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Proposed HCMC Flood Risk Management Project

Ho Chi Minh City Steering Center of the Urban Flood Control (SCFC)

ESIA REPORT (DRAFT)

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People's Committee of Ho Chi Minh City
Ho Chi Minh City Steering Center of the Urban Flood Control Program

Preparation of Ho Chi Minh City Flood Risk Management Project

Credit No.: 4779-VN

Package FRM-PPTAF 02: Environmental and Social Impact Assessment, and Environmental and Social Management Plan

Project Location: District 8, 12, Go Vap, Tan Binh, Tan Phu, Binh Thanh, Binh Tan, Binh Chanh, Hoc Mon

Representing Client: Project Management Unit of Works Construction under Ho Chi Minh City Steering Center of the Urban Flood Control Program

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CHAPTER 1: INTRODUCTION

1.1. Background and Project Objectives

1.1.1. Project's Background

Ho Chi Minh City (HCMC) currently has 19 urban districts and 05 rural districts with an area of 2,095.01 km^2, a population of 7.995 million inhabitants and average population density of 3,401 people/km^2. HCMC is the economic center of Vietnam and accounts for a large proportion of Vietnam economy. Thanks to its favorable natural conditions HCMC became an important traffic hub for Vietnam and Southeast Asia, including road, railway, waterway and airway.

Due to rapid population growth, inadequate and poorly functional infrastructure, low public awareness. HCMC is challenged with environmental pollution, the causes of which include direct discharge of untreated wastewater to canals, creeks and rivers. In recent years, HCMC has been significantly flooded, especially during rainy season from June to November and during flood-tide between September and December. Flooding in HCMC is caused by high intensity of rainfall, flood-tide, poor effectiveness of wastewater drainage system in rural area, inefficient operation of reservoirs and land subsidence due to groundwater withdraw. Heavy rainfall events have been increased in recent centuries. Wastewater and storm water drainage systems of HCMC have been downgraded and overloaded during heavy rainfall events while those systems have still not been constructed in many places in HCMC. As a result, flooding due to high rainfall intensity has been frequent. High tides in the East Sea obstruct water flow of upstream river and the urban drainage to the sea causing flash floods. On top of improving drainage capacity of canals and sewer systems in central areas of the city to combat flooding caused by frequent high-intensity rainfall, HCMC is also challenged with inflow of the East Sea to canal system. This inflow causes an increase of water level in canals and obstructs its flow from the City center to Sai Gon River, especially during high tides.

In addition to frequent high intensity rainfall and high tides, flooding in HCMC is caused by draining water from hydropower and irrigation reservoirs located in the upstream. HCMC, in 2000, was severely flooded due to draining water of Tri An reservoir (2,000 m^3/s) and Dau Tieng reservoir (600 m^3/s). Furthermore, HCMC is affected by flooding in Mekong River through Vam Co Dong and Vam Co Tay rivers. HCMC's sewer systems have been developed locally and untreated wastewater has been discharged into rivers, creeks and canals causing severe pollution that damages water quality.

Regarding the feasible study 2012 conducted by HCMC Government, flooding in HCMC is a frequent event affecting an area of 5,944 ha (40% of total area of the catchment) and a population of 700,000 inhabitants (35% of total people living in the catchment). Average flooded depth is varied from 0.5 m to 1.2 m, where flooding duration is from 30 minutes to 150 minutes. In addition, Hy Vong Canal (a canal connected to Tham Luong – Ben Cat – Nuoc Len canal) is designed to receive water drained from Tan Son Nhat airport which is usually facing flooding that need to be resolved.

Industrial operation along Tham Luong canal has been considered as a major source of pollutants that cause severe damage of the canal.

Survey results indicate that wastewater flow generated from factories outside the industrial park is ranged from 30,000 to 40,000 m^3/day, in which 2.4 tons of suspended solids are comprised. Total flow of wastewater generated from industrial parks such as Tan Tao, Tan Binh, Vinh Loc A, Tan Thoi Hiep is estimated to be more than 32,000 m^3/day. This flowrate can potentially contribute about 6.4 tons of suspended solids into Tham Luong canal if the discharged wastewater can meet allowable standards. In addition, the canal can be damaged severely due to tons of air pollutants generated from stacks of textile processing factories and of waste illegally disposed along the canal.

In recent years, climate change, including sea water rise, causes severe flooding for many areas in the world in general and in Vietnam in particular that affects production and human well-being. Researching to propose specific measures to mitigate effects of climate change is essential, which requires a committed determination and coordination of the whole society (i.e. residents, business leaders, authorities, NGOs).

As described above, HCMC residents and economy are frequently affected by flooding and salinity intrusion becomes more severe during the past decades. Flooding in HCMC is considered as major priority needed to be resolved not only due to the large concentrations of people and assets in urban areas but also its direct impact on the city’s economic growth.

On top of rapid urbanization, the major targets proposed in Resolution 16.NQ-TW of the Politburo to sustain GDP growth at 1.5 times of national growth targets will require a serious consideration of urban flooding, its associated impacts, and exposure to the population at risk, economic activities, infrastructure, built-up areas and associated health issues.

Under the guidelines of Vietnamese Government, Ministries and determination of HCMC government, several areas have been invested to reduce the effects of flooding. However, as predicted sea water rise due to climate change will proceed more rapidly and more dangerously that requires HCMC government to have mitigation measures. Budget required is expected considerably to undertake this mission, but HCMC is having difficulty in mobilizing the financial sources for the projects relating to flood mitigation measures.

Several organizations, in recent years, have supported HCMC government to construct and operate facilities relating to drainage, flood control and pollutants removal. Some typical projects are currently effectively operating, including irrigation facilities along Sai Gon River (AFD), Vietnam - Ho Chi Minh City environmental sanitation (Nhieu Loc-Thi Nghe Basin) (World Bank (WB)), urban development project (WB), and improving the quality of the water in the Tau Hu-Ben Nghe-Doi (JICA).

Mitigation measures on urban flooding have been actively undertaken recently, where the following works have been carried out: maintaining (dredging and repairing drainage pipes and manholes), researching on alternative methods for operating 30 mobile and fixed pump stations (44 pumps) and 2 tidal sluice gates to avoid flooding in the city center, installing 246 drainage pipes with total length of 333.4 km, mobilizing manpower from "Green Summer Campaign" and residents to dredge 233 canals to improve the landscape, environment and sanitary, constructing and operating 1,077 tidal valves and improving operation procedures of tidal sluice gate to reduce flooding while waiting for projects under Plan 1574, undertaking 219 projects under government's budget to reduce or delete flooding in several places.

Integrated flood risk management approach for HCMC, under support of the World Bank, is established to continually improve drainage systems, flood control and environmental sanitation for the City, where a focal point will be a catchment of Tham Luong - Ben Cat – Nuoc Len canal.

1.1.2. Objectives of the Project

General Objectives

The proposed Project Development Objective is to reduce flood risk and improve drainage in selected areas in Ho Chi Minh City

Accordingly, the general objectives of the proposed project are followings:

- Enhancing the management capability in order to prevent flooding in combination with to improve the environment sanitation in Ho Chi Minh city.
- Coordinating with the projects of relevant plans in order to ensure tide control, drainage for flood reduction in the core inner city (taking the climate change into account).
- Aligning with the World Bank's twin goal of eliminating extreme poverty and boosting shared property.
- The aforesaid objectives are fully consistent with the World Bank Country Partnership Strategy (CPS) for 2012-2016 in the outcomes 2.3 and 3.2, which are the enhancement of preparedness for natural hazards and climate change, and the improvement of basic infrastructure and public service delivery and access, respectively.

Specific Objectives

- Conducting the flood prevention and drainage plan for the Ho Chi Minh core inner city, comprising: improvement of the drainage and storage capacity of Tham Luong - Ben Cat - Nuoc Len main canal and secondary canals; finishing the drainage and flood prevention systems for Go Vap district, which belongs to Tham Luong - Ben Cat - Nuoc Len basin with total area of 14.900 ha in the 9 districts of Ho Chi Minh City.
- Conducting feasibility studies of tidal sluice gates under Plan 1547 approved by the Prime Minister for tide control in the core inner city.

- Building and strengthening the capability and institution for the integrated urban flood risk management in Ho Chi Minh city, including the execution management and operation of drainage and flood prevention systems, early warning system, inter - reservoir operation, ground water extraction management and urban development, etc.
- Improving the environment sanitation conditions, creating good landscape for Tham Luong - Ben Cat - Nuoc Len basin. Improving the people's lives, ending extreme poverty, increasing the income of about 2 million people in the catchment (Estimated population in 2020)

1.2. Policy, Legal and Institutional Framework

This chapter summarizes the Administrative Framework for the Project, covering national requirements as well as applicable international treaties and conventions, and internal guidelines and standards voluntarily committed to by the World Bank. The intent of this chapter is to lay out the regulatory and non-regulatory performance requirements for all stages of the Project.

1.2.1. National Legal Obligation

The National Assembly is the highest legislative body in Vietnam and is responsible for enacting framework legislation. The Government uses the legislation as a framework to develop policies, decisions, decrees and directives. Ministries (at the National level) within their area of competence issue guidelines and standards and ensure implementation of the same. The guidelines and standards issued by the Ministries are in line with Government policies and within the legislative framework issued by the National Assembly. At the provincial level, People's Committees take the role of Ministries.

Summary of Applicable Legal Obligation

National environmental and social standards and targets in Vietnam are mainly derived from the Environmental Protection Law No. 55/2014/QH13 by the National Congress of the Socialist Republic of Vietnam adopted on June 23, 2014. Section 3 of Chapter 2 of this Law provides related issues of environmental impact assessment for development activities. The report of environmental impact assessment must be carried out in the project preparation stage. Objects, conditions of implementing environmental impact assessment and evaluation and approval of reports specified in Chapter IV, Article 12, 13 and 14 of Decree No. 18/2015/ ND-CP by the Government dated February 14th, 2015 provides environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plan.

The LEP's associated Decrees, Decisions and Circulars prescribe the various environmental and social regulations'. Some relevant standards and targets are also contained in health and safety legislation.

These regulations refer to the official Vietnamese standards and national technical regulations abbreviated as TCVNs (Tieu Chuan Viet Nam) and QCVNs (Quy Chuan Viet Nam). The national standards and technical regulations generally prescribe maximum permissible levels of pollutants, such as emissions or waste streams. Individual provinces can establish their own standards but these must be more stringent that the national standards.

This EIA has been prepared in consideration of and in compliance with the following legal obligations which govern such development processes:

Legislation

- Law of Environmental Protection No. 55/2014/QH13, dated 23 June 2014, issued by the National Congress of the Socialist Republic of Vietnam;
- Water Resources Law No. 17/2012/QH13, dated June 21, 2012, issued by the National Congress of the Socialist Republic of Vietnam;
- Labour Law No. 10/2012 /QH13, dated 18 June 2012, issued by the National Congress of the Socialist Republic of Vietnam;
- Biodiversity Law No. 20/2008/QH12, dated 13 November 2008, issued by the National Congress of the Socialist Republic of Vietnam
- Law on Chemicals No. 06/2007/QH12, dated 21 November 2007, issued by the National Congress of the Socialist Republic of Vietnam;
- Standards and Technical Regulations Law No. 68/2006/QH11, dated 29 June 2006, issued by the National Congress of the Socialist Republic of Vietnam;
- The Constitution of The Socialist Republic of Vietnam 2013;
- Land Law No. 45/2013/QH13, dated 29 November 2013, issued by the National Congress of the Socialist Republic of Vietnam; effective from 1 July 2014.

Decree

- Decree No. 19/2015/ND-CP, dated 14 February 2015, on detailed regulation for implementing some articles of the Environmental Protection Law, issued by the Government;
- Decree No. 18/2015/ND-CP, dated 14 February 2015, providing environmental protection planning, strategic environmental assessment, environmental impact assessment and environmental protection plans, issued by the Government;
- Decree No. 80/2014/ND-CP, dated 6 August 2014, on drainage and wastewater treatment, issued by the Government;
- Decree No. 179/2013/ND-CP, dated 14 November 2013, on the handling of violations of law in environmental protection , issued by the Government;
- Decree No. 15/2013/ND-CP, dated 6 February 2013, on the management of construction works quality; issued by the Government;

- Decree No. 26/2011/ND-CP, dated 8 April 2011, amending and supplementing a number of articles of the Government's Decree No. 108/2008/ ND-CP of October 7, 2008, detailing and guiding a number of articles of the Chemical Law, issued by the Government;
- Decree No. 12/2009/ND-CP, dated 12 February 2009 and Decree No. 83/2009/ND-CP, dated 15 October 2009, on the management of the construction investment project , issued by the Government;
- Decree No. 59/2007/ND-CP, dated 9 April 2007, on Solid Waste Management, issued by the Government;
- Decree No. 127/2007/ND-CP, dated 1 August 2007, on "detailed regulation for implementing some articles of the Standards and Technical Regulations Law", issued by the Government;
- Decree No. 43/2014/ND-CP dated 15/5/2014 of the Government on detailing a number of articles of the Land Law;
- Decree No. 44/2014/ND-CP dated 15/5/2014 regulation on land price;
- Decree No. 47/2014/ND-CP dated 15/5/2014 of the Government on compensation, support and resettlement upon land recovery by the State;
- Decree No. 38/2013/ND-CP of April 23, 2013 on management and use of official development assistance (ODA) and concessional loans of donors;
- Decree No. 201/2013/ND-CP dated November 27, 2013 of the Government detailing the implementation a number of articles of the Law on Water Resources.

Circular

- Circular No. 27/2015/TT-BTNMT, dated 29 May 2015, detailing a number of articles of the Government's Decree No. 18/2015/ ND-CP on Strategic Environmental Assessment, Environmental Impact Assessment and Environmental Protection Commitment, issued by the Ministry of Natural Resources and Environment;
- Circular No. 27/2013/TT-BLĐTBXH, dated 18 October 2013, providing for occupational safety and hygiene training, issued by Ministry of Labour, Invalid and Social Affairs.
- Circular No. 12/2011/TT-BTNMT, dated 14 April 2011, stipulating hazardous waste management, issued by the Ministry of Natural Resources and Environment;
- Circular No. 28/2010/TT-BCT, dated 28 June 2010, detailing a number of articles of Chemical Law and Decree No. 108/2008/ND-CP detailing and guiding the implementation of a number of articles of the Chemical Law, issued by the Ministry of Industry and Trade;
- Circular No. 16/2009/TT-BTNMT, dated 7 October 2009, defining national technical regulations on environment, issued by the Ministry of Natural Resources and Environment;

- Circular No. 36/2014 / TT-BTNMT dated June 30, 2014, regulating method of valuation of land; construction, land price adjustment; specific land valuation and land valuation advisory;
- Circular No. 37/2014/TT-BTNMT dated on June 30, 2014 regulating compensation, assistance and resettlement when the State acquires land.

Decision

- Decision No. 16/2008/QĐ-BTNMT, dated 31 December 2008, on the promulgation of national technical regulation on environment, issued by the Ministry of Natural Resources and Environment;
- Decision No. 04/2008/QD-BTNMT, dated 18 July 2008, on the regulations of the National technical standard for environment, issued by the Ministry of Natural Resources and Environment;
- Decision No. 04/2008/QD-BXD, dated 3 April 2008, on the promulgation of national technical regulations on building codes, issued by the Ministry of Construction;
- Decision No. 3733/2002/QD-BYT, dated 10 October 2002, promulgating hygienic standards in workplace;
- Decision No. 1956/2009/QD-TTg, dated 17/11/2009, of GoV approving the Master Plan for vocational training for rural workers in 2020;
- Decision No. 52/2012/QD-TTg, dated 16/11/2012, on policies to support employment and vocational training for farmer whose land is recovered by the State;
- Decision No. 23/QĐ-UBND, issued on 15/5/2015 by Ho Chi Minh City People's Committee on Compensation, assistance and resettlement when the State recovers land in Ho Chi Minh. City.

Technical Standards

This EIA has also considered the following Vietnamese and other relevant environmental, safety, social and economic standards and technical regulations that are applicable to either the development of the Project site or the proposed activities to be conducted at the Project site.

Water quality

- *QCVN 02:2009/BYT* - National Technical Regulation on Domestic Water Quality*;*
- *QCVN 01:2009/BYT* - National Technical Regulation on Drinking Water Quality*;*
- *QCVN 14:2008/BTNMT* - National Technical Regulation on Domestic Wastewater;
- *QCVN 09:2008/BTNMT* - National technical standard on groundwater quality*;*
- *QCVN 08:2008/BTNMT* - National technical standard on surface water quality*;*

Air Quality

- *QCVN 05:2013/BTNMT*- Air Quality - National technical standard on Ambient Air Quality;

Noise and vibration

- *QCVN 26:2010/BTNMT* - National Technical Regulation on Noise*;*
- *QCVN 27:2010/BTNMT* - National Technical Regulation on Vibration*;*
- *TCVN 6962:2001* Vibration and shock. Vibration emitted by construction works and factories. Maximum permitted levels in the environment of public and residential areas
- *QCVN 3985:1999* Acoustics. Allowable noise levels at working place
- *TCVN 5948:1999* Acoustics. Noise emitted by accelerating road vehicles. Maximum Permitted Noise Level
- *TCVN 6436:1998* Acoustics. Noise emitted by stationary road vehicles. Maximum Permitted Noise Level

Sediment

- *QCVN 43:2012/BTNMT* - National Technical Regulation on Sediment Quality

Solid waste and hazardous waste

- *QCVN 07:2009/BTNMT* - National technical standard on threshold of hazardous waste;
- *TCVN 6705 : 2009* - Non-hazardous solid waste – Classification;

Other regulations

- *TCVN 5507:2002 -* Hazardous Chemicals - Code of practice for safety in production, commerce, use, handling and transportation;

Legal Aspects of the Project

- Decision No. 752/QĐ-TTg, dated 19 June 2001, approving the Master Plan of drainage system in Ho Chi Minh City to 2020, issued by the Prime of Government;
- Document No. 1131 / CP-CN, dated 13 August 2004, approving the pre-feasibility study report of drainage and pollution treatment for Tham Luong - Ben Cat – Nuoc Len canal, issued by the Prime of Government;
- Decision No. 2064/QĐ-UB, dated 12 February 2007, approving the project of drainage and pollution treatment for Tham Luong - Ben Cat – Nuoc Len canal (phase 1) projects, issued by the Ho Chi Minh City People's Committee;
- Decision No. 589/QD-TTg, dated 20 May 2008, approving the master plan on construction of the Ho Chi Minh City region up to 2020, with a vision toward 2050, issued by the Prime of Government;

- Decision No. 1547/QĐ-TTg, dated 28 October 2008, approving the master plan for flood prevention in Ho Chi Minh City, issued by the Prime of Government;
- Decision No. 66/QĐ-UBND, dated 14 September 2009, approving the planning of the waterway network and port system in Ho Chi Minh City from now until 2020, issued by the the Ho Chi Minh City People's Committee;
- Decision No. 4107/QĐ-SGTVT, dated 16 December 2009, on the classification of inland waterways system of Ho Chi Minh City, issued by Department of Transportation of Ho Chi Minh City;
- Decision No. 853/QĐ-BNN-KHCN, dated 06 April 2010, on the promulgation of technical standards applied in the calculation of hydraulic and hydrological irrigation against flooding of Ho Chi Minh City project , issued by the Ministry of Agriculture and Rural Development;
- Decision No. 1600/QĐ-BNN-XDCB, dated 14 June 2010, on approving the results of calculations of hydraulic and hydrological irrigation against flooding of Ho Chi Minh City project , issued by the Ministry of Agriculture and Rural Development;
- Profile of geological and topographical surveys performed by TV&CGCN on April 2009;
- Evaluation Flood Risk Management Report performed by consultancy partnership Deltares, Royal Haskoning DHV, VMEC on April 2015;
- Environmental Impact Assessment Reports of seven project components;
- Feasible Study of seven project components;
- Project Description; and
- Flood Risk Management – Ho Chi Minh City (World Bank, 2013).

1.2.2. World Bank's Safeguard Policies and Guidelines

The environmental impact assessment study for the sanitation project is designed to evaluate its status with respect to all applicable World Bank Safeguard Policies as well as national legislation. According to Operational Policy (OP)/Bank Procedure (BP) 4.01: Environmental Assessment (http://go.worldbank.org/OSARUT0MP0), the overall project is classified as Category A project and therefore requires the completion of full-scale EIA.

OP/BP 4.01 on Environmental Assessment

The objectives of the World Bank's safeguard policies OP 4.01 for Environmental Assessment is: (i) to inform decision makers of the nature of environmental and social risks, (ii) to ensure that projects proposed for Bank financing are environmentally and socially sound and sustainable (promote positive impacts, avoid/mitigate negative impacts, (iii) to support integration of environmental and social aspects of projects in the decision-making process, and

(iv) to increase transparency and provide mechanism for participation of stakeholders in the decision-making process for the project (WB Safeguards Workshop 2010).

The project triggers the Bank safeguard policy on Environmental Assessment (OP/BP 4.01) and is classified as Category A project due to significant impacts associated with the proposed investments/activities under components 1 and 2. On the positive side, the project will help reduce flood risk and improve environmental conditions in Tham Luong- Ben Cat basin in Ho Chi Minh City therefore, overall the project will bring positive impacts to degraded waterways such as Saigon River. However, there will be temporary, site-specific environmental impacts primarily during the construction period (due to air pollution, noise and vibration due to the operation of heavy equipment, waste generation at the construction site, and traffic interferences),. Other key negative impacts during construction would include generation of land acquisition for canal rehabilitation; the loss of land for affected people; the risk on landslide and subsidence during the construction of canal embankment and from construction interceptor using pipe jacking method; the generation of excavated soil and dredged sediments from the rehabilition of the main canal, secondary connecting canals and construction of interceptor, primary and secondary sewer network in Go Vap district, which would require the appropriate disposal solution. At the operational period, the environmental concerns would include maintenance activities and awareness raising for the local people to ensure the aesthetic, proper functions of structural works preventing flood risks. In addition; better monitoring, evaluation and management of pollution sources entering the rehabilitated canal are critical to the sustainability of the project.

OP/BP 4.04 on Natural Habitat

The policies is triggered as the project interventions including dredging, canal rehabilitation, and land clearing will be located primarily in urban area.The project is expected to have positive impacts on natural habitats such as the rehabilitated canal and rivers.

OP/BP 4.11 on Physical Cultural Resources

The project activities take place in urban areas of OP/BP 4.11 HCMC, specifically along the TL-BC-NC canal of 32.7 km where PCRs are unknown. However, the policy is triggered as the Project involves excavation and dredging activities which may result in chance finds.

OP/BP 7.50 Project on International Waterways

OP 7.50 is triggered to the project since the Saigon River and its tributaries are international waterways given the nature of project activities. The project interventions include rehabilitation, additions, improvements and upgrading of the Tham Luong – Ben Cat– Rach Nuoc Len Canal system.

The location of the proposed project is in HCMC in the basin of the Tham Luong-Ben Cat-Nuoc Len (TL-BC-NC) canal which is 32.7 km long, covers an area of about 14,900 ha and occupies 30% of the HCMC inner city area. The waters of this canal are hydraulically connected with

Saigon River (which is an international river), Cho Dem River (national river), and several catchments such as Tham Luong-Ben Cat, Saigon West, and Binh Tan. The relevant characteristics of these two main rivers are:

- Cho Dem River is a tributary of Saigon River and runs exclusively within Vietnam, and Vietnam is the lowest downstream riparian of the Saigon River which is an international waterway that eventually discharges to the South China Sea;
- Saigon River originates in Cambodia and meets the Cho Dem River at the downstream, near its confluence with the Dong Nai River after which Sai Gon River turns into Nha Be River, which discharges to the South China Sea; and
- Both Cho Dem and Saigon Rivers are part of the Dong Nai River Basin.

OP/BP 4.12 Involuntary Resettlement

The policy aims to avoid involuntary resettlement to the extent feasible, or to minimize and mitigate its adverse social and economic impacts. It promotes participation of displaced people in resettlement planning and implementation, and its key economic objective is to assist displaced persons in their efforts to improve or at least restore their incomes and standards of living after displacement. As required by the policy, a Resettlement Policy Framework (RPF) and a Resettlement Action Plan (RAP) have been prepared for the project.

The project triggers OP4.12 on Involuntary BP 4.12 Resettlement because it will cause physical and economic displacement of people

Public Consultation and Information Disclosure

According to WB's safeguard policy OP 4.01 for category A project, proposed for IBRD or IDA financing, during the EA process, the borrower consults project-affected groups and local non-governmental organizations (NGOs) about the project's environmental aspects and takes their views into account. The borrower initiates such consultations as early as possible.

For Category A projects, the borrower consults these groups at least twice: (a) shortly after environmental screening and before the terms of reference for the EA are finalized; and (b) once a draft EA report is prepared. In addition, the borrower consults with such groups throughout project implementation as necessary to address EA-related issues that affect them.

The document with the summary of main investment items, key environmental issues, and environmental protection solutions associated with the project should be sent to organizations and individuals participating in the public consultation in a timely manner, in an understandable language and at an accessible place prior to the public consultation.

The World Bank Group's Environmental, Health and Safety Guidelines (WBG's EHS Guidelines)

While the normal World Bank Policy for Environmental Assessment is guided by Operational Policy/Bank Procedure (OP/BP) 4.01 represent the guidance for the ESIA and sustainable social and environmental management for the Project, the IFC's EHS Guidelines provide guidance on general and industry best practice as well as recommended numerical limits for emissions to the atmosphere, noise, liquid and solid wastes, hazardous wastes, health and safety, and other aspects of industrial facilities and other types of development projects. The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP). The World Bank group uses the EHS Guidelines as a technical source of information during environmental assessment process

In general, where different standards are prescribed by the different agencies, the most stringent of the national and international standards will apply to the Project:

"When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects are expected to achieve whichever is more stringent. If less stringent levels or measures than those provided in these EHS Guidelines are appropriate, in view of specific project circumstances, a full and detailed justification for any proposed alternatives is needed as part of the site-specific environmental assessment. This justification should demonstrate that the choice for any alternate performance levels is protective of human health and the environment." (IFC General EHS Guidelines, page 1).

Overall, the IFC's EHS Guidelines are the more comprehensive and stringent. Compliance with national standards is always required.

Table 1.1 Applicable WBG's EHS Guidelines

Applicable IFC's EHS Guidelines
General Environmental Guidelines
1. Environment
1.1 Air Emissions and Ambient Air Quality
1.2 Energy Conservation
1.3 Wastewater and Ambient Water Quality
1.4 Water Conservation
1.5 Hazardous Materials Management
1.6 Waste Management
1.7 Noise
1.8 Contaminated Land
General Occupational Health and Safety Guidelines
2. Occupational Health and Safety

2.1 General Facility and Design and Operation
2.2 Communications and Training
2.3 Physical Hazards
2.4 Chemical Hazards
2.5 Biological Hazards
2.6 Radiological Hazards
2.7 Personal Protective Equipment (PPE)
2.8 Special Hazards Environments
2.9 Monitoring
General Community Health and Safety
3.1 Water Quality and Availability
3.2 Structural Safety and Project Infrastructure
3.3 Life and Fire Safety (L&FS)
3.4 Traffic Safety
3.5 Transport of Hazardous Materials
3.6 Disease Prevention
3.7 Emergency Preparedness and Response
General Construction and Demolition Guidelines
4.1 Environment
4.2 Occupational Health and Safety
4.3 Community Health and Safety
Sectors Specific EHS Guidelines

1.2.3. Other international treaties and conventions

- Kyoto Protocol to the UNFCC on Climate Change (1997);
- United Nations Convention on Biological Diversity (1992);
- Basel Convention (1989);
- Ramsar Convention on Wetland (1971);
- International Union for Conservation of Nature and Natural Resources, Red List of

Threatened Species (1964).

The Kyoto Protocol on Climate Change (UNFCC)

Vietnam became a signatory to the UNFCC in 1998 with full accession in 2002. This obligates Vietnam to assure that future development in the country meets the conditions of the Convention. Relevant to this project are impacts associated with water rise resulted from climate change and its proposed mitigation measures.

The United Nations Convention on Biodiversity 1992

This Convention seeks to conserve biodiversity and promote its sustainable use. It requires the identification and monitoring of the biodiversity in an area and adopting the necessary conservation measure. Vietnam became party to this Convention in 1994.

The Basel Convention 1989

This was developed under the auspices of the United Nations Environmental Programme (UNEP) in response to the growing worldwide awareness of the problem of international traffic in hazardous waste. The Basel Convention 1989 is the first and foremost global environmental treaty that strictly regulates the trans-boundary movement of hazardous wastes. It obligates parties to ensure environmentally sound management, especially during the disposal process.

The objectives of the Convention are to:

- Ensure that waste is disposed of as near as possible to the place or source of its generation;
- Reduce trans-boundary waste and where it cannot be avoided, to be disposed of in an environmentally sound and efficient manner; and
- Provide assistance to developing countries in the management of hazardous waste and the generation.

The Convention places a ban on the export of hazardous waste from Organization for Economic Cooperation and Development (OECD) countries to non-OECD countries.

The Ramsar Convention

The Ramsar Convention is an intergovernmental treaty adopted on 2 February 1971 with the mission “the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world”. In 1989, Vietnam signed on to the Ramsar Convention and become the fifty country of this Convention. As a commitment to the Ramsar Convention, Vietnam has committed for national action and international cooperation on conservation and use of wetlands.

International Union for Conservation of Natural and Natural Resources, Red List of Threatened Species

The IUSCN Red List, in 1964, was founded in order to provide a comprehensive inventory of the global conservation status of biological species, and to set of precise criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are applicable to all species and all regions of the world. Following the guidelines of the IUSCN Red List, Vietnam's Red List was produced in 1992, updated in 2007, and has been an effective guideline for conservation of extinction species in Vietnam.

CHAPTER 2: PROJECT DESCRIPTION

2.1. Project name

"**HO CHI MINH CITY FLOOD RISK MANAGEMENT"**

2.1.1. Sponsor

World Bank (WB)

2.1.2. Governing body, project owner

Governing body: People's Committee of Ho Chi Minh City.

- Address : 86 Le Thanh Ton, District 1, Ho Chi Minh city
- Phone number : +84 8 38226191
- Fax : +84 8 38296723

Project owner**: **The steering center of Urban Flood control program of Ho Chi Minh city

- Address : 10 Trần Nhật Duật, Tan Dinh Ward, District 1, Ho Chi Minh city
- Phone number : +84 8 3526 7497
- Fax : +84 8 3526 5354

The Agency performing owner tasks: *Project Management Unit (PMU) of Works Contruction.*

- Address : 176 Hai Bà Trưng, Đa Kao ward, District 1, Ho Chi Minh city
- Phone number : +84 8 38232119
- Fax : +84 8 38232119

2.1.3. Estimated project duration

- Project preparation stage: 2013 – 2016
- Project implementation stage: 2016 – 2021

2.1.4. Project site

ThamLuong – BenCat - NuocLen channel system is located in central of Hochiminh city (North East – South West), which flow into Sai Gon river and Cho Dem river. Project area: 14,899 hectares (accounting of 7% of city natural area). The proposed project has construction works which is located in nine (09) districts of HCMC such as Binh Thanh district, Go Vap district, district 12, Tan Binh district, Tan Phu district, Binh Tan district, district 8, Binh Chanh district and Nha Be district.

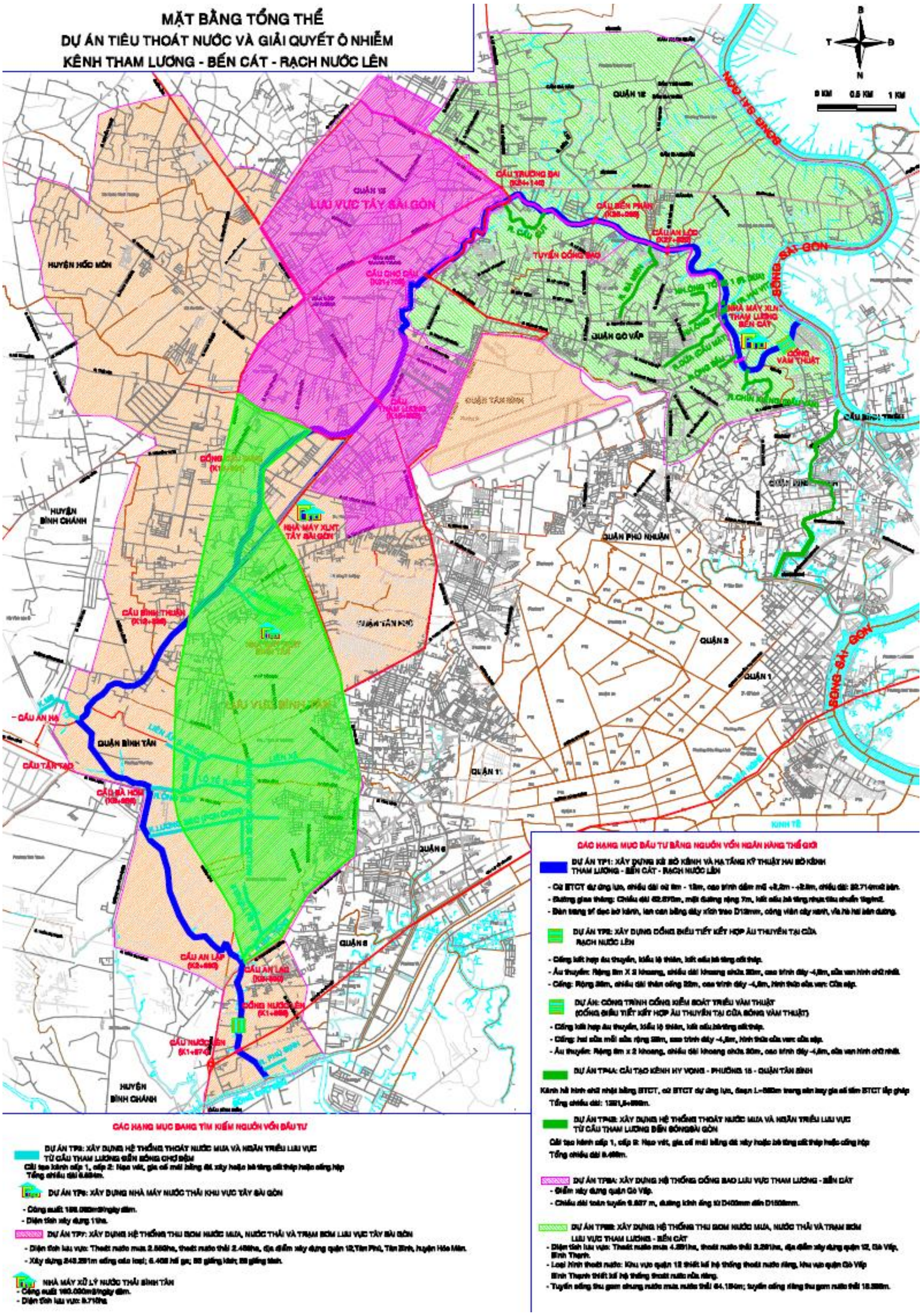


Figure 2.1 Master plan of HCM City Flood Risk Management Project.

Natural Area of project: 14,899 hectares, divided by district as follow

Table 2.1 Project area divided by districts

No	District	Total area (ha)	Area of urban land (ha)	Area of Agriculture land (ha)	Urban ratio (%)
1	District 12	3,083.4	2,244.4	839	73
2	Go Vap District	1,915.7	1,827.5	88.2	95
3	Tan Binh District	525.1	525.1	0-0	100
4	Tan Phu Disrict	1,706.5	1,654.7	51.8	97
5	Binh Tan District	1,445.6	1,044.6	401.0	72
6	Hoc Mon District	1,526.1	584.3	914.8	41
7	Binh Chanh District	4,589.1	2,117.1	2,472.0	46
8	District 8	93.3	93.3	0,0	100
9	Binh Thanh District	14.2	14.2	0,0	100
	Total	**14,899**	**9,698.4**	**5,200.6**	**79**

Source: Feasibility Study report, 2015.

2.1.5. Project's beneficiaries

Once the infrastructure works are put into use (comprising tidal sluice gates, improved canals and sewers for flood prevention, interceptor sewers and wastewater treatment plants), flooding caused by tide and rain would be controlled, contributing to the growth of kry services - tourism, industries, high - tech and sustainable agriculture. The direct project beneficiaries are the following:

(i) Close to 550,000 direct beneficiaries will be protected from flood control measures and improved sanitation, in addition to 500,000 indirect beneficiaries living in the sub-catchment, of which 51.9% of the population are women;

(ii) City and National level agencies involved in flood risk management who will benefit from new equipment and capacity strengthening activities ; and

(iii) FDI and private enterprises, most of them in industrial zones, who will benefit through improvement in infrastructure and reduced disruption due to flooding. Of this total population, 5.6% are estimated to be in the bottom 40% of Vietnam's income distribution, and 1.3% is estimated to be poor by the national poverty line of 653,000 VND per person per month in 2010.

2.1.6. Project description and components

This project will help reduce flood risk and improve drainage in selected areas in HCMC through a combination of (i) institutional development measures and tools needed to enhance the performance of relevant flood risk management agencies (SCFC, Southern Regional Center for Hydrometeorological Forecasting, Department of Natural Resources and Environment, etc.); and (ii) "no/low regrets" structural investments to minimize flooding to the inner core area of HCMC. The complementary nature of these two components aligns with best practices in integrated flood risk reduction to address both structural (Component 2), non-structural and institutional (Component 1) aspects of flood risk management process. Part of this process, especially the structural investments, will help improve drainage in selected areas to specifically contribute to flood risk reduction.

Component 1 - Integrated Urban Flood Risk Management *(Total Cost: US$ 13 million, from Loan Proceeds)*

This component will contribute to reducing flood risk by strengthening the capacity of the HCMC SCFC and other public institutions to better plan and implement flood risk management measures (including disaster preparedness through flood forecasting, early warning, flood emergency response, and risk reduction through risk sensitive spatial and sector planning), as well as safeguard the water quality and the health of the people living along the proposed canals.

- *Subcomponent 1.1 – Modernization of Hydromet Equipment and Flood Forecasting System.* Improving flood forecasting capacity of the Southern Center for Hydro-Meteorological Forecasting (SCHMF), with specific focus on urban flooding in HCMC, including: (i) Installation of 05 weather stations, 01 C-band bi-polar weather radar, 80 rainfall stations and 20 hydrological stations; (ii) Upgrading of the numerical weather and flood forecasting models; (iii) Extension of the telemetry system; and (iv) Implementing a flood forecasting system based upon a wide variety of meteorological data and the hydrological-hydrodynamic model developed by SCFC under sub-component 1.2**.**

  The modernization of the hydromet observation network and improvement of the flood forecasting system for HCMC, including equipment specifications and forecasting platform, will follow the architecture design and standards of the national hydromet equipment upgrading and forecasting system that is being supported by the on-going Vietnam – Managing Natural Hazards Project.

- *Subcomponent 1.2 - Integrated Urban Flood Risk Management and Early Warning System.* Strengthening city's capacity on flood risk reduction investments planning, preparedness, early warning dissemination and emergency response including: (i) Establishment of a city-level Operations/Command Center at SCFC, fully equipped with hardware and software, facilitating the collection, storage, retrieval, presentation and dissemination of flood related information; (ii) Establishment of an Integrated Flood Information System at SCFC connecting to the office of the HCMC People's Committee and other public institutions, outreaching to flood vulnerable communities; (iii) Development of a reliable detailed integrated hydrological – hydrodynamic model for HCMC to be used jointly for flood forecasting, flood hazard mapping and the evaluation of flood protection measures; and (iv) Production and updating of flood hazard and flood risk maps for HCMC.

- *Subcomponent 1.3 - Water Quality Monitoring Equipment.* Installation of 6 monitoring stations along the Tham Luong – Ben Cat – Rach Nuoc Len canal and a study on sediment management will be financed by the project budget, and managed by city's Department of Natural Resources and Environment (DONRE). Additional strengthening of the water quality monitoring program and improvement of local capacity for solid waste management will be financed directly by HCMC's budget.

Component 2 - Priority Flood Risk Reduction Interventions *(Total Cost: US$324 million, of which US$ 304 million from loan proceeds and US$ 21 million from counterpart funds)*

This component will contribute to reducing flood risks and improving drainage in the Tham Luong –Ben Cat sub-catchment through significant prioritized no-regret structural measures proposed in the JICA Plan (Plan 752) and MARD Plan (Plan 1547). Counterpart funding will be used to finance land-acquisition and resettlement, while the loan proceeds will finance the design, implementation, contingency and construction supervision costs. The scope of this Component includes:

- Construction of two (2) combined ship lock - tidal sluice gates of Vam Thuat and Rach Nuoc Len in Tham Luong – Ben Cat – Rach Nuoc Len canal to control tidal water inflows;
- Upgrading/Improvement of canal bank revetments in the main canal of Tham Luong – Ben Cat – Rach Nuoc Len to improve its ability to discharge flood waters at the appropriate designed safety level including green structures where appropriate;
- Construction of main interceptor and upgrading of primary and secondary combined storm water drainage and waste water sewage system at the appropriate designed safety levels to improve rainwater discharge and environmental sanitation capacity in Go Vap district;

  Upgrading/Improvement of secondary canals that are connected with primary Tham Luong – Ben Cat – Rach Nuoc Len Canal at the appropriate designed safety level to improve the urban flood management and to reduce the pollution of the Canal and Sai Gon River with sewage water.

  Additionally, this component will finance supports to civil works implementation, including technical, fiduciary, and safeguards aspects, as well as to the preparation of feasibility study for two (02) other MARD Plan's Cay Kho and Phu Dinh tidal sluice gates.

Component 3 - Implementation Support *(Total Cost: US$ 11 million, from counterpart funds)*

This component will provide support SCFC for project implementation, Project Technical and Financial Audits, Monitoring and Evaluation (M&E), and other operating costs. Training to City's PMU on procurement, financial management and safeguard policies will be provided by the World Bank in combination with other World Bank-funded projects' training program.

2.2. Technical Considerations for Component 1

Subcomponent 1.1 - Modernization of Hydromet Equipment and Flood Forecasting System. *Improving flood forecasting capacity of the Southern Center for Hydro-Meteorological Forecasting (SCHMF), with a specific focus on urban flooding in Ho Chi Minh City.*

Monitoring coverage of the flood prone areas in Ho Chi Minh City is currently insufficient in terms of quantity and quality to support the implementation of a reliable flood forecasting system. In addition, expansion of the water level sensors in the city canal system is also needed for the control of the two tidal sluice gates to be constructed under this project. The project will support the acquisition and installation of the following monitoring equipment: 5 weather stations, 80 rainfall stations and 20 hydrological stations, the last ones distributed equally along rivers and along city canals.

A new **weather radar** has been proposed to significantly increase the quality of rainfall observations. The choice of C-band bi-polar equipment will enable the nowcasting of rainfall impacting the city a few hours ahead. Altogether, the new weather radar is an essential component in the forecasting system and allows for a reduction in the earlier proposed density of the extended rainfall gauge network. Increased operation and maintenance costs associated with the radar have been considered and will addressed in the sustainability plans for project investments.

The significant extension of the monitoring network requires an increase in telemetry capacity. Increased transmission of data also implies the need for more ***data storage*** capacity at SCHMF. In addition, there is a need for extending the capacity of data transmission lines. As a consequence, also data back-up services have to be re-assessed, in particular with the current trend of using the cloud for such service.

Upgrading of the ***numerical weather models***, based upon the weather modelling systems Weather Research and Forecast (WRF) and High Resolution Regional Model (HRM), respectively, is also essential for the reliability of flood forecasts for Ho Chi Minh City. The model grid size will decrease from 16 km to 2 km, nearly enough to foresee the growth of potentially damaging convective storms. The upgraded software will be supplied through the on-going Vietnam – Managing Natural Hazards project (VN-Haz), including consultancy services to calibrate the new models. The higher frequency of forecast simulations and the denser network leads to the need to increase computer hardware capacity.

The ***flood forecasting system*** providing flood level forecasts for HCMC will be developed and installed at SCHMF. Apart from the mandate SCHMF has for flood forecasting it is also the most logical location as it is strongly connected to the quality and completeness of the incoming monitored data and the numerical weather model results. While the flood forecasting system is operational at SCHMF, SCFC will be guaranteed to receive instantaneously the same information as available at SCHMF, for further actions related to early warning and flood emergency response, and be provided with the functionality to do “what-if” scenario simulations with the system.

The flood forecasting system will be built upon an ***IT platform*** which allows for the processing of all sources of meteorological data, such as satellite images, numerical weather model results, weather radar images and ground stations. The flood forecasting platform should enable the incoming data quality control, gap filling, rainfall data aggregation to quantify precipitation on hydrological sub-basins, etc. It will also allow for the coupling of various hydrological and hydrodynamic models. In particular, it will couple the integrated hydrological – hydrodynamic model for Ho Chi Minh City to be developed by SCFC. In addition, it will couple the coastal model for the simulation of tides and storm surges at the East Sea. The platform should also allow for a future extension of the models to include the Dong Nai catchment upstream of the reservoirs.

Software will be ***made available through the VN-Haz Project***, which envisages the installation of one common flood forecasting system over the complete area of Vietnam. For the implementation for HCMC, the work involves the tailoring of the system by specifying and activating the connection of data flows, connection of the models via adaptors, defining the frequency of data refreshment and model simulations, activation of processes and processing results for agreed dissemination. In cooperation with SCFC, this activity will be taken up by the VN-Haz project as a pilot for the country wide flood forecasting system development. However, the delivery of required hardware will be supported under this HCMC subcomponent.

Subcomponent 1.2 - Integrated Urban Flood Risk Management and Early Warning System. *Strengthening the city's capacity on flood risk reduction to support: investment and spatial planning, preparedness, early warning dissemination, and response.*

The **Operations Center** to be established at SCFC will be much more than a platform showing flood forecasting results. A database will be built containing a wide variety of information relevant to floods, such as flood hazard and risk maps, web cam images, detailed information on the flood defense system, evacuation routes and refuge accommodation, locations of public administration, hospitals, police and fire stations, industries, etc. If development timelines allow, the database software will be the same as the database under development for the DRM project of VN-Haz. The need for backups of **databases** has been discussed and the project should consider the choice between fixed location backup and the use of cloud services, such as provided by Microsoft, for example. Criteria for selection will have to be reliability and costs.

Functional design and database will be developed, and should include an analysis of public participation, line agencies to be connected and information flows have to be defined and established. Investments in physical housing, data storage, screens, electronic billboards, etc. are planned under this subcomponent. During implementation, specific areas like crowd-sourcing data collection and sharing will be finalized with the City.

For flood management planning and for the flood simulations as part of the flood forecasts, SCFC needs a ***reliable hydrological – hydrodynamic model,*** which will be built/upgraded from the existing models. This model will have to cover the Dong Nai Basin downstream of the two main upstream reservoirs and down to the sea, as well as the description of the primary underground drainage system in the urban area. It will help improve coordination with upstream reservoirs. Maps of flood hazards and flood risks for the city area will be produced as a result of the model, and updated/maintained regularly by SCFC.

Subcomponent 1.3 - Water Quality Monitoring Equipment

This activity will be financed by the project budget, and managed by the city's Department of Natural Resources and Environment (DONRE). It should be noted that the automatic sampling only partly substitutes manual sampling, as there will still be a need to sample for parameters such as heavy metals, phosphates and nitrates. Two of these stations have recently been installed by Ho Chi Minh City. From the 39 remaining installations 6 will be financed from this project budget. Focus is the monitoring of water quality improvements following the dredging of the Tham Luong – Ben Cat – Rach Nuoc Len canal. In addition, a sediment management study of Tham Luong – Ben Cat – Rach Nuoc Len canal is proposed to help the city in better managing sedimentation and establishing a dredging plan.

Strengthening of the water quality monitoring program and improvement of local capacity for solid waste management will be financed directly by Ho Chi Minh City's budget.

Maintenance

The investments in monitoring equipment, in particular the radar installation, will require future maintenance. In addition, the installations will increase the need for staffing. It has to be realized that non-structural flood management provisions such as a forecasting system have a high economic rate of return. Due to the fact this value is hardly measurable, there is a tendency to neglect its importance after installation of the services. Currently, maintenance budgets in Ho Chi Minh City are already low. It is strongly recommended to allocate sufficient maintenance resources for Component 1.

2.3. Technical Options for Component 2

2.3.1. Subcomponent 2.1 - Two (02) combined ship lock and tidal sluice gates: Vam Thuat and Nuoc Len.

- **Vam Thuat tidal sluice gates**

Location: at the Vam Thuat river mouth in District 12 and Binh Thanh, Ho Chi Minh city. At this location, tide and flood from Saigon river into the central area through Tham Luong - Ben Cat - Nuoc Len canal will be prevented.

Figure 2.2 Location map of Vam Thuat Sluice gate with ship lock.

Main technical solutions:

- Vam Thuat tidal sluice gates designed for 2 separated ship lock and sluice gate. Ship lock is arrange two sides and priorily constructed cofferdams. Vam Thuat is designed with sluice span of B = 52 m, bottom elevation of -4.5 m, and selected 2 lock chambers with B = 8x2 = 16 m. Its design ensures to combine with requirements of waterway trasportation such as waterway grade V, self- propelled ship load is from 10 to 50 tons with the largest length of 17.4 m and the largest width of 4.78 m;
- Gate design options
  - For lock chambers, using rectangular gate;
  - For sluice chambers, using flap gate

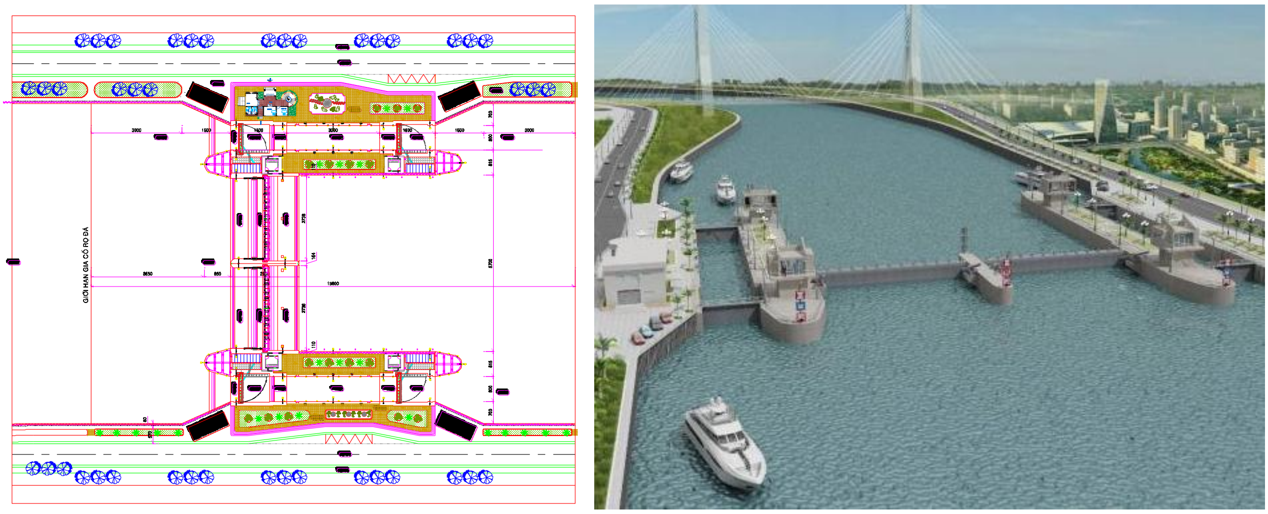


Figure 2.3 Perspective view of Vam Thuat tidal sluice gate.

Table 2.2 Sum of works scale for Vam Thuat tidal sluice gates

No	Items	unit	Scale	Notes
I.1	**Ship lock**			
1	Work type			Open with reinforced concrete.
2	Lock Width	m	8.0 x2	
3	Length of head of ship locks with self-regulating gate.	m	18.0 x2	Reinforced concrete
4	Length of lock chambers	m	30.0	Reinforced concrete wall
5	Bottom elevation	m	-4.50	
6	Chamber bottom elevation	m	-4.50	
7	Top gate elevation	m	+2.50	One way opening and closing, rectangular gate
I.2	**Sluice gate**			
1	Work type			Open with reinforced concrete.
2	Sluice width	m	52.0	2x26 m
3	Length of approach canal behind sluice gate	m	84.0	Prestressed concrete pile

No	Items	unit	Scale	Notes
4	Width of approach canal behind sluice gate	m	55.50	
5	Length of sluice body	m	22.0	
6	Sluice bottom elevation	m	-4.50	Reinforced by gabion
7	Top gate elevation	m	+2.50	Steel flap gate
II	**Appoach canal before and after sluice gate.**			
1	Upstream approach canal			Prestressed concrete pile
	+ Span of canal bed	m	55.5÷99.25	Reinforced by gabion mattress
	+ Canal slope coefficient		0	
	+ Canal bed elevation	m	-4.50÷-5.0	
	+Length of canal	m	30.00	
	+ Canal bank elevation.	m	+2.20	
2	Downstream approach canal			Prestressed concrete pile
	+ Span of canal bed	m	55.5÷99.5	Reinforced by gabion mattress
	+ Canal slope coefficient		0	
	+ Canal bed elevation	m	-4.50÷-5.25	
	+ Canal length	m	30.00	
	+ Canal bank elevation	m	+2.20	
III	**Management building**			
1	Surrounding area	m^2		Be inside sluice area
2	Construction area	m^2	100.0	
IV	**Corridor**			
1	Length of corridor	m	166	
2	Span of corridor	m	9&11	Left and right bank

No	Items	unit	Scale	Notes
3	Corridor structure			Interlocking concrete pavement
4	Park areas	m²	3,320	
V	**Internal and along canal roads**			
1	Length of main road	m	166x2	
2	Width of main road	m	7.0	Asphalt lining
3	Lenghth of internal road	m	230	
4	Width of internal road	m	5.0	Asphalt lining

➢ **Nuoc Len tidal sluice gates**

Location: At the Nuoc Len canal mouth in Binh Tan District, Ho Chi Minh city. At this location, tide and flood from Cho Dem river into the central area through Tham Luong - Ben Cat - Nuoc Len canal will be prevented.

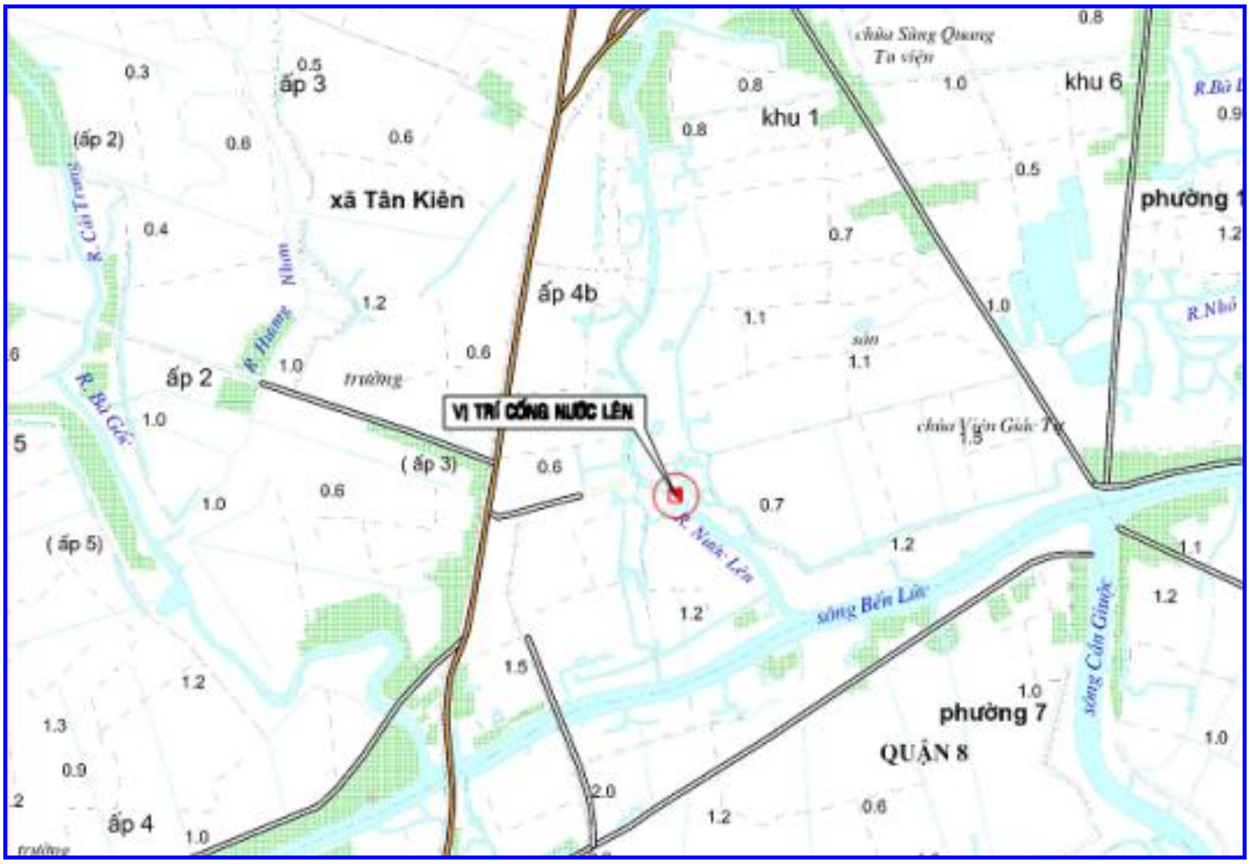


Figure 2.4 Location map of Nuoc Len Sluice gate with ship lock.

Main technical solutions:

- Nuoc Len tidal sluice gates designed for 2 separated ship lock and sluice gate. Ship lock is arranged two sides and priorily constructed cofferdams;
- Ship lock has 2 lock chambers with 8m of width, using rectangular gates. A chamber with gate is structured by reinforced concrete. A watertight chamber enclosed boats is 30m of length, and structured by reinforced concrete;
- The culvert section with non waterway transport is used flap gate which opened or closed as required. The culvert width B = 30 m. The later is 30 m length canal before leading into the main canal which is reinforced by gabions and prestressed concrete pile wall.

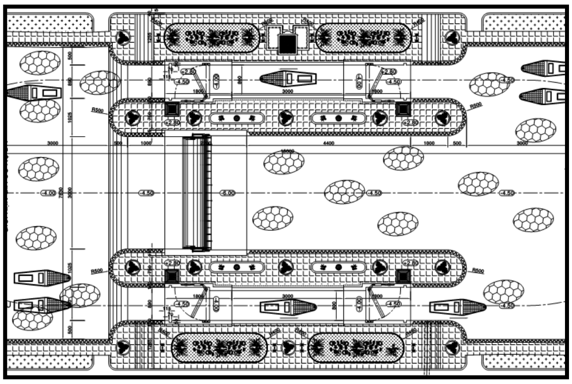


Figure 2.5 Perspective view of Nuoc Len tidal sluice gate.

Table 2.3 Sum of works scale for Nuoc Len tidal sluice gates

No	Items	Unit	Scale	Note
I.1	**Navigation locks**			
1	Work type			Open with reinforced concrete
2	Lock width	m	8.0x2	
3	Length of head of ship lock with self-regulating gate	m	18.0 x2	Reinforced concrete
4	Length of lock chambers	m	30.00	Prestressed concrete pile wall
5	Sluice bottom elevation	m	-4.00	
6	Chamber bottom elevation	m	-4.00	
7	Top gate elevation	m	+2.50	One way opening or closing, rectangular gate
I.2	**Sluice**			
1	Work type			Open with reinforced concrete
2	Sluice width	m	30.0	
3	Length of approach canal behind sluice gate	m	84.0	Prestressed concrete pile
4	Width of approach canal behind sluice gate	m	30.5	
5	Length of sluice body	m	22.0	
6	Sluice bottom elevation	m	-4.00	reinforced by gabions
7	Top gate elevation	m	+2.50	Steel flap gate
II	**Appoach canal before and after sluice gate**			
1	Upstream approach canal			Prestressed concrete pile
	+ Span of canal bed	m	71.25	Reinforced by gabion mattresss
	+ Canal slope coefficient		0	
	+ Canal bed elevation	m	-4.00	
	+ Canal length	m	30.0	

No	Items	Unit	Scale	Note
	+ Canal bank elevation	m	+2.20	
2	Downstream approach canal			Prestressed concrete pile
	+ Span of canal bed	m	71.50	Reinforced by gabion mattresss
	+ Canal slope coefficient		0	
	+ Canal bed elevation	m	-4.50	
	+ Canal length	m	30.0	
	+ Canal bank elevation	m	+2.20	
III	**Management building**			
1	Surrounding area	m^2		Be inside sluice area
2	Construction area	m^2	100.0	
IV	**Corridor area**			
1	Length of corridor	m	166	
2	Span of corridor	m	15 & 17	Left and right bank
3	Corridor structure			Interlocking concrete pavement
V	**Internal and along canal roads**			
1	Length of main road	m	166x2	
2	Width of main road	m	7.0	Asphalt lining
VI	**Work grade**		I	Hydological and hydraulic features
			II	Stability, structural features

2.3.2. Subcomponent 2.2 - Construction of embankments in Tham Luong - Ben Cat - Nuoc Len canal

Location: Tham - Luong - Ben Cat - Nuoc Len canal is the main south - north axis of the city and it is one of Works under Plan 1547 for flood prevention. The canal is through the following districts: Binh Chanh, 8, Binh Tan, Tan Phu, Tan Binh, 12, Go Vap, Binh Thanh, in Ho Chi Minh city. This canal drains for Tham Luong - Ben Cat - Nuoc Len basin with the total area is about 14,900 ha.

Main technical solutions: This is a combined option for revetment/earthwork of the full 32.7km of length on each canal bank in its original footprint. Investments include 20.6km of concrete piles (Km6.9 - Km27.6) and 12.2km of slope revetment (Km0.0 - Km6.9 and Km20.6-Km32.7). These works will increase flood discharge capacity and storage capacity of the canal. The design safety level of the canal embankment will be at 10 year return period. Various options of canal structures and revetments were considered from economic and environmental perspectives. Options for eco-friendly embankment designs have been recommended considering that they improve water environment conditions, provide public recreation space and tourist attractions.

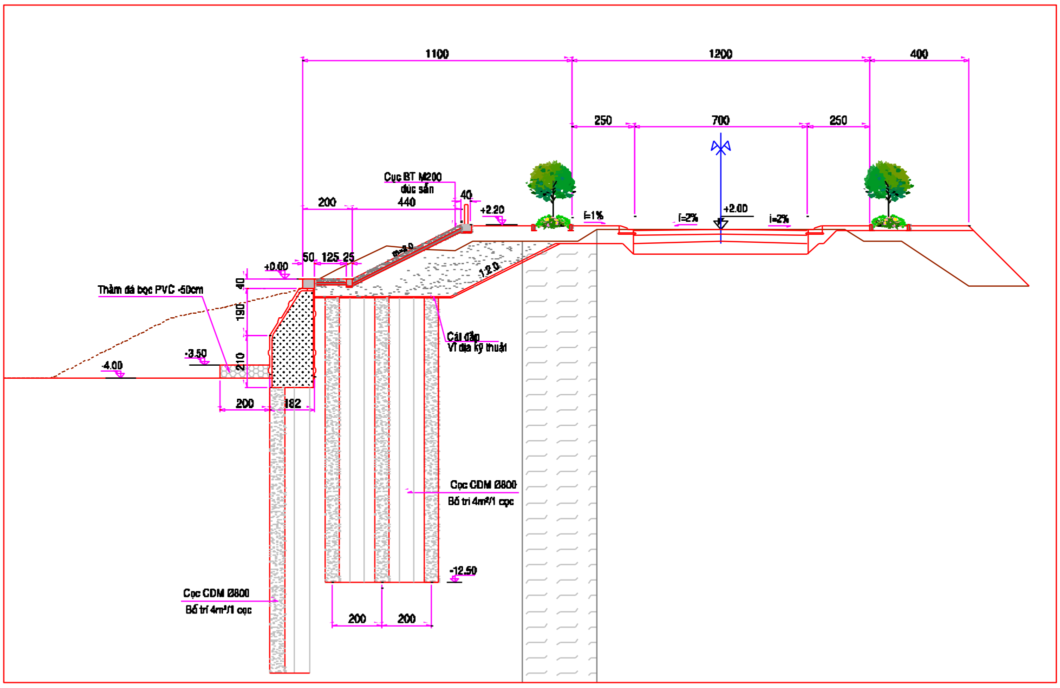


Figure 2.6 Struture of vertical embankment with slope emabankment.

Table 2.4 Bridges on main canal

No.	Bridge's name	Location	Description
1	Bridge over Canal 19-5	K17+915	One span of 24.54 m length
	Lo Voi	K27+507	
2	Bridge over Canal 19-5	K13+762	Three span of 18.60 m length
	Bridge over Rach Cut	K24+997	
	K26+682	K26+682	
	Bridge over Rach Sau	K27+244	
	Bridge over Rach Hai Vit	K29+847	
	Bridge over Rach Lang	K31+547	

No.	Bridge's name	Location	Description
3	K0+582	K13+762	Three span of 12.50 m length
	Bridge over Rach Chia	K2+423	
	Bridge over Rach Ba Tieng	K2+606	
	Bridge over Rach Hung Nhon	K4+079	
	K5+356	K5+356	
	Bridge over Rach Cau Kinh	K6+256	
	K7+883	K7+883	
	Bridge over Rach Ba Mien	K27+283	
	Bridge over Rach Dat Set	K27+825	
	Bridge overa Rach Cau Mat	K30+168	
	Bridge over Rach Cau Van	K31+266	

2.3.3. Subcomponent 2.3 - Selected storm and waste water systems in Go Vap District

Location: Location of the drainaige culvert system: Along the right bank of Tham Luong – Ben Cat canal, in the defined width of the technical border (BKT) : 20.0 m counting from the edge of the canal, and filling the ground by sand for construction road later (with the clearance border of 20 m which had been carried out in stage 1 of the project on drainage and pollution improvement for Tham Luong – Ben Cat – Nuoc Len.

- Starting point of the drain: Cho Cau bridge - Go Vap District (K0 (m));
- Ending point of the drain: Collecting wells of the waste water treatment plan at An Phu Dong ward, District 12 (K0+9.073 (m)).

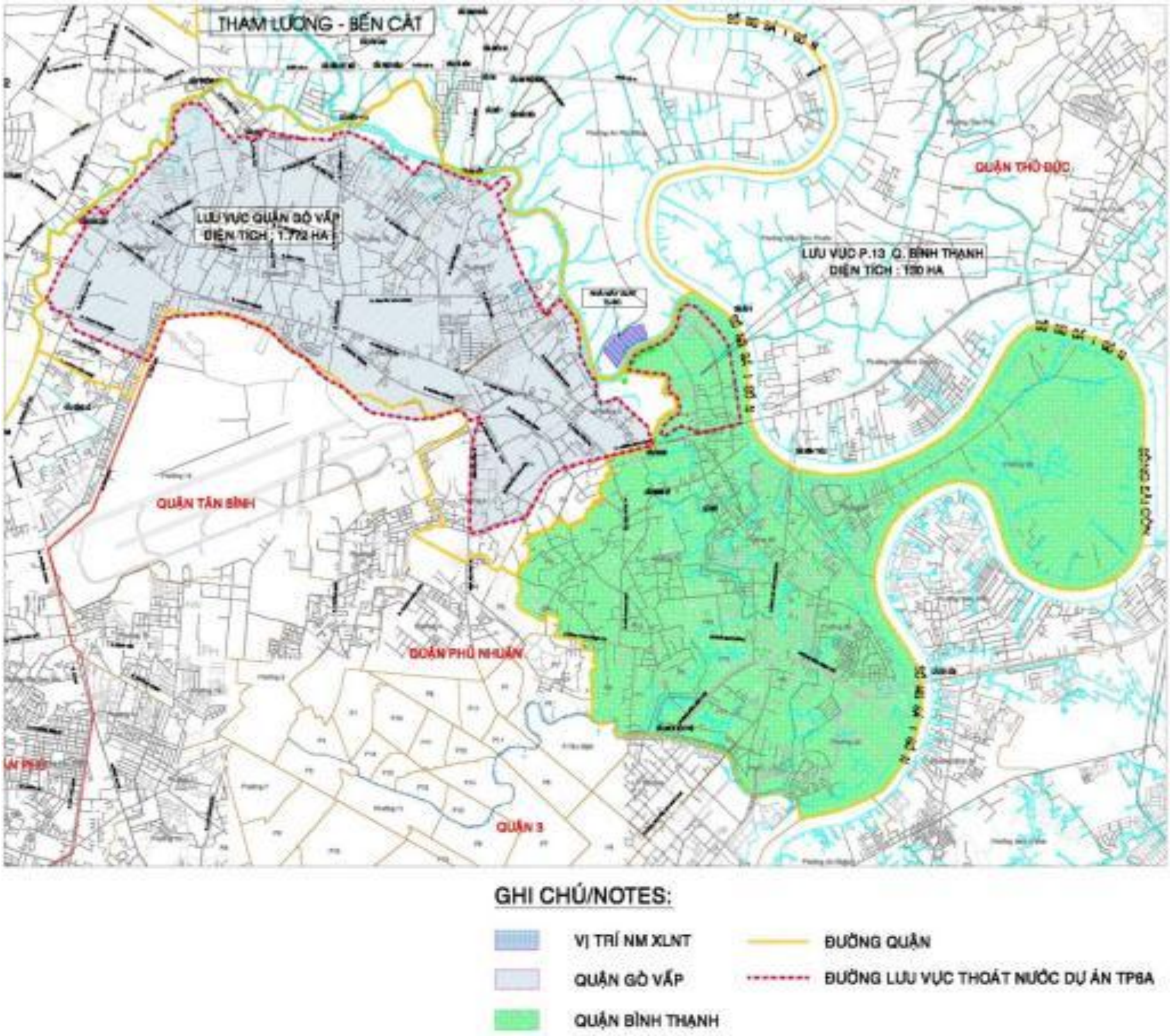


Figure 2.7 Administrative map of Go Vap and Binh Thanh District and project's border.

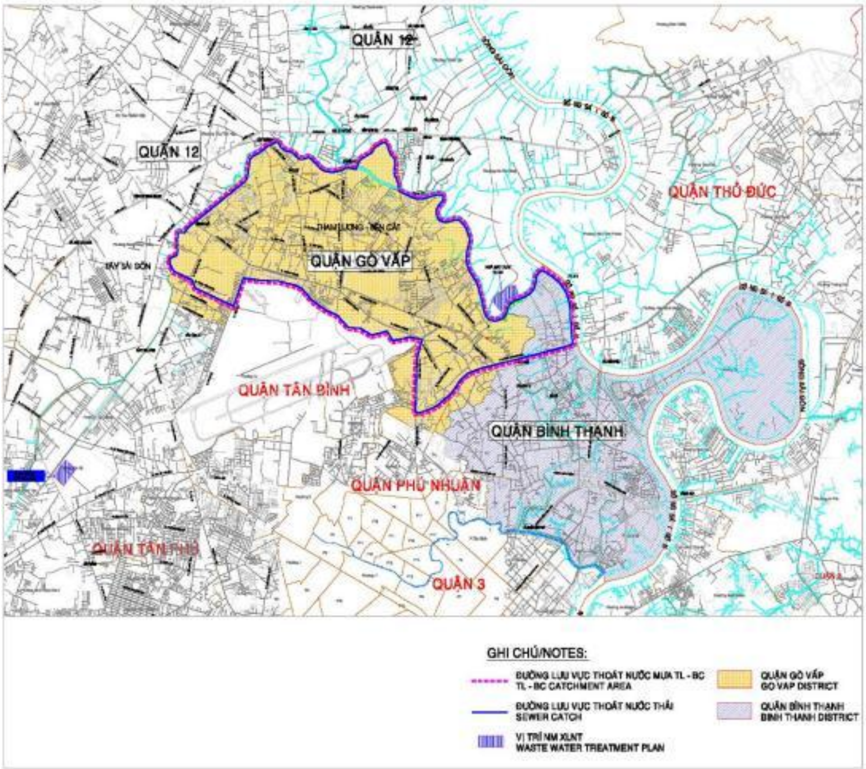
Main technical solutions: A 9km-of-length main interceptor will be constructed to cover 1,772ha in Go Vap district. The interceptor will follow the alignment of the main canal. This main interceptor will be a deep gravity sewer which will convey the diverted wastewater flows to the Vam Thuat waste water treatment facility to be constructed by the city. It will be constructed of precast reinforced concrete pipe sections installed by pipe jacking. The main interceptor will receive wastewater and rainwater from the primary and secondary combined storm water and sewer systems to be built in Go Vap district below.

Primary and secondary combined sewer system and secondary interceptor system in Go Vap District

Location: The areas of the project has a circle form from the North Eastern part to the South Western part of the City, connect Sai Gon river from the East to Cho Dem river from the South West; it includes 3 regions: Go Vap District, 5 wards of District 12 and ward 13 of Binh Thanh District with estimation of 4,361 ha.

Main technical solutions:

- ***Primary and secondary combined storm water and sewer systems*** and the secondary interceptor in Go Vap district will divert all wastewater and rainwater flow into the interceptor. The sewer systems will generally be reinforced concrete structures sized to contain sewage flow diversion and canal water backflow devices and pipe connections to the interceptor. The total length of primary combined drainage is about 48 km, of which 24km of pipe culverts and 24km of box culverts. The secondary combined drainage system is about 68km length with secondary pipe and box culverts. The safety levels of 10 and 5 year return periods will be applied for primary and secondary drainage systems respectively.[1]



[1] Regarding the return period for designing drain culverts storm water, Table 3 of the Design Standard TCVN 7957:2008 allows selecting 5 years for main culverts and 1-2 years for branching culverts (in cities of grade 1 and above), but there is a foot note specifying that the above values can be increased in case the drains serve important areas (where important infrastructure such as metro, tunnel, railway exist or where flood can cause big economic

Figure 2.8 Rain and waste water collection area I.

- Approach for water discharge at the sub-region II (includings 05 ward of District 12):Construction the separated drainage for rain water to discharge into the canal, and sewer system for wastewater to flow into WWTP at An Phu Dong ward, District 12.

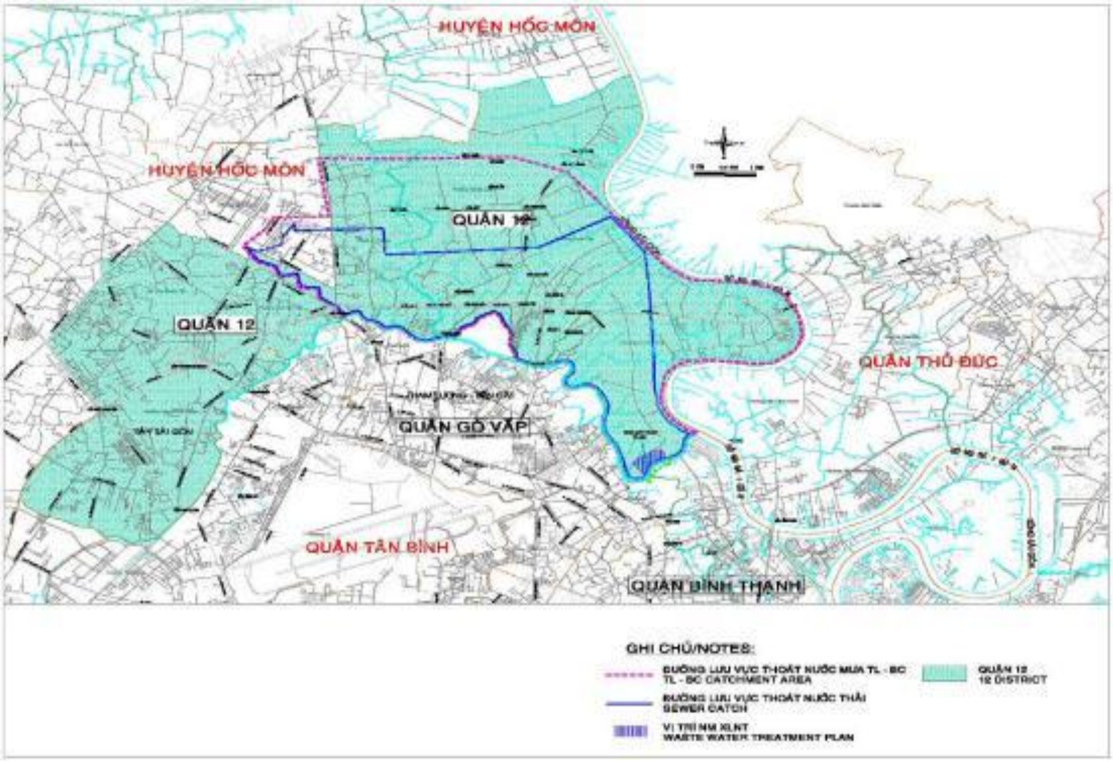


Figure 2.9 Rain and waste water collection area II.

2.3.4. Sub-Component 2.4 - Secondary canals improvements

Location

These secondary canals are connected to Tham Luong - Ben Cat - Nuoc Len main canal to drain for the basin belongs to Go Vap and Tan Binh district. In combination with the main canal, these secondary canals ensure drainage, tide prevention, water storing and regulating the water level in the canals.

Main technical solutions: A total of 6.9km secondary canals system, including Hy Vong, Chin Xieng, Ba Mieng, Ong Tong, and Ong Bau connected to main canal of Tham Luong – Ben Cat – Rach Nuoc Len will be upgraded at the safety level of 10-year return period to reduce the pollution with sewage water and improve the rainwater drainage capacity of about 1,000ha in Go Vap, Binh Thanh and Tan Binh districts. Especially, flooding problem in Tan Son Nhat International Airport will be completely addressed..

- For the secondary canals which have the existing small width, high bottom elevation, and being polluted (usually, they are the first sections in the residential area): replacing secondary canal with box culverts with dimensions from (1.6m x 1.6m) to (3.0m x 3.0m), backfilled with planting soil , and sidewalks are constructed along both sides.

- For the secondary canals which have the existing small width, medium bottom elevation, and good soil condition: designing Reinforced Concrete (RC) open canals with rectangular shape/trapezoid shape, and sidewalks are constructed along both sides.
- For the secondary canals which have the existing large width, and weak soil condition (usually, they are the last sections closed to Tham Luong - Ben Cat - Nuoc Len main canal): designing open canals with rectangular shape reinforced by pre-stressed RC piles, and sidewalks are constructed along both sides.

Table 2.5 Technical parameters of canals

No	Names of canal	Section	Bđ (m)	Zbottom	m	Road		Notes
						B (m)	Z (m)	
1	Hy Vong	K0 ÷ K0+600	4.0	2.35÷2.15	0.00	2.50	+6.0 ÷ +5.4	Open canal- reinforced Concrete
		K600 ÷ K1+674	6.0÷7.5	2.15÷-1.58	0.00	2.50	+5.4 ÷ +2.5	Open canal reinforced Concrete
		K1+674 ÷ K1+821,5	10.0	-1.58÷-2.0	0.00	2.50	+2.50	pre-stressed pile
2	Chin Xieng (Cau Van)	K0 ÷ K0+138	2.0x2.0	-0.50÷-1.15	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete
		K0+138 ÷K0+978	10÷18	-1.15÷-1.96	0.00	2.50	+2.00	pre-stressed pile
	Chin Xieng sub-creek	K0+32,2 ÷ K0+165	2.0x2.0	-0.80÷-0.90	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete
3	Ong Tong + Branch 3 of Ong Tong sub-creek	K0 ÷ K0+235	2.5x2.5	-1.00÷-1.18	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete

No	Names of canal	Section	Bđ (m)	Zbottom	m	Road		Notes
		K0+235÷ K0+810,3	26÷35	-1.2÷-1.25	0	2.50	+2.00	pre-stressed pile
	Ong Tong creek (Dua creek)	K0 ÷ K0+200	2.0x2.0	-0.50÷-0.80	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete
		K0+200÷ K0+920	15÷36	-0.88÷-1.09	0	2.50	+2.00	pre-stressed pile
4	Ba Mieng	K0+160 ÷ K0+759	2.0x2.0	7.51÷2.0	rectangular shaped	2.50	+5.3÷+11.47	rectangular shaped canal - reinforced Concrete
		K0+759÷ K1+236	2x(2x2)	2.01÷1.57	rectangular shaped	2.50	+2.00÷+5.0	
		K1+236÷ K1+741,8	14÷33	-1.76÷-1.90	0	2.50	+2.00	pre-stressed pile
5	Cau Cut	K0 ÷ K0+600	3.0	-0.80÷-1.03	0	2.50	+2.00	rectangular shaped open canal- reinforced Concrete
		K0+600÷K0+940	5.0	-0.87÷-1.06	0	2.50	+2.00	
		K0+940÷K0+969	8,0	-1.06	0	2.50	Cau Cut	
		K0+969÷K1+274	17÷32	-1.06÷-2.86	0	2.50	+2.00	pre-stressed pile
6	Ong Bau creek	K0+016 ÷ K0+426	1.6x2.0	-0.65÷-0.03	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete
	Ong Bau sub-creek	K0 ÷ K0+125	1.6x1.6	-0.51÷-0.26	rectangular shaped	2.50	+2.00	rectangular shaped canal - reinforced Concrete

It is to be noted that Component 2 will likely to finance detail design and feasibility studies, the scope of which will be determined during the implementation phase. The provisions of the ESIA will apply to detail design and feasibility studies and that the Terms of ToRs for these technical documents will require that the studies take in consideration Bank safeguard policies provisions when developed.

2.4. Project area of influence

From the point of view of the environmental and social assessment of a project, it is important to define the area for that environmental and social impacts are being considered. Regarding to the OP 4.01, Area of Influence for this project will identified to include "*all its ancillary aspects, such as power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, and construction camps, as well as unplanned developments induced by the project (e.g., spontaneous settlement, logging, or shiftin g agriculture along access roads).*

On the other words, the area of influence may include, for example*, "(i) the watershed within which the project is located; (ii) any affected estuary and coastal zone; (iii) off-site areas required for resettlement or compensatory tracts; (iv) the airshed (e.g., where airborne pollution such as smoke or dust may enter or leave the area of influence); (v) migratory routes of humans, wildlife, or fish, particularly where they relate to public health, economic activities, or environmental conservation; and (vi) areas used for livelihood activities (hunting, fishing, grazing, gathering, agriculture, etc.) or religious or ceremonial purposes of a customary nature".*

The area that needs to be studied in order to adequately understand and describe the Baseline likely to be affected by the Project. At a minimum, the Study Area will encompass the Project Footprint and the Area of Influence, and in some cases it may extend farther to further establish the context for the Baseline.

With such definition and basing on the project description, the study area in this ESIA covers 32.7 km length of Tham Luong – Ben Cat – Nuoc Len, covering an area of about 14,900 ha, where 9 districts in HCMC will be affected, including Go Vap District, Binh Thanh District, District 12, Tan Binh District, Binh Tan District, Tan Phu District, District 8, Binh Chanh District and Hoc Mon Distric. In addition to those area, Da Phuoc landfill and Tham Luong Ben Cat Wastewater treatment plant are also identified within the studied area as employed as disposal area for wastewater and dregged sludge and other waste types generated from construction and operation activities of the project as disposal area for wastewater and dregged sludge and other waste types generated from construction and operation activities of the project. In addition, the area of influence also include the borrow pits for revertment and tour for material transportation.

The sub-components will be undertaken at different locations along the Tham Luong Ben Cat Nuoc Len Canal, where different sensitive receptors will be affected. In order to assess the significane of impacts on receptors, the environmental baseline at those receptors need to be identified given the baseline environment will integrate with emission factors generated from project activities that can result a top up impacts on the receptors. Section 2.3 already provides the locations of environmental survey and those locations can be considered as sensitive receptors that can be receive different impacts from different activities of the project components. Table 2.6 identify sensitive receptors in a relation to activities of project component and locations of environmental baseline survey.

Table 2.6 Sensitive receptors in a relation to activities of sub-components and locations of environmental baseline survey

No	Sub-components	Locations	Potential impacts	Receptors Sensitivities				
				Air quality	Water quality	Groundwater	Soil	Aquatic Ecology
1	Construction of Nuoc Len tidal sluice gate and 2 ship locks	At Nuoc len creek, located between Nuoc Len bridge and An Lac bridge, being of 158m from Nuoc Len bridge	Air quality, water quality, water quality, noise and vibration and aquatic ecology	K9, K10, K11	SW10, SW9, Cho Dem River	GW8, GW9	-	Se9, Se10, Cho Dem River
2	Construction of Vam Thuat tidal sluice gate and 2 ship locks	At Vam Thuat River, located between Vam Thuat bridge and Tham Luong Ben Cat Wastewater Treatment Plant, being of 178m from Vam Thuat birdge	Air quality, water quality, water quality, noise and vibration and aquatic ecology	K1, K2, K3	SW1, SW2, SW3, Sai Gon River	GW1	S8	Se1, Se2, Se3, Sai Gon River
3	Dredging and construction of canal bank revetment in the main canal of Tham Luong – Ben Cat – Nuoc Len	Undertaken on an area of 14,899 ha, covering following districts: Go Vap, Binh Thanh, District 12, Tan Binh District, Binh Tan District, Tan Phu Disitrct, District 8, Binh Chanh District, Hoc Mon District	Air quality, water quality, water quality, noise and vibration and aquatic ecology	K1, K2, K3, K4, K5, K6, K7, K8, K9, K10, K11	SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, Sai Gon River, Cho Dem River	GW1, GW2, GW3, GW4, GW5, GW6, GW7, GW8, GW9	S1, S2, S3, S4, S5, S6, S7, S8	Se1, Se2, Se3, Se4, Se5, Se6, Se7, Se8, Se9, Se10, Cho Dem River, Sai Gon River
4	Construction of	Main interceptor is constructed	Air quality, water	K1, K2,	SW1, SW2,	GW1,	S3, S4,	Se1, Se2, Se3, Se4,

	main interceptor in Go Vap district	along Tham Luong - Ben Cat - Nuoc Len Canal. The interceptor will collect wastewater generated from a catchment being of area of 1,902 ha where 16 wards of Go Vap District and Ward 13 in Binh Thanh District are covered.	quality, water quality, noise and vibration and aquatic ecology	K3, K5, K6	SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, Cho Dem River, Sai Gon River	GW2, GW3	S5, S6, S7, S8	Se5, Se6, Se7, Se8, Se9, Se10, Cho Dem River, Sai Gon River
5	Construction and improvement of primary and secondary combined sewer systems and the secondary interceptor in Go Vap district	The project will be undertaken on an area of 5 wards of District 12, 16 wards of Go Vap District, and ward 13 of Binh Thanh District	Air quality, water quality, water quality, noise and vibration and aquatic ecology	K1, K2, K3, K4, K5, K6	SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, Cho Dem River, Sai Gon River	GW1, GW2, GW3	S3, S4, S5, S6, S7, S8	Se1, Se2, Se3, Se4, Se5, Se6, Se7, Se8, Se9, Se10, Cho Dem River, Sai Gon River
6	Improvement of secondary canals (Hy Vong, Cau Cut, Ba Mieng, Ong Tong, Ong Bau, Chin Xieng)	Including six distributary canal conecting to Tham Luong Ben Cat Nuoc len Canal at Tan Binh District and Go Vap District, from Tham Luong bridge to Sai Gon River, with total length of 8,213.4	Air quality, water quality, water quality, noise and vibration and aquatic ecology	K1, K2, K3, K4, K5, K6, K7	SW1, SW2, SW3, SW4, SW5, SW6, SW7, SW8, SW9, SW10, Cho Dem River, Sai Gon River	GW1, GW2, GW3, GW4	S1, S2, S3, S4, S5, S6, S7, S8	Se1, Se2, Se3, Se4, Se5, Se6, Se7, Se8, Se9, Se10, Cho Dem River, Sai Gon River

2.5. Linked Investments

The EIAs conducted a thorough review of other, large completed, ongoing or planned investments in the project cities to identify possible linkages impacts. Details of linked project are shown in Annex 6. Following linked projects has been identified, including Da Phuoc Solid Waste Treatment Complex, Tham Luong Ben Cat Wastewater Treatment Plan.

