located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Inform the 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. - Prohibit gathering of construction materials within 100m in front of the church. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as churches. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the church. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
		- Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the church.
	 Ngoc Nhon monastic located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Inform the monastery 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. - Prohibit gathering of construction materials within 100m in front of the monastery. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the church. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the monastery.
	 Phong Lan kindergarten located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- 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 - Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction operations to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	 Dong Da secondary school located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes when children go to and leave the kindergarten. - Do not load construction materials within 20m from school and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Immediately addess any issue/problem caused by the construction activities and raised by the schools.
	 Quy Nhon Twin Towers located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Prohibit gathering of construction materials within 200 around the towers. - Prohibit construction of workers camps within 1 km from the towers. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the towers. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Reinforce trench walls with steel sheet piles for deep excavation to avoid subsidence. - Cover the incomplete trenches under construction at day's end. - Provide night lighting system with luminously painted fence and night lamp. - Carry out well worker management and avoid the conflict between workers and locals, visitors.
4	**Hoc Ba Bep area - Construction of stormwater drainage culvert** 	- Provide a standby pump in case of localized flooding at Hoc Ba Bep area - Inform the railway management company of the construction activities and their potential impacts such the risks of interference with the railway train schedule and railway traffic safety, and the detail construction work schedule at least 01 month before construction starts. - Sett up construction and traffic warning signs at the construction site. - Set up barriers around the construction area to separate working area with the railway.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	Railway passing through the construction area of Hoc Ba Bep area (alley 1083)	- Construct the sewer under passing the railway using safe tunneling method. - Deploy a qualified technical staff to supervise construction activities near the railway. - Only execute construction activities when there is no train schedule. - Prohibit scattering of construction material and wastes near and on the railway. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and during transporting materials crossing the railway. - Immediately collect any domestic wastes and construction spoils around and near the railway and dispose in a designated site.
5	**Bach Dang road – Construction of stormwater drainage culvert**  Truc Lam pagoda located on Doan Thi Diem road, 2m from the stormwater drainage culvert	- Inform the pagoda 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. - Prohibit gathering of construction materials within 100m in front of the pagoda. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as pagodas. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the temple. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the pagada.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	 Dam market located on Hoang Quoc Viet road, 100m from the stormwater drainage culvert	- Inform the market management and the community 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. - Prohibit gathering of construction materials within 200m from the market. - Ensure a drainage ditch at the site and clean any clogs. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at day’s end. - Provide night lighting system with luminously painted fence and night lamp. - Manage the worker force to any avoid the conflict with the local people and traders. - Immediately addess any issue/problem caused by the construction activities and raised by the market management.
	 Sen Hong kindergarten on Bach Dang road, 2m from the stormwater drainage culvert	- 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 - Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction operations to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes when children go to and leave the kindergarten. - Do not load construction materials within 20m from school and tidy construction materials and stockpiles every working session.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
		- Immediately addess any issue/problem caused by the construction activities and raised by the kindergarten management.
6	**Construction of the school toilets:** School children and teachers of the 12 primary and secondary schools: Le Loi Primary School; Hai Cang Primary School; Dong Da Primary School; Phuoc My Secondary School; Bui Thi Xuan Secondary School; Bui Thi Xuan Primary School; Nhon Phu 1 Primary School; Nhon Phu 2 Primary School; Nhon Hoi Secondary School; Nhon Hai Secondary School; Nhon Hai Primary School; Nhon Ly Primary School.	- 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. - Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction activities to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during 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. - Tidy construction materials and stockpiles every working session. - Immediately addess any issue/problem caused by the construction activities and raised by the school management.
7	Alley no. 1083 is a narrow alley and related to construction of stormwater sewer in Hoc Ba Bep area	- Apply speed limit at 10km/h; - Arrange staff to direct traffic at peak hours; - Load the construction materials neatly; - Arrange staff to direct the driver during loading/unloading of large pipes; - Avoid construction activities at peak hours otherwise arrange workers to direct traffic at peak hours; - Remove the waste from the site in parallel with excavation/pipe installation; - Apply Larsen sheet piles for erosion prevention; - Conduct survey on the conditions of existing structures along the road prior to construction
8	Vo Van Dung road is a small road and related to construction of upstream ditch of Bau Sen lake	
9	Tran Hung Dao road related to the construction of stormwater and wastewater drainage lines and related to material transport route for the entire construction items of the	- Informing the community of the construction schedule at least one week before the construction. - Place fences and warning signs of construction at site.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
	subproject (except construction item of Phu Hoa canal)	- Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes. - Place stockpile materials at a designated place tidily and successively according to construction schedule. - Reinforce trench walls with steel sheet piles for deep excavation to avoid subsidence. - Spray water three times per day to reduce dust during dry days. - Tidy up construction site during and after every working a session. - Safely cover incomplete construction items and the incomplete ditches at the end of the day. - Provide strong wooden planks or concrete slabs across the trench under construction for temporary access to the houses or businesses. - Provide night lighting system and luminously painted fences. - Reinstall the road surface if occurring the damages during construction
10	Bach Dang road related to the construction of stormwater and wastewater drainage lines and related to material transport route of the subproject	
11	Road no.24 related to the construction of Phu Hoa canal and related to material transport route of the subproject	
12	National highway 1A related to the construction of Long My landfill and related to material transport route of the subproject	
	Componen 2	
13	**Construction of Y bridge**  Wastewater pipeline running parallel with the existing Y-shaped bridge	- Inform the wastewater management company of the construction activities, schedule, and potential risks to the wastewater pipelines schedule at least 01 month before start of the construction. - Together with the company work out an emergency plan for responding to the risks of wastewater pipeline breakage or disposition. - Use safe construction method near the pipeline such as vibratory pile driving. - Do not pack heavy machines and do not put heavy weights for static pile load test within 50m of the pipeline. - Request qualified technical staff to supervise construction activities near the pipeline. - Immediately inform the wastewater compony and local authority of the accidental breakage or disposition of the pipeline and implement the emergency plan.
	 Boats moving under Y-shaped bridge	- Inform the fishermen of the construction activities, schedule, and potential risks to the waterway transport at least two weeks before start of the construction. - Coordinate with the waterway transport authority to regulate the waterway transport during demolition and construction. - Work with the fishermen and local authority to find a temporary place for fish landing and anchoraging the boats. - Set up construction signs, warning waterway traffic buoys at the construction area and on Ha Thanh river.

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
		- Deploy technical staff to guide the waterway traffic during construction during bridge demolition and to guard high risk operations. - Provide night lighting system with luminously painted fence and night lamp. - Lining construction canvas to avoid materials and construction wastes falling into the Ha Thanh river.
	 Business households living along Ha Thanh river	- Inform the local authorities and communities of the construction plan and schedule, block off and demolition of the existing bridge, or any temporary disruption of services at least one month before start of the construction. - Install signboard directing the traffic diversion 600m from the Y-Shape bridge before the existing bridge is blocked off for demolition and reconstruction. - Fence off the construction sites by iron sheet of 2.5m high to ensure safety for people. - Signboards and fences shall be placed and maintained to safely block off access to the two ends of the existing bridge. Allocate staff to guard the site 24 hours per day. Ensure adequate lighting at night time. - Prohibit discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the Ha Thanh River. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly. - Use the mobile toilets to avoid polluting the surrounding environment, especially the Ha Thanh river. - During the construction phase, the contractor would arrange the marker posts, construction site signs, speed limit signs at the proper distance that easily visible of traffic participants. Staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste. - Reasonably arrange time for materials transportation that avoid the peak hours from 6am to 8am and from 16 pm to 18 pm. - Regularly maintain, repair roads used for transporting the construction materials. - Request drivers to control the speed as prescribed: maintain vehicle speed to ensure the safety in accordance with regulations for the vehicles on the road when crossing the localities. - Strictly prohibit to use the air horn when crossing through the residential areas. - Restrict the construction activities at night. If the construction activities at night are unavoidable or disrupt services (supplying
14	**Construction of Huynh Tan Phat bridge**  1B residential area located on Huynh Tan Phat road, 70m from the construction area of the bridge	

No	Sensitive receptors and their relation to subproject activity	Site-specific mitigation measures
		electricity, water, etc.), the community must be informed at least one week in advance. - Restore the damaged infrastructure after construction completion.
	 Small business households located on Huynh Tan Phat road	- Set up vehicles washing station in front of site's entry. - Cleaning up site at the end of the day. - Arrange garbage bins on site. - Watering to reduce dust on site. - Administrative management for workers. - Set up mobile toilet on site. - Training labor safety, dissemination and social evils prevention for workers - Restore the damaged infrastructure after construction completion.
15	Thap Doi road related to the construction of Y-shaped bridge and related to material construction route of the 2 subproject	- Clean up the transport vehicles before leaving construction site. 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. - Do not park vehicles in the roads longer than necessary. Do not allow construction vehicles and materials to encroach upon the pavements. - Maintain the required speed limit and do not overuse horn. - Preriodically registry and supervise the quality of transport vehicles as required by the government regulations. - Comply with the traffic safety regulations while participating traffic - Clean up wastes dropped off on road - Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes. - Place stockpile materials at a designated place tidily and successively according to construction schedule. - Spray water three times per day to reduce dust during dry days if required. - Reinstall the road surface if occurring the damages during construction
16	Thap Doi road related to the construction of Huynh Tan Phat bridge and related to material construction route of the 2 subproject	

5.4. Specific Mitigation Measures during Operation

5.4.1. Nhon Binh Wastewater Treatment Plant

Succesful operation of the WWTP will depend on a number of factors including: i) selection of appropriate treatment technologies, the quality and quantity of raw wastewater and its variability; available land area for the treatment facility; ii) resources for capital expenditures, operation, maintenance, and repair; and iii) availability of skilled operators, operator training, maintenance personnel, treatment chemicals, and replacement parts. The following sections focus on the mitigation measures to address impacts of the WWTP on the environment during its operation.

Institutional arrangement for the management of the WWTP is addressed in the techinical design documentation of the subproject:

i) Mitigation measures for air pollution

- The odor arising from the receiving tank, sand sedimentation tank, primary sedimentation tank, sludge compressed tank, wastewater separation devices would be collected through the lids, tubes and vacuum pumps to deodorization tower. The installed works that would be covered include screening, grit chamber, primary sedimentation tank, sludge treatment tank.
- Plant trees around the fences of the treatment area in order to control odor dispersion.
- Contain the waste (sludge and domestic solid waste) in standardized containers to minimize dispersion and gases and solid waste into the environment.
- Develop and implement a plan to periodically test and monitor aimbient air quality to obtain proper operation evaluation and control.

ii) Odor control

Odor and air emission problems during the operation will be controlled with control measures integrated in the design of the WWTP as described in section 5.1.1 (i). The following measures are required to prevent, minimize, and control air emissions and odors during operation:

- Safely store waste and sludge generated during the operation of the plant in a closed area before being transported away by URENCO to serve the planting of urban green trees or to be dumped at Long My landfill. This will reduce bad odors generated from sludge.
- 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.
- Contain the waste (sludge and domestic solid waste) in standardized containers to minimize dispersion and gases and solid waste into the environment.
- Periodically test and monitor air concentrations to obtain proper evaluation and control operation processes in a logical manner.

iii) Noise control

- Periodically monitor and maintain the pumps at the plant.
- Ensure the operation which should be in line with designed capacity.
- Plant trees in the the treatment plant area.
- The wastewater treatment area: the noise generated from the pump station, sludge dewater would be sound proof by structure design.

iv) Domestic wastewater control

- Use the existing wastewater system of the wastewater treatment plant.
- Wastewater from the WWTP would be pretreated through 3 compartments of septic tanks before being discharged into combined sewers and would be directed to the treatment area.

v) Control the solid waste from the operation of the WWTP

Solid waste from the treatment processs

The operation of the wastewater treatment plant would not be worked without the screen bar to remove the floating debris at the initial treatment process to avoid the pipe blockage or damage the pumps, etc. If the solid waste from this stage would not be collected and treated efficiently, the environment would be seriously affected. The measures to control include:

- It should have plan to periodically collect solidwaste at screen bar and disposal at Long My landfill.
- Provide trainning to the operation workers how to separate the domestic garbage from the those of treatment plant.

For domestic solid waste: The solid waste of the staffs in the treatment plant would be collected, transported by Long My landfill.

vi) Hazardous waste control

- The Owner would register as the owner of hazardous waste according to Circular No. 36/2015/TT-BTNMT dated 30 June 2015. Containers of hazardous waste would be placed on flat floors without tilting, tumbling, and must be free from stormwater infiltration. Collected hazardous waste would be stored in containers/houses and labeled as currently stipulated. Packing and packaging materials for chemicals would be returned to suppliers.
- Once every 2-3 months, the Plant would have to employ a local unit with assigned tasks of handing hazardous waste to collect, transport and handle such waste.

vii) Measures to minimize impact on receiving waters

- Install an online monitoring system at the WWTP for controlling the quality of the influent and effluent at the WWTP.
- Analizes the quality of sample effluent from the WWTP at least once every 3 months.
- Check the treatment facilities periodically and maintain 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.
- Treated wastewater must be discharged into the right receiving water as stipulated in the operational license of the treatment plant. Local environmental authorities would regulate specific allowable discharging flows, waste amounts, limitation and scope of the mixing area and monitoring requirements specifically for each wastewater treatment station.

viii) Measures to control sludge of the WWTP and septic tank sludge

- 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 QCVN03-MT:2015/BTNMT – national technical regulation on allowable limits of the heavy metals in the soils.
- Sludge will be compacted with gravity compactors and dewatered with gravity belt compressors. Dried mud cakes will be stored in a roofed warehouse at the sludge dewatering area. Periodically one time per month, the plant will hire URENCO to transport this sludge

amount way to serve the planting of urban green trees or to be dumped at Long My solid waste landfill of the city.

- Compressed raw waste will be put in 6m^3containers. Full containers will be replaced with empty ones and disposed of at Long My landfill.
- Land application or other beneficial re-use of the WWTP residuals should be considered but only based on an assessment of risks to human health and the environment. Quality of residuals for land application should be consistent with the relevant public health-based guidance from the World Health Organization (WHO)[8] and applicable national requirements.
- Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable national requirements.
- Be scheduled in every 3 years, the HDPE anti-odor sheets would be removed for sludg drying and pond dredging. URENCO will be employed to periodically dredge sludge from sewer systems and transport this sludge for disposal at Long My landfill. Transportation will be carried out by specialized tank trucks to avoid odor emission and sludge spillage along the route.

ix) Minimize the pollution of soil and groundwater

- Monitoring and controlling of groundwater quality in the area to assess the level of impacts due to operation of wastewater treatment plant in order to propose corrective measures.
- Applying the waterproofing for biological lake bottom to prevent the harmful microorganisms from discharging into the environment.
- Regularly checking the plant operations in order to timely detect leakages in the joints/transition of the pressure pipeline to propose timely corrective measures.

x) Worker health and safety at the WWTP, pump stations, and drainage and sewer system

Worker occupational health and safety impacts associated with theoperational phase of the WWTP primarily include the following: i) Accidents and injuries; ii) Chemical exposure; ii) Hazardous Atmosphere; and iii) Exposure to pathogens and vectors.

Accidents and Injuries:

Work at the WWTP is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment. Work at the WWTP may also involve entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions.

- The following procedures are required to prevent, minimize, and control chemical exposure at the WWTP:
- Install railing around all process tanks and pits.
- Implement a confined spaces entry program that is consistent with applicable national requirements and standards. Valves to process tanks should be locked to prevent accidental flooding during maintenance.

[8] WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater (2006).

- 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.
- When installing or repairing the sewers and stormwater drainage sewers adjacent to roadways, implement procedures and traffic controls, such as:
  - 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.
  - For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists.
- Locate all underground utilities before digging.

Chemical Exposure and Hazardous Atmospheres:

- The chlorine station must be equipped with chlorine leakage detectors, ventilation facilities, sirens, flashing warning lights, gas masks, compressed oxygen breathing apparatuses, protective clothing, and a system of emergency watering/showering/ eyewash of the chlorination house.
- 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.
- Prepare escape plans from areas where there might be a chlorine or ammonia emission.
- Install safety showers and eye wash stations near the chlorine equipment and other areas where hazardous chemicals such as chlorine are stored or used.
- Use protective goggles, protective clothes and boots, chlorine masks, and personal gas detection equipment while working at the WWTP.
- Monitoring chlorine gas in the air: Before being discharged it into the surrounding if chlorine levels of exceed permissible maximum concentrations with alarm signals from the gas analyzer, the air purification system must be initiated.
- 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:

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.
- Reduce aerosol formation and distribution, for example by:
    - Planting trees around the aeration basin to shield the area from wind and to capture the droplets andparticles.
    - Using diffused aeration rather than mechanical aeration and using finer bubbles for aeration.
    - Reducing aeration rate, if possible.
    - Use of floating covers on the mixed liquor of the aeration basin.
    - Suppression of droplets just above the surface, (e.g.by installing a screen or mesh above the basin).
    - Collection of droplets (e.g. by sedimentation, scrubber, electrostatic precipitator, or fabric filter).
    - Disinfection of airborne particles (e.g., by using ultraviolet lights).
    - Use of submerged effluent collector (such as pipes with orifices) rather than weirs.
- 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

5.4.2. Long My landfill

Environmental impacts and associated mitigation measures applicable to the domestic soiled waste collection and transport; waste receipt, unloading, landfilling, and closure and post-closure are described below.

i) Waste Collection and Transport

Litter and clandestine dumping

The causes of littering and clandestine dumping in urban areas occur because of inadequate availability of litter bins along walkways, inadequate public awareness of their responsibilities as urban dwellers, and inadequate refuse collection service. Littering occurs everywhere and often into drains, while clandestine dumping is commonly on vacant lots, public spaces, or along waterways. Accumulated waste may attract disease vectors, contribute to clogging of drainage and sewerage networks, make waste readily accessible to neighborhood animals and birds, and pollute waterways.

Recommended management strategies to minimize litter and clandestine dumping include:

- Encourage use of containers or bags for waste at the point of collection for each household and establishment.
- Implement a regular collection schedule with sufficient frequency to avoid accumulation of garbage.
- Use vehicles appropriate for the geographic conditions and waste types to maximize reliability of collection (e.g., compactor trucks may be appropriate for neighborhoods with wide streets and low-density trash, while smaller vehicles may be appropriate for neighborhoods with narrow streets and higher-density garbage).
- Encourage separation of recyclable materials at the point of generation, so that the collection points do not become sorting points for informal sector waste pickers.
- Cover collection and transfer vehicles along the entire route of transport to avoid windblown litter.
- Clean vehicles used for waste hauling before transportation of any goods, including compost.
- Encourage residents to put waste out at designated times and locations.
- Where possible, blocking off access to dumping sites and fining illegal dumpers.

Air Emissions

Air emissions from MSW collection and transport include, dust and bio-aerosols, odors, and vehicle emissions.

a, Dust, Bio-aerosols, and Odors

Recommended management strategies to minimize dust, bio-aerosols, and odors include:

- Establishing frequent waste collection schedules;
- Instituting a washing program for waste collection vehicles and for company-owned waste collection and transfer containers;
- Promoting the use of bags to reduce the odors from soiling of waste collection and transport equipment.

b, Vehicle Emissions

Emissions from on-road vehicles may be regulated through national or regional programs. In the absence of these, specific measures to prevent, minimize, and control vehicle air emissions during waste collection and transport include the following:

- Optimize waste collection routes to minimize distance traveled and overall fuel use and emissions.
- Implement transfer stations for small vehicles to consolidate waste into large vehicles for transportation to a treatment or disposal facility.
- Waste collection and transport vehicle owners and operators should implement the equipment manufacturers' recommended engine maintenance, along with the mechanical maintenance for the safe operation of the vehicle, including proper tire pressure.
- Drivers should also be instructed on the benefits of driving practices which reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits (working with garbage truck drivers can save as much as 25% on fuel use and reduce maintenance by 15%).

ii) Waste Receipt, Unloading, Processing, and Storage

Control of the incoming waste stream is necessary to ensure safe and effective processing, treatment, and disposal of the waste. Recommended measures include:

- Visually evaluate, weigh, and document incoming waste loads.
- Reject or, if the facility is equipped to process the waste, segregate potentially hazardous materials or wastes identified, including infectious waste, and manage as a hazardous or infectious waste, as applicable.
- Analyze suspected hazardous materials before acceptance so that they are segregated relative to compatibility and so that they can be adequately treated and disposed of.
- If possible, isolate size reduction equipment (e.g., shredders or grinders) in an explosion-proof area with proper ventilation and pressure relief to reduce the impacts of potential explosions that could be caused by materials such as gas cylinders and ignitable liquids that may be present in the waste. Visual inspection of the incoming waste, along with sorting and removal procedures, can minimize this potential hazard.
- Separate recoverable secondary materials for recycling and organic waste for composting to the extent practical.

Contaminated Runoff

Recommended contaminated runoff management strategies include:

- Use impermeable materials for roads, waste processing and storage areas, and vehicle washing areas, and install curbs to prevent runoff to permeable areas.
- Collect runoff and leachate from areas used for waste storage, and treat runoff to meet applicable environmental standards before discharge to surface water or the municipal sewage system (e.g., screen to remove large material, install silt traps to remove particulates, and remove separate-phase liquids with an oil/water separator). Discharge to the municipal sewage system (via pipe or tanker truck), where available, is preferred for runoff from waste storage and handling areas.
- Re-use collected water in on-site disposal processes to the extent practical or store with collected leachate awaiting treatment.
- In addition, management strategies for contaminated runoff from vehicles include:
- Cover containers during transport.

- Ensure vehicle equipment is designed to collect drainage and that it is held in a sump container until the vehicle reaches a safe discharge location.

Litter

The following measures are recommended to prevent, minimize, and control litter and solid waste during waste receipt, unloading, processing, and storage:

- Provide adequate storage for waste not immediately treated or disposed of.
- Implement good housekeeping procedures.
- Consider use of enclosed/covered areas for waste tipping, shredding, compacting, etc.
- Install catch fences and netting to trap windblown litter.

Air Emissions

The following measures are recommended to prevent, minimize, and control vehicle emissions and emissions of dust, odors, and bioaerosols during waste receipt, unloading, processing, and storage:

- Select vehicles and containers that minimize air emissions during waste loading and unloading.
- Design drop-off points to minimize queuing of vehicles.
- Sweep waste management areas and roads frequently and use water spray for dust control where needed.
- Pre-treat wastes as needed (e.g., solidification, encapsulation, or wetting sufficient to reduce dust but without forming leachate).
- Use enclosed waste handling and storage areas for malodorous wastes or wastes that generate hazardous dust (e.g., asbestos). Enclosed waste storage and handling areas are preferred for all wastes.
- Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions (e.g., bag filter).
- Remove, treat, or dispose of all biological/malodorous wastes in an expeditious manner;
- Use odor-neutralizing sprays where necessary (EM product). Key measures being used in the Long My landfill would be using EM solution. After being sprayed or sprinkled to garbage, with a very high density of microorganism populations in EM, they would quickly dominant to the decomposition microorganism. As a result, the decomposition reaction in the garbage would not cause any odors.

Noise and Vibration

Principal sources of noise and vibration include truck traffic; loading equipment (e.g., cranes, wheeled loaders), stationary compactors, balers, grinders, and other treatment and conveyance systems. Recommended noise management strategies include:

- Construct a buffer zone between the facility and the external environment or locate facilities away from sensitive receptors.

- Include noise and vibration considerations during design, including use of models to predict noise levels at specified noise-sensitive locations, using standardized sound power levels for construction plant.
- Maintain site roads in good condition to reduce noise and vibration from vehicle movements.
- Use acoustic screens around fixed/mobile plant and equipment.
- Select equipment that has low noise emission levels.
- Fit silencing equipment to plant, e.g. baffles/mufflers.
- Use buildings to contain inherently noisy fixed plant equipment (e.g., locate waste shredder in the tipping hall, and enclose tipping hall on all sides) and consider use of sound-insulating materials in construction.

iii) Landfilling

Leachate

The leachate generated at the landfill will be collected and primarily treated in the onsite primary leachate treatment system with the capacity of 200m^3/day before transporting to Bau Lac wastewater treatment plant.

Groundwater and Leachate Monitoring

Recommended measures for groundwater and leachate monitoring include the following:

- Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality not attributable to weather or other factors may indicate changes in the liner, leachate collection, or landfill cover systems.
- Install groundwater monitoring wells outside the landfill perimeter at locations and depths sufficient to evaluate whether leachate is migrating from the landfill into the uppermost groundwater unit. This groundwater monitoring network should usually include, at a minimum, one monitoring well located in the upgradient groundwater flow direction from the landfill and two monitoring wells located in the down gradient direction. The groundwater monitoring system should be consistent with applicable national regulations.
- Regularly sample the monitoring wells and analyze for constituents, selected based on:
    - The types, quantities, and concentrations of constituents in wastes managed in the landfill.
    - The mobility, stability, and persistence of waste constituents their reaction products in the unsaturated zone beneath the waste management area.
    - The detectability of indicator parameters, waste constituents, and reaction products in ground water.
    - The constituent concentrations in the groundwater background.

Landfill Gas Emissions

Recommended methods to control and monitor landfill gas emissions include the following:

- Include landfill gas collection system designed and operated in accordance with applicable national requirements and recognized international standards including recovery and pre-use processing or thermal destruction through an efficient flaring facility. Prevent condensation from accumulating in extraction systems by arranging the pipe work to fall to a removal point such as a knock out-pot.

- Use landfill gas as fuel if practical, or treat before discharge (e.g., by using enclosed flare or thermal oxidation if methane content is less than about 3 percent by volume).
- Use gas blowers (boosters) of sufficient capacity for the predicted gas yield and constructed of materials appropriate for landfill gas duty; blowers should be protected by flame arrestors at both gas inlet and outlet.
- Install and regularly sample boreholes surrounding the landfill to monitor for migration of landfill gas.

Recommended methods to control dust and odor emissions include the following:

- Compact and cover waste promptly after discharge from the vehicle delivering the waste.
- Minimize open tipping face area.
- Dispose of odorous sludge in covered trenches.
- Restrict acceptance of loads known to be particularly odorous.
- Restrict tipping activities during periods of adverse weather (e.g., wind toward sensitive receptors).
- Seal sump covers.
- Aerate leachate storage areas.

Litter

The following measures are recommended to prevent, minimize, and control dispersal of litter:

- Provide perimeter planting, landscaping, or fences to reduce wind.
- Pin waste by use of dozers and landfill compactors immediately after discharge from the vehicles delivering the waste.
- Use soil or artificial cover materials so that deposited waste is held in place. More frequent application of cover may be required during high winds or in exposed areas.
- Use scaring techniques or natural predators to control scavenging birds.
- Provide an emergency tipping area/foul weather cell for lightweight wastes such as paper.
- Construct temporary banks and bunds immediately adjacent to the tipping area, install strategically placed mobile catch fences close to the tipping area or on the nearest downwind crest, and/or fully enclose of the tipping area within a mobile litter net system.
- Install wind fencing upwind of the tipping area to reduce the wind strength as it crosses the facility.
- Temporarily close the facility to specific or all waste or vehicle types when weather conditions are particularly adverse.

iv) WWTP Operator Occupational Health and Safety

The most significant occupational health and safety impacts typically associated with workers at waste management facilities occur during the operational phase and include: i) Accidents and injuries; ii) Chemical exposure; and iii) Exposure to pathogens and vectors.

Accidents and Injuries

The following procedures are recommended to prevent, minimize, and control accidents and injuries for the operators working at the landfill:

- In landfills, conduct compaction of wastes in thin layers using heavy equipment and place regular cover material over each compacted layer of waste, so that any underground fires within a waste cell are not able to spread throughout the landfill and lead to significant cave-ins.
- Use maximum side slopes of 3:1 in this non-seismic areas with regular drainage of water so that saturated conditions do not develop and lead to slope subsidence.
- Provide workers with appropriate protective clothing, gloves, respiratory face masks and slip-resistant shoes for waste transport workers and hard-soled safety shoes for all workers to avoid puncture wounds to the feet. For workers near loud equipment, include noise protection. For workers near heavy mobile equipment, buckets, cranes, and at the discharge location for collection trucks, include provision of hard hats.
- Provide refuse collection vehicles and landfill equipment with audible reversing alarms and visible reversing lights.
- Improve the storage of solid wastes at the source so that the loads to be collected are well contained and not too heavy.
- Locate exhaust pipes on waste collection vehicles so that exhaust does not discharge into the breathing zone of workers on the riding steps.
- Restrict access to disposal sites such that only safety trained personnel with protective gear are permitted to high-risk areas.
- Provide workers with communications tools, such as radios. Special signaling codes have been developed for communications on landfill sites.

Chemical Exposure

Chemical hazards encountered at waste management facilities are similar to those at other large industrial facilities, such as toxic and asphyxiating gases. The following procedures are recommended to prevent, minimize, and control chemical exposure at waste management projects:

- Control and characterize incoming waste (see waste receipt, unloading, processing and storage).
- Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work.
- Ventilate enclosed processing areas (e.g., dust in waste size reduction areas, VOCs driven off by high temperatures during composting).
- Prohibit eating, smoking, and drinking except in designated areas.
- Provide air filtered and air conditioned cabs for heavy mobile equipment used at landfills as necessary.

Dust

Waste processing can generate nuisance and hazardous dust, including organic dust. Dust control measures discussed in Section 1.1 above, will also help to reduce worker exposure to dusts.

Pathogens and Vectors

Workers can be exposed to pathogens contained in manure and animal excreta found in the landfill from the disposal of sludge, carcasses, diapers, and yard trimmings containing domestic animal waste. The following measures are recommended to prevent, minimize, and control pathogens and vectors:

- Provide and require use of suitable personal protective clothing and equipment.
- Provide worker immunization and health monitoring (e.g. for Hepatitis B and tetanus).
- Maintain good housekeeping in waste processing and storage areas.
- Use automatic (non-manual) waste handling methods if practical.
- For landfills, promptly emplace, compact and cover of wastes in defined cells, especially for waste with the potential to attract vermin and flies, such as food wastes (especially animal by-products if accepted at the facility) and tannery wastes.
- Clean and wash with disinfectant the cabins of heavy mobile equipment used at regular intervals.
- Grade the area properly to prevent ponding (to minimize insect breeding areas).
- Use integrated pest-control approaches to control vermin levels, treating infested areas, such as exposed faces and flanks with insecticide, if necessary.
- Provide and require use of dust masks or respirators under dry and dusty conditions. Charcoal-filled respirators also reduce odor perception.
- Provide prompt medical attention for cuts and bruises. Cover open wounds to prevent contact with the incoming loads or feedstock.
- Fully enclose the waste management site with fencing so that no livestock or wildlife is able to come in contact with the waste, which contains significant potential to enable the spread of livestock and zoonotic disease, as well as spillover disease to wildlife. Provide daily cover of wastes to minimize the attraction to birds, which can become infected with avian influenza and other bird diseases that can then be carried off-site.

iv) Closure and Post-Closure

Landfill facility operators should plan for the closure and post-closure care of the facility. Such planning should take place as early as possible in the project cycle so that potential closure and post-closure issues are incorporated in the financial and technical planning. Closure and post-closure planning activities should include the following elements:

- Development of a closure plan which specifies the necessary environmental objectives and controls (including technical specifications), future land use (as defined in consultation with local communities and government agencies), closure schedule, financial resources, and monitoring arrangements;
- Evaluation, selection, and application of closure methods consistent with post-closure use and which should include the placement of a final cover to prevent further impacts to human health and the environment;
- Application of final cover components that are consistent with post closure use and local climatic conditions. The final cover should provide long term environmental protection by preventing direct or indirect contact of living organisms with the waste materials and their

constituents; minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs.

Financial instruments in place to cover the costs of closure and post-closure care and monitoring

5.4.3. Other works

a) Stormwater drainage and wastewater collection systems

Operations of stormwater drainage and wastewater collection systems under Coastal Cities Sustainable Environment Subproject – Quy Nhon City Sub-subproject would have impacts on the areas: (i) by the operation of the pumping stations (noise, vibration); (ii) the probability of flooding due to congestion of drainage sewer section; (iii) affected by odors from sludge which is dredged periodically; (iv) impacts from disposal of dredged septage; (v) impacts on the aquatic environment due to temporary receiving wastewater discharged from untreated sewer section (this ends when wastewater treatment plants commence stable operations). Mitigation measures are as follows :

➢ *Minimize the pollution caused by the operation of the pumping stations:*

The pumping stations with the large capacity often cause vibration and noise at high levels. Pump sets would be placed in a separate room. The pumps would be installed with equipment to prevent vibration and noise. Specifically:

Technical measures when installing:

- Construct proper machine room for pump sets
- Foundation to put the machine would be built with high-quality concrete
- Install anti-vibration buffer made from rubber
- Install silencers equipment

Management and maintenance measures:

- The pumps would be examined the balance and adjusted if necessary.
- Periodic maintenance and lubrication to minimize noise.

Measures to minimize environmental pollution caused by fuel leakage during the operation of pumping stations:

- Do not store fuel at the pumping stations to minimize the possibility of fuel leakage to the receiving source.
- Feeding the fuel into the pumps would be done in careful manner to avoid fuel spillage.
- Lubricant, greasy rags from maintenance and operations of the pumps must be entirely collected and transported to appropriate treatment areas.

➢ *Minimize pollution due to congestion of drainage sewers:*

- The management of stormwater drainage and wastewater collection systems should be focused and examined regularly to detect the congested drainage sewer sections and carry out dredging.
- Conduct periodic planning decentralization and dredging sewer sections and manholes in order to minimize the flow congestion (every 6 months).

➢ *Control disposal of sludge:*

- Similar to the construction phase, those who manage the water drainage systems would have contracts with relevant authorities of sludge dredging from the sewer sections and manholes and then transport to Long My landfill by specialized tank trucks to avoid odor emission and spillage during transportation.

b) Toilets of schools

Control of odors:

- The area for the construction of school sanitation blocks must be appropriately distant from classrooms and located at the end of wind direction.
- Ventilation systems would be designed and installed.
- The toilets must be supplied with adequate water.
- Pupils/students should be reminded to flush after using toilets.
- Toilets would be regularly cleaned.

Control the amount of sludge, septic tanks:

- Dredge periodically.
- The dredged sludge would be transported to Long My landfill by specialized tank trucks to avoid the odor emission and spillage during transportation.

Domestic wastewater:

Domestic wastewater would be treated preliminarily by 3-compartment septic tanks before being discharged into common sewers and then be directed to treatment stations

c) Component 2 - Minimize impacts of Y-shaped and Huynh Tan Phat bridges

Traffic safety measures on the routes:

- Warning, instruction and speed limit signs would be designed on the roads.
- Periodically check the quality of the bridge to avoid the risk of potential accidents
- Install barriers, separators, road markings, traffic signs according to the charter of road sign 22TCN 237-01 of Vietnam Road Administration.
- The lighting system in the sections crossing the bridge would be designed following the standards TCXDVN 259-2001 of the Ministry of Construction.

Minimize the impacts of traffic congestion:

- Streamline and redirect traffic, consult with the ward authorities and communities in advance
- Implement the necessary measures such as placing signals, signs... to ensure traffic order and safety.

5.5. Measures to Mitigate Cumulative Impacts

The assessment indicates that the cumulative impacts of the CCSEP and the associated projects are mostly positive. The negatives cumulative impacts are minor to moderate and can be addressed individually at the project level.

5.6. Measures to Manage, Prevent and Respond to Risks and Incidents in the Subproject

5.6.1. Preparation Phase

Safety regulations on construction and labor safety must be complied with during demolition for site clearance.

During the site clearance, when conflicts arise leading to complaints and disputes, the Subproject Management Board would receive grievance and complaints of citizens and propose specific guidelines and explanations:

- Disclose the subproject information and grievance redress procedure to the affected people.
- Provide guidance to affected households how to submit the grievance request starting from People's Committee of Commune/Ward. If the affected household do not agree with the resolution of People's Committee of Commune/Ward, they can further request to People Committee of District and/or Province and and ultimately the People's Courts.

5.6.2. Construction Phase

- ***Measures to prevent fire, electric shock:***

The most important incident for the whole area would be fire incidents. To prevent these incidents, investors would implement the following measures :

- Power lines in offices and construction sites must be safely installed. Power connectors must not be left on the ground and must have plugs and sockets. Outdoor electrical panels must be securely placed in protective boxes/cabinets.
- Safety rules must be posted at construction sites.
- Warning signs on areas prone to fire and explosion must be installed.
- Construction sites must be equipped with fire extinguishers.
- Install appropriate lighting system.
- Install automatic fire equipment for the whole area..
- Install fire extinguishing system inside the wall.
- Arrange fire and explosive rescue system.
- Inspect the fire and explosive prevention on a regular basis .
- Regularly communicate, train officials, workers on fire protection methods .
- Design and construct water supply systems with a sufficient storage capacity to ensure the fire prevention and protection in the entire subproject area.
- Fully comply with fire protection and prevention regulations, such as fire protection and prevention Act, TCVN 2622-1995 on fire protection and prevention for houses and buildings - design requirements; TCVN 5738-2000: automatic fire alarm systems - technical requirements, TCVN 5760-1993: Fire prevention system - General requirements for the design, installation and usage. TCVN 5040-1990: group fire protection and prevention equipment - symbols on the diagram of fire prevention - technical requirements.
- Regularly check the equipment on the probability of fire and explosives such as electrical appliances for daily activities .

- Manage the use of electrical equipment in the offices and operating rooms of wastewater treatment plant properly. Avoid using overloaded electrical equipment that may affect the electrical system of whole works.

Measures to prevent Subsidence:

- Prior to construction, survey and investigation must be carried on the geology of relevant areas to work out appropriate construction plans.
- Reinforcements must be performed with piles and steel piles at the construction sites for large-size pipelines and with great depths.
- In case of incident, construction must be immediately suspended, and repairs and compensation must be made for local people.

- ***Safety measures during transportation***
  - When automobiles are mobilized, brake and safe navigation system must be inspected, transportation vehicles must have wide lights and signboard
  - When it is foggy or smoky affecting visibility less than 30m, turn yellow lights or taillights. When the visibility is less than 30m or it is rainy or has thunderstorms which are dangerous, automobiles must be stopped running.
  - Transportation vehicles to/from the construction sites must not generate dust and mud on the routes.
- ***Measures to ensure safety for the construction of bridges***
  - All staffs and workers who work in construction sites must be equipped with sufficient labor protection, life buoys, water pumping against sinking, anti-perforation tools.
  - The vehicles must have sufficient buffers to ensure the safety during construction, arrange the guards to conduct regular checks on the vehicles involved in the construction to ensure the safety of equipment and people.
  - Contractors arrange qualified workers with, good health, being trained appropriately to the job.
  - Contractors are completely responsible for the safety of their people, facilities and equipment during construction.
  - Arrange medical personnel to be on duty in construction sites to perform promptly in emergency, when workers are sick or suffer from occupational accidents.
  - Officials and workers involved in construction would learn and be trained regularly on occupational safety and environmental hygiene.
  - The construction facilities are equipped with fire-fighting tools such as fire extinguishers, fire extinguishing blankets...

5.6.3. Operational Phase

- **Stormwater drainage sewer sections, collection of wastewater on the (Component 1)**

<u>*Congestion of drainage sewers*</u>

- The management of stormwater drainage and wastewater collection systems should be focused and examined regularly to detect the congested drainage sewer sections and carry out dredging.
- Develop plan and periodic dredging the sewer sections and manholes in order to minimize the flow congestion.

Fuel leakage during the operation of pumping stations::

+ Do not store fuel used for pumping operations at the pumping stations to minimize fuel leakage leading to the pollution of the receiving source.

+ Feeding the fuel into the pumps need to be done carefully to avoid fuel spillage.

+ Lubricant, greasy rags from maintenance operations of the pumps need to be entirely collected and transported to appropriate treatment areas.

- **Landfill cells**

Subsidence of landfill cells

- During operation of landfills, there would be likely subsidence of landfill cells due to leachate absorbing to the outside and gas emission after landfill plots have been filled and covered.
- The subsided landfill plots would be filled with further soil in order to stabilize the landfill and improve the process of environment regeneration later on.

Fire and explosion

- During operation of landfill cells, gases generated from landfill would be flammable, causing fire and explosion as CH4, C2H2,... Hence, during the operation of landfill cells, the operator should be complied with technical requirements. At the same time, the fire protection and prevention drills would be periodically demonstrated in order to improve the response capability of the staff upon arising incidents.
- Equip sufficient fire fighting facilities.
- When there is a fire incident, all personnel involve in fighting and contact with the nearest fire fighting department.

Incidents of the leachate treatment system

- It should have plans for handling and remedy when an incident occurs. When the treatment system is out of work, the water would be pumped into the non-activated cells then pumped back to the garbage reservoir after the problem is handled.

Disease transmission

- The disease which would be identified as being from landfills are normally caused by intermediate hosts of disease transmission such as rats, cockroaches, flies, mosquitoes... it is necessary to spray in landfills and affected communities. There are supporting policies for the sick.

- **Nhon Binh Wastewater treatment plants**

Incidental discharge from the WWTP:

- Prepare an emergency plan for incidental discharge of untreated waste water and conduct emergency training for the operators.
- Inform the residents of the incident and mitigation measures.

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 incidents due to breakage, damage, or leakage:
- Normally, a problem – if any - happens in only one module, the WWTP Company will operate the remaining module while repairing the mal functioning one. If fixing the incident takes too much time, exceeding the storage time of work items in the system, the Company will suspend operation to solve the said incident problem.
- 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.
- 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 water and pollutes the environment for a long time, the Company will report this incident to the management agency, i.e. Quy Nhon Department of Natural Resources and Environment, 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.
- Standby generators must be always available.

Chemical leakage

- Chemicals used for treating wastewater Nhon Binh WWTP mainly are $FeCl_3$, Polymer anion and javen solution. Thus, incident of chemical leakage does not cause the big influences to worker’s healthy, however, it also need to be paid attention to avoid chemical leakage. This incident is a waste of chemicals.

Malfunction of machinery and equipment

- In case there would have malfunction of machinery and equipment in wastewater treatment station, backup device should be used (as mentioned in the design process).
- If repairing period is too long, it is necessary to disinfect wastewater before discharging it into receiving source.

Minimize fire and explosive incidents

- Fire extinguishers must be equipped.
- Fire alarm systems and alarm information systems must be set up.

- Lightning arresting systems must be installed in highly-elevated areas.
- Electrical equipment must be maintained in safe working condition, preventing electrical sparks in dangerous areas.
- Electrical machines and equipment must be grounded against electrical leaks and electromagnetic accumulation.
- The technical level of operating workers, especially regulations fire safety and regulations on fire prevention and firefighting regulations, must be raised through exercise and practice of fire prevention and firefighting. Workers must be regularly checked on and reminded of regulations on environmental safety and fire prevention and fighting. Security guards and the firefighting team have to be on duty 24 hours a day.
- Plans for preventing and fighting fire and explosion are to be submitted to State management agencies for approval and implementation.

Operating workers' health

- Workers must be adequately equipped with labor protective clothing.
- First-aid kits would be available on site.
- Workers must be trained on health safety;
- The awareness of environmental hygiene and social is to be propagated to workers.
- Workers' health is to be periodically checked.
- Y-shaped and Huynh Tan Phat bridges

Cracked bridge:

Bridges need to be regularly checked and maintained. If there would have an incident, traffic on the bridge should be blocked and repaired promptly.

Traffic congestion

- Streamline and redirect traffic, consult with local authorities and communities in advance
- Implement the necessary measures such as placing signals, signs... to ensure traffic order and safety.

Measures to prevent traffic accidents on the routes

- The barriers, separators, road markings, traffic signal system should be installed in accordance with the provisions of Regulations No. 22TCN 237-01 issued by the Ministry of Transport.
- Lighting system on the bridge should be designed in accordance with the provisions of standard TCXDVN 259-2001 issued by the Ministry of Transport.
- Develop the operation and maintaince plan of bridge management unit: barriers, separators, road markings, traffic signs according to the charter of road sign

CHAPTER 6. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

On the basis of the assessment of negative impacts presented in Chapter 3 and the measures of impact mitigation recommended in Chapter 5, this Chapter will present the Environmental and Social Management Plan (ESMP) for Nha Trang Sub-project. The Environmental Management Program will identify the activities/actions to be implemented in the city of Nha Trang Sub-project, including the environmental monitoring program and its implementation schedule, taking into account the compliance with the provisions of the Government's ESIA and safety policies of the World Bank (WB).

To ensure that all sources of pollution arising from the subproject activities during the preparation stage and the construction stage as well as in the operation period will not cause any negative impacts on the environment and public health, it is compulsory that the management, monitoring and supervision of environmental quality be executed in a scientific, systematic and regular manner. Below is a summary of environmental impacts, mitigation measures and responsibilities of stakeholders.

ESMP's mitigation measures are divided into 3 basic parts: (1) ECOP, (2) Specific mitigation measures for the specific types of works, and (3) Site-specific mitigation measures for each sensitive location to be affected by the subproject's works items.

(1) All of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction projects to minimize impacts such as noise, dust, vibration, waste generation, traffic hindrance, public safety, etc. In this context, an ECOP has been prepared describing specific requirements to be carried out by contractor to mitigate the subproject potential impacts considered to be general impacts (Section 6.1). The contractor will also be required to mitigate site-specific impacts which will be identified to address issues specific to the subproject.

(2) In addtion to adopting the ECOPS, specific mitigation measures have been identified (Section 6.2) for addressing the impacts associated with the specific types of works under the subproject such as the WWTP, sewers, drainage systems. These measures will be included in the contracts for corresponding packages.

(3) All the impacts specific for each sensitive receptor of which mitigation measures could not be addressed through implementation of the ECOPs, site-specific mitigation measures will need to be implemented (Section 6.3).

Measures to mitigate impacts from land acquisition and resettlement are mentioned separately in the Resettlement Plan (RP) and those measures will be carried out and supervised separately.

6.1. Mitigation Measures for General Construction Impacts

Typical common impacts which will be minimized by mitigation measures defined in ECOP include: (1) Dust, exhaust gases, noise and vibration; (2) wastewater management; (3) Solid waste management; (4) Hazardous waste; (5) Water pollution management; (6) Impacts on aquatic species and terrestrial ecology; (7) Management of impacts on urban landscape and beauty; (8) Management measures of sedimentation, erosion and flooding; (9) Traffic safety management; (10) Influence to existing infrastructure and services, (11) Management of impacts on social activities; (12) Management of impacts on cultural and religious works; (13) Measures to secure community healthand safety; (14) Measures to secure worker's health and safety, (15) Management of warehouses and borrow pits, (16) Communication to local community.

Table 6.1. Environmental Codes of Practices for addressing general construction impacts (ECOPs)

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
1. Generated dust, emission, noise, vibration	• Maintain the level of emission at construction sites within the permissible limit provided for in QCVN 05: 2013/BTNMT: National Technical Regulation on Ambient Air Quality. • Vehicles in Vietnam must undergo a regular emissions check and obtain certification: "Certificate of conformity from inspection of quality, technical safety and environmental protection" following Decision No. 35/2005/QD-BGTVT • Carry out watering for dust control at least 3 times a day: in the morning, at noon, and in the afternoon during dry weather with temperatures of over 25^{o}C, or in windy weather. Avoid overwatering as this may make the surrounding muddy. • 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 by workers where dust levels are excessive • There should be no burning of waste or construction materials on site. • Cement processing plants should be far from residential areas. • Only use transportation vehicles with valid registry. • Neatly gather construction materials and wastes. Arrange for the workers to collect and gather construction materials and wastes to the designated places at the end of each day or shift. • Do not overload the materials/soils and stones to extreme heights onto trucks, as this may result in drops along transportation routes. Tightly cover the trucks carrying wastes and bulk materials before getting out of construction sites or quarries and borrow pits so as to restrict scattering along transportation routes. • Put temporarily gathered materials and waste heaps with a volume of about 20m^{3}within barriers or covered so as to avoid dust dispersion. • Transport wastes out of construction sites to the designated locations for reuse or to the disposal sites in the soonest possible time.	• QCVN 05: 2013/MONRE:National technical regulation on ambient air quality • QCVN 26:2010/BTNMT: National technical regulation on noise • QCVN 27:2010/BTNMT: National technical regulation on vibration • TCVN 6438-2005**:** Road vehicles. Maximum permitted emission limits of exhaust gas • Decision No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection;	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	• Do not put vehicles and machines to run idle in more than 5 minutes. • Avoid preparations of construction materials such as mixing concrete near local people's houses or other sensitive works like pagodas, school gates, or offices. • Locate vehicle washing stations at the exit/entrance of big construction sites such as the areas for WWTPs, stormwater and wastewater pumping stations. • Periodically wash the trucks used for transporting materials and construction wastes. • Avoid construction operations generating great vibration and loud noise within the time between 6pm and 7am when construction takes place near residential areas. Night construction must be informed to the community at least 2 days in advance. • Perform the method of successive construction for each sewer section in construction sites of long sewer lines. • Observe and secure construction progress correctly. • Set up 2.5m-high fences of corrugated iron around the construction sites such as the areas for the WWTP, bridges. • When needed, measures to reduce noise to acceptable levels must be implemented and could include silencers, mufflers, acoustically dampened panels or placement of noisy machines in acoustically protected areas • Avoiding or minimizing transportation through community areas and avoiding as well as material processing areas (such as cement mixing).			
2. Wastewater management	• The Contractor must be responsible for compliance with Vietnamese legislation relevant to wastewater discharges into watercourses. • Employ local workers to limit the amount of generated domestic wastes and wastewater. • Provide septic tanks for toilets for treating wastewater before it can be discharged into the environment. On-site mobile toilets with 3-compartment septic tanks can be used in areas for major work items as traffic roads, WWTP. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a	• QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater; • QCVN 40: 2011/ BTNMT:	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any waterbody • Wastewater containing pollutants over standards set by relevant Vietnamese technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors**.** • Clear ditches around the workers' camps every week. • Build sedimentation ponds and ditches to receive stormwater runoff at the construction sites such as the areas for WWTP, stormwater and wastewater pumping stations. • Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding. • Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contracts have been obtained. • At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off	National technical regulationon industrial wastewater		
3. 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 the Contractors and it must be carefully followed during construction activities. • Before construction, all necessary waste disposal permits or licenses must be obtained. • 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. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • No burning, on-site burying or dumping of solid waste shall occur. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor	• Decision No, 59/2007/NĐ-CP on garbage management; • Decision No, 38/2015/NĐ-CP dated 24/04/2015 on waste and scrap management	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses. • Limit waste pollution from litter and drop of materials. Place dustbins at the workers' camps. • Temporarily collect and separate domestic wastes. Provide watertight dustbins for domestic waste and tightly cover them to avoid giving rise to bad odors and leachate leakage, attracting flies, mice and other pathogenic species. Periodically collect and transport the waste to the dispose at Long My landfill. • Perform concrete mixing on impermeable ground. Collect waste and wastewater containing cement through drainage ditches with sedimentation pits in construction sites before being discharged into receiving waters. • Separate the components and parts which can be reused or recycled in the construction wastes before transporting the waste to Long My landfill in accordance with design documents acceptable to the supervision engineer. • Weathered soil, wood and bricks can be reused for useful purposes such as ground leveling. Wood scraps may be used for cooking. Corrugated iron, iron, steel, packing materials and other materials which can be recycled can be delivered and sold to scrap traders. • Collect waste and tidy up construction sites at the end of a working day/shift and the transport waste out of the construction sites in the soonest possible time. If dredged materials are to be temporarily stored, necessary measures must be applied to control pollution such as gathering them within enclosures, under coverings, within fenced areas, etc. with warning signs. • The Contractor will sign a contract with Quy Nhon Urban Environment Company to collect solid waste, conforming to Decree No. 59/2007/ND-CP dated 09 April 2007 on solid waste management and Decree No. 38/2015/ND-CP dated 24 April 2015 on management of waste and waste materials.			
4. Hazardous waste management	• Temporarily collect, store, and transported for treatment all hazardous wastes (road asphalt, waste oil and grease, organic solvents, chemicals, oil paints, etc.)	• Circular No. 36/2015/TT-BTNMT on	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	in accordance with Circular No. 36/2015/TT-BTNMT on management of hazardous waste. • 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 • Chemical waste of any kind shall be disposed of at an approved appropriate landfill site and in accordance with local legislative requirements. The Contractor shall obtain needed disposal certificates. • The removal of asbestos-containing materials or other toxic substances shall be performed and disposed of by specially trained and certified workers. • Used oil and grease shall be removed from site and sold to an approved used oil recycling company. • Used oil, lubricants, cleaning materials, etc. from the maintenance of vehicles and machinery shall be collected in holding tanks and removed from site by a specialized oil recycling company for disposal at an approved hazardous waste site. • 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 labeling • Appropriate communication and training programs should be put in place to prepare workers to recognize and respond to workplace chemical hazards • Prepare and initiate a remedial action following any spill or incident. In this case, the contractor shall provide a report explaining the reasons for the spill or incident, remedial action taken, consequences/damage from the spill, and proposed corrective actions.	hazardous waste management; • Decision No. 38/2015/NĐ-CP dated 24/04/2015 on waste and scrap management		