Da Phuoc Solid Waste Treatment Complex

The Da Phuoc Solid Waste Treatment Complex near Ho Chi Minh City is Vietnam's largest solid waste processing complex. It is located in Da Phuoc Commune, Binh Chanh District, Ho Chi Minh City. Total area of the complex is 128.22 ha, including Waste Treatment Company (128 ha) treating municipal waste; Peace Company's Project managingseptic tanks sludge; Urban Environmental Company's Project investing in cemetery estate and cremated services (about 57 ha); the Green Saigon's company responsible for wastewater sludge treatment (47 ha) and a planned investment for hazardous waste treatment (1.7 ha).

Solid waste generated by project construction and operation, including domestic waste, dredging sludge, construction and hazardous waste, will be disposed at the Waste Treatment Company. Regarding to EIA approved in 2011, the Waste Treatment Company is designed to treat 3,000 tons of municipal solid waste per day. Currently, this capacity is upgraded to 10,000 tons of municipal solid waste per day; EIA for this upgrade was approved in 2015, This capacity designed allows the Complex to collect whole domestic solid waste generated from Ho Chi Minh City and to partly collect the solid waste generated from Long An Province.

For dredged sludge, a first extension of Da Phuoc Landfill capacity is planned for 2018 (capacity up to 2,600m3/day). By 2020 the Da Phuoc Landfill capacity shall be sufficient to receive stabilized and dewatered (composted) sludge (with a maximum daily capacity of 5,200) (See Table 2.7).

Table 2.7 Capacity of receiving and treating sludge

No.	**Type of waste**	**Da Phuoc Sludge Treatment Plant capacity (m^3/day)**	
		Construction phase 1 (2014 -2016)	Construction phase 2 (2017 -2020)
1	Sludge from drainage system	800	800
2	Sludge from channel dredging	800.6	1700
3	Sludge from other sources (incl sludge from WWTPs)	500	2,200
4	Excreta from livestock and poultry	50	50
5	Sludge from septic tanks	450	450
Total capacity		*2,600.6*	*5,200*

The Complex linked to the project component 2 through receiving the dredged sludge and construction and domestic solid waste generated from activities of construction and operation stage of sub-components of the project. In addition to 500 m3 per day of the Binh Hung

WWTP's sludge and dredging sludge (and excavated materials) from Tan Hao-Lo Gom Canal (WB project), the dredging sludge of XXX tons generated from the project component 2 should be acceptable with the current and planning capacity of the Waste Treatment Company.

The Waste Treatment Company design the landfill to include main facilities as follow: (i) spaced vertical wells to collect the biogas that is flared then; (ii) landfill cells equipped with HDPE layer and geomembrane and collection pipe network of leachate wastewater; (iii) the wastewater treatment plan to treat leachate wastewater and storm runoff wastewater. Operation methods of the landfill is

The operation of the Da Phuoc landfill is monitored by the Management Board of Waste Treatment Complexes (MBS) under DONRE in HCMC.Two specialists from MBS are inspecting the landfill activity daily in line with the landfill managementplan.The MBS has the mandate to carry out periodical environmental quality monitoring for surface water, groundwater and air quality every 3 months.

Tham Luong Ben Cat Wastewater Treatment Plan

Tham Luong Ben Cat Wastewater Treatment Plan is designed to collected domestic wastewater generated from a catchment of 5,141 ha of District 12, Go Vap District and Binh Thanh District. It is located at An Phu Dong Ward, District 12, Ho Chi Minh City. Wastewater from the beneficiary areas of the FRM project, especially GO vap District and Bin Thanh District, will be collected and pumped to the Tham Luong Ben Cat wastewater treatment plant for treatment. Following completion, this WWTP will have positive contribution to reduce the pollutants of Tham Luong Ben Cat Canal.

Total capacity of the WWTP is 250,000 m^3 per day, divided into two phases, in which 131,000 m^3 per day for phase 1 and upgrading to 250,000 m^3 per day for phase 2. The EIA of the phase 1 was approved by the local authority (DONRE) of Ho Chi Minh City in 2015. The phase 1 of project is now under construction and expected to complete at the end of 2016. The WWTP is designed with a technology of Sequencing Batch Reactor (SBR), which is ensured to have optimal performance by the pretreatment and tertiary treatment units. The wastewater followed treatment meets the standards of QCVN 40:2011/BTNMT, column A. The downstream of Vam Thuat River which is also identified as a section of Tham Luong Ben Cat Nuoc Len Canal is designed as a receiving stream of the WWTP.

As mentioned above, the construction duration of phase 1 of this WWTP is extended from May 2015 to December 2016. If the project component 2 is launched this year, the cumulative impacts caused from construction activities of two projects are possible. During operation, if being operated inappropriately, the wastewater treatment plant is able to contribute the negative cumulative impacts to the water quality of Tham Luong Ben Cat Nuoc Len Canal.

In summary, considerable information is available on possibly linked projects. All of the potential linkages are likely to have positive impacts, such as Tham Luong Ben Cat WWTP receiving and treating wastewater generated from a catchment of three districts before discharge to the Tham Luong Ben Cat Nuoc Len Canal. The potential cumulative impacts caused by the operation performance of those projects, can be managed with coordination of schedules at the city level, and good construction and operation management during implementation.

CHAPTER 3: EXISTING CONDITIONS OF SOCIO-ECONOMIC AND ENVIRONMENTAL BASELINE IN PROJECT AREA

3.1. Natural and socio-economic conditions of Ho Chi Minh City

3.1.1. Natural conditions

a) Location and topography

Ho Chi Minh City is located at 10°10'- 10°38'N, 106°22'- 106°54'E in the southeastern region of Vietnam. It borders Binh Duong province to the north, Tay Ninh province to the north west, Dong Nai province to the East and North East, Ba Ria – Vung Tau province to the south east, and Long An and Tien Giang provinces to the west and south west. Ho Chi Minh City is 1,760 km south of Hanoi, the capital of Vietnam and is at the crossroads of international maritime routes. The city center is 50km from the East Sea in a straight line. It is an international transport hub of the southern region and a gateway to the world with the largest port system and airport in Vietnam.

Ho Chi Minh City belongs to a transitional region between the southeastern and Mekong Delta regions. The general topography is that HCM City terrain gets lower from north to south and from east to west. There are three types of terrain.

The high terrain lies in the north-northeastern area and part of the northwestern area encompassing northern Cu Chi, northeastern Thu Duc and District 9. This is the bending terrain with average height of 10-25 meters. Long Binh Hill in District 9 is the highest at 32 meters.

The depression terrain lies in the southern-southwestern and southeastern part encompassing districts 9, 8, 7, Binh Chanh, Nha Be and Can Gio. The area’s height is in the range of 0.5 to 2 meters.

The medium-height terrain lies in the middle of the city, encompassing most old residential areas, part of districts 2 and Thu Duc, and the whole of districts 12 and Hoc Mon. The area’s height is 5-10 metres.

Ho Chi Minh City has four poles, namely:

• North Pole as Phu My Hung Commune, Cu Chi District;

• West Pole as Thai My Commune, Cu Chi District;

• Sounthern Pole as Long Hoa Commune, Can Gio District;

• East Pole as Thanh An commune, Can Gio District.

b) Hydrology

Located in the downstream Dong Nai – Saigon river system, Ho Chi Minh City has a developed network of rivers and canals. Dong Nai River originates from the plateau Langbiang (Dalat). As it has many tributaries such as La Nga River and Be River, the basin is large, approximately

45,000 km2. It has an average flow of 20-500 m3/s with the highest flow during flood of up to 10,000 m3/s. Dong Nai – Saigon river system is the main supply of fresh water for Ho Chi Minh City with an annual capacity of 15 billion m3. Saigon River originates from Hon Quan plateau, flowing over 200 km from Thu Dau Mot to the city and flows 80 km along the city area. Saigon river has many tributaries with an average flow of about 54 m3/s.

Width of Saigon River is 225-370 m and the depth is up to 20 m. Dong Nai River and Saigon River are connected through the expanded urban part by Rach Chiec canal system. Nha Be River formed by the confluence of Dong Nai and Saigon rivers, about 5km away from the city center to the southeast. It flows to the sea through two main estuaries: Soai Rap of 59km in length, 2km in width with dry riverbeds and slow flow rate; Long Tau flowing out to Ganh Rai Bay with 56km in length, 0.5km in width and deep riverbed, and being the main waterway for ships to enter Saigon harbor.

In addition to the main rivers, the city also has a complicated network of canals, such as the Saigon River system with Lang The canal, Nong Bau canal, Tra canal, Ben Cat, An Ha, Tham Luong, Cau Bong, Nhieu Loc-Thi Nghe, Ben Nghe, Lo Gom, Te canal, Tau Hu, Doi canal. The southern part of the city in the districts of Nha B and Can Gio has a dense canal coverage. This, togetherwith level 3-4 canal system of Eastern Cu Chi and An Ha, and Xang canals in Binh Chanh makes effective irrigation and favorable water exchange. The city government has also gradually implemented projects of dredging and innovation of catchment areasto create a beautiful urban water landscape. .

Groundwater in Ho Chi Minh City is mostly concentrated in the northern half - on sediment Pleixtoxen; more to the south (South Binh Chanh District 7, Nha Be, Can Gio) - on Holoxen, groundwater is often affected by acidity and salinity.

Most parts of the former urban area have significant underground water resources of which quality is not very good. However, in this area, groundwater is often exploited in three main levels: 0-20m, 60-90m and 170-200m. Districts 12, Hoc Mon and Cu Chi underground water reserves are abundant with good quality and usually operated at 60-90m level. This is an important additional water source of the city.

Hydrologically, most rivers Ho Chi Minh City are affected by semi-daily tidal oscillations of the East Sea. Each day, the water up and down twice, the tide penetrates deeply into the city's waterways accordingly, causing significant impacts on agricultural production and limit the drainage in urban areas.

The highest average tide is 1.10m. Months with the highest water level are October and November and the lowest level shall be in June & July. During the dry season, the small flow of river source with salinity of 4% may penetrate along Saigon River to Lai Thieu (Thuan An, Binh Duong province) , sometimes ever reaching far to Thu Dau Mot while Dong Nai River seep into Long Dai (District 9). The rainy season with large flow rate makes salinity pushed further away and more diluted.

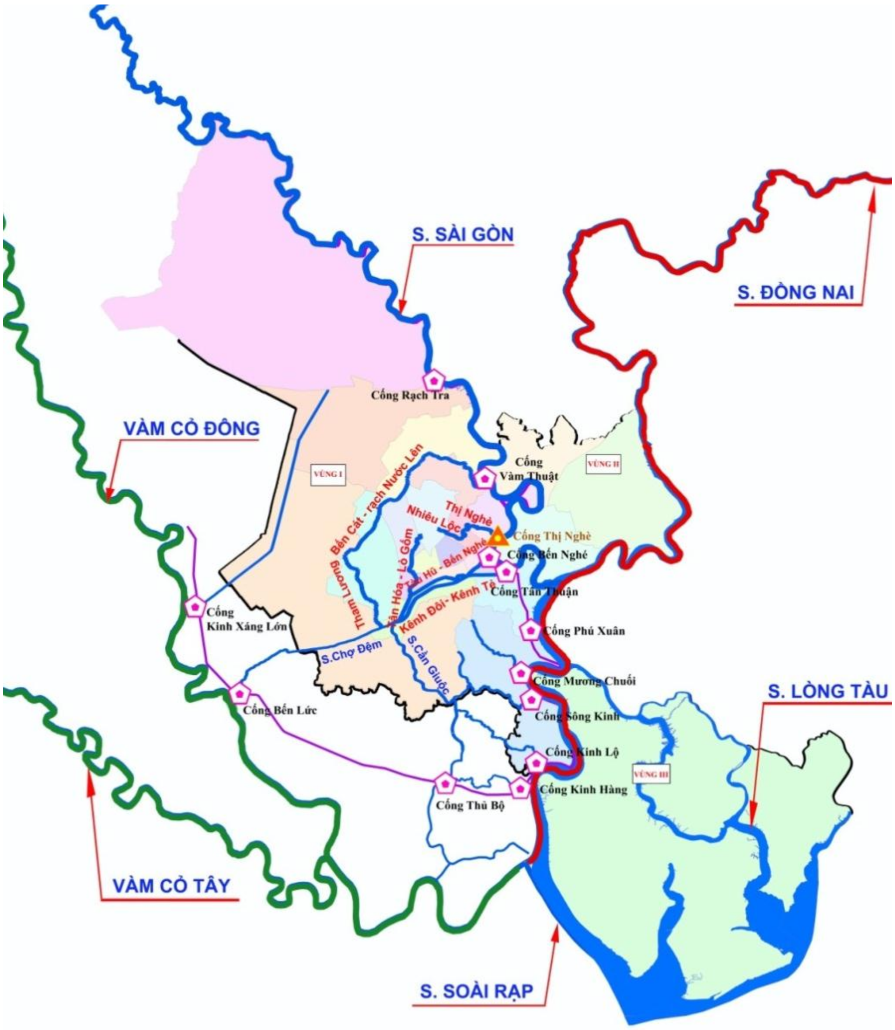


Figure 3.1 Map showing main river systems in Ho Chi Minh City.

Since the establishment of irrigation projects such as Tri An hydroelectric dam on the Dong Nai River in Vinh Cuu, Dong Nai and Dau Tieng Lake in Tay Ninh province, the natural flow regime is modified by turbineswitches turbine, weirs and close-discharge sluices. Therefore, the downstream area from Northern Nha Be upwwards become influenced by the upstream with lower salinity level. The flow rate in the dry season tends to increase, especially during the months from February to May, by 3-6 times compared to the natural one.

In the rainy season, water is retained in the reservoir to regulate, reducing possibility of flooding to low-lying areas; whereas, saltwater intrusion goes deeper again. However, in general, crop area has been expanded by increasing the cultivated crops. In addition, the development of the canal system has the effect of raising groundwater levels on the surface to 2-3m, increasing water supplies to serve production and daily life of the city.

c) Climate - Weather

Ho Chi Minh City is located in the equatorial monsoon tropical region. As in southern provinces, the general characteristics of HCMC climate-weather temperature is evenly high year around with two clear rainy and dry seasons , which impacts profoundly to the area environment. The rainy season lasts from May to November, dry season from December to April of next year. According to the observational records from several years of Tan Son Nhat station, characteristic climate of Ho Chi Minh City shown through the main meteorological factors as follows:

The amount of radiation is plentiful, averaging about 140 Kcal/cm^2/year with the average number of sunny hours/month of 160-270 hours. The average air temperature is 27^{0}C. The absolute high temperature is 40^{0}C, absolute low temperature 13,8^{0}C. The month with the highest average temperature is in April (28,8^{0}C), the lowest average temperature is between December and January (25,7^{0}c). Yearly there are more than 330 days at the average temperature of 25-28^{0}C. The conditions of temperature and light are favorable for the development of plant species and animals at high biological yield; and accelerate the decomposition of organic substances of waste, contributing to reduce urban pollution.

Rainfall: High rainfall with average rate/year 1,949 mm, years of the highest rate is 2718 mm (1908) and the smallest of 1392 mm (1958). The average number of rainy days/year is 159 days. About 90% of annual precipitation occurs in the rainy season from May to November in which June and September usually has the highest rainfall. The little rain happens in Jannuary, February and March with unconsiderable rainfall. On the scope of city space, rainfall is unevenly distributed, tends to increase gradually along Southwest - Northeast axis. The inner city and the North and Eastern North parts (District 9 and Thu Duc has the highest from 1700-1900 mm and Tan Son Nhat: 1,930 mm). The coastal area Can Gio has the smallest rainfall (less than 1.200 mm). The other areas have an average rainfall from 1500-1700 mm.

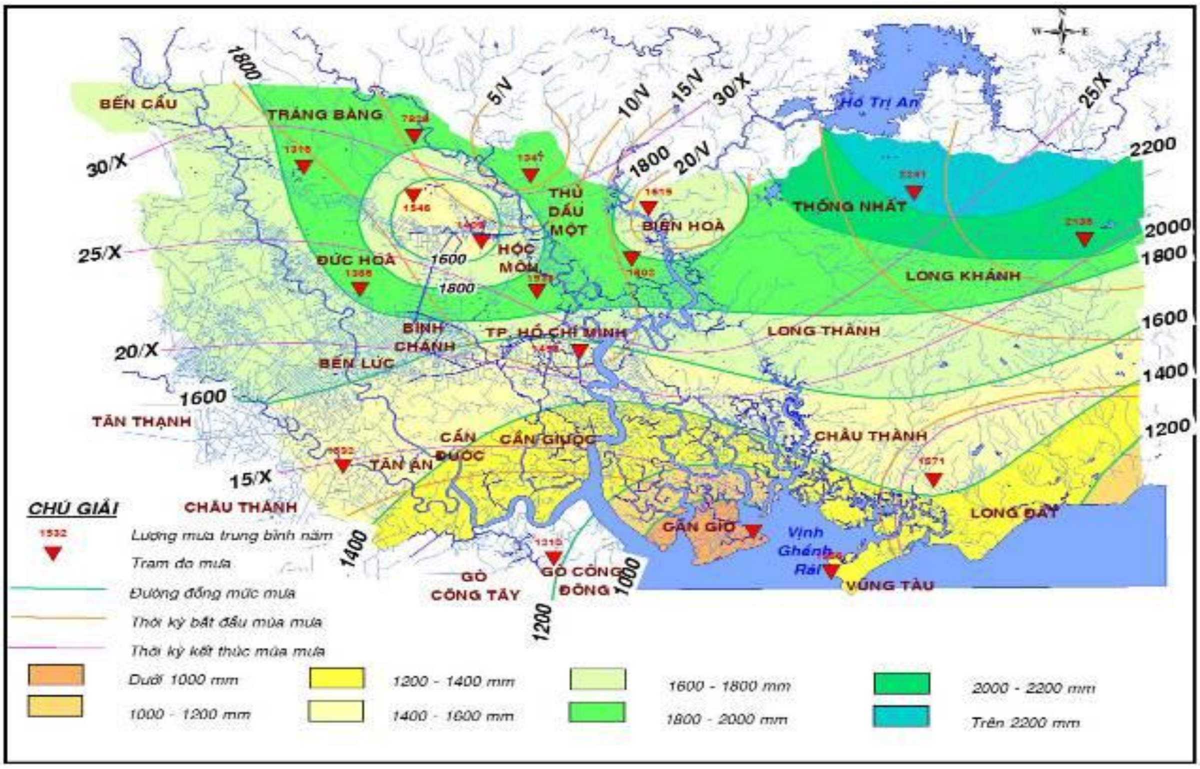


Figure 3.2 Map showing annual rainfall in the Sai Gon - Dong Nai river basin.

Due to the influence of the South-West monsoon direction - the major cause of rain in the area, the annual rainfall also fluctuate significantly. The variation of monthly rainfall is quite large as well. Due to larger and fairly steady rainfall over the years in the middle months of the rainy season, the Cv coefficient is only about 0.3 ÷ 0.6, which, in which August and September are the months with overall steady rainfall. The fluctuation is larger during the first and the last month of the rainy season, with Cv reaching 0.5 ÷ 41.0. In the dry season, as rain is negligible, just a heavy rain of 100 mm can cause huge volatility. The coefficient of skew Cs ranges from Cv to 2Cv.

Table 3.1 Average monthly rainfall in the project area and the vicinity

(Unit: mm)

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Binh Chanh	8.4	3.9	15.1	47.6	192.7	237.0	211.4	212.7	225.2	220.2	104.2	30.5	1508.8
Cu Chi	6.6	4.7	15.2	65.9	194.1	228.6	256.1	218.1	274.0	258.4	129.2	30.4	1681.2
Nha Be	6.7	3.2	12.2	46.5	197.9	291.2	276.1	259.2	256.1	209.8	104.9	37.7	1701.5
Tan Son Hoa	9.0	7.3	19.0	55.5	204.2	281.1	292.6	271.0	287.8	297.1	150.7	40.4	1915.7
Hoc Mon	16.6	3.0	18.4	42.1	145.9	208.3	224.7	188.7	243.1	218.9	105.4	31.0	1446.0
Mac Dinh Chi	8.9	5.4	15.2	43.8	216.1	253.5	287.2	265.8	277.4	248.4	124.2	36.0	1781.9
Ben Luc	3.0	1.0	6.0	58.0	137.0	234.0	212.0	236.0	271.0	241.0	98.0	14.0	1511.0
Bien Hoa	6.0	5.0	14.0	52.0	173.0	242.0	293.0	285.0	305.0	245.0	101.0	29.0	1752.0
Binh Duong	14.0	2.0	22.0	47.0	217.0	274.0	285.0	285.0	323.0	246.0	125.0	42.0	1882.0

Air humidity: Relative air humidity per year is 79.5%; with the average value in the rainy season being 80% and the absolute value up to 100%; the average value during the dry season is 74.5% and the absolute low level goes down to 20%.

Wind: Ho Chi Minh City is affected by two main wind directions – West-Southwest and North-Northeast. The West-Southwest wind blowing from the Indian Ocean in the rainy season, between June to October, with an average speed of 3.6 m/s and the strongest wind in August with an average speed of 4.5m/s. The North-northeast wind blowing from the South China Sea in the dry season, roughly from November to February with an average speed of 2.4 m/s. In addition, there are monsoon winds in the south-southeast direction between March to May with an average speed of 3.7m/s. Basically, the city is in the hurricane free zone. In 1997, fluctuations due to El-Nino phenomenon caused Typhoon No. 5, only mildly affecting Can Gio district.

d) Environment

Due to rapid population growth rate, old-fashioned infrastructure, low population awaress…, Ho Chi Minh City is currently facing the problem of environmental pollution. Like other big cities in the country, untreated wastewater discharged directly into canals and rivers becomes increasingly popular. The amount of garbage in Ho Chi Minh City is up to 6000 tons per day, among which a large portion of solid waste is not collected. Monitoring results in 2007 showed that, compared with 2006, organic pollution increased by 2 to 4 times. Transport vehicles, construction and production activities also contributes to air pollution. In the suburban areas, soil is also contaminated due to pesticides from agricultural production. According to a report from the Ho Chi Minh City Environment Protection Agency (HEPA) (2010), with a population of nearly 8 million people, thousands of offices, schools and more than 8,000 large, medium and small industrial parks, approximately 6000-6500 tons of urban solid wastes are discharged daily, among which about 4900-5200 tonnes are collected by the waste treatment companies; 700-900 tonnes are recycled, and the remaining volume are discharged into canals and the surrounding environment. The domestic solid wastes are estimated to be around 5500 tonnes per day; industrial solid wastes 500 tonnes per day and hospital waste 20 tonnes per day. It is estimated that in the upcoming years, the average amount of garbage will increase by 10% per year.

Currently, most of the solid wastes in Ho Chi Minh City are collected and transported to the landfill, including hazardous waste. The operation of all landfills is managed by a factory under CITENCO. The whole system of classification of solid wastes into scrap and recycling is privatized. Part of industrial solid wastes is collected, treated and recycled at some private companies and small enterprises. Medical wastes are collected and processed by combustion in Binh Hung Hoa. Landfill is the only technology used to process municipal solid wastes of Ho Chi Minh City. The capacity of landfills in Ho Chi Minh City is as follows:

- Phuoc Hiep landfill: 3,200 tonnes per day (50 km from the city centre, closed in 2014);
- Go Cat landfill: 1,200 tonnes per day (16.5 km from the city centre);
- Dong Thanh site: 1,000 tonnes per day (receive cesspoolsonly);
- Da Phuoc Solid Waste Treatment Complex in Binh Chanh District: 5000 tonnes per day and about to increase.

In the recent years, heavy flooding has become common in Ho Chi Minh City, especially during the rainy season from June to November, and during high tides from September to December. The causes of flooding include heavy rainfall, high tides, poor drainage systems in urban areas, inadequate coordination between the operation of reservoirs and land subsidence from groundwater pumping. Heavy precipitaion has gradually in the past few decades. The city drainage system has been getting old with inadequate capacity for drainage in heavy precipitation while drain system is still unavailable in many areas of the city. Urban Flooding due heavy rains has therefore become popular.

Tidal flow from the East Sea have hindered the flow from upstream rivers and urban drainage systems. In addition to the importance of improving the drainage capacity of sewer and canal systems in central urban areas to deal with the frequent downpours, HCMC also faced with the challenges posed by sea water intrusion into the canal system. This penetration make water level in canals increase and clog the flow from the downtown area to Saigon River, especially during high tide season.

In addition to rain and tide, flooding status of city is also affected by the discharge of water from the upstream irrigation and hydropower reservoirs. In 2000, the city was seriously flooded due to discharging flow from the Tri An reservoir (2,000 m3/s) and Dau Tieng (600 m3/s), which is on Dong Nai river.. Besides, the city is also affected by the floods from Mekong River delta through the Vam Co Dong and Vam Co Tay river system. City sewer system was only developed locally with large untreated wastewater volume discharging into rivers causing severe pollution and affecting water quality.

According to a feasibility study in 2012 for sub-basin including Tham Luong - Ben Cat – Nuoc Len conducted by HCMC, flooding has become an annual event on the catchments that affected 5944 ha (40% of the total area of sub-basin) and about 700,000 people (35% of the population living in sub-basin). The depth of flood is from 0.5m to 1.2m on average and flooding timeis about 30 minutes to 150 minutes. In addition, the Hy Vong l canal linking to Tham Luong-Ben Cat – Nuoc Len) which receives drain water from the Tan Son Nhat airport is now facing flood situation need to be resolved soon.

Indeed, industrial production along Tham Luong canal is recognized as the most serious pollution waste and one of factor cause its canal stream as a dead channel. Survey results in 2011 recored from the basin shows that wastewater volume from enterprises outside the Industrial Zone is 30,000 - 40.000m3/day, including more than 2.4 tons of suspended solids. At the Industrial Parks such as Tan Tao (Binh Tan District), Tan Binh (Tan Binh District), Vinh Loc A (Binh Chanh District), Tan Thoi Hiep (District 12), total wastewater is more than 32.000m3/day. Even ifits water treatment system is up to standards, 6.4 of suspended sediment are still being discharged into Tham Luong canal, not to mention tons of smoke and dust emitted from loads of chimney of dyeing facilities owned by private sector and tons of garbage and waste illegally dumped along the canal.

During past years, the impact of climate change and rising sea levels have flooded badly for many regions of the world in general and Ho Chi Minh City area in particular has strongly influenced on production and the people's life. The study with specific solutions to cope with climate change issues is urgently critical with the joint hands of agencies and departments and the whole society.

3.1.2. Socio-economic conditions

a) Economic development

Ho Chi Minh City always maintained an important role in Vietnam's economy. Thanks to favorable natural conditions, Ho Chi Minh City became an important traffic hub of Vietnam and Southeast Asia, including road, rail, waterways and air. Economic Social results of the City in 2011 has made remarkable achievements, the majority of society economic indicators has exceeded the proposed plans. Gross domestic product (GDP) on the city territory in 2011 is estimated at VND 512,721 billion, accounting 20.91% GDP of the whole country and 21.42% increase compared to 2010.

The economy of the city is in diverse sectors, from mining, fisheries, agriculture, processing industry, construction to tourism, finance. In the economic structure of the city, State-owned sector accounts for 33.3%, Nonstate-owned accounting for 44.6% , the rest is foreign investment sectors. Regarding economic sectors, services account for the highest proportion: 51.1%. The rest of industry and construction accounted for 47.7%, agriculture, forestry and fisheries accounted for only 1.2%.

In 2011, the value of industrial production and construction reached VND 228,332 billion, accounting for 44.5% GDP of the whole city and increased 19.39% compared to 2010. The value of agricultural, forestry and fisheries is VND 6,308 billion accounting for 1.20% the city GDP and increased 23.73% compared to 2010. The value of tourism and services reached VND 278,408 billion, representing 54.3% GDP of the whole city and increased 25.44% year on year 2010.

In 2011, total investment of the city is estimated at VND 201,500 billion, increased by 18.5% year over year; exceed 0.9% of the annual plan and by 39.3% of GDP. Total investment in capital construction in the province is estimated at VND 164,042.6 billion, compared with previous year increased by 18.42%.

b) Population

Nowadays Ho Chi Minh City comprises of 19 inner districts and 5 subsurban districts with a total area of approximately 2,095.01 km2. Since 1975, the population of Ho Chi Minh City increased rapidly, especially it cannot control the number of residents who illegally immigrated to the city and built up houses indiscriminately. According to the statistics of the General Statistics Office of Vietnam, as of 2012, the city's total population is nearly 7,750,900 headcount, population density reaches 3,699 persons/ km^2, in which population lives in cities reached nearly 6,433,200 people, the population living in rural areas reached 1,317,700 million people. Number of Male is 3,585,000 million people while females reach 3,936,100 million people. The rate of natural increase of population allocated by province has increased by 7.4‰. In recent decades, Ho Chi Minh City always has the lowest sex ratio of Vietnam; the flow of migrants from other provinces into Ho Chi Minh City with number of women is always more than men.

Table 3.2 Population Development of Ho Chi Minh City

Year	Population	Rate
1995	4.640.400	—
1996	4.747.900	+2,3%
1997	4.852.300	+2,2%
1998	4.957.300	+2,2%
1999	5.073.100	+2,3%
2000	5.274.900	+4.0%
2001	5.454.000	+3.4%
2002	5.619.400	+3.0%
2003	5.809.100	+3.4%
2004	6.007.600	+3.4%
2005	6.230.900	+3.7%
2006	6.483.100	+4.0%
2007	6.725.300	+3.7%
2008	6.946.100	+3.3%
2009	7.196.100	+3.6%
2010	7.378.000	+2.5%
2011	7.517.900	+1.9%
2012	7.663.800	+1.9%
2013	7.818.200	—

The population distribution in Ho Chi Minh City is uneven. While some inner districts such as 4, 5,10 and 11 have a density of over 40,000 people/km², the suburban district of Can Gio relatively low density of 98 people/km² (by Vietnam GSO in 2009). Regarding the growth rate of population, while the natural growth rate of approximately 1.07%, the mechanical growth rate amounted to 2.5%. Immigration status in the city continues to grow in recent years. Since 1999 up to now, the population of 8 districts within the city is decreasing while the population of surburban districts and newly-setup districts grew rapidly. The mechanical increase of the city's population is going strongly and difficult to control as indicated in Binh Chanh: population increasing per year was ever up to 30,000 people, equivalent to the population of one commune. According to facts estimated in 2005, about 1 million of non-regular visitors arrived at Ho Chi Minh per day on average. By 2010, this figure is estimated to be 2 million (by Ho Chi Minh City

Institute of Economics). Problems of urbanization and migration to cities is posing significant challenges need to be addressed in the process of sustainable development of the city, of which the most visible is the pressure from the population to public services and urban infrastructure.

3.2. Socio-economic conditions of the project area

3.2.1. Population and labor

The project area covers approximately 14,900 hectares (7% of the city area) with a population of about 1,108,260 people (2007 statistics). Residential component mainly workers, employees, retailers live in personal house or collective housing which were built scatteredly across the region. In the wet season the flooded area is about 3,714 hectares and 232,700 people live in the flooded areas (data from the feasibility study report).

Table 3.3 Administrative units and population in the Project area (2007)

No.	District	Number of wards	Area (ha)	Population (persons)	Density (person/ha)	Note
1	District 12	10	3083.4	181.127	59	**Only area and population within the Project area**
2	Go Vap	11	1915.7	313.798	161	
3	Binh Thanh	01	14.2	19.624	138	
4	Tan Binh	01	525.1	37.244	71	
5	Tan Phu	07	1706.5	218.843	128	
6	Binh Tan	10	1445.6	199.316	131	
7	Binh Chanh	03	4589.1	29.670	7	
8	Hoc Mon	05	1526.1	99.574	65	
9	District 8	01	93.3	9.054	97	
	Total: 9 districts	**49**	**14.899**	**1.108.250**	**74**	

The main income of households are mainly from salaries, accounting for 46.82%. Their cccupations are mostly workers of factories and plants, part of them are state employees and officials. However, this income source is not stable, depending on the season of plants and factories' production...The highest percentage of households with incomes from salary is District 12, accounting for 57.14%, followed by Tan Binh District, accounting for 47.11% and Go Vap District, accounting for 42.56%.

In addition, some households earn incomes from business operation, mainly from small businesses like restaurants, groceries in the markets and schools and most of them leasing space in other areas for business operation; income from this source accounting for 15.78%, concentrates most in Go Vap District, accounting for 17.44% because residents located mostly in canalside directly affected by the pollution, the percentage of households with income from livestock , agriculture or gardening is very small .

The proportion of households with income from gardening is very low, accounting for 1.78% (almost in District 12). Most tree and plants here give the low yield. In recent years, some plants have died partly due to polluted water sources, partly because of harmful emissions emitted from factories around the region.

The rate of the main income sources of local households is listed in Table 3.4.

Table 3.4 Main income source of local population

Income source	Tan Binh district	Go Vap district	District 12	Average
	Percentage (%)	Percentage (%)	Percentage (%)	Percentage (%)
Salary	47,11	42,56	57,14	46,82
Gardening	0,00	0,51	7,79	1,78
Breeding farm	0,00	1,54	5,19	1,78
Business	13,22	17,44	15,58	15,78
Cultivation	0,00	0,51	1,30	0,51
Others	39,67	37,44	12,99	33,33

Source: Data gathered from previous EIAs of the project.

Statistics on the number of poor and nearly poor households in nine districts within the project area are summarized in the table below:

Table 3.5 Number of poor and nearly poor households in the project area

No	Location	Total poverty households (Average income less than VND 12 mil./capita/year)	(%)	Total nearly-poverty households (Average income VND 12 -16 mil./capita/year)	(%)
1	District 12	236	0.22	4060	3,71
2	Go Vap District	809	0.60	2345	1,75
3	Bình Thạnh District	0	0	4135	3,68
4	Tan Binh District	0	0	1386	1,34

No	Location	Total poverty households (Average income less than VND 12 mil./capita/year)	(%)	Total nearly-poverty households (Average income VND 12 -16 mil./capita/year)	(%)
5	Tan Phu District	0	0	1145	1,11
6	Binh Tan District	0	0	4331	2,73
7	Binh Chanh District	579	0,51	10,317	9,14
8	Hoc Mon District	1115	1,27	4,361	4,96
9	District 8	930	0,95	3098	3,16

Source: Data provided by the Project Management Unit.

3.2.2. Agricultural activities

In recent years, the Tham Luong - Ben Cat – Nuoc Len canal system has been severely polluted, agricultural production is thus restricted. The livestock industry, agriculture or gardening are not developed. The crops grown in this basin do not produce high yields. A number of trees and crops are dead due to contaminated water sources and toxic gases emitted from factories around the region.

The surveys show that the proportion of households with incomes from agriculture is very low, accounting for only 0.51% in Go Vap District and 1.30% in District 12, although previously a large part of this area was agricultural land. In the recent years, the rapid urbanization rate has led to changes in land use purposes; agricultural land has been converted into residential area as well as area for companies, plants, and enterprises.

3.2.3. Industrial activities

The industry in the region thrives with many different industries. The project area has hundreds of establishments, industrial factories, livestock farms, including: food processing, dye-textile, chemical, plastic and rubber processing, in which one-third located scatteredly in residential areas and more than 60 establishments located along the two banks of the canal. These include:

- Tan Binh Industrial Zone: 179 ha with 27 industrial factories;

- VinhLoc Industrial Zone (BinhChanh District): 202 ha;

- BinhHoa Industrial Zone (BinhThanh District): 18 ha;

- Tan Tao Industrial Zone (BinhChanh District): 443 ha.

3.2.4. Transport and infrastructure

The transport system is quite convenient with inter-province Route 50 and Can Giuoc River. Internal roads have not been much invested and upgraded, the project area has many trails and waterfront, making difficult transportation.

- Transport by air: Tan Son Nhat International Airport is deep-seated within the city, the larger operation (estimated at about 5 million passengers from the current increased to 12 million passengers/year) requires large-scale solution for more traffic outside linking to the city center and the districts (roads and parking terminals).
- Road transportation: road area is about 7% of on the general area with 2.48 m^2/ capital. Presently intersections are in the inner area and surburban areas. In the project area there are 16 main routes distributed as follows:
- Hoc Mon district : 5 routes , $\sum L = 24{,}800$ m
- District 12: 4 routes, $\sum L = 16{,}800$ m.
- Go Vap District: 3 routes, $\sum L = 15{,}000$ m.
- Tan Binh District: 3 routes, $\sum L = 10{,}200$ m.
- Binh Chanh District: 8 tuyến, $\sum L = 42{,}000$ m.

On the main roads there are big bridges such as: An Loc, Ben Phan, Truong Dai, Cho Cau, Tham Luong, Binh Thuan, Ba Hom, Lac An, An Lap. For the project area: the main roads and bridges crossing Tham Luong - Ben Cat – Nuoc Len is listed as follows:

Table 3.6 Main road and bridges crossing over Tham Luong – Ben Cat

No.	Road Name	L (m)	Road type	Bridge Route
1	National route 1	24,250	Asphalted road.	Binh Thuan, An Lap
2	National route 22	7,750	-ditto-	
3	Provincal route 14	8,250	-ditto-	
4	Provincal route 16	1,550	-ditto-	Truong Dai
5	Quang Trung street	9,650	-ditto-	Cho Cau
6	Nguyen Oanh street	6,175	-ditto-	An Loc
7	Truong Chinh street	4,250	-ditto-	Tham Luong
8	Road No 13	3,375	-ditto-	Sewer pipeline 2ϕ100, 3ϕ100
9	Tan Ky – Tan Quy street	2,650	-ditto-	Tan Ky – Tan Quy
10	Provincal route 10	4,375	-ditto-	Ba Hom
11	District route 5	11,250	-ditto-	
12	District route 9	4,000	Aggregate road-	
13	District route 11	5,750	ditto-	
14	District route 2	3,750	-ditto-	
15	District route 4	3,750	-ditto-	
16	District route 10	2,250	-ditto-	

In which:

- An Loc, Ben Phan, An Lạc bridges was upgraded and expanded;
- Truong Dai, Cho Cau, Binh Thuan, An Lap Bridges are in progress of construction;
- Tham Luong, Tan Ky Tan Quy, Ba Hom bridges are in planning of upgrade and expansion.

Besides, there are some rural bridges (or culverts) crossing over canal route of on inter-communes paths (temporary concrete bridge or wooden bridge):

- Route 19/5: 3 wooden bridges (K3+60) (1/5+60) (2/4) (8/2) v sewer 4ϕ80 (K3+60);
- Rach Chua route: 2 concrete bridges (K6+760) (K10+970); 1 steel bridge (K2+700), 1 wooden bridge (K5+320); Sewer 3ϕ100 (K8);

Waterway: city waterways system is relatively well developed, with a total length of over 700 kilometers of canals, including nearly 50% of the total length of water navigation. The Project canal route is one of the planned inner belt waterway in connection the city with the neighborhood, namely:

- In the Southern: there are Te channel, Đoi channel, Nha Be River - Soai Rap and Long Tau leading to East Sea;
- In the Eastern: Saigon River links with Dong Nai River;
- In the The Western: Can Giuoc, Ben Luc, An Ha rivers connecting to Vam Co Dong.

Seaway system: inflows mainly from TP. Ho Chi Minh City - Vung Tau through Long Tau - Soai Rap river.

Canal Hub of Tham Luong - Ben Cat – Nuoc Len is the main waterway in the project area.

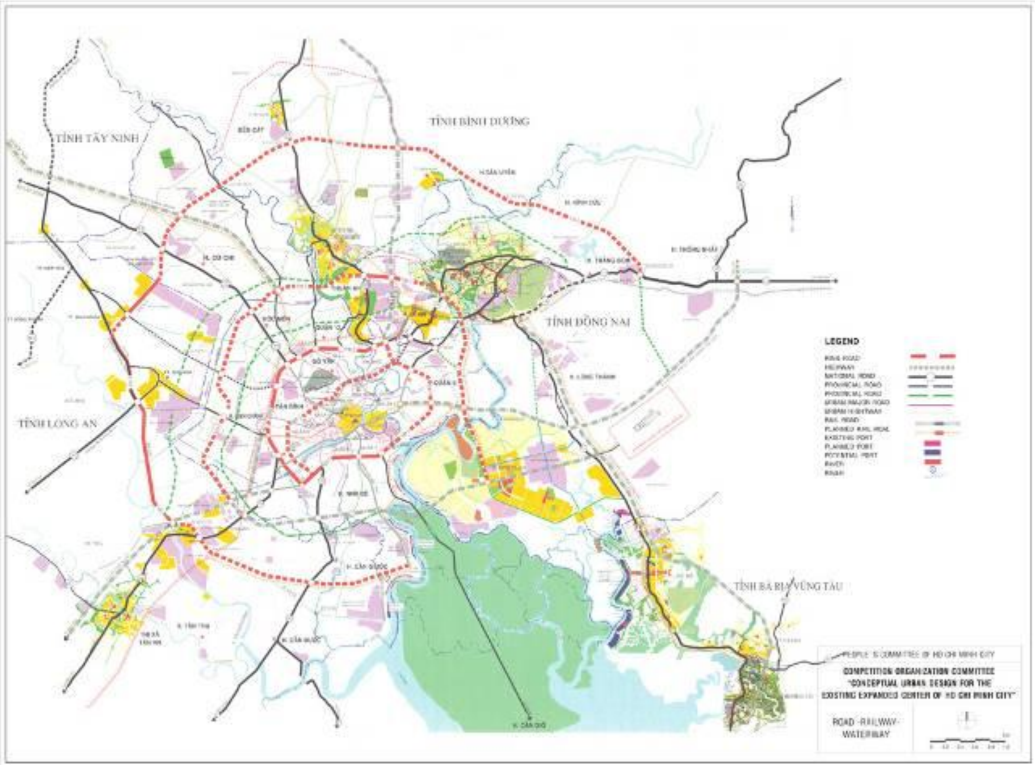


Figure 3.3 Map of traffic planning in the area up to 2025.

3.2.5. Scope of Land Acquisition

A drainage and pollution improvement project for canal Tham Luong – Ben Cat - Nuoc Len was approved by HCMC in May 2002, and the design subsequently amended in February 2007 and July 2012. The project covers 8 districts of HCMC, of which 7 districts were subjected to land acquisition and resettlement impacts, including Binh Tan, Binh Chanh, Tan Phu, Tan Binh, District 12, Go Vap and Binh Thanh. The total land area affected by the project was calculated as 153.46 ha, with a total number of 3,212 Households being affected (see details below). As these activities are linked, a due diligence of the resettlement conducted under City-funded activities has been prepared to ensure its consistency with the WB OP4.12 that all affected people are able to restore or improve the lost assets and livelihood as before the project.

- The Project requires permanent acquisition of 1,534,600,000 m^2 belonging to 3,212 households [2]and enterprises. By land use, these comprise 309,527m^2 of residential land; 238,822m^2 of specially used land, and 986,251 m^2 of agricultural land;
- 1342 households have to relocate, of which 946 households registered to receive resettlement houses while 391 households opted to self-relocation[3];

[2] In fact, there is an increase in the number of PAHs as three households in Binh Tan District are separated from HoBac Company and 13 households under the name of the Waterway Construction Company.

[3] Data is based on the report by the PMU until October 22 2015 and collected from the DCARBs; however, these figures are not complete as some districts were unable to provide these data.

- 1,870 households are partially affected; of which, 498 households are affected on a part of their houses and have sufficient remaining area to reorganize (including production establishment/business households);
- 46 enterprises are also affected by the Project.

By district, the scope of impacts of the Phase 1 are as follows:

1. **District No. 8:** The Tham Luong-Ben Cat-Nuoc Len Canal in the District 8 starts from the K_{0+000} ÷ K_{0+694} (694m from Cho Dem River); site clearance was already done in this area by PhuDinh River port project.

2. **Binh Tan District:** The canal section in Binh Tan starts from the K_{0+694} ÷ K_{17+115} (1,224m from Cho Dem River to Cau Bung Sluice Gate); this section is 16,421m long, traversing eight wards, namely An Lac, Binh Tri Dong B, Tan Tao A, Tan Tao, Binh Tri Dong A, Binh Hung Hoa B, Binh Hung Hoa A, and Binh Hung Hoa.

   The total number of households and enterprises affected by the Project in this district is 2,267. In which total, 983 households are fully affected, 498 households are partially affected; 761 households are affected on agricultural land; and 25 enterprises are fully affected.

3. **Tan Phu District:** has 5 affected enterprises.

4. **Tan Binh District:** The canal section in Tan Binh starts from the K_{18+692} ÷ K_{19+692} (1,000 m from Tham Luong Bridge). With the length of 1,000m, the canal section runs through Ward 15, affecting 38 households. The total cost is 51.467 billion dong. Area acquired is 1.91 ha.

5. **District No. 12:** The length of the canal section in the District 12, starting from K_{17+115} ÷ K_{24+163} (from CauSa ditchto Truong Dai Bridge) is 7,048m. The canal section passes through Tan ThoiNhat, Dong Hung Thuan, and Tan ThoiHiep wards. The total number of affected households is 167 (including 5 enterprises). The total cost is 198.936 billion dong for an acquired area of 19.1 ha.

6. **Go Vap District:** The canal section in the area of Go Vap, from K_{19+692} to K_{31+583} (from the boundary with Binh Tan Districtto Lang canal), is 11,891m long, traversing Ward No. 5, No. 6, No. 13, No. 14, and No. 15. The total number of affected households is 670. The total compensation cost is 421.874 billion dong with the total acquired area of 27.34 ha.

7. **BinhThanh District:** The canal section in BinhThanh District starts from K_{31+583} to K_{32+714} (1,131m from SaiGon River), a right bank L=1.131m, passing through the area of Ward No. 13. There are 3 PAHs in the district area.

8. **BinhChanh District:**A total 65 affected households in two communes, namely Tan Kien and VinhLoc B.

The scopes of project's impacts are summarized in the following Table 3.7.

Table 2.7 Scope of Project Impacts (Phase 1)

No.	District	Permanently acquired area (ha)	No. of HHs affected by land acquisition			No. of PAHs affected on houses					Total compensation cost up to date (bil. dong)
			Total	Individual households	Enterprises	Fully affected	Partially affected	Self-relocated HHs	No. of HHs registered for resettlement houses	HHs were allocate with resettlement houses/ plots	
1	Binh Tan D	83.62	2,267	2,242	25	983	498	359	624	530	901.09
2	BinhChanh	9.2	65	63	2	4		4		0	48.62
3	Tan Phu	9.56	5	0	5	0				0	91.57
4	Tan Binh	1.91	35	28	7	2		1	1	0	51.65
5	No. 12	19.1	167	162	5	55		27	28	28	198.94
6	Go Vap	27.34	670	669	1	298			298	200	421.87
7	BinhThanh	2.73	3	2	1	0				200	3.19
	Total	**153.46**	**3,212**	**3,166**	**46**	**1,342**		**391**	**951**	**758**	**1,716.93**

Source: Compiled from the Report on Implementation Progress of the Drainage System and Water Environment Improvement of ThamLuong- Ben Cat- Nuoc Len Canal Project (Phase 1) up to October 22 2015.

Land Acquisition Progress

So far, three districts have completed the land acquisition activities for the Project, including BinhChanh, Tan Phu, and BinhThanh. The remaining four districts have not finished land acquisition, namely Binh Tan, Tan Binh, District 12, and Go Vap. Details are as follows:

- Total number of PAHs: 3,212 households;
- In which total, number of PAHs who have already handed over site to the Project: 2,937 households;
- Number of PAHs who have not handed over site: 268 households. Of which, 44 households have already received compensation. The compensation for 212 households were deposited in the bank while the remaining 12 households are not yet provided with compensation.

Table 3.8 Land Acquisition Progress Up to Date

No.	District	Total PAHs (HHs)	No. of PAHs already handed over site (HHs)	No. of PAHs not yet handed over site (HHs)
1	Binh Tan	2,267	2,011	256
2	Binh Chanh	65	65	**0**
3	Binh Thanh	3	3	0
4	District 12	167	158	9
5	Go Vap	670	669	1
6	Tan Binh	38	36	2
7	Tan Phu	5	5	0
	TOTAL	3,215	2,937	268

Source: Report on Implementation Progress of the Drainage System and Water Environment Improvement of Tham Luong- Ben Cat- Nuoc Len Canal Project (Phase 1) up to November 20 2015.

Accumulated Impacts

In Binh Tan District, 19 households who are affected by the Phase 1 of the Project will continue to be affected in the Phase 2. Of which, five households will be fully affected. This will cause difficulties for the PAHs to restore their living standards; therefore, special policies are needed to apply for these households. Some of the outstanding issues include:

Low compensation rates

To date, there are 268 outstanding complaints from 268 PAHs. In which total, 256 households are in Binh Tan District, mainly in Binh Hung Hoa Ward (234 households), nine households in

District 12, two households are in Tan Binh, and one household in Go Vap District. Of the total 268 households, 42 households have already received compensation but not yet handed over sites. 12 households have not been issued with compensation payment decisions yet while the remaining 214 households refuse to receive compensation (their payment decisions are already issued). Their compensation has been deposited into a bank by the DCARBs. The main reason for a large number of PAHs refusing to hand over site is low compensation rates. Even combined with the support packages, these rates still cannot meet the market prices.

PAHs whose houses are allocated by the enterprise

There is only one outstanding case in Go Vap. However, in fact, this involves 13 households who are the employees of the Waterway Construction Company. These households were officially allocated land by the company in 2007. To date, they households still refuse to receive compensation and hand over site. According to them, they have resided on this area before; however, the land allocation documents indicate the year 2007. After DMS was carried out, according to the Directive 08/2002 by the City PC, these households are not considered as eligible households for compensation.

There is no regulation to support the affected tenants

Among 234 PAHs in Binh Hung Hoa who were surveyed by the Ward PC, 60 households are renting houses. Hence, most of these affected people do not have any other places to live as the majority of them are from other provinces earning a living in Ho Chi Minh City. Therefore, as the compensation and assistance policies of the Project do not have any provision related to the compensation and assistance for the tenants, these households will face more difficulties.

Affected enterprises and production establishments

10 enterprises have not carried out site clearance due to overlapping in planning of the Tan Tao Industrial Park and the land acquisition boundary of the Project.

For the registered enterprises, allowances for affected employees have been applied. However, for the small-scale enterprise and production establishments in form of households that hired workers, these allowances were not applied as they did not have official papers to prove the hiring. In addition, the establishments had to relocate themselves at that time because it coincided with the time when the City's decision on the removal of establishments producing pollutant out of the city area was issued.

Directive No. 08/2002as a cut-off date to structures

The City's Directive 08 was issued on April 22 2002, which is considered as an important milestone in deciding the eligibility of the APs for compensation for their affected structures. However, this directive, in fact, was not disclosed to the local communities in the project area.

The resettlement sites are not appropriate

The RS of the Project does not meet a principle stipulated in the Decree No. 22/1998, which is the principle of equivalent value.

The area of apartments in the RS is not suitable to the diversity of the households and the fact that the apartment buildings with corrugated iron roofs are not suitable to the weather. Moreover, the RS is too far with little opportunity for economic development. Therefore, the PAHs do not want to receive houses in the RS.

Policy application in accordance with regulations but not a good practice

The application of the Decree No. 22/1998/ND-CP for compensation of the Project is in compliance with the regulations stipulated in the Decree No. 197/2004/ND-CP (Item 2, Article 50)[4]. However, this is also the main reason for the outstanding complaints and delays of the Project, which is costly because the project is not completed and causes adverse social impacts.

Project delays and re-encroachment

The delay of the Project for 13 years and unfinished land acquisition have given chances for the households to reoccupy the area. To date, in the Ward No. 5 of Go Vap District, more than 50 households are reoccupying the cleared area to open coffee shops and eateries, which will cause difficulties for the civil works of the Project in the second phase.

3.2.6. Influences of Tham Luong - Ben Cat – Nuoc Len on local population

In the context of speedy urbanization and rapid economic development, in parallel with economic development and improving material and spiritual life of local residents, environmental pollution is a dilemma. The improvement of economic life while creating a clean environment and urban landscape is very essential for the surrounding residential area of Tham Luong - Ben Cat – Nuoc len in particular and the people of the city in general.

a) Improvement from existing works

In the initial period, improvement of the Tham Luong – Ben Cat – Nuoc Len was funded by the municipal authorities and a number of works have been implemented in the three districts: Go Vap, District 12 and Binh Tan. Although many of the works remain at a modest scale, the respondents highly appreciate their value in mitigating the negative impacts of the local flood conditions. In particular, in Go Vap, the completed works includeconstruction of earth embankments, 2-metre earth coverage of dyke embankments, and site clearance in preparation for the upcoming worksin Wards 5, 6, 15, 14, 17 and 13. In addition, a number of drainage works have been implemented with local funds, including the maintenance of drainage works

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[4]**Article 50. Implementation Effect**

2. This Decree replaces the Government's Decree No. 22ll998lND-CP of April 24, 1998 on damage compensation when the State recovers land for defence and security purposes, national interests, public interests. All previous regulations on compensation, support and resettlement when the State recovers land, which are contrary to this Decree, are hereby annulled.

For projects, project items that have completed the compensation, support and resettlement work; that have approved the compensation, support and resettlement plans or are making payments for compensation, support and resettlement according to the plans approved before the effective date of this Decree, the approved plans shall be implemented without application of, or adjustment according to, the provisions of this Decree.

(dredging, and maintenance of the drainage system with the annual municipal budget), and construction of a drainage system along the main roads of Pham Huy Thông, Nguyen Văn Nghi, and Tran Quoc Tuan. The city-funded work has improved the flood conditions considerably.

In particular, Neighbourhood 1, Ward 13, Go Vap is located along the Tham Luong canal. The flooding situation has been improved considerablly after the initial stage of the city's work, together with people-funded road upgrading. However, new alphalted roads have substantial height differences, some being heightened by 0.5 meter and others by 1 metre, due to local residents' varied affordability.

In Thanh Xuan Ward, District 12, flooding used to be very common as a consequence of high tides but respondents report that the situation has been improved considerably since the construction of the Bo Hu Canal. Some minor rain floods happen in certain small areas, but the rainwater is fully discharged to the canal, usually around half an hour after a rain. In neighbourhood 1, residential units 2 and 5 remain often flooded as affected by the water flow from the Cán Dua drainpipe. Househoolds with difficult living conditions reside alongside the canal in temporary shelters with leaf or roofing, which have been built on dyke borderlines. Respondents report that tidal floods in this area have been tackled (World Bank 2014).

b) Remaining constraints

However, according to the Qualitative Assessment Report of Poverty and Social Impacts of Flooding in Selected Neighborhoods of HCMC conducted by the World Bank (2014), there remain some issues to be addressed, as follows:

- Despite road heightening, flooding as a result of combined effects of rainwater and high tides still happens in some parts of the study sites as a result of the unsatisfactory draining system; degraded road quality due to large traffic circulation; and drainpipes blocked with rubbish, resulting in slow discharge of rain and wastewater;
- Improper use of the sluice gates by local people for their own advantages is reported;
- Maintenance of sluice gates is unsatisfactory. Some sluice gates in Ward 13, Go Vap, have broken down, thus the water cannot push them through;
- The existing earth embankment causes inconvenient transport for local residents;
- The local people throw rubbish and plastic bags on the earth embankment, seriously polluting the local environment; and
- Risks for children are a concern.

The survey assessing the influence level of the canal system Tham Luong - Ben Cat – Nuoc len to the life of local households shows that the percentage of households answering pollution of canal system directly affecting their living activities accounted for 75.38%. Among this, the highest rate is in Go Vap District, accounting for 97.08%; 96.77% is for District 12 (most of the surveyed households are living along the channel or 50m away the channel). The proportion of households who think that contamination of the canal system does not affect their daily life activities is 24.62%, mostly those belonging to Tan Binh district (75%). This is because these households are 300m away from the canal and therefore do not notice the impact from water pollution.

Table 3.9 Percentage of households directly affected by the canal system

Status	Tan Binh district		Go Vap district		District 12		Average	
	Number of household	(%)	Number of household	(%)	Number of household	(%)	Number of household	(%)
Affected	25	25.00	166	97.08	60	96.77	251	75.38
Non-affected	75	75.00	5	2.92	2	3.23	82	24.62

The factor affecting people's daily life the most are insects such as flies, mosquitoes, accounting for 39.46%, the highest rate of which is 92.31% from Tan Binh district. The second most important reason affecting health of the local population is the unpleasant stench emitting from the waste ordecomposition of waste in the canal accounting for 38.56%, the highest rate of which from District 12 accounts for 46.51% and Go Vap District being 38.50%. Also, there are some other offensive symtoms such as headache and rhinitis occupying 12.97%. Diseases such as malaria, dengue fever and cholera in the region are not in high portion. In addition to the above-mentioned effects, the canal water during the rainy season overflowing into the project area causes other diseases such as scabies and itchy feet. The results of influences from canal pollution are shown in the following table:

Table 3.10 Influence of canal pollution on household activities

Description	Tan Binh district		Go Vap district		District 12		Average	
	Number of Household	(%)	Number of Household	(%)	Number of Household	(%)	Number of Household	(%)
Affect to living activities	0	0.00	18	4.50	3	2.33	21	3.78
Causing unpleasant stench	0	0.00	154	38.5	60	46.51	214	38.56
Causing malaria, dengue,	0	0.00	22	5.50	3	2.33	25	4.50
Causing cholera	0	0.00	4	1.00	0	0.00	4	0.72
Flies and mosquitoes	24	92.31	136	34.0	59	45.74	219	39.39
Others	2	7.69	66	16.5	4	3.10	72	12.97

Results of the survey assessing the influence of canal pollution on production activities and business operation shows that 91.59% of the surveyed households are not affected. This is because most of them live in the area of being unable to do the business or trading due to unfavorable traffic system, less densely populated and heavily polluted environment. The remaining 8.41% of households is affected especially in the rainy season but not frequent as the majority of them are doing small business at home. In particular, the highest level of impact is in Go Vap district, around 14.62%. Survey results of influence from the canal system are shown in the following table:

Table 3.11 Percentage of households having production and business activities affected

Status	Tan Binh district		Go Vap district		District 12		Average	
	Number of Household	(%)	Number of Household	(%)	Number of Household	(%)	Number of Household	(%)
Affected	1	1.00	25	14.62	2	3.23	28	8.41
Non-affected	99	99.00	146	85.38	60	96.77	305	91.59

Among the affected households, it is said that contamination to the food business accounted for 57.14%. Some small food production businesses had to stop its activities due to the quality of products, which account for 10.71%. Some other influences include sparsely populated area and unfavorable local for business trading account for 32.14%.

In the rainy season, households suffering from flooding caused by overflowing from the canal account for 70.87%, mainly in Go Vap and District 12 (69.35% and 61.99% respectively). Especially Tan Binh district, 87.00% of households are flooded during the rainy season. Although the surveyed households live in a distance from the canal but still incur flooding from rainwater due to clogged culvert leading no drainage to the channel or large water volume during in-spate season backflow from canals and culverts into residential areas. According the local households, previously there was no submerged condition, but since the canal started to receive large amounts of industrial wastewater, and domestic discharge, especially solid waste, this has impeded drainage, causing flooding of low-lying areas. Only 29.13% of the households are not flooded in the rainy season because they live far away from the canal system or are protected by river embankments. Although their houses are not flooded, the surrounding area has been affected.

The proportion of households regularly flooded during the rainy season accounts for 58.37%. Some residents in Go Vap district must move by boat in the flood season. The highest proportion of households regularly incur flooding is in Tan Binh District, accounting for 68.97%; 57.28% from Go Vap District and the lowest being 39.53% from District 12. The percentage of households occasionally suffering from water overflowing into the house occupies 41.63%, mostly concentrating in District 12 with 60.47% and the lowest being 31.03% in Tan Binh District.

Table 3.12 Summary of impacts of flooding on poor, nearly-poor households, immigrants and vulnerable groups

Indicator	Description
Health	- Water-borne and respiratory diseases - High medical costs
Livelihood	Reduced wages, and reduced or lost revenues from renting services.

Indicator	Description
Housing and sanitation	- Property damage - Insects, such as flies, mosquitoes and cockroaches
Access to social services	Hard travel in flooded areas to reach schools and clinics, occasional power cuts in some areas during a flooding period, and poor quality of water, especially from drilled wells
Local Business	- Delay of production and delivery of products - Loss of business revenues - Unsatisfactory environmental and hygiene conditions - Reduced incomes reduced or lost jobs due to flooding impacts
Women and children	- Women suffer more than men, especially in terms of sanitation and health conditions. - More vulnerability to infectious diseases for children - Safety concern during flood

Source: World Bank 2014.

3.2.7. Health care and education

a. Health care

Immunization programs for infants and children are fully implemented in the project area.

In Go Vap District, there are six health clinics operating at full capacity, two of which have been upgraded as dermatology and child care clinics. However, the ones for tuberculosis and mental health have badly deteriorated and needs to be renovated. Facilities and equipments at the district health center currently meet the demand for medical treatment. However, many ward-level health centers ward lacks basic equipment compared to national standards such as equipments for ophthalmology and orthodontic examination.

In District 12, there is no district-level health center and 9 over 10 wards have health clinics. There are many drawbacks in the development of health facilities: two over nine health clinics sharing with local clinics has deteriorated, one over nine clinics does not meet construction standard construction. The private sector has 26 clinics, 28 pharmacies, 15 dental clinics and 8 drugstores. Most health clinics are equipped with medical facilities and can perform mini-operations. Currently, the local health sector has been equipped with two dental machines, one of which is damaged; one X-ray machine and one ECG machine.

Table 3.13 Number of people suffered from infectious diseases and serious diseases

Diseases (in persons)	Year 2002	Year 2003	Year 2004	Year 2005
Cholera	28	0	1	0
Dangue fever	2,783	7,537	7,714	7,650

Diseases (in persons)	Year 2002	Year 2003	Year 2004	Year 2005
Whooping cough	85	98	38	10
Measles	449	158	10	9
HIV	13,067	17,782	22,445	27,560
AIDS	4,814	5,933	8,408	9,940

Source: Statistical Yearbook of Ho Chi Minh City 2005 – 2010.

b. Education

Education quality is quite good in the project area. Each district has enough schools at three levels and kindergarten with experienced teachers. The number of children attending school is quite high with significant increase in some years and insignificant increase in the others.

Table 3.14 The number of classes, pupils and teachers in the 2009-2010 academic year of Go Vap District

	Quantity
Kindergarten	
Public	731
Semi-public	200
Private	82
Preschool	
Public	5,399
Semi-public	755
Private	3,117
Teacher	
Vocational	278
College	108
University	61
High school	274
Classroom	
Public	168
Semi-public	39

Private	86
Primary	29,767
Secondary	20,375
High school	7.395

Source: Statistical Yearbook of Ho Chi Minh City 2010.

In Go Vap District, there is a full variety of education, from preschool to primary school, junior high, high school, vocational education and higher education. There is one university and one technical college which is an advantage compared to other districts. Many schools are fully equipped with teaching equipments such as laboratories, audio-visual rooms and computer rooms. However, only about a quarter of schools are equipped. Many schools do not have separate labs for each subject. The provision of reference books for teachers is minimal and library services are limited.

Table 3.15 Number of schools, pupils and teachers in the 2010-2011 academic year in the project area

District	***Preschool***			***School***		
	Student	**Teacher**	**School**	**Student**	**Teacher**	**School**
District 12	8,314	339	17	*36,590*	*1,211*	*28*
Go Vap	12,225	567	34	*6,129*	*1,869*	*40*
Tan Binh	9,470	444	32	*68,741*	*2,754*	*53*
Binh Thanh	10,731	529	34	*56,200*	*1,975*	*48*
Binh Tan	5,174	212	11	*23,317*	*834*	*19*
Binh Chanh	5,946	222	19	*33,579*	*1,307*	*45*
Hoc Mon	6,912	312	21	*42,567*	*1,684*	*41*

Source: Statistical Yearbook of Ho Chi Minh City 2010.

3.2.8. Historic sites in the project area

Ho Chi Minh City is a young city but with many resources for cultural and tourism development. Those are ancient architectural sites such as Nha Rong, Quoc To temple, Xa Tay Palace (headquarters of the City People's Committee), Opera House, City Post Office, a system of ancient pagodas (Giac Lam, Ba Thien Hau, Giac Vien), and a system of ancient churches (Notre Dame, Huyen Sy, Thong Tay Hoi, Thu Duc). As the cultural center of the country, the city currently has 22 art units and 9 theaters, accounting for 15.5% and 18.6% of the country's art units and theaters respectively. The City Department of Culture and Information has developed the master plan until 2020 towards modern urban development rich in national identity.

The census conducted by Ho Chi Minh City Department of Culture and Information showed that there are approximately 1,000 historic sites and landmarks in the city. Among these, there are 239 war-related historic sites, 493 architectural monuments (over 100 years), 9 historic headstones, 34 ancient traditional houses, 102 ancient gravestone, 8 landscapes. The result of the census is the basis for the Ministry of Culture and Information to recognize further 144 landscapes and monuments of the city. The following temples; Tan Tuc (Binh Chanh), Phan Cong Hon, Tan Thoi Tu (Hoc Mon) and Linh Tay (Thu Duc) have just been recognized as city-level historic and architectural cultural landmarks. Ho Chi Minh City has a total number of 260 temples, 57 of which are located in Binh Chanh District and the rest scattered in other districts. In addition to religious purposes, some temples were used as secret shelters for the communist soldiers during wartime such as Binh Dong Temple in District 8 and Phong Phu Temple in District 9.

In addition, there are some city-level historic sites as follows;

- Binh Chanh District: Lang Le – Bau Co, Binh Truong Temple;
- Binh Thanh District: ancient traditional house of Vuong Hong Sen;
- Tan Binh District: Giac Lam Pagoda, Phu Tho Hoa bomb warehouse, Phan Chau Trinh grave;
- Hoc Mon District: Tan Thoi Nhi Temple, Hoc Mon District Temple, Nga Ba Giong;
- Go Vap District: An Nhon Temple, Thong Tay Hoi Temple, Sac Tu Truong Tho Pagoda

Overall, there are many historic sites in the project area. Each citizen must be aware of protecting and promoting these historic sites.

3.2.9. Past and on-going education and communication programs to raise community awareness of environmental protection

- Mass media

Communication measures: cooperating with radios, televisions and news to effectively raise community awareness of environmental protection, communicating about the meaning of the Project and project beneficiaries to build credibility with local communities and encouraging their contribution to environmental protection by not throwing wastes into the catchment area during construction and post-construction phases.

- Social activities

Education measures: this is an important measure. Educating local communities about awareness against environmental pollution and reducing wastes during construction phases. Wastes need to be collected and treated to prevent environmental pollution.

- Social organizations, unions and schools

Enhancing communication and encouragement of local communities to participate in environmental protection. Organizing workshops to increase awareness of environmental protection. Social unions and schools should take advantage of this communication form.

Organizing non-official meetings and group discussions in various forms.

Organizing forums, workshops and meetings with civic and social organizations to present and announces social and environmental issues related to the project.

Organizing conferences about the project to publicly announce project benefits to encourage community participation.

At present, in some districts such as Binh Tan and District 12, the Youth Union is organizing the event "Green Sunday" to encourage youth members to participate in collecting wastes in the catchment area and planting trees to protect local environment. This activity should be promoted and popularized in other districts to encourage environmental protection in these areas.

- Public areas

Local governments have not developed any feasible measure to encourage community participation in canal protection in public areas. This is because the budget of district for environmental protection activities is inadequate. However, in the future, districts will make efforts to develop the most effective measures for environmental protection.

- Households

At present, Binh Tan and District 12 has directed the Youth Union to help local communities have better understanding of the responsibility for environmental protection of the catchment area. Whenever there are policies about environmental protection in the area, the Youth Union will print flyerer with readable and easy-to-understand content to distribute to every household. This activity helps people to update and apply policies in the fastest way.

3.3. Existing Environmental Quality

3.3.1. Environmental Quality Sampling Plan and Analytical Parameters

EXP. was in collaboration with the Environmental Technology and Management Center (ETM) to conducted surveys, samplings, and sample analyses on 12 and 13 October 2015. The method for evaluating environmental quality is as follows:

- Air quality is assessed by micro-climate (temperature, humidity, wind direction, wind speed); noise; suspended dust particles; exhaust gases (NO_2, SO_2, CO, NH_3, H_2S and VOC);. Air samples are taken from the project area, at the site where the construction activities of the project will be taken place (11 samples)
- Water quality is assessed by the following criteria: pH, Total hardness, Turbidity, Color, DO, total suspended solids, TDS, COD, BOD_5, NH_4^+, Cl^-, F^-, N-NO_2^-, SO_4^{2-}, P-PO_4^{3-}, heavy metals (Arsenic, Cadmium, Lead, Chromium, Copper, Zinc, Manganese, Iron, Mercury) Oil and grease and E.Coli; 10 samples of surface samples were analyzed included: including 02 samples at the two ends of the main canal, 06 samples at conjunction of the 06 secondary canals with the main canal; 01 samples in tcentral section of the main canal at the An Lac bridge near Tan Tao IZ WWTP; 01 samples near outlet of the WWTPs of Tan Binh. Samples

are taken during high tide and low tide. The quality of soil was assessed with the following criteria: pH, Arsenic, Cadmium, Copper, Lead, Zinc and Mercury. There are total 08 soil samples; taken at the bank of Tham Luong-Ben Cat canal. These soils were the dredged from first phase of the rehabilitation of the main canal and used for making the soil embankment along the canal.

- Groundwater quality is assessed by the following criteria: pH, Turbidity, Cl^-, TDS, TS, COD, BOD_5, NH_4^+, N-NO_2^-, N-NO_3^-, P-PO_4^{3-}, heavy metals (Arsenic, Cadmium, Lead, Mercury, Chromium, Iron) Oil and grease, E.Coli and Coliform. Ground water were taken at 9 points along the main canal including:Thai Son football ground's well - Chin Xieng canal area; household's well - Cau Cut canal area; Nam Bang company's well - Truong Dai bridge area; well at wood shop - Hy Vong canal; store near Tham Luong bridge; household's well - Binh Thuan bridge; household's well - Ba Hom bridge; household's well - from An Lac bridge to An Lap bridge; household's well - from Nuoc Len bridge to Cho Dem river.
- Sediment analysis is assessed by the following criteria: Organochlorine Pesticides, PAHs, DDT, Hg, As, Fe, Cd, Pb, Cr. Sediment were taken at 12 points along the main canal including: 02 points at the two ends Vam Thuat and Nuoc Len; 06 points at the conjunctions of the main canal with 06 secondary canal; 02 points near outlets of the WWTPs of Tan Binh and Tan Tao IZ; 02 points are taken at the ongoing construction packages of the project canal improvement (first phase, financed by Gov budget). For each points, the sediments are taken at 02 layers, at the depth of 0.1 m (surface sludge) and 0.5 m (depth layer).
- Bethos and Aquatic Plancktons.

Sampling locations and analytical results on environmental quality are shown in the Annex 1 and Annex 2.

In addition, details descriptions on sampling locations for air and water anlayses are provided in Annex 2, respectively. Locations for sludge/soil sampling in the project study area are coincident with locations for surface water and wastewater sampling.

3.3.2. Results of Air Quality

Surveying and sampling were conducted on 12 and 13 October 2015. The air sampling locations were selected according to the following criteria: (1) located within the project area, (2) located on the roads to be used for transport of building materials during construction of the project items or situated in environmentally sensitive locations.

The air quality in Tham Luong Ben Cat Nuoc Len Canal basin is significantly affected by:

- Foul odour from Tham Luong Ben Cat Nuoc Len Canal due to the presence of NH3, H2S, VOC;
- Pollutants generated from wastewater and from surrounding industries;
- Air emissions from vehicles and traffic congestion; and
- Air emissions from routine cooking activities, and other services.

The detailed results are presented in Annex 2 and summarized as follows:

- NO_2, SO_2, and CO concentrations do not exceed threshold limit values based on ambient air quality (TCVN 5937, 5938.2005) at the 11 monitoring locations at the different time periods;
- The concentration of suspended particulates do not exceeded the air quality standard most of the time, excepting three out of 11 monitoring location are just over the standards including K4, K6 and K8;
- NH_3 and H_2S concentrations are lower than the allowable standard in all monitoring locations.

Noise: Noise level at the proposed locations of the project is from 65.1 to 81.0 dBA. Seven of them are exceed the allowable standards value of 70dBA (QCVN 26: 2010/BTNMT). Thoes can be due to being measured at busy traffic period.

3.3.3. Water Quality

The assessment of water quality in the project areas was based on analyses conducted by EXP. And ETM Center on 12 and 13 October 2015. Given the Tham Luong Ben Cat Nuoc Len Canal has been considered as inland waterway, the water quality has examined based on the level B2 of QCVN 08:2015/BTNMT. The water sampling was undertaken at 11 locations to where the construction activities can potentially affect. The detailed results are presented in Annex 2 and summarized as follows:

- The Canal is highly contaminated with E. Coli and Coliform at high tide and low tide;
- Two end points of the Canal is slightly contaminated, where DO, NH_4^+, NO_2^- do exceed the allowable standards of level B of QCVN 08:2015/BTNMT at high tide and low tide;
- In the middle of the Canal, it is more polluted, where DO, NH_4^+, NO_2^-, COD, BOD_5, PO_4^{3-}, oil and grease exceed the allowable standards of level B2 of QCVN 08:2015/BTNMT at high tide and low tide; and
- The Canal's water does not contains heavy metals for both of tidal regimes.

Table 3.16 Examination of water quality of Tham Luong Ben Cat Nuoc Len Canal

Codes	Location	Examination of water quality	
		High Tide	Low Tide
SW1-HT and SW1 - LT	At 200 meter from Sai Gon river towards the Vam Thuat canal	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO and NH_4^+, NO_2^-, Coliform and E.coli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO and NH_4^+, NO_2^-, Coliform and E.coli.
SW2-HT and SW2	At the junction of Chin Xieng canal with Tham Luong –	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT),	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT),

Codes	**Location**	**Examination of water quality**	
		High Tide	**Low Tide**
- LT	Ben Cat – Nuoc Len canal	excepting DO and NH_4^+, NO_2^-, Coliform and E.coli.	excepting DO, TSS, NH_4^+,Coliform and E.coli.
SW3-HT and SW3 - LT	At the junction of Ong Bau canal with Tham Luong – Ben Cat – Nuoc Len canal	The water quality indicates this location is slightly polluted, where COD, BOD_5, DO, NH_4^+, PO_4^{3-}, oil and grease, coliform and E.coli exceed the allowable standards of level B2 (QCVN 08:2015).	The water quality indicates this location is slightly polluted, where COD, BOD_5, DO, NH_4^+, NO_2^-, PO_4^{3-}, oil and grease, coliform and E.coli exceed the allowable standards of level B2 (QCVN 08:2015).
SW4-HT and SW4 - LT	At the junction between Ong Tong canal and Tham Luong – Ben Cat – Nuoc Len canal	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO and NH_4^+, NO_2^-, Coliform and Ecoli.	The water quality indicates this location is slightly polluted, where COD, BOD_5, DO, NH_4^+, PO_4^{3-}, coliform and E.coli exceed the allowable standards of level B2 (QCVN 08:2015).
SW5-HT and SW5 - LT	At the junction between Ba Mien canal and Tham Luong – Ben Cat – Nuoc Len canal	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, NH_4^+, PO_4^{3-}, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, TSS, COD, NH_4^+, PO_4^{3-}, Coliform and Ecoli.
SW6-HT and SW6 - LT	At the junction between Cau Cut canal and Tham Luong – Ben Cat – Nuoc Len canal	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, TSS, COD, BOD_5, NH_4^+, PO_4^{3-}, oil and grease, Coliform and Ecoli.
SW7-HT and SW7 - LT	At the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len canal	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, oil and grease, Coliform and Ecoli.
SW8-HT and SW8 - LT	At the Tham Luong bridge where a discharge point of Tan Binh Industrial Park is located.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, Coliform and Ecoli.

Codes	Location	Examination of water quality	
		High Tide	Low Tide
SW9-HT and SW9 - LT	At the An Lac bridge (Tan Tao Industrial Park)	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, COD, BOD_5, NH_4^+, PO_4^{3-}, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, NH_4^+, NO_2^-, Coliform and Ecoli.
SW10-HT and SW10 - LT	At 200 meter from Cho Dem river toward the Nuoc Len bridge	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, NH_4^+, Coliform and Ecoli.	Most of parameters exceed the allowable standards of level B2 (QCVN 08:2015/BTNMT), excepting DO, NH_4^+, NO_2^-, Coliform and Ecoli.

3.3.4. Result of Groundwater Quality

Ground water quality survey for the Canal was done by Exp. and ETM Center. All drilled wells surveyed are depth layer drilled wells, above 20m. Many wells have high concentration of NH_4 (GW1, GW2, GW3, GW4, GW8 and GW9) and low pH (GW1, GW2, GW3, GW4, GW7, GW8 and GW9). Other parameters of groundwater do not exceed the allowable value of QCVN 09:2008/ BTNMT. It means that the water in all the surveyed wells has been just slightly polluted.

3.3.5. Result of Soil quality

Surveying and sampling were conducted on 12 and 13 October 2015. The soil sampling locations were selected at positions covered by sludge of 4 packages in phase 1. Soil were taken at 8 points including:

- From Tham Luong bridge to Cho Cau bridge, at the Tham Luong canal that distance from the Hy Vong cannal 500m (Soil was covered from 2013);
- From Tham Luong bridge to Cho Cau bridge, the Hy Vong cannal;
- From Cho Cau bridge to Truong Dai bridge, at Cho Cau bridge area;
- From Cho Cau bridge to Truong Dai bridge, at Truong Dai bridge area (Soil was covered from 2012-2013);
- From Truong Dai to An Loc bridge, at Cau Cut canal area (Soil was covered from 2013);
- From Truong Dai to An Loc bridge. at Ba Mien canal area (Soil was covered from 09/2015);
- From An Loc bridge to Sai Gon river, at Ong Tong canal area (Soil was covered from 2012 to2013);
- From An Loc bridge to Sai Gon river, at Ong Bau canal area (Soil was covered from 08/2015).

All most parameters of soil do not exceed the allowable value of QCVN 03:2008/ BTNMT for residental and commercial land. Cu concentration of S7 - from An Loc bridge to Sai Gon river, at Ong Tong canal area (Soil was covered from 2012-2013) exceed the allowable value of QCVN 09:2008/ BTNMT for residental land.

3.3.6. Sludge quality/Sediment

Surveying and sampling were conducted on 12 and 13 October 2015. Sediment samples were taken at 12 points (see Annex 2). For each points, the sediments are taken at 02 layers, at the depth of 0.1 m (surface sludge) and 0.5 m (depth layer).

All parameters of sediment samples do not exceed the allowable value of QCVN 43:2012/ BTNMT – National technical regulation on sediment quality.

3.3.7. Aquatic and Plankton

Surveying and sampling were conducted on 12 and 13 October 2015. The Aquatic and Plankton sampling were taken at 10 points for two tide (high tide and low tide) including 02 samples at the two ends of the main canal, 06 samples at conjunction of the 06 secondary canals with the main canal; 01 samples in central section of the main canal at the An Lac bridge near Tan Tao IZ WWTP; 01 samples near outlet of the WWTPs of Tan Binh.

- **Phytoplankton**

Species composition

According to the results of the study on community structure, a total 31 species belonged to 4 class including Cyanophyceae, Chlorophyceae, Euglenophyceae và Bacillariophyceae were distinguished. Among them, species of Bacillariophyceae (Pennales), Chlorophyceae and Euglenophyceae had the highest species number fluctuating from 7 to 9 species. All of phytoplankton species in the project area were originated from fresh water.

Most species of Cyanophyceae, Chlorophyceae and Euglenophyceae indicated for the rich nutrient water and organic pollution.

Lowest number of species (5 species) are recorded in SW3-LT, whereas SW2-HT and SW9-HT are recognized position with the highest number of species (17-18 species). Most of the other samples had 8-12 species.

Phytoplankton abundance and Indices

Quantity of phytoplankton in the project area highly fluctuated from 3,380,000 to 25,250,000 organisms/m^3. Phytoplankton abundance at SW10-HT is the highest value and lowest value at SW1-LT.

The results show that most species of Cyanophyceae, Chlorophyceae and Euglenophycea are pollution indicator species for mesosaprobic level to polysaprobic level such as *Oscillatoria* sp.1, *Oscillatoria* sp.2, *Nitzschia sigma, Nitzschia vitrea, Actinastrum hantzschii, Ankistrodesmus gracilis, Ankistrodesmus spiralis, Pediastrum duplex, Pediastrum tetras, Scenedesmus* *accuminatus, Scenedesmus quadricauda, Euglena acus, Euglena oxyuris, Lepocinclis fusiformis, Phacus pleuronectes.*

Biodiversity index H': biodiversity index H' of phytoplankton had a value from 0.94 to 2.42. Among them, most of the monitoring positions have the average H' value from 1 to 2, indicating for low biodiversity.

Dominant index D: dominant index D of phytoplankton had a value from 0.24 to 0.75. There's over 65% samples with D index value approximately 0.5 or higher. This suggests the stability is not high in phytoplankton community. Additionally, most dominant species in these samples are pollution indicator species, except in SW1, SW2 and SW4.

- **Zooplankton**

Species composition

Based on the analysis, 15 species and 1 larva of zooplankton were recorded in the project area. The number of Cladocera species prevails in species composition but not dominant high (5 Cladocera species/total 16 species).

All of zooplankton species in the project area were originated from fresh water. There were low species in each sample ranging from 1 species to 7 species. Lowest number of species (1-2 species) are recorded in SW5 and SW8, whereas SW10 are recognized position with the highest number of species (5-7 species).

Zooplankton abundance and Indices

Quantity of zooplankton in the project area highly fluctuated from 300 organisms/m^3 (at SW5-HT) to 4,300 organisms/m^3 (at SW7-HT). The dominant species were *Paramoecium putrinum, Philodina roseola, Scaridium longicaudum, Pristina longiseta, Moina dubia, Thermocyclops hyalinus*.

Biodiversity index H': biodiversity index H' of zooplankton had a value from 0 to 1.68. H' of SW10-HT is the highest zooplankton biodiversity index, whereas H' of SW3-HT, SW5, SW8 are recorded as the lowest zooplankton biodiversity indices (H' from 0 to 0.67).

Dominant index D: dominant index D of zooplankton had a value from 0.29 to 1. The highest D value, the highest instability in aquatic organisms. Thus, the results show that the highest stability of zooplankton recorded at SW2-LT, SW3-LT and SW9; the lowest stability of zooplankton recorded at SW5-HT, SW8-HT with maximun D value.

- **Benthic macroinvertebrates**

Species composition

The results show that only 3 species of Oligochaeta *Limnodrilus hoffmeisteri, Branchiura sowerbyi* and *Aulodrilus pluriseta* were recorded in the project area. These species indicated for the rich nutrient water and organic pollution from mesosaprobic level to polysarprobic level.

Benthic macroinvertebrates abundance and Indices

Quantity of benthic macroinvertebrates in the project area is very low and ranges from 0 to 660 organisms/m^2 (at SW1). The number of samples that not detected benthic macroinvertebrates is over 55% of the total samples. Besides, the survey in field also recorded almost all sediments at monitoring positions of the project area have smell and black sand or sludge background.

SW1, SW2, SW4, SW5 and SW10 recorded only Oligochaeta benthic macroinvertebrates indicated pollution environment. This shows that it is also need to alarm about pollution state at these positions.

Biodiversity index H': biodiversity index H' of benthic macroinvertebrates had a very low value from 0 to 0.66.

Dominant index D: dominant index D of benthic macroinvertebrates had a value from 0.63 to 1 severely indicated the instability of benthic macroinvertebrates .

3.3.8. Fishes

A sample of fish were collected in October 2015 at Saigon river areas from Tham Luong sluice, Ben Cat and Nuoc Len canals. They were collected directly from fishing gears: simple trap net, long trap net, cast net, electronic fishing, etc. In addition, fishes were bought directly at fishing locations in Saigon River. This work was conducted at the time that fishermen began collecting fish species (including night), in order to avoid the confusion of fishes which had caught from other areas that were outside the scope of our study areas.