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
5. Water pollution	• The Contractor is responsible for controlling the surface water quality when discharging it out of the construction site, in accordance with QCVN 08-MT:2015/BTNMT – *National Technical Regulation on surface water quality* and QCVN 14:2008/BTNMT – *National Technical Regulation on domestic wastewater quality*. • Provide preliminary sedimentation ponds and ditches of stormwater runoff at the construction sites such as the areas for WWTPs, balancing lakes, stormwater pumping stations, and main pumping stations. • Provide construction workers on site with mobile toilets. • Avoid excavation and backfilling during rains. • Gather materials and wastes generated during excavation and backfilling, collect and transport them out of the construction site to the approved disposal sites within the soonest possible time. • Do not allow temporary gathering of bulk materials and mixing of concrete within 50m from ponds, lakes, rivers, streams, or other water sources. Maintain maximum distances possible between the gathering points to water sources in the construction of Ha Thanh river • Store used and unused oil and petrol in closed containers on impermeable ground covered with roofs and contained within surrounding banks for easy control and collection in case of leakage. Do not locate oil and petrol storages within 25m from ponds, lakes, rivers, and streams. • Collect and transport excavated soils from the construction of sewers and ditches out of the construction site within 24 hours. • Only perform maintenance work of motored vehicles and equipment, including oil replacement or lubrication in designated areas, without allowing chemicals, petrol, oil, or grease to leak onto soil or into the drainage system or water sources. Trays are to be used to hold rags and materials used in maintenance. Collect and discard wastes in accordance with hazardous waste management regulation.	• QCVN 09:2008/BTNMT: National technical regulation on underground water; • QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater; • QCVN 40: 2011/ BTNMT: National technical regulationon industrial wastewater; • TCVN 7222: 2002: General requirements for concentrated wastewater treatment plants	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
6. Impacts on plants and aquatic species	• The Contractor shall prepare a Clearance, Re-vegetation and Restoration Management • Plan for prior approval by the Construction Engineer, following relevant regulations. The Clearance Plan shall be approved by the Construction Supervision Consultant and followed strictly by the contractor. Areas to be cleared should be minimized as much as possible. • Limit disturbances to areas with construction operations, especially in locations covered with green trees or vegetation. Do not use chemicals to clear vegetation. • Do not gather materials and wastes at places covered with vegetation or with green trees, but on vacant land instead. • Use sheet pile driving method using Larsen piles to limit impacts on the water quality. • If possible, green trees should be moved and replanted in other places if the trees are in the way of the pipelines to be constructed. • The contractor shall remove topsoil from all areas where topsoil will be impacted by construction activities, including temporary activities such as storage and stockpiling, etc; the stripped topsoil shall be stockpiled in areas agreed to by the Construction Supervision Consultant for later use in re-vegetation and shall be adequately protected. • Trees cannot be cut down unless explicitly authorized in the vegetation clearing plan. • When needed, temporary protective fencing will be erected to efficiently protect the preserved trees before commencement of any works within the site. • No area of potential importance as an ecological resource should be disturbed unless there is prior authorization from CSC, who should consult with PMU, IEMC and the relevant local authorities. This could include areas of breeding or feeding for birds or animals, fish spawning areas, or any area that is protected as a green space. • The Contractor shall ensure that no hunting, trapping, shooting, poisoning of fauna takes place.	• Law on environmental protection No. 55/2014/QH13	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
7. Impacts on urban landscape and beauty	• Carefully cover transport vehicles for materials and waste and periodically wash and clean the vehicles. • Dismantle the camps as well as other temporary works set up during construction and restore the site before the completed work could be handed over to the subproject owner. Back fill and tightly seal toilet pits, septic tanks, and temporary sewerage ditches. • Do not temporarily gather construction materials and wastes within 20m from the gate of schools, offices temples, pagodas, etc. • The Contractor will have to work out construction plans in such a way as to avoid the 1st and 15th days of each lunar month if construction is to be carried out near historical and cultural works such as pagodas, churches, temples, etc. • Regularly collect materials and wastes and tidy up the construction site. • Materials and waste around the construction site must be regularly collected and construction sites are to be neatly tidied up.	• Law on environmental protection No. 55/2014/QH13 • TCVN 4447:1987: Construction regulation • Circular No. 22/2010/TT-BXD on requirements on safety	Contractor	PMU, CSC, IEMC
8. Sedimentation, erosion, flooding, subsidence and slides	• Avoid disturbances and damage to the existing vegetation and green trees. • 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 leveling and rolling after discarding materials at disposal sites.	• TCVN 4447:1987: Construction regulation • Circular No. 22/2010/TT-BXD: Regulation on construction safety • QCVN 08:2008/BTNMT – National technical regulation on surface water quality	Contractor	PMU, CSC, IEMC
9. Traffic management	• Before construction, carry out consultations with local government and community and with traffic police.	• Law on communication	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	• Arrange and provide separate passageway with safe and easy access for pedestrian and for people with disability and mobility issues especially the areas in proximity of schools, including easy wheel chair access and hand rail. Make staff available any time for helping people with disability if needed. • 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. • During construction near schools, deploy staff at the site to guide the traffic at the start of school time and when school is over. 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 areas near schools. • Install night lighting of all construction sites. • 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 circulation. • Employ safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hours. • Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signposts shall be installed appropriately in both water-ways and roads where necessary.	and transport No. 23/2008/QH12; • Law on construction No. 50/2014/QH13; • Law No. 38/2009/QH12 dated 19/6/2009 amending and supplementing some articles of the Law relating to capital construction investment • Circular No. 22/2010/TT-BXD on regulation on construction safety		

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
10. Influence to existing infrastructure and services	• Provide information to affected households on working schedules as well as planned disruptions (at least 2 days in advance). • The Contractor must only use vehicles of sizes and loads within permissible limits for the roads along such vehicles' route. • During the construction under power lines, deploy qualified staff to observe and give instructions to the drivers of cranes and excavators so as to avoid causing damages to power lines, telecommunications lines, etc. • Stop construction when existing works 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. • Reinstall the road surface and sidewalks at construction sites after the construction of sewer lines has been completed. • The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day. • Any damages to existing cable utility systems shall be reported to the authorities and repaired as soon as possible.	• Decree No. 73/2010/ND-CP on administrative penalization of violations related to security and social affairs	Contractor	PMU, CSC, IEMC
11. Social mitigation measures through worker management	• Inform the community at least 2 weeks before commencement of the construction. In case electricity and water supplies are to be disrupted, the PMU must inform PAHs of the same at least 2 days in advance. • Employ local laborers for simple tasks. Instruct workers on environmental issues, safety and health before construction tasks are assigned. It is advisable to communicate to migrant workers on local customs, practices and habits in order to avoid conflicts with local people. • The subproject 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 subproject owner and contractor are to cooperate with local authorities in preventing and fighting against social evils. Conduct sensitization campaigns	• Decree No. 73/2010/ND-CP on administrative penalization of violations against security and social affairs	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	with both workers and communities on these issues, liaison with local organizations to ensure monitoring, and a grievance redress system to which the community can refer to. • The subproject will cooperate with the local health agency in developing and implementing plans for control of diseases among workers. • Workers temporarily residing at the camps and rented houses must be registered with the local authorities for temporary residence. • Train workers on issues related to social security, social evils, diseases and epidemics, prostitution and drug use, environment, safety and health, HIV/AIDS and infectious diseases within 2 weeks prior to the commencement of packages with construction items lasting at least 6 months. • Prohibit workers from: + Consuming alcoholic drinks during working time + Quarreling and fighting + Gambling and indulging in social evils such as drug use and prostitution + Disposing of garbage indiscriminately			
12. Control of impacts on cultural works	• Do not gather materials and wastes within 20m from cultural, historical, and religious works such as temples, pagodas, churches, monuments, historic relics, etc. Water spray the construction sites next to such works. • Do not use machines generating loud noise and high vibration levels near cultural, historical, and religious works. • In case of archeological objects being unearthed during the implementation of earthwork, all parties will conform to the following 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	• Law on cultural heritage No. 28/2001/QH10; • Amended and supplemented Law on cultural heritage No. 32/2009/QH12; • Amended and supplemented Decree No. 98/2010/ND-CP	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	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 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			
13. Community's safety and health	• The Contractor will have to conform to regulations in Circular No. 22/2010/TT-BXD by the Ministry of Construction on safety in construction. • The subproject 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 subproject owner and contractor are to cooperate with local authorities in preventing and fighting against social evils.	• Circular No. 22/2010/TT-BXD regulation on construction safety • Directive No. 02/2008/CT-BXD on safety and	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	• Fence off the construction sites of the pumping stations and the WWTP with corrugated iron sheets at least 2m high. • 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 subproject will cooperate with the local health agency in developing and implementing plans for control of diseases among workers.	sanitation issues in construction units • TCVN 5308-91: Technical regulation on construction safety • Decision No. 96/2008/QD-TTg on clearance of UXOs		
14. Workers' health safety	• Train workers on issues related to environment, safety and health, thus enhancing their awareness of HIV/AIDS and infectious diseases within 2 weeks prior to the commencement of packages with construction items lasting at least 6 months. • Provide workers with and request them to use adequate safety gear such as masks, helmets, shoes/boots, goggles, etc. depending on job characteristics. • Safely install power lines at offices and in construction sites and do not lay connectors on the ground or water surface. Electric wires must be with plugs. Place outdoor electric panels in protection cabinets. • Limit the speeds of vehicles traveling inside construction sites to be 5km/hour. • Provide fire-extinguishers, first-aid bags, and medical cabinets with sufficient medicines for treating general diseases in the locality must be provided at construction sites. • Safely store fuels and chemicals 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. • In case of chemical and fuel leakage, the following steps will have to be taken:	• Decree No. 22/2010/TT-BXD on regulation of construction safety; • Directive No. 02 /2008/CT-BXD on safety and sanitation issues in construction units; • TCVN 5308-91: Technical regulation on safety in construction; • Decision No. 96/2008/QD-TTg	Contractor	PMU, CSC, IEMC

Environmental-social issues	**Mitigation measures**	**Vietnamese regulation**	**Responsibility**	**To be supervised by**
	+ Immediate check must be carried out to detect any possible case of injury. In case of injury, first-aid must be given and the injured person must be rushed to the nearest medical station for healthcare, and at the same time the case must be informed to the Supervision Engineer and the PMU; + Carry assessment to determine the kind of leaking/overflowing fuel/chemical; + Do not flush overflowing chemicals into drainage systems. Send staff with suitable safety gear to the site to handle the leakage by scattering sawdust (in case of small volumes of leaks/overflow) or sand (for high volumes of leaks/overflow). Use shovels to remove the surface soil layer if the leakage/overflow takes place on vacant land; and + Subsequent to the occurrence of such incident or accident, the Contractor will have to prepare a detailed report describing the incident and performed activities and submit the same to the Supervision Engineer and the PMU for consideration and filing. Such report will also be presented to the Department of Natural Resources and Environment or functional agencies at their request.. • Set up the camps with sufficient supplies of clean water, power, and sanitation 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 in good sanitation conditions. 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.	on clearance of UXOs.		
15. Management of warehouses and borrow pits	• All borrow pit locations to be used must be previously identified in conformity with approved construction technical specifications. Sensitive sites such as scenic spots, areas of natural habitat, areas near sensitive receiving waters, or areas near water sources should be avoided. An open ditch shall be built around the stockpile site to intercept wastewater. • Retaining walls are to set uparound disposal areas if necessary.		Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	• The use of new sites for stockpiling, gathering or exploiting materials necessary for construction operations must obtain prior approval from the Construction Engineer. • In case landowners are affected by the use of their areas for stockpiling, gathering or exploiting materials, such landowners must be included in the project resettlement plan. • If access roads are needed for these new sites, they must be considered in the environmental assessment report. • PMU's Environment Officer should conduct due diligence to make sure that borrow pits and quarries are legally operating by undertaking a rapid review of quarry sites to assess if operations are in compliance with Vietnamese laws and Bank requirements prior to construction. • Include the requirement that the contractors shall be required to buy materials from licensed borrow pit and quarry operators into the civil work contractual documents.			
16. Communication to local community	• Open communications channels are to be maintained with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leaders of hamlets) for agreed schedules of construction operations in areas nearby sensitive places or during sensitive times (e.g. religious festival days). • Copies of Vietnamese versions of these ECOPs and of other relevant environmental protection documents shall be made available to local communities and to workers at the site. • Project information will be disseminated to affected parties (e.g. local authorities, enterprises and affected households, etc.) through community meetings before construction commencement. • A contact address will be provided to the community. • The community will be provided with all information, especially technical findings, in a language that is understandable to the general public and in a form convenient to interested citizens and elected officials through the preparation of	• Decree No. 73/2010/ND-CP on administrative penalization of violations related to security and social affairs	Contractor	PMU, CSC, IEMC

Environmental-social issues	Mitigation measures	Vietnamese regulation	Responsibility	To be supervised by
	fact sheets and news releases, when major findings become available during project phase. • Community concerns and requested information are to be monitored as the project progresses. • Inquiries must be responded by telephone and written correspondence in a timely and accurate manner. • Local residents must be informed about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition operations, as appropriate. • Technical documents and drawings will be provided to local People's Committees, especially the sketch of construction areas and the EMP of the construction site. • Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that affected people could have a channel to voice their concerns and suggestions.			

6.2. Specific Mitigation Measures for the Specific Types of Works

These specific measures should be used in conjunction with relevant government technical regulations and the ECOPs of the subproject to address the specific types of civil works including construction of the wastewater sewers, wastewater treatment plants, pumping stations, embankment, and roads

Table 6.2. Specific Mitigation Measures for the Specific Types of Works

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
Component 1			
1. Construction of the Box Culverts at Phu Hoa Canal and Upstream Ditch of Bau Sen Lake			
Dust, noise, exhaust gases, vibration and excavated soil	• 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. • Excavation for pipeline installation will be implemented in stages, following the rolling method:	Contractor	PMU, CSC, IEMC

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	✓ For sewers, pipe trenches shall be excavated along the street at 50m long for each section. After the pipes are installed, the contractor shall proceed with refilling the trench and making temporary road surface instatement immediately, before moving to the next section. Each 50 m long section will be implemented within 24 hours. For asphalt road, final road surface reinstatement will take place within three weeks from excavation. ✓ For storm water drainage, each section up to 300 long should be excavated at one time. After installation is completed, refilling should be carried out immediately as per technical specifications before moving to the next 300 m section. Avoid excessive excavation and prolonged construction on any street in order to minimize the negative impacts on daily life of the households living along the roads. The excavated soil shall be transported out of excavated areas to the landfill as soon as possible and within 24 hours • Train workers on how to respond to landslide: • Do not store the materials along the ditch. Cover construction site carefully. • Set up 2 meters fence in height surrounding construction site. • Carry out the construction activities carefully in order to avoid all the concrete slabs are removed at the same time which causes odor spread. • Immediately remove dredging material to avoid giving rise odor. • Cover the ditch with woven sheets to decrease the odor after each working day when no construction is being carried out. Clean up the site after each construction session. • Encouraged to use low-noise equipment and adopt proper construction methods. • Suspend the construction activities during the local's break time (during noon and from 6 pm to 6 am). • Collect wastes and tidy up the construction sites at the end of a working day/shift; transport the wastes out of the construction sites as soon as possible. If dredged materials would to be temporarily stored, necessary measures must be applied to control pollution such as gathering them within enclosures, under coverings, within fenced areas, etc. with warning signs being set up. • Use specialized tank truck to transport sludge or fully covered vehicles while transporting sludge in a way that do not drop sludge on public roads. • Sign the contract with URENCO unit for transportation and disposal as well as sludge treatment at the Long My landfill. • Use the mobile toilet to avoid polluting the surrounding environment.		

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Stormwater runoff: Use drains combined with sand sedimentation holes before discharge into the sewer system. • Provide training on occupational safety for workers. • Post internal rules and safety signs at site. • Regularly check the safety of equipment and construction machineries. • Place the healthcare tools and addresses to look for in case of accident, such as medical cabinets, emergency eyewash and shower equipment, addresses and phone numbers of hospitals would be clearly informed. • Conduct traffic diversion, diversion signs, speed signs and erect warning signs. • Strictly prohibit the use of air horn when crossing residential area. • Only implement the construction within the cleared ground area. • Inform migrant workers of local culture and norms. • Perform tanagement of construction workers who are temporarily residing at the locality would be performed in close coordination through relevant authorities. - Arrange construction plans and schedules to avoid in festival/holidays on the 1st and 15th of each lunar month. Regularly clean up materials, wastes gathering sites near Nguyen Hue pagoda on Phu Hoa canal, Ngoc Nhon temple, Truc Lam pagoda (Tran Hung Dao road).		
2. Stormwater Drainage Culverts on Tran Hung Dao and Bach Dang Streets, in Hoc Ba Bep Area, and Tertiary Culvert Networks			
Dust, noise, exhaust gases, vibration and excavated soil, solid waste, wastewater	• Erect and maintain the bulletin boards at the site, containing the following information: full name and phone number of the Site Manager, Supervision Consultants and Owner, duration and scope of work. • Devise and carry out a plan for successive construction, with each section of a length of 50m for wastewater sewers and 300 m for stormwater sewers. The site of each completed construction would be reinstated within 24 hours. In sections to be asphalted, asphalting must not exceed 3 weeks from the date of site reinstatement. After stormwater drainage lines are installed, backfilling must immediately be carried out in accordance with technical requirements before excavation for the next section can be started. • Erect fences, sign boards, warning boards, beacons, and barriers along ditches and roads under construction in accordance with current regulations. "Sorry for any conveniences caused" signs during construction must be placed in densely populated areas with many restaurants, hotels, etc.	Contractor	PMU, CSC, IEMC

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• During construction, staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste. • Neatly garther materials and wastes to avoid the encroachment on existing roadways, sewers, and drainage manholes. Thoroughly collect xxcavated soil falling in existing stormwater manholes and drains. • Before the construction of street crossing sewers, relevant authorities must be coordinated to make arrangements for traffic channelization if necessary. In case the construction area takes up only 50% of the road width, construction is to be carried out in one half of the pavement, with the other half reserved for vehicle circulation. Construction would only be carried out in this other half after the pavement of finished first half has been temporarily reinstated. The construction of road-crossing sewers should be carried out at times of light traffic as at night, during which lighting must be properly provided. • Do not allow construction activities from 12:00-13:00pm, before 7:00am, and after 6:00pm to not disrupt rest time of the local peoples. If construction needs to be carried out at night, inform the community least 2 days in advance. • Install temporary bridges to give access to roadside houses, and shops, affected by ditch excavation. • Clean and tidy up construction sites after every construction session. • Use wall piles in excavated pits and ditches with a depth of 2.5m and over. Check and reinforce bearing walls to ensure the stability of excavated pits Backfill excavated ditches, pits, reinstate pavements in the soonest possible time		
3. Wastewater booster pumping station to Bau Lac wastewater treament plant			
Subsidence, dust, noise, vibration, labor safety	• 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; • Put corrugated iron enclosures with a minimum height of 2m around the construction site. • Fence off the construction sites by iron sheet of 2m high to ensure safety for people. • Put warning signs of construction site, deep pits, and speed limits on the section passing the construction site. • Use Larsen sheet piles to prevent wall slumping.		

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Gather materials and excavated soils around foundation pits and properly monitored to ensure minimum scope of disturbance. • Collect wastes and construction materials within 20m around pumping stations every day. • Provide ladders to the workers for safe operations in deep pits		
4. Nhon Binh Wastewater Treatment Plant			
Landslide, dust, noise, vibration and occupational safety	• 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. • Put corrugated iron fences with a minimum height of 2m. • Locate the places for washing vehicles at the entrance to the sites. Channel wastewater from vehicle washing to a settling pond before discharging into the environment. • Excavate and maintain the ditches and canals which collect and direct stormwater to mud pits before stormwater could overflow from the plant site to the outside. • Make macadam on the service roads in the plant premises to limit dust and prevent materials from being washed off by stormwater. • Spray water onto the site within 20 m from the gate of the plant and local roads at least three times a day on dry days. • Carefully cover bulk materials and keep in temporary storehouses. • Restore the road for community travel in the WWTP area upon completion of the construction. • Store or cover construction materials such as sand and cement in the designated palce to prevent spreading to the surrounding environment. Do not storeb construction materials near the management building and administrative building of the existing WWTP to avoid affects on the staff. • Utilize the toilet of the existing WWTP to avoid the discharge of untreated wastewater • Prioritize the hiring of local worker to minimize the discharge of domestic wastewater. • Collect and gather all the waste from the worker camp into the 200-liter-containers and hire URENCO to dispose of at Long My landfill. • Collect 100% of the oil and grease waste and rags into the separate containers and put in a closed roofed area at the landfill. The containers would be located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills.	Contractor	PMU, CSC, IEMC

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Collect hazadous waste in the separated bin and then label and stored in the roofed area and hire URENCO to periodically collect and treat at the harzadous waste treatment facility. • Arrange and maintain the drainage ditches around the construction area. These ditches would ensure the water drainage for the area and avoid localized flooding when it rains. • Restore infrastructure restoration: access road, traffic roads, the other infrastructure works which affected by the subproject construction before handing over for the Investor, which is considered as a prerequisite for the Investor to sign for certification.		
5. Long My landfill			
Landslide, dust, noise, vibration and occupational safety	• Cover the material transport vehciles (soil, sand, rock, cement, etc.) in order to prevent dispersal of dust into the surrounding environment in the transportation process. This measure would decrease by 90- 95% of the dust generation compared without covering. • Frequently clean up the transportation vehicle before leaving the landfill. Places for washing vehicles should be located at the entrance of the sites. • Comply with the procedures and norms of construction in the landfill, avoid the impact to the crop of local people. • Utilize the existing sanitation system in the construction areas of Long My landfill. • Prioritize the use of local workers in order to minimize the amount of wastewater from bathing and hygiene in the construction area because most of these workers come back their homes after work, which would partly reduced the amount of domestic wastewater. • Collect wastewater from vehicle washing and left to settle in a settling pond before discharging into the environment. • Arrange the garbage containers in the construction site and use the service of garbage collection and treatment at Long My landfill. • Collect 100% of the oil and grease waste and rags into the separate containers and put in a closed roofed area at the landfill. The containers would be located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills. • Prepare the backup pumps in the construction areas for heavy rains risk at the landfill area. • Cover and reinforce the roof of the adjacent ceel of the landfill to prevent any landfill collapse. • Equip fire fighting equipment such as fire extinguishers for timely rescue when the incident occurs. Because the landfill is in operation, the flammable landfill gas would be high risk of fire.	Contractor	PMU, CSC, IEMC

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Periodically check the workers' health at the construction site need to determine the health status of each person so as to arrange their work appropriately. • Upon completion of the construction remove the worker camps and collect the waste materials on the construction site to discharge into the landfill. • Restore roads, works in the landfill area if the construction process damages these works		
Component 2			
1. Construction of Y-shaped bridge abd Huynh Tan Phat bridge			
Occupational safety, dust, noise and vibration	• Inform the local authorities and communities of the construction plan and schedule, block off and demolition of the existing bridge, or any temporary disruption of services at least one month before start of the construction. • 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. • The Contractor shall be required to prepare specific Environmental, Health and Safety Plan (EHSP) before the demolition of the existing bridge and construction of the new bridge. At minimum, the EHSP shall satisfy the following requirements: Descriptions on measures for spill prevention, and sedimentation control, surface water flow diversion, reinstatement, etc. • Install signboard directing the traffic diversion 600m from the Y-Shape bridge before the existing bridge is blocked off for demolition and reconstruction. • Signboards and fences shall be placed and maintained to safely block off access to the two ends of the existing bridge. Allocate staff to guard the site 24 hours per day. Ensure adequate lighting at night time. • The bridge works shall be scheduled to avoid the high river flow season. • Place warning signs of "Authorized personnel only", restrict the access of unauthorized subjects to the bridge construction site. Arrange the float on the Ha Thanh river to warn the crossing boat. • Coordinate with the local waterway transport authority to regulate the waterway transport at the river section where construction of the bridge is ongoing. • Provide fife vests and protective equipment to the workers and enforce the use when working in or above water surface, especially during construction of bridge abutments (2-3m high above the water surface).	Contractor	PMU, CSC, IEMC

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Prohibit discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the Ha Thanh River. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly. • Use the construction method that include close coffer dam with steel sheet piles to limit disturbances of the benthic community and sedimentation from the construction. • Concrete mixing directly on the ground shall not be allowed and shall take place on impermeable surfaces and at lease 500m from Ha Thanh River. • All runoff from batching areas shall be strictly controlled, and cement-contaminated water shall be collected, stored and disposed of at the approved site. • Unused cement bags shall be stored out of the rain where runoff won't affect it; Used (empty) cement bags shall be collected and stored in weatherproof containers to prevent windblown cement dust and water contamination. • All excess concrete shall be removed from site on completion of concrete works and disposed of. Washing of the excess into the ground is not allowed. All excess aggregate shall also be removed. • Install the stormwater drainage ditch in the construction site. Set up sedimentation ponds to remove the solid before discharging into the Ha Thanh river. • Prohibit Workers to discharge garbage into the Ha Thanh river. • Equip from 1 to 2 oil and grease container with capacity of 150 liters and locate at the subproject site. The containers are located in the flat ground, avoiding tilt, fall in order to avoid infiltration of stormwater causing oil spills. • Use the mobile toilets to avoid polluting the surrounding environment, especially the Ha Thanh river. • During the construction phase, the contractor would arrange the marker posts, construction site signs, speed limit signs at the proper distance that easily visible of traffic participants. Staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste. • Reasonably arrange time for materials transportation that avoid the peak hours from 6am to 8am and from 16 pm to 18 pm. • Regularly maintain, repair roads used for transporting the construction materials.		

Environmental –social issues	Mitigation measures	Responsibility	To be supervised by
	• Request drivers to control the speed as prescribed: maintain vehicle speed to ensure the safety in accordance with regulations for the vehicles on the road when crossing the localities. • Strictly prohibit to use the air horn when crossing through the residential areas. Restrict the construction activities at night. If the construction activities at night are unavoidable or disrupt services (supplying electricity, water, etc.), the community must be informed at least one week in advance.		