Sampling locations:

- The first area (KV 1) begins at An Phu Đong ferry to Tu Quy bridge;
- The second area (KV 2): An Phu Đong to Tham Luong bridge;
- The third area (KV 3): Nuoc Len bridge to Song Chua bridge.

By analysis of the samples are collected from the surveys, there are 6 species belonging to 6 families, 6 genera, and 3 orders at Tham Luong sluice - Ben Cat - Nuoc Len canal. Among orders, Perciformes is most abundant with 4 species; Siluriformes and Synbranchiformes with 1 species each orders (Table 3.19).

Table 3.17 The fish species composition at Tham Luong sluice - Ben Cat - Nuoc Len canal

N_o	Scientific name	Vietnamese name	Sampling locations		
			KV 1	**KV 2**	**KV3**
I	**Siluriformes**	**Catfish**			
	Clariidae	**Airbreathing catfishes**			
	Clarias gariepinus (Burchell, 1822)	North African catfish	+		+
II	**Synbranchiformes**	**Spiny eels**			

N$_o$	**Scientific name**	**Vietnamese name**	**Sampling locations**		
			KV 1	**KV 2**	**KV3**
	Synbranchidae	**Swamp-eels**			
	Monopterus albus (Zuiew, 1793)	Asian swamp eel			+
III	**Perciformes**	**Perch-likes**			
1	**Anabantidae**	**Climbing gouramies**			
	Anabas testudineus (Bloch, 1792)	Climbing perch			
2	**Helostomatidae**	**Kissing gourami**			
	Helostoma temminkii Cuvier, 182 9	Kissing gourami			
3	**Osphronemidae**	**Gouramies**			
	Trichopodus trichopterus (Pallas, 1770)	Three spot gourami			
4	**Channidae**	**Snakeheads**			
	Channa striata (Bloch, 1793)	Striped snakehead			
Total			**5**	**0**	**2**

There are 5 fish species, such as *Clarias gariepinus*, *Anabas testudineus*, *Helostoma temminkii*, *Trichopodus trichopterus*, *Channa striata* at the near An Phu Đong ferry areas, form Mieu Noi to the junction of Saigon river. Often found in areas with dense vegetation (as water hyacinth) and closing to the riverside. These fish have very small size. They are sold to farmers who feed them in the ponds near Saigon river or made cattle food.

Average fishing production of long trap net about 2-5kg/per day. *Anabas testudineus* making up of 32% of the total species number, *Clarias gariepinus*: 20%, *Trichopodus trichopterus*: 5%, the remaining fish species make up rather low rate. Large size species are released into the river for religion purpose, they make up 43% of the total species number.

Results record that these fish species have high fishing production in the rainy season, their production can estimate 10-30 kg/per day for long trap net and electronic scoop net.

Clarias gariepinus and *Monopterus albus* are main species that are caught by cast net and long trap net with the number of the number of individuals are very few at the Nuoc Len bridge areas. They concentrate mainly in close to shore but almost totally absent in the river bed.

The remaining areas (from An Lac bridge to Tham Luong-Nuoc Len bridges) aren't almost recorded and collected fish sampling. Consultative results of fishermen who are living along the riverside, show that fish species can't afford to live in these areas, as well as the fishemen can't catch any fish in here.

CHAPTER 4: ANALYSIS OF PROJECT ALTERNATIVES

4.1. Analyses Of Needs Of The Project

Ho Chi Minh City (HCMC) is the economic centre of Vietnam and accounts for a large proportion of Vietnam economy. Thanks to its favourable natural conditions HCMC became an important traffic hub for Vietnam and Southeast Asia, including road, railway, waterway and airway. However, due to rapid population growth, inadequate and poorly functional infrastructure, low public awareness. HCMC is challenged with significant flood and environmental pollution.

HCMC, in recent years, has been significantly flooded, especially during rainy season from June to November and during flood-tide between September and December. Flooding in HCMC is caused by high intensity of rainfall, flood-tide, poor effectiveness of wastewater drainage system in rural area, inefficient operation of reservoirs and land subsidence due to groundwater withdraw. Heavy rainfall events have been increased in recent centuries. Wastewater and storm water drainage systems of HCMC have been downgraded and overloaded during heavy rainfall events while those systems have still not been constructed in many places in HCMC. As a result, flooding due to high rainfall intensity has been frequent. High tides in the East Sea obstruct water flow of upstream river and the urban drainage to the sea causing flash floods. On top of these, HCMC is also challenged with inflow of the East Sea to canal system. This inflow causes an increase of water level in canals and obstructs its flow from the City centre to Sai Gon River, especially during high tides.

In addition to frequent high intensity rainfall and high tides, flooding in HCMC is caused by draining water from hydropower and irrigation reservoirs located in the upstream. HCMC, in 2000, was severely flooded due to draining water of Tri An reservoir (2.000 m^3/s) and Dau Tieng reservoir (600 m^3/s). Furthermore, HCMC is affected by flooding in Mekong River through Vam Co Dong and Vam Co Tay rivers.

Regarding the feasible study 2012 conducted by HCMC Government, flooding in HCMC is a frequent event affecting an area of 5,944 ha (40% of total area of the catchment) and a population of 700,000 inhabitants (35% of total people living in the catchment).

In addition to the flooding, the causes of which include direct discharge of untreated wastewater to canals, creeks and rivers. Industrial operation along canals and discharge of community activities has been considered as major source of pollutants that cause severe damage of them.

Ho Chi Minh City has five large Canals, including Nhieu Loc Thi Nghe Canal, Tau Hu Ben Nghe Canal, Doi Te Canal, Tan Hoa Lo Gom Canal and Tham Luong Ben Cat Canal. Excepting Tham Luong Ben Cat Nuoc Len Canal, the other have been supported by international organisations to construct and operate facilities relating to drainage, flood control and pollutants removal, such as World Bank for Nhieu Loc Thi Nghe Canal and Tan Hoa Lo Gom Canal, JICA for Tau Hu Ben Nghe Canal and Doi Te Canal.

In fact, the upgrading of Tham Luong Ben Cat Nuoc Len Canal and its associated facilities and infrastructures requires many of construction works that requires the HCM City Government to call for budget for this investment and potentially affect to environment and socioeconomics along the Canal and at area within the catchment area of the Canal. For social impact, the upgrading of main Canal will require land acquisition where affected people will need to relocate to resettlement sites. Consequently, their livelihood and culture and social relations will be affected accordingly. For environment, the construction and operation works will cause negative impacts to local residents and environmental receptors (ambient air, surface water, soil and groundwater, terrestrial and aquatic ecology).

However, if compared to negative impacts of upgrading the canal and its associated facilities, the negative impacts of floodwater and pollution from no upgrading those is much more substantial, relating to human health, livelihood, transportation, infrastructure and water sanitation. An upgrading the Canal and its associated facilities and infrastructures are highly important that will bring many of benefits on significant improvement of environment performance and drainage capacity, from where HCMC residents, entrepreneurs and functional departments are ensured to be beneficial including:

For HCMC residents:

- Being able to live in improved environmental and living condition, whereby they can improve their health, security and safety;
- Reducing poverty and having more opportunities to develop their own business (i.e. tourism activities, restaurants, shop) to increase their income;

For entrepreneurs

Domestic and international manufacturing enterprises and companies located in the drainage catchment will be no longer challenged with vicious cycle of flooding and environmental pollution, whereby, their business can be developed stably and their economic growth target can be achieved, positively contributing to the economic growth of HCMC and stabilising the income of their labour.

Government department

Being provided professional training relating to operation of modern system, programs and facilities of flood risk management.

4.2. With Project Alternatives

4.2.1. Sub-component 2.1: Construction of Nuoc Len combined tidal sluice gate and 02 ship locks

Nuoc Len tidal sluice gate and ship locks are proposed to be located in Nuoc Len Creek to enhance the capacity of draining rainwater, prevent inundation due to rain and tidal flood and sea level rise for now and for the future and ensure water navigation in case sluice closed and establishing bus routes in the Canal. This sub-component is proposed two options of locations and two technical designs whose impacts analyses on environment, socioeconomic, engineering and economic are shown in Table 4.1.

Table 4.1 Alternatives on locations of Nuoc Len combined sluice gate and ship locks

Alternatives	Options 1	Option 2
Description	The combined sluice gate and ship locks is located 400 m distant from Cho Dem river side, near the Phu Dinh Port	The combined sluice gate and ship locks are located 1,740m distant from Cho Dem river side, near the Nuoc Len bridge.
Technical	More difficult Construction is more complex as the inland waterway is more condensed than option 2. The width of the river section is larger than option 2 (50 compared to 40m) and the river section is more winding.	Less difficult.
Environment	During construction, the cumulative impacts on air emission, noise, water quality is higher as the location is already condensed with other emission sources	During construction, the cumulative impacts on air emission, noise, water quality is lower than option 1 as the location is more remote than the option 1
Social	Risk on waterway traffic congestion and accidents is higher than option 1 Land acquisition and resettlement is not required	Risk on waterway traffic congestion and accidents is lower than option 1 Land acquisition and resettlement is required
Cost	Lower cost due to no requirement of land acquisition and resettlement	Higher cost due to land acquisition and resettlement

Conclusion:

Even having lower investment cost, the location at 400m from Cho Dem riverside was rejected given construction method of this sub-component at this site is more complicated and construction at this site will bring more cumulative impacts on environmental and social receptors (air quality, surface water and groundwater, soil, terrestrial and aquatic ecology, inland waterway traffic) than that at 1,740 m distant from Cho Dem Riverside.

Table 4.2 Alternatives on technical design of Nuoc Len combined sluice gate and ship locks

Alternatives	Options 1	Option 2
Description	Sluice gates and two chambers of ship lock arranged at same side of the sluice gate	The sluice gate and two chambers of ship lock arranged at both side of the sluice gate
Technical	Construction is less completed	Construction is more complex
Social	The likelihood of inland waterway congestion and even accidents during operation phase is higher.	During operation phase, it is expected low marine traffic congestion or even accidents
Environment	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will higher	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will less
Cost	Lower	Higher

Conclusion:

The generated environmental impacts are not very much different between two options during construction phase, but are relatively different during operation phase, where the likelihood of inland waterway congestion and even accidents resulted from option 1 will be higher, which likely leads to cumulative impacts on environmental (air emission, noise, water quality) and social receptors (inland waterway traffic). Even having higher investment cost, the option 2 was selected as it bring less environmental and social impacts.

4.2.2. Sub-component 2.1: Construction of Vam Thuat tidal sluice gate and 2 ship locks

Similar to the sub-component 1, two options of location and technical designs were proposed for sub-component 2, Vam Thuat tidal sluice gate and 2 ship locks**.** Table 4.3 presents an analysis of impacts on environment, socioeconomic, engineering and economic aspects for those options.

Table 4.3 Alternatives on locations of Vam Thuat combined sluice gate and ship locks

Alternatives	Options 1	Option 2
Description	The combined sluice gate and ship locks is located 200 m distant from Sai Gon river side	The combined sluice gate and ship locks is located 600 m distant from Sai Gon river side
Technical	More difficult Construction is more complex as the inland waterway is deeper and more	Less difficult.

Alternatives	Options 1	Option 2
	widening than option 2.	
Environment	During construction, environmental impact significance is more given the residents located nearby the site.	During construction, environmental impact significance is less given the residents nearby are fewer.
Social	More residents are affected by the project construction and operation Land acquisition and resettlement is required	Fewer residents are affected by the project construction and operation Land acquisition and resettlement is not required
Cost	Higher cost due to requirement of land acquisition and resettlement and more complex method of construction	Lower cost due to no requirement of land acquisition and resettlement and simple method of construction

Conclusion:

Due to having fewer impacts on environmental and social receptors together with lower cost of no land acquisition and resettlement and simple method of construction, option 2 was selected.

Table 4.4 Alternatives on technical design of Vam Thuat combined sluice gate and ship locks

Alternatives	Options 1	Option 2
Description	Sluice gates and two chambers of ship lock arranged at same side of the sluice gate	The sluice gate and two chambers of ship lock arranged at both side of the sluice gate
Technical	Construction is less completed	Construction is more complex
Social	The likelihood of inland waterway congestion and even accidents during operation phase is higher.	During operation phase, it is expected low marine traffic congestion or even accidents
Environment	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will higher	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will less
Cost	Lower	Higher

Conclusion:

The generated environmental impacts are not very much different between two options during construction phase, but are relatively different during operation phase, where the likelihood of inland waterway congestion and even accidents resulted from option 1 will be higher, which likely leads to cumulative impacts on environmental (air emission, noise, water quality) and social receptors (inland waterway traffic). Even having higher investment cost, the option 2 was selected as it bring less environmental and social impacts.

4.2.3. Sub-component 2.2: Improvement/Upgrading of revetment in the main canal of Tham Luong – Ben Cat – Nuoc Len

The location of this sub-component was assigned by the local government, at Tham Luong Ben Cat Nuoc Len Canal. Therefore, alternative for locations is not analysed. For technical design, two technical designs were proposed as presented in Table 4.5 that shows an analyses of alternative options.

Table 4.5 Alternatives on technical design for the embankment of Tham Luong-Ben Cat-Rach Nuoc Len canal

Alternatives	Options 1	Option 2
Description	Combined slope revetment at the two ends (at the end of Vam Thuat and Nuoc Len canals) and vertical revetment (the centre section).	Building vertical embankment for the whole Canal.
Technical	Less complicated as the slope embankment does not require installation of vertical pile to prevent subsidence. Need less mobilization of heavy equipment for piling work.	The topographic elevation of the Canal was affected by accumulation of sediment. In order to install vertical piles, the construction procedure is more complicated as requiring additional technical solution to deal with subsidence. In addition, given the sub-component is wholly constructed with vertical roof embankment, this needs more heavy equipment for pilling works.
Social	Land acquisition at the two ends is higher, as the slope embankment will require more land.	Land acquisition at the two ends is less.

Alternatives	Options 1	Option 2
Environment	Lower impacts on noise and vibration during construction. Fewer dredging works generate fewer sludge amounts, reducing negative impacts on air emission from sludge transportation. Lower risk on subsidence of houses.	Higher impacts on noise and vibration during construction period due to piling work. More dredging works generate more sludge amounts, increasing negative impacts on air emission from sludge transportation. Higher risk on subsidence of houses.
Cost	- For land acquisition higher - For construction, lower as it required less complex construction method for the slope revetment section. → In total, this option result is lower cost.	- Cost for land acquisition is lower - Cost for construction is higher as it required more complex construction method. → In total, this option result in higher cost.

Conclusion:

Even requiring land acquisition, the option 1 was selected due to having fewer impacts on environmental during construction phase together with lower cost and simple method of construction.

4.2.4. Sub-component 2.3: Construction of drainage culvert system in Go Vap district

Location of the drainage culvert system is along the right bank of Tham Luong – Ben Cat canal where starting point of the drain is Cho Cau bridge - Go Vap District and ending point of the drain is collecting wells of the waste water treatment plan at An Phu Dong ward, District 12. Two options of constructing the drainage culvert system are: (i) constructing interceptors with installation of pumping stations; and (ii) constructing interceptors without installation of pumping stations. Table 4.4 presents analyses of impacts on environment, socioeconomic, engineering and economic aspects for those options.

Table 4.6 Alternatives on technical design of drainage culvert system in Go Vap district

Alternatives	Options 1	Option 2
Description	Constructing interceptors by excavation of soil.	Constructing interceptors by hydraulic jack.
Technical	Being simpler as requiring excavation equipment to make trenches.	Being more complicated as requiring high-tech equipment and well trained employees

Alternatives	Options 1	Option 2
Social	Large occupation of land leads to more impacts on the livelihood of nearby residents. The likelihood of traffic congestion and even accidents during construction phase is higher.	Less occupation of land leads to fewer impacts on the livelihood of nearby residents. The likelihood of traffic congestion and even accidents during construction phase is lower.
Environment	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will higher. The volume of soil generated is higher due to excavation to make trenches. The vehicles that are required to transport soil to disposal site potentially affect to air quality and ambient noise.	Due to the lower likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will less. Impacts on air quality and ambient noise are fewer.
Cost	Lower cost due to low-tech equipment and unskilled labour	Higher cost due to high-tech equipment and skilled employees

Conclusion: Even having higher cost of construction and more complex method, it was selected due to being of significantly lower impacts on environmental and social receptors.

4.2.5. Sub-component 2.3: Construction and improvement of primary and secondary combined sewer systems and the secondary interceptor in Go Vap district

The scope of works of this project is to construct and improve primary and secondary combined sewer systems and the secondary interceptor in Go Vap District. The areas of the project has a circle form from the North Eastern part to the South Western part of the City, connecting Sai Gon river from the East to Cho Dem river from the South West. It includes three regions: Go Vap District, 5 wards of District 12 and ward 13 of Binh Thanh District with estimation of 4,361 ha. The sub-component 5 requires an application of semi-separate sewer system for Binh Thanh District and Go Vap District and separate sewer system for District 12. Table 4.5 presents analyses of impacts on environment, socioeconomic, engineering and economic aspects for those options.

Table 4.7 Alternatives on technical design of primary and secondary combined sewer systems and the secondary interceptor in Go Vap district

Alternatives	Options 1	Option 2
Description	- Semi-separate sewer system - Trench technology	- Separate sewer system - Hydraulic jack
Technical	*Semi-separate sewer system* Under the existing sewer system of Go Vap District, the construction design of semi-separate sewer system is more complex given the it is more complicated, in which some sections were damaged that need to be replaced *Trench technology* This technology is simpler as it only requires excavation equipment to make trenches.	*Separate sewer system* Under the existing sewer system of District 12, the system construction is simpler because it is likely remote are, where the sewer system has been not fully developed. *Hydraulic Jack* This technology is more complicated given it requires high-tech equipment and well skilled employees.
Social	*Trench technology* Large occupation of land leads to more impacts on the livelihood of nearby residents. The likelihood of traffic congestion and even accidents during construction phase is higher.	*Hydraulic Jack* Less occupation of land leads to fewer impacts on the livelihood of nearby residents. The likelihood of traffic congestion and even accidents during construction phase is lower.
Environment	Due to the higher likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will higher. The volume of soil generated is higher due to excavation to make trenches. The vehicles that are required to transport soil to disposal site potentially affect to air quality and ambient noise.	Due to the lower likelihood of traffic congestion, cumulative impact on air emission, noise, water quality at the site of investment will less. Impacts on air quality and ambient noise are fewer.
Cost	Lower cost due to low-tech equipment and unskilled labour	Higher cost due to high-tech equipment and skilled employees

Conclusion: Even having higher cost of construction and more complex method, it was selected due to being of significantly lower impacts on environmental and social receptors.

4.2.6. Sub-component 2.4: Improvement of secondary canals (Hy Vong, Cau Cut, Ba Mieng, Ong Tong, Ong Bau, Chin Xieng)

The sub-component 6 is undertaken with six canals, creeks connected with the main canal of Tham Luong – Ben Cat – Nuoc Len in Tan Binh and Go Vap district from Tham Luong bridge to Sai Gon river with total length 8.213,4m (consist of: Hy Vong canal, Cau Cut creek, Ba Mieng creeek, Ong Tong creek, Ong Bau creeek, Chin Xieng creek).

Table 4.8 Alternatives on technical design of secondary canals (Hy Vong, Cau Cut, Ba Mieng, Ong Tong, Ong Bau, Chin Xieng)

Alternatives	Options 1	Option 2
Description	Culvert box is proposed for canals at where cross section is narrow and its surface water is heavily polluted	Open canal – It is used for canals with large existing cross-sections.
Technical	Being more complex due to transporting and laying the culvert box into trench	Being more simple
Social	Transporting and laying the culvert box to the project site can affect to safety of local residents given those can be collapsed.	Fewer impacts on safety of local residents
Environment	Potential impacts on environment and social receptors generated from upgrading the canal to be open canals are impacts on land acquisition, odours, water quality, solid waste, noise and vibration.	Not different
Cost	Lower due to no land acquisition	Higher due to land acquisition

CHAPTER 5: ENVIRONMENTAL IMPACT ASSESSMENT

AND PROPOSED MITIGATION MEASURES

5.1. Environmental Impact Assessment

5.1.1. Expected Positive Impact

<u>Component 1: Integrated Urban Flood Risk Management</u>

- Densification and modernization of monitoring equipment widens the coverage, reliability and quality of rainfall observations and flood forecasting;
- Enhanced technical and scientific capacity of staff involved in flood forecasting, flood management and development planning, and disaster risk reduction management;
- Instantaneous receipt of information between agencies and the ability to do "what-if" scenario simulations with the system.
- Strengthening the capacity of agency involved in water quality monitoring;
- Improvement of the local capacity and awareness for better solid waste management.

<u>Component 2: Priority Flood Risk Reduction Interventions</u>

For HCMC residents:

- Being able to live in improved environmental and living condition, whereby the community can improve their health, security and safety;
- Reducing poverty and having more opportunities to develop their own business (i.e. tourism activities, restaurants, shop) to increase their income;

For entrepreneurs

- Domestic and international manufacturing enterprises and companies located in the drainage catchment will be no longer challenged with vicious cycle of flooding and environmental pollution, whereby, their business can be developed stably and their economic growth target can be achieved, positively contributing to the economic growth of HCMC and stabilizing the income of their labors.

Government department

- Being provided professional training relating to operation of modern system, programs and facilities of flood risk management. Overall, the government capacity can be strengthened effectively.

5.1.2. Potential Negative Impact

5.1.2.1.Type and Scale Of Project Impact

Potential impacts have been identified through a systematic process whereby the features and activities (both planned and unplanned) associated with the pre-construction, construction, and operation of the Project components have been considered with respect to their potential to interact with resources/receptors. Potential impacts have each been classified in one of three categories:

- **No interaction:** where the Project component's activities are unlikely to interact with the resource/receptor;
- **Interaction likely, but not likely to be significant:** where there is likely to be an interaction, but the resultant impact is unlikely to change baseline conditions in an appreciable/detectable way; and
- **Significant interaction:** where there is likely to be an interaction, and the resultant impact has a reasonable potential to cause a significant effect on the resource/receptor.

As a tool for conducting scoping, the various component features and activities that could reasonably act as a source of impact were identified, and these have been listed down the vertical axis of a Potential Interactions Matrix. The resources/receptors relevant to the Baseline environment have been listed across the horizontal axis of the matrix. Each resulting cell on the Potential Interactions Matrix thus represents a potential interaction between a Project feature/activity and a resource/ receptor. The completed Potential Interactions Matrix is presented in Table 5.1.

Those cells that are coloured white are 'scoped out' of further consideration in the IA Process. Those interactions that are shaded black are retained for further consideration in the IA Process.

It should be noted that the list of Project activities is not intended to be exhaustive but rather an identification of key aspects of the operations that have the potential to interact with the environment and cause environmental impacts. The list of resources/receptors is also a focused list of the key aspects of the environment that are considered vulnerable or important in the context of the project's construction and operation activities.

Cumulative impacts will be presented in a section 5.3 in which the cumulative impact assessment will linked to impacts assessment of for activities of the project component 1 and component 2.

Table 5.1 Level of Potential Negative Impacts of Project

Resource/ Receptors											
Project Activity	**Physical**			**Biological**		**Socio**			**Others**		
	Air, noise, vibration	Land, soil, water	Solid waste, Sludge	Forest, natural habitats	Fish, aquatic life	Land acquisition, resettlement	PCR	Livelihood, community disturbance	Local flood, traffic, safety	UXO	Off-site impacts
Project Component 1: Combined Construction of Nuoc Len and Vam Thuattidal sluice gate and 2 ship locks											
Pre - Construction											
Operation of machinery/vehicles for land clearance and house demoliton	■	■	■				■	■	■	■	
Land acquisition						■					
Transporting waste to the disposal site	■							■	■		■
Workers onsite		■	■	■	■		■	■	■	■	
Construction											
Operation of machinery/vehicles	■	■	■				■	■	■	■	
Transporting waste and material from/to disposal site and supply sources	■							■	■		■
Infrastructure construction (excavation, compacting)	■	■	■								
Workers onsite		■	■	■	■		■	■	■	■	
Operation											
Operation of tidal sluice gate and ship locks		■	■	■	■				■		
Transportation of boats/ship	■							■	■		■
Project Component 2: Dredging and construction of canal bank revetment in the main canal of Tham Luong – Ben Cat – Nuoc Len											

Pre - Construction											
Operation of machinery/vehicles for land clearance and house demoliton											
Land acquisition											
Transporting waste to the disposal site											
Workers onsite											
Construction											
Operation of machinery/vehicles											
Transporting waste and material from/to disposal site and supply sources											
Workers onsite											
Operation											
Operation of the rehabiliateted canal											
Transportation of boats/ship											
Activities of visitor at the project site											
Project Component 3: Selected storm and waste water systems in Go Vap District											
Construction											
Operation of machinery/vehicles											
Transporting waste and material from/to disposal site and supply sources											
Workers onsite											
Operation											
Operation of sewage pipes											
Project Component 6: Improvement of secondary canals (Hy Vọng, Cầu Cụt, Bà Miêng, Ông Tổng, Ông Bầu, Chín Xiểng).											
Pre - Construction											
Operation of machinery/vehicles for land clearance and house demoliton											

Land acquisition											
Transporting waste to the disposal site											
Workers onsite											
Construction											
Operation of machinery/vehicles											
Transporting waste and material from/to disposal site and supply sources											
Workers onsite											
Operation											
Operation of the rehabiliateted canal											
Transportation of boats/ship											
Activities of visitor at the project site											

5.1.2.2.Socioeconomic Impact

(i) Land Acquisition and Resettlement

Involuntary Resettlement is the inevitable relocation affects in the process of implementing the project, including affected people (PAP) to rebuild their homes, property and income restoration. The affected include those subject to compulsory land acquisition by the projects financed by the World Bank and lead to: Must relocate or be homeless; Lose assets or ability to access to assets; Lose income sources or means of livelihood, whether people affected should or not to move to another location; and be restricted access to the area is required by law or protected areas detrimental to the livelihoods of those affected.

(ii) Potential differential impacts on women and vulnerable in particular landless HH to be relocated

No differential adverse impacts were identified on any vulnerable households. In almost all such cases there was other earning members in the households. However, with disabled persons the households face higher expenditures on medical treatment and loss of productive members. For single women with dependents tend to have unstable income from professions like making nail, selling lottery tickets, hairdressing and making-up, propose to building small credit program suitably for this group may develop household economy.

(iii) Other social impacts

Component 2: Priority Flood Risk Reduction Interventions

- Affect the movement of people during construction;
- The risk of impoverishment for occupied households living in the TLBCNL canals and river embankments;
- The risk of accidents on workplace safety without adequate warning systems;
- Increase social ills without suitable livelihood recovery programs;
- Loss of family income for those traders and some business households along the Canal
- The relocation of the former residence to the new place will affect people with incomes from motorcycle/car patch, motorbikes, manicure, hairdressing, etc.

5.1.2.3.Impact to on Physical Cultural Resources (PCR)

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

5.1.2.4.Impact to Nature Habitat

In the project area, no rare species plants were protected as it is mainly in urban area and agricultural land was used for resettlement purposes, there was no natural conservation area. Therefore, project implementation and operation will bring no impact to wildlife and natural ecosystems.

5.1.3. Detailed environment impact assessment for component 1 on Integrated Flood Risk Management

The proposed number of weather stations, rainfall stations and hydrological stations including the new weather radar and operations center to house equipment and other support facilities will require land acquisition, and construction activities that will have physical impacts to the environment.

Although information on locational as well as area requirements are not available at this time, potential impacts can be predicted and these may include but not necessarily be limited to involuntary resettlement; and impacts to ambient air, noise, water quality, soil and groundwater, waste, terrestrial ecology, and noise and vibration during the pre-construction, construction and operational phases of Component 1.

These are however anticipated to be small-scale in nature, and of shorter lifespan for each installation sites commensurate to the duration of the construction activities of each installations, and building requirements.

Quantitative and/or modeling requirements had not been attempted at this time due to the non-availability of information but this can be done at a later time following the content for each of the impacts identified and quantified for the priority infrastructures for Component 2 discussed in the appropriate sub-sections of this report.

It is however noteworthy to mention major pre-construction activities that may have to be undertaken and necessary to discuss the impacts associated with each development phase (pre-construction, construction and operation) for purposes of planning, consultation and disclosure to potential directly affected project stakeholders.

5.1.3.1.Impact assessment during pre-construction phase of component 1

a) Air quality

During site preparation, the activities of machinery and equipment may result in dust generation and re-suspension, and emissions.

(i) Dust generated by soil disturbance from site preparation and waste handling of component 1

The site from which the installations will be placed will require preparation by way of land disturbance and excavations that may be necessary. Wastes generated from these activities may also require removal of vegetation, structures and other assets depending on the preferred site. These information are not yet available at this time but it is anticipated that regardless of the site circumstances, dusts maybe generated and excavated construction wastes may have to be handled.

(ii) Transportation of construction wastes of component 1

The assessment had not determined the transportation requirements for waste handling to the disposal site. However, it is anticipated that vehicles transporting these materials will generate emissions from running engine, including NO_2, SO_2, CO, particulate matter and VOC. Given that this emission source is mobile, the effect to the community living along the road where the trucks will travel through to the disposal site will be expected. Unprotected waste materials in the vehicles may be also dumped along the way.

(iii) *Operation of machinery during site preparation phase of component 1*

Site preparation may use equipment and machineries. Although the number and type had not been determined for such activity, their use may generate exhaust gases from fuel burning containing fine particle matter and other gaseous pollutants including carbon monoxide (CO), nitrogen oxide (NO2), carbon dioxide (CO2), and sulfur dioxide (SO2). No estimate had been made but it is expected that emissions shall meet both government and international standards owing to the small-scale nature of the site installation activities.

The impacts of the activity are anticipated to be localized, and limited only to the local community surrounding installation sites and communities along the transportation routes. The impact of magnitude of the air emission is anticipated to be Small. In the absence of site-specific baseline air quality and adopting precaution, the sensitivity of the air quality at project site and surrounding area is High. Overall, the significance of impacts should be assigned as Moderate.

b) Noise and vibration

Noise and vibration result from the operation of machinery and vehicles during site clearing and transportation of wastes to the disposal site. At the time of writing, the number and types of equipment and machineries has been not defined yet, but it is anticipated that regardless of the site circumstances, noise and vibration impacts maybe generated from site preparation. Given the construction is undertaken within temporary duration and locally, the magnitude of the impact can be considered as Medium. In the absence of baseline noise levels, the sensitivity of the receptors is Medium adopting precaution against IFC standards of daytime noise levels. Overall, significance of the impact is considered Moderate.

c) Wastewater

Wastewater including domestic wastewater and storm runoff water will be generated during land preparation phase. At the time of writing, the number of workers, area and duration of site preparation have been not defined yet, but it is anticipated that regardless of the site circumstances, wastewater impacts maybe generated from site preparation. Pollutants concentration in untreated domestic wastewater and storm runoff water are expected to be over the QCVN 14:2008, Column B, but the magnitude of those types of wastewater is considered

Small given number of workers and disturbed site area is limited. Sensitivity of the receiving stream (TLBCNL Canal, Sai Gon River and Cho Dem River) is Medium in accordance with Decision No. 16/2014/QĐ-UBND of HCMC. Therefore, significance of the impacts is estimated Minor.

d) Solid waste

Solid waste generated during pre-construction phase includes demolition waste, domestic waste and hazardous waste. Given this phase may mainly include the house demolition works, the volume of demolition waste is expected to be significantly higher than domestic waste and hazardous waste, which is considered minor volume. At the time of writing, the workloads have been not defined yet, but those waste types can be predicted to potentially cause environmental impacts such as (i) generating unpleasant odor from decomposition of organic solid waste; (ii) impact to the aesthetics of the local area surrounding each of the installation sites; (iii) blocking of the walking pathways of local communities; (iv) increasing the concentration of suspended solid if washed out to the adjacent waterways, for example, TLBCNL Canal; and (v) contaminating soil, groundwater, and surface water if the oil-contaminated rags are not properly managed.

Magnitude of those impacts are expected to be Small given the site clearance works is undertaken at local site in anticipated temporary duration and generate small volume of solid waste. For precaution purpose, the sensitivity of the receptor is estimated Medium. Overall, the impact significance is ranked as Minor.

e) Traffic management

Land clearance phase will require a mobilization of machineries and equipment to undertake the house demolition and transport the demolition waste to the disposal site. Those activities will increase the number of vehicles on local roads and affect the normal traffic flow, may diminish or interrupt access to properties, and can increase the number of traffic accidents, incidents and congestion. Traffic issues tend to be the most serious at rush hours on the crowded roads. Given the duration of land clearance phase is temporary, magnitude of those impacts are expected to be Small. For precaution purpose, the sensitivity of the receptor is estimated Medium. Overall, the impact significance is ranked as Minor.

f) Social disturbance

Generally, the camping site is not required during land clearance phase; therefore, its impact to surrounding residents can be rejected. The activities of construction equipment, machinery, open holes, transport vehicles could lead to social disturbance, risks and noise. Detail of this impact can be referred to Chapter 7.

g) Biodiversity

The scope of land preparation has been not defined yet, but clearance of vegetation may be required. Although there is lack of information of terrestrial ecosystem, the terrestrial wildlife is defined low value of conservation based on the common information on the project site. Consequently, the magnitude of impacts and sensitivity of the receptors are considered Small. and Low. Overall, significance of the impacts on biodiversity is defined as Negligible.

5.1.3.2.Impact assessment during construction phase of component 1

a) Air quality

Construction activities generating the air emission include operation of machineries and equipment, material and waste transportation, installation site soil excavation and access road construction.

(i) Operation of machineries and equipment

Depending on the area and location, the installation sites may require heavy machinery and vehicles in several of its activities (i.e. activities of vehicles and machinery to undertake the site works).

The implementation schedule for Component 1 is from 2016 to 2021 (Source: Feasibility Study 2015). However, the schedules of the installation activities of all and each of the equipment have not been established. The impacts under each of the site installations shall therefore be considered on a per site basis which would then be short-term in duration. The extent of its impacts is anticipated to be highly localized covering only the immediate surroundings of the local communities. There are no baseline air qualities for each of the sites; therefore, the sensitivity of the air quality at each site and surrounding areas is impossible to be identified. However, for purposes of precaution, the impact of magnitude of the air emission and sensitivity of ambient air are Medium and High. Under this circumstance, the significance of the impacts is estimated as Major.

(ii) Transportation

The volume of materials and construction wastes to be generated has yet to be estimated for each of the installation sites. Although the pollutants emitted by transportation vehicles also needs to be estimated during the construction phase, it is anticipated that it will consist of carbon monoxide, particulates, nitrogen oxide, sulfur dioxide, and hydrocarbon. The volume and composition of these pollutants are dependent on fuel composition, level of engine maintenance, engine temperature, and emission control technology. During the construction period, construction materials such as cement, steel, sand etc. will be transported to the site by trucks. The exhaust gas from these trucks may cause impacts to the communities along the route.

The assessment has indicated that impacts to air quality from machineries and vehicles used during construction are expected to be localized, and of short-term duration. At the time of writing, the numbers and types of vehicles have been not finalized yet; therefore, it is impossible to correctly identify the magnitude if the impacts. However, for precaution purpose, the impact magnitude can be considered as Medium.

Receptors that are expected to receive the impacts are those living along the routes where vehicles passes through and in residential areas that maybe adjacent to the installation sites. Although baseline air quality is not available for each of the installation sites, precaution shall assign sensitivity of the air quality at the installation sites and surrounding areas as maybe High. Therefore, significance of the impacts is estimated Major.

(iii) Soil excavations at installation site

The volume of potential excavated and/or filling soils for each of the installation sites have not yet been estimated. However, it is anticipated that the concentration of TSP below the Vietnam Standards.

The assessment anticipates that impacts to air quality from soil excavations are expected to be localized and temporary in nature occurring over the duration of construction. The magnitude of dust impacts is determined as Negligible based on guidance from IFC. There are no available baselines for each of the installation sites. As a precaution, the sensitivity of the air quality at each of the installation sites and surrounding areas is assigned High. Overall, significance of the impacts is estimated Negligible.

(iv) Access road construction

It is not yet certain if each installation sites may need new access road or avail existing roads (which are ideal since this will further minimize or avoid right of way concerns). If access road maybe necessary to be constructed, dusts will be generated from loading sand and macadam into trucks and dumping these materials onto these roads. It is expected that total dust emission (TSP) can be estimated to be below the Vietnam standards compared.

The assessment anticipated that impacts to air quality from road construction are expected to be localized, temporary occurring over the construction period. The magnitude of dust impacts is determined as Negligible based on guidance from IFC. There are no baseline air qualities for each of the installation sites. As a precaution, the sensitivity of the air quality at the installation sites and surrounding areas is assigned High. Overall, significance of the impacts is estimated Negligible.

b) Noise and vibration

During the construction period, noise and vibration will primarily be generated by various vehicles and construction equipment (i.e. engines and mobile equipment). It is not certain how many of the equipment installations will be located near residential areas, but is expected that those can potentially generate the noise impacts to surrounding residents at least 90m (as compared to QCVN 26:2010/BTNMT) and 600m (as compared to IFC EHS Guideline). Given the construction is undertaken within short duration and locally, the magnitude of the impact can be considered as Medium. In the absence of baseline noise and vibration levels, the sensitivity of the receptors is Medium adopting precaution against IFC standards of daytime noise levels. Overall, significance of the impact is considered Moderate.

c) Wastewater

The different activities during construction have the potential to generate wastewater which, upon discharge, could lead to impacts on the quality of the adjacent and/or surrounding water bodies. Water quality may be influenced from domestic wastewater, construction wastewater and contaminated surface water runoff discharges. Given the construction works are mainly related to installation and undertaken in short duration, the latter two are expected to contribute limited pollutant loading to receiving stream.

For domestic wastewater, even the information of number of labor undertaking the installation is unknown, domestic wastewater is usually characterized as having significant pollutant loading. The discharge of domestic effluent varies with the implementation of each installation sites, where the extent of the impact extent is highly localized and impact scale is estimated to be point-based. In the absence of information about peak manpower demand for each installation site during construction, the magnitude of this impact is anticipated to be Medium as a precaution. In line with Decision No. 16/2014/QĐ-UBND of HCM, the sensitivity of receiving stream (TLBCNL Canal, Sai Gon River, and Cho Dem River) is considered as Medium. For precaution owing to lack of other attributable information, overall, significance of the impacts is estimated Moderate.

d) Solid waste

The generation of wastes will occur in all areas associated with the construction activities and workers facilities during the construction phase. These include domestic solid waste, construction waste and hazardous waste.

The generation of domestic solid waste from worker activities is estimated based on the workforce estimations during the construction phase and the likely domestic solid waste generation rate. It is estimated that the total domestic solid waste generation rate will be between 0.3 and 0.5 kg/person/day. However, the total number of workers required for each installation site had not yet been estimated. Therefore, the total volume cannot be also estimated but the impact can be estimated using the per capita generation discussed above.

Building and construction wastes from construction activities especially for the Operations Center will be generated. The waste composition mainly includes excavated soils generated from preparation of the equipment and building foundation. On top of this waste, generation of other wastes (i.e. packing waste, steel, rock, and cement and many others) can be considered, but may not be significant in amount for each installation sites.

Hazardous liquid wastewater and hazardous solid wastes will be generated during construction. These may include oily wastes from machinery and vehicles, liquid waste residuals, oily and chemical containers/drums, used batteries cartridges/fluorescent tubes, other contaminated materials

The discharge of those types of waste varies with the implementation of each installation sites, where the extent of the impact extent is highly localized and impact scale is estimated to be point-based. In the absence of information about peak manpower demand and volume of construction waste and hazardous waste for each installation site during construction, the magnitude of this impact is anticipated to be Medium as a precaution. The sensitivity of environmental receptors is also anticipated to be Medium. Overall, the significance of the impacts is Moderate.

e) Traffic management

Land transportation for material and solid waste will increase the number of vehicles on the local road and affect the normal traffic flow may diminish or interrupt access to properties, and can increase the number of traffic accidents, incidents and congestion. Da Phuoc landfill is assigned as disposal site of solid waste where the routes of transportation designed to reach include:

(i) Scenario 1: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 1 (Nuoc Len Creek to Can Giuoc River to Da Phuoc Site) in which the traffic flow is characterized low

(ii) Scenario 2: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 2 (Vam Thuat end to Sai Gon River to Tau Hu Ben Nghe Canal to Ong Lon Creek to Da Phuoc Site) in which the traffic flow is characterized low.

(iii) Scenario 3: All excavated material transported by barge to the transfer site inside project area) follows the land transportation route option 3 (Nuoc Len Creek to Nguyen Van Linh street to Highway 50 to Da Phuoc Site) in which the traffic flow of inland waterway and land is respectively characterized low and high.

Related to material required for project construction, it is potentially imported from surrounding province/city including Ho Chi Minh, Ba Ria Vung Tau, Long An, Binh Duong and Dong Nai to the project site through either inland waterway or road. Being similar to routes of waste disposal, traffic flow of inland waterway is often lower than that of road transportation.

Impact magnitude on inland waterway and land traffic flow is assigned as Small and Medium given the flow of the second is significantly higher than land traffic flow. For precaution purpose, the sensitivity of the receptor is estimated Medium. Overall, the impact significance is ranked as Minor and Moderate for inland waterway traffic and land traffic respectively.

f) Social disturbance

Following activities cause social disturbance on human health and livelihood, including: (i) activities of the project cause air emission, noise, vibration, domestic wastewater and solid waste at the project site; (ii) transportation through the roads causing noise and vibration and traffic congestion and accidents; and (iii) material exporting facilities located in Ho Chi Minh, Ba Ria Vung Tau, Long An, Binh Duong and Dong Nai. More details are presented in Chapter 7.

g) Biodiversity

The aquatic ecosystem is potentially affected from discharging the untreated domestic wastewater, run-off storm water, solid waste and oil spill. If those cannot be control properly, it will potentially significantly cause the negative impacts on environment whose magnitude is expected to be Large. The data of ecology baseline survey indicate that value of aquatic biodiversity is low. Overall, the significance of the impacts on biodiversity is considered Moderate.

5.1.3.3.Impact assessment during operation phase

a) Impacts on hydro-meteorological data gathering and water quality monitoring

The positive and negative impacts of Component 1 during its operation include the following:

Positive impacts

- Monitoring coverage of the flood prone areas in Ho Chi Minh City in terms of quantity and quality will be sufficiently addressed to develop a reliable flood forecasting system;
- Coverage of water level sensors for the city canal system will be likewise increased, partly because some will be needed for the control of the two gates constructed under this project;
- The new weather radar will significantly increase the quality of rainfall observations and will also enable the now casting of rainfall a few hours ahead;
- Water quality monitoring sampling will be automated albeit partly as there will still be a need to sample for parameters such as heavy metals, phosphates and nitrates;
- Better flood management and development planning; and disaster risk reduction management.

Negative impacts

- Data collected might not be properly managed and used in achieving better flood management and disaster risk reduction management outcomes.
- Turnover of technical as well as scientific staff will hamper the sustained capacity of the Government to address disaster risk reduction management problems.

If the installations and equipment including the database assets are not operated properly, it will defeat the expected outcomes for better disaster risk reduction management. The operation phase is permanent that can affect flood management and development planning as well as water quality monitoring of the waterways of the city. Scale of the impact can be estimated as large area, including related drainage catchments and distributary canals. Magnitude of the impacts is expected to be Large. Sensitivity of the receptors is High. Overall, the significance of the impacts is Major.

b) Impact on technical and scientific capacity of the government for integrated flood risk management of component 1

Following the completion of the project, the technical as well as the scientific capacity of the Government for integrated flood risk management will be enhanced with suitably qualified candidates able to plan and manage disaster risk reduction management outcomes. In this regard, better and suitably qualified staffs able to competently collect, process, analyse and advice Government policy- and decision makers plays a significant role in sustainable development efforts of the country.

Magnitude of the impact is expected to be Large. The sensitivity of surrounding environment should be High. Overall, it is estimated that the significance of impact is Major.

c) Security of hydromet equipment and flood forecasting system and water quality monitoring equipment

Some of hydromet equipment and flood forecasting system and water quality monitoring equipment will be installed outdoor; therefore, the risks of that equipment are stolen are high. In addition, the safety of security guy can be threatened due to presence of the robber. However, the likelihood of these incidents is unlikely and magnitude of these impacts is Medium. Overall, the significance of the impact is Minor.

d) Equipment safety

Component 1 will install the following monitoring stations: 5 weather stations, 80 rainfall stations and 20 hydrological stations distributed equally along rivers and along city canals. In addition, a new C-band bi-polar weather radar has been proposed to be placed at a new location. Information in regard to the specific Component 1 rainfall and hydrologic stations are not specified in the available feasibility study report. It is however anticipated that these installations will have the following typical instruments:

- Thermometer for measuring air and sea surface temperature
- Barometer for measuring atmospheric pressure
- Hygrometer for measuring humidity
- Anemometer for measuring wind speed
- Pyranometer for measuring solar radiation
- Rain gauge for measuring precipitation over a set period of time
- Runoff samplers
- Tide gauges
- Sensors

In addition, additional instruments that may be installed include but not necessarily limited to the following:

- Weather/precipitation identification sensors for identifying falling precipitation
- Disdrometer for measuring drop size distribution
- Transmissometer for measuring visibility

- Ceilometer for measuring cloud ceiling

It is anticipated that based on the profile of these instruments where the operational requirements are small-scale (with the exception of the weather radar where the operation may be highly technical and scientific), no occupational or operational safety risks to people are imminent.

5.1.4. Impact Assessment for Component 2 on Priority Flood Risk Reduction Interventions

5.1.4.1.Impact assessment during pre-construction phase

During pre-construction phase, the project component 2 will affect to environment and socioeconomic by following activities: rehabilitation, clearance, worker activities, maintenance of vehicle and machinery.

a) Land acquisition

The residential land acquisition and relocation of affected households cause more impacts on the physical and spiritual lives of the people, even to create social problems and prolonged litigation. The relocation to a new place also creates a strong impact on people and to emerge issues related to social living conditions of the resettled households will be changed dramatically, keep them away with the familiar relationship of the surrounding villages, social amenities and living conditions which they are enjoyed, even convenient business opportunities, they will take a long time to adapt to the new location. Further detail of this impact can be referred to Chapter 7.

b) Air

Air pollution from pre-construction activities/sites has many sources: (i) Dust generated from ground clearance; (ii) Emissions generated from transportation; (iii) Emission generated from machinery.

(i) Dust generated by soil disturbance from house demolition and waste handling

Waste generated from house demolition is mainly structures of houses such as roofs, walls, floors and ceilings, and foundation and basement. The house demolition will be undertaken for sub-component 2.1, 2.2 and 2.4 where dust generation for each is estimated based on the Emission Factor (EF) from AP-42: Compilation of Air Pollution Emission Factors Fifth edition developed by USEPA (USEPA, 1995) and BOX model as below.

$$E = k \times 0.0016 \times (U/2.2)^{1.3}/(M/2)^{1.4} \text{ (kg/tons)} \qquad \textbf{Equation 5.1}$$

In which:

- *E: Emission factor (kg dust/tons of waste)*
- *K: Particle size multiplier (K for TSP is 0.74) (USEPA, 1998)*
- *U: Average wind speed (m/s), (U = 4.5 m/s for peak annual wind speed as worse case).*
- *M: Material Moisture Content (%), M = 2% (referred from a Petrochemical project in South of Vietnam, 2014)*

BOX model, a simplest type of model (Norazian Mohamed Noor), is applied to estimate the dust concentration at the project sites. The model is represented in Equation 5.2.

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

Where

- *PC Concentration of the pollutant (mg/m3)*
- *B Background pollution concentration (mg/m3)*
- *q Emission loading (mg/s.m2)*
- *u Wind speed (m/s)*
- *L Length of site (m)*
- *H Mixing Height (m)*

Table 5.2 Overall impacts of dust generated from house demolition and waste handling of sub-component 2.1, 2.2 and 2.4

Subcomponent	Number of house demolished	Volume of waste (tons)	Baseline (mg/l)	Dust concentration top up (mg/l)		QCVN 05:2013/BTNMT for dust
				House demolition	Waste handling	
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len.	6	67.32	0.1-0.14	0.18-0.22	**0.3-0.41**	0.3
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	77	864	0.1-0.23	0.2-0.33	**0.37-0.5**	0.3
Sub-Component 2.4: Secondary canals systems.	356	4000	0.1-0.33	0.2-0.42	**0.3-0.53**	0.3

Duration of the land clearance phase of above sub-components are three days, thirty days and forty days respectively that are considered as temporary duration. The extent of its impacts is localized, just covering the local community surrounding project area and community along the transportation routes. Based on the estimated dust concentration (Table 5.2), the magnitude of dust impacts is determined as Small for house demolition and Large for waste handling based on guidance from IFC (ERM 2012). Baseline air quality results at the project sites indicate that the sensitivity of the air quality at project site and surrounding area is Medium to High. Therefore, significance of the impacts is estimated Minor to Major.

(ii) Emissions generated from transportation

For each sub-component, 10-tons trucks will be mobilized in order to transport the demolition waste to the disposal site. During operating, those vehicles will generate the polluted air from running engine, including NO_2, SO_2, CO, particle and VOC. Given this emission source is mobile, it will effect to community living along the road where the trucks will travel through to the disposal site. The distance from the project site to the disposal site is estimated to be 50km. The emission factor emitted from vehicle movement and air emission concentration referred from Department of Infrastructure, Planning and Natural Resources, Australia (2004) for land transportation (Table 3.1 and Table 3.2 in Annex 3).

The assessment has indicated that impacts to air quality from transportation of machinery and vehicles are expected to be localized at the project sites, temporary occurring over three days, thirty days and sixty days for subcomponent 2.1, 2.2 and 2.4 respectively of construction period. Based on the guideline of IFC, the impact magnitude of NO_2 is large while the other has negligible impacts magnitude. Overall, the impact of magnitude of the air emission is Small. Baseline air quality indicates that the sensitivity of the air quality at project site and surrounding area is High. Therefore, significance of the impacts is estimated Moderate.

(iii) Emission generated from operation of machinery

During house demolition, one excavator, one bulldozer and two 10-tons trucks will be mobilized to demolish the houses and loading the waste to the truck for each sub-component. The exhaust gases from fuel burning by these machines/ vehicles contain fine particle matter and other gaseous pollutants including carbon monoxide (CO), nitrogen oxide (NO_2), carbon dioxide (CO_2), and sulfur dioxide (SO_2). The "Worst case scenario" for an estimation of pollutants from diesel exhaust is undertaken, where those vehicles' activities occur concurrently. The emission factors of NO_2, SO_2, TSP, and CO are referred from Southern California International Gateway Project (Table 3.3 in Annex 3). Using Equation 5.2, the results of estimation are presented in Table 3.4 (see Annex 3).

For each sub-component, excepting CO and SO_2 parameters within QCVN 05: 2013/BTNMT at all sampling locations, NO_2 and TSP parameters at sampling locations exceed QCVN 05: 2013/BTNMT. Based on the guideline of IFC, the impact magnitude of NO_2 and TSP is large while others have negligible impacts magnitude. Overall, the impact of magnitude of the air emission is Large. Receptors that are expected to receive the impacts are living in along the routes where vehicles travel through and from residential area nearby the project site. Baseline air quality indicates that the sensitivity of the air quality at project site and surrounding area is almost High. Therefore, significance of the impacts is estimated Major.

c) Noise and vibration

Noise

During land clearance, each component is expected to employ 1 excavator, 1 bulldozer and 2 trucks to undertake the house demolition and waste handling and transportation. Noise impacts are mainly resulted from operation of machinery and vehicles during house demolition and cause negative impacts to surrounding receptors. Noise health effects are the consequences of exposure to elevated sound levels and can include hearing impairment, hypertension, ischemic heart disease, annoyance, and sleep disturbance. Changes in the immune system and birth defects can also be attributed to high noise exposure.

Noise level will be decreased in accordance with the distance and can be estimated based on the following formula:

$L_P(x) = L_P(x_o) + 20 \times \log_{10}(xo/x)$ **Equation 5.3**

- $L_P(x)$: *noise level at l5m (dBA)*
- $x_o = 15m$
- $Lp(x)$: *Noise level at calculation site (dBA)*
- *x: calculation site from noise generated source (m).*

For the each subcomponet, it is necessary to calculate the overall noise level produced by the simultaneous operation of several pieces of equipment. The overall noise level at a receptor is simply the sum (on an energy basis) of the individual contributions of each piece of equipment. Mathematically, the overall noise level at a receptor from several sources can be calculated using Equation 5.2.8:

$L_{\sum} = 10 \times lg \sum_i^n 10^{\,0,1Li}$ **Equation 5.4**

In which:

- *LΣ : Total noise level*

- *Li : noise level of source i*

- *n : number of noise source*

The distances to estimate the effects of the noise generated by individual equipment and by combined equipment are from 100m to 800m that fully covers the receptors, including workers and nearby local residents. It is noted that these distances are accounted from the project boundary to the receptors nearby the project site. Based on the above, the total overall noise level expected at various sensitive receptors during the pre-construction phase due to Project activities is shown in Table 5.3.

Table 5.3 Overall noise levels generated by operation of machinery during pre-construction phase of each site of subcomponent 2.1, subcomponent 2.2 and subcomponent 2.4

Machineries number	Machineries	Noise level at 15 m (dBA)	Noise levels at distances (m) Lp (x) (dBA)				
			100	200	400	600	800
1	Excavator	85	69	63	56	53	50
1	Bulldozer	85	69	63	56	53	50
2	Truck	85	69	63	56	53	50
Overall noise levels generated by operation of machinery during pre-construction phase (Lp (x) (dBA))			75	69	63	59	56
QCVN 26:2010/BTNMT National Technical Regulation on Noise (daytime)			**70**				
IFC's General EHS Guidelines (daytime)			**55**				

The noise levels indicate that for distances at 100m and further, noise level emitted from individual equipment/machinery is below the Vietnam standards (QCVN 26:2010/BTNMT) and exceed the IFC standards until at a distance of 600m.

In order to fully cover noise impacts, the worst-case scenario, where all equipment and machineries are working concurrently, is proposed. On the other words, the combined noise level will be assessed to examine the impacts to the receptors. The combined noise levels only meets the Vietnamese Standard at 200m to further and IFC Standard at from 1000m to further.

For all receptors living within the distance from 15 m to 75m, the magnitude impact of combined noise level is assessed to be medium given combined daytime noise level greater than 75-80 dBA (ERM, 2014). The sensitivity of the receptors at each project site is medium based on the baseline noise results against to IFC standards of noise level for daytime (ERM 2012). Overall, significance of the impact is considered Moderate.

Vibration

Construction activity can result in varying degrees of ground vibration, depending on the equipment and methods employed. Operation of construction equipment causes ground vibrations that spread through the ground and diminish in strength with distance. Buildings founded on the soil in the vicinity of the construction site respond to these vibrations, with varying results ranging from no perceptible effects at the lowest levels, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest levels.

The assessment for vibration impacts is undertaken on two types, including damage assessment and annoyance assessment. The following procedure is used to assess those impacts, including:

<u>*Damage Assessment:*</u>

In order to assess the damage caused by vibration impacts, PPV_{equip} should be estimated based on Equation 5.5, then compared to the vibration damage criteria from Table 5.6 to examine significance of impacts.

$PPV_{equip} = PPV_{mf} \, x \, (25/D)^{1.5}$ **Equation 5.5**

where:

- *PPV_{equip}: is the peak particle velocity in second of the equipment adjusted for distance*
- *PPV_{ref} is the reference vibration level in m/sec at 7.62m (25 feet) from Table 5.5*
- *D is the distance from the equipment to the receiver.*

<u>*Annoyance Assessment:*</u>

- If desired for consideration of annoyance or interference with vibration-sensitive activities, estimate the vibration level Lv at any distance D from the following equation:

Lv(D) = Lv(7.62 m) – 301og(D/25) **Equation 5.6**

Where:

- *Lv(D): Vibration level at D m;*
- *Lv(7.62 m): Vibration level at 7.62 m from Table 5.5.*
- *D: distance from vibration to receiver.*

Using above methodology, the estimated peak particle velocity levels at the sensitive receptors nearest to the Project are shown in Table 5.5. When comparing the calculated with the Vibration Damage Potential Threshold Criteria (PPV) and the Vibration Annoyance Potential Criteria (VdB) (Table 5.4), it is found that the vibration levels of bulldozer and excavator are not likely to cause harm to building structures and human annoyance. It is slightly different for truck as it will affect to building and be perceptible by humans within 10ft (3m) from truck.

Vibration from construction activities is likely to impact the nearby residential areas within 3m from the project boundary. Vibration caused by construction activities will occur only temporarily during demolition works, for only approximately three days and will only occur when such machinery is being operated. Therefore, the impact magnitude is considered Negligible. The sensitivity of the local residents is High. Based on these criteria, significance of potential vibration impacts during the construction phase is assessed to be Negligible.

Table 5.4 Guideline for vibration damage potential threshold criteria (Sub-component 1)

No.	Building Category	PPV (in/s)	Approximate Lv (VdB)
1	Reinforced-concrete, steel or timber (no plaster)	0.5	102
2	Engineered concrete and masonry (no plaster)	0.3	94
3	Non-engineered timber and masonry buildings	0.2	98
4	Buildings extremely susceptible to vibration damage	0.12	90

Source: Swiss Consultants for Road Construction Association, "Effects of Vibration on Construction" VSS-SN640-312a, Zurich, Switzerland, April 1992.

Table 5.5 Vibration level for construction equipment during pre-construction phase of each site of subcomponent 2.1, 2.2 and 2.4

No.	Vehicles	PPVequip (D) at 7.62m (in/sec)	Lv (D) at 7.62m (m/sec)
1	Bulldozer	0.003	58
2	Truck	0.076	86
3	Excavator	0.003	58

Table 5.6 Vibration level for construction equipment at different distances for each subcomponent

No.	**Vehicles**	**PPVequip (D) (in/sec) (in ft)**					**Lv (D) (ft)**				
		10	17	34	66	75	10	17	34	66	75
1	Bulldozer	0.01186	0.00535	0.00189	0.00070	0.00058	69.9	63.0	54.0	45.4	43.7
2	Truck	0.300	0.136	0.048	0.018	0.015	97.9	91.0	82.0	73.4	71.7
3	Truck	0.300	0.136	0.048	0.018	0.015	97.9	91.0	82.0	73.4	71.7

d) Wastewater

(i) Domestic wastewater

Total number of worker who working for all item is estimated about 35 workers. Demand for water use of each worker's prescribed in QCXDVN 01:2008/BXD is about 45 liters/person/day including water for washing, cooking and personal hygiene. The amount of wastewater is calculated by 100% of water used daily. Thus, the amount of domestic wastewater is generated at about 1.6 m^3 per day for three subcomponents. Ingredients of wastewater include suspended solids, oil, grease, high concentrations of organic matter, residue, dissolved organic matter (through the BOD5, COD indicators), nutrients (Nitrogen, Phosphor) and microorganisms. According to the pollutants emission of the World Health Organization (WHO) for developing countries in Table 4-45, the estimated load and average concentration of pollutants in the domestic wastewater before treatment through septic tanks are listed as follows:

Table 5.7 Loads And Pollutants Concentration of Domestic Wastewater (untreated)

No.	Pollutants	Pollution factor(*) (g/person.day)	Load (kg/day)	Pollutant factor (mg/l)	
				Untreated	QCVN 14:2008 Column B
1	BOD_5	45 – 54	1.6 – 1.89	1000 - 1200	50
2	COD	72 – 102	2.52 – 3.57	1600 – 2666	-
3	TSS	70 – 145	2.45 – 5.10	1555 – 3222	100
4	Grease	10 – 30	0.35 – 1.05	222 - 666	20
5	Total Nitrogen	6 – 12	0.21 – 0.42	133 - 266	50
6	Ammonia ($N-NH_4$)	2.4 – 4.8	0.084 – 0.17	53 - 107	10
7	Phosphor	0.8 – 4.0	0.028 – 0.14	17.8–88.9	10
8	Total Coliforms	10^6 - 10^9	35 x 10^6 – 35 x 10^9	22x10^6 – 22x10^9	5000 (MNP/100ml)

Source: WHO, 1993.

In the table above, the pollution load, number of workers and wastewater flow, pollutants concentration in wastewater can be calculated by the following formula:

$$C = \frac{C_0.}{Q}$$

Equation 5.7

In which:

- *C: Pollutant concentration, (mg/L)*
- *C_0: Pollutant load, (g/day)*
- *Q: Wastewater flow, (m^3/day)*

Comparing to the pollutants concentration in untreated domestic wastewater with the QCVN 14:2008, Column B, most of the parameters are over the standards. Duration of the pre-construction phase is sixty days, considered as temporary duration. The extent of its impacts is localized, potentially effecting to water quality of receiving receptors (TLBCNL Canal, Sai Gon River, Cho Dem River). The magnitude of impact can be considered medium. Receiving receptors includes TLBCNL Canal, Sai Gon River, and Cho Dem River that are considered to have medium sensitivity. Overall, significance of the impacts is estimated Moderate.

(ii) Runoff storm water

During the construction phase, storm water run-off from the Project site will be potentially contaminated by soil particles, solid waste, organic matters, oil, and grease. Based on the meteorological baseline data, peak rainy is happened from May to November annually. At the time of writing this report, a detailed schedule of deployment of the project has been not provided. Therefore, the peak rainy intensity will be selected to estimate run-off water flow based on the following equation:

Q = C x I x A/1000 *(Source: Storm water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices, EPA, 2005)* ***(Equation 5.8)***

In which:

- *Q: flow of storm water run-off (m^3/day);*
- *C: run-off factor, depending on the surface characteristic; (1 for paved area, and 0.7 for unpaved area)*
- *I: maximum rainfall (mm/h); (I peak = 50 mm/day)*
- *A: Demolition area (m^2)*

With 8780 m^2 of house demolition for three subcomponents, flowrate of storm water is estimated at 439 m^3 per day. Surface runoff from the exposed soil surface stockpiling etc. can be expected to contain elevated suspended sediments (SS) and may also contain debris (discarded construction material, vegetation) and other contaminants (e.g. oils, fuel, grease etc.).

The assessment has indicated that impacts to water quality as a result of stormwater runoff discharge are expected to be localized, periodic, temporary duration occurring over sixty days of the land development period. The magnitude of the impacts is considered Medium. The sensitivity of those sensitive receptors (TLBCNL Canal, Sai Gon River, and Cho Dem River) based on Decision No. 16/2014/QĐ-UBND of HCM is considered Medium. Overall, the negative impact is ranked of Moderate significance.

e) Solid waste

(i) Domestic Solid waste

Solid waste coming from workers in pre-construction phase discharged about 0.35kg/person/day. With the number of workers is estimated about 35 people for three subcomponents, the amount of solid waste should generate around 12.25 kg/day. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment. The number of workers in the pre-construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, investors should also take some measures to collect and ensure environmental hygiene of working areas.

(ii) Construction solid waste by clearance process

- Site clearance: Vegetation is removed during clearance phase, but generated with limited volume.
- Demolition of existing structures: Materials in existing structures may include bricks, tiles, concrete waste, steel, soil, waste rock, wood, etc. The demolition process will create noise and dust. However, the volume of dust and waste and the period of demolition are very limited. Impacts will be localized and of small scale. Table below present the total of solid waste from the clearance process.

Table 5.8 Total of house demolition waste from the clearance process for three subcomponents

Subcomponent	Number of demolished house	Estimated amount of solid waste (tons)
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len.	6	67.32
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	77	864
Sub-Component 2.4: Secondary canals systems.	356	4000
Total		4931

(iii) Waste oil

After operating, the machinery and construction vehicles using on site must be maintained to avoid damage and ensure the stable operation. This process will generate an amount of Waste oil from machinery and vehicles. The amount of oil for once change is estimated about 16 liters/truck. The changing cycle is about 3-6 months, depending on the working time of machinery. The amount of hazardous waste generated from cleaning rags, oil machinery, oil tanks, etc. in this phase is minimal. The estimated amount of Waste oil for once change is 10 liters.

The amount of waste generated during land clearance phase is significance, especially demolition waste. The solid waste is generated during sixty days, considered a temporary duration; the extent of its impacts is localized. Therefore, the magnitude of the impact is Medium. The sensitivity of the environmental and social receptors surrounding the subcomponents sites are estimated Medium. Consequently, the overall significance of impacts is Moderate.

f) Traffic management

Total estimated trips of waste transportation will be 20 trips. Land transportation for solid waste will increase the number of vehicles on the local road and affect the normal traffic flow may diminish or interrupt access to properties, and can increase the number of traffic accidents, incidents and congestion. Da Phuoc landfill is assigned as disposal site of solid waste where the routes of transportation designed to reach include:

(i) Scenario 1: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 1 (Nuoc Len Creek to Can Giuoc River to Da Phuoc Site) in which the traffic flow is characterized low.

(ii) Scenario 2: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 2 (Vam Thuat end to Sai Gon River to Tau Hu Ben Nghe Canal to Ong Lon Creek to Da Phuoc Site) in which the traffic flow is characterized low.

(iii) Scenario 3: All excavated material transported by barge to the transfer site inside project area) follows the land transportation route option 3 (Nuoc Len Creek to Nguyen Van Linh street to Highway 50 to Da Phuoc Site) in which the traffic flow of inland waterway and land is respectively characterized low and high.

Impact magnitude on inland waterway and land traffic flow is assigned as Small and Medium given the flow of the second is significantly higher than land traffic flow. For precaution purpose, the sensitivity of the receptor is estimated Medium. Overall, the impact significances are ranked as Minor and Moderate for inland waterway traffic and land traffic respectively.

g) Social disturbance

It is estimated that there will be one worker camps established with 35 workers for three subcomponents during the land clearance period. The activities of construction equipment, machinery, open holes, transport vehicles could lead to social disturbance, risks and noise during nighttime.

The main social problems could be listed as the below:

- Potential impact of spreading infectious disease from employees to local communities and vice versa.

- Potential impact of prostitution, drugs and gambling.
- Potential conflict between workers and local communities because of differences of culture, behavior.
- Potential impacts on local businesses, for example restaurants, shops etc. could be temporary closed or disadvantaged because of project activities and pollution.
- Cultural values could be potentially impacted but because all these values are distanced from project construction areas hence will not be significantly impacted. However, the concentration of huge amount of employees could potentially undesirable conflict with local communities including cultural values;
- Communities could be at risk if they travel around or are close to the construction sites and potentially exposed to accidents.

h) UXO (Unexploded ordnance)

UXO removal is important so as to avoid any potential threat to works and safety for local people and workers. For sub-components, UXO needs to be carefully considered and removed before construction activities can commence. The impacts of UXO in the project area represent significant negative impacts if mitigation measures are not applied, with high risk to human health, life, and also infrastructure. UXO removal must be completed before starting civil works.

5.1.4.2.Impact assessment during construction phase

a) Air emission

The emissions including dust and air emission generated from construction activities include fuel combustion from mobile heavy-duty diesel, gasoline-powered equipment, mobility of construction materials, soil excavation and road construction.

(i) Transportation

The volume of material and waste to be transported to and from the construction site by road is approximately 10,459,800 tons in which detail of material and waste and round trips per day are presented in Table 5.9. The transportation of waste and material can use road or inland waterway, but for conservative approach, the estimation will be estimated for road transportation. In this regard, trucks of 30 tons will be used. Given the construction durations of some of subcomponents are different, the estimated trips are different. The distance for the transportation is approximately estimated 50km from the project site to Da Phuoc landfill or material supplying sources in Dong Nai, Binh Duong, Long An and Vung Tau.

Table 5.9 Volume of material and waste required to transport to project site and disposal site (Da Phuoc landfill)

Component 2	Volume of material and waste (tons)	Round trips per day (trips)

Component 2	Volume of material and waste (tons)	Round trips per day (trips)
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	209,000	24
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	8,720,000	432
Sub-Component 2.2: Selected storm and waste water systems in Go Vap District	1,120,800	60
Sub-Component 2.4: Secondary canals systems.	410,000	41

The emission loading and concentration results are estimated and represented in Table 3.5 and Table 3.6 (see both in Annex 3). The assessment has indicated that impacts to air quality from machinery and vehicles are expected to be localized, short-term occurring over from 2 years to 4 year of construction period. Based on the guideline of IFC, the impact magnitude of NO_2 and TSP are large while the other has negligible impacts magnitude. Overall, the impact of magnitude of the air emission is Large. Baseline air quality indicates that the sensitivity of the air quality at project site and surrounding area is ranked from medium to high. Therefore, significance of the impacts is estimated Major.

(ii) Operation of machinery and vehicles for all subcomponents of component 2

Four subcomponents will employ the different numbers of vehicles and machineries and may have different sensitive receptors; therefore, during operation of those at each site, the significance of air emission from their operation will be likely different. The estimation of pollutants from diesel exhaust are based on the number of machinery and vehicles of (Table 3.7 to Table 3.11 in Annex 3) when those vehicles' activities occur concurrently which is considered as the "Worst case scenario". The emission factors for NO_2, SO_2, TSP, and CO referenced to Southern California International Gateway Project employed to estimate the emission loading, which is used to estimate the air emission concentration using BOX Model (Equation 5.2). The air emission generated from operation of those machineries and vehicles for those subcomponents are presented from Table 3.7 to Table 3.11 (See Annex 3).

The assessment has indicated that impacts to air quality from machinery and vehicles are expected to be localized, short-term occurring from 2 years to 4 year of-construction period. Excepting CO and SO_2 parameters within QCVN 05: 2013/BTNMT at all sampling locations, NO_2 and TSP parameter exceed QCVN 05: 2013/BTNMT (Table 3.12 in Annex 3). Based on the guideline of IFC, the impact magnitude of NO_2 and TSP is large while others have negligible impacts magnitude. Overall, the impact of magnitude of the air emission is Large. Baseline air quality indicates that the sensitivity of the air quality at project sites and surrounding area is from medium to high. Therefore, significance of the impacts is estimated Major.

(iii) Soil excavation and filling for construction of main infrastructure of subcomponent 2.1, 2.2, 2.3 and 2.4

The construction of main infrastructures of those subcomponents potentially generates the dust emission, especially during excavating and filling soil. Following table provides the volume of excavated soil and filled soil of subcomponent 2.1, 2.2 and 2.3 that will be used to quantitatively be assessed. Only the data of subcomponent 2.4 is still not available and will be assessed qualitatively as below.

The top up concentration of dust generated from excavating and filling soil of the subcomponents are below QCVN 05:2013/BTNMT. Some locations of those subcomponent is exceed the standard given dust baseline is higher than standard. It means that the contribution of those activities is minor in top up concentration. The assessment has indicated that impacts to air quality from machinery and vehicles are expected to be localized, temporary occurring over 6 months of construction period. The magnitude of dust impacts is determined as Negligible based on guidance from IFC. Baseline air quality at the site of each subcomponent indicates that the sensitivity of the air quality at project site and surrounding area is high. Overall, significance of the impacts is estimated Negligible.

Table 5.12 Dust generation of filling and excavating soil of subcomponent 2.1, 2.2, 2.3 and 2.4

Component 2	Excavated soil (tons)[1]	Filled soil (tons)[1]	Baseline data (mg/l)	Top up concentration of dust (mg/l)		QCVN 05:2013/ BTNMT for dust
				Excavated soil	Filled soil	
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	259,496	112,127	0.1-0.14	0.11 – 0.15	0.1 – 0.14	0.3
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	832,693.88	940,910	0.1-0.23	0.13 – 0.17	0.13 – 0.17	0.3
Sub-Component 2.3: Selected storm and waste water systems in Go Vap District	178,906	53,672	0.1-0.38	0.1 – 0.38	0.1-0.38	0.3

Note: Referred from Feasibility Study of project subcomponents, 2012

(iv) Road construction for subcomponent 2.1 and 2.3

Road construction is one of scope of subcomponent 2.1 and 2.2 that it can contribute to dust emission. Similar to section (iii) above, the dust estimation is conducted using sing the volume of excavated soil and filled soil and emission factors calculated from Equation 5.2. Table 5.13 presents top up concentration of dust after considering the dust emission of the project activities.

The top up concentration of dust generated from excavating and filling soil of the subcomponents are below QCVN 05:2013/BTNMT. It means that the contribution of those activities is minor in top up concentration. The assessment has indicated that impacts to air quality from machinery and vehicles are expected to be localized, temporary occurring over 6 months of construction period. The magnitude of dust impacts is determined as Negligible based on guidance from IFC. Baseline air quality at the site of each subcomponent indicates that the sensitivity of the air quality at project site and surrounding area is high. Overall, significance of the impacts is estimated Negligible.

Table 5.11 Dust generation of filling and excavating soil of subcomponent 2.1 and 2.2

Component 2	Macadam (tons)	Sand (tons)	Baseline data (mg/l)	Top up concentration of dust (mg/l)	QCVN 05:2013/BTNMT for dust
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	3,519.2	6,860.56	0.1-0.14	0.1-0.14	0.3
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	660,734	317, 340	0.1-0.23	0.1-0.23	0.3

(v) Odors from dredging process of subcomponent 4

Dredged material is mainly sediments coming from wastewater and surface runoff accumulated at the bottom of the canal. Such sludge contains many complex organic compounds which are biologically degraded in anaerobic condition and release odorous compounds. Types of odorous compounds created by anaerobic decomposition include inorganic gases, mercaptans and other compounds such as organic acids, phenol, and p-cresol. During dredging process, odorous compounds can be released and cause nuisance odor problems in nearby community. This impact mainly occurs in transfer site, where dredged materials are gathered and prepared to water way transport for treatment. Dredging activities take place in a short time and cause the nuisance locally. As a result, the magnitude of odour impacts is Medium. Given the sensitivity of local residents is Medium, the overall significance of impacts is Moderate.

b) Noise and vibration

<u>Noise</u>

During the construction period, noise will primarily be generated by operation of vehicles and equipment (i.e. engines and mobile equipment). The level of noise depends on the types and numbers of vehicles and equipment subcomponent are going to employ during construction phase. In order to assess the noise impact, the individual noise of each equipment and overall noise of all needs to determined. The assessment is examined at different distances, from 100m to 1200m to fully cover the noise impacts on sensitive receptors. Out of four subcomponents, the noise impacts of subcomponent 2 and subcomponent 4 will be similar given they both use the same types and numbers of equipment. This is similar to each investment items within subcomponent 1 (Vam Thuat and Nuoc Len) and subcomponent 3 (the interceptor and primary and secondary combined storm water and sewer systems).

Individual noise levels are constant at a defined distance that is estimated for all subcomponents (see Table 3.13. 3.14 and 3.15 in Annex 3). The result indicates that the noise levels, excepting noise level emitted from hammer, of other indicate that individual noise level at distances from 100m to further is below the Vietnam Standards (QCVN 26:2010/BTNMT), but higher than IFC from 600m to further. The individual noise level of hammer only meets the Vietnamese Standard at 600m and IFC Standard at 3000m while cutter suction dredger (for subcomponent 2) is below the Vietnamese Standard at 200m and IFC Standard at 800m.

In order to fully cover noise impacts, the worst-case scenario, where all equipment and machineries are working concurrently, is proposed. The results are presented in Table 3.13. 3.14 and 3.15 in Annex 3 and interpreted as follow:

(i) Noise impacts from machineries operation of subcomponent 1

The combined noise levels only meets the Vietnamese Standard at 800m to further and IFC Standard at from 4000m to further.

For all receptors living within the distance from 15 m to 2000m, the magnitude impact of combined noise level is assessed to be medium given combined daytime noise level greater than 60 dBA (ERM, 2014). The sensitivity of the receptors is Medium based on the baseline noise results against to IFC standards of noise level for daytime. Overall, significance of the impact is considered Moderate.

(ii) Noise impacts from machineries operation of subcomponent 2 and 4

The combined noise levels only meets the Vietnamese Standard at 1200m to further and IFC Standard at from 7,500m to further.

For all receptors living within the distance from 15 m to 4,500m, the magnitude impact of combined noise level is assessed to be medium given combined daytime noise level greater than 60 dBA (ERM, 2014). The sensitivity of the receptors is medium based on the baseline noise results (K1 to K11) against to IFC standards of noise level for daytime. Overall, significance of the impact is considered Major.

(iii) Noise impacts from machineries operation of subcomponent 3

The combined noise levels only meets the Vietnamese Standard at 600m to further and IFC Standard at from 1000m to further.

For all receptors living within the distance from 15 m to 2000m, the magnitude impact of combined noise level is assessed to be medium given combined daytime noise level greater than 60 dBA (ERM 2012). The sensitivity of the receptors is medium based on the baseline noise results against to IFC standards of noise level for daytime. Overall, significance of the impact is considered Moderate.

Vibration

The assessments for damage assessment and annoyance assessment are undertaken for four subcomponents based on the Equation 5.5 and Equation 5.6 in which the results are presented in Table 3.16 (see Annex 3). Comparing the calculated with the Vibration Damage Potential Threshold Criteria (PPV) and the Vibration Annoyance Potential Criteria (VdB) (Table 5.6), it is found that the vibration levels of bulldozer, excavator, crane, concrete mixer and pile jack are not likely to cause harm to building structures and human annoyance. In contrast, building is affected within 5m from truck and drilling operation; human is perceptible with vibration within 10m from those operation. The most severe impact of vibration comes from the operation of piling work given it will cause structures damage and human annoyance within 23m radius.

c) Wastewater

Wastewater generated during this phase includes domestic wastewater, construction wastewater and storm water.

(i) Domestic wastewater

There will be domestic wastewater stream originating from the area of office, toilets and washing facilities from the construction workforce and visitors. With the peak number of construction workers about 25 residents, the domestic wastewater can be estimated around 1,125 m^3 per day (45 liters per person per shift) for water consumption of one person). If this wastewater types is not well managed, the surface water will be potentially contaminated with high concentration of solids (suspended and dissolved), biochemical oxygen demand (BOD) and chemical oxygen demand (COD), nutrients (nitrogen, ammonia) and faecal coliform counts.

The discharge of domestic effluent is within 2 -4 years, where impact extent is local and impact scale is estimated to be point-based sources from the project area. In addition, the domestic wastewater is significant in pollutant loading. The magnitude of this impact is expected to be Large. Sensitivity of receiving receptors includes TLBCNL Canal, Sai Gon River, and Cho Dem River is considered Medium. Overall, significance of the impacts is estimated Major.

(ii) Construction wastewater

Wastewater generated from construction works include foundation, piling concrete mixing, washing of workplace and tools. If this wastewater type cannot be controlled properly, it will effect to water quality of TLBCNL Canal, Sai Gon River and Cho Dem River by elevating the suspended solid and other contaminants (i.e. debris, oils, fuel, and grease)

The magnitude of impacts is considered Medium. The sensitivity of receiving stream (TLBCNL Canal, Sai Gon River and Cho Dem River) is considered Medium. The significance of potential impacts to surface water quality is considered Moderate.

(iii) Runoff water

The facilities construction activities may result in loosened top soil at some areas, resulting in increased runoff to adjacent water bodies. Surface runoff from the exposed soil surface stockpiling, backfilling, etc. can be expected to contain elevated suspended sediments (SS) and may also contain debris (discarded construction material, vegetation) and other contaminants (e.g. oils, fuel, grease etc.). Increasing SS in the canal is enabling to change water characteristics where some organism in the canal can be negative influenced.

The assessment has indicated that impacts to water quality as a result of stormwater runoff discharge are expected to be localized, periodic, short-duration occurring over 2 years of the construction period. The magnitude of the impacts is considered medium. Receiving receptors includes TLBCNL Canal, Sai Gon River, and Cho Dem River. Regarding to Decision No. 16/2014/QĐ-UBND of HCM, the water quality of those receptors will classified B level meaning that their water quality is not concern for water supply or any entertainment purposes. Therefore, the sensitivity of those sensitive receptors is considered Medium. Overall, the negative impact is ranked of Moderate significance.

d) Solid waste

Solid waste generated from activities of four sub-components comprise of domestic solid waste, construction waste and hazardous waste.

(i) Domestic solid waste

Solid domestic waste includes paper, cardboard, unused food, metal, wood, etc. A worker produces about 0.35 kg of waste per day . With the number of workers is estimated about 80 people for each item, the amount of solid waste should generate around 28 kg/day/work. This solid waste contains 60-70% organic ingredient and 30-40% other substances, and may contains many bacteria, pathogens. These solid wastes would be collected and processed in order to limit the negative impact on human health and the local environment. The number of workers in the construction phase is not too much, so the amount of solid waste generating from construction area is insignificant. However, inappropriate waste disposal can cause environmental impacts on hygiene, human health and aesthetic qualities as well as provide habitats for disease vectors. Quality of land, air and water can be adversely affected.

(ii) Construction waste

Construction-generated solid waste causing by drainage pipeline installation, dredging process., The soil excavated is 1,271,095 tons as estimated in Table 5.12. Assuming 50% of that will be reused for refilling, total soil volume transported to disposal site should be 635,547.5 tons. At the time of writing this report, the amount of dredged sludge of subcomponent 4 cannot be defined due to limited information of dredging plan. However, it is anticipated that the volume of dredged sludge should be significant.

(iii) Hazardous waste

After operating, the machinery and construction vehicles using on site must be maintained to avoid damage and ensure the stable operation. This process will generate an amount of waste oil and cleaning rags, oil machinery, oil tanks, etc., but the volume of waste oil is expected to be the most. The amount of oil for once change is estimated about 16 liters/truck. The changing cycle is about 3-6 months, depending on the working time of machinery. The estimated amount of Waste oil for once change is 10 liters.

The amount of waste generated during construction phase is significance, especially construction waste and dredged sludge. The solid waste is generated during 2 years to 4 years, considered a short-term duration; the extent of its impacts is localized. Therefore, the magnitude of the impact is Large. The sensitivity of the environmental and social receptors surrounding the subcomponents sites are estimated Medium. Consequently, the overall significance of impacts is Major.

e) Soil and groundwater

Soil and groundwater contamination during the construction phase may result from leaks and spills of oil, lubricants, or fuel from heavy equipment, improper handling of sanitary effluent and waste or chemical/fuel storage.

Oil, lubricants and fuels are used by the vehicles and heavy equipment operating during the construction phase. Spills and leaks may occur during vehicle/equipment operation, fuelling, and maintenance. Temporary storage of fuels/oil/lubricants is also a potential source of spills/leaks.

The construction of the project may involve the temporary use of various chemicals. Accidental releases of these chemicals may result in a sub-surface impact.

The construction activities will generate various types of hazardous wastes (e.g. waste oils, oily rags and containers, chemical-stained containers, batteries, discarded fluorescent bulbs, etc). Construction workers working on-site will also generate domestic waste and wastewater. These waste streams, if not properly managed, will be released to the ground and have the potential to impact the subsurface environment.

Contaminated or polluted soil can directly affect human health through direct contact with soil or via the infiltration of soil contamination into groundwater aquifers, sometimes in areas far from apparent sources of above ground contamination.

Extent and scale of the impacts are dependent on the magnitude of the spills or leaks. It may transport further downstream if those incidents are significant. The permeability of soil at the project site is ranged from $3x10^{-6}$ to $8.8x10^{-4}$, indicating a medium vulnerability of contaminating the soil and groundwater. Sensitivity of soil and groundwater is considered High based on the surveyed results. Overall, the sensitivity of soil and groundwater is ranked High. The magnitude of such impacts is considered Low based on characterizes of works. Overall, the significance of the impacts is Moderate.

f) Traffic management

Total estimated trips of material and waste transportation is 557 trips per day, considered as considerable trips, potentially significantly increasing the number of vehicles on the local road and inland waterway and affect the normal traffic flow. For inland waterway, the traffic can be disturbed from blockage of waterway to constructing the sluice gate and ship locks and dredging in the secondary canal. For road transportation, traveling to the roads directly connect to the project site, such as Nguyen Oanh, Nguyen Kiem, Truong Chinh, Cach Mang Thang 8, Cong Hoa, etc. will make the traffic congestion more visible.

With waste transportation, the destination should be Da Phuoc Landfill that will potentially be assigned as disposal site of the project. In order to travel to Da Phuoc Landill, following routes should be considered:

(i) Scenario 1: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 1 (Nuoc Len Creek to Can Giuoc River to Da Phuoc Site) in which the traffic flow is characterized low.
(ii) Scenario 2: All excavated material transported by barge (the transfer site inside project area) follows the waterway transportation route option 2 (Vam Thuat end to Sai Gon River to Tau Hu Ben Nghe Canal to Ong Lon Creek to Da Phuoc Site) in which the traffic flow is characterized low.
(iii) Scenario 3: All excavated material transported by barge to the transfer site inside project area) follows the land transportation route option 3 (Nuoc Len Creek to Nguyen Van Linh street to Highway 50 to Da Phuoc Site) in which the traffic flow of inland waterway and land is respectively characterized low and high.

For material transportation, the material providing sources can be at surrounding provinces, such as Long An, Tien Giang, Dong Nai, Vung Tau and Binh Duong. Those provinces are also connected to Ho Chi Minh City through inland waterway network; therefore, in addition to road transport option, the inland waterway should be a potential alternative. As mentioned above, the roads to project site are almost crowded and potentially congested if the project transport enters to in the rush hours.

In summary, the traffic flow on roads is more crowded than that on inland waterway. Therefore, impact magnitude on traffic flow is assigned as Small for inland waterway and Large for road transportation during the rush hours. The sensitivity of the receptor is estimated Medium. Overall, the impact significances are ranked as Minor and Major for inland waterway traffic and land traffic.

g) Social disturbance

Contact between constructions workers and the local residents are expected to be significant. As a result of migrant influx, the non-local workforce will bring along with it its own behavioural traits, habits and lifestyle which may at times be alien to the local community. These behavioural traits may cause discomfort/ inconvenience to the community resulting in disagreement and at times conflicts. There are some potential impacts between local community and construction workers include risk of prostitution, increased tension between local between local men and the contractors in question, and increased alcohol and drug abuse. Further assessments are referred from Chapter 6.

h) Biodiversity

The wealthy of the Canal biodiversity will be affected by many of different activities of the subcomponents including:

- Reduced mixing between the water of Canal and Cho Dem river/Sai Gon River will enhance the settlement of suspended solid, where the sediment thickness will be increased, that alters the ambient environment of the benthic organism, particularly nearby the sluice gates. In addition, slightly saline water of Cho Dem River/Sai Gon River will potentially increase salinity of the Canal water, where the salt resistant organism can potentially be dominant, instead of the native organism.
- Dredging sludge in the secondary canal will make the water more turbid that reduce sunlight to photosynthetic organism in water column and in bottom. However, this is often a temporary problem lasting only as long as the dredging activities: the weeks or months.
- Domestic wastewater and solid waste generated from activities of subcomponents discharged to the Canal will greatly negatively change the water quality and then the wealthy of aquatic ecosystem.