6.3. Site-specific Impacts and Mitigation Measures

Table 6.3. Specific Mitigation Measures for the Specific Types of Works

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	Component 1				
1	**Phu Hoa canal – Construction of twin box culvert**				
	 Nguyen Hue pagoda located on the local unnamed road, 2m From Phu Hoa canal	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Potential risk of land subsidence during culvert installation causing damages to the pagoda. - Increased traffic congestion and risks of	- Inform the pagoda 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. - Prohibit gathering of construction materials within 100m in front of the pagoda. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as pagodas. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the temple.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		traffic accidents due to construction and transportation. - Interference with religious events at the pagoda due to construction activities.	- Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the pagoda		
	 Dong Hai Mechanical Limited Company located on Road no.24, 20m from Phu Hoa canal	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding.	- Inform the company and the You Union 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. - Sett up construction and traffic warning signs at the construction site.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	 Binh Dinh provincial Youth Union Center located on Dien Bien Phu road, 45m from Phu Hoa canal	- Increased traffic congestion and risks of traffic accidents due to construction and transportation.	- Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Sprey water at least three time during dry and sunny days. - Tidy site after every working session - Installing night lighting at site to ensure safety for road users. - Reinforce steel piles to avoid subsidence. - Clean up the site daily. - Immediately addess any issue/problem caused by the construction activities and raised by the company.		
	 Some high-voltage power poles on Road no.24, along the Phu Hoa canal	- Risks of damage to the high voltage power line causing loss of property and power outage. - Risk of electrical accidents to the workers and communities.	- Do not carry out the construction activities within 7m at any direction near the high-voltage power line. - Prohibit construction activities within 20m of the power line during rainy days. - Provide workers with personal protective equipment and enforce them to use. - Deploy qualified technical staff to supervise construction activities near the power towers and lines. - Set up night ligting system	- Contractor	- PMU, CSC, IEMC
2	***Upstream ditch of Bau sen lake – Construction freestone ditch***				

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	 The households living along ditch	- Inundated when occurring downpour - Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Potential traffic accidents and community safety risks due to construction and transportation. - Risk of subsidence of people's housing due to dredging activity. - Clogging of household wastewater drainage due to construction excavation. - Interference with the daily living activities of local people due to construction activities. - Potential conflict between local people and the workers.	- Provide a standby pump in case of localized flooding at upstream ditch of Bau Sen lake - Inform the community 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. - Ensure a drainage ditch at the site and clean any clogs to ensure household drainage system, provide alternative dranaige for them if needed. - Reinforce steel piles to avoid subsidence. - Provide a standby pump in case of localized flooding at the site. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk construction activities. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at day's end. - Providing night lighting system with luminously painted fence and night lamp.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Manage the worker force to any avoid the conflict with the local people and immediately addess any issue/problem caused by the construction activities and raised by the local people		
3	**Tran Hung Dao road – Construction** of **stormwater drainage culvert**				
	 Tay Ninh church located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Potential traffic congestion and accident on Bach Dang street, especially night. - Potential localized flooding due to construction. - Hindering of access to the church due to construction activities directly on the road. - Interference with religious events at the church due to construction activities.	- Inform the 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. - Prohibit gathering of construction materials within 100m in front of the church. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as churches. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the church. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the church		
	 Ngoc Nhon monastic located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with religious events at the monastery	- Inform the monastery 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. - Prohibit gathering of construction materials within 100m in front of the monastery. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the church. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		due to construction activities.	- Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the monastery		
	 Phong Lan kindergarten located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of	- 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 - Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction operations to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	 Dong Da secondary school located on Tran Hung Dao road, 5m from the stormwater drainage culvert	traffic accidents due to construction and transportation. - Interference with school children learning hours due to nose and vibration.	- Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes when children go to and leave the kindergarten. - Do not load construction materials within 20m from school and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Immediately addess any issue/problem caused by the construction activities and raised by the schools		
	 Quy Nhon Twin Towers located on Tran Hung Dao road, 5m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of	- Prohibit gathering of construction materials within 200 around the towers. - Prohibit construction of workers camps within 1 km from the towers. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the towers. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		traffic accidents due to construction and transportation. - Hindering of access to PCR by tourist visitors due to construction activities. - Temporary disturbance of the beauty of the site.	- Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Reinforce trench walls with steel sheet piles for deep excavation to avoid subsidence. - Cover the incomplete trenches under construction at day's end. - Provide night lighting system with luminously painted fence and night lamp. - Carry out well worker management and avoid the conflict between workers and locals, visitors		
4	**Hoc Ba Bep area - Construction of stormwater drainage culvert**				
	 Railway passing through the construction area of Hoc Ba Bep area (alley 1083)	- Inundated when occurring downpour - Potential land subsidence due to excavation activities negatively affecting the raiway. - High risks of railway traffic accidents for the construction vehicles workers due to busy construction activities, especially at night. - Potential interference with the rainway schedule.	- Provide a standby pump in case of localized flooding at Hoc Ba Bep area - Inform the railway management company of the construction activities and their potential impacts such the risks of interference with the railway train schedule and railway traffic safety, and the detail construction work schedule at least 01 month before construction starts. - Sett up construction and traffic warning signs at the construction site. - Set up barriers around the construction area to separate working area with the railway. - Construct the sewer under passing the railway using safe tunneling method.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Deploy a qualified technical staff to supervise construction activities near the railway. - Only execute construction activities when there is no train schedule. - Prohibit scattering of construction material and wastes near and on the railway. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and during transporting materials crossing the railway. - Immediately collect any domestic wastes and construction spoils around and near the railway and dispose in a designated site		
5	***Bach Dang road – Construction of stormwater drainage culvert***				
	 Truc Lam pagoda located on Doan Thi Diem road, 2m from the stormwater drainage culvert	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to	- Inform the pagoda 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. - Prohibit gathering of construction materials within 100m in front of the pagoda. - Pile driving activities will not be carried out before 7 am or after 6 pm, or at days and hours advised by the monks. - Environmental training for the workers includes codes of conducts when working in pubic areas and sensitive receptors such as pagodas.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		construction and transportation. - Interference with religious events at the church due to construction activities - Hindering of access to the pagoda by tourist visitors due to construction activities. - Temporary disturbance of the beauty of the site.	- Sprey sufficient water to suppress dust during dry and windy days at least three times a day at the area of the temple. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at end of the working day. - Provide night lighting system with luminously painted fence and night lamp. - Avoid construction activities during religious events every first and 15th days of the lunar month and during festival days if possible. - Immediately addess any issue/problem caused by the construction activities and raised by the pagada		
		- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting the	- Inform the market management and the community 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. - Prohibit gathering of construction materials within 200m from the market.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	Dam market located on Hoang Quoc Viet road, 100m from the stormwater drainage culvert	market foods and product for the local people. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.	- Ensure a drainage ditch at the site and clean any clogs. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Clean the construction area after each working. - Sett up construction and traffic warning signs at the construction site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes, and to guard high risk operations. - Ensure successive supply of materials according to construction schedule, and tidy construction materials and stockpiles every working session. - Cover the incomplete trenches under construction at day's end. - Provide night lighting system with luminously painted fence and night lamp. - Manage the worker force to any avoid the conflict with the local people and traders. - Immediately addess any issue/problem caused by the construction activities and raised by the market management.		
		- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater	- 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	-	-

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	 Sen Hong kindergarten on Bach Dang road, 2m from the stormwater drainage culvert	due to construction activities. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents for the school children due to construction and transportation. - Interference with school children learning hours due to nose and vibration.	- Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction operations to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during transportation, loading and unloading of construction materials and wastes when children go to and leave the kindergarten. - Do not load construction materials within 20m from school and tidy construction materials and stockpiles every working session. - Immediately addess any issue/problem caused by the construction activities and raised by the kindergarten management		
6	School children and teachers of the 12 primary and secondary schools: Le Loi Primary School; Hai Cang Primary School; Dong Da Primary School; Phuoc My Secondary School; Bui Thi Xuan Secondary	- Increased dust, exhaust gases, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities.	- 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.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	School; Bui Thi Xuan Primary School; Nhon Phu 1 Primary School; Nhon Phu 2 Primary School; Nhon Hoi Secondary School; Nhon Hai Secondary School; Nhon Hai Primary School; Nhon Ly Primary School.	- Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Interference with school children learning hours due to noise and vibration.	- Construction area to be fenced and marked with warning signs to prevent pupils and unauthorized people from entering. - Teachers to be informed of construction activities to keep pupils off the site during their break time. - Prohibit use of construction methods that cause noise during school learning hours. - Sprey sufficient water to suppress dust during dry and windy days at least three times a day at site. - Immediately collect any domestic wastes and construction spoils around the school and dispose in a designated site. - Deploy staff to guide the traffic during construction during 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. - Tidy construction materials and stockpiles every working session. - Immediately addess any issue/problem caused by the construction activities and raised by the school management		
7	Alley no. 1083 is a narrow alley and related to construction of stormwater sewer in Hoc Ba Bep area	- Hindering access to households living at Hoc Ba Bep area - Dredging and culvert installation may cause wall sluming of the households	- Apply speed limit at 10km/h; - Arrange staff to direct traffic at peak hours; - Load the construction materials neatly; - Arrange staff to direct the driver during loading/unloading of large pipes;	- Contractor	- PMU, CSC, IEMC
8	Vo Van Dung road is a small road and related to construction				

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	of upstream ditch of Bau Sen lake	- Risks of traffic accidents - Dust, waste, damaged landscape - Affecting drainage capability	- Avoid construction activities at peak hours otherwise arrange workers to direct traffic at peak hours; - Remove the waste from the site in parallel with excavation/pipe installation; - Apply Larsen sheet piles for erosion prevention; - Conduct survey on the conditions of existing structures along the road prior to construction		
9	Tran Hung Dao road related to the construction of stormwater and wastewater drainage lines and related to material transport route for the entire construction items of the subproject (except construction item of Phu Hoa canal)	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction materials during construction ; - Traffic risks: at the starting and ending points junction with Thap Doi and Tran Dung Dao road; - Inconveniences to locals' business activities as access to business establishments will be obstructed; - Affecting drainage capability;	- Informing the community of the construction schedule at least one week before the construction. - Place fences and warning signs of construction at site. - Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes. - Place stockpile materials at a designated place tidily and successively according to construction schedule. - Reinforce trench walls with steel sheet piles for deep excavation to avoid subsidence. - Spray water three times per day to reduce dust during dry days. - Tidy up construction site during and after every working a session. - Safely cover incomplete construction items and the incomplete ditches at the end of the day.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		- Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench; - Safety risks to vehicles and community, especially at night when excavation is performed to depths of 2 m	- Provide strong wooden planks or concrete slabs across the trench under construction for temporary access to the houses or businesses. - Provide night lighting system and luminously painted fences. - Reinstall the road surface if occurring the damages during construction		
10	Bach Dang road related to the construction of stormwater and wastewater drainage lines and related to material transport route of the subproject	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction materials during construction ; - Risks of traffic accidents; - Inconveniences to locals' business activities as access to business	- Informing the community of the construction schedule at least one week before the construction. - Place fences and warning signs of construction at site. - Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes. - Place stockpile materials at a designated place tidily and successively according to construction schedule. - Reinforce trench walls with steel sheet piles for deep excavation to avoid subsidence. - Spray water three times per day to reduce dust during dry days.	- Contractor	- PMU, CSC, IEMC
11	Road no.24 related to the construction of Phu Hoa canal and related to material transport route of the subproject				
12	National highway 1A related to the construction of Long My landfill and related to material transport route of the subproject				

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		establishments will be obstructed; - Affecting drainage capability; - Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench	- Tidy up construction site during and after every working a session. - Safely cover incomplete construction items and the incomplete ditches at the end of the day. - Provide strong wooden planks or concrete slabs across the trench under construction for temporary access to the houses or businesses. - Provide night lighting system and luminously painted fences. - Reinstall the road surface if occurring the damages during construction		
	Componen 2				
13	***Construction of Y bridge***				
	 Wastewater pipeline running parallel with the existing Y-shaped bridge	Impact on water quality and aquatic species: - Negative impacts on water quality due to construction, domestic, and hazardous wastes. - Negative impacts on aquatic species and bentic community due to limited loss of habitats and potential increased total suspended solids and wastes in the river due to construction.	- Inform the wastewater management company of the construction activities, schedule, and potential risks to the wastewater pipelines schedule at least 01 month before start of the construction. - Together with the company work out an emergency plan for responding to the risks of wastewater pipeline breakage or disposition. The emergency plan needs to be submitted to the PMU and Construction Supervision Consultant for review and approval before start of the bridge demolistion and construction. - Arrange all construction activities on the opposite site to the wastewater pipeline. - Use safe construction method near the pipeline such as vibratory pile driving.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
		Impact on the wastewater sewer: - Risk of damage to the wastewater sewer such as break or crack affecting wastewater collection and pollution to the river. Impact on road transport and connectivity between the two bank of the river: - Temporaty disconnection of the traffic connecting the two bank of the river affecting people and vehicles that have to cross the river at this site.	- Do not pack heavy machines and do not put heavy weights for static pile load test within 50m of the pipeline. - Request qualified technical staff to supervise construction activities near the pipeline. - Strictly follow the emergency plan and immediately inform the wastewater compony and local authority of the accidental breakage or disposition of the pipeline.		
	 Boats moving under Y-shaped bridge	- Loss of moring place for the local fishing boats. - Risk of waterway accidents for the local fishermen due to construction activities.	- Inform the fishermen of the construction activities, schedule, and potential risks to the waterway transport at least two weeks before start of the construction. - Coordinate with the waterway transport authority to regulate the waterway transport during demolition and construction. - Work with the fishermen and local authority to find a temporary place for fish landing and anchoraging the boats. - Set up construction signs, warning waterway traffic buoys at the construction area and on Ha Thanh river.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Deploy technical staff to guide the waterway traffic during construction during bridge demolition and to guard high risk operations. - Provide night lighting system with luminously painted fence and night lamp. - Lining construction canvas to avoid materials and construction wastes falling into the Ha Thanh river		
	 Business households living along Ha Thanh river	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting daily life of the local people. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Temporary hindering of customers' access to the business households and restraurant along the river due to demolition of the bridge negatively affecting their income.	- Inform the local authorities and communities of the construction plan and schedule, block off and demolition of the existing bridge, or any temporary disruption of services at least one month before start of the construction. - Install signboard directing the traffic diversion 600m from the Y-Shape bridge before the existing bridge is blocked off for demolition and reconstruction. - Fence off the construction sites by iron sheet of 2.5m high to ensure safety for people. - Signboards and fences shall be placed and maintained to safely block off access to the two ends of the existing bridge. Allocate staff to guard the site 24 hours per day. Ensure adequate lighting at night time. - Prohibit discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the Ha Thanh River. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			and shall not be allowed to discharge to the rivers directly. - Use the mobile toilets to avoid polluting the surrounding environment, especially the Ha Thanh river. - During the construction phase, the contractor would arrange the marker posts, construction site signs, speed limit signs at the proper distance that easily visible of traffic participants. Staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste. - Reasonably arrange time for materials transportation that avoid the peak hours from 6am to 8am and from 16 pm to 18 pm. - Regularly maintain, repair roads used for transporting the construction materials. - Request drivers to control the speed as prescribed: maintain vehicle speed to ensure the safety in accordance with regulations for the vehicles on the road when crossing the localities. - Strictly prohibit to use the air horn when crossing through the residential areas. - Restrict the construction activities at night. If the construction activities at night are unavoidable or disrupt services (supplying electricity, water, etc.), the community must be informed at least one week in advance.		

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Restore the damaged infrastructure after construction completion		
14	***Construction of Huynh Tan Phat bridge***				
	 1B residential area located on Huynh Tan Phat road, 70m from the construction area of the bridge	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting business activities of the 1B residential are. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.	- Inform the local authorities and communities of the construction plan and schedule, block off and demolition of the existing bridge, or any temporary disruption of services at least one month before start of the construction. - Install signboard directing the traffic diversion 600m from the Y-Shape bridge before the existing bridge is blocked off for demolition and reconstruction. - Fence off the construction sites by iron sheet of 2.5m high to ensure safety for people. - Signboards and fences shall be placed and maintained to safely block off access to the two ends of the existing bridge. Allocate staff to guard the site 24 hours per day. Ensure adequate lighting at night time. - Prohibit discharge or dumping of any wastewater, slurry, waste, fuels and waste oil into the Ha Thanh River. All these materials must be collected and disposed of on land at the banks. The slurry and sediment shall also pump to the banks for disposal and shall not be allowed to discharge to the rivers directly.	- Contractor	- PMU, CSC, IEMC

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
			- Use the mobile toilets to avoid polluting the surrounding environment, especially the Ha Thanh river. - During the construction phase, the contractor would arrange the marker posts, construction site signs, speed limit signs at the proper distance that easily visible of traffic participants. Staff must be deployed to keep an outlook on the traffic and give instructions and warnings, especially when vehicles come in and out of the construction sites or stop for loading and unloading of materials and waste. - Reasonably arrange time for materials transportation that avoid the peak hours from 6am to 8am and from 16 pm to 18 pm. - Regularly maintain, repair roads used for transporting the construction materials. - Request drivers to control the speed as prescribed: maintain vehicle speed to ensure the safety in accordance with regulations for the vehicles on the road when crossing the localities. - Strictly prohibit to use the air horn when crossing through the residential areas. - Restrict the construction activities at night. If the construction activities at night are unavoidable or disrupt services (supplying electricity, water, etc.), the community must be informed at least one week in advance. - Restore the damaged infrastructure after construction completion		

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	 Small business households located on Huynh Tan Phat road	- Increased dust, exhaust gases, noise, vibration, construction wastes, hazardous waste, domestic wastes, and wastewater due to construction activities affecting the market foods and product for the local people. - Clogging of local drainage canal leading to localized flooding. - Increased traffic congestion and risks of traffic accidents due to construction and transportation. - Hindering of access by the customers to the market due to construction activities affecting income of the business people.	- Set up vehicles washing station in front of site's entry. - Cleaning up site at the end of the day. - Arrange garbage bins on site. - Watering to reduce dust on site. - Administrative management for workers. - Set up mobile toilet on site. - Training labor safety, dissemination and social evils prevention for workers - Restore the damaged infrastructure after construction completion.	- Contractor	- PMU, CSC, IEMC
15	Thap Doi road related to the construction of Y-shaped bridge and related to material construction route of the 2 subproject	- Typical impact: mostly related to traffic as construction operations will occupy one part of road surface, while the other part will be used for gathering machinery and storage of construction	- Clean up the transport vehicles before leaving construction site. 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.	- Contractor	- PMU, CSC, IEMC
16	Huynh Tan Phat road related to the construction of Huynh Tan				

No	Sensitive receptors and their relation to subproject activity	Site-specific impacts	Specific mitigation measures	Responsibility	To be supervised by
	Phat bridge and related to material construction route of the 2 subproject	materials during construction ; - Risks of traffic accidents; - Inconveniences to locals' business activities as access to business establishments will be obstructed; - Affecting drainage capability; - Dust, waste, damaged landscape; - Risks of landslides and subsidence; damages to existing works along road sides from deep excavation for the construction of pipe trench	- Do not park vehicles in the roads longer than necessary. Do not allow construction vehicles and materials to encroach upon the pavements. - Maintain the required speed limit and do not overuse horn. - Preriodically registry and supervise the quality of transport vehicles as required by the government regulations. - Comply with the traffic safety regulations while participating traffic - Clean up wastes dropped off on road - Assign staff to guide the traffic during transportation, unloading, and loading of construction materials, equipment, and wastes. - Place stockpile materials at a designated place tidily and successively according to construction schedule. - Spray water three times per day to reduce dust during dry days if required. - Reinstall the road surface if occurring the damages during construction		

The details on the DMMP (Phu Hoa canal and upstream ditch of Bau Sen lake) and Disposal Site:

The contractors are requested to prepare a specific dredging material management plan (DMMP) and submit the same to the 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, control of polluting material during temporary gathering and transportation, pollution control, and risks at disposal sites. The detailed guidelines on DMMP are provided in Annex 6.

6.4. Specific Impacts and Mitigation Measures during Operation

6.4.1. Nhon Binh Wastewater Treatment Plant

Succesfful operation of the WWTP will depend on a number of factors including: i) selection of appropriate treatment technologies, the quality and quantity of raw wastewater and its variability; available land area for the treatment facility; ii) resources for capital expenditures, operation, maintenance, and repair; and iii) availability of skilled operators, operator training, maintenance personnel, treatment chemicals, and replacement parts. The following sections focus on the mitigation measures to address impacts of the WWTP on the environment during its operation. Institutional arrangement for the management of the WWTP is addressed in the techinical design documentation of the subproject:

i) Mitigation measures for air pollution

- The odor arising from the receiving tank, sand sedimentation tank, primary sedimentation tank, sludge compressed tank, wastewater separation devices would be collected through the lids, tubes and vacuum pumps to deodorization tower. The installed works that would be covered include screening, grit chamber, primary sedimentation tank, sludge treatment tank.
- Plant trees around the fences of the treatment area in order to control odor dispersion.
- Contain the waste (sludge and domestic solid waste) in standardized containers to minimize dispersion and gases and solid waste into the environment.
- Develop and implement a plan to periodically test and monitor aimbient air quality to obtain proper operation evaluation and control.

ii) Odor control

Odor and air emission problems during the operation will be controlled with control measures integrated in the design of the WWTP as described in section 5.1.1 (i). The following measures are required to prevent, minimize, and control air emissions and odors during operation:

- Safely store waste and sludge generated during the operation of the plant in a closed area before being transported away by URENCO to serve the planting of urban green trees or to be dumped at Long My landfill. This will reduce bad odors generated from sludge.
- 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.
- Contain the waste (sludge and domestic solid waste) in standardized containers to minimize dispersion and gases and solid waste into the environment.
- Periodically test and monitor air concentrations to obtain proper evaluation and control operation processes in a logical manner.

iii) Noise control

- Periodically monitor and maintain the pumps at the plant.
- Ensure the operation which should be in line with designed capacity.
- Plant trees in the the treatment plant area.

- The wastewater treatment area: the noise generated from the pump station, sludge dewater would be sound proof by structure design.

iv) Domestic wastewater control

- Use the existing wastewater system of the wastewater treatment plant.
- Wastewater from the WWTP would be pretreated through 3 compartments of septic tanks before being discharged into combined sewers and would be directed to the treatment area.

v) Control the solid waste from the operation of the WWTP

Solid waste from the treatment processs

The operation of the wastewater treatment plant would not be worked without the screen bar to remove the floating debris at the initial treatment process to avoid the pipe blockage or damage the pumps, etc. If the solid waste from this stage would not be collected and treated efficiently, the environment would be seriously affected. The measures to control include:

- It should have plan to periodically collect solidwaste at screen bar and disposal at Long My landfill.
- Provide trainning to the operation workers how to separate the domestic garbage from the those of treatment plant.

For domestic solid waste: The solid waste of the staffs in the treatment plant would be collected, transported by Long My landfill.

vi) Hazardous waste control

- The Owner would register as the owner of hazardous waste according to Circular No. 36/2015/TT-BTNMT dated 30 June 2015. Containers of hazardous waste would be placed on flat floors without tilting, tumbling, and must be free from stormwater infiltration. Collected hazardous waste would be stored in containers/houses and labeled as currently stipulated. Packing and packaging materials for chemicals would be returned to suppliers.
- Once every 2-3 months, the Plant would have to employ a local unit with assigned tasks of handing hazardous waste to collect, transport and handle such waste.

vii) Measures to minimize impact on receiving waters

- Install an online monitoring system at the WWTP for controlling the quality of the influent and effluent at the WWTP.
- Analizes the quality of sample effluent from the WWTP at least once every 3 months.
- Check the treatment facilities periodically and maintain 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.
- Treated wastewater must be discharged into the right receiving water as stipulated in the operational license of the treatment plant. Local environmental authorities would regulate specific allowable discharging flows, waste amounts, limitation and scope of the mixing area and monitoring requirements specifically for each wastewater treatment station.

viii) Measures to control sludge of the WWTP and septic tank sludge

- 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 QCVN03-MT:2015/BTNMT – national technical regulation on allowable limits of the heavy metals in the soils.
- Sludge will be compacted with gravity compactors and dewatered with gravity belt compressors. Dried mud cakes will be stored in a roofed warehouse at the sludge dewatering area. Periodically one time per month, the plant will hire URENCO to transport this sludge amount way to serve the planting of urban green trees or to be dumped at Long My solid waste landfill of the city.
- Compressed raw waste will be put in 6m^{3}containers. Full containers will be replaced with empty ones and disposed of at Long My landfill.
- Land application or other beneficial re-use of the WWTP residuals should be considered but only based on an assessment of risks to human health and the environment. Quality of residuals for land application should be consistent with the relevant public health-based guidance from the World Health Organization (WHO)[9] and applicable national requirements.
- Processing, disposal and re-use of wastewater treatment plant residuals should be consistent with applicable national requirements.
- Be scheduled in every 3 years, the HDPE anti-odor sheets would be removed for sludg drying and pond dredging. URENCO will be employed to periodically dredge sludge from sewer systems and transport this sludge for disposal at Long My landfill. Transportation will be carried out by specialized tank trucks to avoid odor emission and sludge spillage along the route.

ix) Minimize the pollution of soil and groundwater

- Monitoring and controlling of groundwater quality in the area to assess the level of impacts due to operation of wastewater treatment plant in order to propose corrective measures.
- Applying the waterproofing for biological lake bottom to prevent the harmful microorganisms from discharging into the environment.
- Regularly checking the plant operations in order to timely detect leakages in the joints/transition of the pressure pipeline to propose timely corrective measures.

x) Worker health and safety at the WWTP, pump stations, and drainage and sewer system

Worker occupational health and safety impacts associated with theoperational phase of the WWTP primarily include the following: i) Accidents and injuries; ii) Chemical exposure; ii) Hazardous Atmosphere; and iii) Exposure to pathogens and vectors.

Accidents and Injuries:

Work at the WWTP is often physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment. Work at the WWTP may also involve entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, and pump stations. Methane generated from anaerobic biodegradation of sewage can lead to fires and explosions.

[9] WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater (2006).

- The following procedures are required to prevent, minimize, and control chemical exposure at the WWTP:
- Install railing around all process tanks and pits.
- Implement a confined spaces entry program that is consistent with applicable national 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.
- When installing or repairing the sewers and stormwater drainage sewers adjacent to roadways, implement procedures and traffic controls, such as:
  - 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.
  - For night work, provision of proper illumination for the work space, while controlling glare so as not to blind workers and passing motorists.
- Locate all underground utilities before digging.

Chemical Exposure and Hazardous Atmospheres:

- The chlorine station must be equipped with chlorine leakage detectors, ventilation facilities, sirens, flashing warning lights, gas masks, compressed oxygen breathing apparatuses, protective clothing, and a system of emergency watering/showering/ eyewash of the chlorination house.
- 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.
- Prepare escape plans from areas where there might be a chlorine or ammonia emission.
- Install safety showers and eye wash stations near the chlorine equipment and other areas where hazardous chemicals such as chlorine are stored or used.
- Use protective goggles, protective clothes and boots, chlorine masks, and personal gas detection equipment while working at the WWTP.
- Monitoring chlorine gas in the air: Before being discharged it into the surrounding if chlorine levels of exceed permissible maximum concentrations with alarm signals from the gas analyzer, the air purification system must be initiated.

- 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:

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.
- Reduce aerosol formation and distribution, for example by:
    - Planting trees around the aeration basin to shield the area from wind and to capture the droplets andparticles.
    - Using diffused aeration rather than mechanical aeration and using finer bubbles for aeration.
    - Reducing aeration rate, if possible.
    - Use of floating covers on the mixed liquor of the aeration basin.
    - Suppression of droplets just above the surface, (e.g.by installing a screen or mesh above the basin).
    - Collection of droplets (e.g. by sedimentation, scrubber, electrostatic precipitator, or fabric filter).
    - Disinfection of airborne particles (e.g., by using ultraviolet lights).
    - Use of submerged effluent collector (such as pipes with orifices) rather than weirs.
- 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

6.4.2. Long My landfill

Environmental impacts and associated mitigation measures applicable to the domestic soiled waste collection and transport; waste receipt, unloading, landfilling, and closure and post-closure are described below.

i) Waste Collection and Transport

Litter and clandestine dumping

The causes of littering and clandestine dumping in urban areas occur because of inadequate availability of litter bins along walkways, inadequate public awareness of their responsibilities as urban dwellers, and inadequate refuse collection service. Littering occurs everywhere and often into drains, while clandestine dumping is commonly on vacant lots, public spaces, or along waterways. Accumulated waste may attract disease vectors, contribute to clogging of drainage and sewerage networks, make waste readily accessible to neighborhood animals and birds, and pollute waterways.

Recommended management strategies to minimize litter and clandestine dumping include:

- Encourage use of containers or bags for waste at the point of collection for each household and establishment.
- Implement a regular collection schedule with sufficient frequency to avoid accumulation of garbage.
- Use vehicles appropriate for the geographic conditions and waste types to maximize reliability of collection (e.g., compactor trucks may be appropriate for neighborhoods with wide streets and low-density trash, while smaller vehicles may be appropriate for neighborhoods with narrow streets and higher-density garbage).
- Encourage separation of recyclable materials at the point of generation, so that the collection points do not become sorting points for informal sector waste pickers.
- Cover collection and transfer vehicles along the entire route of transport to avoid windblown litter.
- Clean vehicles used for waste hauling before transportation of any goods, including compost.
- Encourage residents to put waste out at designated times and locations.
- Where possible, blocking off access to dumping sites and fining illegal dumpers.

Air Emissions

Air emissions from MSW collection and transport include, dust and bio-aerosols, odors, and vehicle emissions.

a, Dust, Bio-aerosols, and Odors

Recommended management strategies to minimize dust, bio-aerosols, and odors include:

- Establishing frequent waste collection schedules;

- Instituting a washing program for waste collection vehicles and for company-owned waste collection and transfer containers;
- Promoting the use of bags to reduce the odors from soiling of waste collection and transport equipment.

b, Vehicle Emissions

Emissions from on-road vehicles may be regulated through national or regional programs. In the absence of these, specific measures to prevent, minimize, and control vehicle air emissions during waste collection and transport include the following:

- Optimize waste collection routes to minimize distance traveled and overall fuel use and emissions.
- Implement transfer stations for small vehicles to consolidate waste into large vehicles for transportation to a treatment or disposal facility.
- Waste collection and transport vehicle owners and operators should implement the equipment manufacturers' recommended engine maintenance, along with the mechanical maintenance for the safe operation of the vehicle, including proper tire pressure.
- Drivers should also be instructed on the benefits of driving practices which reduce both the risk of accidents and fuel consumption, including measured acceleration and driving within safe speed limits (working with garbage truck drivers can save as much as 25% on fuel use and reduce maintenance by 15%).

ii) Waste Receipt, Unloading, Processing, and Storage

Control of the incoming waste stream is necessary to ensure safe and effective processing, treatment, and disposal of the waste. Recommended measures include:

- Visually evaluate, weigh, and document incoming waste loads.
- Reject or, if the facility is equipped to process the waste, segregate potentially hazardous materials or wastes identified, including infectious waste, and manage as a hazardous or infectious waste, as applicable.
- Analyze suspected hazardous materials before acceptance so that they are segregated relative to compatibility and so that they can be adequately treated and disposed of.
- If possible, isolate size reduction equipment (e.g., shredders or grinders) in an explosion-proof area with proper ventilation and pressure relief to reduce the impacts of potential explosions that could be caused by materials such as gas cylinders and ignitable liquids that may be present in the waste. Visual inspection of the incoming waste, along with sorting and removal procedures, can minimize this potential hazard.
- Separate recoverable secondary materials for recycling and organic waste for composting to the extent practical.

Contaminated Runoff

Recommended contaminated runoff management strategies include:

- Use impermeable materials for roads, waste processing and storage areas, and vehicle washing areas, and install curbs to prevent runoff to permeable areas.

- Collect runoff and leachate from areas used for waste storage, and treat runoff to meet applicable environmental standards before discharge to surface water or the municipal sewage system (e.g., screen to remove large material, install silt traps to remove particulates, and remove separate-phase liquids with an oil/water separator). Discharge to the municipal sewage system (via pipe or tanker truck), where available, is preferred for runoff from waste storage and handling areas.
- Re-use collected water in on-site disposal processes to the extent practical or store with collected leachate awaiting treatment.
- In addition, management strategies for contaminated runoff from vehicles include:
- Cover containers during transport.
- Ensure vehicle equipment is designed to collect drainage and that it is held in a sump container until the vehicle reaches a safe discharge location.

Litter

The following measures are recommended to prevent, minimize, and control litter and solid waste during waste receipt, unloading, processing, and storage:

- Provide adequate storage for waste not immediately treated or disposed of.
- Implement good housekeeping procedures.
- Consider use of enclosed/covered areas for waste tipping, shredding, compacting, etc.
- Install catch fences and netting to trap windblown litter.

Air Emissions

The following measures are recommended to prevent, minimize, and control vehicle emissions and emissions of dust, odors, and bioaerosols during waste receipt, unloading, processing, and storage:

- Select vehicles and containers that minimize air emissions during waste loading and unloading.
- Design drop-off points to minimize queuing of vehicles.
- Sweep waste management areas and roads frequently and use water spray for dust control where needed.
- Pre-treat wastes as needed (e.g., solidification, encapsulation, or wetting sufficient to reduce dust but without forming leachate).
- Use enclosed waste handling and storage areas for malodorous wastes or wastes that generate hazardous dust (e.g., asbestos). Enclosed waste storage and handling areas are preferred for all wastes.
- Use extraction system to remove dust from working areas, buildings, and storage vessels, and treat as needed to control particulate emissions (e.g., bag filter).
- Remove, treat, or dispose of all biological/malodorous wastes in an expeditious manner;
- Use odor-neutralizing sprays where necessary (EM product). Key measures being used in the Long My landfill would be using EM solution. After being sprayed or sprinkled to garbage, with a very high density of microorganism populations in EM, they would quickly

dominant to the decomposition microorganism. As a result, the decomposition reaction in the garbage would not cause any odors.

Noise and Vibration

Principal sources of noise and vibration include truck traffic; loading equipment (e.g., cranes, wheeled loaders), stationary compactors, balers, grinders, and other treatment and conveyance systems. Recommended noise management strategies include:

- Construct a buffer zone between the facility and the external environment or locate facilities away from sensitive receptors.
- Include noise and vibration considerations during design, including use of models to predict noise levels at specified noise-sensitive locations, using standardized sound power levels for construction plant.
- Maintain site roads in good condition to reduce noise and vibration from vehicle movements.
- Use acoustic screens around fixed/mobile plant and equipment.
- Select equipment that has low noise emission levels.
- Fit silencing equipment to plant, e.g. baffles/mufflers.
- Use buildings to contain inherently noisy fixed plant equipment (e.g., locate waste shredder in the tipping hall, and enclose tipping hall on all sides) and consider use of sound-insulating materials in construction.

iii) Landfilling

Leachate

The leachate generated at the landfill will be collected and primarily treated in the onsite primary leachate treatment system with the capacity of 200m^3/day before transporting to Bau Lac wastewater treatment plant.

Groundwater and Leachate Monitoring

Recommended measures for groundwater and leachate monitoring include the following:

- Measure and record the quantity and quality of leachate generated. Changes in leachate quantity or quality not attributable to weather or other factors may indicate changes in the liner, leachate collection, or landfill cover systems.
- Install groundwater monitoring wells outside the landfill perimeter at locations and depths sufficient to evaluate whether leachate is migrating from the landfill into the uppermost groundwater unit. This groundwater monitoring network should usually include, at a minimum, one monitoring well located in the upgradient groundwater flow direction from the landfill and two monitoring wells located in the down gradient direction. The groundwater monitoring system should be consistent with applicable national regulations.
- Regularly sample the monitoring wells and analyze for constituents, selected based on:
  - The types, quantities, and concentrations of constituents in wastes managed in the landfill.
  - The mobility, stability, and persistence of waste constituents their reaction products in the unsaturated zone beneath the waste management area.

- The detectability of indicator parameters, waste constituents, and reaction products in ground water.
- The constituent concentrations in the groundwater background.

Landfill Gas Emissions

Recommended methods to control and monitor landfill gas emissions include the following:

- Include landfill gas collection system designed and operated in accordance with applicable national requirements and recognized international standards including recovery and pre-use processing or thermal destruction through an efficient flaring facility. Prevent condensation from accumulating in extraction systems by arranging the pipe work to fall to a removal point such as a knock out-pot.
- Use landfill gas as fuel if practical, or treat before discharge (e.g., by using enclosed flare or thermal oxidation if methane content is less than about 3 percent by volume).
- Use gas blowers (boosters) of sufficient capacity for the predicted gas yield and constructed of materials appropriate for landfill gas duty; blowers should be protected by flame arrestors at both gas inlet and outlet.
- Install and regularly sample boreholes surrounding the landfill to monitor for migration of landfill gas.

Recommended methods to control dust and odor emissions include the following:

- Compact and cover waste promptly after discharge from the vehicle delivering the waste.
- Minimize open tipping face area.
- Dispose of odorous sludge in covered trenches.
- Restrict acceptance of loads known to be particularly odorous.
- Restrict tipping activities during periods of adverse weather (e.g., wind toward sensitive receptors).
- Seal sump covers.
- Aerate leachate storage areas.

Litter

The following measures are recommended to prevent, minimize, and control dispersal of litter:

- Provide perimeter planting, landscaping, or fences to reduce wind.
- Pin waste by use of dozers and landfill compactors immediately after discharge from the vehicles delivering the waste.
- Use soil or artificial cover materials so that deposited waste is held in place. More frequent application of cover may be required during high winds or in exposed areas.
- Use scaring techniques or natural predators to control scavenging birds.
- Provide an emergency tipping area/foul weather cell for lightweight wastes such as paper.
- Construct temporary banks and bunds immediately adjacent to the tipping area, install strategically placed mobile catch fences close to the tipping area or on the nearest downwind crest, and/or fully enclose of the tipping area within a mobile litter net system.

- Install wind fencing upwind of the tipping area to reduce the wind strength as it crosses the facility.
- Temporarily close the facility to specific or all waste or vehicle types when weather conditions are particularly adverse.

iv) WWTP Operator Occupational Health and Safety

The most significant occupational health and safety impacts typically associated with workers at waste management facilities occur during the operational phase and include: i) Accidents and injuries; ii) Chemical exposure; and iii) Exposure to pathogens and vectors.

Accidents and Injuries

The following procedures are recommended to prevent, minimize, and control accidents and injuries for the operators working at the landfill:

- In landfills, conduct compaction of wastes in thin layers using heavy equipment and place regular cover material over each compacted layer of waste, so that any underground fires within a waste cell are not able to spread throughout the landfill and lead to significant cave-ins.
- Use maximum side slopes of 3:1 in this non-seismic areas with regular drainage of water so that saturated conditions do not develop and lead to slope subsidence.
- Provide workers with appropriate protective clothing, gloves, respiratory face masks and slip-resistant shoes for waste transport workers and hard-soled safety shoes for all workers to avoid puncture wounds to the feet. For workers near loud equipment, include noise protection. For workers near heavy mobile equipment, buckets, cranes, and at the discharge location for collection trucks, include provision of hard hats.
- Provide refuse collection vehicles and landfill equipment with audible reversing alarms and visible reversing lights.
- Improve the storage of solid wastes at the source so that the loads to be collected are well contained and not too heavy.
- Locate exhaust pipes on waste collection vehicles so that exhaust does not discharge into the breathing zone of workers on the riding steps.
- Restrict access to disposal sites such that only safety trained personnel with protective gear are permitted to high-risk areas.
- Provide workers with communications tools, such as radios. Special signaling codes have been developed for communications on landfill sites.

Chemical Exposure

Chemical hazards encountered at waste management facilities are similar to those at other large industrial facilities, such as toxic and asphyxiating gases. The following procedures are recommended to prevent, minimize, and control chemical exposure at waste management projects:

- Control and characterize incoming waste (see waste receipt, unloading, processing and storage).
- Provide adequate personnel facilities, including washing areas and areas to change clothes before and after work.

- Ventilate enclosed processing areas (e.g., dust in waste size reduction areas, VOCs driven off by high temperatures during composting).
- Prohibit eating, smoking, and drinking except in designated areas.
- Provide air filtered and air conditioned cabs for heavy mobile equipment used at landfills as necessary.

Dust

Waste processing can generate nuisance and hazardous dust, including organic dust. Dust control measures discussed in Section 1.1 above, will also help to reduce worker exposure to dusts.

Pathogens and Vectors

Workers can be exposed to pathogens contained in manure and animal excreta found in the landfill from the disposal of sludge, carcasses, diapers, and yard trimmings containing domestic animal waste. The following measures are recommended to prevent, minimize, and control pathogens and vectors:

- Provide and require use of suitable personal protective clothing and equipment.
- Provide worker immunization and health monitoring (e.g. for Hepatitis B and tetanus).
- Maintain good housekeeping in waste processing and storage areas.
- Use automatic (non-manual) waste handling methods if practical.
- For landfills, promptly emplace, compact and cover of wastes in defined cells, especially for waste with the potential to attract vermin and flies, such as food wastes (especially animal by-products if accepted at the facility) and tannery wastes.
- Clean and wash with disinfectant the cabins of heavy mobile equipment used at regular intervals.
- Grade the area properly to prevent ponding (to minimize insect breeding areas).
- Use integrated pest-control approaches to control vermin levels, treating infested areas, such as exposed faces and flanks with insecticide, if necessary.
- Provide and require use of dust masks or respirators under dry and dusty conditions. Charcoal-filled respirators also reduce odor perception.
- Provide prompt medical attention for cuts and bruises. Cover open wounds to prevent contact with the incoming loads or feedstock.
- Fully enclose the waste management site with fencing so that no livestock or wildlife is able to come in contact with the waste, which contains significant potential to enable the spread of livestock and zoonotic disease, as well as spillover disease to wildlife. Provide daily cover of wastes to minimize the attraction to birds, which can become infected with avian influenza and other bird diseases that can then be carried off-site.

iv) Closure and Post-Closure

Landfill facility operators should plan for the closure and post-closure care of the facility. Such planning should take place as early as possible in the project cycle so that potential closure and post-closure issues are incorporated in the financial and technical planning. Closure and post-closure planning activities should include the following elements:

- Development of a closure plan which specifies the necessary environmental objectives and controls (including technical specifications), future land use (as defined in consultation with local communities and government agencies), closure schedule, financial resources, and monitoring arrangements;
- Evaluation, selection, and application of closure methods consistent with post-closure use and which should include the placement of a final cover to prevent further impacts to human health and the environment;
- Application of final cover components that are consistent with post closure use and local climatic conditions. The final cover should provide long term environmental protection by preventing direct or indirect contact of living organisms with the waste materials and their constituents; minimize infiltration of precipitation into the waste and the subsequent generation of leachate; control landfill gas migration; and minimize long term maintenance needs.

Financial instruments in place to cover the costs of closure and post-closure care and monitoring

6.4.3. Other Works

a) Stormwater drainage and wastewater collection systems

Operations of stormwater drainage and wastewater collection systems under Coastal Cities Sustainable Environment Subproject – Quy Nhon City Sub-subproject would have impacts on the areas: (i) by the operation of the pumping stations (noise, vibration); (ii) the probability of flooding due to congestion of drainage sewer section; (iii) affected by odors from sludge which is dredged periodically; (iv) impacts from disposal of dredged septage; (v) impacts on the aquatic environment due to temporary receiving wastewater discharged from untreated sewer section (this ends when wastewater treatment plants commence stable operations). Mitigation measures are as follows :

➢ *Minimize the pollution caused by the operation of the pumping stations:*

The pumping stations with the large capacity often cause vibration and noise at high levels. Pump sets would be placed in a separate room. The pumps would be installed with equipment to prevent vibration and noise. Specifically:

Technical measures when installing:

- Construct proper machine room for pump sets
- Foundation to put the machine would be built with high-quality concrete
- Install anti-vibration buffer made from rubber
- Install silencers equipment

Management and maintenance measures:

- The pumps would be examined the balance and adjusted if necessary.
- Periodic maintenance and lubrication to minimize noise.

Measures to minimize environmental pollution caused by fuel leakage during the operation of pumping stations:

- Do not store fuel at the pumping stations to minimize the possibility of fuel leakage to the receiving source.
- Feeding the fuel into the pumps would be done in careful manner to avoid fuel spillage.

- Lubricant, greasy rags from maintenance and operations of the pumps must be entirely collected and transported to appropriate treatment areas.

➢ *Minimize pollution due to congestion of drainage sewers:*

- The management of stormwater drainage and wastewater collection systems should be focused and examined regularly to detect the congested drainage sewer sections and carry out dredging.
- Conduct periodic planning decentralization and dredging sewer sections and manholes in order to minimize the flow congestion (every 6 months).

➢ *Control disposal of sludge:*

- Similar to the construction phase, those who manage the water drainage systems would have contracts with relevant authorities of sludge dredging from the sewer sections and manholes and then transport to Long My landfill by specialized tank trucks to avoid odor emission and spillage during transportation.

b) Toilets of schools

Control of odors:

- The area for the construction of school sanitation blocks must be appropriately distant from classrooms and located at the end of wind direction.
- Ventilation systems would be designed and installed.
- The toilets must be supplied with adequate water.
- Pupils/students should be reminded to flush after using toilets.
- Toilets would be regularly cleaned.

Control the amount of sludge, septic tanks:

- Dredge periodically.
- The dredged sludge would be transported to Long My landfill by specialized tank trucks to avoid the odor emission and spillage during transportation.

Domestic wastewater:

Domestic wastewater would be treated preliminarily by 3-compartment septic tanks before being discharged into common sewers and then be directed to treatment stations

c) Component 2 - Minimize impacts of Y-shaped and Huynh Tan Phat bridges

Traffic safety measures on the routes:

- Warning, instruction and speed limit signs would be designed on the roads.
- Periodically check the quality of the bridge to avoid the risk of potential accidents
- Install barriers, separators, road markings, traffic signs according to the charter of road sign 22TCN 237-01 of Vietnam Road Administration.
- The lighting system in the sections crossing the bridge would be designed following the standards TCXDVN 259-2001 of the Ministry of Construction.

Minimize the impacts of traffic congestion:

- Streamline and redirect traffic, consult with the ward authorities and communities in advance
- Implement the necessary measures such as placing signals, signs... to ensure traffic order and safety

6.4.4. Responsibilities for the implementation

The operating unit has responsible for implementing environmental mitigation measures during operation of the project. Responsibilities for the implementation areshown in the table 6.4 below.

Table 6.4. Responsibilities for implementation of mitigation measures in operation phase

No	Items	Project owner	Representative of project owner	Operator
1	Pipelines	Binh Dinh PPC	Binh Dinh CIW PMU	Binh Dinh CIW PMU and Urban Management Department of Quy Nhon city
2	Pumping stations, WWTP			Urban Management Department of Quy Nhon city
3	Nhon Binh WWTP			Asscociation with Phu Dien JSC and Vietnam SFC
4	Long My landfill			URENCO
5	Sanitary facilities for schools			Division of Education and Training Quy Nhon
6	Bridge			Quy Nhon road repair and management JS Company

6.5. Role and Responsibilities for ESMP Implementation

6.5.1. 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 beresponsible 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 costsare included in the CSC service contract;
- IEMC will be responsible for overall environmental monitoring which includes support to the PMU in implementing environmentalsupervision and monitoring, and responsible for reporting on the implementation through monitoring reports.

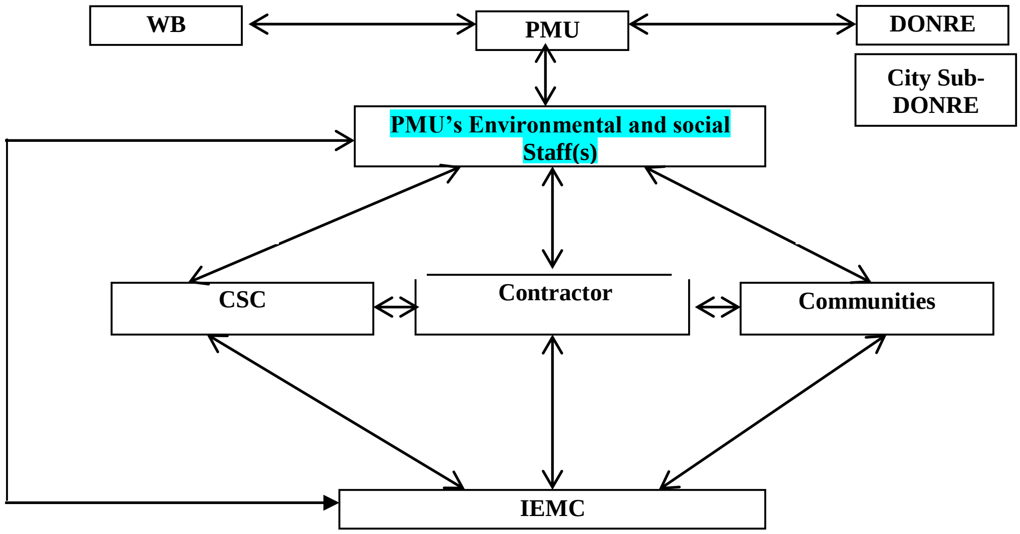


Figure 6.1. Organization chart for ESMP Implementation

Table 6.5. Roles and responsibilities of key parties

Community/ Agencies	Responsibilities
PMU (Binh Dinh Civil and Industrial Works Construction Investment Project Management Unit)	- PMU will be responsible for monitoring the overall subproject implementation, including environmental compliance of the subproject. PMU will have the final responsibility for ESMP implementation and environmental performance of the subproject during the construction and operational phases. - Specifically the PMU will: (i) closely coordinate with local authorities in the participation of the community during subproject preparation and implementation; (ii) monitor and supervise ESMP implementation including incorporation of ESMP into the detailed technical designs and bidding and contractual documents; (iii) ensure that an environmental management system is set up and functions properly; (iv) be in charge of reporting on ESMP implementation to the DONRE and the World Bank. - In order to be effective in the implementation process, PMU will assign Environmental Staff(s) (ES) to help with the environmental aspects of the subproject.
PMU Environmental and Social Staff(s) (ES)	- The ES is responsible for monitoring the implementation of the World Bank's environmental and social safeguard policies in all phases and process of the Project. Specifically, ES will be responsible for: (i) helping PMU incorporate ESMP into the detailed technical designs and civil works bidding and contractual documents; (ii) helping PMU incorporate responsibilities for ESMP and RAP monitoring and supervision into the TORs, bidding and contractual documents for the Construction Supervision Consultant (CSC) and other safeguard consultant (IEMC) as needed; iii) providing relevant inputs to the consultant selection process; (iv) reviewing reports submitted by the CSC and safeguard consultants; (v) conducting periodic site checks; (vi) helping the PMU on solutions to handle social and resettlement issues of the subproject; and vii) preparing environmental and social performance section on the progress and review reports to be submitted to the DONRE and the World Bank.

Construction Supervision Consultant (CSC)	- The CSC will assgin Environmental and Social Staff(s) and will be responsible for routine supervising and monitoring all construction activities and for ensuring that Contractors comply with the requirements of the contracts and the ECOP. The CSC will engage sufficient number of qualified staff (e.g. Environmental Engineers) with adequate knowledge on environmental protection and construction project management to perform the required duties and to supervise the Contractor's performance. - The CSC will also assist the PMU in reporting and maintaining close coordination with the local community.
Contractor	- The contractor will assign Enviromental and Social Staff(s) to carry out Enviromental and Social mitigation measures proposed in ESIA/ESMP. - Based on the approved environmental specifications (ECOP) in the bidding and contractual documents, the Contractor is responsible for establishing a Contractor ESMP (CESMP) for each construction site area, submit the plan to PMU and CSC for review and approval before commencement of construction. In addition, it is required that the Contractor get all permissions for construction (traffic control and diversion, excavation, labor safety, etc. before civil works) following current regulations. - The Contractor is required to appoint a competent individual as the contractor's on-site *Safety and Environment Officer (SEO)* who will be responsible for monitoring the contractor's compliance with health and safety requirements, the CESMP requirements, and the environmental specifications (ECOP). - Take actions to mitigate all potential negative impacts in line with the objective described in the CESMP. - Actively communicate with local residents and take actions to prevent disturbance during construction. - Ensure that all 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 local authority and PMU and CSC if environmental accidents occur and coordinate with agencies and keys stakeholders to resolve these issues.
Independent Envionmental Monitoring Consultants (IEMC)	- IEMC will, under the contract scope, provide support to PMU to establish and operate an environmental management system, offers suggestions for adjusting and building capacity for relevant agencies during subproject implementation and monitor the CESMP implementation in both construction and operation phases. IEMC will also be responsible to support PMU to prepare monitoring reports on ESMP implementation. - The IEMC will have extensive knowledge and experience in environmental monitoring and auditing to provide independent, objective and professional advice on the environmental performance of the subproject.
Local community	- Community: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and the PMU. If unexpected problems occur, they will report to the CSC and PMU.

Province and City People's Committees (PPCs/DPCs), Provincial DONRE	- Oversee implementation of subprojects under recommendations of DONRE and PMU to ensure compliance of Government policy and regulations. DONRE is responsible for monitoring the compliance with the Government environmental requirements.

6.5.2. Environmental Compliance Framework

(i) Environmental Duties of the Contractor

The contractor firstly shall adhere to minimize the impact that may be result of the project construction activities and secondly, apply the mitigation measures under ESMP to prevent harm and nuisances on local communities and environment caused by the impacts in construction and operation phases.

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 PMU 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 PMU 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 PMU and CSC.

(ii) Contractor's Safety, Social and Environmental Officer (SEO)

The contractor shall be required to appoint competent staff(s) as the Contractor's on-site safety, Social and environmental officer (SEO). The SEO must be appropriately trained in environmental management and must possess the skills necessary to transfer 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 PMU and CSC
- Inform the contractor and ES (of PMU and CSC) of environmental issues, submit contractor's ESMP Implementation Plan to the ES of PMU and CSC, and relevant authorities, if required;
- Keep detailed records of all site activities that may relate to the environment.

(iii) 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 PMU shall carry out the monitoring.

- 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 PMU and World Bank (respectively every 03 months for PMU and every 6 months for WB in construction phase).
- IEMC will also supply specialized assistance to PMU and ES in environmental matters.

(iv) Environmental and Social Supervision during Construction (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 subproject 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 PMU whether the construction design meets the requirements of the mitigation and management measures of the ESMP,
- Supervise site environmental management system of contractors including their performance, experience and handling of site environmental issues, and provide corrective instructions;
- Review the ESMP implementation by the contractors, verify and confirm environmental supervision procedures, parameters, monitoring locations, equipment and results;
- Report ESMP implementation status to PMU and prepare the environmental supervision statement during the construction phase; and

(v) 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 PMU for approval to see whether sufficient environmental protection and pollution control measures have been included.

The CSC and PMU shall also review the progress and program of the works to check that relevant environmental laws have not been violated, and that any potential for violating the laws can be prevented.

The Contractor shall copy relevant documents to the SEO and the ES of CSC and PMU. The document shall at least include the updated work progress report, the updated work measure, and the application letters for different license/permits under the environmental protection laws, and all the valid license/permit. The SEO and the ES shall also have access, upon request, to the Site Log-Book.

After reviewing the documents, the SEO or the ES shall advise the PMU and the contractor of any non-compliance with the contractual and legislative requirements on environmental protection and pollution control for them to take follow-up actions. If the SEO or the ES concludes that the status on license/permit application and any environmental protection and pollution control preparation works may not comply with the work measure or may result in potential violation of environmental protection and pollution control requirements, they shall advise the Contractor and the PMU accordingly.

(vi) Environmental Claims and Penalty System

In the compliance framework, if non-compliance with environmental regulations are discovered by CSC/ES/IEMC/PMU during the site supervision, 2% values of interim payment of the contractor of this month will be held back. The Contractor will be given a grace period (determined by CSC/PMU) to repair the violation. If the Contractor performs the repairs within the grace period (confirmed by CSC/PMU), no penalty is incurred and keeping 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 keeping money).

In case of IEMC/CSC/PMU not detected of non-compliance with environmental regulations of the contractor, they will be responsibility payment to repair the violation.

(vii) Reporting Arrangements

ESMP monitoring and reporting requirements are summarized in Table 6.6 below.