If those issues cannot be controlled properly, the magnitude of the impacts is expected to be Large. Ecology baseline survey indicates that value of aquatic biodiversity is low with low conservation interest. Overall, the significance of the impacts on biodiversity is considered Moderate.

i) Risk on subsidence during construction of embankment, interceptor, sluice gate

During construction of facilities for component 2, following activities can cause the risk on subsidence:

- Embankment: Pilling is one of stage required for embankment process. As estimated in Section b) Noise and vibration, this machine can cause harm to building structures located within 23m radius. If the piling process is undertaken near the house, the cracks/collapse of the surrounding houses is visible.
- Interceptor: Pile Jack is mainly designed to minimize the social impacts during installation of sewage pipes. However, it can cause risks of subsidence if the process is not controlled well.
- Sluice gate and ship locks: given the units is located in the water, the risk of subsidence is potentially highly occurred, especially at two side of sluice gates and ship locks and the approach canal before and after sluice gate.

The incidents of broke embankment will directly affect the life of people living near the embankment system, affect the quality of houses, buildings and structures that located on protection range of embankment system. If no mitigation measures to control the subsidence are proposed, the likelihood of those incidents is high. The sensitivity of surrounding residents is high. Consequently, the overall significance of impacts is Major.

j) Disruption of navigation during rehabilitation of main canal and construction of tidal sluice gate

Currently, the inland waterway traffic has been still progressed in the Canal, but will be potentially affected from rehabilitation of main canal and construction of tidal sluice gate. The water will be diverted so as to allow installation of stalling 02 tidal gates and 05 shiplocks. In addition, a certain wet area of the canal will be occupied to undertake the pilling works. The impacts extent is localized at construction site from 2 to 4 years. As a result, magnitude of the impact is assigned Medium. The sensitivity of the waterway traffic should be assigned Medium for precaution purpose. Overall, the impact significance of those impacts is Moderate.

k) Impact on flooding

Flooding is potentially occurred when the construction works of those components affects to existing drainage capacity (i.e. replacing the existing sewage pipes, temporarily blocking the drainage to install new pipes, unintentionally blocking the sewage pipes following completion, change the slope or elevation of roads affecting the flow direction of storm water). However, the likelihood of those is generally low. The impacts of flooding are localized in temporary duration (i.e. a few hours). The magnitude of this is considered Small. The sensitivity of the local residents is assigned High. Overall, the impact significance is ranked Moderate.

5.1.4.3.Impact on operation phase

a) Impacts on hydrology regime and water quality of TLBCNL Canal

As the tidal sluice gate and ship locks enter operation, it will change the hydrologic regime and water quality of TLBCNL Canal whose positive and negative impact are presented as follow.

Positive impacts

- Water levels in TLBCNL Canal and its distributary canals can be controlled with the appropriate operation of the tidal sluice gate.
- Opening the tidal sluice gates at high tide will enhance a dilution of treated wastewater discharged from Tan Tao Industrial Park (IP), Tan Binh IP, Tham Luong Ben Cat Wastewater Treatment Plant and other small scale factories located in the catchment area of TLBCNL Canal.

Negative impacts

- As improperly being operated, the tidal sluice gate will reduce the dilution of Sai Gon River to the water of the TLBCNL Canal. In addition, improper operation can result the flooding for TLBCNL Canal distributary canals and drainage catchment, affecting to living condition of the local community.

The operation phase is permanent that can affect to flooding equalization and water quality of the canal if the operation is not undertaken properly. Scale of the impact can be estimated to include the drainage basin and distributary canals of TLBCNL Canal. Magnitude of the impacts is expected to be Medium. Sensitivity of the receptors, including affected residents and water quality of the Canal, is Medium. Overall, the significance of the impacts is Moderate.

b) Impacts on water quality

In the operation phase, the water quality of TLBCNL, Sai Gon River, and Cho Dem River will be improved; however, the water body can be re-polluted by the illegal wastewater discharging from both domestic and industrial wastewater, especially in dry weather. Even the TLBC Wastewater Treatment Plan are constructing to collect all wastewater generated from industrial and domestic activities, the water of the Canal is still re-contaminated occasionally if those contributors do not tightly legally committed to the government. In addition, the Canal water can be contaminated by residents discharging the solid waste and domestic wastewater to the Canal. Furthermore, the water quality can be affected from poor dilution with Sai Gon river due to inappropriate program of tidal sluice gates.

If those cannot controlled closely, the magnitude of the impacts on water quality can be Large. Receiving receptors includes TLBCNL Canal, Sai Gon River, and Cho Dem River. Regarding to Decision No. 16/2014/QĐ-UBND of HCM, the water quality of those receptors will classified B level meaning that their water quality is not concern for water supply or any entertainment purposes. Therefore, the sensitivity of those sensitive receptors is considered Medium. Overall, the impacts on water quality is identified Major.

c) Impact of solid waste

In a case that community awareness in environmental protection is not improved, throwing municipal solid waste into the canal may be frequently happened in operation phase. This makes the canal more polluted. In order to assess the magnitude of this impact, impacts of solid waste to Nhieu Loc Thi Nghe Canal should be referred. Regarding to the Environmental Information (2015) (a member of Foundation of Natural and Environmental Protection), the solid waste generation has been from 5 tons to 14 tons daily, mainly by the local community, including households along the Canal, residents and public bars.

Another aspect of impacts from solid waste to environment is sludge accumulated in the sewage system during operation phase and dredging sludge generated from maintenance program of the main and distributary canal and tidal sluice gate.

If those waste cannot controlled closely, corresponding impacts on environment is expected to be significant. The magnitude of the impacts on environment (i.e. water quality, soil and groundwater, air, public health) from solid waste discharge is Large. The sensitivity of the terrestrial and aquatic environment and residents at the Canal is Medium. Overall, the sensitivity of the impacts is ranked Major.

d) Impacts on biodiversity

The wealthy of the Canal biodiversity will be dependent on its water quality. As mentioned above, the water can be polluted due to the discharge of domestic and industrial wastewater and solid waste into the Canal. In addition, the inappropriate operation programs of tidal sluice gate also potentially increase the salinity and reduce the water quality of canal with poor dilution. If those cannot control properly, the wealthy of the Canal habitat can be threaten. Such potential issues indicate the large magnitude of the impacts on aquatic ecology. The value of ecology is expected to be Low due to its low conservation interest. Overall, the significance of the impacts on biodiversity is considered to be Moderate.

e) Impacts by odour

Odor is generated from sludge and solid waste accumulated in the sewage pipes and from dredging works under maintenance program of the main, secondary canals and tidal sluice gates.

Inadequate operation and maintenance of drainage system could cause odor in local area. However, the level of impact will not be significant and easily managed by the proper operation and maintenance of the Ho Chi Minh City

Ineffective operation of sewerage and wastewater collection facilities, especially for interceptors and pumping, if can create excessive odor, flooding in the area, and potentially serious health impacts. Blocking of garbage, soil, and other solid wastes could exacerbate the situation.

The impact extent of odor is localized, but may progress for a long time if no any measures to remove odor is proposed. The magnitude of those impacts is considered Medium. The sensitivity of the local residents is Medium. Overall, the impact significance is ranked Moderate.

5.1.4.4.Unplanned and accidental events

This section presents the probable impacts of unplanned events associated with construction and operation of the project component 1 and component 2. The unplanned events are considered separately from routine and non-routine activities as they arise as a result of a technical failure, human error, or as a result of natural phenomena. The unplanned events considered include:

- Occupation accidents
- Oil spill Incident;
- Vessel Collision;
- Fire, Explosion, and Toxic Release;
- Flood; and
- Cyclone/storm
- Traffic accidents
- Failure of system operation

The assessment of significant impact of unplanned events considers the probability of event occurring and estimates the severity of the consequences of the events. In assessment of severity of impact due to oil spill incident, fire, explosion, and toxic release, qualitative assessment was undertaken to predict the extent of the resulting impact. Following is an analysis of potential cause that can lead to those unplanned events.

Occupation accidents

High density of construction equipment in the construction site will lead to risks and hazards such as physical contact, spills, dust, emissions, and noise. Noise from these vehicles is also a hazard that the worker will have to bear. Slip and fall injuries are caused by working at height, working over water as well as poor housekeeping such as excessive waste debris, loose construction materials, liquid spills, etc. During construction phase, lack of good management and training for Workers might be high potential risk of slips and fall accidents. On the other hand, large construction area and the long construction period are also a factor for the risk of slip and fall occurring.

Struck by Objects is a hazard involved in construction and demolition activities. The hazards come from falling material or tools, ejection of solid particles, etc. and may cause injuries in the head, eyes, and extremities. Fatalities due to vehicle accidents are one of the main causes of fatality in the Construction Industry in general. The risks associated with transportation are exacerbated in congested areas like the Worksite. In particular, information suggests that the combination of poor drivers, poor vehicles and poor roads are significant contributory factors.

The long construction period (48 months) and the hard work involved in operating the construction equipment will cause over-exertion and ergonomic injuries and illnesses to the workers on the construction site due to repetitive motion, falls, over-exertion, and constant manual handling, among others.

Oil spill Incident

The transportation of fuel oil by road may cause a risk of spillage and fire/explosion when fuel lorry gets an accident on the road. It may causes risks to people who are traveling on and live near the road. The risks are inhalation of toxic chemical, fire, explosion and contamination of the environment to community.

Vessel Collision

Project activities including importation of construction materials, disposal of dredged materials during construction and operation of project port require inland waterway transportation. There will be an increase in the number of vessels navigating in-out the port as a result of the project that will increase the risk of collision or maritime incident. Project activities including the construction of port structure and dredging may obstruct the navigation of ships including. These activities may increase the risk of vessel collisions.

Fire, Explosion, and Toxic Release

The operation of the project involves certain dangerous substances that have potential to cause serious danger to person or damage to properties due to the fire, explosion, and toxic release or known as “Major Hazards”. The occurrences that are classified as a major hazard incident include: (i) Fire (loss of containment which could lead to fire, jet fire, fireball etc.); (ii) Explosion (Boiling Liquid Expanding Vapour Explosion (BLEVE), Vapour Cloud Explosion (VCE), dust explosion etc.); (iii) Implosion (for example, vacuum from steam condensation etc.); and (iv) Escape, spillage or leakage.

Flood

The underlying causes of flooding, heavy rain and high sea levels, are, essentially, uncontrollable. Flooding may post environmental and health impacts both construction and operation period. Flooding in the project area can be caused by heavy and extensive rainfall, coastal flooding for instance large wave, tide, and storm.

During construction, flood can mobilize pollutants such as sediment, oil, chemical and other building materials onsite into surface water and causing harm to aquatic animals. For Operation, the water can cause structural damage to equipment and building. Flood may trigger the secondary impacts if water can reach to the water reactive chemicals and result in fire, explosion, and toxic cloud.

Traffic congestion and accidents

During construction phase, a part of road will be occupied to undertake the construction of the project components. Reducing the road space will highly increase potential traffic congestion and accidents if the traffic flow through this area cannot be equalized. Traffic congestion will increase number of vehicles at certain space where can be polluted by air emission and noise generated from traffic vehicles. Local residents who have endured this impact for a long time will potentially challenge with respiratory sickness.

Cyclone/storm

Tropical storm is natural phenomenon that could result in severe property damage and potentially injury to personnel. The employees working at the sites are at risk due to severe condition and may lead to injury or fatalities. Run-off from the plant may contaminate surface water and soil. For the sites, storms may damage equipment or structures. Strong winds allegedly blew or bring down the facilities of projects whose movement can injure the workers onsite and local residents

Failure of system operation

During operation, facilities of the projects can fail in their operation and lead to error function that leads to negative results, such as flooding from error operation of tidal sluice gate or clogged sewer pipes due to solid waste. Some operation failures are objective, such as discharging solid waste to the Canal by the local community that is a hardship to deal with.

Following the analyzing the potential unplanned events, each project will be assessed impact magnitude and receptor sensitivity to identify the impacts significance of each unplanned events. The results of assessment are shown in Table 5.12.

Table 5.12 Impact assessment for unplanned accidental events

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
Occupational accidents	**Magnitude of the impacts**	The project is mainly related to equipment installation that can potentially expose to electric shock. The installation requires well trained employees. Therefore, the likelihood is unlikely. The magnitude of impact is small	The project utilizes the heavy machineries to undertake the work. Most of workers hired for this project are generally not fully educated. Therefore, if they cannot access the proper training to understand the scope of works and EHS policy and procedure, the occupational accident are visibly happened. Therefore, the likelihood is seen likely. The magnitude of the impacts is considered as medium.	Similar to Project subsubcomponent2. 1. The magnitude of the impacts is considered as medium.	Similar to subcomponent2.1, but given the duration of the project is more extended and the scope of works is more complicated, the magnitude of the impacts is considered major.	Similar to Project subcomponent2.1. The magnitude of the impacts is considered as medium.
	Receptor Sensitivity	Sensitivity of the employees onsite is ranked high	Sensitivity of the workers onsite is ranked high	High	High	High
	Impact significance	Moderate	Major	Major	Major	Major
Fire explosion and toxic release	**Magnitude of the impacts**	Given there are a number of heavy machineries utilized, chemical, such as fuel	Similar to component 1. In addition, any chemical spill or leakage will be able to release the toxic to surrounding environment,	Similar to Project subcomponent1, the magnitude of the impacts is	Similar to Project subcomponent 2.1, but given the duration of the	Similar to Project subcomponent 2.1, the magnitude of the impacts is

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
		oil, cleaning agents, are required. The use of those chemical can potentially cause fire and exploration. Given the likelihood of this incident is unlikely, the magnitude is classified medium.	where worker onsite and local resident can expose by inhaling or digestion pathway and where ambient environment can be contaminated. Given the likelihood of this incident is unlikely, the magnitude is classified medium.	considered as medium.	project is more extended and the scope of works is more complicated, the magnitude of the impacts is considered as major.	considered as medium.
	Receptor Sensitivity	Sensitivity of the employees onsite and local residents is ranked high	Receptors are workers onsite, local residents, ambient environment (surface water, groundwater, air, ecology). The sensitivity of these receptors is High.	High	High	High
	Impact significance	Major	Major	Major	Major	Major
Oil spill	**Magnitude of the impacts**	During construction phase, oil spill can be happened anytime if they are not stored properly and can be induced by the	Similar to Project component 1, the magnitude of the impacts is considered as medium.	Similar to Project subcomponent1, the magnitude of the impacts is considered as medium.	Similar to Project subcomponent 2.1, but given the duration of the project is more extended and the	Similar to Project subcomponent 2.1, the magnitude of the impacts is considered as medium.

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
		external factors, such as influence of workers, storm, and flood. The extend of this impact is on the ambient environment (surface water, groundwater, aquatic and terrestrial ecology and soil), local residents and workers onsite. However, this incident likelihood is expected unlikely. Therefore, the magnitude of the impact is Small.			scope of works is more complicated, the magnitude of the impacts is considered as major.	
	Receptor Sensitivity	Sensitivity of the employees onsite and local residents is ranked high	Receptors are workers onsite, local residents, ambient environment (surface water, groundwater, air, ecology). The sensitivity of these receptors is High.	High	High	High

Unplanned and accidental events	**Impacts Assessment**	**Component 1**	**Sub-component 2.1**	**Sub-subcomponent 2.2**	**Sub-subcomponent 2.3**	**Sub-subcomponent 2.4**
	Impact significance	Moderate	Major	Major	Major	Major
Traffic accident	**Magnitude of the impacts**	Traffic accidents can be potentially occurred during transportation of waste to disposal site and material to the project site. The likelihood of these should be unlikely. Magnitude of the impact is Low	This project site is at river bank, located at Nuoc Len creek, where the residents are not populated. The roads have not been through this site; therefore the impacts on land traffic are not significant. Even for inland waterway traffic, undertaking the construction works at this location will not raise many of traffic issues given the inland waterway traffic flow through this site has been also limited. The magnitude of the impacts is ranked Small.	Similar to Project subcomponent1, the magnitude of the impacts is considered as Small.	Given the project will occupy a portion of road to undertake the construction works, the movement of the traffic flow will be reduced, leading to traffic congestion, or even traffic accident. It is visible that traffic impact is the most concerned issue of this project when it enters to construction phase. The likelihood of this impact is likely. Therefore, the magnitude of	Similar to Project subcomponent3, the magnitude of the impacts is considered as Large.

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
					this impact is Large.	
	Receptor Sensitivity	Sensitivity of the local residents and workers are High.	High.	High	High	High
	Impact significance	Moderate	Moderate	Moderate	Major	Major
Flooding	**Magnitude of the impacts**	In HCMC, the flooding is formed due to failure of sewer system operation and high tidal period. The construction site may be challenged with flood with high tide period, where they can expose to the difficulty in the construction of tidal sluice gate and ship lock. However, this challenge is much belonged to technical solution. The	Similar to Project component1, the magnitude of the impacts is considered as low.	Similar to Project component1, the magnitude of the impacts is considered as low.	Similar to Project component1, the magnitude of the impacts is considered as low.	The project site is located in the Go Vap District where is considered less exposure with flood. However, when the rain is heavy, the potential flood may be visible, especially at area where the sewer system has been not operated well. The livelihood of the impact is likely.

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
		likelihood for this impact is unlikely. As a result, the magnitude can be classified Low.				Consequently, the magnitude is seen Medium.
	Receptor Sensitivity	The receptors are worker onsite, project facilities, ambient environment (surface water, soil and groundwater, terrestrial and aqautic widlife). Its sensitivity is medium.	Medium	Medium	Medium	Medium
	Impact significance	Minor	Minor	Minor	Minor	Moderate
Storm	**Magnitude of the impacts**	Recently, HCMC has some weather spell including high rain intensity, strong wind and cyclone. The appearance frequency of this is unpredictable at certain place, but	Recently, HCMC has some weather spell including high rain intensity, strong wind and cyclone. The appearance frequency of this is unpredictable at certain place, but visible to be occurring. The project is located along river bank, where is	Similar to Project subcomponent1, the magnitude of the impacts is considered as medium.	Similar to Project subcomponent1. However, given the location of the project is less exposure with the storm, the magnitude of the	Similar to Project subcomponent3, the magnitude of the impacts is considered as medium.

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
		visible to be occurring. The project is located along river bank, where is extremely feasible to be exposed by strong wind or cyclone. The likelihood of this impact is likely. As a result, this impact magnitude is considered Large.	extremely feasible to be exposed by strong wind or cyclone. The likelihood of this impact is likely. As a result, this impact magnitude is considered Large.		impacts is considered as medium.	
	Receptor Sensitivity	The receptor is local community, worker onsite, project facilities. Its sensitivity is medium.	The receptor is local community, worker onsite, project facilities. Its sensitivity is medium.	Medium	Medium	Medium
	Impact significance	Major	Major	Moderate	Moderate	Moderate
Failure of operation	**Magnitude of the impacts**	During operation, the inappropriate operation of equipment can lead to	During operation, the inappropriate operation of sluice gate can lead to failure of flooding prevention, particularly in high	Similar to subcomponent 2.1, the magnitude of the impact is	Following the completion of the Canal, it will attract more resident to	The operation of sewer system can be failed if those system are clogged

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
		failure of flooding forecast. This likelihood is likely. As a result, the magnitude of the impact is Medium.	tide period. This frequency becomes more practical in the severe weather, including high tide regime, heavy rain together with inappropriate operation of the sluice gate. This likelihood is likely. As a result, the magnitude of the impact is Medium.	Medium.	visit due to its upgrading facilities service. However, experience indicates that some of them will discharge the solid waste into canal. In addition, local community living along the canal, especially in bar shop, may discharge the wastewater into the canal. Another pollutant contributor is industrial park, factories and many of restaurant and business center located in	by solid waste and sediment discharged by the residents. It will reduce the drainage capacity of water that then leads to flooding. The likelihood of these impacts is likely. The magnitude is Large.

Unplanned and accidental events	Impacts Assessment	Component 1	Sub-component 2.1	Sub-subcomponent 2.2	Sub-subcomponent 2.3	Sub-subcomponent 2.4
					TLBCNL Catchment. The likelihood of these impacts is likely. The magnitude is Large.	
	Receptor Sensitivity	Local residents. Their sensitivity is Medium.	Local residents. Their sensitivity is Medium.	Medium	Water quality of TLBCNBLC Canal and local resident. Their sensitivity is medium.	Local residents. Their sensitivity is medium.
	Impact significance	Moderate	Moderate	Moderate	Major	Major

5.1.5. Requirement of level of assessment for FS proposed for Cay Kho va Phu Dinh

The FS proposed for Cay Kho va Phu Dinh needs to imply TOR that is designed to include environmental and social requirement to meet the OP4.01 - WB's policy on Environmental Assessment.

5.2. Proposed mitigation measures

There are several strategies (avoidance, minimization, rectification, and/or compensation) that have been applied to mitigate the potential negative impacts identified in above sections of this chapter. During the preparation of the project, effort has been made to avoid potential adverse impacts on resettlement and land acquisition by reducing scope and/or modification of the basic design of the project investment. In developing the mitigation measures the strategies to minimize and/or rectify the impacts have been applied and where appropriate compensation has been incorporated. The proposed mitigation measures to reduce the impacts due to land acquisition and resettlement are described in the RP and RPF.

This chapter identifies mitigation measures of the key project impacts during the construction (which include site clearance, ground leveling, and construction) and operation phases. Given that most of the key impacts will occur due to civil works and transportation of construction/waste materials, many of the potential negative impacts on physical, biological, and social environment could be mitigated through a set of general measures that are typically applied to most of construction projects to minimize impacts such as noise, dust, water, waste, etc. As part of the Environmental Management Plan (EMP) for the project these general measures have been translated into a standard environmental specification to be incorporated into the bidding and contract documents. These are referred to as Environmental Codes of Practice (ECOPs) and it will be applied to mitigate typical impacts of the project's civil works. Section 5.8.1 briefly explains the scope and content of the ECOPs, which are presented in Chapter 7.

However, for those project components there are site-specific impacts that require site-specific measures both during the construction and operation phases. Section 5.8.2 discusses site-specific measures during construction for the subcomponents that require mitigation measures beyond those identified in ECOPs. Section 5.8.3 describes site-specific measures to mitigate impacts of the key subcomponents during the operation phase. These measures are incorporated into the EMP of the project (Chapter 7).

5.2.1. Measure to Mitigate the Impact of Component 1

Based on the environmental impact assessment for component 1, the following table is provided to list out the mitigation measure.

Table 5.13 Mitigation measure proposed for project component 1

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	**Options for Prevention or Mitigation or Enhancement**
1. Pre-construction Phase	
Installation location identification and planning	Formulate installation site selection criteria for additional stations; utilize existing stations currently being utilized; conduct baselining activities for each station to mitigate impacts associated with new installations; select the best locations with the least impacts.
Property/land acquisition	Utilize public lands, and river easements as much as possible; thoroughly verify ownership documents with responsible government agencies if areas to be acquired for locations of ancillary facilities are privately-owned; compensate privately-owned lands in accordance with applicable Vietnamese Law.
Planning and detailed engineering design	Verify with the responsible agencies; comply with local zoning and building laws of the Vietnamese Government
Permit acquisition	Identify, secure, and comply with all permitting requirements associated with the project.
Procurement and selection of civil works Contractor(s)	Strict monitoring of Contractor(s) performance and compliance with established minimum performance standards and specifications by SRHMC, SCFC and/or DONRE'
Civil works Contractor(s), Mobilization	Provide a professional with experience in the implementation of environmental, occupational, health and safety requirements. Hire as many qualified locals within the immediate vicinity of the installation sites or those living within a reasonable commuting distance; otherwise provide temporary bunkhouses on-site or rent houses in neighboring areas if housing requirements cannot be accommodated in the project site. Encourage patronage for local goods and services; priority of hiring will be those that will be economically-displaced; hire as many qualified locals within the immediate vicinity of the installation site or those living within a reasonable commuting distance of the project site. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Options for Prevention or Mitigation or Enhancement
2.0 Construction Phase	
2.1 Site preparation and removal of materials and debris in each installation site	Formulate traffic management plan where applicable; minimize the presence of parked equipment that may disrupt traffic flow; properly implement the traffic management plan.
	Minimize vegetation loss; modification following established design considerations; compliance with local zoning ordinances
	Provide protection of stockpiles; minimize stockpiling; keep stockpiles away from adjacent waterways; immediately stabilize excavated areas to minimize soil loss during downpours
2.2 Relocation of affected utilities (where maybe applicable)	Coordinate with service providers; ensure proper notification of affected areas through the tri-media; restore services as quickly as possible; schedule disruptions during non-peak hours.
2.3 Equipment foundation excavations/preparation works	Regular watering services during dry periods; minimize/clean spillages on the ground; minimize exposure of stockpiles to wind by covering with appropriate materials. Construction activities shall follow the detailed engineering design plans
	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicles in the road leading to the installation sites. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.
	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.
	Hire as many locals especially those that will be economically displaced by the project due to resettlement.
2.4 Structural; mechanical; electrical; ICT; and water,	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	**Options for Prevention or Mitigation or Enhancement**
sanitation, telecommunications, and fire protection works (in facilities housing ICT installations) related to the equipment/instruments installations and operations	requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.
	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.
	Provide protection of stockpiles; minimize stockpiling; keep stockpiles away from waterways; stabilize excavated areas immediately to minimize soil loss during downpours
	Hire as many locals especially those that will be economically displaced by the project.
2.5 Finishing works related to the equipment/instruments installations and operations	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.
	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.
	Hire as many locals especially those that will be economically displaced by the project.
2.6 Testing and commissioning of the equipment/instruments	Formulate hiring eligibility requirements; advertise available positions and requirements; select the most appropriate and highly qualified staff meeting the hiring eligibility requirements.

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Options for Prevention or Mitigation or Enhancement
	Formulate a Health, Safety and Environment Manual or Plan prescribing organizational and resource requirements, as well as compliance with Vietnamese Government Occupational Safety and Health Standards; hire qualified staff; comply with international standards in the absence of specific requirements; work areas where testing shall be done shall be properly barricaded and provided with warning signs to keep nearby residents from venturing into the work areas; follow manufacturer' manual of instructions.
2.7 Construction debris disposal and management (demobilization of Contractor)	Cover debris during transport operations; re-route transport traffic on less congested roads; no prolonged parking for construction vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.
	Coordinate with land owners or companies requiring reclamation/ fill materials; coordinate with PCs with regard to approved disposal sites within their territory; coordinate with national government agencies that have on-going reclamation activities
	Formulate traffic management plan; re-route transport operations in less congested roads; coordinate with PCs in regard to traffic management requirements
3.1 Installation operation and maintenance	Arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment Prepare preventive maintenance schedule; identify and repair causes of malfunction Provide backup generator; identify and repair cause of failure; prepare preventive maintenance schedule; report power loss to Service Provider. Identify and repair cause of failure; report telecommunications loss to Service Provider. Provide backup systems; identify and repair cause of failure;

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Options for Prevention or Mitigation or Enhancement
	prepare preventive maintenance schedule; report failure to fire protection installation company.
	Provide backup water storage system; prepare preventive maintenance schedule; report water interruptions with the Service Provider
	Formulate a human resource management plan; provide training and educational scholarships with fixed tenure bonding as may be allowed under Vietnamese regulations (i.e. for every year of scholarship, the staff will stay for 3 years of service. Otherwise, staff will pay for the full cost of the scholarship expenses.); provide industry-competitive salaries and incentives.
3.2 Field data acquisition, data processing and information management	Formulate field data acquisition protocols; provide training to staff; provide quality control checks

5.2.2. Measures to Mitigate General Impacts during Construction

The ECOPs describe typical requirements to be undertaken by contractors and supervised by the construction supervision consultant during construction. The final ECOPs will be incorporated into the bidding and contract documents (BD/CD) during the detailed design stage. Scope and content of the ECOPs is as follows:

Scope: Construction activities for small works governed by these ECOPs are those whose impacts are of limited extent, temporary and reversible, and readily managed with good construction practices.

The measures identify typical mitigation measures for the following aspects:

- Dust generation
- Air pollution
- Impacts from noise and vibration
- Water pollution
- Drainage and sedimentation control
- Management of stockpiles, quarries, and borrow pits
- Solid waste
- Management of dredged materials
- Disruption of ecological resources
- Traffic management
- Interruption of utility services
- Restoration of affected areas

- Worker and public safety
- Communication with local communities

5.2.3. Measures to Mitigate Site-specific Impacts during Construction

5.2.3.1. Site-specific Measures for Construction of Nuoc Len tidal sluice gate and 2 ship locks

The subcomponents impacts are considered to be major, short term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts include risks due to land clearance, including house, trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries, UXO, blocking the water flow of the Canal at construction site, contaminating surface water due to waste discharge (i.e. oil spill, run-off storm water, domestic wastewater, construction wastewater), inland waterway traffic incidents (i.e. congestion, accident) at construction site, noise and vibration from the extensive pile driving required for constructing the tidal sluice gate and ship lock, dust and VOC (asphalt) emission from road construction works

To mitigate impacts of the project construction, following measures will be carried out by the PMU:

- Clear the area before construction by qualified and licensed UXO clearance experts;
- Ensure that there is no land clearance outside defined construction site boundaries;
- Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction;
- Ensure the contract for the works requires the contractor to prepare a plan for working at site to manage the waste generated from construction activities to prevent the contamination of water at area surrounding the construction site, to fully implement health and safety policy to prevent the any incidents affect to workers onsite and surrounding community;
- Assigning the flagman to control the inland waterway traffic flow through the construction site; and
- Ensure that pile driving work is carried out only during daylight hours, on normal working days.

5.2.3.2. Site-specific Measures for Construction of Vam Thuat tidal sluice gate and 2 ship locks

The subcomponents impacts are considered to be major, short term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are identical to those for the Nuoc Len tidal sluice gate and locks referred to above. To mitigate the impacts the following measures will be carried out by PMU: As for the Nuoc Len works above.

5.2.3.3. Site-specific Measures for Dredging and construction of canal bank revetment in the main canal of TLBCNL Canal

The subcomponent impacts are considered to be major, long term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs.

For dredging sludge and upgrading the embankment of the Canal, key site-specific impacts include risks due to UXO; odor and other contamination resulting from the excavation, transport, and disposal of approximately 1,778,701.45 m^3 of wet sludge with a high organic; noise and vibration from the extensive pile driving required by the design for the channel protection works.

For constructing the roads along the Canal, key site-specific impacts include risks due to land clearance, including house, trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries construction, traffic causing danger within the construction site and also to residential and other areas outside the site; vibration from construction equipment damaging buildings in close proximity to the construction site; and dust and VOC (asphalt) emission from road construction works.

To mitigate impacts of dredging sludge and upgrading the embankment of the Canal, following measures will be carried out by the PMU:

- Clear the area before construction by qualified and licensed UXO clearance experts;
- Ensure that the detailed design for the canal rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites (landfills for material that testing shows is not contaminated beyond specified limits, and prepared sanitary landfills – for example the existing site at Da Phuoc Landfill – for material that is contaminated beyond specified limits);
- In the case of dredged sludge transported to Da Phuoc Landill, the PMU needs to ensure a legal commitment between Da Phuoc Landfill, HCMC DONRE and PMU, whereby the Da Phuoc Landfill must ensure an availability of capacity for disposing the dredged sludge and construction waste.
- Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of the channel in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues such as noise, air emission, wastewater and security;
- Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; and

- Ensure that pile driving work is carried out only during daylight hours, on normal working days.

To mitigate impacts of road construction of the Canal, following measures will be carried out by the PMU:

- Ensure that the contractor prepares and implements a site specific environmental management plans (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOPs:
  - Ensure that there is no land clearance outside defined construction site boundaries;
  - Ensure that, from the commencement of construction, site drainage is a priority activity, to include channels, silt traps, flow abatement structures, etc.;
  - Ensure that borrow areas are developed, operated, closed, and restored in the same manner as earthworks sites for the project works, and that are subject to the same EMP and other contractual requirements;
  - Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic;
  - Ensure that equipment repair facilities, material stockpiles for example – are set up away from streams, residential areas, and other sensitive sites;
  - Ensure that all drivers, equipment operators, etc., are qualified for their respective tasks and are trained in, and required to adhere to, the site's traffic management plan; and
  - Ensure that all equipment are operated in appropriate manners; whereby they can reduce the impacts to surrounding environment and local people

5.2.3.4. Site-specific Measures for Construction of main interceptor in Go Vap district

The subcomponent impacts are considered to be major, short-term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts are identical to those for the Canal upgrading works referred to above, including UXO, noise and vibration from the extensive pile driving required by the operation of tunnel boring machine, dust and VOC (asphalt) emission from road construction works. However, there will be impacts for traffic disruption and site safety issues where the interceptors need to be taken across roads in deep trenches.

To mitigate the impacts the following measures will be carried out by PMU:

- Clear the area before construction by qualified and licensed UXO clearance experts;
- Ensure an appropriate traffic management plan that will be committed to implement by the PMU and their subcontractors to minimize the traffic congestion at and surrounding project site;

- Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of sewage pipes in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues and social issues.
- Ensure also that the contract requires the contractor, before he commences work, to provide a construction plan that sets out how the contactor will organize and maintain the EHS policy, schedule, workforces and facilities to complete the work within the requirement of EMP for this project proposed in Chapter 7; and
- Ensure that pile driving work is carried out only during daylight hours, on normal working days.

5.2.3.5. Site-specific Measures for Construction and improvement of primary and secondary combined sewer systems and the secondary interceptor in Go Vap district

The subcomponent impacts are considered to be major, short-term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts include risk due to UXO; odor and spillage resulting from the excavation, transport and disposal of wet, contaminated sludge accumulated in the existing sewer system, traffic disruption and site safety issues where the interceptors need to be taken across roads in deep trenches.

To mitigate the impacts the following measures will be carried out by the PMU:

- Clear the area before construction by qualified and licensed UXO clearance experts;
- Ensure that the contract requires the contractor to prepare a detailed work methodology, prior to commencing work, for excavation, transport, and disposal of sludge accumulated in existing sewer system;
- Ensure an appropriate traffic management plan that will be committed to implement by the PMU and their subcontractors to minimize the traffic congestion at and surrounding project site;
- Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of sewage pipes in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues and social issues.
- Ensure also that the contract requires the contractor, before he commences work, to provide a construction plan that sets out how the contactor will organize and maintain the EHS policy, schedule, workforces and facilities to complete the work within the requirement of EMP for this project proposed in Chapter 7; and

5.2.3.6. Site-specific Measures for Improvement of secondary canals (Hy Vong, Cau Cut,

Ba Mieng, Ong Tong, Ong Bau, Chin Xieng)

Similar to the Canal upgrading works, the subcomponent impacts are considered to be major, short-term and localized and most of them can be mitigated through the typical mitigation measures identified in ECOPs. Key site-specific impacts include risk due to UXO; odor and other contamination resulting from the excavation, transport, and disposal of wet sludge with a high organic

To mitigate these impacts the following measures will be carried out by the PMU:

- Clear the area before construction by qualified and licensed UXO clearance experts;
- Ensure that the detailed design for the canal rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites (landfills for material that testing shows is not contaminated beyond specified limits, and prepared sanitary landfills – for example the existing site at Da Phuoc Landfill – for material that is contaminated beyond specified limits);
- In the case of dredged sludge transported to Da Phuoc Landill, the PMU needs to ensure a legal commitment between Da Phuoc Landfill, HCMC DONRE and PMU, whereby the Da Phuoc Landfill must ensure an availability of capacity for disposing the dredged sludge and construction waste.
- Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of the channel in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues such as noise, air emission, wastewater and security;
- Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; and
- Ensure that pile driving work is carried out only during daylight hours, on normal working days.

5.2.4. Measures to Mitigate Impacts during the Operation Phase

5.2.4.1. Site-specific measures for operation of Nuoc Len tidal sluice gate and 2 ship locks

Inappropriate operation program of tidal sluice gate and ship locks can affect the tidal regime of TLBCN Canal and its dilution capacity that leads to low performance of the water quality improvement and flooding abatement of whole canal. It is proposed a scientific development of the operation program of tidal sluice gate and ship locks in the regard of tidal regime related to water quarter dilution and flooding abatement, where technical professional expert must be included.

5.2.4.2. Site-specific measures for operation of Vam Thuat tidal sluice gate and 2 ship locks

Measures for the Vam Thuat tidal sluice gate and locks are similar to that for the Nuoc Len; therefore, they are referred to above.

5.2.4.3. Site-specific measures for operation of canal bank revetment in the main canal of TLBCNL canal

Following the completion of the canal bank revetment and associated facilities (i.e. park, light, upgraded pavement), more residents will visit this place, contributing the high potential of waste generation, such as solid waste and wastewater, which affects the water quality of the Canal. In addition, the water quality can be re-contaminated by the illegal discharge effluent from discharge contributors (Industrial parks, factories, local community). Furthermore, after the canal habitat is rehabilitated, fish community may grow up and attract hunting activities of local fisher. If this activity cannot be balanced, it may affect the aquatic ecosystem the Canal. On top of this, after road construction is completed, there will be operations of various vehicles on the new road. Key short term impacts would include an increase in traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic; premature failure of pavements, embankment or cut slopes, and drainage structures due to inadequate maintenance.

To mitigate these impacts the following measures will be carried out by PMU:

- Organizing a campaign of increasing awareness of local community toward environmental protection for TLBCNL Canal, where authorities, NGOs and community living along the Canal should be involved.
- Other measures include: (i) applying financial penalties for who intentionally discharges waste into the Canal or hunts fish, (ii) regularly collecting solid waste and sediment in the Canal by an assigned sanitary team, (iii) more frequent monitoring of water quality of discharge contributors, especially at industrial park and factories.

Moreover, in order to control the traffic flow on the new roads, following measures will be implemented by the city road maintenance agency:

- Ensure that traffic safety provisions, including signs, lights, and pavement markings, that were installed during construction are permanently and effectively maintained, and renewed as necessary;
- Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition;
- Ensure, with the assistance of the traffic control authority, that overloaded vehicles do not use the road.

5.2.4.4. Site-specific measures for operation of main interceptor in Go Vap District

Ineffective operation of sewerage and wastewater collection facilities, especially for interceptors and pumping, if can create excessive odor, flooding in the area, and potentially serious health impacts. Blocking of garbage, soil, and other solid wastes could exacerbate the situation. In order to resolve these issues, the maintenance program should be proposed, financed and ensured to be implemented by the City's/Drainage Company. In addition, the issues of solid waste discharge from local community should be integrated in the increasing awareness campaign proposed in Section 5.8.4.3.

5.2.4.5. Site-specific measures for operation of primary and secondary combined sewer systems and the secondary interceptor in Go Vap District

Measures for this project component are similar to those for main interceptor in Go Vap District; therefore, they are referred to above.

5.2.4.6. Site-specific measures for operation of secondary canals (Hy Vong, Cau Cut, Ba Mieng, Ong Tong, Ong Bau, Chin Xieng)

Given the issues generated from this project component during operation phase is identical with the project of upgrading the TLBCNL Canal, mitigation measures proposed will also be identical with those of project component 3.

5.3. Cumulative Impact Assessment

5.3.1. General approach

International Finance Corporation proposed a Good Practice Handbook to assess cumulative impact of a project. Good practice requires that sponsors assess if project may contribute to cumulative impact on VEC's (valued environment components). When there is a lack of baseline data the handbook propose to develop a Rapid Cumulative Impact Assessment Approach. The Good Practice Handbook, also proposing a logical framework with six interactive steps. Figure 1 below illustrates this approach.

The sequence of activities is:

1) Determine project boundaries
2) Identify Valued Environmental Components (VEC)
3) Determine present conditions of VEC
4) Assess the contribution of project
5) Predict the cumulative impact of project
6) Design mitigation measures.

Indicators for five VECs were identified and required a model depicting the change in watershed conditions. We used a map describing the zone of influence (ref to sampling section). A variety of data was used from previous studies. Project development scenarios for

20 years into the future are using a combination of trend analysis. The model selected is evaluated with the Chemiotox Index tool

Once the cumulative impacts are determined, their significance must be considered relative to an established threshold limit, an established legal guideline or policy, or a qualitative assessment based on professional opinion and consultation. In any case, the significance of the cumulative impacts must be defensible. The significance of the cumulative impacts and the contribution of the project must be subsequently evaluated by project decision makers. The consultant needs to define the level of "significance" or scale and apply it consistently. The significance should be assessed across past, present and future projects on the trends of each VEC. The significance of the project interventions' contribution to the cumulative impacts should be defined in one of the following ways:

- The project has a measurable effect on the resource;
- The project acts in conjunction with the effects of past present or future projects and activities; and
- The project in conjunction with other projects and activities shifts the resource to an unacceptable level or exceeds a threshold such that the impact is considered significant, in that:
  - The project's contribution to cumulative effects is responsible for exceeding or not the threshold and therefore is significant or,
  - The project is contributing with the effects of other projects and activities and the project contribution may or may not be significant, depending on the level of the contribution.

The Chemiotox Index model is a mathematical tool for evaluating the overall picture of the toxic substances discharged into the environment. This evaluation is based on the chemical characterization results of toxic substances (mg/L), following the weighting (FTOX) of the relative toxic potential of each substance present in the waste discharged. For practical purposes, partial indicators (Chemiotox unit, CU) are calculated on the basis of individual results of each toxic substance in order to integrate these and obtain an overall indicator (Chemiotox Index, $CI = \Sigma\ CU$). These indicators allow the comparison and integration of important quantities of characterization data.

The toxicity weighting methodology is quite simple and, serves uniquely *environmental management purposes*. Water quality criteria represent an exhaustive census of toxicological information on pollutants (*persistence, bio-accumulation and part of the food chain*). This census aims to define the acceptable concentration limit (mg/L) for the protection of human life and aquatic ecosystems. The more toxic the substance, the smaller the criterion. In the CHEMIOTOX model, two water quality criteria were retained, that is the chronic toxicity criteria (CTC, mg/L) and those pertaining to the contamination of aquatic organisms (CAOC, mg/L).

With these two types of criteria, the toxic effects of chronic exposure to a substance and its bio-concentration capacity in the food chain are both taken into account. The toxic weighting factor, F_{TOX-I} related to each substance I, could be arbitrary by defined as proportional to the inverse of the most stringent water quality criterion for each substance (MSC_I):

$$\boldsymbol{Most\ stringent\ criteria = Most\ severe\ of\ CTC\ and\ CAOC}$$

Or:

$$\boldsymbol{MSC_I = Min\ (CTC, CAOC)}$$

Then, for purposes of managerial communications, the $\mathbf{F_{TOX-I}}$ could be arbitrarily defined as the ratio of $MSC_{REFERENCE}$ of a reference substance to the MSC_I of the concerned priority pollutant I.

$$\boldsymbol{F_{TOX-I} = \frac{MSC_{REFERENCE}}{MSC_I}}$$

This is a dimensionless number that represents the toxic potential of a pollutant I in comparison to the toxicity of a reference contaminant. Generally it is recommended to select as reference a well-known contaminant. It has to be assigned to a given pollutant to evaluate its relative importance in the global discharge of a list of priority (selected) pollutants.

The reference substance could be the well-known parameter Fe_{TOT} whose most stringent criteria is equal to 0,3 mg/L (CAOC). In this case, the F_{TOX-I} of a substance i becomes as follows:

$$\boldsymbol{F_{TOX-I} = \frac{MSC_{Fe}}{MSC_I}}$$

Let remind that it is necessary to select a well-known reference contaminant for environment management and large communication purposes. Illustrate the usefulness of the tool with the data and results gathered for the channel THAMLUONG – BENCAT –NUOCLEN in order to summarize the state of the situation in some simple figures that should be understood for most of project stakeholders.

5.3.2. Determine project boundaries

It is noted that environmental impact assessment for the project is conducted based on the guidelines of OP4.01. PMU and **exp** agreed on a Sampling Program which was conducted from June 2015 to September 2015. For deserving the design works, it is necessary to determine boundaries of zone of influence. As proposed in feasibility study, it is recommended by the Consultant to divide the zone of influence into 9 large drainage basins.

Some data were collected from previous monitoring data, available from the PMU, SCFC and DONRE (Department of Natural Resources and the Environment). However, in order to obtain sufficient baseline data for ESIA, **exp** carried out the required additional sampling and testing work for surface water, groundwater, sediment/sludge, soil, air quality, plankton & phytoplankton. Details on the Plan for measurement, sampling, collecting information, including information on: environmental monitoring, the number of sampling locations, monitoring parameters, sampling frequency and quality standards applied for result analysis are summarized in Annex.

Meanwhile, existing data were analysed and compilation was done and calculation were done with Chemiotox index analysis. The sampling point were completed at the stations identified with PMU. The next map show these sample point stations. Existing data referring to these sampling points were extracted to calculate the existing Chemiotox Index and to evaluate a cumulative impact of contamination before 2012 and in 2015.

5.3.3. Identify Valued Environmental Components (VEC)

The environmental components that will be considered and assessed are: air, climate and noise; soil and groundwater; water and aquatic resources (fauna and flora), sediment and settled sludge. For modeling and impact evaluation, impact on five VEC's will be measured. Information is collected to ensure a prediction of environmental quality of the following:

- Surface Water Quality – in the main TL-BC-NL canal and the secondary canals; Plankton & Phytoplankton in surface water
- Sediment and Sludge characterization including waste classification for hazardous waste;
- Groundwater Quality;
- Soil quality;
- Ambient air quality

5.3.4. Summarizing the past conditions of the VEC (before 2012)

In the preliminary step, it is necessary to produce the synthesis of previous results and data gathered during the feasibility studies (Components 1, 2, 4A, 4B, 6A and 6B) and from various environment monitoring reports in order to avoid the replication of future project monitoring activities.

Summary of results (before 2012) on surface water

For defining the quality of surface water the MoNRE has established the QCVN 08:2008/BTNMT. While it is not a complete and sufficient tool for managing and controlling the quality of rivers and other water bodies that must deserve simultaneous multiple purposes (supply water, supply water in case of available treatment plant, irrigation and fluvial navigation), one should rely at least on its quality criteria and add adequate other ones depending on each situation (spatial and temporal).

The details of calculations are presented in Appendices for interested lectors. The available results, one can preliminary estimate that the Environment Monitoring report (July 2011) reveals a greater level of cumulative environ impact (due to various discharge) within the central area, approximately close to CAUBUNG area. The situation should be worse approximately at the junction of the sewer CAUBUNG and the main channel. At this location the daily hydraulic tidal effects would be low and could not contribute to the purge-mix of surface water toward directly the Saigon River (at VAMTHUAT) and indirectly the CHODEM channel.

Summary of results (before 2012) on sediment/sludge

The QCVN 43:2012/BTNMT has been published in 2012. It can be serves as a technical explanation why monitoring campaigns aiming sediments & settled sludge had not focused enough on complete lists of heavy metals and other such organic toxic pollutants as pesticides. Hover on the basis of incomplete useful results the CHEMIOTOX INDEX methodology has produced a meaningful overview of the state on contamination and buildup of pollutants in the bottom volume on sediments along the main channel TL-BC-NL. The CHEMIOTOX calculations have been based on a mix of data from QCVN 43:2012/BTNMT and QCVN 03:2008/BTNMT, its equivalent for soils. Most of the monitoring activities before 2012 have been based on contaminants listed in the latter that includes the heavy metals Cu and Zn. The more recent QCVN 43:2012/BTNMT does not include these metals and Fe.

Summary of results (before 2012) on groundwater

Previous results (before 2012) are the less significant because water samples were not taken for piezometers (observation wells) implemented accordingly to a scientific method based at least on the knowledge of underground soil and aquifer layers. The water samples seem be randomly taken at available inhabitant wells. The inhabitants would find themselves the best locations for implementing useful wells offering suitable service water (domestic purposes) and avoid the contaminated locations. So we should give less attention to the previous results.

Summary of results (before 2012) on ambient air quality

The QCVN 05:2013/BTNMT and QCVN 06:2009/BTNMT together deserve the assessment of ambient air quality according the CHEMIOTOX INDEX methodology. The reference contaminant will be the well-known CO whose MAC is 30 000 μg/m^3 or 30 mg/m^3. Most of parameters listed in the QCVN 05:2013/BTNMT should be related to air contaminants due to local traffic or industrial combustion while the gaseous contaminants NH_3 and H_2S should be due to emanations from anaerobic biodegradation within the liquid body of the main channel or due to savage solid waste dumping along the banks of the main channel.

Table 5.14 The FTOX for ambient air quality

			QCVN 05:2013/BTNMT				Toxicity Factors			
No.	Parameter	Unit	Avg-1h	Avg-8h	Avg-24h	Avg-year	Ftox (1h)	Ftox (8h)	Ftox (24h)	Ftox (year)
	SO_2	µg/m^3	350		125	50	85,7			
	CO	µg/m^3	30 000	10 000	5 000		1,0			
	NOx	µg/m^3	200		100	40	150,0			
	O_3	µg/m^3	180	120	80		166,7			
	TSP	µg/m^3	300		200	140	100,0			
	PM_{10}	µg/m^3			150	50				
	Pb	µg/m^3			1,5	0,5				
			QCVN 06:2009/BTNMT							
	NH_3	µg/m^3	200				150,0			
	H_2S	µg/m^3	42				714,3			

The measured fluctuations along the main channel depend strongly of the contributor sources but also meteorological conditions (wind, rains, etc.). While the QCVN 05:2009/BTNMT establish a maximum allowable concentration (MAC) of 30 000 µg/m^3 for the well-known contaminant CO (carbon monoxide), the "bad" quality of ambient air can be assessed by a general approximate level of 80 – 130 000 µg/m^3 of CHEMIOTOX Units (or *µg/m^3 CO-equivalent toxicity*).

Fluctuations of SURFACE WATER characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	3,2	2,9	4,7	8,9	8,9	30,5	69,6		162	15,4	25,6	5,9	5,8	4,6	6,5	74,4	5,4	5,4	5,4	7,6	3,5

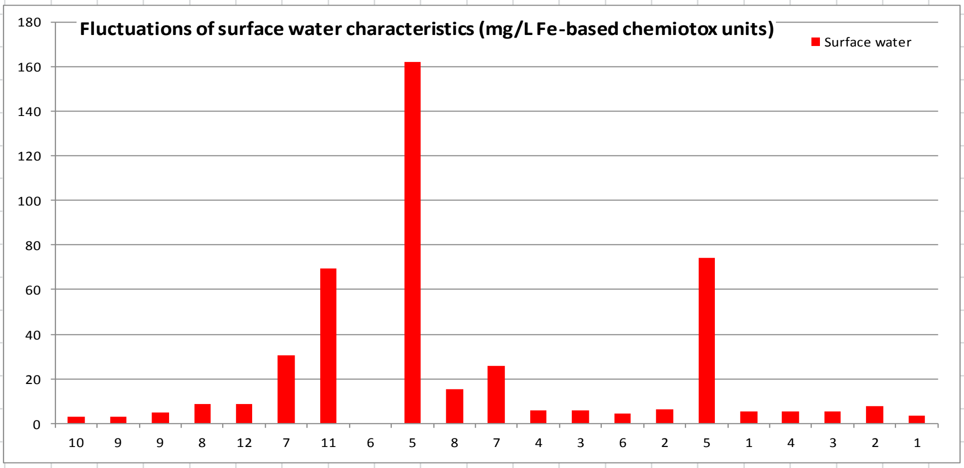


Figure 5.1 Overall portrait of surface water characteristics along the main channel TL-BC-NL.

Fluctuations of SEDIMENT characteristics along the main channel																					
Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	136,2		128,1		124,6		98,2			147,8	153,6	202,6	186,6	183,1	241,8	139,9				98,3	119,2

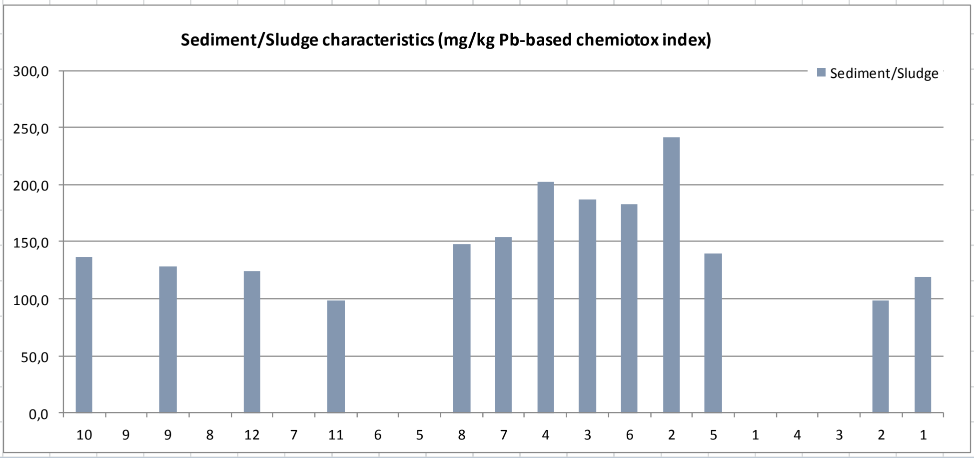


Figure 5.2. Overall portrait of the contamination of sediment and settled sludge.

Fluctuations of GROUNDWATER characteristics along the main channel																					
Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index		1,392		1,219		1,419		0,960	0,504		0,896	0,517	0,389		1,500	0,400	0,357	0,456			1,645

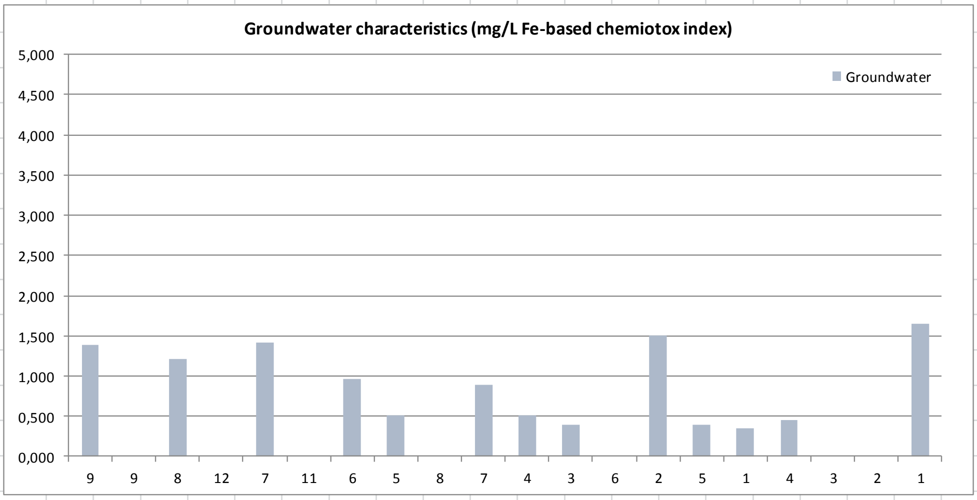


Figure 5.3. Overall portrait of the groundwater characteristics at private domestic wells.

Fluctuations of AMBIENT AIR characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	83 183	130 063	104 086	110 356	113 393	136 183	88 107	83 183	101 857	136 154	119 497			112 046	97 627	92 725	96 249	90 417		101 673	75 605

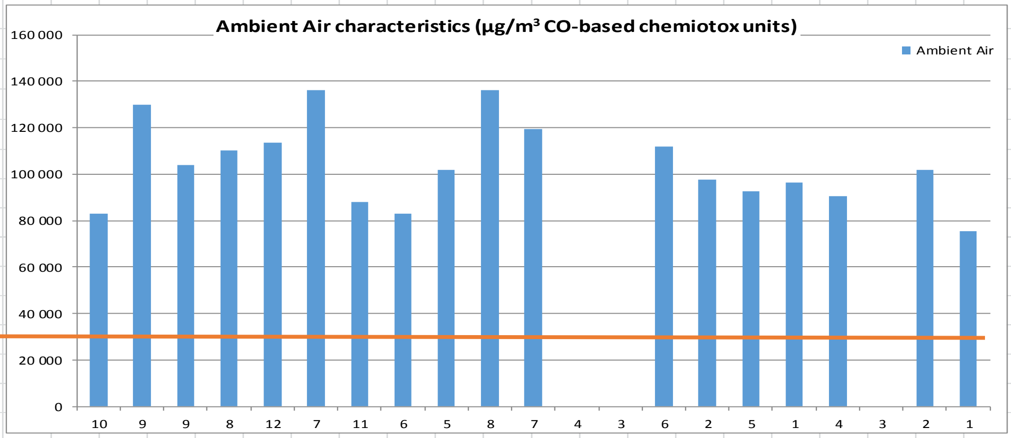


Figure 5. 4 Overall portrait of the groundwater characteristics at domestic wells.

5.3.5. Monitoring of present environmental conditions of VEC (in 2015)

The present environmental conditions of VEC (the state of the existing environment) have been consolidated by field monitoring campaigns completed in September 2015. This section present results screening of that campaign. Raw results will be gathered in the Appendices.

The maximum allowable concentrations listed on the QCVN 08:2008/BTNMT (surface water) under the column B2 (fluvial navigation purposes) have been considered for the calculations of the toxicity factors F_{TOX} related to each contaminant. The surface water has been characterized during the both conditions of low and high tide in order to understand the potential influence of hydraulic tidal effects. Traces of heavy metals have been largely analyzed (As, Cd, Pb, Cr, Cu, Zn, Fe and Hg). As usual, the MAC for the main contaminant Fe (2 mg/L) has been considered as reference for the calculation of F_{TOX}. For instance, in the case of the contaminant Hg, the calculation is as follows:

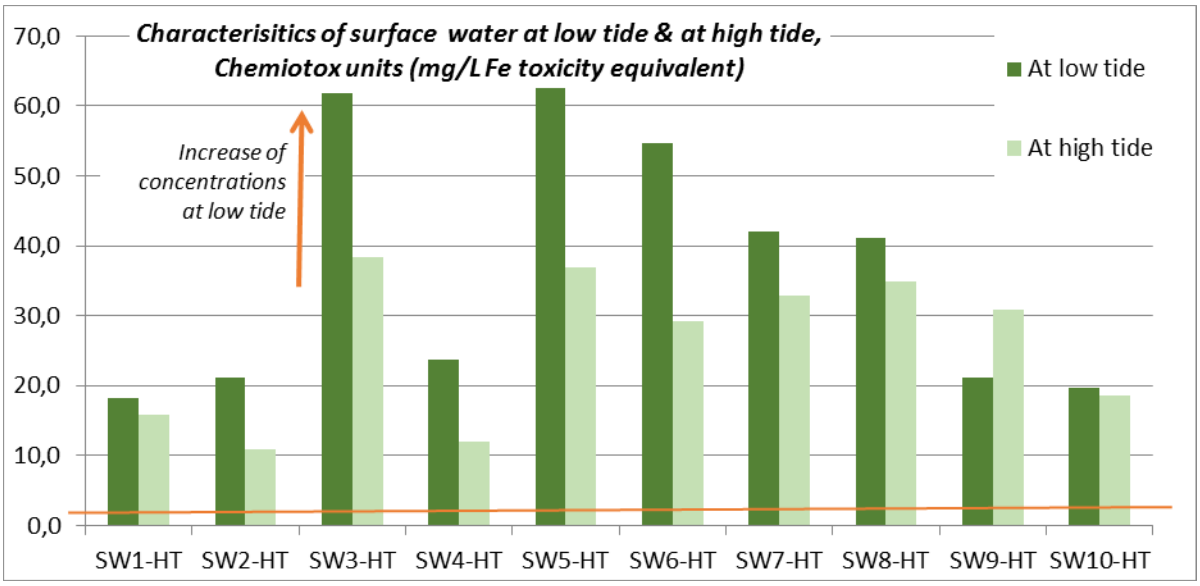
F_{TOX-Hg} = MAC of Fe / MAC of Hg = 2 mg/L / 0,002 mg/L = 1 000

Surface Water monitoring along the ThamLuong–BenCat–NuocLen channel

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 08:2008/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the CHEMIOTOX model uses the MAC for the parameter FeTOTAL: 2 mg/L (column B2: case of fluvial transportation). According to the calculations:

- At low tide, there is a build-up of the presence of contaminants if during this period, discharges of the latter continue on a regular or permanent basis (e.g. continuous discharge (24/7) of the final effluent of the wastewater treatment plant of BinhHungHoa, 150 000 m3/d, continuous free discharge of raw wastewater through combined domestic sewers, etc.)

- Build-up of contaminants seems more higher at monitoring locations where hydraulic tidal effects would be less important (from OngBau Canal/SW3 to ThamLuong Bridge/SW8)
- From a managerial point of view, the cumulative effects on aquatic fauna (plankton) and flora (phytoplankton) would be far greater than the ones due to the sole MAC of 2 mg/L of Fe toxicity equivalent.



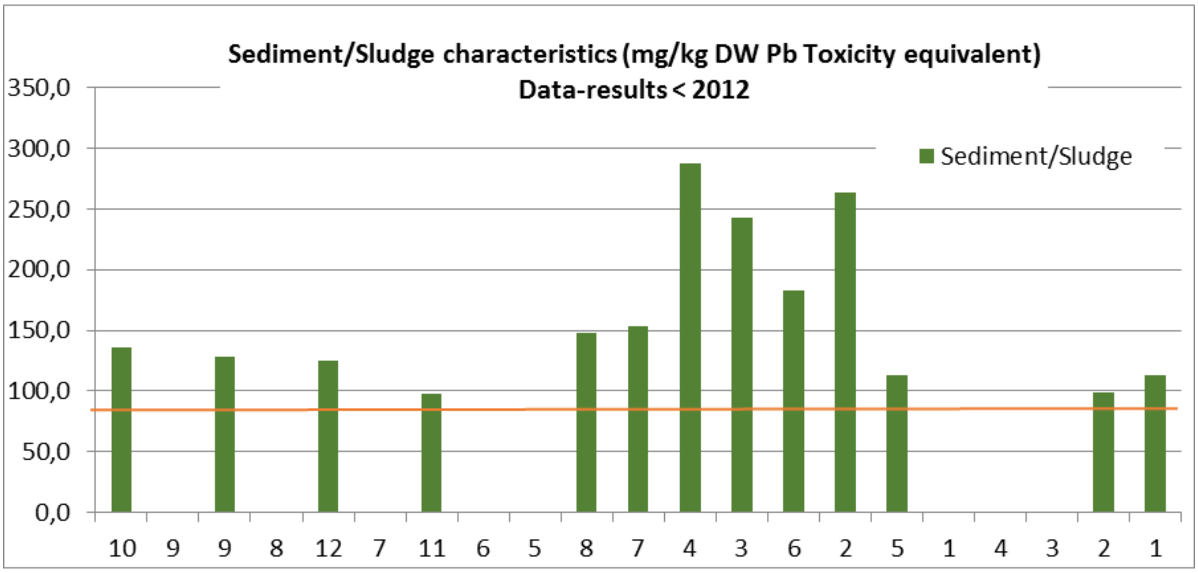
The sediment/sludge along the TL-BC-NL canal

Sediments have been largely monitored along the main channel. During the present mandate, EXP has focused on the potential effects of high and low tide, at some monitoring locations near the junction with Saigon River. The reference for Chemiotox calculations has been the QCVN 43:2012/BTNMT and the pollutant of reference is Pb. Its MAC is 91,3 mg/kg DW. A summary of results has been gathered on the Table 5.9.2. We can notice a build-up of concentrations at the locations where hydraulic tidal effects are the less important: central areas and in the deep layer of sediment.

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 43:2012/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the Chemiotox model uses the MAC for the parameter PbTOTAL: 91,3 mg/kg DW. According to the calculations:

- Along the main channel ThamLuong-BenCat-NuocLen, the results gathered during the previous project steps demonstrate a cumulative impact at the locations where hydraulic tidal effects would be less important.

- For a fixed area, three would be a progressive build-up of pollutants contents (heavy metals) at deep layers of sediment / sludge.
- The recent results indicate an absence of PAHs and pesticides in the sediments. There would be present under dissolved forms (in surface water).



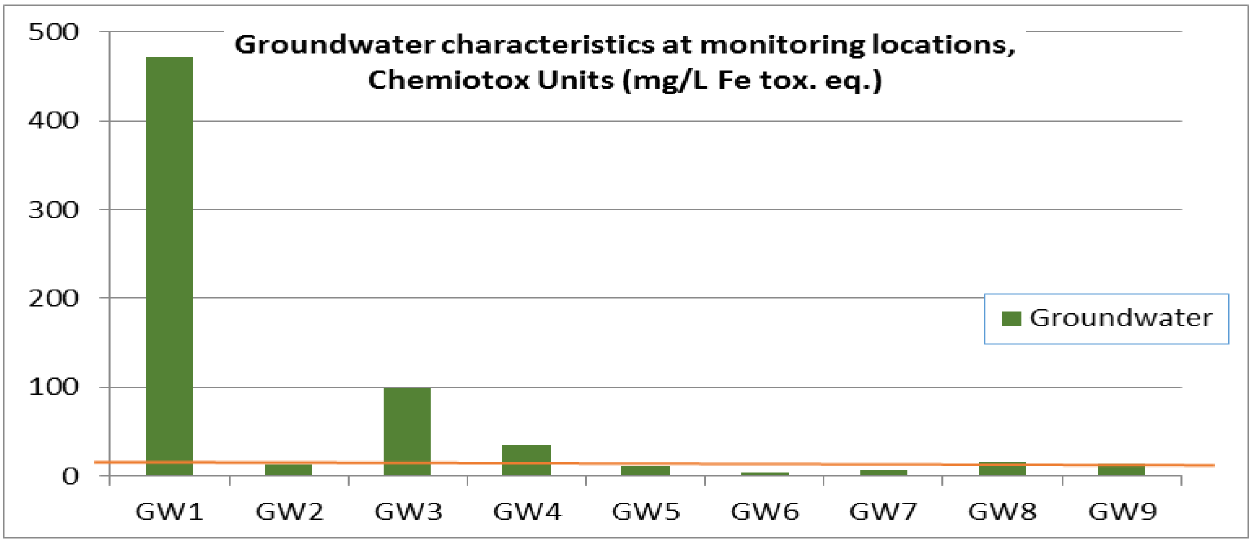
The groundwater along the TL-BC-NL canal

The analytical results are compared to the MAC of QCVN 09:2008/BTNMT and the MAC of the parameter FeTOTAL: 5 mg/L has been taken in consideration for applying the Chemiotox Index methodology. The results are summarized on the Table 5.9.3. While most of the groundwaters are moderately contaminated, the first monitoring location (near the Saigon River, at Chin Xieng canal junction area) indicates a case of strong contamination by NH4-N and Fe.

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 09:2008/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the Chemiotox model uses the MAC for the parameter FeTOTAL: 5 mg/L. According to the calculations:

There should be 2 monitoring locations where contamination of groundwater is very high (Chinh Xieng canal area, TrungDai to ChoCau area). The main pollutant would be NH4-N and Fe.

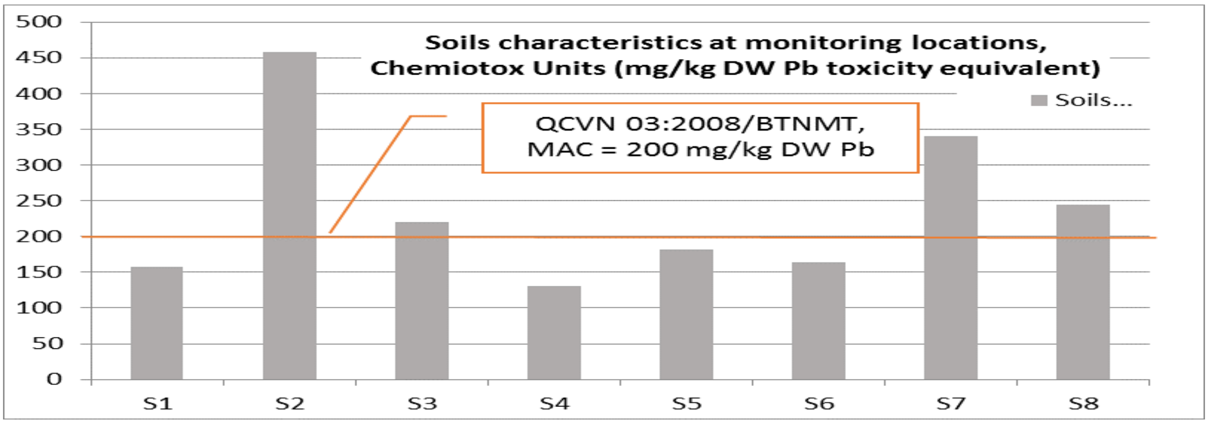
The pH would be often low (acid, less than 5,5)



The soil along the TL-BC-NL canal

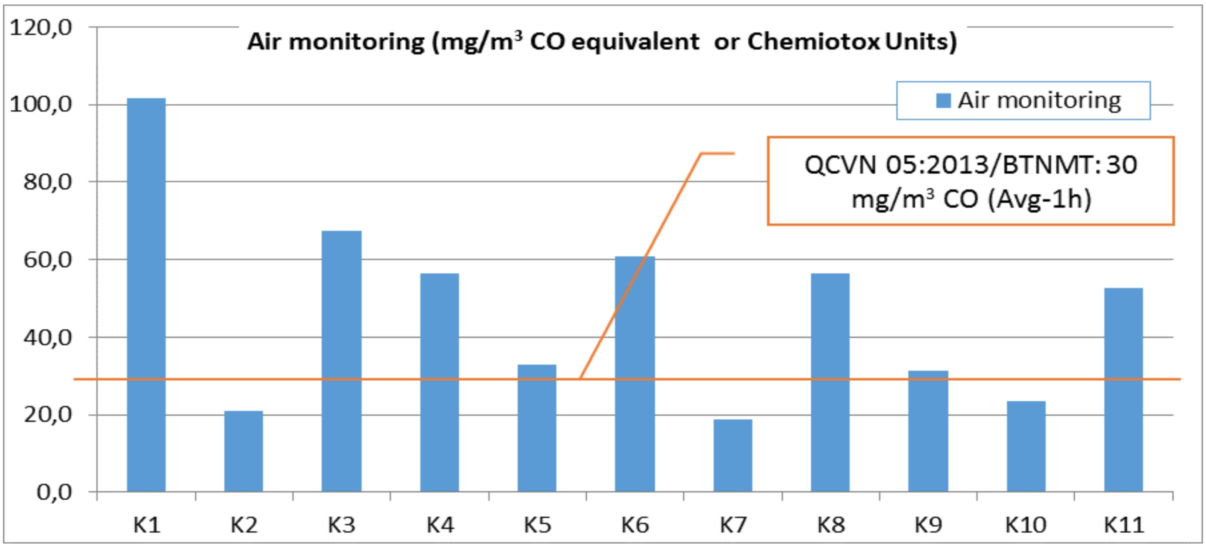
The soil along the main channel area is moderately contaminated by heavy metals. The reference is the QCVN: 03:2008/BTNMT and the MAC of Pb contaminant has been taken in consideration: 200 mg/kg DW. At several locations, the cumulative impact due the aimed heavy metals has demonstrated a value of Chemiotox Units greater than the MAC.

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 03:2008/BTNMT. For the assessment of the cumulative impact of the considered heavy metals, the Chemiotox model uses the MAC for the parameter PbTOTAL: 200 mg/kg DW (commercial uses of land). According to the calculations: At almost 50% of monitoring locations the contents in aimed heavy metals are greater than 200 mg/kg DW Pb toxicity equivalent. The use of sediment/sludge as cover soil without preliminary treatment would increase the contents in heavy metals



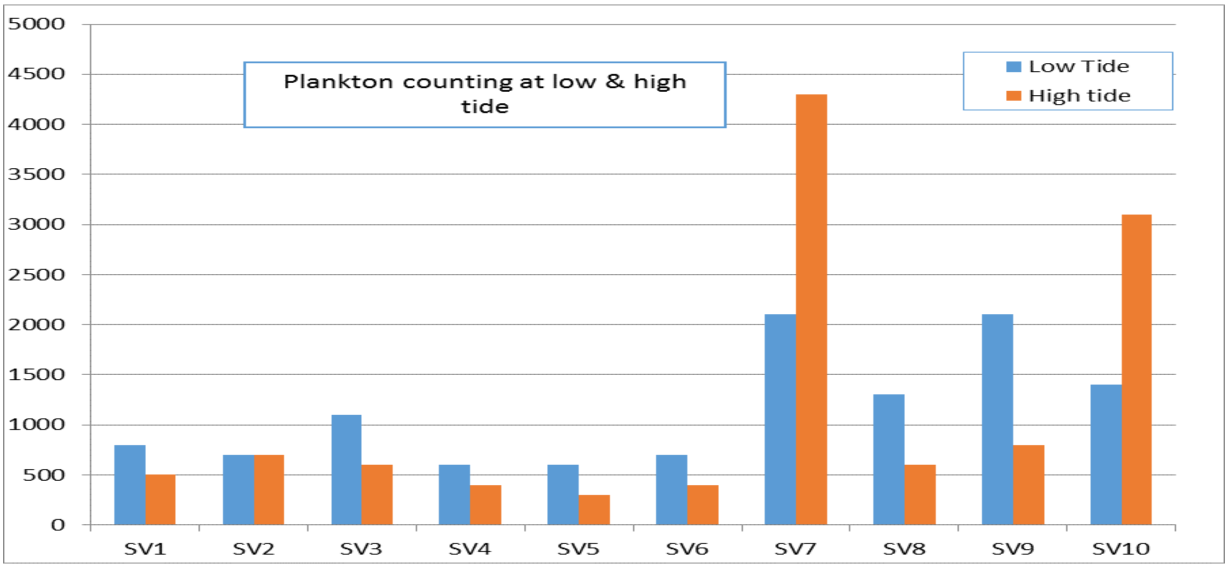
The characteristics of ambient air along the TL-BC-NL canal

Characteristics of ambient air can be altered by both local traffic (TSP, CO & CO2, SO2, NO2, etc.) and emission for aquatic environment (mainly NH3, H2S and VOCs). Both QCVN related to the two series of contaminants are considered: QCVN 05:2013/BTNMT (average 1 hour) and QCVN 06:2009/BTNMT (average 1 hour). The well-known CO contaminant (MAC = 30 mg/m3) is taken in consideration for the calculations of Chemiotox Units. Monitoring activities have focused on air contaminants aimed by QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT and QCVN 26:2010/BTNMT. Detailed results shown low levels of air contaminants (NH3, H2S and VOCs) due to the anaerobic biodegradation within the main water receiving body. Local traffic seems be the main cause of monitored results: TSP, NO2, SO2, CO & Pb. For measuring the cumulative impact, the MAC of CO has been considered. At the majority of monitoring locations, the MAC of 30 mg/m3 CO (Avg-1h) is largely overpassed.



Plankton and Phytoplankton

Biological inventories of plankton and phytoplankton have been organized in order to support the state of aquatic environment along the main channel. Preliminary conclusions would be: in way of eutrophication. The direct Plankton counting (biological inventory) in surface water indicates a living water receiving body including microbiological pathogen species from protozoa to larva. Biodegradable organic matters should be abundant to allow such living conditions. The over-polluted ChoDem canal should contribute to an increase on plankton population at high tide while the less polluted Saigon River contribute to the dilution of identified microorganism species.



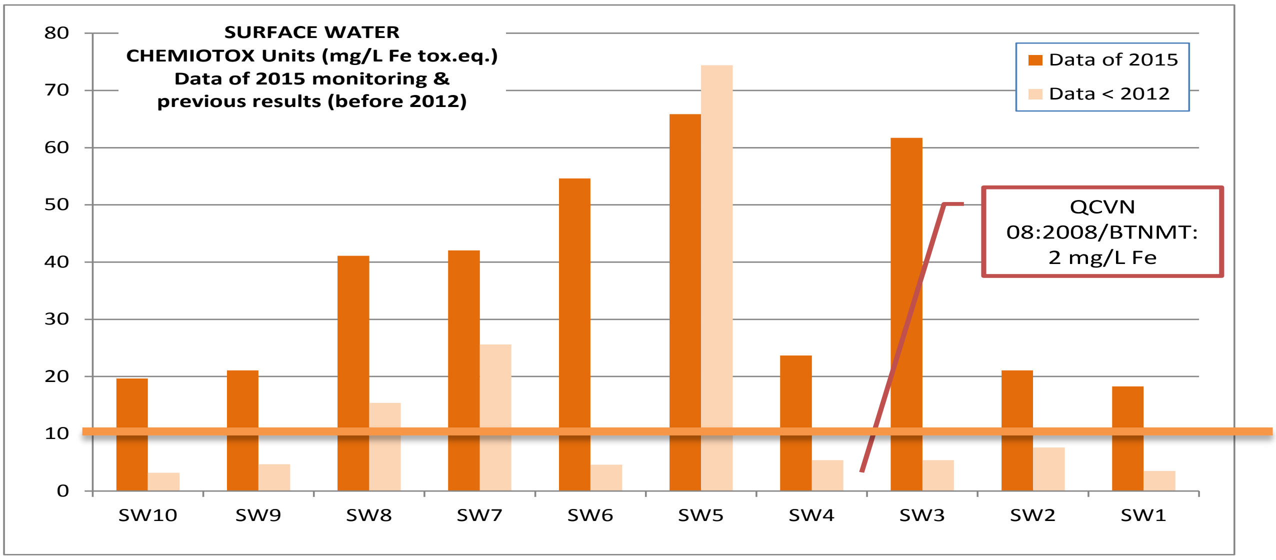
5.3.6. Cumulative impact in 2015

In order to avoid duplicate, the field monitoring activities have focused in areas where previous studies had not sufficient results. Again lab results confirm a build-up of pollutant concentrations in the central areas where we should observe a low level of hydraulic tidal effects. We can observe that the pollutant contents gradually increase in the deeper layer of sediments.

Comparison of 2015's monitoring results and data from the period before 2012

2015 Monitoring locations for surface water	
SW1	Location 200 meter from Sai Gon river towards the Vam Thuat canal.(0603441;1197897)
SW2	Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels.(0602849;1197393)
SW3	Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels.(0602742;1197488)
SW4	Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels.(0602361;1198764)
SW5	Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels.(0601002;1199835)
SW6	Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels (0598939;1200474)
SW7	Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels.(0596170;1197484)
SW8	Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park.(0595884;1196999)
SW9	Location at the An Lac bridge.(0593163;1186046)
SW10	Location 200 meter from Cho Dem river toward the Nuoc Len bridge.(0593205;1184253)

Monitoring < 2012										
Monitoring locations	SW10	SW9	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1
Chemiotox Units (mg/L Fe tox eq.)	3,2	4,7	15,4	25,6	4,6	74,4	5,4	5,4	7,6	3,5
2015 Monitoring										
Monitoring locations	SW10	SW9	SW8	SW7	SW6	SW5	SW4	SW3	SW2	SW1
Chemiotox Units (mg/L Fe tox eq.)	19,67	21,10	41,09	42,04	54,62	65,87	23,69	61,74	21,08	18,27



In order to improve the comparison of previous results (before 2012) and recent data (2015) gathered during the monitoring activities a limitative list of monitoring locations has been selected. They are called SW1 to SW10 (from 200-m close to SAIGON River to 200-m close to CHODEM Channel). Except for the monitoring location SW5 (at the junction of BaMien Canal and the main channel) there is an general increase of CHEMIOTOX UNITS (mg/L Fe tox. Eq.). Globally for qualitative assessment, there is an evidence of attended decline of surface water characteristics.

Increase of eco-toxic contents in Sediments / Settled sludge

Monitoring locations in 2015 for sediments characterization		< 2012	2015
Sed1	Location 200 meter from Sai Gon river towards the Vam Thuat canal (0603441;1197897).	119,2	154,8
Sed2	Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602849;1197393)	98,3	160,5
Sed3	Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602742;1197488)	-	125,0
Sed4	Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602361;1198764)	-	114,3

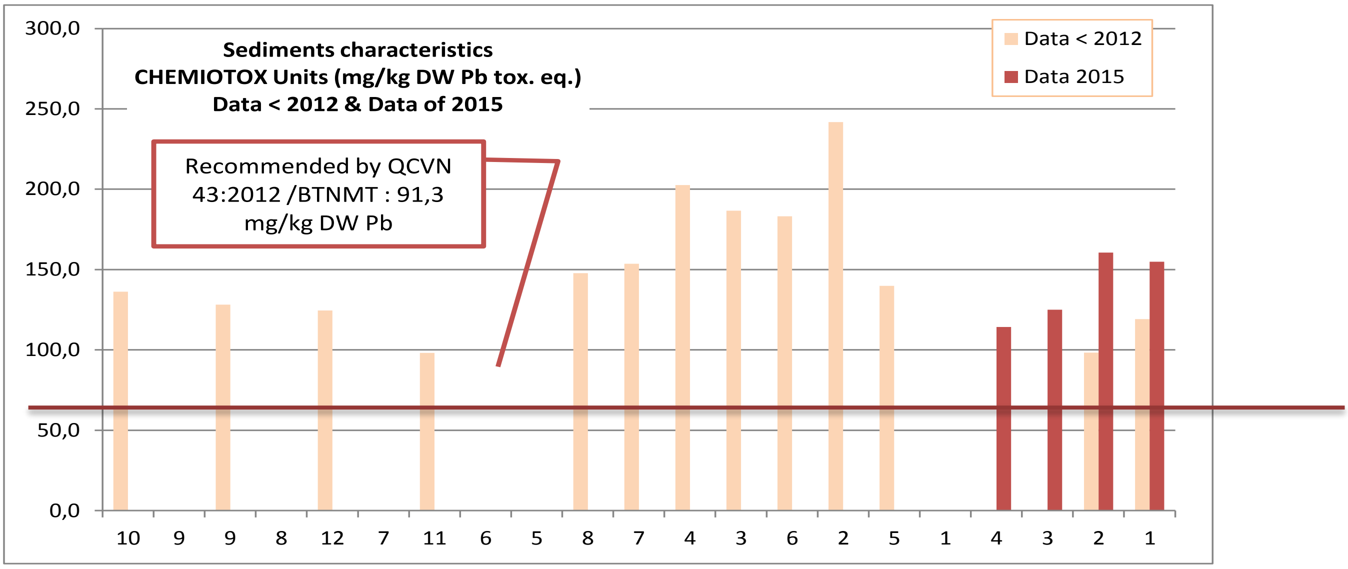


Figure 5.5 Increase in Chemiotox Units in the sediments/settled sludge.

Fluctuations of SEDIMENT characteristics along the main channel																					
Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	136,2		128,1		124,6		98,2			147,8	153,6	202,6	186,6	183,1	241,8	139,9				98,3	119,2

The sediments/settled sludge in the main channel come from a cumulative effect of the sedimentation of total suspended solids (TSS). In the present case, it should be due to the pollutant solids discharged from urban areas (including stand-alone industries), effluents of industrial parks and surely various run-off rainwater materials. The recent (2015) lab chemical characterization of sediments within two different layers has shown a progressive build-up of CHEMIOTOX UNITS (mg/kg DW Pb tox. Eq.) in the deeper layer. The comparison between previous (before 2012) and recent results at the same monitoring locations (relatively deeper bottoms) has indicated a general progressive build-up of pollutant contents. At lower deeps in the central areas, it should be more cumulative effects and build-up of CHEMIOTOX UNITS despite an absence of recent planned monitoring activities. The sedimentation phenomena are more important in the lower-depth sections of the main channel.

5.3.7. Predict the cumulative impact of project development in 2035

The whole investment project comprises 2 components:

- *Component 1: Integrated management of urban flood risk*. Within this component one can expect an improvement of the capacity of environmental management by the implementation of environmental monitoring locations that will allow direct and rapid flows of information on the fluctuating quality of the environment (air and surface water) in order to implement adequate mitigation measures.
- *Component 2*: *Priority flood risk reduction interventions.* This component includes:
  - Construction of 2 tidal sluice gates at the end of VamThuat and NuocLen canals in order to control tidal inflows.
  - Improving the whole ThamLuong - BenCat - NuocLen Channel system through dredging works and embankment construction in order to improve its ability to discharge flood waters at the safe level of frequency of 10 years.
  - Construction of the main interceptor system in GoVap District.
  - Construction and improvement of a primary and secondary combined sewer system for reaching the appropriate safety level, and construction of the secondary interceptor system in GoVap District

Wastewater Collection, Drainage and Sanitation

With rapid population growth and improvement of functional infrastructure, HCMC will be challenged with environmental pollution. The major sources of pollution would directly discharge untreated wastewater or partially treated wastewater to canals, creeks and rivers. The population growth in the zone of influence could increase the densities of all district up to 139 people per hectare which could result in population of 2 000 000 inhabitants or more. The wastewater flow will generate pollution in the drainage network and at the end into the ThamLuong-BenCat-NuocLen Channel. The wastewater flow generated from factories outside the industrial parks is ranged from 30 to 40 000 m3/day, in which 2.4 tons of pollutant suspended solids are comprised. Total flow of wastewater generated from industrial parks such as TanTao, TanBinh, VinhLoc A, TanThoiHiep is estimated to be more than 32 000 m3/day. This flowrate can potentially contribute about 6.4 tons of pollutant suspended solids into ThamLuong Canal if the discharged wastewater could meet allowable standards.