Table 6.6. Regular Reporting Requirements

No.	Report Prepared by	Submitted to	Frequency of Reporting
1	Contractor to the Employer	PMU	Once before construction commences and monthly thereafter
2	Construction Supervision consultant (CSC)	PMU	Weekly and monthly
4	Community Monitoring	PMU	When the community has any complaint about the subproject safeguards implementation
5	PMU	DONRE	Every three-month
6	PMU	WB	Every six-month

6.5.3. Estimated Costs for Each Work of Environmental Protection Measures

Table 6.7. Costs for environmental protection items

No	Construction	Fund (provisional)
1	Hiring place to dump dredging mud/soil	50 million VND
2	Barrier, fence	150 million VND
3	Fund for Firefighting (fire extinguishers, fire hoses, warning lights)	200 million VND
4	Watering	3 million VND per month
5	Garbage bins on site	30 million VND
6	Portable toilet	20 million VND
7	Backup pump	150 million VND
8	Planting more trees at Long My landfill, Nhon Binh WWTP	450 million VND
9	Wastewater treatment plant	13.79 million USD

6.6. Environmental Monitoring Program

6.6.1. Monitoring Location, Parameters and Frequency

Environmental monitoring program is carried out in 3 stages of the project: before construction phase; construction phase; operational phase:

Preparation stage and construction:

Table 6.8. Location, parameters and frequency of monitoring

No	Monitoring items	Preparation stage and construction
I	Monitoring of air quality	
	1.Monitoring parameters	Microclimate, TSP, H_2S, NH_3^+, CO, NO_2^-, SO_2^-, noise
	2.Monitoring frequency	Preparation stage : Sampling 01 time to evaluate the background envionment condition Construction stage : Monitoring 6 month /time
	3. Yardstick	QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT
	4. Position monitoring	**KK1** – Air sample at construction area of upstream channel of Bau Sen lake **KK2** – Air sample at city center city center, intersection of Phan Dinh Phung-Hoang Quoc Viet road (construction area of tertiary wastewater collection system) **KK3** – Air sample at construction area of Y bridge **KK4** – Air sample at Nhon Binh wastewater treatment plant **KK5** – Air sample at residential area near Long My landfill, Thanh Long village, Phuoc My commune **KK6** – Air sample at Long My landfill, Thanh Long village, Phuoc My commune
II	Surface Water Quality Monitoring	
	1. Monitoring parameters	pH, temperature, salinity, TSS, BOD5, NH4+, Cl-, T-N, T-P, Fe, As, Mn, total oil and grease, Coliforms
	2. Monitoring frequency	Preparation stage : Sampling 01 time to evaluate the background envionment condition Construction stage : Monitoring 6 month /time
	3. Yardstick	QCVN 08:2008/BTNMT

No	Monitoring items	Preparation stage and construction
	4. Position monitoring	**NM1**:Surface sample at wastewater receiving area of upstream channel of Bau Sen lake **NM2**: Surface sample at Phu Hoa lake **NM3**:Surface sample near Doi bridge (on Ha Thanh river) **NM4**:Surface sample at wastewater receiving area of Nhon Binh WWTP **NM5**:Surface sample at construction area of Y bridge **NM6**:Surface sample at construction area of Huynh Tan Phat bridge **NM7**: Surface sample at irrgation channel behind Long My landfill
III	Wastewater quality monitoring	
	1. Monitoring parameters	pH, TSS, BOD5, COD, NH4+, T-N, T-P, Fe, As, Cr, Cu, Zn, Pb, total oil and grease, Coliforms
	2. Monitoring frequency	Preparation stage : Sampling 01 time to evaluate the background enviỉonment condition Construction stage : Monitoring 6 month /time
	3. Yardstick	QCVN 14:2008/BTNMT
	4. Position monitoring	**NT1**: Wastewater at Phu Hoa channel **NT2**: Wastewater at upstream channel of Bau Sen lake **NT3**: Wastewater at area of Dam market, intersection of Phan Dinh Phung-Hoang Quoc Viet road (construction area of tertiary wastewater collection system) **NT4**: Input wastewater at Nhon Binh WWTP **NT5**: Output wastewater at Nhon Binh WWTP **NT6**: Wastewater at pumping station PS10, Tran Quang Dieu ward (construction area of tertiary wastewater collection system **RR1**: Input leachate at Long My landfill, Thanh Long village, Phuoc My commune **RR2**: Output leachate at Long My landfill, Thanh Long village, Phuoc My commune
IV	Sludge/soil	
	1. Monitoring parameters	pH, As, Hg,Cd, Cr, Cu, Pb, Zn
	2. Monitoring frequency	Preparation stage : Sampling 01 time to evaluate the background enviỉonment condition Construction stage : Monitoring 6 month /time
	3. Yardstick	QCVN 03 :2008/BTNMT
	4. Position monitoring	**B1**: Mud sample at upstream channel of Bau Sen lake **B2**: Mud sample near area of Dam market, intersection of Phan Dinh Phung-Hoang Quoc Viet road (construction area of tertiary wastewater collection system) **B3**: Mud sample at Phu Hoa channel **B4**: Mud sample at Nhon Binh WWTP **B5**: Mud sample at pumping station PS10, Tran Quang Dieu ward (construction area of tertiary wastewater collection system) **B6**: Soil sample at Long My landfill , Thanh Long village, Phuoc My commune

No	Monitoring items	Preparation stage and construction
VI	Monitoring of solid waste	Monitoring the volume of arising solid waste and dredged mud
VI	Monitoring of hazardous waste	Monitoring hazardous waste at warehouse area
VII	Monitoring of underground water	Monitoring underground water quality at area of Long My landfill

Table 6.9. The total number of monitoring samples

Total construction time	Monitoring frequency	Total monitoring phases	Air and noise samples	Wastewater samples	Total surface water samples	Sludge / soil samples
48 months	3 month/time	16	96	128	112	96

<u>Operation phase:</u>

No	Monitoring items	Preparation stage and construction
I	Monitoring wastewater	
	1. Monitoring parameters	Volume, pH, temperature, DO, TSS, BOD5, COD, DO, goil and grease, TN, TP, Coliform
	2. Monitoring frequency	Measure daily volume , pH, temperature, DO Periodically monitoring 3 months/time
	3. Yardstick	QCVN 14:2008/BTNMT; 40:2011/BTNMT
	4. Position monitoring	Input and output wastewater
II	Monitoring waste mud	
	1. Monitoring parameters	Volume of, Cu, As, Zn, Pb, Cd
	2. Monitoring frequency	Every 3 months
	3. Yardstick	QCVN 03:2015/BTNMT
	4. Position monitoring	Sludge treatment area
III	Monitoring solid waste	Volume of, composition
	1. Monitoring parameters	The volume of solid waste, hazardous waste arising
	2. Monitoring frequency	Monthly
	3. Position monitoring	Warehouse
IV	Monitoring underground water	
	1. Monitoring parameters	pH, total hardness, TDS, oxidation $KMnO_4$, Cl, NH_4^+, SO_4^{2-}, Fe, Mn, As, Coliform
	2. Monitoring frequency	Every 3 months
	3. Position monitoring	Drilling well at Long My landfill
V	Monitoring subsidence	Landfill area

<u>The closure phase of landfill cell</u>

No	Monitoring items	Preparation stage and construction
I	Monitoring leachate	
	1. Monitoring parameters	Flow, pH, temperature, DO, TSS, BOD5, COD, DO, oil and grease, TN, TP, Coliform, heavy metal

No	Monitoring items	Preparation stage and construction
	2. Monitoring frequency	Daily monitoring on pH, temperature, Do and flow Periodically moniotoring 3 months/time
	3. Yardstick	QCVN 14:2008/BTNMT; 40:2011/BTNMT
	4. Position monitoring	Long My landfill cell
II	Monitoring underground water	
	1. Monitoring parameters	pH, total hardness, TDS, oxidantion $KMnO_4$, Cl, NH_4^+, SO_4^{2-}, Fe, Mn, As, Coliform
	2. Monitoring frequency	3 months/time
	3. Position monitoring	Drilling well at Long My landfill
III	Monitoring subsidence	Landfill

6.6.2. The estimated funding for environmental monitoring program

Table 6.10. The budget of monitoring

No	Name analysis tests	Unit	Quantity	Price (VND)	Quantity
I	***Air samples***				
1	Microclimate (temperature, humidity,wind speed, wind direction)	sample	96	56,051	5,380,896
2	Total suspended dust	sample	96	76,297	7,324,512
3	NO2	sample	96	185,742	17,831,232
4	SO2	sample	96	210,554	20,213,184
5	CO	sample	96	200,000	19,200,000
6	H2S	sample	96	258,067	24,774,432
7	HC	sample	96	311,130	29,868,480
8	Noise	sample	96	71,927	6,904,992
	Total I		**96**	***1,369,768***	**131,497,728**
II	***Surface water samples***				
1	pH	sample	128	33,902	4,339,456
2	Temperature	sample	128	33,927	4,342,656
3	Salinity	sample	128	40,180	5,143,040
4	SS	sample	128	123,257	15,776,896
5	BOD_5	sample	128	151,640	19,409,920
6	NH_4^+-N	sample	128	180,089	23,051,392
7	Cl^-	sample	128	174,221	22,300,288
8	T-N	sample	128	278,525	35,651,200
9	T-P	sample	128	225,431	28,855,168
10	Mn	sample	128	292,330	37,418,240
11	Fe	sample	128	292,330	37,418,240
12	As	sample	128	392,052	50,182,656

13	Oil and grease	sample	128	572,726	73,308,928
14	Coliform	sample	128	404,542	51,781,376
	Total II		**128**	**3,195,152**	**408,979,456**
III	***Wastewater samples***				
1	pH	sample	112	40,180	4,500,160
2	SS	sample	112	84,341	9,446,192
3	BOD_5	sample	112	122,596	13,730,752
4	COD	sample	112	124,819	13,979,728
5	NH_4^+-N	sample	112	110,984	12,430,208
6	T-N	sample	112	171,195	19,173,840
7	T-P	sample	112	112,387	12,587,344
8	Fe	sample	112	115,140	12,895,680
9	As	sample	112	130,637	14,631,344
10	Cu	sample	112	130,000	14,560,000
11	Pb	sample	112	130,000	14,560,000
12	Cr	sample	112	199,662	22,362,144
13	Zn	sample	112	129,704	14,526,848
14	Oil and grease	sample	112	368,284	41,247,808
15	Coliform	sample	112	109,454	12,258,848
	Total III		**112**	***2,079,383***	**232,890,896**
IV	***Soil sample***				
1	pH	sample	96	33,902	3,254,592
2	Hg	sample	96	288,023	27,650,208
3	As	sample	96	288,023	27,650,208
4	Cd	sample	96	296,323	28,447,008
5	Cu	sample	96	300,509	28,848,864
6	Pb	sample	96	296,323	28,447,008
7	Cr	sample	96	300,509	28,848,864
8	Zn	sample	96	300,509	28,848,864
	Total IV		**96**	***2,104,121***	**201,995,616**
GRAND TOTAL					**975,363,696**

6.7. Capacity Building Program

Evaluation of PMU's existing capabilities

Project implementation experience:

From the actual implementation of the previous WB-funded projects (the CCESP) and other ODA projects on water and environment, Quy Nhơn PMU has accumulated safeguard experiences. The Quy Nhon CCSEP subproject PMU has been established base on the PMU of CCESP project which had an Environmental Project Management Team (equivalent to department level) for management of Quy Nhon sub-project under CCSEP. Thus, CCSEP's PMU shall basically be capable and implementation of project management including the safeguards aspects of the subproject.

As for staffing capacity:

As mentioned above, the current staffing of the PMU is inherited from the PMU of Quy Nhon City environmental sanitation improvement project and added with highly experienced personnel working for ODA projects, so they have much good experience for the implementation of this sustainable environment project.

With quite even distribution of qualifications and professions on all fields of construction expertise (Civil, Traffic, Irrigation, Infrastructure) and Economy - Finance as above among the current staffing of the PMU, it can be confirmed that the PMU fulfill the criteria to perform the role of the Client and manage projects in the field of civil construction, transportation, irrigation, urban infrastructure for Grade I works and Group A projects. However, it is required to add internal control staff/division of the PMU according to the new regulations of Vietnam in the coming time. Besides, it is seemingly required to strengthen experts on project management and contract management as well as technical and supervision personnel for the project.

The PMU well carried out the contract management and procurement management in the CCESP project. However, the CCSEP ended in 2014 and the CCSEP will last until 2022, some gained knowledge and experience about regulations of WB and Vietnam were/will be supplemented or replaced, the staff of PMU is also required to update during the project implementation and management period.

According to the assessment results of the CCESP, for consistency, some staffing positions contract management and electromechanical technical management, automation required senior personnel and independent experts with good understanding of contract/equipment/goods management to support current professional staff of the PMU to better meet the requirements of the World Bank, progress and investment quality of the Project

As for equipment:

PMU shall need to be supplied, equipped with new softwares for financial and accounting management, analysis and data compilation adequate to Vietnam Accounting Codes as well as of the WB, aiming to establish an adequate and optimum accounting system for financial-accounting tasks.

The table 6.11 below provides a typical training program on safety policies. Training programs will be developed and implemented by a team of Technical Assistance for the implementation of safety policies for PMU. PMU / IEMC with the help of the Technical Assistance Team will provide training for contractors, CSC and other groups.

- *Trainee groups:* the PMU staff, the ESU department staff, the field engineers (FE), construction supervision consultants (CSC), the building contractors, representatives of relevant stakeholders and local communities in the project area. The contractors take the responsibility for training workers and drivers.

- *Training Schedule:* Training will be given at least one month before performing the first construction contract. Subsequent training sessions can be modified to suit the construction schedule for project components.

- *Frequency of training:* The basic training programs given in the table below will be provided every 6 months annually, and the contents will be updated and tailored to items to be implemented. Training programs for PMU staff are expected to continue in the first years of the Project. Three-day training for CSC and contractors is also planned to take place twice a year for at least 2 years.

Table 6.11. Advanced training program on environmental monitoring management capacity

I. Subjects	**PROJECT MANAGEMENT**
Training	Environmentalmonitoring and reporting
Participants	Staff in charge of environmental issues and environmental management staff
Frequency of training	Immediately after the effective project, but at least one month before the first bid package. . The next training will be planned according to the needs.
Time	Four days of training
Content	General environmental management related projects including the World Bank's request, the Department of Natural Resources and Environment, in collaboration with stakeholders and responsible authorities concerned Environmental monitoring for the project include: - The requirements of environmental monitoring; - Monitoring and implementation of mitigation measures; - The involvement of the community in environmental assessment. - Guidance and monitoring contractors, CSC and community representatives in the implementation of environmental monitoring - The form used in environmental monitoring processes; - Reaction and risk control; - How to receive and submit Form. - Other issues will be decided
Responsibility	Independent environmental monitoring consulting (IEMC), PMU, with the help of technical assistance teams implement safety policies
II. Subjects	**CSC, CONTRACTORS, WARD / COMMUNES, COMMUNITY REPRESENTATIVES**
Training	Implementation of mitigation measures
Participants	CSC; The construction managers, environment officer of the contractor; ward / communerepresentatives; representatives of urban groups
Frequency of training	Shortly after the award of contract for the contractor, updated on demand
Time	3 days of training for CSC and contractors and two days of training for others
Content	- Summary overview of the monitoring of the environment; - The requirements of environmental monitoring; - The role and responsibility of the contractor and of CSC; - The content and methods of environmental monitoring; - Reaction and risk control; - Introduce the monitoring form and instructions on how to fill out a form of environmental monitoring and incident reporting; - Other issues will be determined - Prepare and submit a report.
Responsibility	PMU, independent environmental monitoring consulting (IEMC) with the help of technical assistance teams implement safety policies
III. Subjects	**COMMUNITY / WORKERS**
Training	Safety andhygienic environmental

Participants	Representatives of workers (team leaders) working directly for the project components
Frequency of training	Accordingly
Time	1 daypresentation and 1 day presented at the scene
Content	- Presentation of the preliminary safety issues and environmental overview - Key issues require the attention of the public and construction workers to mitigate the safety risks (roads, waterways, equipment, machinery, etc.) as well as reduce pollution (dust, exhaust, oil spills, waste management, etc.) - Management of safety andhygienic environmental on site and camps - Mitigation measures applied on site and camp - Safety measures for electrical, mechanical, transportation, air pollution - Methods for dealing with emergency situations - Other issues will be determined - The rights and responsibilities of environmental monitoring - Environmental monitoring, environmental monitoring form - Measures to mitigate the social impact and monitoring implementationOther issues to be determined
Responsibility	Contractors, PMU with the assistance of independent environmental monitoring consulting(IEMC)

6.8. Total Estimates

The following table provides a cost estimate for the implementation of environmental management plan (ESMP). The cost of ESMP[10] implementation will include (i) the costs of implementing mitigation measures by the contractor, (ii) expenses supervised by CSC, (iii) cost of the independent environmental monitoring consultant (IEMC), (iv) the costs of environmental quality monitoring, (v) the cost of safety management for the PMU, 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 site-specific environmental monitoring plan(SEMP) by the construction supervision consultant (CSC) will be provided in construction supervision contracts. The costs of the PMU operations relating to EMP are allocated from the project management budget of the PMU, 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.

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 communityparticipation, 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

[10]Excluding costs for RP implementation and independent monitoring the performance of RP/EMP

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".

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 6.12. Estimated cost of EMP implementation (US $ million)

	Items ofQuy Nhon subproject (million USD)	**Fund source**
(a) Minimization during construction	As part of the contract	WB
(b) Monitoring safety policies during construction	As part of the cost for Construction Supervision Consultant rent (CSC)	WB
(c) Division responsible for the environmental safeguard policies of the PMU	As part of the costs for the PMU	Counterpart funds
(d) Environmental quality monitoring	0.044	WB
(e) Independent environmental monitoringconsultant (IEMC)	0.083	WB
(f) Capacity building programs on safety policies	0.013	WB

Table 6.13. Estimated costs of IEMC (Exchange rate: 1 USD = 22,230 VND)

No	**Content**	**Unit**	**Volume**	**Price (VND)**	**Amount (VND)**	**Amount (USD)**
1	Salary expert	person-month	45	30,000,000	1,350,000,000	60,728.7
2	Accommodation, per diem	person-day	560	350,000	196,000,000	8,816.9
3	Travel expenses	Trip/ people	80	5,000,000	400,000,000	17,993.7
4	Class organization	Class	8	5,000,000	40,000,000	1,799.4
5	Stationery and communications	monitoring	16	5,000,000	80,000,000	3,598.7
6	Environmental quality monitoring				975,363,696	43,876
	Total				**3,041,363,696**	**136,813.5**

6.9. Grievance redress mechanism (GRM)

Complaints relating to any subproject's problems will be solved through negotiations to achieve the consensus. A complaint will go through three Stages before it can be transferred to the court. The enforcement unit will pay all administrative and legal fees relating to the acceptance of complaints. This cost is included in the project budget.

Complaint procedures and resolution will be performed as follows:

The first level ***People's Committee of ward / commune***. An affected household is to take his/her complaint to any member of the People's Committee of the ward / commune, through the village head or directly to People's Committee of the commune / ward, in written or oral form. The said member(s) of the People's Committee or the village head will inform the People's Committee of the ward/commune on the complaint. The People's Committee of Ward/Commune will work directly in person with the said affected household and will decide on the settlement of the complaint 5 days after receiving such complaint (this may take 15 days in mountainous or remote areas). The Secretariat of the People’s Committee of the relevant commune/ward is responsible for documenting and recording all the complaints that it is handling.

After the Ward/Commune People's Committee issues its decision, the relevant household can make an appeal within 30 days. In case a second decision has been issued but the said household is still not satisfied with such decision, such household can appeal to the municipal (city) People’s Committee (CPC).

The second level *The CPC*. Upon receiving a complaint from a household, the CPC will have 15 days (or 30 days in case of remote and mountainous areas) after receiving the complaint to resolve the case. The CPC is responsible for filing and storing documents on all complaints that it handles.

When the CPC has issued a decision, the household can make an appeal within 30 days. In case a second decision has been issued and the household is still not satisfied with such a decision, they can appeal to the Provincial People’s Committee (PPC).

The third level *The PPC*. Upon receiving a complaint from the household, the PPC will have 30 days (or 45 days in case of remote and mountainous areas) after receiving the complaint to resolve the case. The PPC is responsible for filing and storing documents for all complaints to be submitted.

After the PPC has issued a decision, the household can appeal within 45 days. In case a second decision has been issued and the household is still not satisfied with such decision, they can appeal to the court within 45 days. The PPC will then have to pay the compensation into an account.

The Forth level *Provincial Court*. In case a complainant brings his/her case to a provincial court and the court rules in favor of the complainant, the provincial authorities will have to increase the compensation up to such a rate as may be ruled by the court. In case the court’s ruling is in favor of the PPC, the complainant will be refunded the amount of money that has been paid to the court.

The decision ruling the settlement of complaints will have to be sent to complainants and concerned parties, and shall be publicly posted at the headquarters of the People's Committee of the relevant level. The complainant will receive such ruling three days after the result of complaint resolution at the ward / commune / town level has been decided upon and 7 days at the district or provincial level.

To minimize the number of complaints at provincial level, the PMU will coordinate with the Municipal Compensation Committee to participate and provide consultation in solving complaints and respond to complainants. Municipal Compensation Committee located at no.83 Le Hong Phong street, Quy Nhon city. Its role and capacity is to carry out the compensation, support and arrange resettlement for affected households and displaced persons on Quy Nhon area.

Personnel: The environment and resettlement staff chosen by the PMU will design and maintain a database of the project-related complaints from affected households, including information such as: the nature of the complaint, the source and date of receipt of the complaint, the name and address of the complainant, action plan, and current status.

For oral complaints, the receiving / mediator board will record these requests in a complaint form at the first meeting with the affected person.

Contractor and Construction Supervision Consultant:

During construction, the GRM will also be managed by the contractors under supervision of the CSC. The contractors will inform the affected communities and communes about the GRM availability to handle complaints and concerns about the 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.

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 PPMU within 24 hours since receipt of the complaint.

Information to be recorded in the complaint log will consist of:

- The date and time of the complaint.
- The name, address and contact details of the complainant.
- A short description of the complaint.
- Actions taken to address the complaint, including contact persons and findings at each step in the complaint redress process.
- The dates and times when the compl2ainant is contacted during the redress process.
- The final resolution of the complaint.
- The date, time and manner in which the complainant was informed thereof.
- The complainant's signature when resolution has been obtained.

Minor complaints will be dealt with within one week. Within two weeks (and weekly thereafter), a written reply will be delivered to the complainant (by hand, post, fax, e-mails) indicating the procedures taken and progress to date.

The main objective will be to resolve an issue as quickly as possible by the simplest means, involving as few people as possible, and at the lowest possible level. Only when an issue cannot be resolved at the simplest level and/ or within 15 days, will other authorities be involved. Such a situation may arise, for example, when damages are claimed, the to-be-paid amount cannot be resolved, or damage causes are determined.

Independent environmental and monitoring consultants, who have enough the specialized capacity, would be selected by Binh Dinh CIW PMU through bidding. Independent monitoring consultants are responsible for checking the procedures and decisions on settling complaints. Independent monitoring consultants may propose additional measures to address any outstanding complaints. While checking the procedure for complaint resolution and reviewing the decision on complaint resolution, the independent monitoring agencies are required to closely coordinate with the Vietnam Fatherland Front, whose members are responsible for monitoring law enforcement of local complaints.

***World Bank Grievance Redress Mechanism**:* Communities and individuals who believe that they are adversely affected by a World Bank (WB) supported project may submit complaints to existing project-level grievance redress mechanism or the WB's Grievance Redress Service (GRS). The GRS ensures that complaints received are promptly reviewed in order to address project-related concerns. Project affected communities and individuals may submit their complaints to the WB's independent Inspection Panel which determines whether harms occurred, or could occur, as a result of WB non-compliance with its policies and procedures. Complaints may be submitted at any time after concerns have been brought directly to the WB's attention, and Bank Management has been given an opportunity to respond. For information on how to submit complaints to the World Bank's corporate Grievance Redress Service (GRS), please visit www.worldbank.org/grs. For information on how to submit complaints to the World Bank Inspection Panel, please visit www.inspectionpanel.org.

CHAPTER 7. PUBLIC CONSULTATION AND DISCLOSURE

7.1. Summary on the Implementation of Community Consultation

Public consultation is used to help identify opportunities and risks, improved subproject design and implementation, and increase subproject ownership and sustainability. Public consultation is specifically required by the World Bank's environmental and social safeguard policies. A meaningful public consultation will be used. This is a two-way process in which beneficiaries provide advice and input on the design of the proposed subproject that affect their lives and environment, promotes dialogue between governments, communities, and implementing agencies to discuss all aspects of the proposed subproject. The feedbacks from consultation will be incorporated into the subproject ESIA and design

The objectives of community consultation are as bellows:

- To share all information on items and activities in the subproject plan with the local communities and stakeholders.
- To gather opinions/comments of the local authorities and communities as well as their concerns on local characteristics, environmental issues that are sensitive; issues missed by environmental assessment impact. Based on the collcted information, local communities' concerns may be addressed properly during the selection of design options for the subroject.
- To collect local communities' opinions/comments on preparation and content of thedraft EIA so that environmental impacts are adequately and satisfectorily assessed, and mitigation measures for adversely environmental impacts are developed.

7.1.1. Summary on Community Consultation with Ward/Commune People's Committees

As stated in the Law of Environment Protection No. 55/2014/QH13 issued by National Assembly of Socialist Republic of Vietnam, dated on 23/06/2014 and came into full force on 01/01/2015, Decree No. 18/2015/ND-CP dated on 01/04/2015 from the Government about the regulations for environment protection scheme, strategic environment assessment, environmental impacts assessment and environment protection plan, and Circular No. 27/2015/TT-BTNMT dated on 29/05/2015 from Ministry of Natural Resources and Environment about strategic environment assessment, environmental impacts assessment and environment protection plan. The subproject owner - key subproject management unit of Binh Dinh province has issued Document no.574/QLDA-MT dated 4 July, 2016 for community consultation at the ward and communes in the subproject area, including: Tran Hung Dao, Le Loi, Le Hong Phong, Tran Phu, Ly Thuong Kiet, Nguyen Van Cu, Dong Da, Thi Nai, Hai Cang, Ngo May, Ghenh Rang, Quang Trung, Nhon Binh, Nhon Phu, Bui Thi Xuan, Tran Quang Dieu, Phuoc My, Nhon Ly, Nhon Hai, Nhon Hoi to collect views and opinions in process of preparing environmental and social impact assessment for the subproject. The related councils of people have sent invitation to most of the affected households, representatives of city groups, blocks, teams of their wards and communes. The commune and ward PCs also sent their commnets with views, opinions about the environmental impacts of the subproject and the implementation of methods to minimize the adverse impacts.

7.1.2. Summary the Process of Organizing Meeting for Advisory of Directly Affected Communities in the Project

1st consultation:

The Subproject Management Unit (PMU) of Binh Dinh province coordinated with local authority to carry out consultation process with the community about environmental problems and methods to ensure environmental hygiene of the subproject from 19 to 27/02/2016

The participants included:

- Representatives of the Subproject Owner.
- Representatives of the local authorities.
- Representatives of the consultant unit.
- Representatives of the affected community.

The consultation contents were:

- To disseminate information about the subproject: distributing summary documents about the content of the subproject, items constructing in communes, map of construction area.
- To present positive and negative environmental impacts when the subproject is executed.
- To present proposed methods to minimize negative impacts on natural environment and social environment.
- Advisory of leaders and local people about environmental problems.

2nd consultation:

The PMU of Binh Dinh province coordinated with local authority to carry out advisory process of community about environmental problems and methods to ensure environmental hygiene of the subproject from 7-15/07/2016 after the ESIA was available.

The participants included:

- Representatives of the Subproject Owner.
- Representatives of the local authorities.
- Representatives of the consultant unit.
- Representatives of the affected community.

Activities in consultation meetings include:

- Disseminating information on the subproject: provision of summary on subproject's information, construction items and construction maps in communes.
- Presenting positive and negative social and environmental impacts when the Subproject is implemented;
- Presenting proposed measures to mitigate negative impacts on the natural environmental and the social environment;
- Consulting the opinions of leaders and local people about social and environmental issues.

7.2. Consultation Results

7.2.1. Local Authority's Opinions and Organizations to be Affected Directly by Project

Local authority's oipinons are synthesizedin the Table7.1below:

Table 7.1. Local authority's opinions and requirements

Local authority's opinions	Subproject Management Unit and ESIA Consultant acceptance of comments
○ Allow and support launching the subproject to improve the city environment ○ The subproject needs to have timely and suitable compensation and resettlement assistance plan for local residents ○ Ensure traffic safety during the construction ○ Repair and compensate if residential houses are damaged during the construction. Repair public structures such as roads if damaged. ○ Provide good construction waste management ○ Clean up the sites after construction	○ Subproject Management Unit welcomes and agrees with the opinions and recommendations of the People' Committee ○ Consider the needs and requirements of local people and their suggestions for environmental issues ○ Carefully consider and assess areas sensitive to environmental issues and take measures to prevent and minimize the impact in a scientific and feasible manner, suitable to the specific local conditions ○ Local authorities and people's roles in environment supervision during the Subproject phrases.

7.2.2. Community's Opinions

Community's opinions in 1st consultation (February, 2016) are synthesized in the Table 7.2 below:

Table7.2. Community's opinions in 1nd consultation

No	Local people's opinions and recommendations	Subproject Management Unit (PMU) and Consultant Party acceptance of comments
1	Tran Hung Dao Ward ○ Quickly construct sewer system on Bach Dang road to unblock the traffic and minimize flooding in the area ○ Minimize dust and noise pollution during the construction ○ Local people are very happy to see the subproject to be launched ○ Local people would like the PMU to accelerate subproject launching ○ PMU needs to coordinate closely with local authorities and community within the subproject area	○ PMU welcomes and agrees with the suggestions and comments from local people ○ WB is the subproject financing agency and supports solving environmental problems so that sewerage system could be constructed
2	Le Loi Ward ○ Totally support the construction subproject of sewer system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will inform to local people the detailed time, method of construction
3	Le Hong Phong Ward ○ Local people agree with and support the construction of stone canal at Bau Sen Lake upstream canal. ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction
4	Tran Phu Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, details of time, method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction
5	Ly Thuong Kiet Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Need measures to ensure traffic safety during the construction	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction ○ All the construction items will have different construction proposals to choose the most optimal option

6	Nguyen Van Cu Ward ○ Totally support the construction subproject of sewer system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction
	Dong Da Ward ○ Local people are eager when the subproject is launched on Tran Hung Dao road, especially in Hoc Ba Bep, where flooding usually happens during rainy season. ○ People living in the area of Hoc Ba Bep support and hope the subproject will be launched and constructed soon ○ Some people on Tran Hung Dao road recommend the subproject to pay attention to historical and cultural heritage, namely Twin Towers (Thap Doi), etc ○ Minimize environmental problems during the construction of Hung Thanh (Y-shaped) Bridge and Huynh Tan Phat Bridge ○ Require the PMU to ensure traffic safety by displaying signposts, construction signs to redirect vehicles to other	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ Compensation: PMU will attention to local people's lives, social security and order and have appropriate plans and policies. ○ All the construction items (sewer system and bridges) will have different construction proposals to choose the most optimal option. ○ PMU will pay attention to traffic safety during the construction ○ PMU will provide local people with information and policies so that local community would understand and support the subproject
8	Thi Nai Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Minimize the environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
9	From Hai Cang Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
10	Ngo May Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction

11	Genh Rang Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
12	From Quang Trung Ward ○ Households along the canal agree to cover the Phu Hoa canal because this is an area of pollution, affecting people's health. ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
13	From Nhon Binh Ward ○ Adequate compensation for local people who lose their agricultural land around the area of Nhon Binh Wastewater treatment plant. ○ If problem of odor pollution affecting surrounding households is completely solved, local people will agree and support subproject launching in Nhon Binh ward ○ Reduce environmental problems during construction of Nhon Binh Wastewater treatment plant ○ Some people complain about the odor from Nhon Binh Wastewater treatment plant. ○ People are concerned about the quality of treated wastewater from Nhon Binh Water treatment plant	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will have appropriate compensation policies in accordance with WB and Vietnamese regulations. ○ Output wastewater of Nhon Binh WWTP (capacity of14000m^3/d.n) has granted the license by MONRE. Upgrading Nhon Binh WWTP's capacity up to 28000 m^3/d.n will be carried out in line with regulation of discharge
14	From Nhon Phu Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Need measures to ensure traffic safety during the construction	○ PMU welcomes and agrees with the suggestions and comments from local people.
15	From Bui Thi Xuan Ward ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Need measures to ensure traffic safety during the construction ○ Minimize environmental pollution such as dust and construction debris during the construction	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction

16	From Tran Quang Dieu Ward o Totally support the construction subproject of sewerage system level 3 o Quickly launch the subproject, details of time and method need to be publicly disclosed to local people o Need measures to ensure traffic safety during the construction o Minimize environmental pollution such as dust and construction debris during the construction	o PMU welcomes and agrees with the suggestions and comments from local people o PMU will pay attention to traffic safety during the construction
17	From Phuoc My Commune o Adequate compensation for local people who lose their plants (Chinese banyan and acacia trees) at the expanded area for landfill. o Local people support the subproject	o PMU welcomes and agrees with the suggestions and comments from local people.

Community's opinions in 2st consultation (July, 2016) are synthesized in the Table 7.3 below:

Table7.3. Community's opinions in 2nd consultation

No	Local people's opinions	PMU, consultant's answer
1	**Tran Hung Dao Ward** o Quickly construct sewer system on Bach Dang road to unblock the traffic and minimize flooding in the area o Minimize dust and noise pollution during the construction o Local people are very happy to see the subproject to be launched o Local people would like the Subproject Management Unit to accelerate subproject launching o PMU needs to coordinate closely with local authorities and community within the subproject area	o PMU welcomes and agrees with the suggestions and comments from local people o WB is the non-profit subproject supporters in solving environmental problems so that sewerage system could be constructed
2	**Le Loi Ward** o Totally support the construction subproject of sewer system level 3 o Quickly launch the subproject, details of time and method need to be publicly disclosed to local people	o PMU welcomes and agrees with the suggestions and comments from local people o PMU will inform to local people the detailed time, method of construction
3	**Le Hong Phong Ward** o Local people agree with and support the construction of stone canal at Bau Sen Lake upstream canal. o Quickly launch the subproject, details of time and method need to be publicly disclosed to local people o Minimize environmental pollution such as dust and construction debris during the construction o Signs, speed warning signs should be placed at the construction sites	o PMU welcomes and agrees with the suggestions and comments from local people o PMU will pay attention to traffic safety during the construction
4	**Tran Phu Ward** o Totally support the construction subproject of sewerage system level 3 o Quickly launch the subproject, details of time, method need to be publicly disclosed to local people o Minimize environmental pollution such as dust and construction debris during the construction	o PMU welcomes and agrees with the suggestions and comments from local people o PMU will pay attention to traffic safety during the construction

No	Local people's opinions	PMU, consultant's answer
	○ Signs, speed warning signs should be placed at the construction sites	
5	**Ly Thuong Kiet Ward** ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Need measures to ensure traffic safety during the construction	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction ○ All the construction items will have different construction proposals to choose the most optimal option
6	**Nguyen Van Cu Ward** ○ Totally support the construction subproject of sewer system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people ○ PMU will pay attention to traffic safety during the construction
7	**Dong Da Ward** ○ Local people are eager when the subproject is launched on Tran Hung Dao road, especially in Hoc Ba Bep, where flooding usually happens during rainy season. ○ People living in the area of Hoc Ba Bep support and hope the subproject will be launched and constructed soon ○ Some people on Tran Hung Dao road recommend the subproject to pay attention to historical and cultural heritage, namely Twin Towers (Thap Doi), etc. ○ Minimize environmental problems during the construction of Hung Thanh (Y-shaped) Bridge and Huynh Tan Phat Bridge ○ Require the PMU to ensure traffic safety by displaying signposts, construction signs to redirect vehicles to other roads. ○ The subproject must have resettlement plan for the local people in case of land withdrawal	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ Compensation: PMU will attention to local people's lives, social security and order and have appropriate plans and policies. ○ All the construction items (sewer system and bridges) will have different construction proposals to choose the most optimal option. ○ PMU will pay attention to traffic safety during the construction ○ PMU will provide local people with information and policies so that local community would understand and support the subproject.
8	**Thi Nai Ward** ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people ○ Minimize the environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
9	**Hai Cang Ward** ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, detail of time, method need to be publicly disclosed to local people	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction

No	Local people's opinions	PMU, consultant's answer
	○ Signs, speed warning signs should be placed at the construction sites	
10	**Ngo May Ward** ○ Totally support the construction subproject of sewerage system level 3 ○ Quickly launch the subproject, details of time and method need to be publicly disclosed to local people ○ Minimize environmental pollution such as dust and construction debris during the construction ○ Signs, speed warning signs should be placed at the construction sites	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will pay attention to traffic safety during the construction
11	**Nhon Binh Ward** ○ Adequate compensation for local people who lose their agricultural land around the area of Nhon Binh Wastewater treatment plant. ○ If problem of odor pollution affecting surrounding households is completely solved, local people will agree and support subproject launching in Nhon Binh ward ○ Reduce environmental problems during construction of Nhon Binh Wastewater treatment plant ○ Some people complain about the odor from Nhon Binh Wastewater treatment plant. ○ People are concerned about the quality of treated wastewater from Nhon Binh Water treatment plant	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will have appropriate compensation policies in accordance with WB and Vietnamese regulations.
12	**Nhon Hai** ○ People completely agree with construction of subproject ○ Recommend constructing more school toilet on commune area	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will have appropriate compensation policies in accordance with WB and Vietnamese regulations.
13	**Nhon Ly commune** ○ People completely agree with construction of subproject ○ Recommend constructing more school toilet on commune area	○ PMU welcomes and agrees with the suggestions and comments from local people. ○ PMU will have appropriate compensation policies in accordance with WB and Vietnamese regulations.
14	**Nhon Hoi commune** ○ People completely agree with construction of subproject ○ Recommend constructing more school toilet on commune area	○ PMU welcomes and agrees with the suggestions and comments from local people.
15	**Phuoc My commune** ○ It is necessary to establish the adequate compensation for households losing plants (Acacia, Eucalyptus) in construction area of landfill cell A-4. The subproject should have to refer to the market price for adequate compensation decision	○ PMU welcomes and agrees with the suggestions and comments from local people. ○

No	Local people's opinions	PMU, consultant's answer
	o Issue of access road to the household's forestry land area also takes into account in case of land acquisition o Subproject should pay attention to acquire the remaning land area if any household loses 90-95% their land area o Indentify clearly the land acquisition boundary o People agree with construction of subproject	

7.2.3. Reply and Promise by the Subproject Owner

The Subproject Owner agreed and acknowledges opinions/comments from Wards/Communes – level People's Committee and local residents. The subproject owner and consultants did screen through those opinions/comments and added them into reports. Environmental Impact Assessment Report was completed based on the sound acceptance of those opinions/comments.

The subproject owner will continue to pay attention in implementation of mitigation measures for environmental impacts, and will observe its contractors so those measures are carried out soundly and compliant with EIA.

The subproject owner promises to care and handle reasonably all issues relating compensation and assistance for local people, according to Vietnam Government regulations.

Subproject developer welcomes and agrees with the opinions, comments and suggestions from local People's Committees in subproject areas. The Subproject developer and Consultant revised and supplemented its report and completed its EIA after receiving comments and recommendations from local People's Committees and local people in subproject area.

Subproject developer shall continue and pay attention to supervise its contractors' practice in minimizing environmental impact in compliance with the EIA.

Subproject developer is committed to adequate compensation and supporting local people in accordance with Vietnamese regulations.

Regarding the suggestions and requirements of environmental and resettlement issues in the subproject area proposed by local authorities and people, the Subproject Management Unit of priority constructions in Binh Dinh province – the representative of Subproject developer welcomed and agreed with the suggestion and advice on measures to minimize negative impacts on environment and environmental protection structures of the subproject. Subproject developer will seriously consider those suggestions and advice and promises to take measures to reduce the adverse impacts on environment, prevent and quickly response to environmental incidents as proposed in the ESIA in a scientific and feasible ways suitable to each ward.

- *Minimizing dust, exhaust fume and noise pollution:*

+ Environemtal impacts due to dust and exhaust fumes: in compliance with QCVN 06-2009/BTNMT: National technical regulation on hazardous substances in ambient air;

+ Noise pollution : in compliance with QCVN 26-2010/BTNMT National technical regulation on noise

Subproject developer pledges to adopt measures for minimizing adverse impacts of the subproject as proposed in Chapter 4.

- *Minimizing impact of water pollution and storm water runoff*:

+ Subproject domestic wastewater will be discharged into the wastewater receiving tank of wastewater treatment plant and processed under the concentrated treatment system in accordance with QCVN 14:2008/BTNMT National technical regulation on domestic wastewater quality. Column A indicates C value of pollution index used to calculate the allowed maximum value of domestic wastewater before being discharged into fresh water sources.

+ Rainwater will be treated for sedimentation and grease filtration in a treatment tank of size enough for a heavy rain before being discharged into Dinh River.
+ Subproject developer pledges to adopt measures for minimizing adverse impact of the subproject as proposed in Chapter 4 of ESIA.

- *Minimizing impact during the construction*:

+ Raising officers and workers' awareness of environmental protection. Conducting environment sanitation and waste management.
+ Coordinating with related parties for regular check, monitoring and supervising occupational safety.
+ Planning for effective and safe materials transportation in order to avoid traffic accidents inside and outside the subproject areas.
+ Satisfying the operation standard of trucks, regulating maximum speed in subproject areas. Arranging travelling time for trucks to avoid traffic congestion in the area.
+ Ensuring social security and order, avoiding conflicts between workers and local people.
+ The construction site will be covered therefore local people's daily activities will not be affected.

Those measures shall be recognized in contractor agreements to ensure the effective implementation of measures for minimizing pollution during the construction. The implementation of measures for reducing dust, wastewater pollution from construction sites, noise and vibration pollution shall ensure the compliance of the subproject with National regulations on environment QCVN 05-2013/BTNMT, QCVN 40-2011/BTNMT, QCVN 26-2010/BTNMT and QCVN 27-2010/BTNMT.

– *Coordination with local authority and people*:

+ Subproject developer will closely coordinate with local authorities to protect local environment, social security and order. Subproject developer will strictly comply with regulations on environment protection and pledges to take measures for minimizing negative impacts on natural, economic and social environment as well as people's health as proposed in the EIA and ensure not to affect local community's daily activities.
+ Subproject developer will issue periodical environment monitoring reports in accordance with regulations and report subproject environment situation to Natural Resources and Environment of Binh Dinh province.

– *Commitment fulfillment*:

+ Subproject developer is committed to comply with Vietnamese laws and regulations on environment protection during the subproject.
+ Subproject developer pledges to adopt measures for minimizing adverse impact of the Subproject on environment during the preparation, construction and operation phases as

proposed in Chapter 4 of ESIA.

+ Subproject activities will be supervised by local and central environmental management authorities.

Subproject developer is committed to compensation and remediation for environment pollution and incidents which might happen during the subproject.

7.3. Information disclosure

The draft of ESIA was released at the offices of Quy Nhon City People's Committee and Wards/Communes – level People's Committee on 2016. Information on the releasing date will be public on website of Quy Nhon City People's Committee. Local people could contribute their opinions/comments for this draft of ESIA report. The draft EIA has also been disclosed at the Worlb Bank Infoshop.

CONCLUSION, RECOMMENDATION AND COMMITMENT

1. Conclusion

From the report of the environmental impact assessment of the project "Coastal Cities Sustainable Environment Project", the following conclusions can be drawn:

- Regarding the objectives of the project: The project carried out will ensure to achieve all proposed objectives, including Stormwater drainage to control the flood in the city centerarea; Improving environmental sanitation conditions through the construction and development of the wastewater collection system, the enhancement of the junction of households wastewater system with the City's water drainage system; Resolving the environmental pollutionproblem caused by the waste water through the expansion of the waste water treatment plant; Minimizing the environmental pollution sanitation problems caused by solid waste through the landfill expansion; Strengthening the capacity, means and equipment for the maintenance management of drainage system and waste water treatment plant, improving the solid waste management, training the operation staffs in order to efficiently maintain and operate the constructions simultaneouslystrengthen the consolidation of the organizational structure; Contributing to the completion and development of infrastructure, urban landscaping to meet the development needs of the City in the period up to 2010 and 2020; Improving the public awareness about the environment and environmental protection.
- Regarding the socio-economic efficiency: The complete water drainage system will contribute to create the good environment, strengthen the general economic operation capability of all economic sectors. Quy Nhon's tourism will attract more tourists, income per capita will increase. The exchange communication among the regions of the city gets convenient.
- Regarding the environmental impacts: The project does not cause the serious negative environmental impacts. In the phases of preparation, implementation and operation, the project may cause some negative impacst but the extent is not large such as: dust pollution, noise pollution, pollution caused by stormwater runoff with hight content of suspended sediments, pollution caused by the domestic waste of the workers during the construction period, construction waste and some risks of labor safety, transportation, chemicals. However, with a successive and decentralized execution method, the small number of labors as well as an insignificant number of machines mobilized for construction, the environmental impacts of the project's activities are local, temporary and possibly mitigated.
- The project complies and conforms with the Water Drainage Planning of Quy Nhon City up to 2020 and vision to 2050 taking into account the Climate Change (*Ongoing – stage of submission for approval*) and up to 2020 and Adjustment of general Planning of Quy Nhon City, Binh Dinh province up to 2020 (approved by the Prime Minister on 01 June 2004).

2. Recommendation

This is a project having the significant economic and social benefits; little temporary and possibly mitigated environmental negative impacts. Besides, the project will create a premise towards the long-term sustainable development for Quy Nhon city as well as Binh Dinh province. Therefore, it is respectfully proposed that the Binh Dinh Provincial People's Committee early approvesthe DTM report as a legal basis to continue to implement and put the project into operation soon.

3. Committment

The Investor which is the Project Management Unit of the key construction works in Binh Dinh province hereby commits to comply with:

- Law on Environmental Protection No. 55/2014/QH13 issued by the National Assembly of the Socialist Republic of Vietnam dated 23 June 2014
- Decree No. 80/2014/ND-CP dated 06 August 2014 of the Government providing regulations on water drainage and waste water treatment.
- Decree No. 19/2015/ND-CP dated 14 February 2015 of the Government detailing the implementation of a number of articles of the Law on Environmental Protection.
- Decree No. 18/2015/ND–CP dated 01 April 2015 of the Government providing regulations on the environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plans.
- Circular No. 27/2015/TT–BTNMT dated 29 May 2015 of the Ministry of Natural Resources and Environment on strategic environmental assessment, environmental impact assessment and environmental protection plans of the Minister of the Ministry of Natural Resources and Environment; and other related documents.
- Seriously implement the measures to control the pollution sources arising from the project's activities in accordance with the technical plan presented in the report of environmental impact assessment.
- Fully implement the measures to minimize the negative impacts in the phases of preparation, construction and operation of the project as presented in this report of environmental impact assessment.
- In case of incidents, risks and environmental pollution affecting the surrounding area, we hereby commit to the remediation and restoration of the environment in accordance with the law.
- During the operation of the project, if there is any environmental factor arising, we will immediately report it to the local environment management authority and the specialized authorities to promptly prevent and handle;
- Ensure adequate funding for the implementation of the annual environmental monitoring program.
- Maintain, update and publicize the information of the project's environmental data.

The Investor commits to report to the competent authorities to consider the necessary measures on the environment. The project owner commits that after completing the construction of the project categories will submit a report to the Binh Dinh Department of Natural Resources and Environment for review and confirmation of the implementation according to regulation(if any).

APPENDICES

Appendix 1. Assessment on material quarries' compliance with health and environment safeguard

Appendix 2. Due diligence of Nhon Binh WWTP

Appendix 3. Due diligence of Bau Lac WWTP

Appendix 4. Due diligence of Long My landfill

Appendix 5. Sampling location map

Appendix 6. Dredging material management plan (DMMP)

APPENDIX 1. ASSESSMENT ON MATERIAL QUARRIES' COMPLIANCE WITH HEALTH AND ENVIRONMENT SAFEGUARD

a. Quarry at Giang mountain, Bui Thi Xuan ward, Quy Nhon city, Binh Dinh province

General information:

Quarry is located at Giang mountain, Bui Thi Xuan ward, Quy Nhon city. This mine is under operation since 2013, exploited by Investor Binh Dinh VRG JS Company. Total exploitation area of quarry mine is 8.95ha with average exploitation capacity is 54,470 m^3/year, 27 is the year approved for exploitation time

Quarry located at Giang mountain, Bui Thi Xuan ward, Quy Nhon city has been licensed by Vietnam management agency on environmental resources as following:

- Certificate no.01/GP-UBND dated 04 January, 2013 licensed to Binh Dinh VRG JS Company for approving the exploitation of quarry at Giang moutain, Bui Thi Xuan ward, Quy Nhon city, Binh Dinh province.
- Decision no.2850/GD-CTVBN dated 13 December, 2012 issued by Chairman of Binh Dinh provice regulated on approval of Environmental impact assessment report of the Project "Exploitation and processing of quarry to produce common construction material at Giang moutain, Bui Thi Xuan, Quy Nhon city, Binh Dinh province; Exploitation capacity: 48,000 m^3/year"

The measures to minimize air pollution (dust, emission), water environmental pollution during exloitation process and the processing:

Set up dust pollution mitigation measures; Exploitation process must comply with desgin documents that approved; Drilling and blasting must be conducted in line with regulations; Watering two times per day on site and transport routes to the quarry in morning soon and breaking time; Planting trees at the North-West border of quarry.

Measures to minimize emission polution:

Regulate speed 5km/h for the kinds of vehicles allowed moving in project's campus. Turn off the machinein the meantime of loading and unloading; Periodic checking and repairing to ensure fuel combustion efficiency of the engine; The construction and exploitation vehicles must be certified before using

Measures to minimize water pollution

- o For the overflowing rain:

Planting trees, embanking dyke to prevent subsidence around material gathering area and diposal area of soil, stone; Construct ditchs around campus to lead the overflowing rain to rainwater reservoirat West area.

- o For the domestic wastewater:

Domestic wastewater of workers, staff will be pre-treated before dischaged into the soil

Supervision activities:

Local authorities and relevant agencies will conduct supervising exploitation activities and processing of quarry at Giang moutain, Bui Thi Xuan ward (Bui Thi Xuan ward PC's, Binh Ding provincial DONRE).

Reamark:During field survey, the contractor has carried out management measures to the rehabilitationworks and environmental protection that mentioned in Environmental improvement scheme.

Some on-site images Quarry at Giang Mountain, Bui Thi Xuan ward, Quy Nhon city:

Exploitation site

Material transport activities

Conveyor belt

Temporary camp of workers on site

Headquarter on site

Toilet

b. Sand mine at Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district.

Sand mine belonged to area of Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district. This mine is under operation since 2015, exploited by Investor Thanh Son private enterprise. Total exploitation area of quarry mine is 2,8ha with average exploitation capacity is 10.000m^3/year, 6,5 is the year approved for exploitation time

Sand mine belonged to area of Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district has been licensed by Vietnam management agency on environmental resources as following

- Certification no.49/GP-UBND dated 15 September, 2015 licensed to Thanh Son private enterprise for approving the exploitation of sand mine at Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district
- Decision no.162/QD-STNMT dated 30 June, 2015 issued by Binh Dinh provincial DONRE for approving the Project “renovation and environmental improvement of the sand

exploitation project at Ha thanh river, Phuoc Thanh commune, Tuy Phuoc district, Binh Dinh province".

- *Environmental monitoring program::*
- Local authority Phuoc Thanh commune PC's and relevant agenci Binh Dinh provincial PC's has responsible for carrying out environmental monitoring program
- + Monitoring ambient air quality: Monitoring 01 location at central area of sand mine with monitoring paramters: COx, NOx, SOx, monitoring frequency 2 times/year
- + Monitoring underground water quality: Monitoring underground water qualityat drilling well near sand mine with the monitoring parameters pH, turbility, TDS, COD, Fe, Coliform, monitoring frequency 2 times/year
- + Monitoring surface water quality: Monitoring surface water qualityat West area of sand mine with the moniyoring parameters pH, độ đục, SS, Coliform và E.coli, monitoring frequency 2 times/year

Some other environmental monitoring programs such as waste monitoring, the dismantlement of works on site, afforestation, erosion prevention and subsidence also implemented by authorized units

Reamark: During field survey, the contractor has carried out management measures to the rehabilitationworks and environmental protection that mentioned in Environmental improvement scheme.

Some on-site images Sand mine at Ha Thanh river, Phuoc Thanh commune, Tuy Phuoc district:

Sand transport route

Exploitation activites

Material truck is covered up by canvas

c. Soil mine at Bui Thi Xuan, Quy Nhon, Binh Dinh province

Land mine belonged to Giong Dieu moutain, Binh Nghi commune, Tay Son district, Binh Dinh province. Total exploitation area is 13.7ha, mining reserves is 1,760,000m^3 and average exploitation capacity is 440,000m^3/year. 5 is the year approved for exploitation time

Soil mine at Bui Thi Xuan, Quy Nhon, Binh Dinh provincehas been licensed by Vietnam management agency on environmental resources as following

- Certification no. 35/GP-UBND dated 29 May, 2013 issued by Binh Dinh province licensed toPhuc Loc group JS Company for approving the exploitation of land mine atBui Thi Xuan ward, Quy Nhon, Binh Dinh province

Environmental monitoring program:

Monitoring activites and environmental monitoring progarm will be carried out by local authority and relevant agencies such as representative of Binh Nghi commune, Binh Dinh provincial DONRE.

+ Monitoring ambient air quality: Monitoring 01 location at Acacia planting area with the monitoring parameters: dust, COx, NOx, SOx, monitoring frequency: 06 months/time

+ Monitoring surface water quality: Monitoring surface water quality at Thu Thien lake with monitoring parameters: pH turbility, SS, Coliform và E.Coli, moniroting frequency 06 months/time

Some other environmental monitoring programs such as waste monitoring, afforestation, leveling drainage ditch system, erosion prevention and subsidence also implemented by authorized units

Reamark:During field survey, the contractor has carried out management measures to the rehabilitationworks and environmental protection that mentioned in Environmental improvement scheme.

Some on-site images soil mineat Bui Thi Xuan ward, Quy Nhon, Binh Dinh province:


Exploitation area


Exploitation area


Access road


Garage on site


Warehouse to contain waste, scrap


Kitchen

APPENDIX 2. DUE DILIGENCE OF NHON BINH WWTP

Nhon Binh WWTP is located in Nhon Binh ward, Quy Nhon city. The wastewater treatment plant (WWTP) is about 5km from the center of Quy Nhon city to the Northwest, 1.5 km from Tran Hung Dao Street to the north, about 0.2km from Dien Bien Phu Street to the west, and borders on Nhon Binh Industrial Zone. Nhon Binh WWTP with a capacity of 14,000m^3 was executed during 2012 in the CCESP – Quy Nhon Sub-Project funded by WB. The preparation of this project has complied with WB's environmental and social safeguard policies and with Vietnamese laws. The project's EIA report has also been approved by the People's Committee of Binh Dinh Province on 25 November, 2011 and received WB's NOL on 24 June, 2010. The 14,000m^3 Nhon Binh WWTP was put into operation in 2014.

During operation, the operating unit has also fully complied with the following measures of environmental sanitation:

Nhon Binh WWTP's operation:

- ***Wastewater treatment***: Wastewater from Quy Nhon city → pumping stations (PS 5, 7, 13)→ intake works (sedimentation, bar screens, flow rate meter, chemical mixing) → anaerobic primary sedimentation pond → aeration cascade →secondary pumping station → trickling filter (filtering materials: plastic panels) → secondary sedimentation pond → disinfection tank → Ha Thanh river.
- ***Sludge treatment***: Wastewater drainage at anaerobic sedimentation tanks → dredging and drying sludge. Then, waste sludge would be analyzed and its type identified (whether hazardous or not) for proper and prompt handling. The frequency of dredging waste sludge is about 3 years/time. All the solid wastes and sludge will be collected by Quy Nhon Urban Environmental Company and discharged at Long My Landfill.
- ***Chemicals***: Chemicals used for wastewater treatment: $FeCl_3$ (38%), polymer anion, and NaOCl (10%).