Within the limits of GoVap District, the common technical solution to the drainage of domestic wastewater for the City is using combined or separated drainage system for both run-off rainwater and domestic wastewater collection, depending on the stages of urbanization, economic conditions and environmental sanitation. Box culverts, manholes and pumping stations will deserves the collection and the transfer to the planned wastewater treatment plant (a built-transfer project) that will be located at AnPhuDong Ward, District 12, close to the Saigon River. The main projected interceptor would collect and transfer the mixed wastewater from HyVong Canal area (deserving the TanSonNhat Airport) to the ChinXieng area, close to the location planned for the construction of the tidal sluice gate (VamThuat). Collected wastewater will be pumped to the planned treatment plant (AnPhuDong Ward). The final treated effluent would be discharged at a location downstream the tidal sluice gate or directly into the Saigon River current flow. According to internal regulations of industrial parks, raw wastewaters discharged by industries should be treated (first step) separately by preliminary and primary processes prior to their pumping towards the centralized secondary treatment for a second "finishing" step in order to be compliant with the maximum allowable concentrations of QCVN 24:2009/BTNMT. Then the final effluent would be legally discharged into the main channel.

In the South-West area, a call for investment has been planned for the implementation of canal dredging projects and construction of a centralized wastewater treatment ("Nha May Xu Ly Nuoc Thai, Tay SaiGon"). With this expected project the coverage for wastewater collection and drainage component will be limited to 9 urban districts: District 12, GoVap, BinhThanh, TanBinh, TanPhu, BinhTan, BinhChanh, HocMon, and District 8. For determining the impact due to the increase in population within the 9 covered districts, let us propose to assess a scenario for only one phase with the hypothesis of 139,5 person/ha as density in the horizon of 2035.

Demography

The population distribution in Ho Chi Minh City is uneven. Regarding the growth rate of population, while the natural growth rate reaches approximately 1.07%, the mechanical growth rate amounted to 2.5%. Immigration status in the city continues to grow in recent years. Since 1999 up to now, the population of 8 districts within the city is decreasing while the population of suburban districts and newly-setup districts grew rapidly. The mechanical increase of the city's population is going strongly and difficult to control as indicated in BINHCHANH: population increasing per year was ever up to 30,000 people, equivalent to the population of one commune. (ref: FS Study 2012)

In 2007 the estimated population of Ho Chi Minh City was over 6.5 million, growing at around 2.9% per year. It is forecasted that the Study Area population will reach over 13.8 million by 2025, with 10 million people in HCMC. Most of the population growth is projected to happen in outer areas (the urban fringe, suburban and other outlying communities), while the inner core areas are projected either to decrease their populations (in high density areas) or increase moderately (in medium/low density areas). (Ref: Preparing the Ho Chi Minh City Metro Rail System Project, ADB, Project number 39500, Feb 2010)

At the United Nations Conference on Trade and Development conference (on Investment Policy Review 2007), it was noted that a new airport and training and research facilities will be built outside Ho Chi Minh City. As a population growth scenario, we are assuming that the airport will delocalized and that districts will be constructed with new development. With a population growth of 2.5%, total population of zone of influence should reach 2 000 000 latest 2038. We will assume that density will equalized at the average density of 139.5 persons per hectare. The table 5.15 represent population forecast in each district (zone of influence only) for year 2035 with that density.

Table 5.15 opulation forecasted to 2035 as follows

No.	District	Area	Population 2015	Actual Density	Population 2035
		(ha)	(persons)	(person/ha)	Density 139,5
1	District 12	3 083,4	181 127	59	**430 134**
2	Go Vap	1 915,7	313 798	161	**308 427**
3	Binh Thanh	142	19 624	138	**19 809**
4	Tan Binh	525,1	37 244	71	**73 251**
5	Tan Phu	1 706,5	218 843	128	**238 056**
6	Binh Tan	1 445,6	199 316	131	**201 661**
7	Binh Chanh	4 589,1	29 670	7	**640 179**
8	Hoc Mon	1 526,1	99 574	65	**212 890**
9	District 8	93,3	9 054	97	**13 015**
	Total: 9 districts	**14 899**	**1 108 250**	**74**	**2 137 426**

Calculation of Wastewater Flows

Within the Phase I (to 2035), the Project aim at limiting the wastewater at these figures and propose Design References for 2035 as:

- Flow of domestic wastewater: 180 L/capita/day in 2035.
- Flow of wastewater from Industries, Commerce and Institutional (ICI): 30% $Q_{domestic}$;
- Irregular coefficient of day max: KDAY-MAX = 1,25;
- Known flow from two industrial zones will be added separately.

The table 5.16 is presenting calculation for wastewater daily flow in each district, if all the outfalls are captured and drained to the channel TL-BC-NL.

Table 5.16 Potential Wastewater discharging to the channel Tham Luong Ben Cat Nuoc Len

			Year 2015	Year 2018	Year 2035
No.		AREA	120l/p/day	120l/p/day	180l/p/day
	District	ha	m3/day	WWTP	m3/day

			Year 2015	Year 2018	Year 2035
No.		**AREA**	120l/p/day	120l/p/day	180l/p/day
1	District 12	3083,4	21735	23365	77424
2	Go Vap	1915,7	37656	40480	55517
3	Binh Thanh	142	2355	2531	3566
4	Tan Binh	525,1	4469	4804	13185
5	Tan Phu	1706,5	26261	28231	42850
6	Binh Tan	1445,6	23918	25712	36299
7	Binh Chanh	4589,1	3560	3827	115232
8	Hoc Mon	1526,1	11949	12845	38320
9	District 8	93,3	1086	1168	2343
	Total: 9 districts	**15026.8**	132990	142964	384737

Strom water pollutant

Urban storm water runoff has been the subject of intensive research since the inception of the Water Quality Act of 1965 in USA. The most comprehensive study of urban runoff was NURP, conducted by EPA between 1978 and 1983. NURP was conducted in order to examine the characteristics of urban runoff and similarities or differences between urban land uses, the extent to which urban runoff is a significant contributor to water quality problems nationwide, and the performance characteristics and effectiveness of management practices to control pollution loads from urban runoff (US EPA 1983).

Table 5.17 Pollutant Criteria for Storm Water

BOD mg/l	10	COD mg/l 73	73
TSS mg/l	101	Total Lead µg/l 144	144
Total Copper µg/l	33	Total Zinc µg/l 135	135
Total Kjeldahl Nitrogen µg/l	1900	Nitrate + Nitrite µg/l	736
Total Phosphorus µg/l	383	Soluble Phosphorous µg/l	143

Contamination in Tham Luong Ben Cat Nuoc Len Channel system

Table 5.18 Total Maximum Daily Load (TSS)

No.	District	2015	2018	2035	total
		kg/day	**kg/day**	**kg/d**	**tons**
					20 years
1	District 12	15802	5592	9560	18394
2	Go Vap	17546	4772	6311	17519
3	Binh Thanh	1161	330	440	1113
4	Tan Binh	2937	2937	1628	7626
5	Tan Phu	13300	13300	5291	38493
6	Binh Tan	11801	11801	4482	1099

No.	District	2015	2018	2035	total
		kg/day	**kg/day**	**kg/d**	**tons**
7	Binh Chanh	14306	14306	14229	25188
8	Hoc Mon	8202	8202	4732	20950
9	District 8	615	615	289	1697
	Total: 9 districts	78137	54321	45330	132079

Table 5.19 illustrates the cumulative impact of Suspended Solids that may be discharged in the channel system if WWTP are in operation or not. This situation propose that in 2038 all WWTP will be in operation. According to this hypothesis, there will 132 079 tons of dry sludge in the channel in 2035. The volume of sludge may be 3 301 987 m3 at 4% dryness. After dredging the channel assuming that bottom will be at -4 meter and top average water level will be at +1 meter over the sea level, total effective volume of channel will be 6 060 612 m3. This indicates that the canal will be filled up to 55% if no sludge is removed within 20 years.

To evaluate the contamination of channel, it will be divided in three sections

1) From Cho Dem River to Bridge Ba Hom: 1 273 100m3
2) From Bridge Ba Hom to Bridge Cho Cau: 2 189 700 m3
3) From Bridge Cho Cau to Saigon River: 2,597,812 m3

Section 1 will receive 50% of District Binh Tan, District 8 and part of District Huyen Binh Chanh.

Section 2 will receive district Hoc Mon, 50% of Districts 12, 50% of districts Binh Tan, District Tan Phu, District Tan Binh with the catchment of WWTP Binh Hung Hoa. The treatment plant used aerated lagoon and stabilization pond technology to treat wastewater from nearby Den canal. Den canal has an area of 785 ha and population in the area is around 120.000 (1999). The canal is also received untreated wastewater from surrounding industrial activities, creating black colour and bad odour in the water with physico-chemical parameters as follow: SS 250mg/L, BOD5 200mg/L, COD 300mg/L, NH3-N 25mg/L, and pH 6.5 - 7 (Smet et al.,2006). It will also receive effluent of 2 industrial zone. This treatment is very effective reduce BOD to 5 mg/L.

Section 3 will receive 50% of District 12, District Go Vap and part of District Binh Thanh

Four scenarios were evaluated.

1) Rainy Season after modifications occurring in 2018
2) Dry Season after modifications occurring in 2018
3) Rainy Season in 2035 expecting that all WWTP will be completed
4) Dry Season in 2035 expecting that all WWTP will be completed

According to statistic 85% of rain is falling from May to October and 15% from December to April.

The next table present concentration of pollutant in the channel in 2018 and in 2038 if mitigation measure are applied and if WWTP are in operation. This situation suppose that there will be no water coming from outside the channel system other than rain water drainage and wastewater.

Table 5.19 Concentration of pollutants in Channel TL-BC-NL 2018-2035

	TSS	**TSS**	**TSS**	**TSS**	**COD**	**COD**	**COD**	**COD**
	Dry	**WET**	**DRY**	**WET**	**Dry**	**WET**	**DRY**	**WET**
	2018+	**2018+**	**2035**	**2035**	**2018+**	**2018+**	**2035**	**2035**
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	91	25	96	52	137	38	144	78
2	99	40	96	52	148	60	144	78
3	54	27	98	55	81	40	147	82

The channel may become an anaerobic pond in these conditions. In the dry season the sluice gates will have to be open at high tide to dilute the water in the channel.

Feasibility study also proposed two important measures that could improve the situation.

1) Constructing a retention pond at Go Vap park (available in the planning of control reservoir in HCMC) and to propose size of the reservoir to reduce water level in main canal and reduce inundation for the basin at the head route, nearby Sai Gon river (mainly An Phu Dong ward, Thanh Xuan ward - district 12)
2) Constructing Tan Tao retention pond for climate change by 2100.

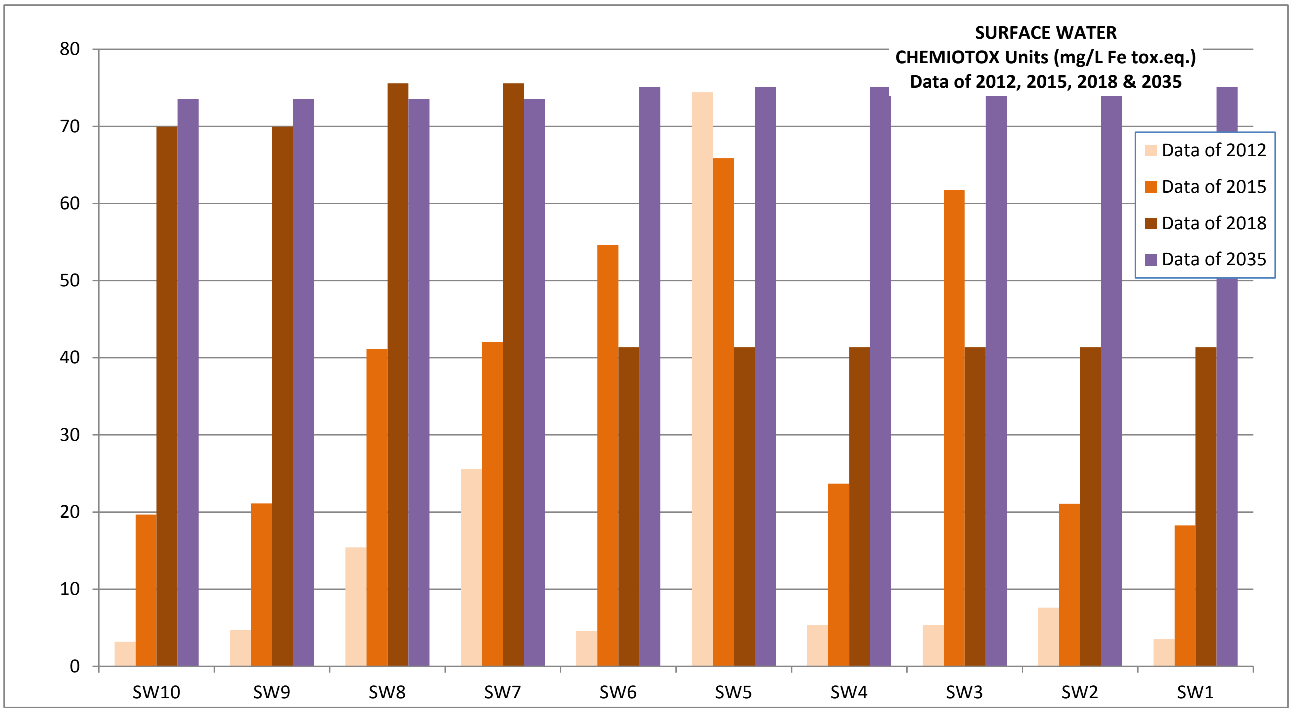
These two measures would have a direct impact to reduce and eliminate contamination coming from storm water. Mitigation measure like application of Low Impact Development Technic would also reduce the load. In these case the load would be limited to wastewater contamination. The WWTP Binh Hung Hoa is already in operation and discharge to Kenh Nuoc Den Canal. This effluent is providing a good quality water. Construction of other Wastewater Treatment plant would also have a positive impact.

The situation in 2035

As earlier mentioned, dredging embankment construction works will modify the hydraulic volumes of the three sections of the main channel. Calculations taking in consideration an increase in population (and pollution discharge into sewerage networks) and an achievement of wastewater treatment plants would allow assessing the pollutant contents in terms of Chemiotox Units in the three sections of the main channel as follow:

	2018		2035	
	Dry Seasons	**Wet Seasons**	**Dry Seasons**	**Wet Seasons**
Section 1: ChoDem Channel (or NuocLen Sluice Gate) to BaHom Bridge	70,0	19,4	73,5	39,8
Section 2: BaHom Bridge to ChoCau Bridge	75,6	30,6	73,5	39,8
Section 3: ChoCau Bridge to Saigon River (or VamThuat Sluice Gate)	41,4	20,4	75,1	41,9

If the operation strategy in the future remains mainly in hydraulic factors (strictly in favor of fluvial navigation) we can again face to a progressive build-up in pollutant contents. The following Figure illustrates the progressive increase in CHEMIOTOX UNITS along the 3 sections of the main channel during wet seasons.



5.3.8. Linked Ancillary Projects

Following table presents a summary of current and future projects whose impacts can be negative, neutral or positive to the factors identified previously. Each project is described with status, status of EIA, detail of EMP, cumulative impact assessment and screening of linked project.

Table 5.20 Cumulative impacts of Linked Ancillary Projects

1. Project Name	**Da Phuoc Solid Waste Treatment Complex**
Description	Scope of work: The Da Phuoc Solid Waste Treatment Complex near Ho Chi Minh City is Vietnam's largest solid waste processing complex. This project was developed, and is currently operated, by Vietnam Waste Solutions (VWS) of Ho Chi Minh City and California Waste Solutions (CWS) of California. This Complex is located in Da Phuoc Commune, Binh Chanh District, Ho Chi Minh City. Capacity of the Complex is currently 10,000 tons per day designed to collect whole domestic solid waste generated by Ho Chi Minh City and partly solid waste collection from Long An province. The complex is planned on an area of 128.22 ha that includes administrative office (0.2%), domestic waste treatment factory (6.64%), industrial waste and hazardous waste treatment factory (1.41%), technical infrastructures (5.08%), green field and utilities (0.21%), high-tech landfill including four cells (68.91), green trees and grass cover (5.48%) and internal roads and yards (12.06%). The Da Phuoc Landfill will receive all the dredged materials and construction waste from the demolition process, construction process and dredging process during pre-construction phase, construction phase and operation phase of six components.
Status	The project has entered operation with a capacity of 10,000 tons solid waste per day
Status of EIA	The EIA of the project with capacity of 3,000 tons per day has been approved by DONRE of Ho Chi Minh City in accordance with a Decree No. 132/QĐ-TNMT dated on 18th April 2005. Following the approval of HCM PC to upgrade from 3,000 tons per day to 10,000 tons per day, the EIA for upgraded capacity was approved in 2015.
Detail of EMP	*Mitigation measure to treat leachate wastewater and storm water:* The complex currently has a wastewater treatment complex with a capacity of 4,280 m^3 per day. Three wastewater treatment plants were constructed in this complex, including two leachate wastewater treatment plants (280 m^3/day and 1,000 m^3/day) and one storm water treatment plant (3,000 m^3/day). Following the treatment, the wastewater of the first two meets QCVN 25:2009/BTNMT (column B1) and QCVN 40:2011/BTNMT (column B) (in accordance with a Decree No. 541/QĐ-TNMT-QLTN dated on 1st June 2012 about extending a license of discharging the treated wastewater to receiving stream) and of the third meets QCVN 25:2009/BTNMT (column B1) (in accordance with a Decree No. 926/QĐ-TNMT-QLTN dated on 4th September 2012 by MONRE about extending a license of discharging the treated wastewater to receiving

	stream). Following increasing up to 10,000 tons of solid waste per day, total capacity will be increased from 4,280 m^3 per day to 4,510 m^3 per day. In this case, the leachate wastewater treatment plant will be upgraded to meet the increased capacity. *Mitigation measure to treat gas emission from landfill:* Gas emissions from landfill revenues are collected by spaced vertical wells. All the collected gas is flared. *Mitigation measures to treat odor and pathogens microorganisms:* In addition to the daily soil cover layer to prevent odors, spraying is also done regularly, especially during the time after the rain. In addition, planting of trees is also done to create buffer areas. Limitations of the residents scavenging and require workers to user PPE when working at the landfill.
Assessment of cumulative impact	Given the Complex has now received a half of 10,000 tons of solid waste per day, it still has enough area and capacity to receive the solid waste generated from the HCM – FRM project. Therefore, negative cumulative impact is assessed to be minimal. WW is discharged in Nga Cay creek which do not directly reach the channel TL-BC-NL.
OP 4.12: Screening of linked project	The Da Phuoc landfill is to accommodate sludge from dredging operation to be supported by HCM – FRM project. This is existing landfill built 10 years ago and it will not require any further civil works or any involuntary land acquisition. Therefore it is noted that this is not considered as linked project, but is considered as ancillary activities.
2. Project Name	Tham Luong Ben Cat Wastewater Treatment Plant
Description	The project of wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len, phase 1, with a total capacity of 131,000 m^3 per day. It is scoped in a project "Wastewater collection system and wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len", where the Prime Minister approved a pre-feasible study regarding to a document No. 1131/CP-CN dated on 13th August 2014 and investment policy under forms of Building and Transfer (BT) regarding to a document No. 383/QĐ-UBND-DT dated on 8th October 2010. The catchment area where wastewater will be collected for treatment by the Tham Luong Ben Cat WWTP is of 5,141 ha of District 12, Go Vap District and Binh Thanh District. It is located at An Phu Dong Ward, District 12, Ho Chi Minh City. Diagram of wastewater treatment technology processing: Wastewater from sewage system ⇒ Screen bar ⇒ Sand sediment tank ⇒ Selector ⇒ C-Tech (biological tank) ⇒ UV disinfaction tank ⇒ Lagoon ⇒ Discharge to Vam Thuat River using pump. In addition to those major treatment units, the WWTP also comprise of units to treat gas and sludge (sludge holding tank, belt press, gas collection and

	treatment). Following treatment, treated wastewater will meet QCVN 40: 2011/BTNMT (column A).
Status	The project is under construction and expected to be completed on May 2017.
Status of EIA	The EIA of project has been approved by the local authority (DONRE) of Ho Chi Minh City. Below is a summary of impact evaluation for each project components: Waste water treatment plant: - Location is An Phu Dong Ward, District 12, Ho Chi Minh City. Point for discharge is Vam Thuat River and the treated wastewater will meet the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge. - Option technology is Sequencing Batch Reactor. The treatment is activated sludge. - Per EIA, most of the negative environmental impacts are short-term and mitigated. Mitigation measures have been properly proposed in EMP, including institutional arrangement for environmental management, monitoring and capacity building program. Community consultation has been conducted during project preparation. Most of the participants raised their concerns on compensation prices, construction-caused disturbance and pollution generated during construction and operation phase and requested PMU to comply with the mitigation measures proposed.
Detail of EMP	Proposed mitigation measures on approved EIA report of WWTP project are : Mitigation measures to treat sludge out of WWTP processing: Sludge out of WWTP processing will be treated by following process: Activated sludge ⇒ sludge holding tank ⇒ Sludge pump⇒ Centrifuge ⇒ Fertilized or disposed to landfill. Controlling the treated wastewater quality out of WWTP: According to an approved decision of an EIA report by Ho Chi Minh City People's Committee - Department of Natural Resources and Environment (DONRE), quality of treated wastewater must satisfy the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge. Environmental monitoring program also included in the EIA report.
Assessment of cumulative impact	Impacts will be positive as wastewater effluent quality will be improve but there will be cumulative impact over time.
OP 4.12: Screening of linked project	The project has been constructed to collect the domestic wastewater generated from local community located in the Tham Luong ben Cat Nuoc Len Catchment. It is scoped in a project "Wastewater collection system and wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len" and constructed to serve the outcomes of project component 4. Therefore, it is considered as a linked project.

3. Project Name	Tan Tao Industrial Park
Description	Tan Tao IP is located in Binh Tan District, Ho Chi Minh City with total area of 380.15ha. It was established on 30th November 1996 following a Decision 906/TTg and 978/QĐ-MT. In 2008, Tan Tao Investment Industry Corporation constructed a WWTP, which has a capacity of 3,000 m3 per day for extension of Tan Tao IP, and completed that in 2010. This WWTP for Tan Tao IP extension was provided completion certification issued a documents No. 171/BQL-KCN-HCM-QLMT dated 14/01/2010. In addition, DONRE of Ho Chi Minh City also issued a document No. 373/GP-TNMT-QLTN dated 23rd April 2012 to provide a discharge license where the project can discharge 3,000 m^3 of wastewater per day to receiving stream. This flowrate together with flowrate of the original Tan Tao IP contribute to generate up to 12,000 m^3 per day. Major industry sectors invested in this IP comprise of textile, leather, rubber, plastic, mechanics, electronics, wood, food. Regarding to document No. 137/CV-ITACO-10, all investors must ensure the wastewater generated from their factories must meet the parameters concentration developed by Tan Tao IP owner before discharging to the central wastewater treatment plant in Tan Tao IP. Currently, approximate 107 business sectors has invested in Tan Tao IP and contribute a total of wastewater flow ranged from 2,300 to 2,400 m^3 per day. Wastewater following pretreatment stage undertaken in each factory is permitted to discharge to central wastewater treatment plant of Tan Tao IP for further treatment to meet the QCVN 40: 2011/BTNMT (Column B). Treated wastewater effluent then enters to sewage system to discharge to Nuoc Len Creek, which is connected to Cho Dem River and Vam Co Dong River.
Status	The project has entered operation, where a WWTP was constructed with a capacity of 12,000 m^3 per day.
Status of EIA	The EIA of project has been approved by the local authority (DONRE) of Ho Chi Minh City.
Detail of EMP	The business sectors must commit to preliminary treat raw wastewater to meet the influent discharge requirement of central WWTP of Tan Tao IP. Mitigation measures to treat wastewater generated from factories in Tan Tao IP: Tan Tao IP (Original): Wastewater from sewage system ⇒ Collection tank ⇒ Screen bar ⇒ Equalization Tank ⇒ Aeration tank (biological tank) ⇒ Clarifier ⇒ Discharge to Nuoc Len Creek Tan Tao IP (Extension): Wastewater from sewage system ⇒ Collection tank ⇒ Fine screen ⇒ Equalization Tank ⇒ Neutralization tank ⇒ Coagulation and flocculation

	tank ⇒ Physical sedimentation tank ⇒ Mutech tank (activated sludge) ⇒ Disinfection tank ⇒ Discharge to Nuoc Len Creek According to the approved decision of the EIA report by Ho Chi Minh City People's Committee - Department of Natural Resources and Environment (DONRE), quality of treated wastewater must satisfy the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge.
Assessment of cumulative impact	Negative cumulative impact is assessed to be limited as the WWTP can accommodate wastewater generated from factories located in Tan Tao IP to meet QCVN 40: 2011/BTNMT (column A) before discharge. However, if the discharge cannot be monitored well in term of treatment performance, it can cause negative impacts to receiving streams. There will be cumulative impact over time

5.3.9. Design mitigation measures

5.3.9.1.Objectives

The main goal of the in the Tham Luong Ben Cat Nuoc Len Channel restoration is to restore the degraded reservoir to a level that can be permanently sustained through protection and conservation. The water quality target should be in accordance with the quality of natural water and without stresses that cause degradation, i.e. with a good ecosystem health, long-term stability and sustainability.

The water quality management of the channel must be at first oriented to control eutrophication and the external factors causing the increase of nutrient load. Restoration program is also oriented to enhance the biodiversity of the channel. Fortunately, in the last decade, many good experiments have been realized and many solutions are now available to control the eutrophication by minimizing the nutrient inflows from the point sources and from the non-point sources (NPS).

5.3.9.2.Cumulative impact from wastewater and drainage water pollution

Wastewater treatment engineering design has to bring solutions for the 3 issues with equal emphasis: odour removal, main influent treatment and sludge disposal. Referring to the results obtained in the previous section, we can conclude that by installing barriers at each end of the channel, it will become a closed tank. Previously the rising and falling tide of the Saigon River and Cho Dem River had a washing effect and allow a dilution of pollution in the channel. Tests show that the central portion of the channel is much more contaminated than the remainder of the channel. By closing the channel, this washing effect will disappear. An alternative water management solution will be needed. A strategic sanitation and drainage plan would conduct to implement long term measures.

5.3.9.3.Green Infrastructure

PMU should propose a strategic sanitation and drainage plan with Green Infrastructure. PMU should establish what level of sanitation exists in each district, in terms of facilities, in terms of institutions and in terms of the people's perspectives and the level of service expected. PMU should proposed green approach in designing services. By introducing Green Infrastructures the quality of storm water will be improved by a pre-filtration effect. LID (Low Impact Development) measures are proposed.

LID is a multi-barrier approach that uses features at the lot, neighborhood, and watershed level to maintain the on-site water balance (Gyurek, 2009). The proposed plan must integrate this multi-barrier approach to reduce the water footprint in the development. This involves: Designing strategies to provide quantity and quality control and enhancement of groundwater recharge (through infiltration of runoff into the soil), retention or detention of runoff for permanent storage or for later release, and pollutant settling and entrapment (by conveying runoff slowly through vegetated swales and buffer strips or small wetlands). (Gyurek, 2009)

In the proposed approach, all LID features are introduced to maximize water quality. The concept includes features such as rain gardens, bio-retention, and bio-swales. To integrate all systems, it is necessary to protect canals on-site and to link all parts of the system with that water body as the core.

LID Features are local infrastructures. There are numerous features to consider in the layout of a LID, with features typically selected and arranged according to the topography and landscape of the site. The LIDC proposes that the following features be incorporated into design.

5.3.9.4.Rain Gardens

Rain Gardens enhance local water quality by allowing water to be filtered naturally by soil instead of being piped untreated into large bodies of water (LIDC 2011). A rain garden is a landscaped garden in a shallow depression that receives the storm water from nearby impervious surfaces, thereby recharging it (Dussailsant 2004). Beyond its environmental use, rain gardens provide attractive landscaping and a natural habitat for birds, bees, and butterflies, while encouraging environmental stewardship and community pride (LIDC 2011).

5.3.9.5.Street Storage

Street storage refers to the technology of temporarily storing storm water (in densely populated urban areas) on the surface — on- and off-street — and, as needed, below the surface, close to the source (Carr, Esposito & Walsh 2000). The use of street storage and catchment basins reduces the rate of runoff entering storm sewer systems, reducing the required minimum size of water mains conveying storm water pipes (LIDC 2011).

5.3.9.6.Bio-Retention

Bio-retention is an alternative to runoff treatment, acting on storm water before it is discharged into waterways (Hsieh & Davis 2003). A landscaped island containing a curb inlet drains a large area or street, channeling rainwater through a small pipe into a municipal storm drain system. Bio-retention consists of porous media layers that can remove pollutants by infiltrating runoff through mechanisms that include adsorption, precipitation, and filtration (Hsieh & Davis 2003).

5.3.9.7.Permeable Pavements

Permeable pavement systems restore soil infiltration functions in the urban landscape. These systems are mainly composed of porous pavement systems in parking areas (LIDC). Permeable pavements offer one solution to the problem of increased storm water runoff and the decreased stream water quality associated with automobile usage (Brattebo & Booth 2003). Permeable pavements with reservoir structures consisting of concrete paving stones offer the possibility for decentralized, sustainable storm water management and source control in urban areas. Runoff from streets and parking areas with low traffic densities can be infiltrated to support groundwater recharge and to reduce hydraulic stress in sewer systems. Infiltration can help to return the urban water cycle to its natural condition, increasing the level of groundwater (Dierkes et al. 2002).

5.3.9.8.Vegetated Roof Cover

Green roofs (roofs with a vegetated surface and substrate) provide ecosystem services in urban areas, including improved storm water management, better regulation of building temperatures, reduced urban heat island effects, and increased urban wildlife habitat (Oberndoofer et al. 2007). The use of vegetation on a rooftop as an alternative to traditional roofing materials is an increasingly utilized example of GI practice. The vegetation and growing media perform a number of functions that improve environmental performance, including absorption of rainfall, reduction of roof temperatures, improvement in ambient air quality, and the provision of urban habitat (Carter & Keeler 2007).

5.3.9.9.Bioswales

Bioswales are broad ditches with gentle slopes. Swales are vegetated open channels designed to accept sheet flow runoff and convey it in a broad shallow flow. Swales are used to reduce storm water volume through infiltration, improve water quality through vegetative and soil filtration, and reduce flow velocity by increasing channel roughness (Lukes & Kloss 2008). Bioswales can take many forms. Generally, bioswales can be contained in approximately one per cent of the land area draining into them. Since bioswales are linear, they work well along impermeable surfaces such as roads and sidewalks (Wahl 2009).

5.3.9.10. Rainwater Harvesting

Rainwater harvesting, which involves the collection of rainwater from impervious surfaces and storing it for later use, is a technique that has been used for millennia. Although, rainwater harvesting has not been widely employed in industrialized societies, which rely primarily on centralized water distribution systems, with the increasing recognition of the need to address the problems of limited water resources and storm water pollution, and the emergence of green building design, the role of rainwater harvesting in water supply is being reassessed (Kloss 2009).

5.3.9.11. Tertiary treatment

In addition to the site consideration, sizing the facility need to physically accommodate future treatment plant expansions; it is necessary for the designer to include provisions to accommodate the future expansion and/or process changes. Onsite sewage additional treatment should be designed such that their capacity can be increased and/or parallel facilities constructed without the need for major disruption of plant operation. The layout and sizing of channels and plant piping should be such that additional treatment units can be added in the future or increases in loading rates can be accommodated hydraulically. The location of buildings and tanks should allow for the location of the next stages of expansion. Buffer areas should be provided.

Treatment beyond the norm of secondary or equivalent level for various *watersheds* may be necessary due to limited assimilation capacity and/or critical downstream uses being made of the receiving body of water. Some sewage treatment plants are required to meet more stringent effluent quality requirements than associated with secondary treatment. The receiving water-based effluent requirements are incorporated into the A and B QCVN 40:2011 and QCVN 14: 2008, as effluent compliance limits with appropriate effluent quality objectives in terms of concentrations and loadings. Depending on the effluent requirements, there are a number of suitable alternative sewage treatment processes that can be considered. In this case to mitigate cumulative impact of Load discharged into the Channel TL-BC-NL, a tertiary treatment should be added to the proposed process.

Granular media filters may be used as an advanced treatment process for the removal of residual TSS and TP from secondary effluent. Filters may be necessary where effluent concentrations of less than 15 mg/L of TSS and/or 0.5 mg/L of TP need to be achieved. A pre-treatment process such as chemical coagulation and sedimentation or other acceptable process should precede the granular media filter units where effluent suspended solids requirements are less than 10 mg/L.

In this case, provision for Continuous backwashing up flow sand filters should be planned to eliminate Suspended Solids in the effluent of futur WWTP.

CHAPTER 6: SOCIAL IMPACT ASSESSMENT AND MITIGATION MEASURES

6.1. Study approach

The approach and methodology employed during the social impact assessment is outlined in the following sub-sections. The SIA was conducted through a combination of qualitative research methods, quantitative household surveys, and desk study.

6.1.1. Data collection

Relevant recent information from the Project Feasibility Study Report, Assessment of Poverty and Social Impacts of Flooding in Selected Neighborhoods of HCMC, statistical reports from statistical offices, and existing EIA reports was used to inform the impact assessment. A quantitative household survey was also conducted in September 2015 on more than 500 households in the project area to collect further information for baseline study as well as public opinions of the project.

Desk review of relevant documentation

The following documents were reviewed at a desk level:

- Project Feasibility Study Report;
- Assessment Report of Poverty and Social Impacts of Flooding in Selected Neighborhoods of HCMC prepared by the World Bank consultant team in 2014;
- Environmental Impact Assessment of the Project conducted in 2007 (including all the EIA reports of 7 components of the Project);
- Involuntary Resettlement Assessment Report prepared by Consultant for Resettlement Plan of the Project;
- Policy for Resettlement and Rehabilitation provided by the Project Management Unit.

Field work

A preliminary site visit to the project area was conducted in July 2015. Primary data collection was subsequently undertaken during August and September 2015. This included a survey on household composition, education levels, general health status, employment, income, expenditure, the impacts of flooding on household level and their opinions of the project.

The first public consultation on the project was conducted in the 9 districts of the project area in August and September 2015. The public consultation meetings helped the Consultant gain deeper contextual understanding of the social environment and public attitudes towards the project.

6.1.2. Defining 'social' area of influence

Defining a 'social area of influence' does not necessarily require the articulation of a geographic boundary. Instead, the social extent of the project can be determined through a combination of stakeholder analysis and social mapping, and through an iterative process of understanding the social, economic, political and environmental changes induced by the project and the livelihoods and networks of potentially impacted people.

Stakeholder analysis

Direct stakeholders include:

- Physically and economically displaced people;
- People living in communities close to the Project area;
- Local labour pools for job seekers;
- Local women's groups;
- Local business owners, such as fish farmers;
- Local social and community service providers (e.g. health and education);
- Local governmental bodies related to public welfare, environmental protection and permitting for the Project;
- Neighbouring and supply chain industries and businesses including livestock owners.

Indirect stakeholders can be defined as those persons or organizations that may be interested in or able to influence the outcome of the Project, either because they can contribute knowledge or improve Project design or mitigate social and/or environmental impacts, or because they have political influence in the Project that needs to be considered. All of these stakeholders are considered to be 'interest-based'. Indirect stakeholders relevant to the Project are identified in Table 6.1.

Table 6.1 Indirect Stakeholder Groups

No.	Stakeholder Group	Reasons for Inclusion within the Consultation Process
1	International Bodies (e.g. the World Bank)	Interest-based: The World Bank influence government policy which affects the Project, including funding, resettlement plan and environment, health and safety policies during project construction and operation.
2	National Government	Interest-based: Meeting the requirements of country's EIA process before project construction, setting national policies, providing project approvals.
3	Provincial/Local Government Departments	Impact-based and Interest-based: Managing local impacts, facilitating project implementation and consultation.

4	Civil Society, NGOs, Research Bodies	Interest-based: Protection of rights of residents of the local communities during the project implementation; should be involved in external monitoring and identification of environmental and social issues.
5	Press and Media	Interest-based: Informing residents living in HCMC and in the Project affected area about the planned activities, reporting Project activities.

6.2. Impact assessment methodology

Please check Annex 5 for the description of our social impact assessment methodology and process.

6.3. Social Positive Impacts

6.3.1. During project construction phase (2016-2021)

Potential positive impacts anticipated during this phase include the followings:

- Creation of employment opportunities
- Increase in business opportunities in local services

Creation of employment opportunities

The construction sector is one of the largest single contributors to employment. It can be expected that opportunities will be available for unskilled, semi-skilled and skilled employment of the local population during the construction. The following table estimates the number of workers required for each stage of the project.

Table 6.2 Number of workers required to each sub-component of Project Component 2

	Preparation (persons)	Construction (persons)		Operation (persons)	Total
		Total	Unskilled workers		
Sub-component 2.1	5	25	10	3	**33**
Sub-component 2.2	0	25	10	3	**28**
Sub-component 2.3	5	50	20	0	**55**
Sub-component 2.4	0	50	25	0	**50**
Sub-component 2.5	0	50	20	0	**50**
Sub-component 2.6	5	50	25	0	**55**

Total	15	250	110	6	**271**

Source: previous EIA report.

It is roughly estimated that the construction phase of the project will require the recruitment of around 250 persons for the 7 components, of which 110 are unskilled workers. The construction is preliminarily estimated to be 18 months. This will create jobs and attract a group of local population who are seasonal workers, especially the male ones.

The nature of this impact is considered to be positive. However, the magnitude of the impact is minor as the local working age population is many times larger than the employment demand of the project. The impact significance is minor.

Increase in business opportunities in local services

During the construction phase of the project, there is expected to be migrant workforce in the project area in addition to the number of workers that might be employed from the local population. This will create more demand for goods and local services such as food, accommodation and health care.

The nature of this impact is positive but the magnitude of the impact is minor as the required number of construction workers is only around 250 and concentrating mainly around the construction site. The impact significance is therefore minor.

6.3.2. Positive impacts of the overall project

When the construction is finished, Project Component 2 is expected to bring about the following positive impacts:

- Poverty reduction;
- Improvement of living conditions;
- Improvement of transport conditions/ accessibility;
- Improvement of work environment;
- Improvement of social security;
- Leisure and tourism;
- Increase in property prices;
- Increase in business opportunities.

Poverty reduction

According to the final report of Ho Chi Minh City's Poverty Reduction Programme for phase 2014-2015, the poverty rate of the city is 0.89%. Compared to this rate, the project area has 04 wards with a higher poverty rate than the city's average rate. 2 over 4 wards are located in Ward 14 and Ward 5 of Go Vap District. The Poverty Assessment and Social Impact Report prepared by the World Bank consultant team in 2014 showed that urban flooding strongly affected people's well-being in the project area, especially the poor and near-poor households in terms of their livelihoods, employment, incomes, and access to social services including health, education, housing and sanitation. Table 6.3 summarizes the impacts of flooding on poor and near-poor households in some districts in the Project area as specified in the Poverty Assessment and Social Impact Report.

Table 6.3 The effects of flooding on poor and near-poor households

Indicator	Percentage
% households whose health was affected	67.5
% members affected with water borne diseases	54.6
% members affected with respiratory diseases	52.3
% households whose employment was affected	58
% factory workers suffering from work disruption	55
% day laborers suffering from work disruption	45.3
% households whose income was affected	43.6
% factory workers suffering from income loss	50.1
% day laborers suffering from income loss	43.6

Source: World Bank, 2014.

The Flood Risk Management Project will improve the local flooding situation, thereby contributing to poverty reduction in the project area by improving poor households' accessibility to social services, reducing their risks of water-borne and respiratory diseases, and providing them with more employment opportunities.

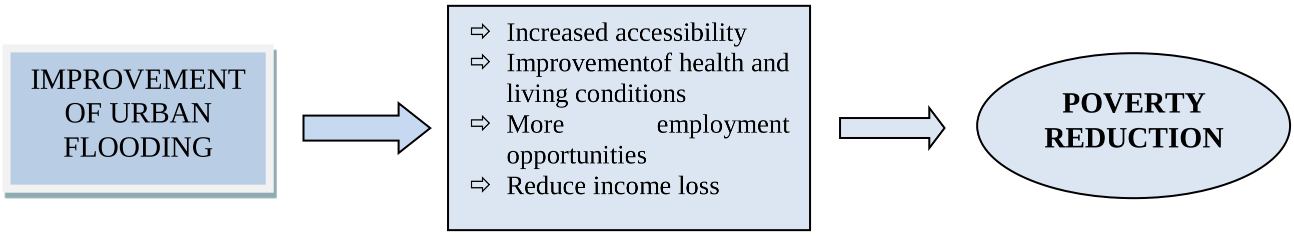


Figure 6.1 The relationship between improvement of flooding and poverty reduction.

The nature of this impact is positive, the type of impact is indirect but the duration of impact can be permanent. The magnitude of impact is large and the impact significance is major.

Improvement of health and living conditions

The HCMC Flood Risk Management Project can contribute to the quality of life and the social underpinnings of communities. The Jacobs report, The Benefits of Inland Waterways, published in 2009, highlighted many positive benefits of waterway restorations, including significant community improvements and cohesion benefits, which they argue can be sufficient justification for investment in such restoration. In the survey assessing the influence of Tham Luong–Ben Cat–Nuoc Len sub-catchment on living conditions of local households, 75.38% of the respondent households answered that their daily life was directly affected by pollution of the sub-catchment and flood in the area. 90% of the respondent said that flooding affects their health at different levels. This included insects transmitting diseases such as flies and mosquitos, untreated wastes in the sub-catchment and floods during the rainy seasons. Other impacts of flood include access to health services, daily travel and housing quality (see Table 6.4, Table 6.5 and Table 6.6).

Table 6.4 Impact of flood on health of local residents

Level of impact on health	Percentage
Extremely serious impact	32.4%
Serious impact	29.7%
Impact but not serious	29.0%
No impact	8.9%
Total	100.0%

Table 6.5 Impact of flood on health services

Impact to health services	Percentage
Impact means of travel	51.2%
Impact travel costs	12.1%
Impact travel time	28.1%
No impact	8.6%
Total	100.0%

Table 6.6 Impact of flood on daily travel

Level of impact on daily travel	Percentage
Extremely serious impact	23.8%
Serious impact	37.3%
Impact but not serious	32.7%
No impact	6.2%
Total	100.0%

When the construction is finished, it is expected that the whole community in the project area will experience significant positive changes in their living conditions such as better health and environmental conditions, air and water quality, more open public spaces, less flooding and less risks of diseases caused by pollution of the sub-catchment area.

The nature of this impact is positive, the magnitude of impact is large and the impact significance is major.

Improvement of infrastructure and accessibility

The project will significantly improve road conditions in the sub-catchment area by making roads clearer and more spacious, thereby reducing journey time and traffic congestion. This will also means less flooded roads in the rainy seasons. Therefore, the accessibility of local households to health care, social services, education and entertainment will be greatly improved.

The project is also expected to improve inland waterway transport activities in the area as the waterway is expanded.

The nature of this impact is positive, the magnitude of impact is large and the impact significance is major.

Improvement of work environment

The existing conditions of Tham Luong – Ben Cat – Nuoc Len sub-catchment area have little impacts on the industrial parks in the project area. However, pollution and flooding exert many influences on local small-scale businesses in terms of production, revenue, work environment as well as worker incomes and employment (World Bank 2014).

The Project is expected to reduce flooding and pollution in the area and improve infrastructure conditions in the area, thereby contributing to improve the work environment, production, income and revenue of local small-scale businesses and casual workers. The improvement of infrastructure conditions will also attract more investment in the area, leading to further development of the industry and business sectors.

The nature of this impact is positive, the type of impact is indirect, the magnitude of impact is moderate and the impact significance is moderate.

Leisure and tourism

One of the main impacts identified in the restoration of canals, is forecast to be leisure and tourism. According to Ho Chi Minh City Department of Tourism (2015), the city has focused on developing waterway tourism over the past two years. The boat tour on the Nhieu Loc – Thi Nghe canal which had been restored under a project funded by World Bank, was launched by the city government in early September 2015. Similarly, the restoration of the Tham Luong – Ben Cat canal has the potential to generate high levels of recreational use. The canal-side areas will become open places for public gathering, sport and children playground.

The previous environmental impact assessment report forecast that the revenue from economic, commercial, services and tourism would increase by 3-5% after completion of the project construction.

The nature of this impact is positive, the extent is regional, and the magnitude of impact is major, as not only the local population but also people in the city also enjoy the restored canal as a new place for leisure. The impact significance is major.

Increase in property prices

Research from previous canal restoration projects such as Nhieu Loc – Thi Nghe, Tan Hoa – Lo Gom and Tau Hu – Ben Nghe shows that the restoration canal projects have brought a life-changing event to thousands of households living along the canal when their houses suddenly become street-front, which significantly increases prices of their properties.

In the route Tan Hoa - Lo Gom of Tan Phu District, many household owners are preparing to increase their rental prices by 10-15% from May 2015 with the reason that the streets have become more spacious and more convenient for transportation.

It is expected that the restoration of Tham Luong – Ben Cat – Nuoc Len sub-catchment area will also increase the price of surrounding properties.

The nature of this impact is positive. The magnitude of impact is moderate and the impact significance is moderate.

Increase in business opportunities

The restoration of the Tham Luong – Ben Cat – Nuoc Len sub-catchment area is expected to open up new opportunities for home-based food businesses such as cafes, pubs and food stalls long the canal routes. This would provide local households with more opportunities for income generation, especially those whose houses become street-front.

However, there is possibility that local businesses along the canal routes and their customers will not put garbage in the right places, causing pollution in the canal. The mitigation measure for this potential negative consequence will be proposed in the next part for mitigation measures.

Overall, the nature of this impact is positive, the extent is local, and the magnitude of impact is moderate. The impact significance is moderate.

6.4. Social negative impacts

Potential negative impacts are divided into two groups: impacts resulting from land acquisition and resettlement, and impacts other than those caused by land acquisition.

6.4.1. Land acquisition and resettlement impacts due to the project

The implementation of the project require permanent land acquisition of 159,945 m^2. This land area is under the land use right of 717 households and organizations, including 697 households, 10 companies and 10 other organizations (including ward level People's Committee) and is under the management of 15 wards and communes in the project area.

The composition of acquired land is as follows:

- Housing land: 24,205m^2, accounting for 15.1%;
- Agricultural land: 84,388m^2, accounting for 52.8%;
- Garden land: 18,094 m^2, accounting for 11.3%;
- Land for non-agriculture business (renting houses, local food store, etc): 9,457 m^2 , accounting for 5.9%;
- Catchment land: 18,645m^2, accounting for 11.7%;
- Other land (including land for transport and office buildings under state management): 23,801 m^2, accounting for 14.9 %;

The levels of impacts due to land acquisition are summarized as follows

- There are 65 heavily affected households, in which 60 households are affected from 20% and 5 households are affected from 10% of their agricultural land (including garden land).
- There are 481 affected households in terms of housing, in which 74 households are completely affected and 392 households are totally partly affected. Among these 299 households can renovate their houses and continue to live.
- There are 157 affected household in terms of business, with 78/157 households having business registration. Of these, 2 households have income generate from business operation being completely affected.
- There are 38 out of 697 affected households due to land acquisition identified to be in the vulnerable group. Among these, 17 are female household head with dependents, ethnic minorities 2 households, 2 are ethnic minorities, 7 are poor households, 8 are households under preferential treatment policies and 8 households with disabled people.

The area of land acquisition and scale of influence to households and organization by administrative boundaries are shown in the following table:

Table 6.7 The scale of the land acquisition by ward

No.	Ward/ district	Area/ household	Urban housing land	Agricultural land	Garden land	Aquaculture land	Land for non-agricultural business	Canal	Other land type	Total
I	Go Vap district	m²	9,522	1,618	-	-	-	18,645	638	11,778
		household	303	21		-	-	-	8	424
1	Ward 5	m²	1,563	99	-	-	-	-	94	1,756

		household	77	7	-	-	-	-	2	156
2	Ward 6	m²	290	-	-	-	-	-	-	290
		household	9	-	-	-	-	-	-	9
3	Ward 13	m²	2,350	1,012	-	-	-	-	505	3,867
		household	7	7	-	-	-	-	3	17
4	Ward 14	m²	516	404	-	-	-	-	-	920
		household	5	4	-	-	-	-	-	9
5	Ward 15	m²	2,187			-	-	18,645	-	2,178
		household	33			-	-	-	-	33
6	Ward 16	m²	1,243	103		-	-	-	-	1,346
		household	46	3	-	-	-	-	-	49
7	Ward 17	m²	1,373	-	-	-	-	-	39	1,412
		household	126	-	-	-	-	-	3	129
II	**District 12**	m²	5,804	81,466	16,095	-	9,457	-	21,825	134,647
		household	34	113	9	-	2	-	10	168
1	Thoi An	m²	2,134	15,509	9,598	-	2,396	-	21,825	51,462
		household	24	6	3	-	-	-	10	43
2	Thanh Loc	m²	2,974	2,985	-	-	7,061	-	-	13,020
		household	2	1	-	-	2	-	-	5
3	Thanh Xuan	m²	470	1,788	6,371	-	-	-	-	8,629
		household	5	7	5	-	-	-	-	17
4	An Phu Dong	m²	226	61,184	126	-	-	-	-	61,536
		household	3	99	1	-	-	-	-	103
III	**Binh Tan district**	m²	3,603	1,147	1,999	-	-	-	1,119	7,868
		household	26	4	5	-	-	-	3	38

1	An Lac ward	m²	3,459	951	1,999	-	-	-	1,119	7,528
		household	25	3	5	-	-	-	3	36
2	Binh Hung Hoa ward	m²	144	-	-	-	-	-	-	144
		household(1)	1	-	-	-	-	-	-	1
3	Binh Hung Hoa B ward	m²	-	196	-	-	-	-	-	196
		household(1)	-	1	-	-	-	-	-	1
IV	**Tan Binh district**	m²	5,276	157	-	-	-	-	219	5,652
		household	118	5	-	-	-	-	6	129
1	Ward 15	m²	5,276	157	-	-	-	-	219	5,652
		household	118	5	-	-	-	-	6	129
Total		**m²**	**24,205**	**84,388**	**18,094**	**-**	**9,457**	**18,645**	**23,801**	**159,945**
		household	**481**	**143**	**14**	**-**	**2**	**-**	**27**	**759**

Potential negative consequences resulting from land acquisition include:

- **Loss of sense of place due to physical displacement**: Displaced households may find it hard to get adapted to the new neighborhood and potential conflicts with the new neighbors might occur. They may also need to find new schools for their children and travel longer distances to workplace;
- **Unemployment risks**: In 2013, a survey conducted by Ho Chi Minh City Institute for Development Studies on livelihood of people who had been displaced to new areas for construction of new infrastructure projects showed that only 57.1% of people in the working age found a new job when they moved to the new place. They also encountered many challenges in their new places. This led to the situation in which thousands of apartments for resettlement were abandoned while people had to make both end meets for jobs and accommodation. The development of alternative livelihood strategies should be the preferred mitigation measure, maximizing all possibilities for involvement in employment.

Results of the Social Economic Study (SES) conducted by the RAP consultant team shows that most households live in poor sanitary conditions and are subject to high risk of flooding. The SES survey also showed that some affected households who do not have legal document to be able to receive full compensation for land acquisition are largely households living on encroached land and catchment area. They are not eligible to be granted a land use right certificate. Many of these households have income generated from activities on the affected land. The survey results also show that a great part of the affected population (34%) is doing some business activities, largely house or rooms for rent. 29% of the affected population due to land acquisition in the working age are unemployed or casual laborers.Of the 717 households affected by land acquisition, 60 households have over 20% of their productive land s impacted. The SES result show that in most cases, income loss per person ranges from 5 million VND to 80 million VND per month (data provided by the RAP consultant team).

6.4.2. Impacts other than those caused by land acquisition

Impacts other than those caused by land acquisition include the followings:

- Influx of temporary workers

- Increase in traffic and safety hazards

- Impacts on agriculture

- Construction safety hazards

Influx of temporary workers

Based on the rough estimate of construction workers required for the project, it is anticipated that there will be a buildup of migrant construction workforce in the project area. These new residents may create a strain on community infrastructure, as well as creating social stresses due to changing patterns of social interaction. The local communities may have difficulties in responding to the increased demands on school, health facilities, housing and other social services. Further stresses may be created by resentments between newcomers and long-time residents.

However, the influx of temporary workers during the construction phase of the project may create more demand for local services such as food and accommodation, thus creating more opportunities for local business arising from spending power of construction workers.

As this impact creates both negative and positive consequences, the nature of this impact type is considered to be neutral. The magnitude of impact is medium, given the influx of workers is temporary. The vulnerability of household is medium and the impact significance is therefore Moderate.

Increase in traffic and safety hazards

Construction activities will lead to a significant increase in vehicular traffic. The project location stretches across 9 districts which are inhabited by a large population. During the construction phase, trucks constantly transporting construction materials in and out of the construction sites must go through roads in residential areas. The risks of accidents between construction vehicles and other vehicles are quite high. Increased traffic will also lead to the creation of dust and noise.

Furthermore, the renovation of the roads along the Tham Luong canal, to some extent, will affect traffic in the area. Although the roads under renovation are not the main route with low traffic density, the prolonged construction process will present as traffic obstacles to local people, affecting their daily travel and their access to some social services

The construction phase will also impede inland waterway transport in river sections under construction. In addition, as the construction process takes long time, the project owners should have arrange reasonable construction time to minimize negative impacts on waterway transport.

The nature of this impact is negative, the magnitude of impact is medium, the vulnerability is medium and the impact significance is moderate.

Impacts on agriculture

During the construction phase, the water in the canal will be cut-off, causing water depletion. This will affect agricultural activities along the sub-catchment area. Agricultural land accounts for 30% (5,200 ha) of the project total area. Nevertheless, the proportion of households with incomes from agriculture in the project area is very low, accounting for only 0.51% in Go Vap District and 1.30% in District 12. Therefore the project construction will have negligible impact on agricultural activities.

The nature of this impact is negative, the magnitude of impact is negligible, the vulnerability is low and the impact significance is minor.

Construction safety hazards

Occupational accidents may occur due to negligence or non-compliance with operation regulations. The probability of occurrence depends on how strictly workers follow regulations and safety rules. The level of impact ranged from personal injury to casualty. The causes of occupational accidents are:

- Overwork causing dizziness, fatigue and faint;
- During the rainy days, the possibility of occupational accidents may increase due to landslides, slippery ground, and electrical issues;
- High piles of construction materials can endanger workers in case of spilling.

Problems that may occur during construction include:

- Electrical problems during the construction of power lines and electricity use during the construction project;
- Fire accidents that might result from the use of combustible materials and from temporary houses of workers inside the construction site.

Creation of haven for homeless people and possibility of social evils when the construction is finished

Experiences from Tan Hoa – Lo Gom, Tau Hu – Ben Nghe and Nhieu Loc - Thi Nghe indicate that the parks along the new restored canals can become a haven for homeless people and drug addicts which will possibly lead to the occurrence of many social evils and threaten local social security.

The nature of this impact is negative, the type of impact is indirect, the extent is local, and the magnitude of impact is moderate. The impact significance is moderate. Mitigation measures will be proposed in the next part.

Table 6.8 Social Impact Assessment Matrix

Potential Impacts	Impact Nature	Impact Type	Impact Duration	Impact Extent	Impact Scale	Impact Frequency	Impact Magnitude	Impact Vulnerability	Impact Significance
POTENTIAL POSITIVE IMPACTS									
Creation of employment opportunities	Positive	Direct	Short-term	Local	Individual	One-off	Minor	N.A	Minor
Increase in business opportunities in local services	Positive	Indirect	Short-term	Local	Household	One-off	Minor	N.A	Minor
Poverty reduction	Positive	Indirect	Permanent	Local	Household	Constant	Large	N.A	Major
Improvement of living conditions	Positive	Direct	Permanent	Local	Household	Constant	Large	N.A	Major
Improvement of infrastructure and accessibility	Positive	Indirect	Permanent	Regional	Household level	Constant	Large	N.A	Major
Improvement of work environment	Positive	Indirect	Permanent	Local	Household and business	Constant	Medium	N.A	Moderate
Leisure and tourism	Positive	Indirect	Permanent	Regional	Household and business	Constant	Large	N.A	Major
Increase in property prices	Positive	Indirect	Permanent	Local	Household	One-off	Moderate	N.A	Moderate
Increase in business	Positive	Indirect	Permanent	Local	Household	Often	Moderate	N.A	Moderate

opportunities									
POTENTIAL NEGATIVE IMPACTS									
Physical displacement of households along the sub-catchment area	Negative	Direct	Permanent	Local	Household	One-off	Medium	High	Major
Influx of temporary workers	Neutral	Direct	Short-term	Local	Household	One-off	Medium	Medium	Moderate
Increase in traffic and safety hazards	Negative	Direct	Short-term	Local	Individual	One-off	Medium	Medium	Moderate
Impacts on agriculture	Negative	Indirect	Short-term	Local	Household	One-off	Negligible	Low	Minor
Creation of haven for homeless people and possibility of social evils	Negative	Indirect	Medium-term	Local	Individual	Often	Moderate	Medium	Moderate

6.5. Residual impacts

For the purposes of this assessment, residual impacts are those that remain significant following the application of mitigation measures.

The majority of impacts identified during the impact assessment can be reduced to low significance following the implementation of mitigation measures. However, impacts of physical displacement remain of moderate significance, even with mitigation, due to their permanent nature. As such, monitoring and management measures should extend throughout the life of the project in order to ensure that the quality of life of displaced persons is equal to or better than prior to displacement.

6.6. Recommended mitigation and enhancement measures

This section identifies the mitigation measures for the anticipated negative impacts as well as enhancement measures for positive impacts where these are likely to occur. Each of these measures (to be implemented either at the pre-construction, construction or operational stage) are listed and then cost as appropriate in Section 7 of this report (the Environmental and Social Management Plan) and responsibilities for their implementation assigned.

6.6.1. Mitigation measures for negative impacts

Physical displacement of households along the sub-catchment area

The objective of the mitigation measure for physical displacement is to ensure that the quality of life of displaced households is equal to or better than prior to displacement. The physical displacement of households will require a Resettlement Action Plan (RAP) (please see Annex 6 for a summary of the RAP) . The plan include compensation for structures and loss of assets and support with moving to a new location and establishing a new home.

Alternative livelihood strategies developed as a mitigation measure to maximize all possibilities for involvement in employment opportunities are available. The establishment of appropriate training and skills development at an early stage will allow displaced people to benefit from employment opportunities in their new places, especially displaced people who are occasional workers. Poor and near-poor households in the displaced group should be provided with information about NGOs and organizations supporting poor people such as the Capital Aid Fund for Employment of the Poor (CEP) which is a non-profit Vietnamese microfinance institution that provides microfinance services to the poor and poorest, enabling them to begin and develop small businesses.

A Income Restoration Plan (IRP) should be developed to ensure households are not left worse off following displacement. Furthermore, it is necessary to establish a grievance mechanism prior to project implementation to facilitate the resolution of affected community concerns and grievances, ensuring ongoing interaction with the community in order to build trust and maintain relationships throughout the life of the project.

Influx of temporary workers

The objective of the mitigation measure for influx of temporary workers is to reduce population influx, minimize the possibility of conflicts between workers and the local community and preserve social security in the area.

To minimize the strain on community infrastructure and social stresses due to changing patterns of social interaction, positions for unskilled workers should preferably be employed from the local population to minimize population influx. Furthermore, a dispute prevention and management plan should be developed with an aim to manage conflict and bring about positive change through conflict resolution processes. This will be assisted by ongoing community engagement and stakeholder involvement throughout the process. In addition, the contracts for civil works should include legal covenant requiring priority to be given to local residents for project employment.

Increase in traffic and safety hazards

The objective of the mitigation measure for traffic and safety hazards is to maintain the health and safety of local population.

A detailed health and safety plan must be developed to mitigate construction risks of the proposed project on the surrounding communities. This plan must take into consideration of the following:

- Increased risk of traffic through built-up areas;
- The risk that increased traffic volumes will pose to people;
- Appropriate construction arrangement to minimize influences on inland waterway transport

To minimize the risks of traffic congestion and accidents, it is recommended that the Investor will adopt a number of measures as follows:

- Periodic inspection and maintenance of vehicles; in the event of dangerous incidents during the construction process, investor should not allow the use of these vehicles on the roads until the problem has been resolved;
- Drivers of construction vehicles must be selected carefully, especially in terms of experience, age and level of understanding of traffic rules;
- Drivers who fail to follow traffic rules will receive fines as regulated by law. In addition the Contractor will adopt disciplinary measures such as pay cut or redundancy.
- Assignment of responsibilities in the implementation of measures to strictly control inland waterway transport;
- Limit overloaded shipping boats;
- Place traffic signs on the route;

- Promote the use of lifeboats to minimize damage in the event of emergency and accidents;
- Limit traffic flow during rush hours.

In the event of traffic congestion and accidents within the project construction area, Investor should timely report the issue to relevant authorities.

Impacts on agriculture

Although the impact significance is minor, the affected households with main income from agricultural activities should be engaged in the development of alternative livelihood strategies.

Creation of haven for homeless people and possibility of social evils

This is an indirect induced impact and not easy to evaluate as homeless people can come from other areas in the city. The objective of the mitigation measure is to minimize the disturbance and threats that homeless people and drug addicts pose to the local people. It is important that there is enough security staff in the public parks along the canal area during day and night time to maintain security and prevent crime. Surveillance cameras should also be installed in public places to timely protect against property theft and prevent crime.

6.6.2. Enhancement measures for some positive impacts

Creation of employment opportunities in construction phase

The objective of the enhancement measure for this impact is local population are offered employment opportunities where possible.

It is recommended that a "local labour" desk at the contractor offices should be established to identify a local labour pool. Information about recruitment of employers and workers for the project should be spread widely to local people.

Skill development programs should be implemented to ensure support for local population in obtaining employment opportunities.

Increase in business opportunities in operation phase

The objective of the enhancement measure for this impact is to minimize pollution to the canals resulting from the local food and beverage businesses.

It is the responsibility of the local authority and relevant units to regularly check whether restaurants and cafes allocate enough trash bins to dispose of wastes when customers need and whether there is enough toilets for customers. Restaurants and shops that perform well in doing this should be given some economic incentive.

Leisure and tourism

The objective of enhancement measures of this impact is to maximize its potential as a leisure place and for tourism development.

The public areas along the sub-catchment area will become ideal places for public gathering and recreational activities. However, littering along the restored canals has become an issue in Nhieu Loc - Thi Nghe, Tan Hoa - Lo Gom and Tau Hu - Ben Nghe. It is forecast that Tham Luong - Ben Cat - Nuoc Len sub-catchment area would face the same problem when the construction is finished. A real green, clean and beautiful Tham Luong - Ben Cat canal requires strong cooperation between the local authority and local communities in protecting the canal from untreated wastes.

Local government can work with the retired and the elderly who have a reputation in the community to discourage people in the area from throwing garbage into the canal. Besides, placing additional trash bins and warning signs is another effective way to reduce throwing wastes down into the canal. The trash cans must always be kept clean and convenient for people to dispose of waste. People who fail to follow regulations should receive a fine.

CHAPTER 7: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

Based on the assessment of the potential negative impacts discussed and the mitigation measures proposed in Chapter 5, this chapter presents the Environmental Management Plan (EMP) for the The project of "*Priority Flood Risk Reduction Investments in Tham Luong – Ben Cat –Nuoc Len (TLBCNL) sub-catchment"* The EMP identifies actions to be carried out under the subproject to reduce and/or avoid impacts including the environmental monitoring program and the implementation arrangements, taken into account the need to comply with the Government's EIA regulations and the World Bank Group (WBG)'s safeguard policies, including those of the World Bank Group's Environmental, Health, and Safety Guidelines.

A. Environmental management plan for component

7.1. Basic principles

As a part of the EIA, an Environmental Management Plan (EMP) is a safeguards instrument that is typically used in many projects and which consists of information on and guidance for the process of mitigating and managing adverse environmental impacts throughout project implementation. Typically in Vietnam, an EMP comprises a list of typical mitigation measures to be carried out by contractors, an environmental monitoring program, organization arrangements, and an estimated monitoring cost.

There is a comprehensive regulatory framework in Vietnam related to EIA preparation, environmental standards, protection and management of forest and cultural property, and other aspects related to construction and operation of facilities and infrastructures in Vietnam. This EMP in consistent with these regulations.

To facilitate effective implementation of the EMP, the PMU will: (a) Establish an Environment and Social Unit (ESU) responsible for ensuring timely implementation of the EMP, including monitoring, reporting, and capacity building related to safeguards; (b) Assign the Construction Supervision Consultant (CSC) to also be responsible for supervision of the contractor's safeguard performance as part of the construction contract and this requirement will be included in the CSC's terms of reference; and (c) Hire qualified national consultants as the Independent Environmental Monitoring Consultant (IEMC) to assist the ESU in performing its task.

URENCO, and the Department of Transport will be responsible for implementation of the mitigation measures during the operation stage of the project and they will ensure that the mitigation measures are implemented and adequate budget is provided. The HCMC People Committee (PSC) chaired by the Chairman or Vice Chairman will provide the overall policy guidance and oversight of the project implementation. Roles and responsibilities of the specialized agencies and the Departments of Planning and Investment and Natural Resources and Environment (DONRE) will also be critical.

In terms of laying out the mitigation measures of the EMP, there are two fundamental parts to this EMP. Firstly, the City has developed and will use Urban Construction Environmental Codes of Practice (ECOPs). These ECOPs outline typical generic low-level impacts that can be expected to occur in a wide range of construction activities of the project. They include mitigation measures for these impacts and a process for including them in the construction contracts of contractors. During the detailed design of technical specifications for each contract, the technical design consultant will incorporate into the contract the parts of the ECOPs specific to that contract, as well as the specific measures identified in the EMP.

Secondly, all site-specific impacts that are either not covered in the general ECOPs or which are of an order of magnitude that require mitigation measures not covered in the ECOPs, are described in more detail in the EMP. The mitigation measures are derived from the more detailed analysis of Chapter 5.

Activities to be carried out to mitigate impacts due to land acquisition and resettlement are presented separately (RAP and RPF) and they will be carried out and monitored separately.

7.2. Key mitigation measures for component 2

7.2.1. Urban Construction Environmental Codes of Practice (ECOPs) for Project Component 2

Types of impacts covered in this document are:

- Dust generation;
- Air pollution;
- Impacts from noise and vibration;
- Water pollution;
- Drainage and sedimentation control;
- Management of stockpiles, quarries, and borrow pits;
- Solid waste management;
- Management of dredged materials;
- Disruption of vegetative covers and ecological resources;
- Traffic management;
- Interruption of utility services;
- Restoration of affected areas;
- Worker and public safety;
- Communication with local communities.

Table 7.1 Mitigation Measures Extracted From the Urban Works ECOPs applicable for Project Component 2

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
1. Dust generation	• The Contractor is responsible for compliance with relevant Vietnamese legislation with respect to ambient air quality. • The Contractor shall ensure that the generation of dust is minimized and is not perceived as a nuisance by local residents and shall implement a dust control plan to maintain a safe working environment and minimize disturbances for surrounding residential areas/dwellings. • The Contractor shall implement dust suppression measures (e.g. use water spraying vehicles to water roads, covering of material stockpiles, etc.) as required. • Contractual provisions to be included with all material suppliers (e.g. quarries and haulage contractors) to ensure that the above management measures are implemented throughout the supply chain. • Control speed limit of the trucks and other vehicles not to exceed than 10 km/h within the Project boundary; • Coordination of the construction schedule to minimize dust emissions during peak times of the construction phase throughout utilizing knowledge of meteorological conditions e.g. rainfall periods and prevailing wind patterns • Material loads shall be suitably covered and secured during transportation to prevent the scattering of soil, sand, materials, or dust. • Exposed soil and material stockpiles shall be protected against wind erosion and the location of stockpiles shall take into consideration the prevailing wind directions and locations of sensitive receptors. • Dust masks should be used by workers where dust levels are excessive • Develop and use of the grievance mechanism to record complains from affected stakeholders such that nuisance dust impacts can be identified and rectification measures implemented.	• QCVN 05: 2009/BTNMT**:** *National technical regulation on ambient air quality*

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
2. Air pollution	• All vehicles must comply with Vietnamese regulations controlling allowable emission limits of exhaust gases. • Vehicles in Vietnam must undergo a regular emissions check and get certified named: "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; • There should be no burning of waste or construction materials (eg. Bitumen, etc.) on site. • Install wheel washing facilities at appropriate positions from the site entrance • Use low sulfur fuels for machinery and vehicle; • Undertake scheduled maintenance to reduce fuel use and poor air quality.	• TCVN 6438-2005: Road vehicles. Maximum permitted emission limits of exhaust gas. • No. 35/2005/QD-BGTVT on inspection of quality, technical safety and environmental protection; • QCVN 05:2009/BTNMT: National *technical regulation on ambient air quality*
3. Impacts from noise and vibration	• The contractor is responsible for compliance with the relevant Vietnamese legislation with respect to noise and vibration. • All vehicles must have appropriate "*Certificate of conformity from inspection of quality, technical safety and environmental protection"* following Decision No. 35/2005/QD-BGTVT; to avoid exceeding noise emission from poorly maintained machines. • 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	• QCVN 26:2010/BTNMT: National technical regulation on noise • QCVN 27:2010/BTNMT: National technical

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	protected areas. • Avoiding or minimizing transportation though community areas and avoiding as well as material processing areas (such as cement mixing).	regulation on vibration
4. Water pollution	• The Contractor must be responsible for compliance with the relevant Vietnamese legislation relevant to wastewater discharges into watercourses. • Portable or constructed toilets must be provided on site for construction workers. Wastewater from toilets as well as kitchens, showers, sinks, etc. shall be discharged into a conservancy tank for removal from the site or discharged into municipal sewerage systems; there should be no direct discharges to any water body. • Wastewater over standards set by relevant Vietnam technical standards/regulations must be collected in a conservancy tank and removed from site by licensed waste collectors. • Make appropriate arrangements for collecting, diverting or intercepting wastewater from households to ensure minimal discharge or local clogging and flooding. • Before construction, all necessary wastewater disposal permits/licenses and/or wastewater disposal contract have been obtained. • At completion of construction works, wastewater collection tanks and septic tanks shall be safely disposed or effectively sealed off.	• QCVN 09:2008/BTNMT: National Technical Standard on underground water Quality • QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater; • QCVN 24: 2009/BTNMT: National technical regulation on industrial wastewater; • TCVN 7222: 2002: General

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
		requirements on centralized wastewater treatment plant;
5. Drainage and sedimentation control	• The Contractor shall follow the detailed drainage design included in the construction plans, intended to prevent storm water from causing local flooding or scouring slopes and areas of unprotected soil resulting in heavy sediment loads affecting local watercourses. • Ensure drainage system is always maintained cleared of mud and other obstructions. • Areas of the site not disturbed by construction activities shall be maintained in their existing conditions. • Earthworks, cuts, and fill slopes shall be properly maintained, in accordance with the construction specifications, including measures such as installation of drains, use of plant cover. • To avoid sediment-laded runoff that could adversely impact watercourses, install sediment control structures where needed to slow or redirect runoff and trap sediment until vegetation is established. Sediment control structures could include windrows of logging slash, rock berms, sediment catchment basins, straw bales, storm drain inlet protection systems, or brush fences. • Site de-watering and water diversions: In the case that construction activities require that work be carried out within the watercourse (e.g. culvert or bridge crossing construction, retaining wall construction, erosion protection works), the work area must be dewatered to provide for construction in dry conditions. The sediment laden water pumped from the work area must be discharged to an appropriate sediment control measure for treatment before re-release to the stream. • Use techniques such as berming or diversion during construction to limit the exposure of disturbed sediments to moving water	• TCVN 4447:1987: Earth works-Codes for construction • Decree No. 22/2010/TT-BXD on regulation of construction safety • QCVN 08:2008/BTNMT – National technical regulation on quality of surface water

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	• Stream diversions or construction of cofferdams would require site-specific mitigation measures in the EMP.	
6. Management of stockpiles, quarries, and borrow pits	• Large-scale borrow pits or stockpiles will need site-specific measures that go beyond those in these ECOPs. • All locations to be used must be previously identified in the approved construction specifications. Sensitive sites such as scenic spots, areas of natural habitat, areas near sensitive receptors, or areas near water should be avoided. • An open ditch shall be built around the stockpile site to intercept wastewater. • Stockpile topsoil when first opening a borrow pit and use it later to restore the area to near natural conditions. • If needed, disposal sites shall include a retaining wall. • If the need for new sites arises during construction, they must be pre-approved by the Construction Engineer. • If landowners are affected by use of their areas for stockpiles or borrow pits, they must be included in the project resettlement plan. • If access roads are needed, they must have been considered in the environmental assessment.	
7. Solid waste management	• Hazardous wastes are not covered by these ECOPs and would require specific mitigation measures. • Before construction, a solid waste control procedure (storage, provision of bins, site clean-up schedule, bin clean-out schedule, etc.) must be prepared by Contractors and it must be carefully followed during construction activities. • Before construction, all necessary waste disposal permits or licenses must be obtained. • Measures shall be taken to reduce the potential for litter and negligent behavior with regard to the disposal of all refuse. At all places of work, the Contractor shall provide litter bins, containers and	• Decree No. 59/2007/ND-CP on solid waste management • Decision No. 23/2006/QD-BTNMT with list of

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	refuse collection facilities. • Solid waste may be temporarily stored on site in a designated area approved by the Construction Supervision Consultant and relevant local authorities prior to collection and disposal through a licensed waste collector, for example, URENCO. • Waste storage containers shall be covered, tip-proof, weatherproof and scavenger proof. • No burning, on-site burying or dumping of solid waste shall occur. • Recyclable materials such as wooden plates for trench works, steel, scaffolding material, site holding, packaging material, etc shall be collected and separated on-site from other waste sources for reuse, for use as fill, or for sale. • If not removed off site, solid waste or construction debris shall be disposed of only at sites identified and approved by the Construction Supervision Consultant and included in the solid waste plan. Under no circumstances shall the contractor dispose of any material in environmentally sensitive areas, such as in areas of natural habitat or in watercourses. • 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	hazardous substance • Circular No. 12/2011/TT-BTNMT on management of hazardous substance

Environmental – Social issues	**Mitigation measure**	**Vietnam code/regulation**
	avoid any leakage or affecting workers. The local DONRE must be contacted for further guidance.	
8. Management of dredged materials	• Large quantities of dredged materials, or materials that are contaminated would require mitigation measures not covered in these ECOPs. • Dredging plan should be established including time schedule, method statement to meet the requirements of traffic safety, public health and environmental sanitation. In order to ensure dredging that is consistent with environmental regulations, key decision makers (local authority, DONRE, utility company, CSC, etc.) must be involved and concur in each key decision point in the process leading to preparation and implementation of a plan. • Characteristics of sediment should be determined by sampling and analysis if not already fully evaluated during the EIA. Dredge material that is contaminated would require special mitigation measures.. • Ensure that dredged material management plans incorporate environmental considerations in the identification of short-term and long-term disposal alternatives, consider methods to reduce dredging, and maximize the beneficial use of dredged materials. • Lixiviate from dredged materials should not be allowed to enter watercourses without appropriate filtering or treatment. • Collected dredged materials have to be processed, as per Vietnamese regulations on waste collection, to ensure safe and environmentally secure transportation, storage, treatment and management. • Those involved in handling of dredged materials should be specialized and be certified. • Sanitary landfill site should meet technical requirements, based on level of potential contamination. In the case of disposal at a dumpsite, a hazardous cell may need to be constructed if dredged material is contaminated by heavy metals.	• Decision No. 23/2006/QD-BTNMT with list of hazardous substance • Decree No. 59/2007/ND-CP on solid waste management • Circular No. 12/2011/TT-BTNMT on management of hazardous substance

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
9. Traffic management	• Before construction, carry out consultations with local government and community and with traffic police. • Significant increases in number of vehicle trips must be covered in a construction plan previously approved. Routing, especially of heavy vehicles, needs to take into account sensitive sites such as schools, hospitals, and markets. • Installation of lighting at night must be done if this is necessary to ensure safe traffic circulation. • Place signs around the construction areas to facilitate traffic movement, provide directions to various components of the works, and provide safety advice and warning. • Employing safe traffic control measures, including road/rivers/canal signs and flag persons to warn of dangerous conditions. • Avoid material transportation for construction during rush hour. • Passageways for pedestrians and vehicles within and outside construction areas should be segregated and provide for easy, safe, and appropriate access. Signpost shall be installed appropriately in both water-ways and roads where necessary.	• Law on traffic and transportation No. 23/2008/QH12 • Law on construction No. 16/2003/QH11 • Decree No. 22/2010/TT-BXD on regulation of construction safety
10. Interruption of utility services	• Planned and unplanned interruptions to water, gas, power, internet services: the Contractor must undertake prior consultation and contingency planning with local authorities about the consequences of a particular service failure or disconnection. • Coordinate with relevant utility providers to establish appropriate construction schedules. • Provide information to affected households on working schedules as well as planned disruptions (at least 5 days in advance). • Interruptions of water supply to agricultural areas must also be avoided. • The contractor should ensure alternative water supply to affected residents in the event of disruptions lasting more than one day.	• Decree No. 73/2010/ND-CP on administrative penalization security and society isues

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	• Any damages to existing utility systems of cable shall be reported to authorities and repaired as soon as possible.	
11. Restoration of affected areas	• Cleared areas such as borrow pits which are no longer in use, disposal areas, site facilities, workers' camps, stockpiles areas, working platforms and any areas temporarily occupied during construction of the project works shall be restored using landscaping, adequate drainage and revegetation. • Start revegetation at the earliest opportunity. Appropriate local native species of vegetation shall be selected for the planting and restoration of the natural landforms. • Spoil heaps and excavated slopes shall be re-profiled to stable batters, and grassed to prevent erosion; • All affected areas shall be landscaped and any necessary remedial works shall be undertaken without delay, including green-spacing, roads, bridges and other existing works • Trees shall be planted at exposed land and on slopes to prevent or reduce land collapse and keep stability of slopes • Soil contaminated with chemicals or hazardous substances shall be removed and transported and buried in waste disposal areas. • Restore all damaged road and bridges caused by project activities	• Law on Environment protection No. 52/2005/QH11
12. Worker and public Safety	• Contractor shall comply with all Vietnamese regulations regarding worker safety. • Prepare and implement action plan to cope with risk and emergency • Preparation of emergency aid service at construction site • Training workers on occupational safety regulations • If blasting is to be used, additional mitigation measures and safety precautions must be outlined in the EMP. • Ensure that ear pieces are provided to and used by workers who must use noisy machines such as piling, explosion, mixing, etc., for noise control and workers protection.	• Decree No. 22/2010/TT-BXD on regulation of construction safety • Instruction No. 02 /2008/CT-BXD on safety and sanitation issues in

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	• During demolition of existing infrastructure, workers and the general public must be protected from falling debris by measures such as chutes, traffic control, and use of restricted access zones. • Install fences, barriers, dangerous warning/prohibition site around the construction area which showing potential danger to public people • The contractor shall provide safety measures as installation of fences, barriers warning signs, lighting system against traffic accidents as well as other risk to people and sensitive areas. • If previous assessments indicate there could be unexploded ordnance (UXO), clearance must be done by qualified personnel and as per detailed plans approved by the Construction Engineer.	construction agencies • TCVN 5308-91: Technical regulation on safety in construction • Decision No. 96/2008/QD-TTg on clearance of UXO.
13. Communication with local communities	• Maintain open communications with the local government and concerned communities; the contractor shall coordinate with local authorities (leaders of local wards or communes, leader of villages) for agreed schedules of construction activities at areas nearby sensitive places or at sensitive times (e.g., religious festival days). • Copies in Vietnamese of these ECOPs and of other relevant environmental safeguard documents shall be made available to local communities and to workers at the site. • Reduced playground space, loss of playing fields and car parking: The loss of amenities during the construction process is often an unavoidable source of inconvenience to users in sensitive areas. However, early consultation with those affected, provides the opportunity to investigate and implement alternatives. • Disseminate project information to affected parties (for example local authority, enterprises and affected households, etc) through community meetings before construction commencement; • Provide a community relations contact from whom interested parties can receive information on site activities, project status and project implementation results;	• Decree No. 73/2010/ND-CP on administrative penalization security and society issues

Environmental – Social issues	Mitigation measure	Vietnam code/regulation
	• Provide all information, especially technical findings, in a language that is understandable to the general public and in a form of useful to interested citizens and elected officials through the preparation of fact sheets and news release, when major findings become available during project phase; • Monitor community concerns and information requirements as the project progresses; • Respond to telephone inquiries and written correspondence in a timely and accurate manner; • Inform local residents about construction and work schedules, interruption of services, traffic detour routes and provisional bus routes, blasting and demolition, as appropriate; • Provide technical documents and drawings to PC's community, especially a sketch of the construction area and the EMP of the construction site; Notification boards shall be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, health and safety staff, telephone numbers and other contact information so that any affected people can have the channel to voice their concerns and suggestions.	

7.2.2. Site-specific Enviromental Impacts

Table 7.2 presents site-specific impacts and mitigation measures that are not fully addressed through the application of ECOPs[5]. This may be because the impact is not a typical one and is not included in the ECOPs, because the severity of the impact goes beyond the scope of the mitigation measures in the ECOPs, or because simply of the very specific nature of the mitigation measure that is needed.

Table 7.2 Site Specific Impacts and Mitigation Measures

SUB-COMPONENT 1: CONSTRUCTION OF NUOC LEN TIDAL SLUICE GATE AND 2 SHIP LOCKS	
Pre-Construction	
Impact:	Demolition of houses along the central road to be constructed in the site
Mitigation:	Ensure demolition work is carried out safely, in accordance with contract conditions
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Construction	
Impacts	Land clearance, including house, trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries, UXO, blocking the water flow of the Canal at construction site, contaminating surface water due to waste discharge (i.e. oil spill, run-off storm water, domestic wastewater, construction wastewater), marine traffic incidents (i.e. congestion, accident) at construction site, noise and vibration from the extensive pile driving required for constructing the tidal sluice gate and ship lock, dust and VOC (asphalt) emission from road construction works
Mitigation:	• Clear the area before construction by qualified and licensed UXO clearance experts; • Ensure that there is no land clearance outside defined construction site boundaries; • Ensure also that the contract requires the contractor, before he commences work, to

[5] ECoPs will be suitable for investments under Component 1 (hydromet network expansion; monitoring stations installation, etc.)

	provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; • Ensure the contract for the works requires the contractor to prepare a plan for working at site to manage the waste generated from construction activities to prevent the contamination of water at area surrounding the construction site, to fully implement health and safety policy to prevent the any incidents affect to workers onsite and surrounding community; • Assigning the flagman to control the marine traffic flow through the construction site; and • Ensure that pile driving work is carried out only during daylight hours, on normal working days.
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Inadequate operation of tidal sluice gate affecting the tidal regimes of the Canal that can result flooding to the catchment, especially during the rainy seasons, and resulting traffic congestion/accidents to boat travel through the ship lock
Mitigation:	• Develop a scientific tidal sluice gate and ship locks operation that must be fully implemented by operation employees to ensure a minimizing impacts of flooding and controlling the traffic flow through the ship locks
Implementation mechanisms:	Infrastructure Operations and Maintenance Plan
Responsibility:	City
Fund source:	IDA Credit
Monitoring:	City
SUB-COMPONENT 2: CONSTRUCTION OF VAM THUAT TIDAL SLUICE GATE AND 2 SHIP LOCKS	

Construction	
Impacts	Land clearance, including house, trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries, UXO, blocking the water flow of the Canal at construction site, contaminating surface water due to waste discharge (i.e. oil spill, run-off storm water, domestic wastewater, construction wastewater), marine traffic incidents (i.e. congestion, accident) at construction site, noise and vibration from the extensive pile driving required for constructing the tidal sluice gate and ship lock, dust and VOC (asphalt) emission from road construction works
Mitigation:	• Clear the area before construction by qualified and licensed UXO clearance experts; • Ensure that there is no land clearance outside defined construction site boundaries; • Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; • Ensure the contract for the works requires the contractor to prepare a plan for working at site to manage the waste generated from construction activities to prevent the contamination of water at area surrounding the construction site, to fully implement health and safety policy to prevent the any incidents affect to workers onsite and surrounding community; • Assigning the flagman to control the marine traffic flow through the construction site; and • Ensure that pile driving work is carried out only during daylight hours, on normal working days.
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	Inadequate operation of tidal sluice gate affecting the tidal regimes of the Canal that can result flooding to the catchment, especially during the rainy seasons, and resulting traffic congestion/accidents to boat travel through the ship lock
Mitigation:	Develop a scientific tidal sluice gate and ship locks operation that must be fully implemented by operation employees to ensure a minimizing impacts of flooding

	and controlling the traffic flow through the ship locks
Implementation mechanisms:	Infrastructure Operations and Maintenance Plan
Responsibility:	City
Fund source:	City
Monitoring:	City
SUB-COMPONENT 3: IMPROVEMENT/UPGRADING OF CANAL BANK REVETMENT IN THE MAIN CANAL OF TLBCNL CANAL	
Pre-Construction	
Impact:	Demolition of houses along the central road to be constructed in the site
Mitigation:	Ensure demolition work is carried out safely, in accordance with contract conditions
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Construction	
Impacts	For dredging sludge and upgrading the embankment of the Canal, key site-specific impacts include risks due to UXO; odor and other contamination resulting from the excavation, transport, and disposal of approximately 1,778,701.45 m^3 of wet sludge with a high organic; noise and vibration from the extensive pile driving required by the design for the channel protection works. For constructing the roads along the Canal, key site-specific impacts include risks due to land clearance, including house, trees and other vegetation, undertaken indiscriminately, without reference to construction site boundaries construction, traffic causing danger within the construction site and also to residential and other areas outside the site; vibration from construction equipment damaging buildings in close proximity to the construction site; and dust and VOC (asphalt) emission from road construction works.
Mitigation:	To mitigate impacts of dredging sludge and upgrading the embankment of the Canal,

	following measures will be carried out by the PMU:
	
	• Clear the area before construction by qualified and licensed UXO clearance experts;
	
	• Ensure that the detailed design for the canal rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites (landfills for material that testing shows is not contaminated beyond specified limits, and prepared sanitary landfills – for example the existing site at Da Phuoc Landfill – for material that is contaminated beyond specified limits);
	
	• In the case of dredged sludge transported to Da Phuoc Landill, the PMU needs to ensure a legal commitment between Da Phuoc Landfill, HCMC DONRE and PMU, whereby the Da Phuoc Landfill must ensure an availability of capacity for disposing the dredged sludge and construction waste.
	
	• Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of the channel in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues such as noise, air emission, wastewater and security;
	
	• Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; and
	
	• Ensure that pile driving work is carried out only during daylight hours, on normal working days.
	
	To mitigate impacts of road construction of the Canal, following measures will be carried out by the PMU:
	
	• Ensure that the contractor prepares and implements a site specific environmental management plans (as required by the contract) for each aspect of the works – site clearance, earthworks, temporary and permanent drainage, pavement works, and traffic and site safety. Specifically, and addition to the general requirements set out in the ECOPs:
	  o Ensure that there is no land clearance outside defined construction site boundaries;
	  o Ensure that, from the commencement of construction, site drainage is a priority activity, to include channels, silt traps, flow abatement structures, etc.;
	  o Ensure that borrow areas are developed, operated, closed, and restored in the same manner as earthworks sites for the project works, and that are subject to the same EMP and other contractual requirements;

	○ Ensure that temporary culverts are installed in any natural waterways that are to be crossed by construction traffic; ○ Ensure that equipment repair facilities, material stockpiles for example – are set up away from streams, residential areas, and other sensitive sites; ○ Ensure that all drivers, equipment operators, etc., are qualified for their respective tasks and are trained in, and required to adhere to, the site's traffic management plan; and ○ Ensure that all equipment are operated in appropriate manners; whereby they can reduce the impacts to surrounding environment and local people
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	• Re-contaminating the Canal by solid waste discharged by community and wastewater by the industrial parks, factories, commercial zones, building, restaurant and household. • Increasing air pollution from residents travel through the site and from dredging sludge • Increased traffic and pedestrian accidents, due to higher standard road allowing more and faster traffic • Premature failure of pavements, embankment slopes, and drainage structures due to inadequate maintenance • Failure of road pavements due to vehicle overloading
Mitigation:	• Developing and launching the campaign of increasing awareness of local community toward environment protection for the Canal • Closely monitoring the effluent of IP, factories and other business units and strictly imposing the financial penalty to any case of contaminating the water quality of the Canal • Ensure appropriate maintenance plan to avoid releasing the odour to the local community • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the road in its as-completed condition • Ensure, with the assistance of the traffic control authority, that overloaded

	vehicles do not use the road
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	DONRE, CITENCO and City Road Maintenance Company
Fund source:	IDA Credit
Monitoring:	City
SUB-COMPONENT 4: CONSTRUCTION OF MAIN INTERCEPTOR IN GO VAP DISTRICT	
Construction	
Impacts	Canal upgrading works referred to above, including UXO, noise and vibration from the extensive pile driving required by the operation of tunnel boring machine, dust and VOC (asphalt) emission from road construction works. However, there will be impacts for traffic disruption and site safety issues where the interceptors need to be taken across roads in deep trenches
Mitigation:	• Clear the area before construction by qualified and licensed UXO clearance experts; • Ensure an appropriate traffic management plan that will be committed to implement by the PMU and their subcontractors to minimize the traffic congestion at and surrounding project site; • Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of sewage pipes in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues and social issues. • Ensure also that the contract requires the contractor, before he commences work, to provide a construction plan that sets out how the contactor will organize and maintain the EHS policy, schedule, workforces and facilities to complete the work within the requirement of EMP for this project proposed in Chapter 7; and • Ensure that pile driving work is carried out only during daylight hours, on normal working days.
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU

Operation	
Impacts	Releasing odor to ambient air from the maintenance of sewer system, flooding can be happened due to the accumulation of sludge and solid waste in the sewage pipe network.
Mitigation:	• Developing the scientific maintenance program for sewer system and ensuring this program must be checked by related experts before entering implementation • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the sewer system
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	City Road Maintenance Company
Fund source:	IDA Credit
Monitoring:	City
SUB-COMPONENT 5: CONSTRUCTION AND IMPROVEMENT OF PRIMARY AND SECONDARY COMBINED SEWER SYSTEMS AND THE SECONDARY INTERCEPTOR IN GO VAP DISTRICT	
Construction	
Impacts	Canal upgrading works referred to above, including UXO, noise and vibration from the extensive pile driving required by the operation of tunnel boring machine, dust and VOC (asphalt) emission from road construction works. However, there will be impacts for traffic disruption and site safety issues where the interceptors need to be taken across roads in deep trenches
Mitigation:	• Clear the area before construction by qualified and licensed UXO clearance experts; • Ensure an appropriate traffic management plan that will be committed to implement by the PMU and their subcontractors to minimize the traffic congestion at and surrounding project site; • Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of sewage pipes in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues and social issues. • Ensure also that the contract requires the contractor, before he commences work, to provide a construction plan that sets out how the contactor will organize and maintain the EHS policy, schedule, workforces and facilities to complete the work within the requirement of EMP for this project proposed in Chapter 7; and • Ensure that pile driving work is carried out only during daylight hours, on normal

	working days.
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	
Impacts	Releasing odor to ambient air from the maintenance of sewer system, flooding can be happened due to the accumulation of sludge and solid waste in the sewage pipe network.
Mitigation:	• Developing the scientific maintenance program for sewer system and ensuring this program must be checked by related experts before entering implementation • Ensure the city's operations and maintenance plan, and related budget, includes the work and resources required to maintain the sewer system
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	City Road Maintenance Company
Fund source:	City
Monitoring:	City
SUB-COMPONENT 6: IMPROVEMENT OF SECONDARY CANALS (HY VONG, CAU CUT, BA MIENG, ONG TONG, ONG BAU, CHIN XIENG)	
Pre-Construction	
Impact:	Demolition of houses along the central road to be constructed in the site
Mitigation:	Ensure demolition work is carried out safely, in accordance with contract conditions
Implementation mechanisms:	Contract conditions, supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit

Monitoring:	Supervision Consultant/PMU
Construction	
Impacts	UXO; odor and other contamination resulting from the excavation, transport, and disposal of wet sludge with a high organic
Mitigation:	To mitigate impacts of dredging sludge and upgrading the embankment of the Canal, following measures will be carried out by the PMU: • Clear the area before construction by qualified and licensed UXO clearance experts; • Ensure that the detailed design for the canal rehabilitation works explicitly provides for all aspects of the sludge management process: excavation, transport in leak proof and covered trucks, and deposit into suitably prepared sites (landfills for material that testing shows is not contaminated beyond specified limits, and prepared sanitary landfills – for example the existing site at Da Phuoc Landfill – for material that is contaminated beyond specified limits); • In the case of dredged sludge transported to Da Phuoc Landill, the PMU needs to ensure a legal commitment between Da Phuoc Landfill, HCMC DONRE and PMU, whereby the Da Phuoc Landfill must ensure an availability of capacity for disposing the dredged sludge and construction waste. • Ensure the contract for the works requires the contractor to prepare a plan for working in the densely habituated section of the channel in particular, to include how they will organize the works to minimize disruption to the traffic and community lives in term of environmental issues such as noise, air emission, wastewater and security; • Ensure also that the contract requires the contractor, before he commences work, to provides a construction plan that sets out how he will maintain the flow in the channel and protect the works from flooding during construction; and • Ensure that pile driving work is carried out only during daylight hours, on normal working days.
Implementation mechanisms:	Contract conditions, specifications supplementing those of the ECOPs
Responsibility:	Contractor
Fund source:	IDA Credit
Monitoring:	Supervision Consultant/PMU
Operation	

Impacts	• Re-contaminating the Canal by solid waste discharged by community and wastewater by the industrial parks, factories, commercial zones, building, restaurant and household. • Increasing air pollution from residents travel through the site and from dredging sludge
Mitigation:	• Developing and launching the campaign of increasing awareness of local community toward environment protection for the Canal • Closely monitoring the effluent of IP, factories and other business units and strictly imposing the financial penalty to any case of contaminating the water quality of the Canal • Ensure appropriate maintenance plan to avoid releasing the odour to the local community
Implementation mechanisms:	City operations and maintenance plan
Responsibility:	DONRE, CITENCO and City Road Maintenance Company
Fund source:	IDA Credit
Monitoring:	City

7.3. Key mitigation measures for component 1

As discussed elsewhere in this report, Component 1 impacts most especially during construction are anticipated to be small-scale in nature, and of shorter lifespan for each installation sites commensurate to the duration of the construction activities of each installations, and building requirements. Although information on location as well as area requirements are not available at this time, potential impacts can be predicted and these may include but not necessarily be limited to involuntary resettlement; and temporary impacts to ambient air, noise, water quality, soil and groundwater, waste, terrestrial ecology, and noise and vibration during its pre-construction, construction and operational phases.

Most impacts are anticipated to be short-term and/or co-terminus with the construction activities. Some impacts are unavoidable but could be properly managed together with stricter and closer monitoring during construction by the PMU. During construction, occupational safety and health shall be also given primordial consideration. This shall be in compliance with international standards as well as the GoV' Occupational Safety and Health Standards. Following completion of construction activities, some impacts will sustain because of the operational and maintenance requirements of the project.

Table 7.3 An indicative Impacts Management Plan for Component 1

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
1. Pre-construction Phase				
Installation location identification and planning	Improperly located installations will not maximize the full potential of data acquisition and management	Formulate installation site selection criteria for additional stations; utilize existing stations currently being utilized; conduct baselining activities for each station to mitigate impacts associated with new installations; select the best locations with the least impacts.	SRHMC, SCFC and/or DONRE	Undetermined as of this project phase
Property/land acquisition	Ownership/tenurial conflicts	Utilize public lands, and river easements as much as possible; thoroughly verify ownership documents with responsible government agencies if areas to be acquired for locations of ancillary facilities are privately-owned; compensate privately-owned lands in accordance with applicable Vietnamese Law.	PMU	Undetermined as of this project phase
Planning and detailed engineering design	Non-conforming and incompatible plans and design with the land use/zoning requirements of the project location	Verify with the responsible agencies; comply with local zoning and building laws of the Vietnamese Government	PMU and its Consultants where required	Undetermined as of this project phase
Permit acquisition	Non-compliance and non-issuance of approvals	Identify, secure, and comply with all permitting requirements associated with the	PMU and its Consultants where	Undetermined as of this project

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
		project.	required	phase
Procurement and selection of civil works Contractor(s)	Poor quality work or services that might render the installations inadequate in providing the required data acquisition requirements.	Strict monitoring of Contractor(s) performance and compliance with established minimum performance standards and specifications by SRHMC, SCFC and/or DONRE'	PMU and its Consultants where required	Undetermined as of this project phase
Civil works Contractor(s), Mobilization	Non-observance of regulatory requirements including those relating to environmental management and occupational safety and health. Housing requirement for transient workers and project management and support staff Elevated purchases of local goods and services for the preparation of the construction staging are and project offices.	Provide a professional with experience in the implementation of environmental, occupational, health and safety requirements. Hire as many qualified locals within the immediate vicinity of the installation sites or those living within a reasonable commuting distance; otherwise provide temporary bunkhouses on-site or rent houses in neighboring areas if housing requirements cannot be accommodated in the project site. Encourage patronage for local goods and services; priority of hiring will be those that will be economically-displaced; hire as many qualified locals within the immediate vicinity of the installation site or those	Civil Works Contractor(s) and Consultant as maybe required Contractor(s) and Consultant	Undetermined as of this project phase

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
	Elevated air quality and noise level during mobilization of Contractor(s) equipment	living within a reasonable commuting distance of the project site. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.		Undetermined as of this project phase
2.0 Construction Phase				
2.1 Site preparation and removal of materials and debris in each installation site	Traffic build-up and congestion during hauling operations	Formulate traffic management plan where applicable; minimize the presence of parked equipment that may disrupt traffic flow; properly implement the traffic management plan.	Contractor(s) and Consultant	Incorporated in the civil works construction budget
	Removal of vegetation, structures and other unnecessary obstructions; modification of topography and soil disturbance; non-compliance with local zoning ordinances	Minimize vegetation loss; modification following established design considerations; compliance with local zoning ordinances	Contractor(s) and Consultant	Incorporated in the civil works construction budget
	Contribution of sedimentation to adjacent waterways/outfalls/sewer or	Provide protection of stockpiles; minimize stockpiling; keep stockpiles away from		

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
	drainage lines	adjacent waterways; immediately stabilize excavated areas to minimize soil loss during downpours		
2.2 Relocation of affected utilities (where maybe applicable)	Disruption of services	Coordinate with service providers; ensure proper notification of affected areas through the tri-media; restore services as quickly as possible; schedule disruptions during non-peak hours.		
2.3 Equipment foundation excavations/preparation works	Dust generation and re-suspension during dry construction days	Regular watering services during dry periods; minimize/clean spillages on the ground; minimize exposure of stockpiles to wind by covering with appropriate materials. Construction activities shall follow the detailed engineering design plans		
	Elevated concentration of air pollutants related to traffic slow down and congestion. Elevated noise level due to the use of machineries	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicles in the road leading to the installation sites. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise		

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
		abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.		
	Construction accidents	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.	Contractor(s) and Consultant	Incorporated in the civil works construction budget
	Local employment generation	Hire as many locals especially those that will be economically displaced by the project due to resettlement.		
2.4 Structural; mechanical; electrical; ICT; and water, sanitation, telecommunications, and fire protection works (in facilities housing ICT	Construction accidents	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and		

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
installations) related to the equipment/instruments installations and operations		regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.		
	Elevated concentration of air pollutants related to traffic slow down and congestion due to deliveries of construction materials and installation equipment/instruments. Elevated noise level due to the use of machineries	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.	Contractor(s) and Consultant	Incorporated in the civil works construction budget
	Contribution of sedimentation to adjacent water bodies/outfalls/sewer-drainage lines	Provide protection of stockpiles; minimize stockpiling; keep stockpiles away from waterways; stabilize excavated areas immediately to minimize soil loss during downpours		
	Local employment generation	Hire as many locals especially those that		

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
		will be economically displaced by the project.		
2.5 Finishing works related to the equipment/instruments installations and operations	Construction accidents	Provide primary medical services at construction site; arrange with the nearest hospital for emergency and tertiary medical services requirements; minimize by proper training/safety orientation; providing safety equipment observing traffic rules and regulations; providing appropriate warning signs, providing safety barriers to separate pedestrian and vehicular traffic from construction activities etc.		
	Elevated concentration of air pollutants related to traffic slow down and congestion. Elevated noise level due to the use of machineries	Re-route vehicular traffic on less congested roads; no prolonged parking for construction vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.		

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
	Local employment generation	Hire as many locals especially those that will be economically displaced by the project.		
2.6 Testing and commissioning of the equipment/instruments	Hiring of non-qualified technical and scientific staff	Formulate hiring eligibility requirements; advertise available positions and requirements; select the most appropriate and highly qualified staff meeting the hiring eligibility requirements.	PMU, SRHMC, SCFC and/or DONRE	Incorporate in the budget
	Exposure to accidents; equipment malfunction	Formulate a Health, Safety and Environment Manual or Plan prescribing organizational and resource requirements, as well as compliance with Vietnamese Government Occupational Safety and Health Standards; hire qualified staff; comply with international standards in the absence of specific requirements; work areas where testing shall be done shall be properly barricaded and provided with warning signs to keep nearby residents from venturing into the work areas; follow manufacturer' manual of instructions.		
2.7 Construction debris disposal and management (demobilization of	Dust generation; elevated concentration of air pollutants related to traffic slow down and congestion	Cover debris during transport operations; re-route transport traffic on less congested roads; no prolonged parking for construction	Contractor(s) and Consultant	Incorporated in the civil works construction

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
Contractor)	during loading, transport, and unloading to the disposal site. Elevated noise level at the debris and disposal sites due to the use of machineries and transport vehicles	vehicle in the road. Use only properly maintained and third party-inspected equipment; noise generating equipment to be provided with noise abatement attachments such as mufflers; work area properly barricaded with high walled fence; workers working with noise generating equipment provided with ear muffs.		budget
	Non-availability of disposal sites	Coordinate with land owners or companies requiring reclamation/ fill materials; coordinate with PCs with regard to approved disposal sites within their territory; coordinate with national government agencies that have on-going reclamation activities	Contractor(s) and Consultant	Incorporated in the civil works construction budget
	Traffic congestion	Formulate traffic management plan; re-route transport operations in less congested roads; coordinate with PCs in regard to traffic management requirements	Contractor(s) and Consultant	Incorporated in the civil works construction budget
3.0 Operation Phase				
3.1 Installation operation and maintenance	Accidents	Arrange with the nearest hospital for emergency and tertiary medical services	SRHMC, SCFC and/or DONRE	Incorporate in the project budget

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
		requirements; minimize by proper training/safety orientation; providing safety equipment		
	Equipment (field and data processing) malfunction	Prepare preventive maintenance schedule; identify and repair causes of malfunction		
	Power interruption	Provide backup generator; identify and repair cause of failure; prepare preventive maintenance schedule; report power loss to Service Provider.		
	Telecommunications (SCADA) disruption	Identify and repair cause of failure; report telecommunications loss to Service Provider.		
	Fire protection system disruption in the data management center (Operation Center)	Provide backup systems; identify and repair cause of failure; prepare preventive maintenance schedule; report failure to fire protection installation company.		
	Water Supply disruption in the data management center (Operation Center)	Provide backup water storage system; prepare preventive maintenance schedule; report water interruptions with the Service Provider	SRHMC, SCFC and/or DONRE	Incorporate in the project budget

Project Phase/Environment Aspect (Project Activity Which will Likely Impact the Environmental Component)	Potential Impact	Options for Prevention or Mitigation or Enhancement	Responsible Entity	Cost
	Technical and scientific staff turnover	Formulate a human resource management plan; provide training and educational scholarships with fixed tenure bonding as may be allowed under Vietnamese regulations (i.e. for every year of scholarship, the staff will stay for 3 years of service. Otherwise, staff will pay for the full cost of the scholarship expenses.); provide industry-competitive salaries and incentives.		
3.2 Field data acquisition, data processing and information management	Poor quality data acquired; inaccurate information generated for policy- and decision-making	Formulate field data acquisition protocols; provide training to staff; provide quality control checks	SRHMC, SCFC and/or DONRE	Incorporate in the project budget

7.4. Environment Monitoring Program

7.4.1. Objective and Approach

Main objective of the Environment Monitoring program is to ensure that (a) the potential negative impacts of the project are minimized; (b) the EMP is effectively implemented; and (c) the EMP is adequate to mitigate the potential negative impacts. Given that monitoring the implementation of the RP will be conducted separately, the environmental monitoring program will comprise (a) monitoring the safeguard performance of the contractor during site clearance and construction, (b) environmental quality monitoring, (c) monitoring effectiveness of the EMP.

7.4.2. Monitoring of Contractor's Safeguard Performance

Three levels of safeguard monitoring will be implemented: routine monitoring, periodic monitoring, and community monitoring as follows:

- Routine monitoring: The routine monitoring will be made by the Construction Supervision Consultant (CSC) as assigned by PMU. The CSC will include the monitoring results in the project progress reports;
- Periodic monitoring (every six months): As part of the overall monitoring of the EMP, the ESU assisted by the Independent Environmental Monitoring Consultant (IEMC) will also monitor the contractor performance every 6 months and the results will be reported to the PMU and the WB;
- Community monitoring: Monitoring by local communities will be conducted following the Government practices with the technical and management support from the PMU.

7.4.3. Environmental Quality Monitoring of Component 2

To ensure an acceptable level of environmental quality, monitoring of dust, noise, vibration, air quality, and water quality will be made at project specific locations that are likely to be significantly affected by the construction activities, or requested by local authorities and communities for specific purposes. ESU/IEMC will be responsible for the monitoring of the program.

Below is a list of the key issues and scope of monitoring that will be considered in the implementation of the monitoring program:

- Implementation of the Dredge Material Management Plan (DMMP) for all sludge and similar material excavated from the project work sites: Amount, level of heavy metals, locations and performance at disposal sites, and impacts on local residents will be monitored. Outline DMMPs will be prepared during detailed design, and will be used as the basis for contractors' dredged materials management plans;
- General Construction Impacts: To include local flooding; traffic management especially in residential areas; air, noise, and dust levels in residential areas; and water quality upstream

and downstream of construction sites, with specific attention paid and impact on local residents;

– Others: As agreed with local agencies and communities during the preparation of the monitoring program.

Tables 7.4, 7.5, 7.6, and 7.7 provide general guidance on the monitoring program and estimated cost considering that the activities will be carried out before construction (project baseline environment), during construction (assumed 4 years), and during the first year of operation. Detailed monitoring programs will be prepared during the detailed design stage. An estimated cost for monitoring is incorporated into the EMP cost (Section 6.6). Many of these measurements are required by Vietnamese regulations and would need to be done even if not directly related to expected project impacts.

Table 7.4 Scope of environmental monitoring during construction of component 2

No.	Monitoring items	Before construction	Construction Phase	Standards
I	**Air quality**			
	1. Parameters	Temperature, Wind velocity, Humidity, Particulates (dust), Noise, Pb, NH3, SO2, NO2, CO, H2S, VOCs.	Temperature, Wind velocity, Humidity, Particulates (dust), Noise, Pb, NH3, SO2, NO2, CO, H2S, VOCs.	QCVN 05 :2009/BTNMT, QCVN 06:2009/BTNMT
	2. Frequency	1 location/day	Once per 3 months	
	3. Location	Baseline environmental locations should be established in line with the construction sites at the time of monitoring		
II	**Surface water/waste water quality monitoring**			
	1. Parameters	pH, Hardness, Chromaticity, TDS, Cl-, F-, NO2-, NO3-, SO42-, Fe, As, Cd, Pb, Cu, Zn, Mn, Coliform, DO, BOD5, COD, Turbidity, E.Coli, Oil and Grease.	pH, Hardness, Chromaticity, TDS, Cl-, F-, NO2-, NO3-, SO42-, Fe, As, Cd, Pb, Cu, Zn, Mn, Coliform, DO, BOD5, COD, Turbidity, E.Coli, Oil and Grease.	QCVN 08:2008/BTNMT; QCVN 14:2008/BTNMT; QCVN 24:2009/BTNMT
	2. Frequency	1 location/day	Once per 03 months	
	3. Location	Baseline environmental locations should be established in line with the construction sites at the time of monitoring		
III	**Groundwater**			

No.	Monitoring items	Before construction	Construction Phase	Standards
	1. Parameters	pH, DO, Turbidity, Salinity, SS, BOD5, COD, NO2-, NO3-, PO43-, Cr, Hg, Oil and Grease, E. Coli, Coliform.	pH, Hardness, Chromaticity, TDS, Cl-, F-, NO2-, NO3-, SO42-, Fe, As, Cd, Pb, Cu, Zn, Mn, Coliform, DO, BOD5, COD, Turbidity, E.Coli, Oil and Grease.	QCVN 08:2008/BTNMT; QCVN 14:2008/BTNMT; QCVN 24:2009/BTNMT
	2. Frequency	1 location/day	Once per 03 months	
	3. Location	Baseline environmental locations should be established in line with the construction sites at the time of monitoring		
VI	**Dredged sludge: If required as indicated in the dredge material management plan**			
	1. Parameters	Cu, Pb, Zn, Cd, As	Cu, Pb, Zn, Cd, As	QCVN 03:2008/BTNMT
	2. Frequency	As needed	As needed	
	3. Location	Baseline environmental locations should be established in line with the construction sites at the time of monitoring		
V	**Aquatic Plankton and Benthos**			
	1. Parameters	Species, Communities and Diversity, and Counts per cubic metre, fish	Species, Communities and Diversity, and Counts per cubic metre, fish	NA
	2. Frequency	As needed	As needed	
	3. Location	Baseline environmental locations should be established in line with the construction sites at the time of monitoring		

Table 7.5 Estimated number for soil, water, and air sampling and analysis for environmental monitoring during construction

Construction Items	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
Total time of Construction	24 months	24 months	48 months	18 months	48 months	24 months
Waste/Surface water sample (1 time)	20	20	20	20	20	20
Sludge sample (1 time)	24	24	24	24	24	24
Air sample (1 time)	11	11	11	11	11	11
Groundwater (1 time)	8	8	8	8	8	8
Total monitoring Times	8	8	16	6	16	8
Total surface water samples	160	160	320	120	320	160
Total sediment samples	192	192	384	144	384	192
Total groundwater samples	64	64	128	48	128	64
Total air samples	88	88	176	66	176	88

Note: Component (i): Construction of Nuoc Len tidal sluice gate and 2 ship locks, (ii) Construction of Vam Thuat tidal sluice gate and 2 ship locks; (iii) Improvement and upgrading of canal bank revetment in the main canal of TLBCNL Canal; (iv) Construction of main interceptor in Go Vap district; (v) Construction and improvement of primary and secondary combined sewer systems and the secondary interceptor in Go Vap district; (vi) Improvement of secondary canals (Hy Vong, Cau Cut, Ba Mieng, Ong Tong, Ong Bau, Chin Xieng).

Table 7.6 Estimated cost for samples collection and analysis

No	Content	Unit	Quantity	Price (VND)	Total (VND)	Total (USD)
1	Water sample	Sample	1240	5,000,000	6,200,000,000	
2	Sludge sample	Sample	1488	5,000,000	7,440,000,000	
3	Air sample	Sample	682	3,500,000	2,387,000,000	
4	Groundwater	Sample	496	3,500,000	1,736,000,000	
				Total	17,763,000,000	796,547.1
				Total cost (after being rounded-up)		800,000

7.4.4. Environmental Quality Monitoring of Component 1

The environmental monitoring plan prepared for this project as shown in Table 7.6 is highly indicative and shall be treated as general guidance only. A monitoring program will be further prepared in detail and shall be based on the assessment of the individual installation site requirements prior to the commencement of pre-construction, construction, and operation responsibilities. The primary purpose of the monitoring, validation and evaluation/audits is to ensure that sound environmental management occurs. Specifically, it aims to ensure the following:

- Compliance with the conditions set in DONRE’ requirements;
- Compliance with the EMP;
- Effectiveness of environmental measures on prevention or mitigation of actual project impacts compared with the predicted impacts used as basis for the EMP design; and
- Continual updating of the EMP for sustained responsiveness to project operations and project impacts.

Table 7.7 Environmental Monitoring Program for Component 1

Key Environmental Aspects per Project Phase	Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan			Responsible Entity	Annual Estimated Cost
			Method	**Frequency**	**Location**		
1. Pre-construction Phase							
1.1 Installation location identification and planning	Improperly located installations will not maximize the full potential of data acquisition and management	Appropriate location for the stations	Selection criteria and field validation	During planning	Each of the individual installation sites and their alternatives if there are any.	PMU, SRHMC, SCFC and DONRE	Undertermined but should be included in the Project Cost
1.2 Property acquisition	Ownership conflict	Property Title	Inspection and verification	Once	Lands Office of the Vietnamese Government	PMU	Incorporated in Project Cost
1.3 Planning and detailed engineering design	Non-conformance to standards	Design standards	Due diligence/Client Quality Control	From project concept to final acceptance	Design/consultant's office		
1.4 Permit acquisition	Non-compliance to regulations	Regulatory requirements	Due diligence/Client Quality Control	Each application	Regulatory Offices		
1.5 Procurement and selection of Contractor(s)	Competence	Track record	Pre-qualification	During selection	PMU Offices		

Key Environmental Aspects per Project Phase	Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan			Responsible Entity	Annual Estimated Cost
			Method	Frequency	Location		
			requirements	process			
1.6 Contractor(s) Mobilization	Ambient Air Quality	TSP, Sox, NOx,	Applicable Vietnamese Regulations and Standards	Once prior to civil works	Installation Sites		
	Noise	Noise level (dBA)	Noise meter-direct measurement				
	Housing requirements	Size of temporary accommodation	Engineer's estimate				
	Employment	Number hired	Head count from employee roster				
2. Construction Phase							
2.1 Site preparation and removal of materials and debris in each installation site	Ambient Air Quality	TSP, Sox, NOx,	Applicable Vietnamese Regulations and Standards	Once during the on-going civil work	Installation Sites	Contractor(s) and Consultant(s)	Incorporated in Project Cost
	Dust Generation	TSP	Visual Observation	Daily			
	Noise Employment generation	Noise level (dBA) Number hired	Noise meter measurement Head count from	Prior to civil works Monthly			

Key Environmental Aspects per Project Phase	**Potential Impact**	**Parameter to be Monitored**	**Sampling and Measurement Plan**			**Responsible Entity**	**Annual Estimated Cost**
			Method	**Frequency**	**Location**		
			employee roster				
	Siltation	Turbidity level	Visual	Daily during the activity			
2.2 Relocation of affected utilities (where maybe applicable)	Service disruption	Duration of disruption	Actual observation	Daily during the disruption			
2.3 Equipment foundation excavations/preparation works 2.4 Structural; mechanical; electrical; ICT; and water, sanitation, telecommunications, and fire protection works (in facilities housing ICT installations) related to the equipment/instruments installations and operations 2.5 Finishing works related to the equipment/instruments installations and operations 2.6 Testing and commissioning of the equipment/instruments	Ambient Air Quality	TSP, Sox, NOx,	Applicable Vietnamese Regulations and Standards	Quarterly during the work			
	Dust Generation	TSP	Visual Observation	Daily			Incorporated in Project Cost
	Noise	Noise level (dBA)	Noise meter – direct measurement	Quarterly during the work			
	Employment generation	Number hired	Head count from employee roster	Monthly			
	Accidents and exposure	Number	Headcount	Daily			
	Debris disposal	Volume and	Truckload	Daily			

Key Environmental Aspects per Project Phase	Potential Impact	Parameter to be Monitored	Sampling and Measurement Plan			Responsible Entity	Annual Estimated Cost
			Method	Frequency	Location		
2.7 Construction debris disposal and management (demobilization of Contractor)		number of truckloads transported	count				
	Wastewater discharges	Volume discharged to adjacent waterways	Truckload count or volumetric measurements	Daily			
3. Operation Phase							
3.1 Installation operation and maintenance	Accidents	Number and kind	Oral and written report	Per occurrence	Installation Sites	SRHMC, SCFC and/or DONRE	Incorporated in the operation and maintenance cost provision
	Equipment malfunction	Duration (length of time)					
	Power and Telecommunications failure						
	Fire protection system malfunction						
	Obstructed egress/ ingress due to flood and vehicle obstruction						
	Water Supply Malfunction/Failure	Volume					
	Uncollected debris						
	Sustained employment opportunity	Number and Sex Distribution					

Key Environmental Aspects per Project Phase	**Potential Impact**	**Parameter to be Monitored**	**Sampling and Measurement Plan**			**Responsible Entity**	**Annual Estimated Cost**
			Method	**Frequency**	**Location**		
	Technical and Scientific Staff Turnover						
3.2 Field data acquisition, data processing and information management	Poor quality data acquired; inaccurate information generated for policy- and decision-making	Rainfall volume; flood and tidal heights; area affected; mapping information produced	Automated and semi-automated data gathering; computerized data processing and modelling using available softwares	Daily for data gathering; as requested for processed information to be used in policy- and decision-making purposes	Data Management Center (Operation Center)	SRHMC, SCFC and/or DONRE	Incorporated in project cost

7.4.5. Monitoring Implementation Performance of DMMP

To ensure that dredging, transportation, and disposal activities will not create adverse impacts on local residents and environment, a guideline for preparation and monitoring of the DMMP is provided in box below. Accordingly, the detailed design will include a comprehensive testing program and the development of a DMMP, reflecting the guidelines below as appropriate.

A guideline for preparation and monitoring of a DMMP

Main environmental and social issues related to contaminated dredge materials are: (a) Pollution during the transport of the dredged soil from the dredging site to the disposal area; (b) Potential increase in turbidity and pollution of the water in the canals during dredging; (c) Odor and other disturbance to local residents; (d) and Potential misuse of the contaminated dredged materials for public infrastructure and households. To facilitate the preparation of a DMMP given that the activities will be carried out in an existing water body that may be used by other water users, the following aspects should also be considered:

- *Assessing the quality of the sediments.* The assessment will be carried out to confirm that the sediments will not include large amount of environmentally harmful materials such as heavy metals and/or other toxic substance. 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 bottom sediment/sludge samples will be undertaken for analysis for key pollutants according to the national standards. The sampling and analytical methods should be in line with the Government regulations while the sampling locations will depend on the risk level for each specific site:

Volume of Spoils in cubic m	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 identify the landfill sites and/or land that could be appropriate for the disposal of dredged materials in line with the level of risk associated with it. Public land, land for construction of rural roads, public works, private land, etc. may be used, with an agreement with the project affected households. If the risk due to contamination of sludge is high the sludge materials will be disposed of at Da Phuoc sanitary landfill which has been in operation.

- *Preparing for a dredging and transportation plan.* Dredging procedures and transportation plan will be prepared outlining: (a) methods of dredging (pipeline, water pumping before digging, etc.) and uploading to the disposal area and/or transportation vehicles, and/or temporary storage site. 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.
- *Temporary storage/disposal for uncontaminated sediment/mud.* As the dredged materials are in the state of mud at first before settled for 24 to 48 hours. All drainage water from disposal land shall be driven to the drains and discharged back to the canal. For areas with highly contaminated with organic material and create odor, dredge material/sludge should be hauled by close tanker outside the construction site as soon as possible. For bottom sediment with low contamination of organic materials, the dredged sediment will be transported to a containing area which is appropriately located and properly design with an adequate size. A monitoring plan for tracking the disposal of high contaminated materials will also be prepared.
- *Identifying key area and/or receptacles (business, schools, public services, etc.) that are sensitive to dredging and transportation.* The DMMP shall carry out an inventory analysis on the possible affected local businesses, access to water, and transportation (mainly due to the dredging) and provide a plan to mitigate and/or compensate for the disturbances. The plan should include all measures necessary to avoid impacts on local transportation and water supply access to local residents as much as possible.
- *Identify other key water users.* If dredging occur in water bodies (such as lakes, rivers/stream) where there are potential other water users that may be affected by dredging, prepare a water quality monitoring plan with specific stations and parameters that could be used to monitor the potential impacts to the water users. Priority should be given to monitor the areas that are sensitive to change in water quality (high suspended solid (SS), low pH, high BOD or COD, high salinity, etc.) especially where the water is used as a source of water supply for domestic and agricultural uses. In areas where dredging may cause negative impacts to these water users, respective subproject owner is required to inform/consult them and develop a series of actions to address their concerns, including conduct water quality monitoring in the DMMP.

7.5. Monitoring effectiveness of the EMP

The ESU assisted by IEMC will monitor performance of the EMP implementation during the detailed design/bidding stage as well as during construction and first year operation of the facilities to ensure that (a) appropriate dredging and disposal of drainage sludge is properly carried out, in accordance with the DMMP, 9b) other impacts identified in the EMP are effectively managed and mitigated; and (c) traffic management is adequate and the level of impacts are acceptable (no complaints or outstanding cases. Results/are to be properly kept in the project file for possible review by PMU and the WB. Cost for the monitoring will be part of the PMU cost.

7.5.1. Organization Arrangement

Table 7.6 and Figure 7.1 below summarizes roles and responsibilities of the key parties and their relationships regarding the implementation of the EMP while those for the PMU, CSC, and IEMC are highlighted below while more details are provided in Section 7.4.2.

- Contractors are responsible for implementing mitigation measures. Measures will be included in bidding documents and costs are to be included in construction bids;
- CSC is responsible for monitoring the day-to-day implementation of mitigation measures. Cost included in CSC service contract;
- IEMC will be responsible for environmental monitoring which includes support to the PMU for implementing supervision and monitoring, and reporting on the implementation through monitoring reports.

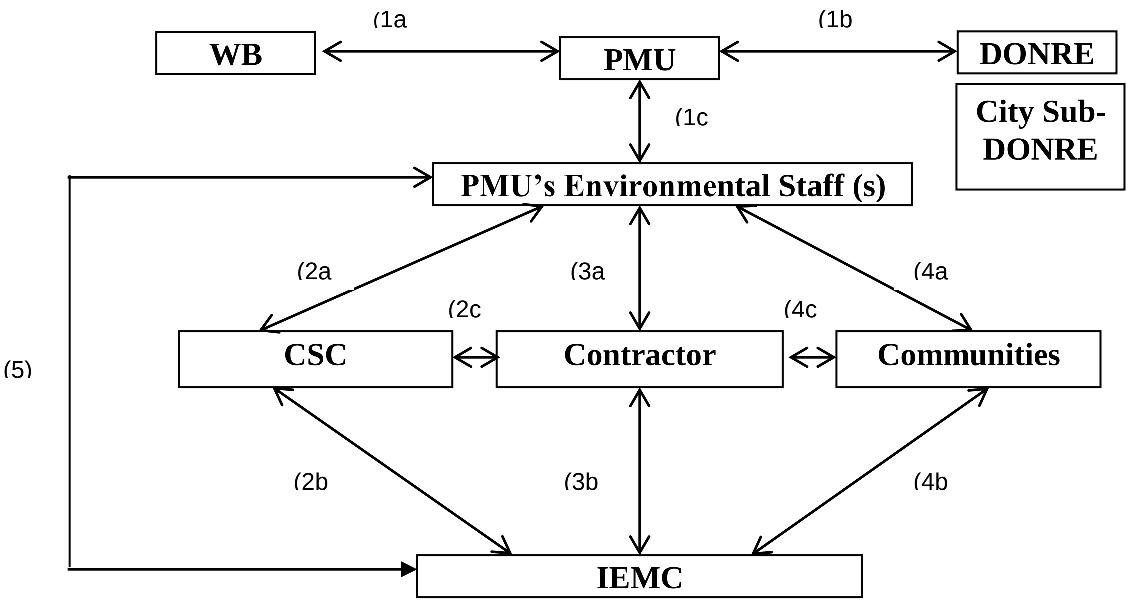


Figure 7.1 Organization Diagram for the EMP Implementation.

Table 7.8 Roles and responsibilities of key parties (Description referred to Figure 7.1)

Description	Roles/Responsibilities
(1a) (1b)	Based on quarterly reports of IEMC, PMU is responsible for preparing periodic reports to submit to WB and to the City DONRE.
(1c)	PMU assigns the safeguard staff (ESU) to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with EMP PMU assigns the safeguard staff (ESU) to supervise, manage and carry out EMP activities and also assigns CSC to closely supervise/monitor safeguard performance of the contractor, including undertaking the environmental monitoring program. PMU/ESU establishes a hotline communication with local community to be responsive to the complaints, comments, and/or recommendations from local people and/or the public throughout the site clearance and construction period.
(2a)	CSC submits periodic monitoring report of environmental mitigation measures to PMU; Recommends to the PMU to suspend in part or completely, construction works if it does not meet labor safety and environmental protection requirements of the contract. PMU reviews CSC's periodical reports to ensure compliance with mitigation measures.
(2b)	CSC: Support, collaborate with IEMC to establish, collect and point out information about essential environmental parameters in the field and information for construction implementation; IEMC: Monitor the implementation of the EMP every 3 months including submission of the field report. Create database of results from environmental supervision and monitoring and train PMU in using such database Coordinate with CSC on monitoring and preparation of safeguard reports on EMP performance; enhance capacity for CSC through a training program on environmental supervision
(3a)	Contractor: Before construction, with assistance from IEMC, prepare a site-specific environment management plan (SEMP) during site clearance and construction process as part of their construction method statement, then submit it to CSC and/or PMU for review and approval; During construction, the contractor has to submit a monthly report on safeguard issues, mitigation, and results throughout the construction period. In case of unexpected problem, the contractor will consult CSC/PMU. PMU/CSC: reviews the SEMP and can propose change as deemed necessary to be

Description	Roles/Responsibilities
	in line with the legal obligations as well as appropriate to each specific site. Daily supervision and monitoring of contractor's safeguard performance will be responsibility of the CSC.
(3b)	Contractor: Carry out the EMP required during site clearance and construction, including conduct self-monitoring and submission of report. IEMC: periodically supervise and monitor the overall project EMP implementation including provision of safeguard training to PMU/ESU staff, community, CSC, and contractors as needed. The training will be designed to enhance the effectiveness of the EMP implementation and reporting.
(4a)	Community: According to Vietnamese practice, the community has the right and responsibility to routinely monitor environmental performance during construction to ensure that their rights and safety are adequately protected and that the mitigation measures are effectively implemented by contractors and/or PMU. In case of unexpected problems, they will report to CSC/PMU and/or call the hotline. PMU: Encourage, support and create good conditions for local community to participate in the environmental supervision and monitoring activities. PMU/CSC will review and response to the requests and/or recommendations made by community to ensure that the potential negative impacts are adequately mitigated.
(4b)	Community: Support and collaborate with IEMC during periodic monitoring and provide inputs to the overall safeguard issues that require attention and/or mitigation. IEMC: Strengthen local community's capacity and relevant agencies through preparation of relevant documents necessary for monitoring, supervision, and reporting including preparation of a database for the activities. IEMC: assist PMU and communities for the implementation of Information-Education-Communication (IEC) activities within Component 4 with regard to environmental hygiene, sanitation, road safety, etc.
(5)	IEMC supports PMU/ESU to implement the EMP in line with Government's environmental regulations as well as the WB safeguard policies. In consultation with DONRE, IEMC will establish specific environmental monitoring program for the project to be implemented by CSC at key locations as shown in detailed design documents. PMU is responsible for preparation of the 6-month progress reports to be submitted to WB and DONRE, based on quarterly reports submitted by IEMC.

7.5.2. Specific Responsibilities of PMU, CSC, and IEMC

Project Management Unit (PMU)

- PMU is responsible for implementing the EMP during the detailed design and construction stages. EMP implementation during operation stage is the responsibility of the facilities operators. PMU will set up an Environmental and Social Unit (ESU) to ensure timely and effective implementation of the EMP, including preparation of reports on safeguard compliance as required by Government and WB.
- PMU/ESU is responsible for ensuring that the related sections in the Contract Documents on the bidding packages for construction items of the project are in compliance with the EMP.
- PMU/ESU is responsible for communicating with relevant local, provincial and national departments; and with parties responsible for implementing and supervising EMP, especially with the provincial Department of Natural Resources and Environment (DONRE) and the concerned wards/communes during planning, monitoring, operation, and management.
- PMU/ESU will coordinate with community organizations to encourage them to actively participate in the planning, management, and implementation of the project, including monitoring of the contractor's performance.
- To ensure effective monitoring and timely implementation of the EMP, PMU/ESU will hire national environmental consultants to assist in carrying out and monitoring the EMP implementation. Responsibilities of the Independent Environmental Monitoring Consultant (IEMC) will be described below.
- For supervision and monitoring of contractor's performance, PMU will be responsible for: (a) Checking project implementation indicators relating to environment; (b) Unannounced inspections to ensure that mitigation measures are being implemented as presented in construction contract by contractor; (c) Reviewing periodic report of construction supervision consultant (CSC) to ensure compliance with mitigation measures; and (d) Based on the periodic reports by CSC and IEMC, PMU will prepare report on environmental compliance of subproject to submit to WB and DONRE (This is part of the submission of a 6-month progress report to WB).
- PMU will coordinate closely with relevant enterprises on water supply, environmental sanitation, solid waste collection and to monitor operation and maintenance during project implementation.

Independent Environmental Monitoring Consultant (IEMC)

The IEMC will be responsible for assisting the PMU in EMP implementation. This also includes advising the CSC, contractors and communities on environmental compliance, and carrying out the monitoring program in accordance with regulations and procedures of the Government and World Bank. Once the detailed operational implementation of the environmental monitoring program is discussed by PMU and World Bank, the IEMC will be responsible for quarterly checking, and supporting the PMU staff to supervise overall project activities to ensure that unified environmental protection policies of the Government and World Bank are applied and supervised during project implementation. The IEMC will be responsible to: (1) provide training and capacity building for construction management for PMU/ESU staff, including field engineers and/or consultants (CSC) in supervising the EMP implementation of the contractor; (2) ensure active participation of the local communities and schools in the project areas, (3) monitor environmental parameters to assess the overall impacts of the project, and (4) establish environmental training program.

Specifically, the IEMC's responsibilities include:

- Ensuring that the approved EMP and all project loan agreements related to environmental safeguards are fully applied and complied during project implementation.
- Assessing the effectiveness of mitigation measures which are provided by contractor and CSC in implementation process; providing proposals and recommendations to the PMU on necessary improvement and supplementation to meet the safeguard requirements.
- Reporting periodically (every 3 months) to the PMU on actual EMP performance during project implementation.
- Establishing standard procedures, methods and forms to assist the PMU and CSC to assess contractors' progress in implementing required impact mitigation and monitoring measures.
- Assisting the PMU's environmental staff to review and check the related sections in the Contract Documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements.
- Measuring, taking samples and monitoring periodically environmental parameters (once per 3 months) during the time of environmental monitoring contract.
- Assistance in the preparation of documents and implementation of training program on environmental monitoring and supervision for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages).
- Via PMU, discussing with relevant enterprises (if necessary) to find suitable solutions for unexpected risks relating to environmental sanitation.

<u>Construction Supervision Consultant (CSC)</u>

The CSC is responsible for monitoring the safeguard performance of the contractor during site clearance and construction, including oversight of the self-monitoring to be conducted by contractor. With regard to safeguards, the CSC's main responsibility will include, but not be limited to, the following:

- Assist IEMC to establish, collect and provide information about both essential environmental indicators on-site and construction work.
- Ensure that construction work complies with approved EMP, relevant indicators and standardized operation in documents for environmental impact mitigation and monitoring.
- Monitor the mitigation measure implementation of contractor, propose and deploy supplementary measures in time to complete mitigation measures and to meet the environmental management safety requirements of project.
- Make action plans/urgent solutions to cope with environmental problems, urgent situation and damages happening in construction
- Recommend PMU to suspend partially or completely construction work if labor safety and environmental protection requirements of the contract are not complied with.
- Organize regularly discussions with relevant enterprises and other stakeholders to provide information about implementation plans and necessary working program to enhance people's awareness of environmental protection during construction process.

<u>Construction Contractor</u>

- The construction contractor's responsibilities in respects of all aspects of the works, including the environmental aspects, are set out in the contract between it and the PMU.
- Construction contractors have their own responsibilities for both carrying out environmental impact mitigation measures and compliance with approved EMP during assembling construction of project packages. In the preparation of technical method statement, contractor will study the project's approved EIA report and propose a construction method that includes environmental mitigation and protection measures that are aligned with the recommendations of the approved EMP.
- Contractor's method statement will be submitted to PMU and CSC for review, as well as to IEMC as deemed necessary. Changes, if there are any, will be evaluated for feasibility and for legal issues (laws, decrees, circulars and other regulations) before suitable adjustments are approved for specific cases on-site.
- During construction work, construction contractor will be closely supervised by PMU, CSC, IEMC, environmental authorities and local community on EMP observation.

7.5.3. Reporting Arrangements

The PMU will prepare reports twice per year for submission to the World Bank including the compliance with the EMP. The report will contain the monitoring results and assessments of the

IEMC that show project progress and the status of implementation of the EMP. The reports will cover, among other matters as appropriate, the following:

- Contractor's compliance with mitigation measures
- Wastewater and environmental sanitation issues
- Existing flood situation where relevant
- Traffic and water supply conditions
- Quality of waste-water receiving water bodies
- Potential project-related risks and risk management issues
- Consultation with local communities in key project areas

7.6. Capacity Building Program

7.6.1. Technical Assistance support for the implementation of safeguards

An assessment of safeguards implementation capacity of existing PMU staff indicates that PMU staffs have limited knowledge on WB safeguard requirements as well as limited knowledge of environment and social issues. Such lack of capacity represents a risk to project implementation of safeguards requirements contained in the EMP and, as required by the WB policy, is to be addressed through capacity building. Therefore it is proposed to provide capacity building through technical assistance that will support the PMU during the implementation of the safeguards requirements. The technical assistance will provide the necessary technical support the PMU in its work with contractors as well as other entities involved in the implementation of the EMP.

The scope of the technical assistance would cover support from experts and training that would cover both the knowledge on safeguards requirements and procedures for the project as well as training that covers both specific knowledge on safeguard procedures and requirement for the project staff, consultants, and national contractor would be important. This would include, for example, assistance in the preparation of documents and implementation of training program on environmental management and environmental monitoring for contractors, CSC and relevant staffs of PMU (environmental staffs and coordinators of packages) to do their tasks. It would also include assisting the PMU's environmental staffs with the review of contract documents on the bidding packages for construction items of the project to ensure compliance with environmental protection policies and impact mitigation and monitoring requirements as well as provide general environmental guidance as requested by the PMU to enhance overall project implementation and performance.

Given the nature, locations, and scale of construction, it is anticipated that the safeguard technical assistance support and training will be provided at least during the first 3 years of the project implementation. The WB safeguard specialists will participate in the capacity building in particular in the training activities as appropriate.

7.6.2. Training programs proposed

Table 7.9 below provides examples of the basic trainings for safeguards during project implementation. The training programs will be developed and delivered by the Technical Assistance team for the implementation of safeguards for the PMU training. The PMU/IEMC with the support of the Technical Assistance team for the implementation of safeguards will provide the training to contractors, CSC and other groups.

Other more specific and tailored training will be developed and agreed upon between PMU, IEMC and the Technical Assistance team for the implementation of safeguards during project implementation based upon a reassessment of needs and the status of safeguards implementation.

- *Target groups for the training:* include PMU staff, ESU staff, field engineers, CSC, construction contractors, local authorities and community representatives in the project area. Training of workers and drivers is the responsibility of the contractor;
- *Training schedule:* At least 1 month before the construction of the first contract. The training can be adjusted in line with the implementation schedule of the subproject/contracts;
- *Training frequency*: The basic training programs proposed in Table 7.7 will take place every six months on a yearly basis and its content updated and adapted to implementation issues. Training frequency and content will be reassessed during implementation depending on needs. It is foreseen that the training program for PMU staff will continue until year three of implementation. Three days of training for CSC and contractors are also planned to take place twice a year on an annual basis for at least two years.

Table 7.9 Training Programs (to be financed by the project and the client) for Capacity Building on Environmental Supervision and Management

I. OBJECTS	**PROJECT MANAGEMENT UNIT**
Training course	Environmental supervision, monitoring and reporting
Participators	Environmental staff and technical staff
Training Frequency	Soon after project effectiveness but at least 1 month before the construction of the first contract. The follow-up training will be scheduled as needed.
Time	Four days of training twice a year to be repeated on a yearly basis until year three of implementation.
Content	General environmental management relating to project including requirements of WB, DONRE, cooperating with relevant enterprises Requirements on environmental supervision;

	Supervision and implementation of mitigation measures; Community participation in environmental supervision. Guide and supervise contractor, CSC and community representatives in implementation of environmental supervision. Forms used in environmental supervision; Risk response and control; Other areas to be determined; Receiving approach and submit forms.
Responsibilities	PMU, IEMC with support of the Technical Assistance team for the implementation of safeguards.
II. OBJECTS	**CSC, CONTRACTOR, COMMUNE/WARDS AUTHORITIES, COMMUNITY REPRESENTATIVES**
Training course	Implementation of mitigation measures
Participators	CSC; on-site construction management staff; environmental staff of contractor; commune/ward/group authorities.
Training frequency	After bidding, update based on requirements
Time	Three days of training for CSC and contractors and two days of training for other also to be repeated twice a year on an annual basis depending on needs
Content	Overview of environmental monitoring; Requirements of environmental monitoring; Role and responsibilities of contractors and CSC Content and methods of environmental monitoring; Response and risk control; Propagate monitoring forms and guide how to fill in the forms and risk report; Other areas to be determined; Preparation and submission of report.
Responsibilities	PMU, IEMC with support of the Technical Assistance team for the implementation of safeguards

III. OBJECTS	**COMMUNITIES AND WORKERS**
Training course	Environmental sanitation and safety
Participators	Representatives of community and/or worker leaders (as appropriate)
Training frequency	As appropriate
Time	One-day presentation and one-day on-the job training twice a year to be repeated on a per needs basis
Content	Preliminary presentation on environmental protection and environmental overview Key issues that require community and workers attention to minimize safety risks (roads, waterways, equipment, machines, etc.) as well as reduce pollution (dust, fume gases, oil/grease spill, waste management, etc.) Management of environmental safety and sanitation in work sites and worker camps; Mitigation measures at construction site and work camps; Safety measures on electricity, mechanical, transportation, air pollution; Other areas to be determined; Procedures to deal with emergency situation.
Responsibilities	Contractor, PMU, with support from IEMC

7.7. Estimated EMP Cost

Table 7.8 provides an estimated cost for EMP implementation (excluding the resettlement cost and RP and EMDP independent monitoring). The EMP cost[6] will comprise (i) cost for implementation of the mitigation measures by contractor, (ii) cost for supervision by the CSC, (iii) cost for environmental monitoring consultant (IEMC) (iv) monitoring of environmental quality (v) PMU safeguard management costs, including technical assistance support for the implementation of safeguards and training. Costs for the implementation of the mitigation measures during construction will be part of the contract cost while cost for monitoring of SEMP by the CSC is provided for in the construction supervision contracts. Costs for PMU operations related to EMP are provided for in the project management budget of the PMU, including basic safeguards training and allowances for people who participate in the monitoring program. After project completion,

[2] Excluding cost for implementation of the RP and EMDP and the independent monitoring of the RP/EMP implementation.

the cost for environmental monitoring of the constructed facilities will be funded by the cities' operations and maintenance budgets.

It is noted that the attendance of community representatives in EMP implementation is voluntary, and without salary. Hence, to encourage the participation of community members, the cost for materials, equipment used for monitoring and rewards for people who are voted to implement monitoring are taken into account. Following decision No. 80/2005/QĐ-TTg dated 18/4/2005 of Prime Minister on regulations of community investment monitoring and joint circular for guidelines of decision implementation No. 80/2005/QĐ-TTg "cost for supporting the investment monitoring of community in commune/ward are calculated in cost estimation of commune/ward fatherland front and are guaranteed by commune/ward people's committee budget; cost for propagation, training courses, guiding, closing of community investment monitoring at district and provincial level are calculated in cost estimation of commune/ward Fatherland Front and are guaranteed by commune/ ward people's committee budget".

Table 7.10 provides an estimated IEMC and environmental quality monitoring cost in line with the country practices for reference. However the final cost will be updated during the detailed design.

Table 7.10 Estimated Cost for EMP implementation (million USD)

	Cost (millions of $US)	**Source of funds**
(a) Mitigation during construction	Part of contracts	WB
(b) Supervision of safeguards during construction	Part of CSC costs in Comp. 4	WB
(c) Environmental Safeguards unit (ESU) of PMU	Part of PMU costs in Comp. 4	WB
(d) Environmental quality monitoring	0.03	WB
(e) Independent Environmental Monitoring Consultant (IEMC)	0.08	WB
(f) Safeguards capacity building program	0.25	WB

Table 7.11 Estimated cost for the IEMC (Exchange rate: 1 USD = 20,800 VND)

No.	**Content**	**Unit**	**Quantity**	**Price (VND)**	**Total (VND)**	**Total (USD)**
1	Specialist salary	Month	33.5	30,680,000	1,027,780,000	50,250
2	Local stays and allowance	Day	720	520,000	374,400,000	18,000

No.	Content	Unit	Quantity	Price (VND)	Total (VND)	Total (USD)
3	Travelling expenses	Turn-person	90	832,000	74,880,000	3,600
4	Training course	Overall	8	5,720,000	45,760,000	2,200
5	Office supply	Overall	18	6,240,000	112,320,000	5,400
6	Office and communication	Overall	18	4,992,000	89,856,000	4,320
	Total					83,770

B. Social management plan

This Section presents the mitigation measures for impacts other than those caused by land acquisition which have been identified and assessed in the previous section in Chapter 6 and summarizes the Income Restoration Plan (IRP) which has been developed in the report for Resettlement Action Plan of the Project.

Table 7.12 Mitigation measures for Social Negative Impacts

Potential impact	**Management/mitigation objectives**	**Impact significance before mitigation**	**Impact significance after mitigation**	**Mitigation measures**	**Timing, frequency and duration of mitigation measures**	**Responsible person/ authority**	**Key performance indicators**
Land acquisition of households along the sub-catchment area	To ensure that the quality of life of displaced households is equal to or better than prior to displacement.	Major	Moderate	- Mitigation measures for land acquisition have been prepared separately in the Report for Resettlement Action Plan (RAP) of the Project. A summary of the Income Restoration Plan (IRP) as part of the RAP is provided in the next section.	Please refer to the RAP for details of this part.	Please refer to the RAP for details of this part.	- Please refer to the RAP for details of this part.

Influx of temporary workers	To reduce population influx, minimize the possibility of conflicts between workers and the local community and preserve social security in the area.	Moderate	Minor	- Positions for unskilled workers should be employed from the local population to minimize population influx. - A dispute prevention and management plan should be developed with an aim to manage conflict and bring about positive change through conflict resolution processes. - Ongoing community engagement and stakeholder involvement throughout the process.	Prior to construction, construction and operation	PMU and construction units	- Dispute prevention and management plan established - Monitoring of stakeholder engagement
Increase in traffic and safety hazards	To maintain the health and safety of local population.	Moderate	Minor	- Development of a detailed health and safety plan to mitigate construction risks of the proposed project on the surrounding	Construction and operation phase.	PMU and construction units	- Health and safety plan developed - Traffic signs on the route placed in time - Monthly health and safety monitoring and reporting

				communities. - Periodic inspection and maintenance of construction vehicles - Place traffic signs on the route - Use of lifeboats - Limit traffic flow during rush hours			
Construction safety hazards	To maintain the health and safety of workers and other staff in the construction site.	Moderate	Minor	- Develop a health and safety plan for construction which specifies measures for risk management, emergency and incident response, prevention and control of fire explosion - Develop fire safety education and training programs for workers - Carry out regular check fire detection and alarm equipment.	Prior to construction and construction	PMU and construction units	- Health and safety plan developed - Health and safety officer appointed - Fire safety education and training programs for workers developed and implemented - Monthly checkup of fire detection and alarm equipment

Creation of haven for homeless people and possibility of social evils	To minimize the disturbance and threats that homeless people and drug addicts pose to the local people.	Moderate	Minor	- Ensure enough security staff in the public parks along the canal area during day and night time to maintain security and prevent crime. - Installment of surveillance cameras in public areas to timely protect against property theft and prevent crime.	Operation	Local government	- Creation of haven for homeless people and possibility of social evils

Table 7.13 Enhancement measures for Social Positive Impacts

Potential impact	Management/mitigation objectives	Impact significance before mitigation	Impact significance after mitigation	Mitigation measures	Timing, frequency and duration of mitigation measures	Responsible person/ authority
Creation of employment opportunities	Local population are offered employment opportunities where possible.	Minor	Minor	- A "local labour" desk at the contractor offices should be established to identify a local labour pool. Information about recruitment of employers and workers for the project should be spread widely to local people. - Skill development programs should be implemented to ensure support for local population in obtaining employment opportunities.	Prior to construction and construction	PMU and construction units

Increase in business opportunities	Minimize pollution to the canals resulting from the local food and beverage businesses.	Moderate	Minor	- Regularly check whether restaurants and cafes allocate enough trash bins to dispose of wastes when customers need and whether there is enough toilets for customers.	Operation	Department of Planning and Investment and local government
Leisure and tourism	Maximize its potential as a leisure place and for tourism development.	Major	Major	- Work with the retired and the elderly who have a reputation in the community to discourage people in the area from throwing garbage into the canal. - Place additional trash bins and warning signs	Operation	City government (e.g. Department of Culture, Sports and Tourism) and local government

The Income Restoration Plan (IRP)

The Income Restoration Plan (IRP) is an additional plan for affected households and is a part of the Resettlement Action Plan of HCMC FRMP. The overall strategy of this plan aims at supporting heavily affected households and vulnerable households to restore their livelihood, focusing on diversification of activities that can create income sources immediately for heavily affected and vulnerable households, thereby meeting the immediate basic needs of the households and enhancing their capacity for building future livelihood. The number of households participated in LRP is estimated to be 235.

Table 7.14 Targets of the Income Restoration Plan

Location	Households with 100% of land acquired	Households with over 20% of production land being affected	Vulnerable households	Households without production land or ineligible for Land use Right Certificate	Total
Go Vap District	25	25	20	25	99
Tan Binh District	20	4	8	19	44
Binh Tan District	16	1	4	9	38
District 12	13	30	7	2	54
Total	**74**	**60**	**38**	**55**	**235**

Source: Social Economic Survey conducted in October 2015.

LRP has various activities focusing on (i) small business model for heavily affected and vulnerable households that want to change income generating activities; (ii) PAPs-N & DBTT want to convert income generating activities; (ii) urban agriculture model for heavily affected and vulnerable households that still have agricultural land remaining after acquisition; (iii) organizing additional vocational training for those in the working age and career counseling and job placement, and (iv) introduction of start-up training courses for households that want to change to business activities.

Figure 7.2 describes organizations and agencies responsible for implementing the LRP.

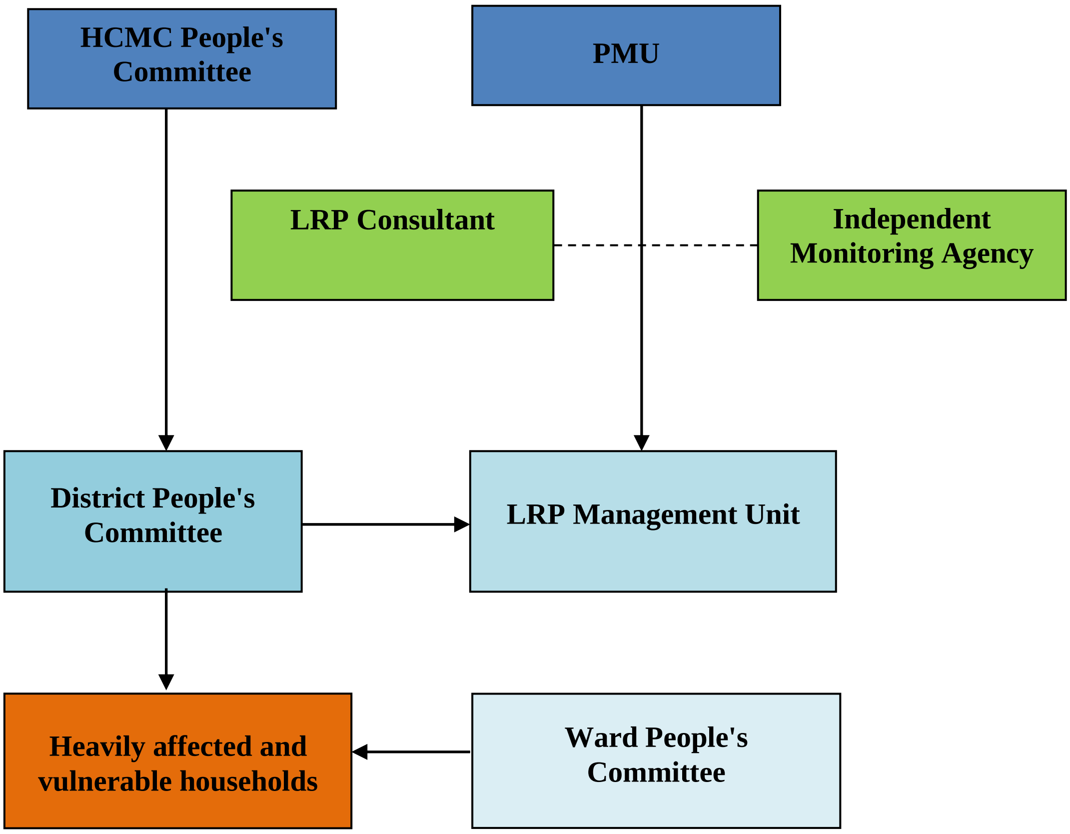


Figure 7.2 Organization chart of LRP.

Total cost for the LRP of the HCMC FRMP is estimated to be around 5.4 billion VND, equivalent to 244,000 USD.

Table 7.15 Cost estimate for implementing the Income Restoration Plan

No.	Cost item	Quantity	Price per unit (million VND)	Total cost (millionVND)
I	Direct investment for households			
1	Households losing over 20% of production land	60	20	1.200
2	Households losing front land for business and vulnerable households	113	20	2.260
3	Additional vocational training	136	5	680
4	Support for trainees	136	2	272
5	Career consulting	136	0.5	68
	Total cost I			4.480
II	Implementation and management cost			448

No.	Cost item	Quantity	Price per unit (million VND)	Total cost (millionVND)
	(10%)			
III	Provisional cost (10%)			448
	Total			5.376

LRP monitoring program

Internal monitoring

- Technical Consultant will develop monitoring indicators.

- District and ward level Project Management Unit will prepare quarterly progress reports on the implementation of the LRP depending on the areas they are in charge of.

- PMU will conduct independent monitoring of these units and submit progress reports to the World Bank.

Independent monitoring

An independent monitoring unit has been hired by PMU to monitor and evaluate the effectiveness of LRP. After one year of implementation, the effectiveness of LRP will be evaluated to determine the socio-economic status of households to see whether they have recovered at least equal to the pre-construction phase of the project.

CHAPTER 8: PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

8.1. Objectives and basic principles

During the course of carrying out the environmental assessment, public consultation is a basic condition to ensure public acceptance of the project as well as to limit adverse impacts and surface issues not being realized by the implementation team. In fact, if the community participates in the early stage of the project preparation, then it is able to build up a close relationship between the community and the project team, and they can give valued proposals for before the project implementation.

The public consultation process in EIA report preparation for the HCMC Flood Risk Management Project is designed to:

- Achieve compliance with the requirements in clause 8, article 20 in Environmental protection law No. 52/2005/QH11 dated 29/11/2005;
- Meet requirements in circular No. 05/2008/TT-BTNMT dated 08/12/2008 of Minister of Ministry of Natural resources and environment. The circular provides guidelines on strategic environmental impact assessment, EIA reporting, and environmental protection commitment.
- In addition, public consultation for the EIA report needs to include Environmental safeguard policies of WB (follow OP4.01).

Objectives of public consultation are:

- To share information about project components and proposed project activities with the community at project area and relevant stakeholders.
- To collect opinions; understand the concerns and sensitivities of local authorities and community on environmental problems created in project area; especially problems which are not recognized by EIA team.Based on this, public cares can be resoanably settled during the course of setting up the Project, and selection of designing solutions
- To perform thorough and comprehensive evaluation of all environmental impacts and propose the most effective mitigation measures that exactly address the adverse environmental impacts.

The basic principles of public consultation are to:

- Facilitate local people and authorities' participation in project area as soon as possible;
- For project group A, the consultation need to conduct public consultation two times:
    - First time: As soon as environmental screening is completed and TOR draft on environmental impact assessment is ready.
    - Second time: After having EIA draft prepared.

8.2. Consultation Process and Methodology

This is a Category A project, thus the WB requires that at least two public consultations are carried out during the EA process. For this specific project, the first public consultation was done shortly after environmental screening and before the terms of reference for the EA are finalized; and the second will be carried out following this draft ESIA is prepared. The public consultations are carried out in the format of open forum under the following process:

- Notification of the requirements and plan to organize public consultation was sent by the PMU and EXP consultant to the relevant districts and agencies for their endorsement, following which invitations were sent from the districts to affected households, Women Union, Youth Union, Veterans, Vietnamese Fatherland Front of the districts, as well as NGOs. In addition, representatives from PMU and FS consultant were invited to attend the meetings to assist EXP as required.
- Printed brochures summarizing basic project information and survey questionnaires were prepared ahead of the consultation, as well as a Power Point presentation and a video on similar projects in the city (Nhieu Loc – Thi Nghe, Tan Hoa – Lo Gom, Tau Hu – Ben Nghe) prepared by PMU for the consultation. The printed brochures were distributed to the district authority one week prior to the consultation, and were included in the invitations. Additional copies of the brochures were also available at the consultation for distribution. The presentation and video were presented at the consultation to give the public a sense of how the final project outcomes could be.
- During the open forum, the participants were given the opportunity to raise their questions and concerns either orally or in writing (through the questionnaire). The open forum enabled direct communication and exchange of information between PMU, FS and EXP consultant, concerned or relevant HCMC District PCs, affected households, and relevant agencies. The issues raised verbally or in the questionnaires were addressed directly at the open forum by the relevant authority and PMU. They were also recorded in this report for reference.
- During the Public Consultation Meeting, the participants were also informed of the PMU's contact information (office address and contact numbers) to which they could send further questions, issues and concerns regarding to the project.
- Issues raised during the consultation were integrated into the terms of reference for the ESIA (first round of consultations) and into the final draft ESIA (second round of consultations).

8.3. Consultation Results

The first round of public consultations was carried out from August 25th to October 29, 2015 at the PC office of different wards in the relevant 9 districts (including Tan Phu District, Binh Thanh District, Tan Binh District, Go Vap District, District 12, Binh Chanh District, District 8 Hoc Mon District, Binh Tan District – *Specific locations are included in the table below*).

Table 8.1 Venue for First Round of Public Consultations

No.	Venue	Date	Duration	Address
1	Tan Phu District	August 25th, 2015	8:00 AM – 9:30 AM	Son Ky Ward PC Office, Tan Phu District. No. 32 Bo Bao Tan Thang Street, Son Ky Ward, Tan Phu District, HCMC.
2	Binh Thanh District	August 26th, 2015	6:30 PM – 8:00 PM	Ward 13 PC Office, Binh Thanh District. No. 285 No Trang Long Street, Ward 13, Binh Thanh District, HCMC.
3	Tan Binh District	August 27th, 2015	8:00 AM – 9:30 AM	Ward 15 PC Office, Tan Binh District. No. 822 Truong Chinh Street, Ward 15, Tan Binh District, HCMC.
4	Go Vap District	September 4th, 2015	8:00 AM – 9:30 AM	Labor Union Go Vap District. No. 507A Quang Trung, Ward 10, Go Vap District, HCMC.
5	District12	September 6th, 2015	8:30 AM –10:30 AM	District 12 PC Office. No. 1 Le Thi Rieng, Ward Thoi An, District 12, HCMC.
6	Binh Chanh District	September 10th, 2015	8:00 AM – 9:30 AM	Tan Kien Ward PC Office, Binh Chanh District. No. C9/18A Duong Dinh Cuc, Tan Kien Ward, Binh Chanh District, HCMC.
7	District 8	September 17th, 2015	8:00 AM – 9:30 AM	Ward 16 PC Office, District 8. No. 450 Phu Dinh, Ward 16, District 8, HCMC.
8	Hoc Mon District	October 20th, 2015	8:00 AM – 9:30 AM	PC office of Xuan Thoi Dong ward. 62 Tran Van Muoi, Xuan Thoi Dong ward, Hoc Mon district, HCMC.
9	Binh Tan District	October 29th, 2015	9:00 AM – 10:30 AM	People Committee of Tan Tao Ward, Binh Tan District. 64 Hồ Văn Long, Tân Tạo Ward, Bình Tân District.

The aim of this first round of consultation was to finalize the TOR for ESIA report**.** A total of 822 participants attended the meeting, of whom 744 are residents in the local districts and the rest are representatives of relevant agencies, PMU, NGOs, etc. The consultations were carried out in the process described above, with the information disclosed prior and at the consultation, and in the following format:

(i) Registration, distribution of brochures, questionnaires, and gifts (raincoat, pen) to participants;

(ii) Welcome and Opening remarks by representative of EXP consultants;

(iii) Overview of the project by representative of PMU;

(iv) Brief TOR and missions of the ESIA by EXP consultant;

(v) Open Forum for Public Question and Answer session by PMU, EXP Consultants, and FS Consultants;

(vi) Consultation closing speech by representative of PMU/District's representative and EXP.

In total, 323 questions, issues and concerns as well as recommendations and suggestions were raised by the participants during the first round of consultations in four main categories: (1) Support for the project, (2) current issues on environment and flooding, (3) clarification of project information, and (4) suggestions and recommendations. Summary of the issues raised are in the table below.

Table 8.2 Summary of first round of public consultations

No	Location	Number of Participants	Opinion	PMU's reponse
1	Tan Phu District	**63** 54 residents 9 PMU and consultants	Complaints on the consequences of the canal pollution and general environment pollution on residents' health and wish the project rapid completion to address these issues Support project but request clarification on the project design and how it contributes to addressing flood risks, implementation schedule and risk of inflation.	Comments were noted and integrated into the TOR for the ESIA. Clarification were provided on the project design and how it is expected to address flood risk in the project area. The implementation schedule was explained, as well as how contingencies have been allocated to take into account risk of inflation.
2	Binh Thanh District	**179** 170 residents 9 PMU and consultants	Complaints on the consequences of the canal pollution on residents' health and wish the project rapid completion to address these issues Support project but request clarification on the project design, especially waste collection and treatment, drainage, inclusion of Lang Canal. Request clarification on the clearance area and project support for relocated residents.	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the project design, with regards to waste water collection and treatment. Lang Canal is not included in the project scope. Area of concern by the residents will not be subject for clearance in the project.
3	Tan Binh District	66 55 residents 11 PMU and consultants	Complaints on the consequences of the canal pollution and general environment pollution on residents' health and wish the project rapid completion to address these issues Support project but request clarification on the project design to treat pollution in Hy Vong Canal, project	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the design of Hy Vong Canal, and project implementation schedule.

No	Location	Number of Participants	Opinion	PMU's reponse
			implementation schedule. Express desire for the CPC to quickly resolve the clearance and resettlement issues.	
4	Go Vap District	36 28 residents 8 PMU and consultants	Complaints on the consequences of the canal pollution and general environment pollution on residents' health and wish the project rapid and high quality completion to address these issues. Support project but request clarification on the project design to treat solid waste. Express concerns on the households who have received compensation are now encroaching and polluting the canal, and on the operations of canal when completed.	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the project design that would not be included in the project scope. Information was provided on efforts of the authority to address re-encroachment of the canal by compensated households.
5	District12	138 129 residents 9 PMU and consultants	Complain about the drainage capacity leading to flood and pollution in the area. Support addressing flood in the central core first. Request clarification on project design, inclusion of Cai Liem Sluice Gate in the project, impacts of the project when completed, relation with the TLBC Wastewater Treatment Plant operations, and possibility to use pumps for flood reduction. Suggest careful survey and information dissemination before implementation. Request clarification on the timing of the consultation and project compensation packages	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the existing investment in Cai Liem Sluice Gate by Department of Transport, as well as aspects of project designs and expected impacts. Clarification was provided on the consultation schedule and how additional information will be provided directly to the affected households by the PMU and authority.

No	Location	Number of Participants	Opinion	PMU's reponse
6	Binh Chanh District	61 53 residents 8 PMU and consultants	Complain about pollution due to industrial zones and flooding due to underdeveloped economy, public awareness, encroaching the river, etc. Support project but express concerns about the long duration of project implementation. Suggest better design for ship-locks to facilitate traffic.	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the design of the ship lock to avoid flooding in the relevant areas.
7	District 8	**104** 98 residents 6 PMU and consultants	Complain about flood situation despite previous upgrading projects. Request clarification on project design of embankment, ship lock and request careful study and design for high impact. Suggest close coordination and information dissemination for city residents on environment protection.	Comments were noted and integrated into the TOR for the ESIA. Clarification was provided on the technical design of the project.
8	Hoc Mon District	**110** 101 residents 9 PMU and consultants	Complain about the flooding situation in selected areas, and consequences due to pollution, and wish the project rapid completion to address these issues.	Comments were noted and integrated into the TOR for the ESIA.
9	Binh Tan District	**65** 57 residents 8 PMU and consultants	Request clarification on project implementation schedule Propose that the sluice gate moved from Nuoc Len bridge to the mouth of Nuoc Len Canal.	Clarification was provided on the project implementation schedule, and on the location of the sluice gate under the Nuoc Len bridge, assuring them that the sluice gate will contribute to address flood risk in the area.

The second public consultation is planned to be carried out mid December 2015 following the completion of this draft ESIA. The results from this consultation will be summarized into the final version of the ESIA.

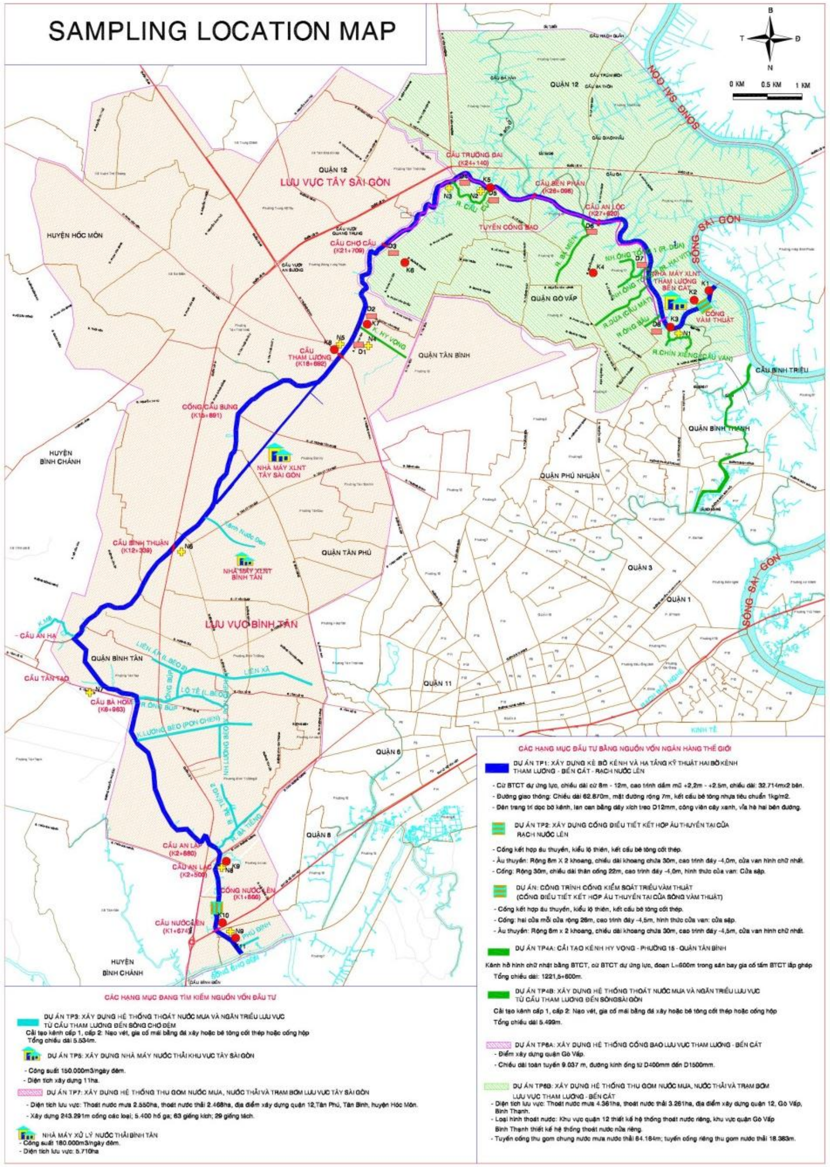
8.4. Information Disclosure

Outside the country, this draft of the ESIA report will be disclosed at the World Bank's InfoShop in Washington DC by December 3, 2015. In country, ESIA report in Vietnamese will be disclosed at the office of the relevant District People's Committees and on the project website.