A 300m buffer zone of trees has been set up at Nhon Binh WWTP to ensure that bad odor and noise would not affect surrounding residential areas. On daily basis, the operating unit tests the effluent at Nhon Binh WWTP's lab, and the effluent quality has met the regulations by MONRE for discharged wastewater in accordance with QCVN 40:2011/BTNMT, column B. The effluent monitoring results of Nhon Binh WWTP during operation are presented in the Table 1 below which indicate compliance with the national standards:

Table 1. The influent and effluent monitoring data of Nhon Binh WWTP in operation phase

No	Parameter	Unit	Result		QCVN 40:2011/BTNMT Column B (kq=0.9, kf=0.9)
			NT1	NT2	
1	pH	-	7.73	7.67	5.5 – 9
2	TSS	mg/l	40	9	100
3	BOD_5	mg/l	38	16	50
4	COD	mg/l	61	22	150
5	NH_4^+ - N	mg/l	18.73	0.36	10
6	T-N	mg/l	19.97	3.81	40
7	T-P	mg/l	5.05	1.55	6
8	H_2S	mg/l	6	0.4	0.5
9	Oil and grease	mg/l	3.6	0.8	10
10	Residual chlorine	mg/l	< 0.3	1.23	2
11	Coliform	MNP/100ml	$7x10^8$	0	5000
12	Hg	mg/l	< 0.002	< 0.002	0.01
13	Pb	mg/l	0.0032	0.0011	0.5

14	Cd	mg/l	0.0016	< 0.001	0.1
15	Cr^{6+}	mg/l	< 0.001	< 0.001	0.1
16	Cr^{3+}	mg/l	< 0.01	< 0.01	1
17	CN^{-}	mg/l	< 0.1	< 0.1	0.1
18	Phenol	mg/l	< 0.02	< 0.02	0.5

Sample symbol: NT: Wastewater sample

Sampling date: 8 July, 2016

Sampling location:

NT1: Input wastewater of Nhon Binh WWTP

NT2: Output wastewater of Nhon Binh WWTP

In the case of overflowing, untreated wastewater would be held up at anaerobic sedimentation tanks and additional chemicals would be utilized to limit as much as possible the pollutant loads before the overflow reaches the environment. Equipping workers with adequate labor protective gear has also been guaranteed.

Proper measures have been taken to ensure that Nhon Binh WWTP is operated continuously in conformity with designed processes, and with the expected efficiency of wastewater treatment process. The operation of Nhon Binh WWTP has not caused any pollution to the environment. Below are some photos of Nhon Binh WWTP:

	
Influent collecting works	Anaerobic sedimentation tank

APPENDIX 3. DUE DILIGENCE OF BAU LAC WWTP

Bau Lac WWTP is located at the foot of Vung Chua mountain in a usable area of 3.5ha. It is stationed on an existing stream, next to a hill and is bordered by paddy fields and trees. The site is close to Ba Hoa mountain and is between the planned road and Bau Lac lake. Bau Lac WWTP was executed during 2012 in the CCESP – Quy Nhon Sub-Project funded by WB. The preparation of this project has complied with WB's environmental and social safeguard policies and with Vietnamese laws. The project's EIA report has also been approved by the People's Committee of Binh Dinh Province on 25 November, 2011 and received WB's NOL on 24 June, 2010. Bau Lac WWTP was put into operation in 2014.

During operation, the operating unit has also fully complied with the following measures of environmental sanitation:

Bau Lac WWTP's operation:

- ***Wastewater treatment***: Wastewater from Quy Nhon city + leachate from Long My Landfill → collecting system and pumping station → intake works (sedimentation, bar screens, flow rate meter, chemical mixing) → oxygen supply tank → anaerobic sedimentation tank → disinfection tank → Ha Thanh river
- ***Sludge treatment***: Sludge pumping station → Compressed sludge tank → Sludge drying yard. The sludge is then dredged and dried. Then, waste sludge would be analyzed and its type identified (whether hazardous or not) for proper and prompt handling. The frequency for dredging waste sludge is about 3 years/time. All the solid wastes and sludge will be collected by Quy Nhon Urban Environmental Company and discharged at Long My Landfill.
- ***Chemicals*:** Chemicals used for wastewater treatment are $FeCl_3$ (38%), polymer anion, and NaOCl (10%).

A buffer zone of trees has been set up at Bau Lac WWTP to ensure that bad odors and noise would not affect neighboring residential areas. However, monitoring results obtained by Phu Dien-SFC in coordination with the Resources and Environment Monitoring Center show that the quality of effluent of Bau Lac WWTP has failed to comply with allowable limits in accordance with QCVN 40:2011/BTNMT. The main cause for this is that the pollutant loads of untreated leachate have exceeded many times the design standards of Bau Lac WWTP. The failure said failure would be overcome under the CCSEP through the upgrading of the leachate treatment station at Long My Landfill. Equipping workers with adequate labor protective gear has also been guaranteed.

The effluent monitoring results of Bau Lac WWTP during operation are presented in the Table 1 below which indicate compliance with the national standards:

Table 1: Analysis result of wastewater sample of Bau Lac WWTP

No	Parameter	Unit	Result		QCVN 40:2011/BTNMT Column B (kq=0.9, kf=0.9)
			NT1	NT2	
1	pH	-	8.76	8.52	5.5 – 9
2	DO	mg/l	KPH	1.12	-
3	TSS	mg/l	85	8	100
4	COD	mg/l	896	256	150
5	BOD_5	mg/l	510	155	50
6	T-N	mg/l	313.8	178.03	40
7	T-P	mg/l	11.66	6.59	6
8	Oil and grease	mg/l	4.2	0.8	10
9	Coliform	MNP/100ml	9000	430	5000

Notice: KPH: not identified

Sample symbol: NT: Wastewater sample
Sampling date: 8 July, 2016
Sampling location:
NT1: Input wastewater of Bau Lac WWTP
NT2: Output wastewater of Bau Lac WWTP

Below are some photos of Bau Lac WWTP:

 Anaerobic sedimentation tank	 Disinfection tank

APPENDIX 4. DUE DILIGENCE OF LONG MY LANDFILL

Long My Landfill is located at Thanh Long hamlet, Phuoc My commune. Long My landfill was executed during 2006-2014 in the CCESP – Quy Nhon Sub-Project funded by WB. The preparation of this Project has complied with WB's environmental and social safeguard policies and with Vietnamese laws. The Project's EIA report has also been approved by the People's Committee of Binh Dinh Province on 19 December, 2011 and received WB's NOL on 23 September, 2010. The landfill was put into operation in 2001. Cell A1 was already closed up in 2012; cells A2 and A3 are in current operation.

During operation, the operating unit has also fully complied with the following measures of environmental sanitation:

Landfill operation: designed capacity: 0.9 million m^3; area: 61.6ha, in which: leachate treatment station (2.01ha), medical waste incinerators (200 kg/h), waste stone powder cell (2.18ha), and Long My compost processing plant (6.6ha) which has been closed down due to the unsatisfactory quality of finished products. The design capacity of Long My landfill is 250 tons of waste per day while 'its average daily reception is 205 tons of waste per day. Operational process: daily reception of waste → spraying deodorant chemicals → leveling and compacting → sprinkling lime and backfilling with 0.2m of soil. Periodically spraying chemical insecticides is carried out 1-4 times/month at landfill cells and in surrounding areas.

Leachate treatment works: designed capacity: 200 m^3/day; operational process: leachate from cells of Long My Landfill collected into preliminary sedimentation tanks and treated by powdered lime. Dredged sludge from preliminary sedimentation tanks would be disposed at C3 cell at Long My Landfill. According to the sludge dredging report of Quy Nhon URENCO (landfill operating unit), the volume of dredged sludge in May and June, 2016 respectively is 64.32 and 23.81m^3 (equivalent to 87.48 and 32.38 tons). The quality of leachate after treatment has failed to meet the standards of wastewater to be pumped to Bau Lac WWTP[11] for subsequent treatment steps.

Location and design technology: As Long My Landfill is located in a hilly area quite far from residential areas, local inhabitants are not affected by bad odors. Long My Landfill also maintains periodically monitoring of groundwater quality at observation wells in the area. Besides, the Landfill is designed in accordance with technical requirements with a layer of clay, a layer of geotextiles, and a waterproof HDPE layer to prevent leachate from penetrating into the soil and polluting groundwater.

Monitoring and management plan: Proper measures have been taken to ensure that Long My Landfill is operated continuously in conformity with designed processes and with the expected efficiency of a landfill operational process. Quy Nhon URENCO has signed a contract with the Center for analysis and testing (directly under Binh Dinh provincial Department of Science and Technology) in order to periodically monitor the quality of soil, groundwater, air and leachate every 3 months; reports are to be prepared and submitted to the authorized units (DONRE, Department of Environmental Protection, Department of Provincial Environment Police, City People's Committee). Overall, the operation of the Landfill has not caused any pollution to the environment. Equipping workers with adequate labor protective gears has been already carried out.

Based on environmental monitoring report of Long My landfill, the monitoring result of air, surface, leachate and groundwater samples are shown as following showing compliance with the national standards:

[11] Construction works invested by WB under CCESP project

A. Air samples (Location: at landfill cell is operating)

Table 1: Analysis result of air sample

No	Parameter	Unit	Result			QCVN05:2013/BTNMT QĐ3733/2002/QĐ-BYT
			KK1	KK2	KK3	
1	Noise	dBA	56.3	62.5	65.4	≤ 85
2	TSP	mg/m^3	0.004	0.085	0.101	300
3	CO	µg/m^3	854	1121	2341	30,000
4	NO_2	µg/m^3	9	14	16	200
5	SO_2	µg/m^3	22	25	40	350
6	NH_3	µg/m^3	1	4	9	25
7	H_2S	µg/m^3	< 0.02	6	10	15

Sample symbol: KK: air sample
Sampling date: 7 – 9 June, 2016
Sampling location: KK1: Administrative office of Long My landfill
KK2: Drainage ditch of Long My landfill
KK3: At medical waste incinerator of Long My landfill

B. Leachate samples (location: at cell no.2 in Long My landfill)

Table 2. Analysis result of leachate sample (May, 2016)

No	Parameter	Unit	Result		QCVN25:2009/BTNMT Column B1 QCVN40:2011/BTNMT Column B
			NT1	NT2	
1	pH	-	7.81	7.84	5.5 – 9
2	TSS	mg/l	93	129	100
3	BOD_5	mg/l	371.8	124.6	100
4	T-N	mg/l	402.4	81.2	60
5	COD	mg/l	1088	355.2	400
6	T-P	mg/l	5.41	2.07	6
7	Coliform	MNP/100ml	2400	240	5000

Sample symbol: NT: Leachate sample
Sampling date: 5 May, 2016
Sampling location:
NT1: Input wastewater of wastewater treatment system of no.1 pumping station (PS1)
NT2: Output wastewater of wastewater treatment system of no.2 pumping station (PS2)

C. Groundwater samples

Table 3: Analysis result of groundwater sample

No	Parameter	Unit	Result				QCVN09-MT:2015/BTNMT
			NN1	NN2	NN3	NN4	
1	pH	-	6.03	6.42	6.49	7.91	5.5 – 8.5
2	DO	mg/l	6.64	4.86	5.57	7.47	–
3	Cr	mg/l	0.01	0.03	0.04	0.04	0.05
4	Cu	mg/l	<0.05	0.07	<0.05	<0.05	1
5	Zn	mg/l	<0.05	0.171	<0.05	<0.05	3
6	Cd	mg/l	<0.002	<0.002	<0.05	<0.002	0.005
7	Pb	mg/l	<0.002	0.008	0.006	<0.002	0.01
8	Ni	mg/l	<0.002	<0.002	<0.002	<0.002	0.02
9	Cl^-	mg/l	15.6	14.2	19.9	130.6	250
10	NO_3^- - N	mg/l	0.8	0.2	0.4	2.8	15
11	SO_4^{2-}	mg/l	<2	<2	4	6	400
12	NH_4^+ - N	mg/l	< 0.02	0.17	0.6	2.9	1
13	COD	mg/l	0.5	3.1	3.2	13.6	4
14	Total Fe	mg/l	0.07	12.5	5.55	1.13	5

15	Totalhardness	$mgCaCO_3/l$	9	79	90	97	500
16	Coliform	MPN/100ml	23	1100	4600	430	3

Sample symbol: N: Groundwater sample
Sampling date: 6 June, 2016
Sampling location:
NN1: Monitoring well at primary school, Long My commune
NN2: Monitoring well at upstream area of Long My landfill
NN3: Monitoring well at office building of Long My landfill

NN4: Monitoring well at downstream area of Long My landfill

D. Surface water samples

Table 4: Analysis result of surface water sample

No	Parameter	Unit	Result		QCVN08-MT:2015/BTNMT Column B1
			M1	M2	
1	pH	-	9.87	7.57	5.5 – 9
2	TSS	mg/l	169	24	50
3	DO	mg/l	4.3	2.7	≥ 4
4	BOD_5	mg/l	32.0	36.2	15
5	Cu	mg/l	< 0.05	< 0.05	0.5
6	Zn	mg/l	< 0.05	< 0.02	1.5
7	Cd	mg/l	< 0.002	< 0.002	0.01
8	Pb	mg/l	< 0.002	< 0.002	0.05
9	Hg	mg/l	< 0.001	< 0.001	0.001
10	NO_3^- - N	mg/l	0.6	0.5	10
11	NO_2^- - N	mg/l	0.57	0.02	0.05
12	NH_4^+ - N	mg/l	2.15	12.8	0.9
13	Cr	mg/l	0.02	0.02	0.04
14	COD	mg/l	120	136	30
15	Coliforms	MPN/100ml	4	4600	7500

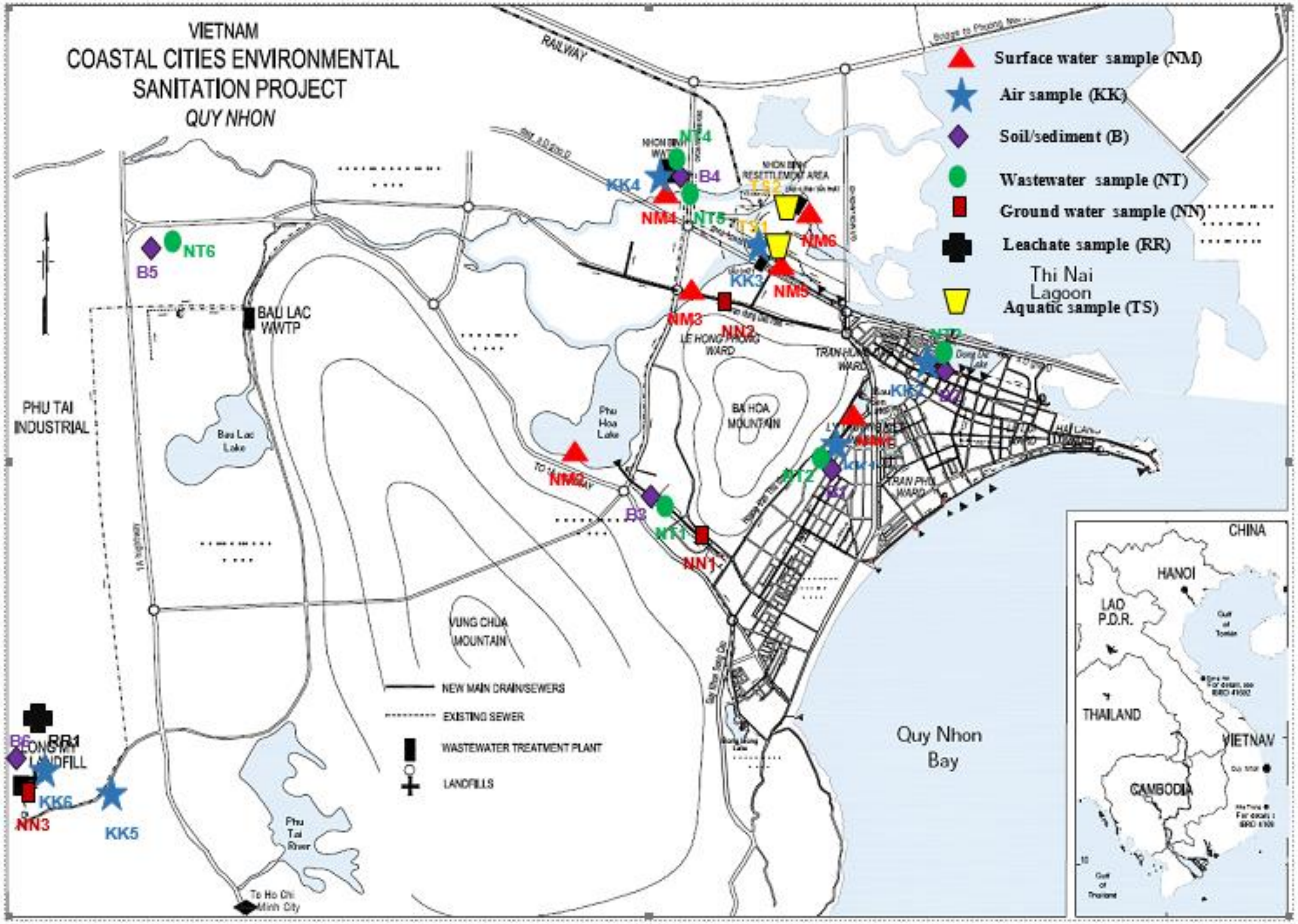
Sample symbol: M: Surface water sample
Sampling date: 6 June, 2016
Sampling location: M1: Stream sample at starting point of Long My landfill
M2: Stream sample at ending point of Long My landfill

Some photos of Long My Landfill are shown below:

Long My Landfill

Leachate treatment station

APPENDIX 5. SAMPLING LOCATION MAP



APPENDIX 6. DREDGING MATERIAL MANAGEMENT PLAN (DMMP)

1. The details on the DMMP (Phu Hoa canal and upstream ditch of Bau Sen lake) and Disposal Site:

- The contractors are requested to prepare a specific dredging material management plan (DMMP) and submit the same to the 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, control of polluting material during temporary gathering and transportation, pollution control, and risks at disposal sites. The number of samples was taken according to guidelines in the Table 1 below.
- Assessing the quality of the sediments. The assessment would be carried out to confirm that the sediments would not include large amount of environmentally harmful materials such as heavy metals, sulfur soils, and residual pesticides. If these materials are found to be more than the thresholds stipulated by the national standards, a special disposal plan should be prepared with a monitoring plan. The special disposal plan should also set out a program to protect the nearby community residents from using the disposed dredged materials for house construction or gardening. The assessment would be carried out based on a sampling basis, and the following guidelines shall be used for the number of samples and items to be measured;

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

- Identifying the available land for disposing the dredged materials. The plan should also identify the possible lands to be appropriated for the disposal of dredged materials. Public land, land for construction of rural roads, public works, private land, etc. may be used, with an agreement with the project affected households. It should also meet local plans for land use.
- Preparing for a transportation plan. In case, the dredge disposal area is far away from the dredged sites, the DMP shall set out a transportation plan including: (a) methods of transportation (pipeline, barges, hopper barges) and uploading to the disposal area. If trucks are used, indicate proposed route of the transport from the dredged site to the disposal area, (b) time of operation, (c) type of vehicles/trucks and proposed measures to reduce the leakage of the dredged materials from the transport trucks, (d) contractors' responsibilities for cleaning the roads and carry out remedial works if necessary, and (e) a communication plan for the nearby communities including contact number for possible complaints.
- Plan for managing the disposal areas including: (a) plan for reducing the drainage, (b) construction of the perimeter dykes, (c) construction of sub-containment area, if applicable, (d) planned thickness of the dredged materials (typically less than 1.5 meters), (e) any measures to protect ground water and soils (e.g., installation of PVC membrane).
- Designing the Draining for Disposal lands. As the dredged materials are in the state of mud at first and soil particles are suspended for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the river. In order to limit the negative impacts of mud (produced by dredging) on the environment as well as the water quality of the canals, the dredged sediment will be transported to a containing area which is appropriately

located and properly design with an adequate size. The dredged spoil will be pumped to the disposal land and then overflow to a settlement pond, where turbidity and total suspended solids are settled. After some time, effluent is returned to the river. A typical design of the dike around each disposal may be as follows: Height: 2m, Footing width: 5 m, and Surface width: 1m. The plan should set out a basic layout.

- Monitoring the Disposed Dredged Materials. A plan for monitoring the dredged materials as well as water quality of effluent would be required. As stated before, an intensive monitoring would be required if the dredged materials contains higher content of the heavy metals and other harmful materials than the national thresholds.
- In order to mitigate the issue of turbidity during dredging operation, the DMP shall set out dredging equipment and/or techniques suitable to the particular site. On laying dredging machines on a barge, contractors can use a proper mud –stopping net for enclosing the dredging site and keeping back mud on land, not to let it goes back to the canal. If the disposal site for dredge materials is located far away from the dredger, a suction dredger should be used to transfer all the mud and soil in water to the disposal sites. The length of dredging sections should be limited less than 1 km and the dredging should be done one by one.
- As for the sections with acid sulphate soil or potential acid sulphate soil, the following measures should be considered: dredging should be carried out in the rainy season when more fresh water could be available for diluting acidic water; Treating acidic water in the disposal areas before returning effluent to the canals; and proper locate and design of the disposal area not to affect the nearby agricultural land.

At the completion of the contract, carry out an assessment on dredged materials, and determine the use of the dredged materials for activities such as: (a) construction (roads and dykes), (b) basis for individual houses, (c) gardening, and (d) dispose at Long My landfill.

2. 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:

i. The Scope of Works in the Contract package, construction method and schedule
ii. Volume and quality of water quality and sediment quality in the dredging area covered by the contract
iii. Water users that may be affected by the dredging and embankment lining
iv. 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,
v. Schedule to inform the nearby communities about the project, disclosure of name and contact number for possible complaints.
vi. Potential social and environmental impacts, including the site-specific impacts and risks
vii. Mitigation measures to address the potential impacts and risks. The mitigation measures should be proposed based on ESIA/ECOP, ESMP, SEMP, the potential impacts and mitigation measures presented in Section 4 and 5 of this Plan and the following requirements:

viii. Environmental Quality Monitoring plan carried out by the contractor (particularly pH,DO, TSS, BOD, salinity etc. for water and heavy metals including pH, Hg, As, Cd, Cu, Pb, Zn and Cr, Organic Materials and Mineral Oils for sediments and soil.

ix. For soil and sediment. The number of samples taken will follow the Table 1 mentioned above.

3. Potential Impacts and Mitigation Measures for Dreddging and Embankment lining:

Impacts and Description	Mitigation Measures
AT DREDGING and TEMPORARY LOADING AREAS	
Odour and air pollution, nuisance Decomposition of organic matters under anaerobic conditions generates strong odour-generated gases such as SO2, H2S, VOC etc. When the muds are disturbed and excavated, these gases are released much faster into the air. Exposure to odour pollution affect the health of workers, local residents and cause public nuisance	- Inform the community at least one week before dredging is started - Minimise the duration of temporary loading of dredged materials on-site - temporary loading materials must be transported to the disposal site within 48 hours - Load the materials on-site tidily - Do not load the materials temporarily outside the construction corridor determined for each canal section - Avoid loading the sludge in populated residential areas or near public buildings such as kindergarten. Load the sludge as far from the houses and buildings as far as possible - Cover the temporary sludge loads when loading near sensitive receptors or longer than 48 hours unavoidable
Dust and nuisance Temporary loading of sludge at the construction site cause nuisance to the public Dry and wet mud may be dropped along the dredging area and on transportation route causing nuisance to the public and traffic safety risks	- Avoid temporary loading of dredged materials on-site - Dredged materials must be transported to the final disposal sites earliest possible and no later than 48 hours from dredging. - Use truck with water-tight tank to transport wet/damp dredged materials; - All trucks must be covered tightly before leaving construction site to minimise 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 - Avoid loading materials and equipment on bridges crossing canals that may disturb or block traffic
Damages to existing infrastructure and related services Existing irrigation ditch, intake, sluices, drainage pipes, sewers etc., power lines, cables etc. may be	- Rebuild the affected irrigation ditch, intake, sluices affected by the canal dredging and embankment lining - Coordinate with relevant authority for repair and connection of the disrupted service

Impacts and Description	Mitigation Measures
demolished or affected during canal expansion and embankment lining	
Social Disturbance Concentration of workers and equipment, construction plants, temporary loading of materials and wastes, traffic disturbance, dusts and odour 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	- Optimise construction duration schedule to maintain irrigation and drainage function but also minimising the impacts on the residents living along the canals - 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 labours 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 canal, not to affect garden or agricultural land - Keep the areas to be disturb minimal - Enforce workers to comply with codes of conducts
Landslide and soil subsiding risks at dredging area Relative deep excavation or cut and fills on the embankments that create slopes may lead to landslide and soil subsiding at the slops or excavated areas, particularly in rainy weather Deep excavation also cause risks to the existing buildings nearby, particularly the weak structures or located too close to the deep excavation area.	- During field survey for the preparation of CDMP, the contractor in coordination with the Environmental Officer of PMU and the Environmental Consultant of the CES identify weak structures that may be at risk and determine appropriate mitigation measures accordingly - Consider and select appropriate dredging method that allow minimising soil subsiding risks, for example carry out stepped excavation, stabilise slops in parallel to dredging - Apply protective measures such as sheet piles at risky locations
Water Quality Degradation Turbidity in water will be increased when the mud is disturbed; Water leaked from dredged material and suface runoff through disturbed ground also contain high solid contents. Muddy water entering irrigation ditch will cause sedimentation. Aquatic livest in the canal would also be affected by turbid water.	- Build coffer dams surrounding the dredging area and pump the water out before starting dredging - If dredging is carried out directly onto the water, dredge at intervals to allow suspended materials to resettle before continuing. Observe water colour at 20 m upstream of the nearest irrigation water intake and stop dredging when water colour 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

Impacts and Description	Mitigation Measures
	- 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 odour and other contaminants from sludge When working in or near relative deep and wide canal, there is a risk of being drown -	- Within two weeks before dredging is started, the contractor will coordinate with local authority to identify good swimmers or those who can dive in the locality, and hire at least one of them at each canal construction site deeper than 3 m and there are workers working on or near water surface. - Provide and enforce the workers to use masks. If and when working in the water, protective cloths, rubber boots, gloves and hats must be wore.
Others	- Other relevant measures specified in ECOP or proposed by the contractors as necessary
MATERIAL LOADING AND TRANSPORTATION	
Dust and nuisance, traffic safety risks Dust or wet materials may be dropped along the transportation route	- Use water-tight tank trucks for transporting wet/dam materials - Cover the materials tightly before leaving the construction site - Do no overload material on the trucks
AT LONG MY DISPOSAL SITE	-
Landslide and soil subsiding risks at Long My 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 45o - Build/create the walls to protect slopes - Create and maintain drainage at the foot of each dump higher than 2 m
Disturbance to existing drainage Unloaded dredged and excavated materials may disturbed, damage or block the existing drains causing localised flooding	- Dispose off the materials at designated areas only - Clean up or repair existing drains if blockage or damages are the contractors' faults. Clean up and repair will be at cost of the contractors