ANNEX

ANNEX 1

MAP OF SAMPLING LOCATIONS



Chú thích - Notes:

Nước ngầm - Groundwater

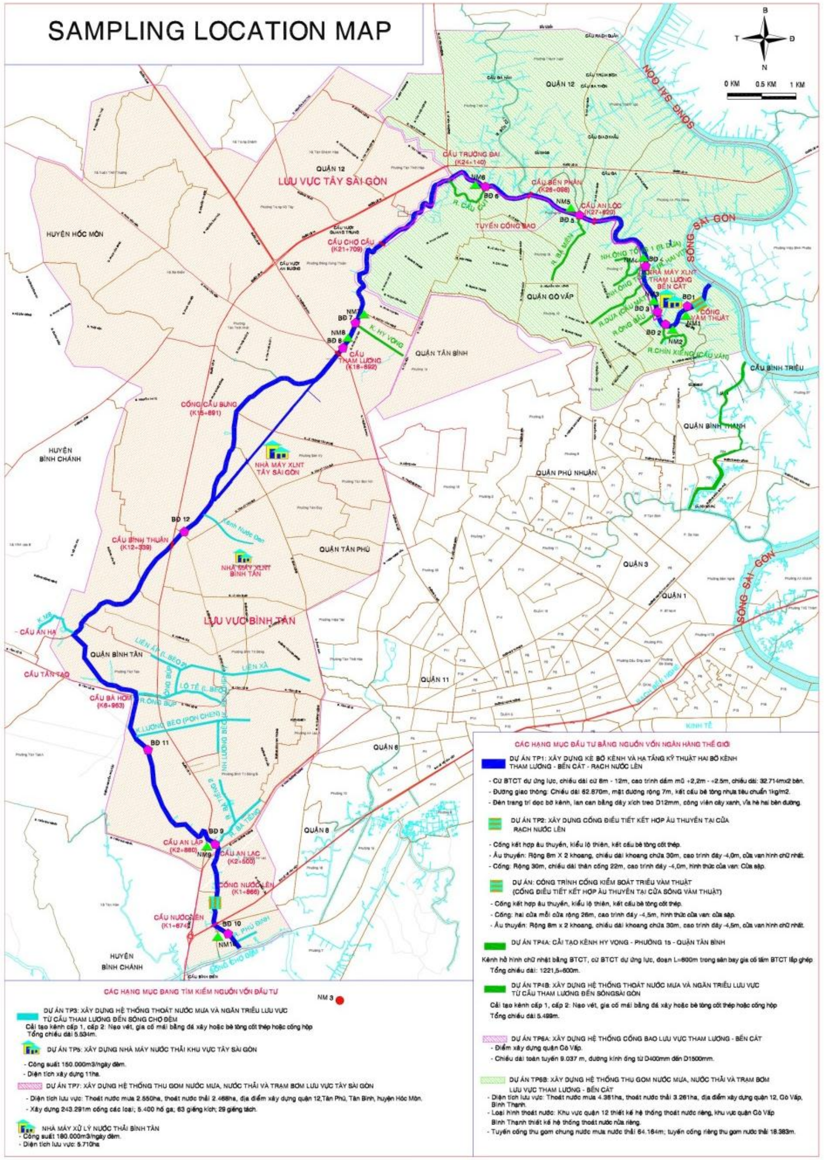
1. Đoạn từ sông Sài Gòn đến cầu An Lộc
   The distance from Sai Gon river to An Loc bridge
2. Đoạn từ cầu An Lộc đến cầu Trường Đai
   The distance from An Loc bridge to Truong Dai bridge
3. Đoạn từ cầu Trường Đai đến cầu Chợ Cầu
   The distance from Truong Dai bridge to Cho Cau bridge
4. Đoạn từ cầu Chợ Đệm đến cầu Tham Lương
   The distance from Cho Dem bridge to tham Luong bridge
5. Đoạn từ cầu Tham Lương đến cống Cầu Bung
   The distance from Tham Luong bridge to Cau Bung bridge
6. Đoạn từ cống Cầu Bung đến cầu Bình Thuận
   The distance from Cau Bung bridge to Binh Thuan bridge
7. Đoạn từ cầu Bình Thuận đến cầu Bà Hom
   The distance from Binh Thuan bridge to Ba Hom bridge
8. Đoạn từ cầu An Lạc đến cầu An Lập
   The distance from Ba Hom bridge to An Lac bridge
9. Đoạn từ cầu Nước Lên đến sông Chợ Đệm
   The distance from Nuoc Len bridge to Cho Dem river

Đất - soil

1. Đoạn từ cầu Tham Lương đến cầu Chợ Cầu, từ bờ kênh Tham Lương đến kênh Hy Vọng 500m
   The distance from Tham Luong to Cho Cau bridge, 500 meter from the Tham Luong channels towards the Hy Vong channel
2. Đoạn từ cầu Tham Lương đến cầu Chợ Cầu, kênh Hy Vọng và kênh Tham Lương - Bến Cát - Nước lên.
   The distance from Tham Luong to Cho Cau bridge, the Hy Vong channels and The Tham Luong - Ben Cat - Nuoc Len channel
3. Đoạn từ cầu Chợ Cầu đến cầu Trường Đai, tại khu vực Chợ Cầu
   The distance from Cho Cau bridge to Truong Dai bridge
4. Đoạn từ cầu Chợ Cầu đến cầu Trường Đai, tại khu vực cầu Trường Đai
5. Đoạn từ cầu Trường Đai đến cầu An Lộc, tại khu vực rạch Cầu Cụt
6. Đoạn từ cầu Trường Đai đến cầu An Lộc, tại khu vực rạch Bà Miên
7. Đoạn từ cầu An Lộc đến sông Sài Gòn, tại khu vực rạch Ông Tổng
8. Đoạn từ cầu An Lộc đến sông Sài Gòn, tại khu vực rạch Ông Bầu

Không khí - Air

1. Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (đầu hướng gió)
   location 200 meter from Sai Gon river towards the Vam Thiat kennel (upwind)
2. Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (cuối hướng gió)
   Location 200 meter from Sai Gon river towards the Vam Thuat kennel (downwind)
3. Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương - Bến Cát - Nước Lên
   Loacation at the junction between the Chin Xieng canal and the Tham Luong - Ben Cat - Nuoc Len channels
4. Vị trí tại điểm giao đường Nguyễn Oanh và đường Lê Đức Thọ
   location at the junction between Nguyen Oanh street and Le Duc Tho stree
5. Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương - Bến Cát - Nước Lên
   Location at the junction between the Cau Cut canal and the Tham Luong - Ben Cat - Nuoc Len channels
6. Vị trí tại điểm giao đường Phan Huy Ích và đường Quang Trung
   Location at the junction between Phan Huy Ich and Quang Trung Street
7. Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương - Bến Cát - Nước Lên
   Location at the junction between the Hy Vong Channel and the Tham Luong - Ben Cat - Nuoc Len channels
8. Vị trí tại cầu Tham Lương, gần KCN Tân Bình
   Location at the Tham Luong bridge, near Tan Binh Industrial Park
9. Vị trí tại cầu An Lạc, gần KCN Tân Tạo
   Location at the An Lac bridge, near Tan Tao Industrial Park
10. Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên (đầu hướng gió)
    Location 200 meter from Cho Dem river toward the Nuoc Len bridge (upwind)
11. Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên (cuối hướng gió)
    Location 200 meter from Cho Dem river toward the Nuoc Len bridge (downwind)



Chú thích - Notes:

Bùn đáy - Sediment sludge

1. Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật
   Location 200 meter from Sai Gon river towards the Vam Thuat kennel
2. Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương
   Loacation at the junction between the Chin Xieng canal and the Tham Luong channels
3. Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương
   Loacation at the junction between the Ong Bau canal and the Tham Luong channels
4. Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương
   Location at the junction between the Ong Tong canal and the Tham Luong channels
5. Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương
   Location at the junction between the Ba Mien canal and the Tham Luong channels
6. Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương
   Location at the junction between the Cau Cut canal and the Tham Luong channels
7. Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương
   Location at the junction between the Hy Vong channels and the Tham Luong channels
8. Vị trí tại điểm cầu Tham Lương
   Location at the junction Tham Luong bridge
9. Vị trí tại cầu An Lạc (Giữa cầu An lạc và An Lập)
   Location at the junction An Lac bridge (between the An Lac bridge and the An Lap bridge)
10. Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên
    Location 200 meter from Cho Dem river toward the Nuoc Len bridge
11. Vị trí gói thầu 4A đang thi công
    Location at the junction the package 4A
12. Vị trí tại cầu Tân Kỳ - Tân Quý
    Location at the junction the Tan Ky - Tan Quy bridge

Nước mặt - Surface water

1. Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật
   Location 200 meter from Sai Gon river towards the Vam Thuat kennel
2. Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương
   Loacation at the junction between the Chin Xieng canal and the Tham Luong channels
3. Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương
   Loacation at the junction between the Ong Bau canal and the Tham Luong channels
4. Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương
   Location at the junction between the Ong Tong canal and the Tham Luong channels
5. Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương
   Location at the junction between the Ba Mien canal and the Tham Luong channels
6. Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương
   Location at the junction between the Cau Cut canal and the Tham Luong channels
7. Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương
   Location at the junction between the Hy Vong channels and the Tham Luong channels
8. Vị trí tại điểm cầu Tham Lương
   Location at the junction Tham Luong bridge
9. Vị trí tại cầu An Lạc (Giữa cầu An Lạc Và An Lập)
   Location at the An Lac bridge (between the An Lac bridge and the An Lap bridge)
10. Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên
    Location 200 meter from Cho Dem river toward the Nuoc Len bridge

Table 1.1 Locations for air sampling in the project area

Air		
Sample code	**Time**	**Location**
K1	Morning	At 200 meter from Sai Gon river towards the Vam Thuat River (upstream wind direction)
K2	Morning	At 200 meter from Sai Gon river towards Vam Thuat river (downstream wind direction)
K3	Morning	At the junction of the Chin Xieng canal with the Tham Luong – Ben Cat – Nuoc Len canal
K4	Afternoon	At the junction of Nguyen Oanh street with Le Duc Tho street
K5	Afternoon	At the junction of Cau Cut canal with Tham Luong – Ben Cat – Nuoc Len canal
K6	Afternoon	At the junction of Phan Huy Ich street with Quang Trung street
K7	Afternoon	At the junction of Hy Vong Canal with Tham Luong – Ben Cat – Nuoc Len canal
K8	Afternoon	At the Tham Luong bridge (Tan Binh Industrial Park)
K9	Morning	At the An Lac bridge (Tan Tao Industrial Park)
K10	Morning	At 200 meter from Cho Dem river toward the Nuoc Len bridge (upstream wind direction)
K11	Morning	At 200 meter from Cho Dem river toward the Nuoc Len bridge (downstream wind direction)
Surface water (SW) at hight tide and low tide		
Codes		**Location**
SW1-HT and SW1 - LT		At 200 meter from Sai Gon river towards the Vam Thuat canal
SW2-HT and SW2 - LT		At the junction of Chin Xieng canal with Tham Luong – Ben Cat – Nuoc Len canal
SW3-HT and SW3 - LT		At the junction of Ong Bau canal with Tham Luong – Ben Cat – Nuoc Len canal
SW4-HT and SW4 - LT		At the junction between Ong Tong canal and Tham Luong – Ben Cat – Nuoc Len canal
SW5-HT and SW5 - LT		At the junction between Ba Mien canal and Tham Luong – Ben Cat –

	Nuoc Len canal
SW6-HT and SW6 - LT	At the junction between Cau Cut canal and Tham Luong – Ben Cat – Nuoc Len canal
SW7-HT and SW7 - LT	At the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len canal
SW8-HT and SW8 - LT	At the Tham Luong bridge where a discharge point of Tan Binh Industrial Park is located.
SW9-HT and SW9 - LT	At the An Lac bridge (Tan Tao Industrial Park)
SW10-HT and SW10 - LT	At 200 meter from Cho Dem river toward the Nuoc Len bridge
Groundwater	
GW1	At Chin Xieng canal area (well (35m depth) - at Thai Son football ground – 566/45 Nguyen Thai Son Street – drilled in 2012)
GW2	At Cau Cut canal area. (household well (30m depth) at Cau Cut canal – 1396/76 Le Duc Tho, Ward 13, Go Vap district - drilled in 1997)
GW3	At Truong Dai bridge area (well at Nam Bang company (100m depth) drilled in 2005)
GW4	At Hy Vong canal (well at wood shop (30m depth), drilled in 2012)
GW5	At Tham Luong bridge (store near Tham Luong bridge (20m depth), drilled in 2000)
GW6	At Binh Thuan bridge (well at Ms. Nguyen Thi Viet house (80m depth) – 839/5, National Highway No.1A, Town 1, Binh Hung Hoa ward, Binh Tan District - drilled between 2000 and 2003)
GW7	At ba Hom bridge (well at Ms.Thuan house (120m depth) – 35 Bo Song street, Town 2, Tan Tao A ward, Binh Tan District – drilled more than 10 years ago)
GW8	An area from An Lac bridge to An Lap bridge (well at household No.1233, National Highway No.1, An Lac ward, Binh Tan District – drilled in 2011, 140m depth)
GW9	An area from Nuoc Len bridge to Cho Dem river (well at Le Tan Be household, drilled in 08/2015, 150m depth)
Soil	
S1	At the Tham Luong canal where is of 500m from Hy Vong cannal 500m (Soil was covered from 2013)
S2	An area from Tham Luong bridge to Cho Cau bridge, the Hy Vong canal
S3	At Cho Cau bridge area

S4	At Truong Dai bridge area (Soil was covered from 2012-2013)
S5	At Cau Cut canal area (Soil was covered from 2013)
S6	At Ba Mien canal area (Soil was covered from 09/2015)
S7	At Ong Tong canal area (Soil was covered from 2012-2013)
S8	At Ong Bau canal area (Soil was covered from 08/2015)
Sediment	
Sed1.1(0.2m) and Sed 1.2 (0.5m)	At 200 meter from Sai Gon river towards the Vam Thuat canal
Sed2.1, Sed2.2	At the junction of Chin Xieng canal with Tham Luong – Ben Cat – Nuoc Len canal
S3	At the junction of Ong Bau canal with Tham Luong – Ben Cat – Nuoc Len canal
S4	At the junction between Ong Tong canal and Tham Luong – Ben Cat – Nuoc Len canal
S5	At the junction between Ba Mien canal and Tham Luong – Ben Cat – Nuoc Len canal
S6	At the junction between Cau Cut canal and Tham Luong – Ben Cat – Nuoc Len canal
S7	At the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len canal
S8	At the Tham Luong bridge where a discharge point of Tan Binh Industrial Park is located.
S9	At the An Lac bridge (Tan Tao Industrial Park)
S10	At 200 meter from Cho Dem river toward the Nuoc Len bridge
S11	Location of tender package 4A
S12	Location of tender package 6A

ANNEX 2

ANALYTICAL RESULTS

KẾT QUẢ PHÂN TÍCH MẪU KHÍ

ANALYTICAL RESULT OF AIR QUALITY

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC KHU VỰC TP. HCM**

Poject :

Ngày đo đạc và lấy mẫu/ *Sampling and measure date* : 12-13/10/2015

Địa chỉ : Tp. Hồ Chí Minh

Address : *Ho Chi Minh City*

Kí hiệu ***Sign***	**Vị trí đo đạc** *Location*	**Tọa độ** ***Coordinates*** VN 2000	**Thời điểm đo đạc**	**Nhiệt độ Temperature** (^0C)	**Độ ẩm Humidity** (%)	**Vận tốc gió Wind speed** (m/s)	**Tiếng ồn** ***Noise (Leq)*** (dBA)	**Bụi** ***Particle*** (mg/m^3)	**NO_2** (mg/m^3)	**SO_2** (mg/m^3)	**CO** (mg/m^3)
K1	Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (đầu hướng gió) *Location 200 meter from Sai Gon river towards the Vam Thuat kennet (top of wind direction)*	0603909 1198324	8h00	29.5	77.4	0.0 – 0.3	75.2	0.23	0.014	0.008	2.73
K2	Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (cuối hướng gió) *Location 200 meter from Sai Gon river towards the Vam Thuat kennet (end of wind direction)*	0594397 1197800	9h25	32.4	68.5	0.0 – 0.3	69.6	0.15	0.013	0.008	2.76
K3	Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels*	0593718 1197291	10h40	32.1	67.3	0.1 – 0.3	68.4	0.18	0.028	0.025	8.04

Kí hiệu *Sign*	Vị trí đo đạc *Location*	Tọa độ *Coordinates* VN 2000	Thời điểm đo đạc	Nhiệt độ Temperature (^{0}C)	Độ ẩm Humidity (%)	Vận tốc gió Wind speed (m/s)	Tiếng ồn *Noise (Leq)* (dBA)	Bụi *Particle* (mg/m^3)	NO_2 (mg/m^3)	SO_2 (mg/m^3)	CO (mg/m^3)
K4	Vị trí tại điểm giao đường Nguyễn Oanh và đường Lê Đức Thọ *Location at the junction between Nguyen Oanh street anh Le Duc Tho street*	0601090 1198763	14h05	31.2	67.9	0.1 – 0.2	81.3	0.33	0.047	0.026	9.78
K5	Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels*	0589803 1200432	15h40	30.2	65.7	0.0 – 0.3	65.1	0.12	0.026	0.019	6.24
K6	Vị trí tại điểm giao đường Phan Huy Ích và đường Quang Trung *Location at the junction between Phan Huy Ich and Quang Trung street*	0597149 1198972	16h40	31.2	62.7	0.1 – 0.2	81.0	0.31	0.053	0.043	15.05
K7	Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the Hy Vong Channal and the Tham Luong – Ben Cat – Nuoc Len*	0596141 1197414	17h30	31.2	65.1	0.1 – 0.3	72.0	0.10	0.014	0.013	3.63
K8	Vị trí tại cầu Tham Lương (KCN Tân Bình) *Location at the Tham Luong bridge (Tan Binh Industrial Park)*	0595788 1196897	16h00	30.4	67.2	0.1 – 0.4	77.9	0.38	0.028	0.023	8.00
K9	Vị trí tại cầu An Lạc (KCN Tân Tạo) *Location at the An Lac bridge (Tan Tao Industrial Park)*	0593008 1186082	10h05	30.3	69.4	0.0 – 0.3	75.0	0.14	0.028	0.022	7.12
K10	Vị trí cách sông Chợ Đệm 200m về phía cầu	0593218	7h15	29.9	67.4	0.0 – 0.4	70.1	0.10	0.023	0.020	7.11

Kí hiệu *Sign*	Vị trí đo đạc *Location*	Tọa độ *Coordinates* VN 2000	Thời điểm đo đạc	Nhiệt độ Temperature (^{0}C)	Độ ẩm Humidity (%)	Vận tốc gió Wind speed (m/s)	Tiếng ồn *Noise (Leq)* (dBA)	Bụi *Particle* (mg/m^3)	NO_2 (mg/m^3)	SO_2 (mg/m^3)	CO (mg/m^3)
	Nước Lên (đầu hướng gió) *Location 200 meter from Cho Dem river toward the Nuoc Len bridge (top of wind direction)*	1185401									
K11	Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên (cuối hướng gió) *Location 200 meter from Cho Dem river toward the Nuoc Len bridge (end of wind direction)*	0593237 1184978	8h25	29.8	65.7	0.1 – 0.2	70.0	0.14	0.025	0.024	7.11
QCVN 05:2013/BTNMT (trung bình 1 giờ) **QCVN 05:2013/BTNMT (average 1 hour)**				-	-	-	-	**0,3**	**0,2**	**0,35**	**30**
QCVN 26:2010/BTNMT (từ 6h - 21h) **QCVN 26:2010/BTNMT (from 6h to 21h)**				-	-	-	**70**	-	-	-	-
Phương pháp đo đạc/phân tích ***Measuring/Analyzing methods***				**TCVN 5508:2009 (★)**		**Đo bằng máy đo vận tốc gió Tubor, Mỹ**	**TCVN 7878-2:2010 (★)**	**TCVN 5067 – 1995 (★)**	**MASA 406 (1988) (★)**	**MASA 704A (1988) (★)**	**52TCN 352 – 89**

Ghi chú/Note*:*

- ***(★)*** *phương pháp đo đạc/phân tích được VILAS công nhận/(★) measuring/analyzing method is accredited by VILAS.*
- *QCVN 05:2013/BTNMT (Quy chuẩn kỹ thuật quốc gia về chất lượng không khí xung quanh)/QCVN 05:2013/BTNMT (National technical regulation on ambient air quality).*
- *QCVN 26:2010/BTNMT (Quy chuẩn kỹ thuật quốc gia về tiếng ồn)/QCVN 26:2010 /BTNMT (National technical regulation on noise).*
- *KPH: không phát hiện/ND: not delected.*

KẾT QUẢ PHÂN TÍCH MẪU KHÍ

ANALYTICAL RESULT OF AIR QUALITY

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC KHU VỰC TP. HCM**

Poject :

Ngày đo đạc và lấy mẫu/ *Sampling and measure date* : 12-13/10/2015

Địa chỉ : Tp. Hồ Chí Minh

Address : *Ho Chi Minh City*

Kí hiệu ***Sign***	**Vị trí đo đạc** *Location*	**Tọa độ** ***Coordinates*** VN 2000	**Thời điểm đo đạc**	**NH_3** (mg/m^3)	**H_2S** (mg/m^3)	**VOC_s** (mg/m^3)	**Pb** (mg/m^3)
K1	Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (đầu hướng gió) *Location 200 meter from Sai Gon river towards the Vam Thuat kennet (top of wind direction)*	0603909 1198324	8h00	KPH (<0.02)	KPH (<0.003)	0.05	0.007
K2	Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật (cuối hướng gió) *Location 200 meter from Sai Gon river towards the Vam Thuat kennet (end of wind direction)*	0594397 1197800	9h25	KPH (<0.02)	KPH (<0.003)	0.01	KPH (<0.005)
K3	Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels*	0593718 1197291	10h40	0.20	0.007	KPH (<0.01)	KPH (<0.005)

Kí hiệu *Sign*	**Vị trí đo đạc** *Location*	**Tọa độ** ***Coordinates*** VN 2000	**Thời điểm đo đạc**	**NH_3** (mg/m^3)	**H_2S** (mg/m^3)	**VOC_s** (mg/m^3)	**Pb** (mg/m^3)
K4	Vị trí tại điểm giao đường Nguyễn Oanh và đường Lê Đức Thọ *Location at the junction between Nguyen Oanh street anh Le Duc Tho street*	0601090 1198763	14h05	0.03	KPH (<0.003)	KPH (<0.01)	KPH (<0.005)
K5	Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels*	0589803 1200432	15h40	0.06	KPH (<0.003)	KPH (<0.01)	KPH (<0.005)
K6	Vị trí tại điểm giao đường Phan Huy Ích và đường Quang Trung *Location at the junction between Phan Huy Ich and Quang Trung street*	0597149 1198972	16h40	0.02	KPH (<0.003)	KPH (<0.01)	KPH (<0.005)
K7	Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên *Location at the junction between the Hy Vong Channal and the Tham Luong – Ben Cat – Nuoc Len*	0596141 1197414	17h30	KPH (<0.02)	KPH (<0.003)	0.03	KPH (<0.005)
K8	Vị trí tại cầu Tham Lương (KCN Tân Bình) *Location at the Tham Luong bridge (Tan Binh Industrial Park)*	0595788 1196897	16h00	0.02	KPH (<0.003)	0.02	KPH (<0.005)
K9	Vị trí tại cầu An Lạc (KCN Tân Tạo) *Location at the An Lac bridge (Tan Tao Industrial Park)*	0593008 1186082	10h05	0.02	KPH (<0.003)	0.02	KPH (<0.005)
K10	Vị trí cách sông Chợ Đệm 200m về phía cầu	0593218	7h15	KPH (<0.02)	KPH (<0.003)	0.02	KPH (<0.005)

Kí hiệu *Sign*	**Vị trí đo đạc** *Location*	**Tọa độ** ***Coordinates*** VN 2000	**Thời điểm đo đạc**	**NH_3** (mg/m^3)	**H_2S** (mg/m^3)	**VOC_s** (mg/m^3)	**Pb** (mg/m^3)
	Nước Lên (đầu hướng gió) *Location 200 meter from Cho Dem river toward the Nuoc Len bridge (top of wind direction)*	1185401					
K11	Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên (cuối hướng gió) *Location 200 meter from Cho Dem river toward the Nuoc Len bridge (end of wind direction)*	0593237 1184978	8h25	0.14	0.005	0.02	KPH (<0.005)
QCVN 06:2009/BTNMT (trung bình 1 giờ) **QCVN 06:2009/BTNMT (average 1 hour)**				**0,20**	**0,042**	**-**	**-**
Phương pháp đo đạc/phân tích ***Measuring/Analyzing methods***				**MASA 401**	**MASA 701**	**NIOSH 1501**	**Technical normal rule & SMEWW 3120 B (2012)**

Ghi chú/Note:

- ***(★)*** *phương pháp đo đạc/phân tích được VILAS công nhận/*(★) *measuring/analyzing method is accredited by VILAS.*
- *QCVN 06:2009/BTNMT (Quy chuẩn kỹ thuật quốc gia về một số chất độc hại trong không khí xung quanh)/QCVN 06:2009/BTNMT (National technical regulation on hazardous substances in ambient air).*
- *KPH: không phát hiện/ ND: not delected.*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0318-0320-0322-0324-0326

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu

Type of sample : Nước mặt – Triều cường

: *Surface water – High tide*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW1-HT 1510.0318**	**SW2-HT 1510.0320**	**SW3-HT 1510.0322**	**SW4-HT 1510.0324**	**SW5-HT 1510.0326**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
1	pH, at 25^{o}C	-	6.61	6.63	6.63	6.35	7.06	**5.5 – 9**	**5.5 – 9**	TCVN 6492:2011 (★) (ISO 10523:2008)
2	Độ cứng tổng/ Total hardness	mgCaCO$_3$/l	6	6	8	8	36	**-**	**-**	SMEWW 2340 C (2012)
3	Độ đục/ *Turbidity*	NTU	57.6	33.9	51.9	45.0	49.9	**-**	**-**	SMEWW 2130 B (2012) (★)
4	Độ màu/ *Color*	Pt-Co	39	32	97	41	69	**-**	**-**	SMEWW 2120 C (2012)
5	DO	mgO$_2$/l	1.02	0.58	0.20	1.20	0.14	**≥ 4**	**≥ 2**	SMEWW 4500-O.G (2012) (★)
6	TSS	mg/l	68	35	53	50	53	**≤ 50**	**≤ 100**	SMEWW 2540 D (2012) (★)
7	TDS	mg/l	90	85	300	80	280	**-**	**-**	SMEWW 2540 C (2012)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW1-HT 1510.0318	SW2-HT 1510.0320	SW3-HT 1510.0322	SW4-HT 1510.0324	SW5-HT 1510.0326	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	Level B2	
8	COD	mgO_2/l	21	16	161	14	52	**≤ 30**	**≤ 50**	SMEWW 5220C (2012)
9	BOD_5	mgO_2/l	14	5	126	5	24	**≤ 15**	**≤ 25**	SMEWW 5210 B (2012) (★)
10	$N\text{-}NH_4^+$	mg/l	1.5	1.4	13.4	1.2	14.0	**≤ 0.5**	**≤ 1**	SMEWW 4500-NH_4^+.C (2012) (★) & SMEWW 4500-NH_4^+.F (2012) (★)
11	Cl^-	mg/l	21.1	18.8	61.9	17.5	51.6	**≤ 600**	**-**	SMEWW 4110 B (2012) (★)
12	F^-	mg/l	0.31	0.13	0.23	0.16	0.31	**≤ 1.5**	**≤ 2**	SMEWW 4110 B (2012) (★)
13	$N\text{-}NO_2^-$	mg/l	0.23	0.13	KPH/ND (LOD = 0.003)	0.15	KPH/ND (LOD = 0.003)	**≤ 0.04**	**≤ 0.05**	SMEWW 4110 B (2012) (★)
14	$N\text{-}NO_3^-$	mg/l	0.38	0.36	KPH/ND (LOD = 0.015)	0.37	KPH/ND (LOD = 0.015)	**≤ 10**	**≤ 15**	SMEWW 4110 B (2012) (★)
15	SO_4^{2-}	mg/l	34.4	33.8	38.1	33.5	63.3	**-**	**-**	SMEWW 4110 B (2012) (★)
16	$P\text{-}PO_4^{3-}$	mg/l	0.07	0.08	0.79	0.11	0.72	**≤ 0.3**	**≤ 0.5**	SMEWW 4500-P&D (2012) (★)
17	As	mg/l	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	**≤ 0.05**	**≤ 0.1**	SMEWW 3120 B (2012) (★)
18	Cd	mg/l	KPH/ND	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 0.01**	**≤ 0.01**	SMEWW 3120 B (2012)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW1-HT 1510.0318	SW2-HT 1510.0320	SW3-HT 1510.0322	SW4-HT 1510.0324	SW5-HT 1510.0326	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	Level B2	
			(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)			(★)
19	Pb	mg/l	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	**≤ 0.05**	**≤ 0.05**	SMEWW 3120 B (2012) (★)
20	Cr	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	0.005	**-**	**-**	SMEWW 3120 B (2012) (★)
21	Cu	mg/l	0.011	0.004	0.094	KPH/ND (LOD = 0.005)	0.011	**≤ 0.5**	**≤ 1**	SMEWW 3120 B (2012) (★)
22	Zn	mg/l	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
23	Mn	mg/l	0.127	0.109	0.092	0.116	0.247	**-**	**-**	SMEWW 3120 B (2012) (★)
24	Fe	mg/l	2.02	1.59	1.13	2.29	2.26	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
25	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	**≤ 0.001**	**≤ 0.002**	SMEWW 3120 B (2012)
26	Dầu. mỡ/ *Oil & grease*	mg/l	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	0.5	KPH/ND (LOD = 0.1)	0.2	**≤ 0.1**	**≤ 0.3**	SMEWW 5520 C (2012)
27	E. Coli	MPN/100ml	9300	24×10^3	93×10^4	24×10^3	93×10^3	**≤ 100**	**≤ 200**	SMEWW 9221 F (2012)
28	Coliform	MPN/100ml	24×10^3	93×10^3	43×10^5	43×10^3	24×10^5	**≤ 7500**	**≤ 10000**	SMEWW 9221 D

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW1-HT 1510.0318**	**SW2-HT 1510.0320**	**SW3-HT 1510.0322**	**SW4-HT 1510.0324**	**SW5-HT 1510.0326**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
										(2012)

Ghi chú/Note:

Phương pháp lấy mẫu nước mặt/*Surface sampling*: TCVN 6663-6:2008 (ISO 5667-6:2005)

(★) Phương pháp đo đạc/phân tích được VILAS công nhận/ *Measuring/analyzing method is accredited by VILAS.*

QCVN 08:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước mặt/ *National technical regulation on surface water quality.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

SW1-HT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-HT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-HT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-HT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-HT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0328-0330-0332-0380-0382

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Nước mặt – Triều cường

Type of sample : *Surface water – High tide*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW6-HT 1510.0328**	**SW7-HT 1510.0330**	**SW8-HT 1510.0332**	**SW9-HT 1510.0382**	**SW10-HT 1510.0380**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
1	pH, at 25°C	-	7.12	7.08	7.24	6.99	7.00	**5.5 – 9**	**5.5 – 9**	TCVN 6492:2011 (★) (ISO 10523:2008)
2	Độ cứng tổng/ Total hardness	$mgCaCO_3/l$	68	36	56	120	118	**-**	**-**	SMEWW 2340 C (2012)
3	Độ đục/ *Turbidity*	NTU	66.3	55.6	41.2	43.4	65.4	**-**	**-**	SMEWW 2130 B (2012) (★)
4	Độ màu/ *Color*	Pt-Co	95	106	125	34	29	**-**	**-**	SMEWW 2120 C (2012)
5	DO	mgO_2/l	0.07	0.08	0.09	0.35	0.08	**≥ 4**	**≥ 2**	SMEWW 4500-O.G (2012) (★)
6	TSS	mg/l	93	38	28	42	59	**≤ 50**	**≤ 100**	SMEWW 2540 D (2012) (★)
7	TDS	mg/l	310	350	470	380	490	**-**	**-**	SOP-HTN06

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW6-HT 1510.0328	SW7-HT 1510.0330	SW8-HT 1510.0332	SW9-HT 1510.0382	SW10-HT 1510.0380	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	**Level B2**	
8	COD	mgO_2/l	68	86	100	68	35	**≤ 30**	**≤ 50**	SMEWW 5220C (2012)
9	BOD_5	mgO_2/l	37	68	62	29	11	**≤ 15**	**≤ 25**	SMEWW 5210 B (2012) (★)
10	$N\text{-}NH_4^+$	mg/l	8.4	10.4	11.2	10.4	5.3	**≤ 0.5**	**≤ 1**	SMEWW 4500-NH_4^+.C (2012) (★) & SMEWW 4500-NH_4^+.F (2012) (★)
11	Cl^-	mg/l	56.8	84.2	101.0	114.0	196.0	**≤ 600**	**-**	SMEWW 4110 B (2012) (★)
12	F^-	mg/l	0.13	0.14	0.18	0.32	0.37	**≤ 1.5**	**≤ 2**	SMEWW 4110 B (2012) (★)
13	$N\text{-}NO_2^-$	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.04**	**≤ 0.05**	SMEWW 4110 B (2012) (★)
14	$N\text{-}NO_3^-$	mg/l	0.017	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	**≤ 10**	**≤ 15**	SMEWW 4110 B (2012) (★)
15	SO_4^{2-}	mg/l	65.3	55.0	64.5	42.3	76.6	**-**	**-**	SMEWW 4110 B (2012) (★)
16	$P\text{-}PO_4^{3-}$	mg/l	1.10	1.32	1.29	0.62	0.21	**≤ 0.3**	**≤ 0.5**	SMEWW 4500-P&D (2012) (★)
17	As	mg/l	0.008	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	**≤ 0.05**	**≤ 0.1**	SMEWW 3120 B (2012) (★)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW6-HT 1510.0328	SW7-HT 1510.0330	SW8-HT 1510.0332	SW9-HT 1510.0382	SW10-HT 1510.0380	QCVN 08:2008/BTNMT Level B1	QCVN 08:2008/BTNMT Level B2	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
18	Cd	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.01**	**≤ 0.01**	SMEWW 3120 B (2012) (★)
19	Pb	mg/l	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	**≤ 0.05**	**≤ 0.05**	SMEWW 3120 B (2012) (★)
20	Cr	mg/l	0.010	0.010	0.023	0.028	0.005	**-**	**-**	SMEWW 3120 B (2012) (★)
21	Cu	mg/l	0.013	0.014	0.012	0.038	KPH/ND (LOD = 0.005)	**≤ 0.5**	**≤ 1**	SMEWW 3120 B (2012) (★)
22	Zn	mg/l	0.020	KPH/ND (LOD = 0.005)	0.015	0.034	KPH/ND (LOD = 0.005)	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
23	Mn	mg/l	0.279	0.258	0.293	0.477	0.557	**-**	**-**	SMEWW 3120 B (2012) (★)
24	Fe	mg/l	3.81	1.92	1.89	2.47	3.81	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
25	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	**≤ 0.001**	**≤ 0.002**	SMEWW 3120 B (2012)
26	Dầu. mỡ/ *Oil & grease*	mg/l	0.2	0.3	0.3	0.2	KPH/ND (LOD = 0.1)	**≤ 0.1**	**≤ 0.3**	SMEWW 5520 C (2012)
27	E. Coli	MPN/100ml	24×10^3	93×10^4	24×10^5	24×10^4	9300	**≤ 100**	**≤ 200**	SMEWW 9221 F (2012)
28	Coliform	MPN/100ml	24×10^4	93×10^5	93×10^5	93×10^4	43×10^3	**≤ 7500**	**≤ 10000**	SMEWW 9221 D

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW6-HT 1510.0328	SW7-HT 1510.0330	SW8-HT 1510.0332	SW9-HT 1510.0382	SW10-HT 1510.0380	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	Level B2	
										(2012)

Ghi chú/Note:

Phương pháp lấy mẫu nước mặt/*Surface sampling*: TCVN 6663-6:2008 (ISO 5667- 6:2005

(★) Phương pháp đo đạc/phân tích được VILAS công nhận/ *Measuring/analyzing method is accredited by VILAS.*

QCVN 08:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước mặt/ *National technical regulation on surface water quality.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

SW6-HT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-HT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-HT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park.*(0595884;1196999)

SW9-HT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge.*(0593163;1186046)

SW10-HT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge.*(0593205;1184253)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0319-0321-0323-0325-0327

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Nước mặt – Triều kiệt

Type of sample : *Surface water – Low tide*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW1-LT 1510.0319**	**SW2-LT 1510.0321**	**SW3-LT 1510.0323**	**SW4-LT 1510.0325**	**SW5-LT 1510.0327**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
1	pH, at 25^oC	-	6.60	6.89	6.60	7.05	7.07	**5.5 – 9**	**5.5 – 9**	TCVN 6492:2011 (★) (ISO 10523:2008)
2	Độ cứng tổng/ Total hardness	$mgCaCO_3/l$	6	24	24	44	52	-	-	SMEWW 2340 C (2012)
3	Độ đục/ *Turbidity*	NTU	65.9	96.8	83.1	57.2	201	-	-	SMEWW 2130 B (2012) (★)
4	Độ màu/ *Color*	Pt-Co	36	33	98	84	119	-	-	SMEWW 2120 C (2012)
5	DO	mgO_2/l	0.89	0.28	0.15	0.45	0.04	**≥ 4**	**≥ 2**	SMEWW 4500-O.G (2012) (★)
6	TSS	mg/l	74	112	57	61	163	**≤ 50**	**≤ 100**	SMEWW 2540 D (2012) (★)
7	TDS	mg/l	110	205	425	290	320	-	-	SOP-HTN06

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW1-LT 1510.0319	SW2-LT 1510.0321	SW3-LT 1510.0323	SW4-LT 1510.0325	SW5-LT 1510.0327	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	Level B2	
8	COD	mgO_2/l	20	37	253	53	116	**≤ 30**	**≤ 50**	SMEWW 5220C (2012)
9	BOD_5	mgO_2/l	8	21	200	26	70	**≤ 15**	**≤ 25**	SMEWW 5210 B (2012) (★)
10	$N\text{-}NH_4^+$	mg/l	2.2	5.6	20.2	7.0	20.2	**≤ 0.5**	**≤ 1**	SMEWW 4500-NH_4^+.C (2012) (★) & SMEWW 4500-NH_4^+.F (2012) (★)
11	Cl^-	mg/l	20.7	36.9	94.0	54.8	55.9	**≤ 600**	**-**	SMEWW 4110 B (2012) (★)
12	F^-	mg/l	0.19	0.15	KPH/ND (LOD = 0.03)	0.12	0.12	**≤ 1.5**	**≤ 2**	SMEWW 4110 B (2012) (★)
13	$N\text{-}NO_2^-$	mg/l	0.23	0.04	0.15	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.04**	**≤ 0.05**	SMEWW 4110 B (2012) (★)
14	$N\text{-}NO_3^-$	mg/l	0.31	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	0.02	KPH/ND (LOD = 0.015)	**≤ 10**	**≤ 15**	SMEWW 4110 B (2012) (★)
15	SO_4^{2-}	mg/l	39.8	45.9	49.1	82.3	24.8	**-**	**-**	SMEWW 4110 B (2012) (★)
16	$P\text{-}PO_4^{3-}$	mg/l	0.15	0.25	1.40	0.86	1.63	**≤ 0.3**	**≤ 0.5**	SMEWW 4500-P&D (2012) (★)
17	As	mg/l	0.009	0.005	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	**≤ 0.05**	**≤ 0.1**	SMEWW 3120 B (2012) (★)
18	Cd	mg/l	KPH/ND	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 0.01**	**≤ 0.01**	SMEWW 3120 B (2012)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW1-LT 1510.0319	SW2-LT 1510.0321	SW3-LT 1510.0323	SW4-LT 1510.0325	SW5-LT 1510.0327	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	**Level B2**	
			(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)	(LOD = 0.003)			(★)
19	Pb	mg/l	KPH/ND (LOD = 0.005)	0007	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	0.011	**≤ 0.05**	**≤ 0.05**	SMEWW 3120 B (2012) (★)
20	Cr	mg/l	KPH/ND (LOD = 0.003)	0.009	KPH/ND (LOD = 0.003)	0.006	0.015	**-**	**-**	SMEWW 3120 B (2012) (★)
21	Cu	mg/l	KPH/ND (LOD = 0.005)	0.022	0.169	0.018	0.056	**≤ 0.5**	**≤ 1**	SMEWW 3120 B (2012) (★)
22	Zn	mg/l	KPH/ND (LOD = 0.005)	0.033	0.030	KPH/ND (LOD = 0.005)	0.081	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
23	Mn	mg/l	0.128	0.235	0.075	0.287	0.364	**-**	**-**	SMEWW 3120 B (2012) (★)
24	Fe	mg/l	2.79	4.97	0.677	2.54	7.39	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
25	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	0.005	**≤ 0.001**	**≤ 0.002**	SMEWW 3120 B (2012) (★)
26	Dầu. mỡ/ *Oil & grease*	mg/l	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	0.5	0.2	0.3	**≤ 0.1**	**≤ 0.3**	SMEWW 5520 (2012)
27	E. Coli	MPN/100ml	24×10^3	24×10^4	93×10^4	24×10^4	93×10^4	**≤ 100**	**≤ 200**	SMEWW 9221 F (2012)
28	Coliform	MPN/100ml	93×10^3	24×10^5	93×10^5	93×10^4	43×10^5	**≤ 7500**	**≤ 10000**	SMEWW 9221 D

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW1-LT 1510.0319**	**SW2-LT 1510.0321**	**SW3-LT 1510.0323**	**SW4-LT 1510.0325**	**SW5-LT 1510.0327**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
										(2012)

Ghi chú/Note:

Phương pháp lấy mẫu nước mặt/*Surface sampling*: TCVN 6663-6:2008 (ISO 5667-6:2005)/

(★) Phương pháp đo đạc/phân tích được VILAS công nhận/ *Measuring/analyzing method is accredited by VILAS.*

QCVN 08:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước mặt/ *National technical regulation on surface water quality*.

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

SW1-LT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-LT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels.*(0602849;1197393)

SW3-LT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0602742;1197488)

SW4-LT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0602361;1198764)

SW5-LT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0601002;199835)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0329-0331-0333-0381-0383

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Nước mặt – Triều kiệt

Type of sample : *Surface water – Low tide*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**SW6-LT 1510.0329**	**SW7-LT 1510.0331**	**SW8-LT 1510.0333**	**SW9-LT 1510.0383**	**SW10-LT 1510.0381**	**QCVN 08:2008/BTNMT**		**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
								Level B1	**Level B2**	
1	pH, at 25^{o}C	-	6.99	6.83	7.28	6.98	6.89	**5.5 – 9**	**5.5 – 9**	TCVN 6492:2011 (★) (ISO 10523:2008)
2	Độ cứng tổng/ Total hardness	mg$CaCO_3$/l	64	40	56	118	114	**-**	**-**	SMEWW 2340 C (2012)
3	Độ đục/ *Turbidity*	NTU	57.6	30.1	38.6	65.1	81.6	**-**	**-**	SMEWW 2130 B (2012) (★)
4	Độ màu/ *Color*	Pt-Co	115	82	145	31	28	**-**	**-**	SMEWW 2120 C (2012)
5	DO	mgO_2/l	0.07	0.04	0.08	0.32	0.08	**≥ 4**	**≥ 2**	SMEWW 4500-O.G (2012) (★)
6	TSS	mg/l	119	17	40	64	80	**≤ 50**	**≤ 100**	SMEWW 2540 D (2012) (★)
7	TDS	mg/l	435	270	455	420	455	**-**	**-**	SOP-HTN06

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW6-LT 1510.0329	SW7-LT 1510.0331	SW8-LT 1510.0333	SW9-LT 1510.0383	SW10-LT 1510.0381	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	**Level B2**	
8	COD	mgO_2/l	144	112	93	48	43	**≤ 30**	**≤ 50**	SMEWW 5220C (2012) (★)
9	BOD_5	mgO_2/l	93	76	60	15	13	**≤ 15**	**≤ 25**	SMEWW 5210 B (2012) (★)
10	$N\text{-}NH_4^+$	mg/l	19.0	15.7	12.3	5.9	5.6	**≤ 0.5**	**≤ 1**	SMEWW 4500-NH_4^+.C (2012) (★)
11	Cl^-	mg/l	87.9	53.3	113.3	123.0	174.7	**≤ 600**	-	SMEWW 4110 B (2012) (★)
12	F^-	mg/l	0.12	0.09	0.21	0.39	0.44	**≤ 1.5**	**≤ 2**	SMEWW 4110 B (2012) (★)
13	$N\text{-}NO_2^-$	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.04**	**≤ 0.05**	SMEWW 4110 B (2012) (★)
14	$N\text{-}NO_3^-$	mg/l	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	0.16	0.17	**≤ 10**	**≤ 15**	SMEWW 4500-NO_3^-.B (2012) (★)
15	SO_4^{2-}	mg/l	41.0	25.2	62.6	68.6	72.4	**-**	-	SMEWW 4110 B (2012) (★)
16	$P\text{-}PO_4^{3-}$	mg/l	1.62	1.08	1.61	0.25	0.17	**≤ 0.3**	**≤ 0.5**	SMEWW 4500-P&D (2012) (★)
17	As	mg/l	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	**≤ 0.05**	**≤ 0.1**	SMEWW 3120 B (2012) (★)
18	Cd	mg/l	KPH/ND (LOD =	KPH/ND (LOD =	KPH/ND (LOD =	KPH/ND (LOD =	KPH/ND (LOD =	**≤ 0.01**	**≤ 0.01**	SMEWW 3120 B (2012) (★)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	SW6-LT 1510.0329	SW7-LT 1510.0331	SW8-LT 1510.0333	SW9-LT 1510.0383	SW10-LT 1510.0381	QCVN 08:2008/BTNMT		Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
								Level B1	**Level B2**	
			0.003)	0.003)	0.003)	0.003)	0.003)			
19	Pb	mg/l	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	0.010	KPH/ND (LOD = 0.005)	0.006	**≤ 0.05**	**≤ 0.05**	SMEWW 3120 B (2012) (★)
20	Cr	mg/l	0.007	KPH/ND (LOD = 0.003)	0.019	0.015	0.011	-	-	SMEWW 3120 B (2012) (★)
21	Cu	mg/l	0.015	0.006	0.023	0.015	0.006	**≤ 0.5**	**≤ 1**	SMEWW 3120 B (2012) (★)
22	Zn	mg/l	0.037	KPH/ND (LOD = 0.005)	0.063	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
23	Mn	mg/l	0.197	0.086	0.394	0.485	0.559	-	-	SMEWW 3120 B (2012) (★)
24	Fe	mg/l	3.60	0.965	3.86	3.62	3.98	**≤ 1.5**	**≤ 2**	SMEWW 3120 B (2012) (★)
25	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	**≤ 0.001**	**≤ 0.002**	SMEWW 3120 B (2012)
26	Dầu. mỡ/ *Oil & grease*	mg/l	0.4	0.4	0.3	0.2	KPH/ND (LOD = 0.1)	**≤ 0.1**	**≤ 0.3**	SMEWW 5520 C (2012)
27	E. Coli	MPN/100ml	24×10^5	24×10^5	24×10^5	93×10^3	24×10^3	**≤ 100**	**≤ 200**	SMEWW 9221 F (2012)
28	Coliform	MPN/100ml	93×10^5	24×10^6	24×10^6	43×10^4	24×10^4	**≤ 7500**	**≤ 10000**	SMEWW 9221 D (2012)

Ghi chú/Note:

Phương pháp lấy mẫu nước mặt/ *Surface sampling*: TCVN 6663-6:2008 (ISO 5667- 6:2005

(★) Phương pháp đo đạc/phân tích được VILAS công nhận/ *Measuring/analyzing method is accredited by VILAS.*

QCVN 08:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước mặt/ *National technical regulation on surface water quality.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

SW6-LT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-LT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-LT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge. after the discharging point of Tan Binh Industrial Park.*(0595884;1196999)

SW9-LT: Vị trí tại cầu An Lạc, KCN An Lac / *Location at the Tham Luong bridge*, *Tan Tao Industrial Park.* (0593163;1186046)

SW10-LT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge.*(0593205;1184253)

LT: Triều kiệt/ *Low tide*

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KẾT QUẢ PHÂN TÍCH PHIÊU SINH ĐỘNG VẬT

ANALYZING RESULT OF AQUATIC PLANKTON

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0318-0320-0322-0324-0326

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ : 12-13/10/2015

Sampling date

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-HT	**SV2-HT**	**SV3-HT**	**SV4-HT**	**SV5-HT**
	PROTOZOA					
	Paramoecidae					
1	*Paramoecium putrinum Clap. & Lach.*					
	ROTATORIA					
	Philodinidae					
2	*Philodina roseola (Ehrenberg)*	100				
3	*Rotaria rotaria (Pallas)*		200			
	Notommatidae					
4	*Scaridium longicaudum (O.F. Muller)*		400			
	OLIGOCHAETA					
	Naididae					
5	*Pristina longiseta Ehrenberg*	200				
	CLADOCERA					
	Sididae					
6	*Diaphanosoma excisum Sars*					
7	*Diaphanosoma leuchtenbergianum Fischer*					
	Daphniidae					
8	*Ceriodaphnia rigaudi Richard*			200		
9	*Moina dubia de Guerne et Richard*			400		300

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-HT	**SV2-HT**	**SV3-HT**	**SV4-HT**	**SV5-HT**
	Chydoridae					
10	*Euryalona orientalis (Dalay)*				100	
	COPEPODA					
	Diaptomidae					
11	*Eodiaptomus draconisignivomi Brehm*					
	Cyclopidae					
12	*Mesocyclops leickarti (Claus)*					
13	*Thermocyclops hyalinus (Rehberg)*				200	
	OSTRACODA					
	Cypridae					
14	*Heterocypris anomala Klie*	200	100		100	
	INSECTA					
	Tomoceridae					
15	*Tomocerus sp.*					
	LARVA					
16	*Nauplius copepoda*					
	Số lượng (cá thể/m^3)	500	700	600	400	300

Ghi chú/Note:

SW1-HT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-HT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-HT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-HT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-HT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH ĐỘNG VẬT

ANALYZING RESULT OF AQUATIC PLANKTON

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0319-0321-0323-0325-0327

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV1-LT	**SV2-LT**	**SV3-LT**	**SV4-LT**	**SV5-LT**
	PROTOZOA					
	Paramoecidae					
1	*Paramoecium putrinum Clap. & Lach.*			200		
	ROTATORIA					
	Philodinidae					
2	*Philodina roseola (Ehrenberg)*	400	200		100	
3	*Rotaria rotaria (Pallas)*		200			
	Notommatidae					
4	*Scaridium longicaudum (O.F. Muller)*		100			
	OLIGOCHAETA					
	Naididae					
5	*Pristina longiseta Ehrenberg*			100		
	CLADOCERA					
	Sididae					
6	*Diaphanosoma excisum Sars*					
7	*Diaphanosoma leuchtenbergianum Fischer*					
	Daphniidae					
8	*Ceriodaphnia rigaudi Richard*			400		
9	*Moina dubia de Guerne et Richard*			400		500

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-LT	SV2-LT	SV3-LT	SV4-LT	SV5-LT
	Chydoridae					
10	*Euryalona orientalis (Dalay)*				200	
	COPEPODA					
	Diaptomidae					
11	*Eodiaptomus draconisignivomi Brehm*					
	Cyclopidae					
12	*Mesocyclops leickarti (Claus)*					
13	*Thermocyclops hyalinus (Rehberg)*	100			300	
	OSTRACODA					
	Cypridae					
14	*Heterocypris anomala Klie*	200	200			100
	INSECTA					
	Tomoceridae					
15	*Tomocerus sp.*					
	LARVA					
16	*Nauplius copepoda*	100				
	Số lượng (cá thể/m^3)	800	700	1.100	600	600

Ghi chú/Note:

SW1-LT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-LT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels.*(0602849;1197393)

SW3-LT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0602742;1197488)

SW4-LT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels.*(0602361;1198764)

SW5-LT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0601002;199835)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH ĐỘNG VẬT

ANALYZING RESULT OF AQUATIC PLANKTON

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0328-0330-0332-0380-0382

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV6-HT	**SV7-HT**	**SV8-HT**	**SV9-HT**	**SV10-HT**
	PROTOZOA					
	Paramoecidae					
1	*Paramoecium putrinum Clap. & Lach.*			600		
	ROTATORIA					
	Philodinidae					
2	*Philodina roseola (Ehrenberg)*					200
3	*Rotaria rotaria (Pallas)*					200
	Notommatidae					
4	*Scaridium longicaudum (O.F. Muller)*					
	OLIGOCHAETA					
	Naididae					
5	*Pristina longiseta Ehrenberg*					
	CLADOCERA					
	Sididae					
6	*Diaphanosoma excisum Sars*		500			
7	*Diaphanosoma leuchtenbergianum Fischer*		300			
	Daphniidae					
8	*Ceriodaphnia rigaudi Richard*		100			
9	*Moina dubia de Guerne et Richard*	200	200		300	600
	Chydoridae					
10	*Euryalona orientalis (Dalay)*					
	COPEPODA					

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV6-HT	**SV7-HT**	**SV8-HT**	**SV9-HT**	**SV10-HT**
	Diaptomidae					
11	*Eodiaptomus draconisignivomi Brehm*		100			
	Cyclopidae					
12	*Mesocyclops leickarti (Claus)*				100	100
13	*Thermocyclops hyalinus (Rehberg)*		2.800		200	1.200
	OSTRACODA					
	Cypridae					
14	*Heterocypris anomala Klie*	100				400
	INSECTA					
	Tomoceridae					
15	*Tomocerus sp.*	100				
	LARVA					
16	*Nauplius copepoda*		300		200	400
	Số lượng (cá thể/m^3)	400	4.300	600	800	3.100

Ghi chú/Note:

SW6-HT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-HT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-HT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park.*(0595884;1196999)

SW9-HT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge.*(0593163;1186046)

SW10-HT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge.*(0593205;1184253)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH ĐỘNG VẬT

ANALYZING RESULT OF AQUATIC PLANKTON

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0329-0331-0333-0381-0383

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ : 12-13/10/2015

Sampling date

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV6-LT	**SV7-LT**	**SV8-LT**	**SV9-LT**	**SV10-LT**
	PROTOZOA					
	Paramoecidae					
1	*Paramoecium putrinum Clap. & Lach.*			800		
	ROTATORIA					
	Philodinidae					
2	*Philodina roseola (Ehrenberg)*				200	200
3	*Rotaria rotaria (Pallas)*					
	Notommatidae					
4	*Scaridium longicaudum (O.F. Muller)*					
	OLIGOCHAETA					
	Naididae					
5	*Pristina longiseta Ehrenberg*					
	CLADOCERA					
	Sididae					
6	*Diaphanosoma excisum Sars*		400			
7	*Diaphanosoma leuchtenbergianum Fischer*		500			
	Daphniidae					
8	*Ceriodaphnia rigaudi Richard*	100				
9	*Moina dubia de Guerne et Richard*	300			700	100
	Chydoridae					
10	*Euryalona orientalis (Dalay)*					
	COPEPODA					
	Diaptomidae					

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV6-LT	SV7-LT	SV8-LT	SV9-LT	SV10-LT
11	*Eodiaptomus draconisignivomi Brehm*					
	Cyclopidae					
12	*Mesocyclops leickarti (Claus)*		200		300	100
13	*Thermocyclops hyalinus (Rehberg)*		1.000	500	800	900
	OSTRACODA					
	Cypridae					
14	*Heterocypris anomala Klie*	200				100
	INSECTA					
	Tomoceridae					
15	*Tomocerus sp.*	100				
	LARVA					
16	*Nauplius copepoda*				100	
	Số lượng (cá thể/m^3)	700	2.100	1.300	2.100	1.400

Ghi chú/Note:

SW6-LT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-LT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-LT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge. after the discharging point of Tan Binh Industrial Park.*(0595884;1196999)

SW9-LT: Vị trí tại cầu An Lạc, KCN An Lac / *Location at the Tham Luong bridge, Tan Tao Industrial Park.* (0593163;1186046)

SW10-LT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge.*(0593205;1184253)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH ĐỘNG VẬT ĐÁY

ANALYZING RESULT OF BENTHOS

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0318-0320-0322-0324-0326

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV1-HT	**SV2-HT**	**SV3-HT**	**SV4-HT**	**SV5-HT**
	PHYLUM ANNELIDA					
	CLASS OLIGOCHAETA					
	Order **TUBIFICA**					
	Family Tubificidae					
1	*Limnodrilus hoffmeisteri Claparede*	560	0	0	100	0
2	*Branchiura sowerby Beddard*	60	20	0	20	0
3	*Aulodrilus pluriseta (Piguet)*	40	40	0	0	0
	Số lượng (cá thể/m^2)	660	60	0	120	0

Ghi chú/Note:

SW1-HT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-HT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-HT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-HT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-HT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH ĐỘNG VẬT ĐÁY

ANALYZING RESULT OF BENTHOS

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0319-0321-0323-0325-0327

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV1-LT	**SV2-LT**	**SV3-LT**	**SV4-LT**	**SV5-LT**
	PHYLUM ANNELIDA					
	CLASS OLIGOCHAETA					
	Order **TUBIFICA**					
	Family Tubificidae					
1	*Limnodrilus hoffmeisteri Claparede*	300	40	0	60	0
2	*Branchiura sowerby Beddard*	40	0	0	0	0
3	*Aulodrilus pluriseta (Piguet)*	40	0	0	0	40
	Số lượng (cá thể/m^2)	380	40	0	60	40

Ghi chú/Note:

SW1-LT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-LT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-LT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-LT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-LT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH ĐỘNG VẬT ĐÁY

ANALYZING RESULT OF BENTHOS

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0328-0330-0332-0380-0382

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV6-HT	**SV7-HT**	**SV8-HT**	**SV9-HT**	**SV10-HT**
	PHYLUM ANNELIDA					
	CLASS OLIGOCHAETA					
	Order **TUBIFICA**					
	Family Tubificidae					
1	*Limnodrilus hoffmeisteri Claparede*	0	0	0	0	0
2	*Branchiura sowerby Beddard*	0	0	0	0	40
3	*Aulodrilus pluriseta (Piguet)*	0	0	0	0	20
	Số lượng (cá thể/m^2)	0	0	0	0	60

Ghi chú/Note:

SW6-HT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-HT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-HT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park*.(0595884;1196999)

SW9-HT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge*.(0593163;1186046)

SW10-HT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge*.(0593205;1184253)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH ĐỘNG VẬT ĐÁY

ANALYZING RESULT OF BENTHOS

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0329-0331-0333-0381-0383

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV6-LT	**SV7-LT**	**SV8-LT**	**SV9-LT**	**SV10-LT**
	PHYLUM ANNELIDA					
	CLASS OLIGOCHAETA					
	Order **TUBIFICA**					
	Family Tubificidae					
1	*Limnodrilus hoffmeisteri Claparede*	0	0	0	0	40
2	*Branchiura sowerby Beddard*	0	0	0	0	20
3	*Aulodrilus pluriseta (Piguet)*	0	0	0	0	100
	Số lượng (cá thể/m^2)	0	0	0	0	160

Ghi chú/Note:

SW6-LT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-LT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-LT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park*.(0595884;1196999)

SW9-LT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge*.(0593163;1186046)

SW10-LT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge*.(0593205;1184253)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH THỰC VẬT

ANALYZING RESULT OF PHYTOPLANKTON

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0318-0320-0322-0324-0326

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-HT	**SV2-HT**	**SV3-HT**	**SV4-HT**	**SV5-HT**
	Lớp Cyanophyceae					
1	*Oscillatoria* sp.1	50.000	560.000	1.130.000	820.000	2.920.000
2	*Oscillatoria* sp.2	0	0	490.000	430.000	1.630.000
	Lớp Bacillariophyceae (bộ Centrales)	0	0	0	0	0
3	*Coscinodiscus radiatus*	150.000	90.000	0	0	40.000
4	*Coscinodiscus* sp.1	0	35.000	0	0	0
5	*Coscinodiscus* sp.2	0	15.000	0	0	0
6	*Cyclotella meneghiniana*	400.000	630.000	30.000	1.240.000	330.000
7	*Melosira grannulata*	14.060.000	2.710.000	1.800.000	4.530.000	5.750.000
	Lớp Bacillariophyceae (bộ Pennales)	0	0	0	0	0
8	*Cymbella* sp.	0	0	0	0	0
9	*Eunotia major*	0	90.000	0	40.000	0
10	*Gyrosigma balticum*	0	0	0	0	0
11	*Navicula pusilla*	0	140.000	0	40.000	0
12	*Nitzschia sigma*	0	40.000	0	0	30.000
13	*Nitzschia vitrea*	0	0	0	0	0
14	*Pleurosigma sinensis*	0	0	0	0	0
	Lớp Chlorophyceae	0	0	0	0	0
15	*Actinastrum hantzschii*	940.000	80.000	0	0	0
16	*Ankistrodesmus gracilis*	0	0	0	0	0
17	*Ankistrodesmus spiralis*	0	0	0	0	0
18	*Crucigenia lauterbonei*	410.000	20.000	0	0	0
19	*Pandorina morum*	0	0	0	0	0
20	*Pediastrum duplex*	120.000	160.000	10.000	130.000	0

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-HT	**SV2-HT**	**SV3-HT**	**SV4-HT**	**SV5-HT**
21	*Pediastrum tetras*	0	50.000	20.000	0	70.000
22	*Scenedesmus accuminatus*	2.280.000	170.000	0	440.000	310.000
23	*Scenedesmus quadricauda*	190.000	180.000	0	160.000	120.000
	Lớp Euglenophyceae	0	0	0	0	0
24	*Euglena acus*	0	30.000	50.000	40.000	0
25	*Euglena oxyuris*	0	40.000	20.000	0	0
26	*Lepocinclis fusiformis*	0	0	0	0	0
27	*Lepocinclis ovum*	0	0	0	0	0
28	*Phacus curvicauda*	0	0	0	0	0
29	*Phacus longicauda*	0	0	0	30.000	40.000
30	*Phacus pleuronectes*	80.000	110.000	0	0	0
31	*Phacus tortus*	0	0	0	20.000	0
	Số lượng (cá thể/m^3)	18.680.000	5.150.000	3.550.000	7.920.000	11.240.000

Ghi chú/Note:

SW1-HT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-HT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-HT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-HT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-HT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH THỰC VẬT

ANALYZING RESULT OF PHYTOPLANKTON

Số phiếu/ *No*: BN1041015 – MS/*Code* 1510.0319-0321-0323-0325-0327

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ : 12-13/10/2015

Sampling date

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV1-LT	**SV2-LT**	**SV3-LT**	**SV4-LT**	**SV5-LT**
	Lớp Cyanophyceae					
1	*Oscillatoria* sp.1	110.000	0	1.840.000	270.000	1.920.000
2	*Oscillatoria* sp.2	0	0	620.000	125.000	985.000
	Lớp Bacillariophyceae (bộ Centrales)	0	0	0	0	0
3	*Coscinodiscus radiatus*	130.000	0	0	0	0
4	*Coscinodiscus* sp.1	0	0	0	0	0
5	*Coscinodiscus* sp.2	0	180.000	0	0	0
6	*Cyclotella meneghiniana*	380.000	400.000	0	725.000	1.425.000
7	*Melosira grannulata*	2.400.000	2.100.000	1.175.000	1.770.000	2.985.000
	Lớp Bacillariophyceae (bộ Pennales)	0	0	0	0	0
8	*Cymbella* sp.	40.000	10.000	0	25.000	0
9	*Eunotia major*	30.000	100.000	0	0	0
10	*Gyrosigma balticum*	0	0	0	0	0
11	*Navicula pusilla*	80.000	0	0	45.000	50.000
12	*Nitzschia sigma*	0	125.000	0	0	0
13	*Nitzschia vitrea*	20.000	0	0	0	0
14	*Pleurosigma sinensis*	0	0	0	0	0
	Lớp Chlorophyceae	0	0	0	0	0
15	*Actinastrum hantzschii*	50.000	225.000	0	0	0
16	*Ankistrodesmus gracilis*	0	0	0	0	0
17	*Ankistrodesmus spiralis*	0	0	0	0	0
18	*Crucigenia lauterbonei*	0	0	0	0	0
19	*Pandorina morum*	0	0	0	0	0
20	*Pediastrum duplex*	20.000	120.000	0	60.000	0

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV1-LT	**SV2-LT**	**SV3-LT**	**SV4-LT**	**SV5-LT**
21	*Pediastrum tetras*	0	125.000	0	20.000	0
22	*Scenedesmus accuminatus*	80.000	740.000	0	140.000	795.000
23	*Scenedesmus quadricauda*	0	105.000	0	295.000	240.000
	Lớp Euglenophyceae	0	0	0	0	0
24	*Euglena acus*	20.000	10.000	75.000	40.000	0
25	*Euglena oxyuris*	0	0	125.000	0	0
26	*Lepocinclis fusiformis*	0	0	0	0	0
27	*Lepocinclis ovum*	0	0	0	0	0
28	*Phacus curvicauda*	0	0	0	0	0
29	*Phacus longicauda*	20.000	25.000	0	0	60.000
30	*Phacus pleuronectes*	0	75.000	0	0	0
31	*Phacus tortus*	0	0	0	50.000	0
	Số lượng (cá thể/m^3)	3.380.000	4.340.000	3.835.000	3.565.000	8.460.000

Ghi chú/Note:

SW1-LT: Vị trí cách sông Sài Gòn 200m về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat canal.*(0603441;1197897)

SW2-LT: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602849;1197393)

SW3-LT: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602742;1197488)

SW4-LT: Vị trí tại điểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0602361;1198764)

SW5-LT: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0601002;1199835)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH THỰC VẬT

ANALYZING RESULT OF PHYTOPLANKTON

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0328-0330-0332-0380-0382

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ : 12-13/10/2015

Sampling date

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV6-HT	**SV7-HT**	**SV8-HT**	**SV9-HT**	**SV10-HT**
	Lớp Cyanophyceae					
1	*Oscillatoria* sp.1	2.380.000	60.000	3.980.000	630.000	270.000
2	*Oscillatoria* sp.2	0	0	400.000	520.000	0
	Lớp Bacillariophyceae (bộ Centrales)	0	0	0	0	0
3	*Coscinodiscus radiatus*	0	0	0	0	0
4	*Coscinodiscus* sp.1	0	0	0	0	0
5	*Coscinodiscus* sp.2	0	0	0	0	0
6	*Cyclotella meneghiniana*	280.000	0	50.000	0	2.160.000
7	*Melosira grannulata*	710.000	1.730.000	1.380.000	2.920.000	8.100.000
	Lớp Bacillariophyceae (bộ Pennales)	0	0	0	0	0
8	*Cymbella* sp.	0	0	0	0	0
9	*Eunotia major*	0	0	0	0	0
10	*Gyrosigma balticum*	0	0	0	320.000	0
11	*Navicula pusilla*	30.000	40.000	0	220.000	270.000
12	*Nitzschia sigma*	0	0	0	0	60.000
13	*Nitzschia vitrea*	0	0	0	0	0
14	*Pleurosigma sinensis*	30.000	0	0	280.000	0
	Lớp Chlorophyceae	0	0	0	0	0
15	*Actinastrum hantzschii*	30.000	0	0	840.000	4.230.000
16	*Ankistrodesmus gracilis*	0	1.390.000	0	0	0
17	*Ankistrodesmus spiralis*	0	2.810.000	130.000	0	0
18	*Crucigenia lauterbonei*	0	0	0	0	0
19	*Pandorina morum*	0	0	0	460.000	0
20	*Pediastrum duplex*	0	120.000	30.000	380.000	540.000

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV6-HT	**SV7-HT**	**SV8-HT**	**SV9-HT**	**SV10-HT**
21	*Pediastrum tetras*	310.000	3.480.000	190.000	60.000	0
22	*Scenedesmus accuminatus*	90.000	70.000	20.000	1.120.000	5.850.000
23	*Scenedesmus quadricauda*	220.000	540.000	70.000	540.000	990.000
	Lớp Euglenophyceae	0	0	0	0	0
24	*Euglena acus*	0	0	60.000	360.000	630.000
25	*Euglena oxyuris*	0	0	0	40.000	80.000
26	*Lepocinclis fusiformis*	0	0	0	0	450.000
27	*Lepocinclis ovum*	0	0	0	0	180.000
28	*Phacus curvicauda*	0	0	0	360.000	540.000
29	*Phacus longicauda*	0	40.000	0	140.000	540.000
30	*Phacus pleuronectes*	60.000	0	0	340.000	90.000
31	*Phacus tortus*	0	0	0	80.000	270.000
	Số lượng (cá thể/m^3)	4.140.000	10.280.000	6.310.000	9.610.000	25.250.000

Ghi chú/Note:

SW6-HT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-HT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-HT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park*.(0595884;1196999)

SW9-HT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge*.(0593163;1186046)

SW10-HT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge*.(0593205;1184253)

HT: Triều cường/ *High tide*

KẾT QUẢ PHÂN TÍCH PHIÊU SINH THỰC VẬT

ANALYZING RESULT OF PHYTOPLANKTON

Số phiếu/ *No*: BN1041015-1151015 – MS/*Code* 1510.0329-0331-0333-0381-0383

Dự án : GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM

Project

Ngày lấy mẫu/ : 12-13/10/2015

Sampling date

Stt No	**Tên khoa học Science name**	**Vị trí lấy mẫu Location**				
		SV6-LT	**SV7-LT**	**SV8-LT**	**SV9-LT**	**SV10-LT**
	Lớp Cyanophyceae					
1	*Oscillatoria* sp.1	1.290.000	900.000	6.270.000	140.000	180.000
2	*Oscillatoria* sp.2	610.000	0	290.000	0	0
	Lớp Bacillariophyceae (bộ Centrales)	0	0	0	0	0
3	*Coscinodiscus radiatus*	0	0	0	0	0
4	*Coscinodiscus* sp.1	0	0	0	0	0
5	*Coscinodiscus* sp.2	0	0	0	0	0
6	*Cyclotella meneghiniana*	1.900.000	750.000	0	775.000	740.000
7	*Melosira grannulata*	4.705.000	1.420.000	240.000	2.820.000	800.000
	Lớp Bacillariophyceae (bộ Pennales)	0	0	0	0	0
8	*Cymbella* sp.	0	0	0	0	0
9	*Eunotia major*	0	0	0	0	0
10	*Gyrosigma balticum*	0	0	0	0	0
11	*Navicula pusilla*	0	0	0	290.000	40.000
12	*Nitzschia sigma*	0	0	0	90.000	0
13	*Nitzschia vitrea*	0	0	0	0	0
14	*Pleurosigma sinensis*	0	0	0	0	0
	Lớp Chlorophyceae	0	0	0	0	0
15	*Actinastrum hantzschii*	0	0	0	3.240.000	1.020.000
16	*Ankistrodesmus gracilis*	0	1.770.000	620.000	0	0
17	*Ankistrodesmus spiralis*	0	1.425.000	0	0	0
18	*Crucigenia lauterbonei*	0	0	0	0	0
19	*Pandorina morum*	0	0	0	0	130.000

Stt No	Tên khoa học Science name	Vị trí lấy mẫu Location				
		SV6-LT	**SV7-LT**	**SV8-LT**	**SV9-LT**	**SV10-LT**
20	*Pediastrum duplex*	0	0	75.000	290.000	40.000
21	*Pediastrum tetras*	0	4.915.000	240.000	0	0
22	*Scenedesmus accuminatus*	0	70.000	700.000	1.835.000	780.000
23	*Scenedesmus quadricauda*	125.000	295.000	125.000	125.000	90.000
	Lớp Euglenophyceae	0	0	0	0	0
24	*Euglena acus*	70.000	0	25.000	470.000	170.000
25	*Euglena oxyuris*	60.000	0	90.000	110.000	110.000
26	*Lepocinclis fusiformis*	0	0	0	290.000	0
27	*Lepocinclis ovum*	0	0	0	60.000	160.000
28	*Phacus curvicauda*	0	0	0	0	20.000
29	*Phacus longicauda*	0	0	0	180.000	60.000
30	*Phacus pleuronectes*	0	0	0	1.400.000	0
31	*Phacus tortus*	0	0	0	110.000	0
	Số lượng (cá thể/m^3)	**8.760.000**	**11.545.000**	**8.675.000**	**12.225.000**	**4.340.000**

Ghi chú/Note:

SW6-LT: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels* (0598939;1200474)

SW7-LT: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

SW8-LT: Vị trí tại cầu Tham Lương. sau điểm xả nước thải của KCN Tân Bình/ *Location at the Tham Luong bridge, after the discharging point of Tan Binh Industrial Park.*(0595884;1196999)

SW9-LT: Vị trí tại cầu An Lạc / *Location at the An Lac bridge.*(0593163;1186046)

SW10-LT: Vị trí cách sông Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge*.(0593205;1184253)

LT: Triều kiệt/ *Low tide*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015-1151015 – MS/*Code*1510.0299-0301.0377

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Nước ngầm

Type of sample *Groundwater*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**GW1 1510.0299**	**GW2 1510.0300**	**GW3 1510.0301**	**GW4 1510.0377**	**QCVN 09:2008/ BTNMT**	**Phương pháp đo đạc/phân tích** *Measuring/Analyzing method*
1	pH, at 25^{o}C	-	4.41	4.18	4.25	3.65	**5.5 – 8.5**	TCVN 6492:2011 (★) ISO 10523:2008
2	Độ đục/ *Turbidity*	NTU	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	31.9	**-**	SMEWW 2130 B (2012) (★)
3	Cl^-	mg/l	81.1	101.9	56.7	93.0	**≤ 250**	SMEWW 4110 B (2012) (★)
4	TDS	mg/l	269	254	179	668	**-**	SOP-HTN06
5	TS	mg/l	269	254	179	673	**≤ 1500**	SMEWW 2540 B (2012)
6	COD ($KMnO_4$)	mgO_2/l	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	0.8	**≤ 4**	TCVN 6186 :1996 ISO 8467:1993 (E)
7	BOD_5	mgO_2/l	KPH/ND (LOD = 2)	KPH/ND (LOD = 2)	KPH/ND (LOD = 2)	KPH/ND (LOD = 2)	**-**	SMEWW 5210 B (2012) (✯)
8	$N\text{-}NH_4^+$	mg/l	9.3	0.14	1.87	0.14	**≤ 0.1**	TCVN SMEWW 4500-NH_4^+.F (2012) (★)

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**GW1 1510.0299**	**GW2 1510.0300**	**GW3 1510.0301**	**GW4 1510.0377**	**QCVN 09:2008/ BTNMT**	**Phương pháp đo đạc/phân tích** *Measuring/Analyzing method*
9	$N\text{-}NO_2^-$	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 1.0**	SMEWW 4110 B (2012) (★)
10	$N\text{-}NO_3^-$	mg/l	10.5	0.78	9.09	0.17	**≤ 15**	SMEWW 4110 B (2012) (★)
11	$P\text{-}PO_4^{3-}$	mg/l	KPH/ND (LOD = 0.01)	KPH/ND (LOD = 0.01)	KPH/ND (LOD = 0.01)	KPH/ND (LOD = 0.01)	**-**	SMEWW 4500-P.D (2012) (★)
12	As	mg/l	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	**≤ 0.05**	SMEWW 3120 B (2012) (★)
13	Cd	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.005**	SMEWW 3120 B (2012) (★)
14	Pb	mg/l	KPH/ND (LOD = 0.005)	0.006	KPH/ND (LOD = 0.005)	0.010	**≤ 0.01**	SMEWW 3120 B (2012) (★)
15	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	**≤ 0.001**	SMEWW 3120 B (2012)
16	Cr	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**-**	SMEWW 3120 B (2012) (★)
17	Fe	mg/l	0.017	0.023	0.008	17.64	**≤ 5**	SMEWW 3120 B (2012) (★)
18	Dầu mỡ/ *Oil & grease*	mg/l	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	**-**	SMEWW 5520 C (2012)
19	E.Coli	MPN/100ml	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**Không phát hiện thấy/ Not detected**	SMEWW 9221 F (2012)
20	Coliform	MPN/100ml	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 3**	SMEWW 9221 D (2012)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	GW1 1510.0299	GW2 1510.0300	GW3 1510.0301	GW4 1510.0377	QCVN 09:2008/ BTNMT	Phương pháp đo đạc/phân tích *Measuring/Analyzing method*

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method is accredited by VILAS.*

Phương pháp lấy mẫu nước ngầm*/ Groudwater samling: TCVN 6663-11:2011 (ISO 5667-11:1992).*

QCVN09:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước ngầm*/ National technical regulation underground water quality.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

GW1: Đoạn từ sông Sài Gòn đến cầu An Lộc, tại khu vực rạch Chín Xiểng (giếng tại sân bóng đá Thái Sơn – 566/45 Nguyễn Thái Sơn - khoan năm 2012. sâu 35m)/ *The distance from Sai Gon river to An Loc bridge, at Chin Xieng canal area (well at Thai Son football ground – 566/45 Nguyen Thai Son Street – drilled in 2012, 35m depth*).(0602939;1197249)

GW2: Đoạn từ cầu An Lộc đến cầu Trường Đại, tại khu vực rạch Cầu Cụt (giếng tại nhà ông cụ tại rạch Cầu Cụt – 1396/76 Lê Đức Thọ, phường 13, quận Gò Vấp - khoan năm 1997. sâu 30m)/ *The distance from An Loc bridge to Truong Dai bridge, at Cau Cut cannal area. (well at household at Cau Cut cannal – 1396/76 Le Duc Tho, Ward 13, Go Vap district - drilled in 1997, 30m depth)* (0589803;1200432)

GW3: Đoạn từ cầu Trường Đại đến cầu Chợ Cầu.,tại khu vực cầu Trường Đai (giếng tại Công ty Nam Bang.khoan năm 2005. sâu 100m)/ *The distance from Truong Dai bridge to Cho Cau bridge, at Truong Dai bridge area (well at Nam Bang company, drilled in 2005,100m depth)* (0598243;1200684).

GW4: Đo3;1từ cầu Chợ Đệm đến cầu Tham Lương, tại kênh Hy Vọng (giếng tại xưởng mộc, khoan năm 2012, sâu 30m)/*The distance from Cho Dem bridge to Tham Luong bridge, at Hy Vong canal (well at woodshop, drilled in 2012. 30m depth*)(0596049;1197162)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1151015 – MS/*Code*1510.0372-0376

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Nước ngầm

Type of sample : *Groundwater*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**GW5 1510.0376**	**GW6 1510.0375**	**GW7 1510.0374**	**GW8 1510.0373**	**GW9 1510.0372**	**QCVN 09:2008/ BTNMT**	**Phương pháp đo đạc/phân tích** ***Measuring/Analyzing method***
1	pH	-	4.59	5.20	6.04	5.84	6.17	**5.5 – 8.5**	TCVN 6492:2011 (★) ISO 10523:2008
2	Độ đục/ *Turbidity*	NTU	KPH/ND (LOD = 0.5)	2.34	KPH/ND (LOD = 0.5)	28.3	58.7	**-**	SMEWW 2130 B (2012) (★)
3	Cl^-	mg/l	170.0	18.0	143.0	19	41.0	**≤ 250**	SMEWW 4110 B (2012) (★)
4	TDS	mg/l	316	48.9	249	78.5	138.8	**-**	SOP-HTN06
5	TS	mg/l	316	48.9	249	83	149	**≤ 1500**	SMEWW 2540 B (2012)
6	COD ($KMnO_4$)	mgO_2/l	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 4**	TCVN 6186 :1996 ISO 8467:1993 (E)
7	BOD_5	mgO_2/l	KPH/ND (LOD =2)	KPH/ND (LOD =2)	KPH/ND (LOD =2)	KPH/ND (LOD =2)	KPH/ND (LOD =2)	**-**	SMEWW 5210 B (2012) (✯)
8	N-NH_4^+	mg/l	0.04	0.06	0.05	0.17	0.12	**≤ 0.1**	TCVN SMEWW 4500-NH_4^+.F (2012) (★)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	GW5 1510.0376	GW6 1510.0375	GW7 1510.0374	GW8 1510.0373	GW9 1510.0372	QCVN 09:2008/ BTNMT	Phương pháp đo đạc/phân tích *Measuring/Analyzing method*
9	$N\text{-}NO_2^-$	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 1.0**	SMEWW 4110 B (2012) (★)
10	$N\text{-}NO_3^-$	mg/l	4.70	0.19	0.17	KPH/ND (LOD = 0.015)	KPH/ND (LOD = 0.015)	**≤ 15**	SMEWW 4110 B (2012) (★)
11	$P\text{-}PO_4^{3-}$	mg/l	KPH /ND (LOD = 0.01)	KPH /ND (LOD = 0.01)	KPH /ND (LOD = 0.01)	KPH /ND (LOD = 0.01)	KPH /ND (LOD = 0.01)	**-**	SMEWW 4500-P.D (2012) (★)
12	As	mg/l	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	KPH/ND (LOD = 0.004)	0.005	KPH/ND (LOD = 0.004)	**≤ 0.05**	SMEWW 3120 B (2012) (★)
13	Cd	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**≤ 0.005**	SMEWW 3120 B (2012) (★)
14	Pb	mg/l	0.007	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	KPH/ND (LOD = 0.005)	**≤ 0.01**	SMEWW 3120 B (2012) (★)
15	Hg	mg/l	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	KPH/ND (LOD = 0.001)	**≤ 0.001**	SMEWW 3120 B (2012)
16	Cr	mg/l	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	KPH/ND (LOD = 0.003)	**-**	SMEWW 3120 B (2012) (★)
17	Fe	mg/l	0.036	0.091	0.005	5.25	6.76	**≤ 5**	SMEWW 3120 B (2012) (★)
18	Dầu mỡ/ *Oil & grease*	mg/l	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	KPH/ND (LOD = 0.1)	**-**	SMEWW 5520 C (2012)
19	E.Coli	MPN/100ml	KPH/ND	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**Không phát hiện thấy/ Not detected**	SMEWW 9221 F (2012)
20	Coliform	MPN/100ml	KPH/ND	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 3**	SMEWW 9221 D (2012)

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận/*Measuring/analyzing method is accredited by VILAS.*

Phương pháp lấy mẫu nước ngầm*/ Groudwater samling: TCVN 6663-11:2011 (ISO 5667-11:1992).*

QCVN09:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng nước ngầm/ *National technical regulation underground water quality*.

KPH: Không phát hiện, LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection

GW5: Đoạn từ cầu Tham Lương đến cống Cầu Bưng, tại cầu Tham Lương (quán nước mía cạnh cầu Tham Lương, khoan năm 2000, sâu 20m)/ *The distance from Tham Luong to Cau Bung bridge, at Tham Luong bridge (store near Tham Luong bridge, drilled in 2000, 20m depth)* (0595775;1196964).

GW6: Đoạn từ cống Cầu Bưng đến cầu Bình Thuận, tại cầu Bình Thuận (hộ dân Nguyễn Thị Viết – 839/5 QL1A, khu phố 1, phường Bình Hưng Hòa, Bình Tân - khoan khoảng từ 2000-2003, sâu 80m)/ *The distance from Cau Bung bridge to Binh Thuan bridge, at Binh Thuan bridge (well at Nguyen Thi Viet household – 839/5, National Highway No.1A, Town 1, Binh Hung Hoa ward, Binh Tan District - drilled between in 2000-2003, 80m depth)* (0592222;1192541).

GW7: Đoạn từ cầu Bình Thuận đến cầu Bà Hom, tại cầu Bà Hom (Chị Thuận – 35 đường Bờ Sông, khu phố 2, phường Tân Tạo A, Quận Bình Tân - khoan đã hơn 10 năm, sâu 120m)/ *The distance from Binh Thuan bridge to Ba Hom bridge, at ba Hom bridge (well at Ms.Thuan household – 35 Bo Song street, Town 2, Tan Tao A ward, Binh Tan District - drilled more than 10 years, 120m depth)* (0591433;1189178).

GW8: Đoạn từ cầu An Lạc đến cầu An Lập (tại số nhà 1233 QL1, phường An Lạc, Q. Bình Tân- khoan năm 2011, sâu 140m)/ *The distance from An Lac bridge to An Lap bridge (well at household No.1233, National Highway No.1, An Lac ward, Binh Tan District – drilled in 2011, 140m depth)* (0592998;1186074).

GW9: Đoạn từ cầu Nuoc Len đến sông Chợ Đệm (tại hộ dân Lê Tấn Bê, khoan tháng 08/2015, sâu 150m)/ *The distance from Nuoc Len bridge to Cho Dem river (well at Le Tan Be household, drilled in 08/2015, 150m depth)* (0593359;1185030)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015-1151015 – MS/*Code* 1510.0293-0294.0378-0379

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Đất

Type of sample : *Soil*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**S1 1510.0379**	**S2 1510.0378**	**S3 1510.293**	**S4 1510.0294**	**QCVN 03:2008/ BTNMT**		**Phương pháp đo đạc/phân tích** *Measuring/Analyzing method*
							Residental land	**Commercial land**	
1	pH	-	3.08	3.47	5.86	3.93	**-**	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	As	mg/kgDW	2.37	4.12	1.66	3.00	**≤ 12**	**≤ 12**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	0.51	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 5**	**≤ 5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Cu	mg/kgDW	28.8	91.7	48.5	22.8	**≤ 70**	**≤ 100**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	21.0	59.8	16.4	16.3	**≤ 120**	**≤ 200**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Zn	mg/kgDW	59.4	189	119	28.9	**≤ 200**	**≤ 300**	TCVN 6649:2000,

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	S1 1510.0379	S2 1510.0378	S3 1510.293	S4 1510.0294	QCVN 03:2008/ BTNMT		Phương pháp đo đạc/phân tích *Measuring/Analyzing method*
							Residental land	**Commercial land**	
									SMEWW 3120 B (2012) (★)
7	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	-	-	TCVN 6649:2000, SMEWW 3120 B (2012) (★)

Ghi chú/ Note:

(★) Phương pháp đo đạc/phân tích được VILAS công nhận/*Measuring/analyzing method is accredited by VILAS.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích.

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 03:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về giới hạn cho phép của kim loại nặng trong đất./*National technical regulation on the allowable limits of heavy metals in the soils.*

S1: Đoạn từ cầu Tham Lương đến cầu Chợ Cầu, từ bờ kênh Tham Lương cách kênh Hy Vọng 500m về phía Tham Lương (đất đắp khoảng từ năm 2013*)/ The distance from Tham Luong bridge to Cho Cau bridge, at the Tham Luong canal that distance from the Hy Vong cannal 500m(Soil was covered from 2013)* (0596032;1197167)

S2: Đoạn từ cầu Tham Lương đến cầu Chợ Cầu, kênh Hy Vong (đất đắp khoảng từ năm 2012-2013)/ *The distance from Tham Luong bridge to Cho Cau bridge, the Hy Vong cannal* (0596141;1197414)

S3: Đoạn từ cầu Chợ Cầu đến cầu Trường Đai, tại khu vực cầu Chợ Cầu (đất đang đắp - tháng 10/2015)/ *The distance from Cho Cau bridge to Truong Dai bridge, at Cho Cau bridge*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015 – MS/*Code*1510.0293-0298

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12/10/2015

Ký hiệu mẫu : Đất

Type of sample : *Soil*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**S5 1510.0295**	**S6 1510.0296**	**S7 1510.0297**	**S8 1510.0298**	**QCVN 03:2008/ BTNMT**		**Phương pháp đo đạc/phân tích** *Measuring/Analyzing method*
							Residental land	**Commercial land**	
1	pH	-	3.20	2.55	2.99	2.86	**-**	**-**	TCVN 5979 : 2007 (ISO 10390 : 2005)
2	As	mg/kgDW	3.34	4.00	6.7	8.19	**≤ 12**	**≤ 12**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 5**	**≤ 5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Cu	mg/kgDW	27.7	22.8	85.5	26.3	**≤ 70**	**≤ 100**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	22.5	20.0	27.0	24.3	**≤ 120**	**≤ 200**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Zn	mg/kgDW	71.8	48.1	46.3	46.2	**≤ 200**	**≤ 300**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	S5 1510.0295	S6 1510.0296	S7 1510.0297	S8 1510.0298	QCVN 03:2008/ BTNMT		Phương pháp đo đạc/phân tích *Measuring/Analyzing method*
							Residental land	Commercial land	
7	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	-	-	TCVN 6649:2000, SMEWW 3120 B (2012) (★)

Ghi chú/Note:

(★) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method is accredited by VILAS.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp.

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 03:2008/BTNMT: Quy chuẩn kỹ thuật quốc gia về giới hạn cho phép của kim loại nặng trong đất.*/National technical regulation on the allowable limits of heavy metals*

S5: Đoạn từ cầu Trường Đai đến cầu An Lộc, tại khu vực rạch Cầu Cụt (đất đắp được khoảng từ năm 2013)*/ The distance from Truong Dai to An Loc bridge, at Cau Cut canal area (Soil was covered from 2013)* (0589816;1200448)

S6: Đoạn từ cầu Trường Đai đến cầu An Lộc, tại khu vực rạch Bà Miên (đất đắp từ 09/2015)*/ The distance from Truong Dai to An Loc bridge. at Ba Mien canal area (Soil was covered from 09/2015)* (0591895;1199754)

S7: Đoạn từ cầu An Lộc đến sông Sài Gòn, tại khu vực rạch Ông Tổng (đất đắp khoảng từ năm 2012-2013)*/ The distance from An Loc bridge to Sai Gon river, at Ong Tong canal*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015 – MS/*Code* 1510.0303-0305-0307-0309

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu Bùn đáy – Tầng sâu (0,5m)

Type of sample : *Sediment – Depth layer (0.5m)*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**Sed1 1510.0303**	**Sed2 1510.0305**	**Sed3 1510.0307**	**Sed4 1510.0309**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
1	As	mg/kgDW	4.84	5.25	3.48	4.75	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	87.3	68.6	72.8	62.5	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	40.2	62.7	32.5	25.4	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	46364	42583	25578	26302	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 8272
	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	

	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	Ref. EPA 8272
	Naphthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 391**	
	Phenanthren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 515**	
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	
8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01

9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	-	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor epoxide	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 2.7**	
	a-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	

	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine keton	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận/*Measuring/analyzing method is accredited by VILAS*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality*

Sed1: Vị trí cách sông Sài Gòn 200 về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat kennel*.(0603441;1197897).

Sed2: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602849;1197393)

Sed3: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602742;1197488)

Sed4: Vị trí tại diểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602361;1198764)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLESố phiếu/*No*: BN1041015 – MS/ *Code* 1510.0302-0304-0306-0308

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu

Type of sample : Bùn đáy – Tầng mặt

: *Sediment – Surface layer*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**Sed1 1510.0302**	**Sed2 1510.0304**	**Sed3 1510.0306**	**Sed4 1510.0308**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
1	As	mg/kgDW	4.44	2.57	5.21	4.77	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	68.6	65.0	60.9	55.4	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	28.9	46.3	24.5	23.7	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	35369	33359	30770	28508	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 8272

Stt ***No.***	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed1** **1510.0302**	**Sed2** **1510.0304**	**Sed3** **1510.0306**	**Sed4** **1510.0308**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	
	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	Ref. EPA 8272
	Naphthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 391**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed1 1510.0302	Sed2 1510.0304	Sed3 1510.0306	Sed4 1510.0308	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Phenanthren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 515**	
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	
8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01
9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	Ref. EPA 1699 & AOAC 2007.01
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Heptachlor epoxide	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 2.7**	
	a-chlordane	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed1 1510.0302	Sed2 1510.0304	Sed3 1510.0306	Sed4 1510.0308	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
			(LOD = 5)	(LOD = 5)	(LOD = 5)	(LOD = 5)		
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	
	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	Ref. EPA 1699 & AOAC 2007.01
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed1 1510.0302	Sed2 1510.0304	Sed3 1510.0306	Sed4 1510.0308	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Endrine keton	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận/*Measuring/analyzing method is accredited by VILAS*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality*

Sed1: Vị trí cách sông Sài Gòn 200 về phía cống Vàm Thuật/ *Location 200 meter from Sai Gon river towards the Vam Thuat kennel*.(0603441;1197897).

Sed2: Vị trí tại điểm giao giữa rạch Chín Xiểng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602849;1197393)

Sed3: Vị trí tại điểm giao giữa rạch Ông Bầu với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602742;1197488)

Sed4: Vị trí tại diểm giao giữa rạch Ông Tổng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat- Nuoc Len channels*.(0602361;1198764)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015 – MS/*Code* 1510.0311-0313-0315-0317

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Bùn đáy – Tầng sâu (0,5m)

Type of sample : *Sediment - Depth layer (0.5m)*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**Sed5 1510.0311**	**Sed6 1510.0313**	**Sed7 1510.0315**	**Sed8 1510.0317**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
1	As	mg/kgDW	1.25	3.45	10.6	2.57	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	25.5	55.7	49.5	25.7	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	8.5	25.5	32.1	20.3	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	18925	29874	35913	15540	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed5 1510.0311	Sed6 1510.0313	Sed7 1510.0315	Sed8 1510.0317	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	-	Ref. EPA 8272
	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	
	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	Ref. EPA 8272
	Naphthalen	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 391**	

Stt ***No.***	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed5** **1510.0311**	**Sed6** **1510.0313**	**Sed7** **1510.0315**	**Sed8** **1510.0317**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
			(LOD = 50)	(LOD = 50)	(LOD = 50)	(LOD = 50)		
	Phenanthren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 515**	
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	
8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01
9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor epoxide	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 2.7**	

Stt ***No.***	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed5** **1510.0311**	**Sed6** **1510.0313**	**Sed7** **1510.0315**	**Sed8** **1510.0317**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
			(LOD = 1)	(LOD = 1)	(LOD = 1)	(LOD = 1)		
	a-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	
	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed5 1510.0311	Sed6 1510.0313	Sed7 1510.0315	Sed8 1510.0317	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Endrine keton	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method is accredited by VILAS.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality.*

Sed5: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0601002;1199835)

Sed6: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0598939;1200474)

Sed7: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

Sed8: Vị trí tại cầu Tham Lương, KCN Tân Bình/ *Location at the Tham Luong bridge, Tan Binh Industrial Park*.(0595884;1196999)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1041015 – MS/*Code* 1510.0310-0312-0314-0316

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Bùn đáy – Tầng mặt

Type of sample : *Sediment - Surface layer*

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed5 1510.0310**	**Sed6 1510.0312**	**Sed7 1510.0314**	**Sed8 1510.0316**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
1	As	mg/kgDW	1.70	5.25	0.84	1.39	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	0.79	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	19.6	72.2	14.2	37.0	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	12.2	31.4	14.9	16.9	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	9665	31454	7349	17798	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**Sed5** **1510.0310**	**Sed6** **1510.0312**	**Sed7** **1510.0314**	**Sed8** **1510.0316**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	-	Ref. EPA 8272
	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	
	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	Ref. EPA 8272
	Naphthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 391**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed5 1510.0310	Sed6 1510.0312	Sed7 1510.0314	Sed8 1510.0316	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Phenanthren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 515**	
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	
8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01
9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor epoxide	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 2.7**	
	a-chlordane	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed5 1510.0310	Sed6 1510.0312	Sed7 1510.0314	Sed8 1510.0316	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
			(LOD = 5)	(LOD = 5)	(LOD = 5)	(LOD = 5)		
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	
	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	Ref. EPA 1699 & AOAC 2007.01
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed5 1510.0310	Sed6 1510.0312	Sed7 1510.0314	Sed8 1510.0316	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Endrine keton	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method*

is accredited by VILAS.

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality.*

Sed5: Vị trí tại điểm giao giữa rạch Bà Miên với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Ba Mien canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0601002;1199835)

Sed6: Vị trí tại điểm giao giữa rạch Cầu Cụt với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Cau Cut canal and the Tham Luong – Ben Cat – Nuoc Len channels*.(0598939;1200474)

Sed7: Vị trí tại điểm giao giữa kênh Hy Vọng với kênh chính Tham Lương – Bến Cát – Nước Lên/ *Location at the junction between the Hy Vong channel and the Tham Luong – Ben Cat – Nuoc Len channels*.(0596170;1197484)

Sed8: Vị trí tại cầu Tham Lương, KCN Tân Bình/ *Location at the Tham Luong bridge, Tan Binh Industrial Park*.(0595884;1196999)

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLESố phiếu/*No*: BN1151015 – MS/*Code* 1510.0387-0385-0389-0391

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu : Bùn đáy – Tầng sâu (0,5m)

Type of sample : *Sediment - Depth layer (0.5m)*

Stt ***No.***	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed9** **1510.0387**	**Sed10** **1510.0385**	**Sed11** **1510.0389**	**Sed12** **1510.0391**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/phân tích** ***Measuring/Analyzing method***
1	As	mg/kgDW	2.58	4.87	4.25	1.25	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	56.9	32.2	69.4	11.9	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	30.5	14.2	25.5	3.52	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	35120	35496	32865	12480	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 8272

	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	
	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	Ref. EPA 8272
	Naphthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 391**	
	Phenanthren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 515**	
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	

8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01
9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	-	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	-	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor epoxide	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 2.7**	
	a-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	-	

	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	
	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Endrine keton	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	

Ghi chú/Note:

(✭) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method is accredited by VILAS.*

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality*

Sed9: Vị trí tại cầu An Lạc (giữa cầu An lạc và An Lập)/ *Location at the junction An Lac bridge(between the An Lac bridge and the An Lap bridge).*

Sed10: Vị trí cách công Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge.*

Sed11: Vị trí đang thi công của gói 4A/ *Location at the juction the package 4A.*

Sed12: Vị trí tại cầu Tân Kỳ - Tân Quý/ *Location at the junction the Tan Ky – Tan Quy*

KẾT QUẢ PHÂN TÍCH MẪU

ANALYZING RESULT OF SAMPLE

Số phiếu/*No*: BN1151015 – MS/*Code*1510.0384-0386-0388-0390

Dự án : **GÓI THẦU FRM – PPTAF02 – DỰ ÁN QUẢN LÝ RỦI RO NGẬP NƯỚC CHO KHU VỰC TP.HCM**

Project :

Ngày lấy mẫu/ *Sampling date* : 12-13/10/2015

Ký hiệu mẫu

Type of sample : Bùn đáy – Tầng mặt

: *Sediment - Surface layer*

Stt *No.*	**Chỉ tiêu** *Parameter*	**Đơn vị** *Unit*	**Sed9 1510.0386**	**Sed10 1510.0384**	**Sed11 1510.0388**	**Sed12 1510.0390**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** *Measuring/Analyzing method*
1	As	mg/kgDW	2.83	3.16	5.86	KPH/ND (LOD = 1)	**≤ 17.0**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
2	Cd	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 3.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
3	Cr	mg/kgDW	62.9	49.2	84.6	2.70	**≤ 90**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
4	Hg	mg/kgDW	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	KPH/ND (LOD = 0.5)	**≤ 0.5**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
5	Pb	mg/kgDW	34.7	24.9	31.9	2.70	**≤ 91.3**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
6	Fe	mg/kgDW	43142	37057	46487	908	**-**	TCVN 6649:2000, SMEWW 3120 B (2012) (★)
7	PAHs	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 8272

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed9 1510.0386	Sed10 1510.0384	Sed11 1510.0388	Sed12 1510.0390	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	Acenaphthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 88.9**	
	Acenaphthylen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 128**	
	Anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 245**	
	Benzo(a) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 385**	
	Benzo(e) pyren	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 782**	
	Chrysen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 862**	
	Dibenzo (a.h) anthracen	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 135**	
	Fluoranthen	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 2355**	
	Fluoren	µg/kg	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	KPH/ND (LOD = 20)	**≤ 144**	
	2-Methylnapthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 201**	
	Naphthalen	µg/kg	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	KPH/ND (LOD = 50)	**≤ 391**	Ref. EPA 8272
	Phenanthren	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**≤ 515**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed9 1510.0386	Sed10 1510.0384	Sed11 1510.0388	Sed12 1510.0390	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
			(LOD = 10)	(LOD = 10)	(LOD = 10)	(LOD = 10)		
	Pyren	µg/kg	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	KPH/ND (LOD = 10)	**≤ 875**	
8	DDT	µg/kg	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	KPH/ND (LOD = 3)	**≤ 4.8**	Ref. EPA 1699 & AOAC 2007.01
9	Thuốc trừ sâu gốc clo/ Organochlorine pesticides	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	Ref. EPA 1699 & AOAC 2007.01
	a-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	b-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 1.4**	
	g-lindane	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Heptachlor	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**-**	
	Aldrin	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Heptachlor epoxide	µg/kg	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	KPH/ND (LOD = 1)	**≤ 2.7**	
	a-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	

Stt *No.*	Chỉ tiêu *Parameter*	Đơn vị *Unit*	Sed9 1510.0386	Sed10 1510.0384	Sed11 1510.0388	Sed12 1510.0390	QCVN 43:2012/ BTNMT	Phương pháp đo đạc/ phân tích *Measuring/Analyzing method*
	g-chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Chlordane	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.9**	
	Endosulfan I	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	DDE	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.8**	
	Deildrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 6.7**	
	Endrine	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 62.4**	
	DDD	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**≤ 8.5**	
	Endosulfan II	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine aldehyde	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	Ref. EPA 1699 & AOAC 2007.01
	Endosulfan sulfate	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Methoxychlor	µg/kg	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	KPH/ND (LOD = 5)	**-**	
	Endrine keton	µg/kg	KPH/ND	KPH/ND	KPH/ND	KPH/ND	**-**	

Stt *No.*	**Chỉ tiêu** ***Parameter***	**Đơn vị** ***Unit***	**Sed9 1510.0386**	**Sed10 1510.0384**	**Sed11 1510.0388**	**Sed12 1510.0390**	**QCVN 43:2012/ BTNMT**	**Phương pháp đo đạc/ phân tích** ***Measuring/Analyzing method***
			(LOD = 5)	(LOD = 5)	(LOD = 5)	(LOD = 5)		

Ghi chú/Note:

(✯) Phương pháp đo đạc/phân tích được VILAS công nhận*/Measuring/analyzing method*

is accredited by VILAS.

KPH: Không phát hiện. LOD: Giới hạn phát hiện của phương pháp đo đạc/phân tích./

ND: Not detected. LOD: Limit of detection.

DW: Dry weight.

QCVN 43:2012/BTNMT: Quy chuẩn kỹ thuật quốc gia về chất lượng trầm tích/ *National technical regulation on sediment quality.*

Sed9: Vị trí tại cầu An Lạc (giữa cầu An lạc và An Lập)/ *Location at the junction An Lac bridge(between the An Lac bridge and the An Lap bridg*e).(0593163;1186046)

Sed10: Vị trí cách cầu Chợ Đệm 200m về phía cầu Nước Lên/ *Location 200 meter from Cho Dem river toward the Nuoc Len bridge*.(0593205;1184253)

Sed11: Vị trí đang thi công của gói 4A/ *Location at the juction the package 4A*.(0591376;1188406)

Sed12: Vị trí tại cầu Tân Kỳ - Tân Quý/ *Location at the junction the Tan Ky – Tan Quy* (0591750;1187781)

ANNEX 3

ESTIMATION OF AIR EMISSION CONCENTRATION FOR PRECONSTRUCTION PASE AND CONSTRUCTION PHASE OF PROJECT COMPONENT 2

A. Estimation for air emission generated from subcomponent 2.1. 2.2 and 2.4 of component 2 during pre-construction phase

Table 3.1 Emission factor emitted from vehicle movement of sub-components during pre-construction phase

Activities	NO_2		CO		TSP		SO_2	
	Emission Factor (kg/km)	**Emission loading (kg/day)**	**Emission Factor (kg/km)**	**Emission (kg/day)**	**Emission Factor (kg/km)**	**Emission (kg/day)**	**Emission Factor (kg/km)**	**Emission (kg/day)**
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len.	0.00638	4.29	0.00251	1.68	0.0019	1.28	0.00017	0.11
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.00638	5.51	0.00251	2.16	0.0016	1.64	0.00017	0.15
Sub-Component 2.4: Secondary canals systems.	0.00638	12.76	0.00251	5.02	0.0016	3.80	0.00017	0.34

Table 3.2 Emission concentration emitted from transportation during land clearance phase

Receptors	NO_2- 1 hr average (mg/m^3)		CO- 1hr average (mg/m^3)		TSP- 1 hr average (mg/m^3)		SO_2- 1 hr average (mg/m^3)	
	Baseline	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len.	0.23-0.28	0.17	7.11-7.12	7.17	0.11-0.14	0.14-0.18	0.02-0.024	0.024-0.028

Receptors	NO_2- 1 hr average (mg/m^3)		CO- 1hr average (mg/m^3)		TSP- 1 hr average (mg/m^3)		SO_2- 1 hr average (mg/m^3)	
	Baseline	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.013-0.053	0.19-0.229	2.73-15.05	2.8-15.12	0.1-0.38	0.15-0.38	0.008 – 0.043	0.012-0.047
Sub-Component 2.4: Secondary canals systems.	0.013-0.053	0.42-0.46	2.73-15.05	2.89-15.21	0.1-0.38	0.22-0.5	0.008 – 0.043	0.019-0.054
QCVN 05:2013	**0.2**		**30**		**0.3**		**0.35**	
WHO Guidelines	**0.1**		-		-		-	

B. Estimation for air emission generated from all subcomponents of component 2 during construction phase

Table 3.3 Emission concentration emitted from machineries operation during land clearance

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	1	8	500	1.282	5128	3.589	14356	0.006	24	0.48	1920
Bulldozer	1	8	500	3.053	12212	4.7	18800	0.006	24	0.5	2000
Truck	2	8	-	10.14 (g/hr)	162.24	6 (g/hr)	96	0.03 (g/hr)	0.48	7.46 (g/hr)	119.36

Total					17502.24		33252		48.48		4039.36

Table 3.4 Emission concentration emitted from machineries operation during land clearance

Receptors	NO_2- 1 hr average (mg/m^3)		CO- 1hr average (mg/m^3)		TSP- 1 hr average (mg/m^3)		SO_2- 1 hr average (mg/m^3)	
	Baseline	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len.	0.23-0.28	3.23-3.24	7.11-7.12	8.79-8.8	0.11-0.14	0.49-0.52	0.02-0.024	0.024-0.028
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.013-0.053	3.22-3.23	2.73-15.05	4.41-9.72	0.1-0.38	0.5-0.63	0.008 – 0.043	0.012-0.047
Sub-Component 2.4: Secondary canals systems.	0.014-0.053	**3.22-3.25**	3.63-9.78	5.31-11.5	0.1-0.38	0.51-0.74	0.008 – 0.043	0.018-0.03
QCVN 05:2013	**0.2**		**30**		**0.3**		**0.35**	
WHO Guidelines	**0.1**		**-**		**-**		**-**	

Table 3.5 Emission factor emitted from vehicle movement of sub-components during construction

Activities	NO_2		CO		TSP		SO_2	
	Emission	**Emission**	**Emission**	**Emission**	**Emission**	**Emission**	**Emission**	**Emission**

	Factor (kg/km)	loading (kg/day)	Factor (kg/km)	(kg/day)	Factor (kg/km)	(kg/day)	Factor (kg/km)	(kg/day)
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	0.00638	11.57	0.00251	4.55	0.0019	3.44	0.00017	0.3
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.00638	137.8	0.00251	54.2	0.0019	34.6	0.00017	3.7
	0.0198	0.585	3.1×10^{-3}	0.00675	1.3×10^{-3}	8.91	1.5×10^{-5}	1.4
Sub-Component 2.3: Selected storm and waste water systems in Go Vap District	0.00638	2.95	0.00251	1.16	0.0019	0.88	0.00017	0.08
Primary and secondary combined storm water and sewer systems and the secondary interceptor in Go Vap district	0.00638	17.41	0.00251	6.85	0.0019	5.18	0.00017	0.46
Sub-Component 2.4: Secondary canals systems.	0.00638	38.92	0.00251	15.31	0.0019	11.59	0.00017	1.03

Table 3.6 Emission factor emitted from vehicle movement of sub-components

Receptors	NO_2- 1 hr average (mg/m^3)		CO- 1hr average (mg/m^3)		TSP- 1 hr average (mg/m^3)		SO_2- 1 hr average (mg/m^3)	
	Baseline	Project Top Up	Baseline	Project Top Up	Baseline	Project Top Up	Baseline	Project Top Up
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	0.025-0.028	0.4	7.11-7.12	7.26	0.1-0.14	0.21-0.25	0.02-0.024	0.03

Receptors	NO_2- 1 hr average (mg/m^3)		CO- 1hr average (mg/m^3)		TSP- 1 hr average (mg/m^3)		SO_2- 1 hr average (mg/m^3)	
	Baseline	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.013-0.053	4.44-4.49	2.73-15.05	4.46-16.79	0.10-0.38	1.41-1.71	0.008-0.043	0.126-0.161
Sub-Component 2.3: Selected storm and waste water systems in Go Vap District	0.026-0.053	0.11-0.15	2.73-15.05	2.77-15.09	0.12-0.33	0.15-0.36	0.008-0.043	0.011-0.046
Primary and secondary combined storm water and sewer systems and the secondary interceptor in Go Vap district	0.013-0.053	0.57-0.61	2.73-15.05	2.95-15.27	0.12-0.33	0.28-0.49	0.008-0.043	0.02-0.06
Sub-Component 2.4: Secondary canals systems.	0.013-0.047	1.26-1.30	2.73-9.78	3.22-10.27	0.12-0.33	0.49-0.70	0.008-0.026	0.04-0.06
QCVN 05:2013	**0.2**		**30**		**0.3**		**0.35**	
WHO Guidelines	**0.1**		-		-		-	

Table 3.7 Emission of air pollutants generated by machinery and vehicles (Subcomponent 1- *combined ship lock and tidal sluice gates:* Vam Thuat or Nuoc Len) (Note: This table is estimated only for Vam Thuat or Nuoc Len given those have the same assumption of equipment list)

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	3	8	500	1.282	15384	3.589	43068	0.006	72	0.48	5760
Bulldozer	5	8	500	3.053	61060	4.7	94000	0.006	120	0.54	10800
Truck	4	8	-	10.14	324.48	6	192	0.03	0.96	7.46	238.72
Hammer (piling work)	1	8	50	5.386	2154.4	5.1	2040	0.007	2.8	1.5	600
Concrete mixer	3	8	250	1.118	6708	4.555	27330	0.006	36	0.5	3000
Plate compactor	7	8	300	3.79	63672	5.67	95256	0.01	168	2	33600
Crane	1	8	175	1.29	1806	4.121	5769.4	0.006	8.4	0.52	728
Total					151108.88		267655.4		408.16		54726.72

Table 3.8 Emission of air pollutants generated by machinery and vehicles (Subcomponet 2 - *Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal)*

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	5	8	500	1.282	25640	3.589	71780	0.006	120	0.48	9615.4
Bulldozer	5	8	500	3.053	61060	4.7	94000	0.006	120	0.54	10769.2
Truck	4	8	-	10.14	324.48	6	192	0.03	0.96	7.46	238.8

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Hammer (piling work)	3	8	50	5.386	6463.2	5.1	6120	0.007	8.4	1.50	1800.0
Pilling machine	3	8	250	1.494	8964	4.9	29400	0.0006	3.6	0.62	3692.3
Concrete mixer	6	8	250	1.118	13416	4.555	54660	0.006	72	0.50	5953.8
Plate compactor	10	8	300	3.79	90960	5.67	136080	0.01	240	2.00	48000.0
Crane	6	8	175	1.29	10836	4.121	34616.4	0.006	50.4	0.52	4329.2
Cutter Suction Dredger	2	8	5000	18.24	1459200	9.82	785600	2.88	230400	0.23	18400
Total					1646164.9		1053373		230808.1744		72553.6

Table 3.9 Emission factors of air pollutants generated by vehicles operation (Sub-component 3 - *Selected storm and waste water systems in Go Vap District: m*ain interceptor)

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	2	8	500	1.282	10256	3.589	28712	0.006	48	0.48	3840
Bulldozer	2	8	500	3.053	24424	4.7	37600	0.006	48	0.54	4320

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Truck	4	8	-	10.14	324.48	6	192	0.03	0.96	7.46	238.72
Hammer (piling work)	1	8	50	5.386	2154.4	5.1	2040	0.007	2.8	1.5	600
Concrete mixer	2	8	250	1.118	4472	4.555	18220	0.006	24	0.5	2000
Crane	2	8	175	1.29	3612	4.121	11538.8	0.006	16.8	0.52	1456
Total					45242.88		98302.8		140.56		12454.72

Table 3.10 Emission factors of air pollutants generated by vehicles operation (Sub-component 3 - *Selected storm and waste water systems in Go Vap District:* Primary and secondary combined storm water and sewer systems)

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	2	8	500	1.282	10256	3.589	28712	0.006	48	0.48	3840
Bulldozer	2	8	500	3.053	24424	4.7	37600	0.006	48	0.54	4320
Truck	4	8	-	10.14	324.48	6	192	0.03	0.96	7.46	238.72
Hammer (piling work)	1	8	50	5.386	2154.4	5.1	2040	0.007	2.8	1.5	600
Concrete	2	8	250	1.118	4472	4.555	18220	0.006	24	0.5	2000

mixer											
Crane	2	8	175	1.29	3612	4.121	11538.8	0.006	16.8	0.52	1456
Total					45242.88		98302.8		140.56		12454.72

Table 3.11 Emission of air pollutants generated by machinery and vehicles (Sub-component 4 - *Secondary canals systems*)

Equipment list	Number of equipment	Working Hours	Horse power (HP)	EF CO (g/hp-hr)	Emission loading (g/8 hrs.)	EF NO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF SO_2 (g/hp-hr)	Emission loading (g/8 hrs.)	EF TSP (g/hp-hr)	Emission loading (g/8 hrs.)
Excavator	5	8	500	1.282	25640	3.589	71780	0.006	120	0.48	9615.4
Bulldozer	5	8	500	3.053	61060	4.7	94000	0.006	120	0.54	10769.2
Truck	4	8	-	10.14	324.48	6	192	0.03	0.96	7.46	238.8
Hammer (piling work)	3	8	50	5.386	6463.2	5.1	6120	0.007	8.4	1.50	1800.0
Pilling machine	3	8	250	1.494	8964	4.9	29400	0.0006	3.6	0.62	3692.3
Concrete mixer	6	8	250	1.118	13416	4.555	54660	0.006	72	0.50	5953.8
Plate compactor	10	8	300	3.79	90960	5.67	136080	0.01	240	2.00	48000.0
Crane	6	8	175	1.29	10836	4.121	34616.4	0.006	50.4	0.52	4329.2
Cutter Suction Dredger	2	8	5000	18.24	1459200	9.82	785600	2.88	230400	0.23	18400
Total					1646164.9		1053373		230808.1744		72553.6

Table 3.12 Emission of air pollutants generated by operation of machinery and vehicles of all sub-components of component 2

Receptors	**NO_2- 1 hr average (mg/m^3)**		**CO- 1hr average (mg/m^3)**		**TSP- 1 hr average (mg/m^3)**		**SO_2- 1 hr average (mg/m^3)**	
	Baseline	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**	**Baseline**	**Project Top Up**
Subcomponent 2.1 Combined ship lock and tidal sluice gates: Nuoc Len and Vam Thuat	0.023-0.028	12.93-12.95	7.11-7.12	14.40-14.41	0.1-0.14	2.74-2.78	0.02-0.024	0.039-0.04
Sub-Component 2.2: Canal embankments in the main Tham Luong – Ben Cat – Rach Nuoc Len canal.	0.013-0.053	13.18-13.22	2.73-15.05	25.88-37.3	0.10-0.38	0.72-0.95	0.008-0.043	3.36-3.38
Sub-Component 2.3: Selected storm and waste water systems in Go Vap District	0.013-0.028	1.60-1.61	2.73-8.04	3.45-8.76	0.12-0.23	0.32-0.43	0.008-0.025	0.01-0.03
Sub-Component 2.3: Primary and secondary combined storm water and sewer systems and the secondary interceptor in Go Vap district	0.013-0.053	1.60-1.64	2.73-15.05	3.45-15.77	0.12-0.33	0.32-0.53	0.008-0.043	0.01-0.05
Sub-Component 2.4: Secondary canals systems.	0.014-0.047	16.17-16.21	3.63-9.78	32.29-38.44	0.10-0.33	0.62-0.85	0.013-0.026	4.458-4.471
QCVN 05:2013	**0.2**		**30**		**0.3**		**0.35**	
WHO Guidelines	**0.1**		-		-		-	

Table 3.13 Overall noise levels generated by operation of machinery during construction phase (Sub-component 1)

Number	Type	Noise level at 15 m (dBA)	Noise levels at distances (m) Lp (x) (dBA)				
			100	200	400	600	800
3	Excavator	85	69	63	56	53	50
5	Bulldoser	85	69	63	56	53	50
4	Truck	85	69	63	56	53	50
1	Hammer (piling work)	101	85	79	72	69	66
3	Concrete mixer	85	69	63	56	53	50
7	Plate compactor	80	64	58	51	48	45
1	Crane	85	69	63	56	53	50
1	Generator	80	64	58	51	48	45
Overall noise levels generated by operation of machinery during construction phase (Lp (x) (dBA))			86	80	74	71	68
QCVN 26:2010/BTNMT National Technical Regulation on Noise (daytime)			**70**				
IFC's General EHS Guidelines (daytime)			**55**				

Table 3.14 Overall noise levels generated by operation of machinery during construction phase (Sub-component 2 and 4)

Machineries number	Machineries	Noise level at 15 m (dBA)	Noise levels at distances (m) Lp (x) (dBA)						
			100	200	400	600	800	1000	1200
5	Excavator	85	68.5	62.5	56.5	53.0	50.5	48.5	46.9
5	Bulldoser	85	68.5	62.5	56.5	53.0	50.5	48.5	46.9
4	Truck	85	68.5	62.5	56.5	53.0	50.5	48.5	46.9
3	Hammer (piling work)	101	**84.5**	78.5	72.5	69.0	66.5	64.5	62.9
3	Pilling machine	101	**84.5**	78.5	72.5	69.0	66.5	64.5	62.9
6	Concrete mixer	85	68.5	62.5	56.5	53.0	50.5	48.5	46.9
10	Plate compactor	80	63.5	57.5	51.5	48.0	45.5	43.5	41.9
6	Crane	85	68.5	62.5	56.5	53.0	50.5	48.5	46.9
1	Generator	80	63.5	57.5	51.5	48.0	45.5	43.5	41.9
2	Cutter Suction Dredger	89	**72.5**	66.5	60.5	57.0	54.5	52.5	50.9
Overall noise levels generated by operation of machinery during construction phase (Lp (x) (dBA))			93	87	81	77	75	73	71
QCVN 26:2010/BTNMT National Technical Regulation on Noise (daytime)			**70**						
IFC’s General EHS Guidelines (daytime)			**55**						

Table 3.15 Overall noise levels generated by operation of machinery during construction phase (Sub-component 3)

Machineries number	Machineries	Noise level at 15 m (dBA)	Noise levels at distances (m) Lp (x) (dBA)				
			100	200	400	600	800
2	Excavator	85	69	63	56	53	50
2	Bulldozer	85	69	63	56	53	50
4	Truck	85	68.5	62.5	56.5	53.0	50.5
1	Piling machine	101	85	79	72	69	66
2	Concrete mixer	85	69	63	56	53	50
1	Horizontal Boring Hydraulic Jack	80	64	58	51	48	45
2	Crane	85	69	63	56	53	50
1	Generator	80	64	58	51	48	45
Overall noise levels generated by operation of machinery during construction phase (Lp (x) (dBA))			86	80	74	70	68
QCVN 26:2010/BTNMT National Technical Regulation on Noise (daytime)			**70**				
IFC's General EHS Guidelines (daytime)			**55**				

Table 3.16 Vibration estimation for vehicles operation of component 2

No.	Vehicles	PPVequip (D) (in/sec) (in ft)					Lv (D) (ft)				
		10	17	34	66	75	10	17	34	66	75
1	Truck	0.850	0.300	0.136	0.048	0.018	106.97	97.94	91.02	81.99	73.35
2	Bulldoser	0.034	0.012	0.005	0.002	0.001	78.97	69.94	63.02	53.99	45.35
3	Piling works	**16.972**	**6.000**	**2.707**	**0.957**	**0.354**	**132.97**	**123.94**	**117.02**	**107.99**	**99.35**
4	Drilling	**0.995**	**0.352**	0.159	0.056	0.021	107.97	98.94	92.02	82.99	74.35
5	Excavator	0.034	0.012	0.005	0.002	0.001	78.97	69.94	63.02	53.99	45.35
6	Horizontal Boring Hydraulic Jack	0.01186	0.00535	0.00189	0.00070	0.00058					
7	Crane	0.027	0.013	0.007	0.003	0.002					
8	Concrete mixer	0.270	0.126	0.070	0.033	0.016	**NA**	**NA**	**NA**	**NA**	**NA**

ANNEX 4

HOUSEHOLD SURVEY

"Environmental and Social Impact Assessment

Ho Chi Minh City Flood Risk Management Project"

Tham Luong – Ben Cat – Nuoc Len Sub-catchment"

Confidentiality: ***All data collected in this survey is completely confidential and will only be used for statistical purposes.***

Head of household full name: Gender:

Address: Phone number:

Name of interviewer: Signature of interviewer:

Survey date:

Note: *The following questions are for the head of the household, or any household members over the age of 18 in the household.*

A. SOCIAL DEMOGRAPHY

Question 1: Please provide some general information about the household:

- Are you head of the household? 1. Yes 2. No
- Number of household members___________ Ethnicity

No.	Full name	Gender	Age	Relationship with household owner	Marital status 1. Married; 2. Not married; 3. Divorced; 4. Separated; 5. Widowed; 6. Other (specify)	Education 1. University or higher; 2. High school; 3.Secondary school; 4. Primary school; 5. Illiterate	Job	Monthly income
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
…								
…								

B. HOUSING AND LIVING FACILITIES

Question 2: When was the house constructed? *(Please circle only ONE option)*

1.Before 1993 2. 1993 – 2004 3. 2004 – 2009 4. 2009 – present

Question 3: Location of the house: *(Please circle only ONE option)*

1. On the street
2. In the alley (more than 4 meters in width)
3. In the narrow alley (less than 4 meters in width)
4. Along the canal in the planned area
5. Along the canal/sub catchment area in the unplanned area
6. On the canal

Question 4: Structure of the house: *(Please circle only ONE option)*

1. Above three storeys
2. Two storeys
3. One storey with flat roof
4. Level 4/ Temporary house
5. Apartment

Question 5: Housing condition/quality: *(Please circle only ONE option)*

1. Very good 2. Good 3. Average 4. Bad 5. Very bad

Question 6: Housing area (m^2):

Question 7: Types of ownership: *(Please circle only ONE option)*

1. Rental house 2. Sole ownership 3. Shared house

Question 8: What is the supply source of drinking water?

1. Tap water 2. Well 3. Lake/river 4. Rainwater 5.Other (please specify):

Question 9: How is the household wastewater treated?

1. Through the sewers
2. Through canals/lakes
3. Discharged to the garden
4. Discharged to the street

Question 10: How is your household waste usually treated? *(Please circle only ONE option)*

1. Waste collection service at home
2. Taken to garbage collection site
3. Treat at home (landfill, fertilizer, burning…)
4. Throw somewhere

(please specify where you throw garbage)

Question 11: Please specify availability of the following utensils/amenities in your house?

Property	Quantity	Property	Quantity
1. Bike		5. Washing machine	
2. Motorbike		6. TV	
3. Car		7. Computer	

Property	Quantity	Property	Quantity
4. Air conditioner		8. Internet connection	

C. HOUSEHOLD ECONOMIC ACTIVITIES

Question 12: Which of the following is your source of monthly income?

Source of monthly income	Monthly income (VND)/month	Note
1. Salary for employees in state-owned organizations and enterprises		
2. Salary for workers		
3. Business, service		
4. Pensions		
5. From renting houses		
6. Subsidy		
7. Other:		
8. Total monthly income		

Question 13: Please specify your household's living cost per month:

Cost	Amount (VND/month)	Note
1. Food		
2. Housing		
3. Clothes		
4. Electricity, water, gas, coal, phone		
5. Transport (gasoline, parking…)		
6. Study		
7. Health, medical care		
8. Entertainment and travel		
9. Occasional events (wedding, birthday…)		
10. Other: …		
11. Total cost		

C. FAMILY HEALTH CONDITIONS

Question 14: Is there any family member having health problem in the past one year?

1. Yes 2. No

If **YES**, please specify the health problem/symptoms?

1. Hearing impairment 2. Sight impairment 3. Breathing problem

4. Cholera 5. Tuberculosis 6. Hepatitis B

7. Typhoid 8. Dengue fever 9. Cardiovascular issue

10. Respiratory issue 11. Other:

If **NO**, please go to **Question 15.**

Question 15: Please indicate the extent of flooding impacts on your health and your family's health: *(Please circle only ONE option)*

1. Extremely serious 2. Serious
3. A little serious 4. No impacts

Question 16: How does flooding impact your access to medical services? *(Please circle only ONE option)*

1. Impact means of travel 2. Impact travel costs
3. Impact travel time 4. No impact at all

D. LOCAL INFRASTRUCTURE AND LIVING ENVIRONMENT

Question 17: Please indicate the structure of street/alley/lane where your house is situated? *(Please circle only ONE option)*

1. Paved road 2. Concrete or cement road
3. Rock road 4. Soil road

Question 18: Please evaluate the road condition of your local area *(Please circle only ONE option)*

1. Very good 2. Good 3. Average 4. Bad 5. Very bad

Question 19: To what extent does flooding impact on your daily travel? *(Please circle only ONE option)*

1. Extremely serious 2. Serious
3. A little serious 4. Not serious at all

Question 20: Does your house get flooded? *(Please circle only ONE option)*

1. Yes, due to rising water and/or rainwater 2. Yes, due to rising water
3. Yes, only due to rainwater 4. Never flooded

Question 21: How do you evaluate the air quality of your neighborhood? *(Please circle only ONE option)*

1. Good
2. Normal
3. Lightly polluted
4. Extremely polluted

F. AWARENESS/CONCERN ABOUT THE PROJECT

Question 22: How and since when did you hear about the project? *(Please circle only ONE option)*

When:

1. This is the first time 2. Less than one year ago 3. 1-3 years 4.More than 3 years

How:

1. Newspaper/ TV 2. Announcement from local government

3. Announcement from public groups

4. Public meetings 5. Other:

Question 23: Did you attend any public consultation meeting of the Project?

1. Yes 2. No

Question 24: If YES, do you think that you have been provided with adequate information about the Project, including project description, potential impacts and mitigation plan? *(Please circle only ONE option)*

1. Adequate 2. Not adequate 3. Don't know

If **NOT ADEQUATE**, what information do you want to know about the Project?

1. Project description 2. Other potential impacts 3. Mitigation plan

4. Resettlement area 5. Livelihood recovery program 6. Other: ...

Question 25: Did you ask any question during the public consultation meeting?

1. Yes 2. No

If **YES,** was your question fully answered?

1. Not yet answered 2. Partly answered 3. Fully answered

Question 26: How does flood impact your household living conditions? From 1 to 5, please rank the seriousness of potential impacts.

Impacts	**Yes**	**No**	**Rank** (5 is the most serious impact)				
			1	2	3	4	5
1. Hygienic condition							
2. Water pollution							

Impacts	**Yes**	**No**	**Rank** (5 is the most serious impact)				
			1	2	3	4	5
3. Air pollution							
4. Health							
5. Economic cost (repair cost, property loss…)							
6. Value of the house							
7. Access to electricity and clean water (availability, price, etc.)							
8. Job and income							
For local businesses							
9. Impacts on business activities							
- Delay in production							
- Delay in delivery							
10. Impacts on revenue							
- Damage to production facilities							
- Damage and loss of products							
11. Impacts on work environment							
- Food hygiene and safety							
- Hygiene in workplace							
- Hygiene in production area							
12. Impact on workers' income							

Question 27: Please specify your opinion/expectation towards improving the hygienic conditions and flooding issue in the area? …………………………………………………………

Question 28: To what extent do you support the city's flooding improvement projects such as Nhieu Loc - Thi Nghe and Tham Luong - Ben Cat?

1. Don't support 2. No idea 3. Support 4. Strongly support

Thank you for your participation!

ANNEX 5

DESCRIPTION OF SOCIAL IMPACT ASSESSMENT PROCESS

DESCRIPTION OF SOCIAL IMPACT ASSESSMENT PROCESS

✓ **Articulating the impact**

It is critical to be very specific and clear when articulating household and community health impacts. If impacts are not clearly defined, the impact rating process could result in an inaccurate impact categorisation. When defining impacts, it is important to:

- Clearly specify the source of the impact with clear reference to causal Project activities;
- Summarise the baseline context including specific reference to potential vulnerable groups; and
- State any assumptions.

✓ **Determining the magnitude**

Magnitude of household and community health impacts is understood as a reflection of the 'size' or degree of change caused by social and community health impacts. Magnitude is a function of one or more of the following characteristics:

- Extent;
- Duration;
- Scale;
- Frequency; and
- Likelihood (for unplanned events only).

Please check Annex 3 for definition of characteristics to define magnitude and designation of magnitude.

✓ **Assessing Levels of Vulnerability**

Vulnerability is underpinned by a low existing level of livelihoods assets (such as health or education) or inadequate access to public facilities, services and opportunities for jobs and livelihood. In order to identify vulnerable receptors, it is necessary to identify receptors that experience these circumstances and analyze adaptive abilities of the receptors. It is classified into three types as presented in Table 5.1.

Table 5.1 Levels of Vulnerability

Type	Definition
Low	Minimal vulnerability; consequently with a high ability to adapt to changes brought by the Project and opportunities associated with it.
Medium	Some, but few areas of vulnerability; still retaining an ability to at least in part adapt to change brought by the Project and opportunities associated with it.

Type	**Definition**
High	Profound or multiple levels of vulnerability that undermine the ability to adapt to changes brought by the Project and opportunities associated with it.

✓ ***Evaluating Significance for Social and Health Impacts***

The significance of social and health impacts is evaluated taking into account the magnitude of the impact and the vulnerability of affected receptors. For rating significance for social and community health impacts, the matrix in Table 6.3 is used to assign social and community health impact significance for both negative and positive impacts, and includes the definitions of magnitude and vulnerability designations.

Table 5.2 Impact Significance

		Sensitivity/Vulnerability/Importance of Resource/Receptor		
		Low	**Medium**	**High**
Magnitude of Impact	**Negligible**	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major
Magnitude of Impact	**Positive**	Minor	Moderate	Major

ANNEX 6

SUMMARY OF RESETTLEMENT ACTION PLAN

6.1. Project description

HCMC faces serious problems of flooding during the rainy season from July to November and high tides from September to December each year. The flooding in the urban area of HCMC poses big challenge due to the high concentration of residents and property in the central area, and has direct impacts on the city's economic growth. A lot of plans have been approved in order to manage flood risks in the city area. However, the implemented plans still lack overall orientation in order to have significant effects on reducing floods in HCMC.

The proposed HCMC Flood Risk Management project aims to reduce flood risk and improve drainage in selected areas of HCMC. It will support the coordination of relevant flood risk management plans to prevent tides, adequately drain off the water to stop flood for the City Centre area (taking into consideration climate change impacts). This project will be aligned with the Twin Goals of the WB on poverty reduction and promoting shared prosperity

6.2. The scope of the impacts and land acquisition

The project is to be implemented in the area of 15 ward in 4 districts of HCMC, including:

- Binh Tan District: An Lac Ward, Binh Hung Hoa B Ward, Binh Hung Hoa Ward
- Go Vap District: Ward 6, Ward 5, Ward 13, Ward 14, Ward 15, Ward 16, Ward 17
- District 12: Thoi An Ward, Thanh Xuan Ward, Thanh Loc Ward, An Phu Dong Ward
- Tan Binh District: Ward 15

The project will acquire 185,046 m2 of land belonging to 717 HHs, enterprises and organizations.

- Residential Land: 17,598 m2;
- Agriculture land: 131,773 m2
- Non-agricultural Land: 10,877 m2
- Other land: 24,798 m2

A total 717 households, enterprises and organizations in the project area will be affected due to permanent land acquisition for the purpose of the project. In which:

- 493 households are affected on residential land
- 208 households are affected on agricultural land
- 7 households are affected on non-agricultural land
- 23 household are affected on other land

There are 65 HHs severely affected, of which 60 PAHs suffer from more than 20% and 5 PAHs suffer from more than 10% (for vulnerable households) agricultural land (including gardening land).

There are 424 HHs affected housing, of which 71 totally affected and will need relocation. In additional 77 HHs may need relocation.

There are 157 affected household businesses.

38 HHs out of the 697 households are identified as vulnerable households, including those headed by single women with dependents, poor households, households with the disable, single elderly households, ethnic minorities, and social policy beneficiary households. In which five vulnerable households will lose from 10% of their productive landholdings.

6.3. Socio-economic information in project area

The sample rate used for socio-economic survey project area includes 100% of the seriously PAHs, relocated HHs, and about 20% other PAHs were randomly selected. The survey method is done by the questionnaire interview. The socioeconomic survey results are summarized as follow:

There are 451 HHs with 1,990 inhabitants surveyed. Household size in the PAHs is 4.41 people/household. In total 451 HHs, HHs with male heads account for 268 HHs, while the number of female-headed HHs is 183 HHs. The average age of the household head is 50 years old.

Educational background: the majority of household heads with primary education level are 63%. The number of household heads holding secondary or higher degrees forms 12.2%. Educational attainment of the household members also focuses highest on primary with 51.4%.

Occupation: For homeowners, service trade accounts for a high percentage of all HHs' profession with 66.1%, followed by workers and employees. The number of all HHs with incomes coming from salaries (including pensions) makes up the percentage of 16.6%. In contrast, the percentage of all agricultural HHs is the lowest with 2.44%.

In total 1,340 people in the working age of PAHs surveyed, the number of people working in the service trade sector also accounts for the highest percentage with 20.9%, followed by the percentage of people hired with 16%, workers with 13%, housewife with 10.2%, and the lowest is agriculture with 1:27%.

The average income of 451 HHs is 11,469,426V VND/month, in which the average income of the male head of household is higher than that of female-headed. Income sources of HHs are based on the following four revenue sources: wages; service business, supporting relatives, and agricultural assistance.

6.4. Legal framework

The policy framework and entitlement of the project are developed based on the regulations of the GoV on compensation, support, and resettlement when land is recovered by the State and involuntary resettlement policy of WB. Due to some differences between the policies of the WB and the policy of the GoV on compensation, support, and resettlement, this project requires the exemption from compliance with provisions of the Decree and Vietnam Government. Accordingly, the compensation, support and RAP of the project will be implemented under the RPF of the project approved by the Prime Minister.

The compensation, assistance and resettlement principles of this RPF have been disseminated to the representatives of the District Compensation, Assistance and Resettlement Boards, local authorities, and affected households during the consultation meetings held in October and November 2015. Their feedbacks have been incorporated into the RPF and RAP.

6.5. Resettlement measures

If no other residential land in the respective ward exists, HHs and individuals with the entire house and land acquired by the project, or for whom the rest of area after acquisition not eligible for construction permit, will be entitled to: (i) arrange resettlement; and (ii) in case the land compensation rate is lower than the value of minimum land in resettlement areas, will be supported for the difference by the State as long as the amount of support does not exceed the amount of the difference rate between the land compensation rate and minimum resettlement land prescribed locally.

For the case of PAHs whose residential land is not eligible for compensation (including canal encroaching HHs), if there is no other place on the respective ward, they will be allocated minimum resettlement land in resettlement sites and PAHs must pay land use fees.

The displaced PAHs of the project will be relocated in the available resettlement areas in the city areas.

6.6. Income Restoration Program

The Income Restoration Plan (IRP) will be developed for those affected by land acquisition of the project. Project policy objectives indicate that the livelihoods and incomes of the PAHs must be actually restored at least equal to or higher than the level before displacement or before starting the project if that level is higher.

Gender issues: Socio-economic survey shows that women suffer more than men in the process of resettlement and income restoration. A Gender Strategy will be developed for the project in order to promote participation of women in the process of project implementation as well as to facilitate the development of women.

6.7. Dissemination of information and public consultation

The community consultations, public meeting, and discussion between the PAHs and local officials have been carried out in the relevant wards from October to November 2015. In total 393 affected people participated in the public consultation for information on the subproject, impacts, policies, and entitlements applied. Responses from the public consultation were taken into consideration and updated in this RAP.

6.8. Grievance redress machanism

A mechanism of handling and redressing grievances will be clearly established to redress grievances and complaints of PAHs related to land acquisition, compensation and resettlement in a timely and satisfactory manner. An effective and reliable Grievance Redress Mechanisms is necessary to ensure the social negative impacts, particularly those subjects related to land acquisition, are resolved effectively and promptly. Grievance Redress Mechanism and prosecution complying with current Law on Complaints of the GoV is stipulated in Article 28, Article 32 and Article 33 of the Law on Complaints No. 02/2011 / QH13 dated 11/11/2011.

6.9. Implementation Arrangements

The implementation of compensation, support, and resettlement requires the participation of agencies and local organizations in all levels including city, district, and ward projects. HCMC People's Committee will be responsible for the overall compliance with the provisions in the Resettlement Policy Framework and Resettlement Plan (RP) built under the guidance of the Resettlement Policy Framework of the project.

PMU assists the Project Owner to directly manage project implementation. It is responsible for updating and implementing the RAP of the Project.

The project Consultants have supported PMU and district land clearance and compensation Board to ensure resettlement work are performed in accordance with the policy of involuntary resettlement of the WB.

PMU will submit the updated Land Clearance and Resettlement Plan to HCMC People's Committee and the WB for review and approval prior to implementation of land clearance compensation.

6.10. Implementation Schedule

Compensation, assistance and resettlement activities will be carried out during the 2016.

6.11. Budget

It is estimated that the total cost for compensation and assistance is VND 904,402,793,000 (equivalent to USD 41,109,217.86). This budget includes the cost of compensation, support, and resettlement and Income Restoration Plan, management costs, grievance redressing, independent monitoring, and contingency expenses.

6.12. Monitoring and evaluation

PMU is responsible for the overall internal monitoring of resettlement activities. Progress reports will be submitted to the WB quarterly.

PMU will hire an independent monitoring agency before the start of implementation of the RP. Independent monitoring agency will report the beginning of the period after 1 month of operation. This unit will also submit a report every six months on the progress of implementation of the RP, and propose recommendations on request as well. Independent monitoring agency will conduct post-implementation evaluation of resettlement within 6 - 12 months after the completion of the project resettlement activities.

ANNEX 7

PICTURES OF SAMPLING

Figure 7.1 Monitoring sediment quality at HyVong canal.

Figure 7.2 Monitoring sediment quality at Chin Xieng canal.

Figure 7.3 Monitoring soil quality at Cho Cau bridge.

Figure 7.4 Monitoring soil quality at Ba Mieng canal.

Figure 7.5 Monitoring air quality at Vam Thuat sluice.

Figure 7.6 Monitoring air quality at Nuoc Len sluice.

ANNEX 8

PICTURES OF PUBLIC CONSULTATION

Figure 8.1 Registering to attend the public consultation.

Figure 8.2 Watching the map of the project area.

Figure 8.3 Opening the public consultation.

Figure 8.4 The representative of PMU presented project.

Figure 8.5 The participants gave opinions of project.

Figure 8.6 Discussing questions of participants.

Figure 8.7 The representative of PMU answered the questions of participants.

Figure 8.8 The representative of FS answered the questions of participants.

ANNEX 9

CUMULATIVE IMPACT ASSESSMENT

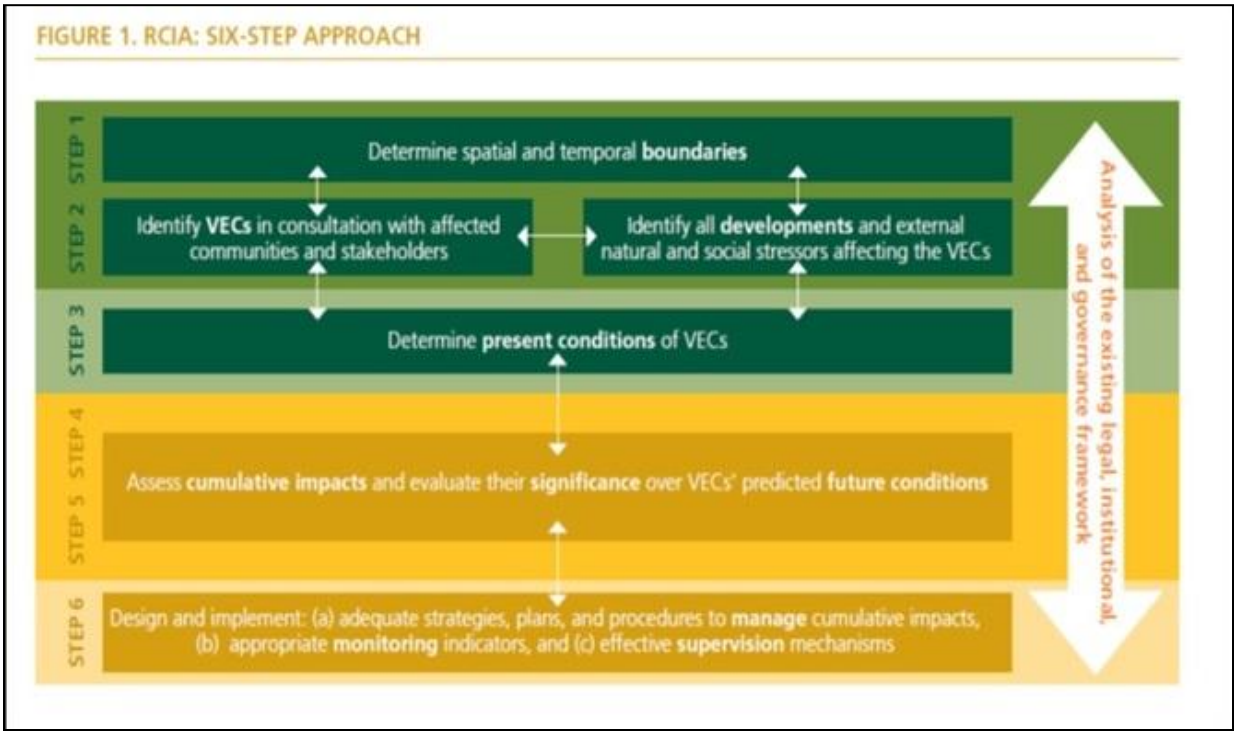
9.1. Introduction

9.1.1 General approach

International Finance Corporation proposed a Good Practice Handbook to assess cumulative impact of a project. Good practice requires that sponsors assess if project may contribute to cumulative impact on VEC's (valued environment components). When there is a lack of baseline data the handbook propose to develop a Rapid Cumulative Impact Assessment Approach. The Good Practice Handbook, also proposing a logical framework with six interactive steps. Figure 1 below illustrates this approach.

The sequence of activities is:

1) Determine project boundaries
2) Identify Valued Environmental Components (VEC)
3) Determine present conditions of VEC
4) Assess the contribution of project
5) Predict the cumulative impact of project
6) Design mitigation measures



Source: IFC Good Practice Handbook

We used a RCIA process that begins with principles of environmental impact assessment generally accepted in Vietnam. The key to this approach is to choose a set of "valued environment components" (VECs) that will be the focus of the assessment. Focusing on VECs, rather than the effects, enables one to ask specific questions in specific places about the effects of a full array of human and economic activities (i.e., the cumulative effects).

The PMU used a RCIA process that begins with the choice of a set of "valued environmental components" (VECs). That focuses the assessment on the cumulative effects on the VECs. We chose specific VEC identified in RFP as our components in RCIA to be monitor:

- Surface Water
- Underground Water
- Air
- Sludge
- Soil

These VECs were chosen largely for the purposes of demonstration. For each VEC we:

- Chose a set of indicators to represent the status of VECs;
- Chose limits of acceptable change or limits of concern for indicators for the VECs as per TCVN references;
- Collect information about the historical and current status of the indicators;
- Project the future status of the indicators (where appropriate).

Indicators for all five VECs required a model depicting the change in watershed conditions. We used a map describing the zone of influence. A variety of data was used from previous studies. We will project development scenarios for 20 years into the future using a combination of trend analysis. The model selected is evaluated with the Chemiotox Index tool

Once the cumulative impacts are determined, their significance must be considered relative to an established threshold limit, an established legal guideline or policy, or a qualitative assessment based on professional opinion and consultation. In any case, the significance of the cumulative impacts must be defensible. The significance of the cumulative impacts and the contribution of the project must be subsequently evaluated by project decision makers. The consultant needs to define the level of "significance" or scale and apply it consistently. The significance should be assessed across past, present and future projects on the trends of each VEC. The significance of the project interventions' contribution to the cumulative impacts should be defined in one of the following ways:

- The project has a measurable effect on the resource;
- The project acts in conjunction with the effects of past present or future projects and activities; and
- The project in conjunction with other projects and activities shifts the resource to an unacceptable level or exceeds a threshold such that the impact is considered significant, in that:
  - The project's contribution to cumulative effects is responsible for exceeding or not the threshold and therefore is significant or,
  - The project is contributing with the effects of other projects and activities and the project contribution may or may not be significant, depending on the level of the contribution.

9.1.2. Modeling

The Chemiotox Index model is a mathematical tool for evaluating the overall picture of the toxic substances discharged into the environment. This evaluation is based on the chemical characterization results of toxic substances (mg/L), following the weighting (FTOX) of the relative toxic potential of each substance present in the waste discharged. For practical purposes, partial indicators (Chemiotox unit, CU) are calculated on the basis of individual results of each toxic substance in order to integrate these and obtain an overall indicator (Chemiotox Index, CI = Σ CU). These indicators allow the comparison and integration of important quantities of characterization data.

The toxicity weighting methodology is quite simple and, serves uniquely *environmental management purposes*. Water quality criteria represent an exhaustive census of toxicological information on pollutants (*persistence, bio-accumulation and part of the food chain*). This census aims to define the acceptable concentration limit (mg/L) for the protection of human life and aquatic ecosystems. The more toxic the substance, the smaller the criterion. In the CHEMIOTOX model, two water quality criteria were retained, that is the chronic toxicity criteria (CTC, mg/L) and those pertaining to the contamination of aquatic organisms (CAOC, mg/L).

With these two types of criteria, the toxic effects of chronic exposure to a substance and its bio-concentration capacity in the food chain are both taken into account. The toxic weighting factor, F_{TOX-I} related to each substance I, could be arbitrary by defined as proportional to the inverse of the most stringent water quality criterion for each substance (MSC_I):

$$\boldsymbol{Most\ stringent\ criteria = Most\ severe\ of\ CTC\ and\ CAOC}$$

Or:

$$\boldsymbol{MSC_I = Min\ (CTC, CAOC)}$$

Then, for purposes of managerial communications, the $\mathbf{F_{TOX\text{-}I}}$ could be arbitrarily defined as the ratio of $MSC_{REFERENCE}$ of a reference substance to the MSC_I of the concerned priority pollutant I.

$$\boldsymbol{F_{TOX-I} = \frac{MSC_{REFERENCE}}{MSC_I}}$$

This is a dimensionless number that represents the toxic potential of a pollutant I in comparison to the toxicity of a reference contaminant. Generally it is recommended to select as reference a well-known contaminant. It has to be assigned to a given pollutant to evaluate its relative importance in the global discharge of a list of priority (selected) pollutants.

The reference substance could be the well-known parameter Fe_{TOT} whose most stringent criteria is equal to 0,3 mg/L (CAOC). In this case, the F_{TOX-I} of a substance i becomes as follows:

$$\boldsymbol{F_{TOX-I} = \frac{MSC_{Fe}}{MSC_I}}$$

Let remind that it is necessary to select a well-known reference contaminant for environment management and large communication purposes. Illustrate the usefulness of the tool with the data and results gathered for the channel ThamLuong – BenCat –NuocLen in order to summarize the state of the situation in some simple figures that should be understood for most of project stakeholders.

9.2. Rapid Cumulative Impact Assessment

9.2.1. Determine project boundaries

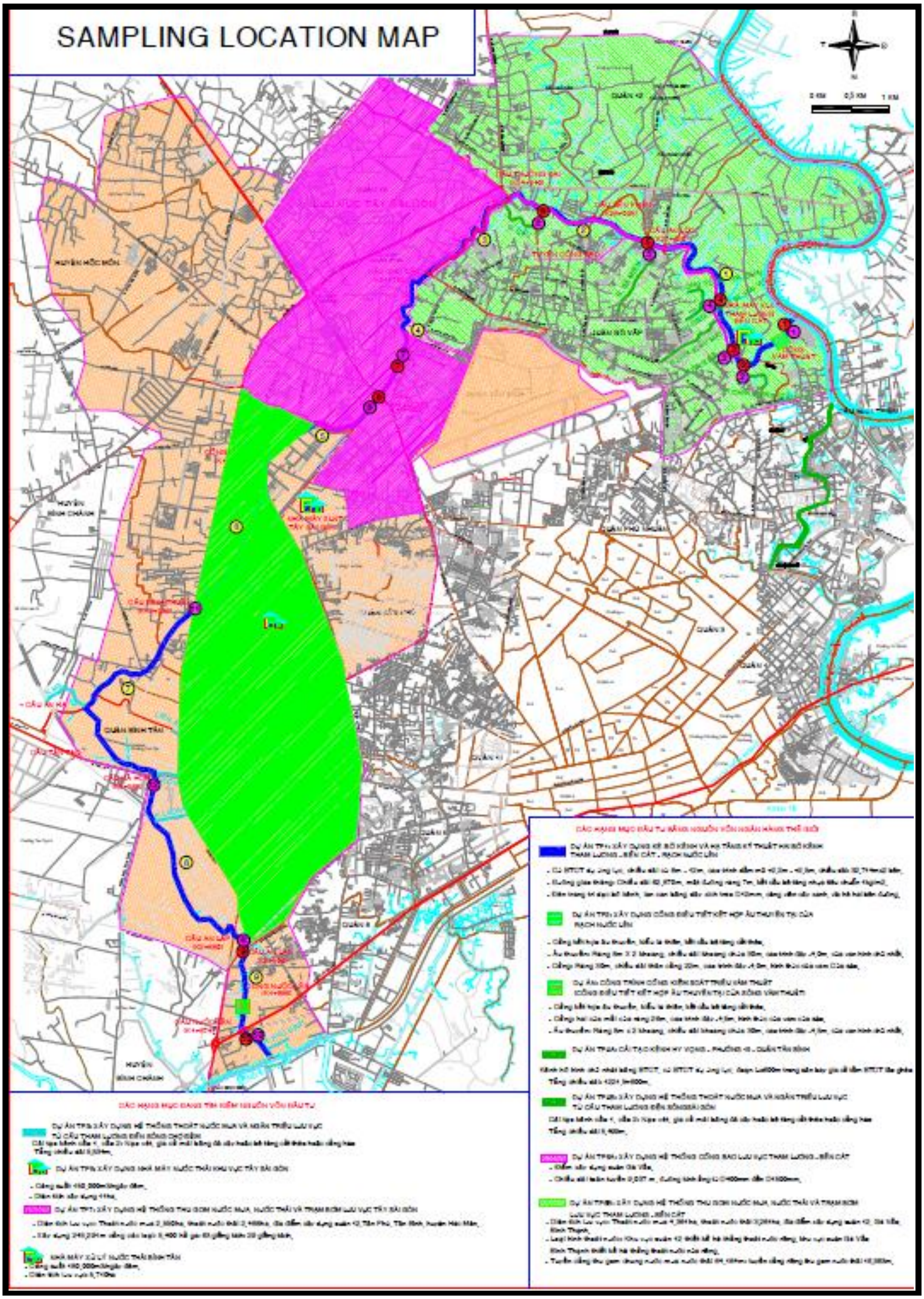
It is noted that environmental impact assessment for the project is conducted based on the guidelines of OP4.01. PMU and **exp** agreed on a Sampling Program. Available documents listed in Table 9.0 were reviewed and data were collected from these documents.

Table 9.1 List of Reviewed Documents

No.	Title	Date of document
1	The FS and EIA for construction of Nuoc Len tidal sluice gate and 2 ship locks.	FS approved by PC on 15/9/2012; EIA approved on 30/12/2011.
2	The FS and EIA for construction of Vam Thuat tidal sluice gate and 2 ship locks.	FS approved by DARD on 24/2/2012; Detailed technical design approved on 21/12/2012; EIA approved on 30/12/2011.
3	The FS and EIA for dredging and construction of canal bank revetment in the main canal of THAM LUONG – BEN CAT – NUOC LEN. (Note: This SP also includes roads and lighting works which are not included in the present WB funding and EIA requirements).	FS approved by PC on 23/3/2012 and EIA approved on 21/11/2011. FS and EIA to be revised in line with the new cost estimates and detailed design.
4	The FS and EIA for construction of main interceptor in GO VAP District (9km long).	FS appraised by DARD on 28/08/12; EIA approved on 07/02/2012.
5	The FS and EIA for construction and improvement of primary and secondary combined sewer systems and the secondary interceptor in GO VAP District.	FS approved by PPC on 01/08/2012; EIA approved on 07/02/2012; cost estimates to be revised.
6	The FS and EIA for improvement of HY VONG secondary canal.	FS appraised by DPI in 2012; EIA approved on 22/6/2012; cost estimates to be revised.
7	The FS and EIA for improvement of secondary canals (CHIN XIENG, BA MIENG, ONG TONG, ONG BAU and CAU CUT) connected to THAM LUONG – BEN CAT – NUOC LEN).	FS appraised by DPI; EIA approved on 22/6/2012; cost estimates to be revised.

Some data were collected from previous monitoring data, available from the PMU, SCFC and DONRE (Department of Natural Resources and the Environment). However, in order to obtain sufficient baseline data for ESIA, **exp** carried out the required additional sampling and testing work for surface water, groundwater, sediment/sludge, soil, air quality, plankton & phytoplankton. Details on the Plan for measurement, sampling, collecting information, including information on: environmental monitoring, the number of sampling locations, monitoring parameters, sampling frequency and quality standards applied for result analysis are summarized in Annex 10.

Meanwhile, existing data were analysed and compilation was done and calculation were done with Chemiotox index analysis. The sampling point will be completed at the stations identified with PMU. The next map show these sample point stations. Existing data referring to these sampling points were extracted to calculate the existing Chemiotox Index and to evaluate a cumulative impact of contamination before 2012 and in 2015.


SAMPLING LOCATION MAP

9.2.2. Identify Valued Environmental Components (VEC)

The environmental components that will be considered and assessed are: air, climate and noise; soil and groundwater; water and aquatic resources (fauna and flora), sediment and settled sludge. For modeling and impact evaluation, impact on five VEC's will be measured. Information is collected to ensure a prediction of environmental quality of the following:

- Surface Water Quality – in the main TL-BC-NL canal and the secondary canals; Plankton & Phytoplankton in surface water
- Sediment and Sludge characterization including waste classification for hazardous waste;
- Groundwater Quality;
- Soil quality;
- Ambient air quality

9.2.3. Summarizing the past conditions of the VEC (before 2012)

In the preliminary step, it is necessary to produce the synthesis of previous results and data gathered during the feasibility studies (Components 1, 2, 4A, 4B, 6A and 6B) and from various environment monitoring reports in order to avoid the replication of future project monitoring activities.

9.2.3.1. Summary of results (before 2012) on surface water

For defining the quality of surface water the MoNRE has established the QCVN 08:2008/BTNMT. While it is not a complete and sufficient tool for managing and controlling the quality of rivers and other water bodies that must deserve simultaneous multiple purposes (supply water, supply water in case of available treatment plant, irrigation and fluvial navigation), one should rely at least on its quality criteria and add adequate other ones depending on each situation (spatial and temporal).

At this step of project let propose the following lists of F_{TOX-I} based on the maximum allowable concentrations (MAC) of QCVN 08:2008/BTNMT:

Table 9.2 The FTOX for surface water quality

			QCVN 08:2008/BTNMT				Toxicity Factors			
			A		B		Ftox (A1)	Ftox (A2)	Ftox (B1)	Ftox (B2)
No.	Parameter	Unit	A1	A2	B1	B2				
	COD	mg/L (O_2)	10	15	30	50	0,05	0,07	0,05	0,04
	NH_4-N	mg/L (N)	0,1	0,2	0,5	1,0	5	5	3	2
	NO_2-N	mg/L (N)	0,01	0,02	0,04	0,05	50	50	37,5	40
	Cl-	mg/L	250	400	600	10 000	0,0020	0,0025	0,0025	0,0002

			QCVN 08:2008/BTNMT				Toxicity Factors			
			A		B		Ftox (A1)	Ftox (A2)	Ftox (B1)	Ftox (B2)
	CN-	mg/L	0,005	0,010	0,020	0,020	100	100	75	100
	F-	mg/L	1	1,5	1,5	2	0,5	0,67	1	1
	PO_4^{3-}	mg/L (P)	0,1	0,2	0,3	0,5	5	5,00	5	4
	As	mg/L	0,01	0,02	0,05	0,10	50	50	30	20
	Cd	mg/L	0,005	0,005	0,010	0,010	100	200	150	200
	Pb	mg/L	0,02	0,02	0,05	0,05	25	50	30	40
	Cr (III)	mg/L	0,05	0,10	0,5	1,0	10	10	3	2
	Cr (VI)	mg/L	0,01	0,02	0,04	0,05	50	50	37,5	40
	Cu	mg/L	0,1	0,2	0,5	1,0	5	5	3	2
	Zn	mg/L	0,5	1,0	1,5	2,0	1	1	1	1
	Ni	mg/L	0,1	0,1	0,1	0,1	5	10	15	20
	Fe	mg/L	0,5	1,0	1,5	2,0	1	1	1	1
	Hg	mg/L	0,001	0,001	0,001	0,002	500	1 000	1 500	1 000
	Surfactant	mg/L	0,1	0,2	0,4	0,5	5	5	3,75	4
	Total Oil & Grease	mg/L	0,01	0,02	0,1	0,3	50	50	15	6,7
	Aldrin + Dieldrin	µg/L	0,002	0,004	0,008	0,010	250 000	250 000	187 500	200 000
	Endrin	µg/L	0,010	0,012	0,014	0,020	50 000	83 333	107 143	100 000
	BHC	µg/L	0,050	0,100	0,130	0,015	10 000	10 000	11 538	133 333
	DDT	µg/L	0,001	0,002	0,004	0,005	500 000	500 000	375 000	400 000
	Endosunfan	µg/L	0,005	0,010	0,010	0,020	100 000	100 000	150 000	100 000
	Lindan	µg/L	0,30	0,35	0,38	0,40	1 667	2 857	3 947	5 000
	Chlordane	µg/L	0,01	0,02	0,02	0,03	50 000	50 000	75 000	66 667
	Heptachlor	µg/L	0,01	0,02	0,02	0,05	50 000	50 000	75 000	40 000

			QCVN 08:2008/BTNMT				Toxicity Factors			
			A		B		Ftox (A1)	Ftox (A2)	Ftox (B1)	Ftox (B2)
	Parathion	µg/L	0,10	0,20	0,40	0,50	5000	5 000	3 750	4 000
	Malathion	µg/L	0,10	0,32	0,32	0,40	5000	3 125	4 688	5 000
	2,4-D	µg/L	100	200	450	500	5,0	5,0	3,3	4,0
	2,4,5-T	µg/L	80	100	160	200	6,3	10,0	9,4	10,0
	Paraquat	µg/L	900	1 200	1 800	2 000	0,6	0,8	0,8	1,0

Several notices are necessary:

- The reference contaminant has been the parameter Fe_{TOT}. For illustration purpose, the various values of F_{TOX} related to the mercury (Hg) will be assessed as follow:
- Supply water :
  - F_{TOX-Hg} (A1) = $[Fe]_{MAC}$ (A1) / $[Hg]_{MAC}$ (A1) = 0,5 / 0,001 = 500
- Supply water with available treatment plant:
  - F_{TOX-Hg} (A2) = $[Fe]_{MAC}$ (A2) / $[Hg]_{MAC}$ (A2) = 1,0 / 0,001 = 1 000
- Irrigation use:
  - F_{TOX-Hg} (A3) = $[Fe]_{MAC}$ (A3) / $[Hg]_{MAC}$ (A3) = 1,5 / 0,001 = 1 500
- Fluvial navigation use:
  - F_{TOX-Hg} (A4) = $[Fe]_{MAC}$ (A4) / $[Hg]_{MAC}$ (A4) = 2,0 / 0,002 = 1 000

Some parameters would be discarded in the assessment of F_{TOX} for several reasons:

- The pH values are based on logarithm.
- Values of D.O. are random and depend on weather conditions. Of course when D.O. is low, it should reveal permanent high anaerobic biodegradation rate but also high warm temperature combined with no-winding conditions.
- TSS often depends on natural turbidity in VietNam that is often high (Mekong, Red River, etc.)
- BOD_5 (20^{o}C) values depends only on easy-biodegradable organics and are not representative in the case of cumulative environment impacts. COD is more representative of BOD_{21} or BOD_{ULT}.

- Nutrients NO_3^- is not really toxic for human and aquatic organisms, and would be discarded from the list of "hard" pollution parameters to be taken in consideration in the case of strongly-polluted urban channels.
- E. coli, Fecal & Total coliforms are certainly present in all the surface water in VietNam due to the general lack of wastewater treatment plants. Their cumulative effects in contaminated surface water are difficult for interpretation. We can just mention that presence is whether greater than the MACs in each case.

The details of calculations will be presented in Appendices for interested lectors. The following Figure 9.1 illustrates the calculation results for the various monitoring locations identified by monitoring activities organized within previous projects (before 2012). With the available results, one can preliminary estimate that the Environment Monitoring report (July 2011) reveals a greater level of cumulative environ impact (due to various discharge) within the central area, approximately close to CauBung area. The situation should be worse approximately at the junction of the sewer CauBung and the main channel. At this location the daily hydraulic tidal effects would be low and could not contribute to the purge-mix of surface water toward directly the Saigon River (at VamThuat) and indirectly the ChoDem channel.

An important lack of results for the official toxic parameters (heavy metals, pesticides and other toxic organics) exists within the various results gathered before 2012. The pollutants related to these parameters are generally non-biodegradable. They are qualified as persistent, bio-accumulative and part of the chain food (bio-amplification) and they should contribute to the cumulative environmental effects over several years.

9.2.3.2. Summary of results (before 2012) on sediment/sludge

The QCVN 43:2012/BTNMT has been published in 2012. It can be serves as a technical explanation why monitoring campaigns aiming sediments & settled sludge had not focused enough on complete lists of heavy metals and other such organic toxic pollutants as pesticides. Hover on the basis of incomplete useful results the Chemiotox Index methodology has produced a meaningful overview of the state on contamination and buildup of pollutants in the bottom volume on sediments along the main channel TL-BC-NL (See Figure 9.2).

The Chemiotox calculations have been based on a mix of data from QCVN 43:2012/BTNMT and QCVN 03:2008/BTNMT, its equivalent for soils. Most of the monitoring activities before 2012 have been based on contaminants listed in the latter that includes the heavy metals Cu and Zn. The more recent QCVN 43:2012/BTNMT does not include these metals and Fe.

9.2.3.3 . Summary of results (before 2012) on groundwater

Previous results (before 2012) are the less significant because water samples were not taken for piezometers (observation wells) implemented accordingly to a scientific method based at least on the knowledge of underground soil and aquifer layers. The water samples seem be randomly taken at available inhabitant wells. The inhabitants would find themselves the best locations for implementing useful wells offering suitable service water (domestic purposes) and avoid the contaminated locations. So we should give less attention to the previous results (See Figure 9.3).

9.2.3.4. Summary of results (before 2012) on ambient air quality

The QCVN 05:2013/BTNMT and QCVN 06:2009/BTNMT together deserve the assessment of ambient air quality according the Chemiotox Index methodology. The reference contaminant will be the well-known CO whose MAC is 30 000 µg/m3 or 30 mg/m3. Most of parameters listed in the QCVN 05:2013/BTNMT should be related to air contaminants due to local traffic or industrial combustion while the gaseous contaminants NH3 and H2S should be due to emanations from anaerobic biodegradation within the liquid body of the main channel or due to savage solid waste dumping along the banks of the main channel. An overall portrait is illustrated into Figure 9.4.

Table 9.2 The FTOX for ambient air quality

			QCVN 05:2013/BTNMT				Toxicity Factors			
No.	Parameter	Unit	Avg-1h	Avg-8h	Avg-24h	Avg-year	Ftox (1h)	Ftox (8h)	Ftox (24h)	Ftox (year)
	SO_2	µg/m³	350		125	50	85,7			
	CO	µg/m³	30 000	10 000	5 000		1,0			
	NOx	µg/m³	200		100	40	150,0			
	O_3	µg/m³	180	120	80		166,7			
	TSP	µg/m³	300		200	140	100,0			
	PM_{10}	µg/m³			150	50				
	Pb	µg/m³			1,5	0,5				
			QCVN 06:2009/BTNMT							
	NH_3	µg/m³	200				150,0			
	H_2S	µg/m³	42				714,3			

The measured fluctuations along the main channel depend strongly of the contributor sources but also meteorological conditions (wind, rains, etc.). While the QCVN 05:2009/BTNMT establish a maximum allowable concentration (MAC) of 30 000 µg/m3 for the well-known contaminant CO (carbon monoxide), the "bad" quality of ambient air can be assessed by a general approximate level of 80 – 130 000 µg/m3 of Chemiotox Units (or µg/m3 CO-equivalent toxicity).

Fluctuations of SURFACE WATER characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	3,2	2,9	4,7	8,9	8,9	30,5	69,6		162	15,4	25,6	5,9	5,8	4,6	6,5	74,4	5,4	5,4	5,4	7,6	3,5

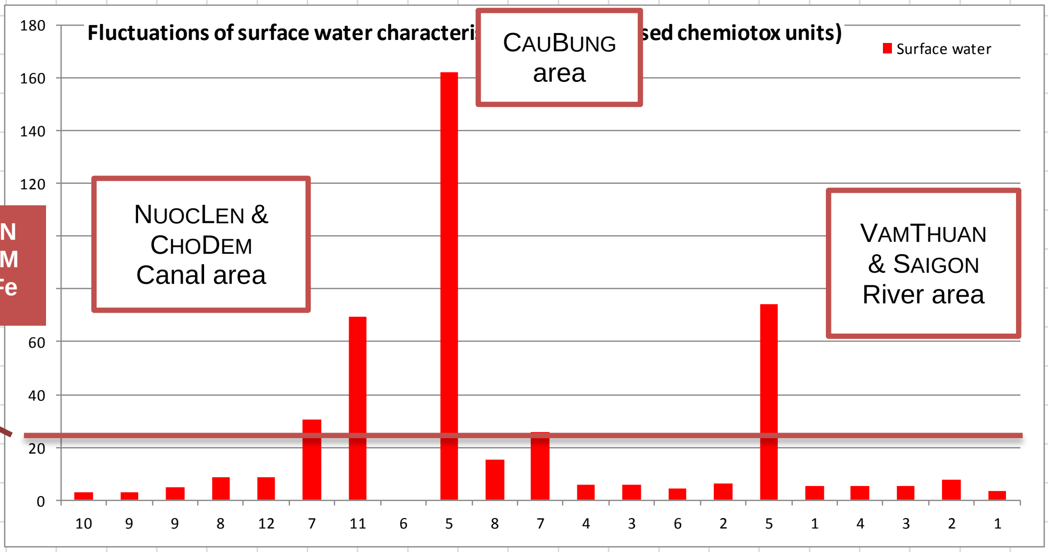


Figure 9.1 Overall portrait of surface water characteristics along the main channel TL-BC-NL.

Fluctuations of SEDIMENT characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	136,2		128,1		124,6		98,2			147,8	153,6	202,6	186,6	183,1	241,8	139,9				98,3	119,2

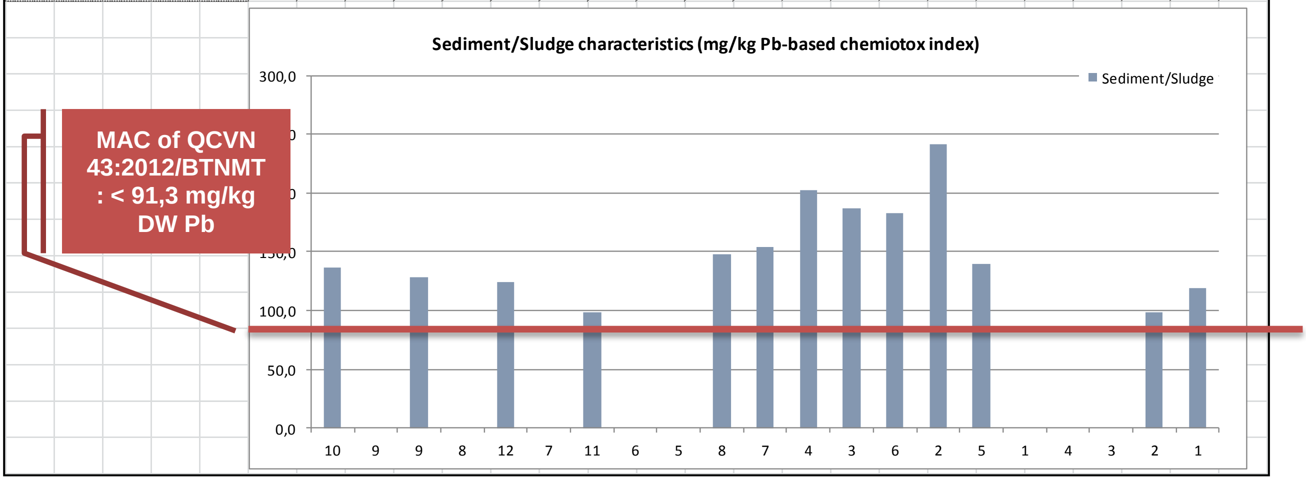


Figure 9.2 Overall portrait of the contamination of sediment and settled sludge.

Fluctuations of GROUNDWATER characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	**9**	**9**	**8**	**12**	**7**	**11**	**6**	**5**	**8**	**7**	**4**	**3**	**6**	**2**	**5**	**1**	**4**	**3**	**2**	**1**
Chemiotox Index		1,392		1,219		1,419		0,960	0,504		0,896	0,517	0,389		1,500	0,400	0,357	0,456			1,645

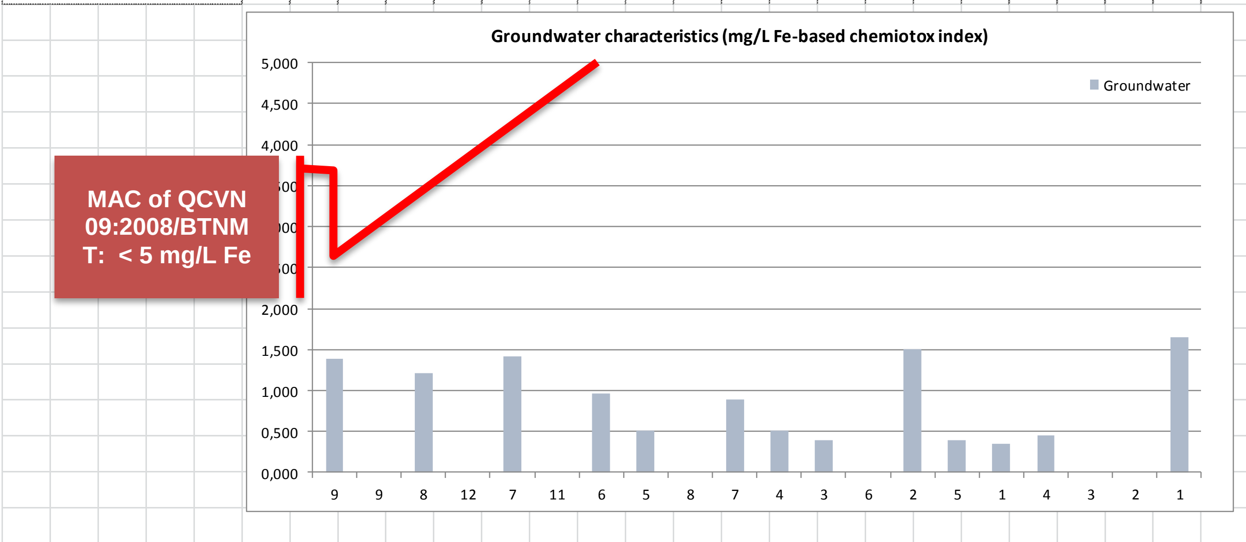


Figure 9.3 Overall portrait of the groundwater characteristics at private domestic wells.

Fluctuations of AMBIENT AIR characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	**9**	**9**	**8**	**12**	**7**	**11**	**6**	**5**	**8**	**7**	**4**	**3**	**6**	**2**	**5**	**1**	**4**	**3**	**2**	**1**
Chemiotox Index	83 183	130 063	104 086	110 356	113 393	136 183	88 107	83 183	101 857	136 154	119 497			112 046	97 627	92 725	96 249	90 417		101 673	75 605

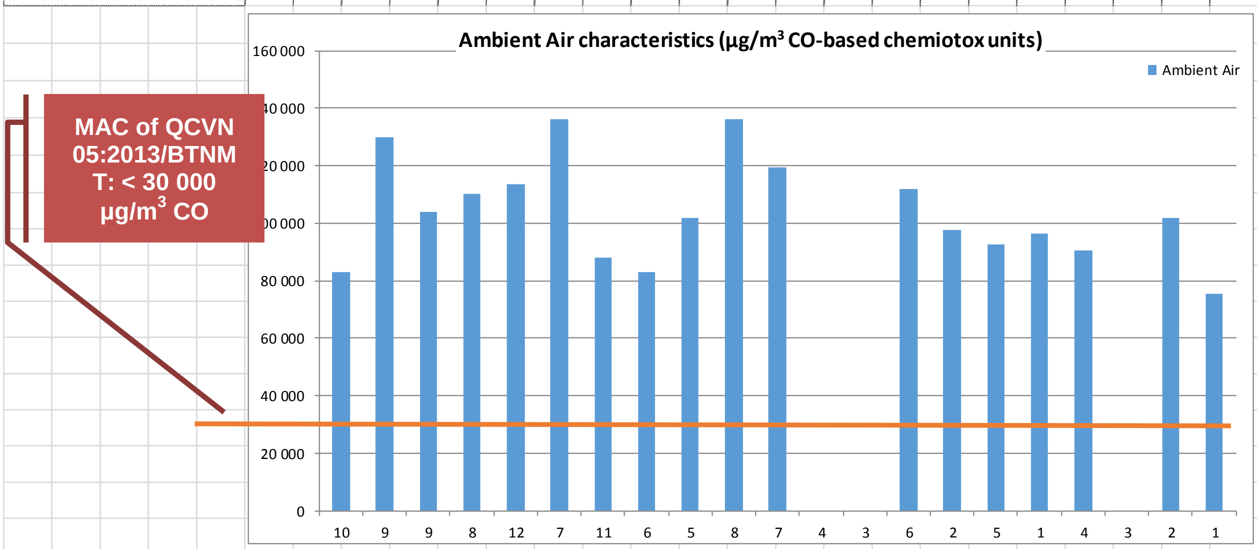


Figure 9.4 Overall portrait of the groundwater characteristics at domestic wells.

9.2.3.5. What is missing in the results (before 2012)

The implementation of a cumulative impact assessment approach requires data related to the contributor sources (the existing wastewater treatment plant, industrial park discharges, city sewers un-connected to the interceptors and various canals) to the global contamination of the main water receiving body. If each contributor can be monitored including the eco-toxic pollutants (heavy metals and other organics: BTEX, VOCs, PAHs, etc.) we could applied the factors FTOX-I to the discharge loads (kg/d) and deduce the specific loads in Chemiotox Index (C.I./d) for each of them. The above schematic (Figure 9.5) illustrates this situation.

Then the cumulative impact per day can be assessed as follows:

$$C.I._{TOT} = \sum_{1}^{n} C.I._i = (C.I.)_1 + (C.I.)_2 + (C.I.)_3$$

The contributor sources would be the following:

- Final effluent of the wastewater treatment plant discharged in the NuocDen canal;
- Effluents of the canals of HyVong, CauCut, BaMien, OngTong, Dua (CauMat); Ong Bau and ChinXieng;
- BenCat River;
- Effluents of the canals of OngBut, LuongBeo, BaNeng and PhuDinh; and
- Various discharge points that are not indicated on the city maps.

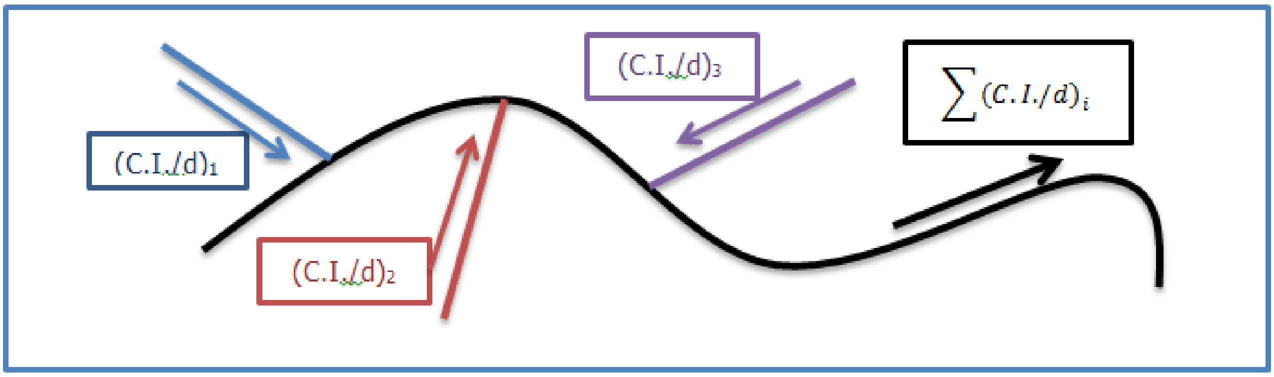


Figure 9.5 Schematic of load discharges in a water receiving body.

It should be emphasized: in order to implement the cumulative impact assessment approach for the future, one must only consider amongst a multitude of potential pollutants the persistent and whole part of food chains (bio-accumulation and bio-amplification). They are generally represented by the eco-toxics (heavy metals and other priority toxic organics).

The construction project will eliminate some percentages or the whole part of certain contributor sources. Other contributor sources can remain at the same levels or less while new ones can add their discharge loads in the future. The Environment Management Plan (EMP) should adopt the same list of parameters for further monitoring activities. With the Chemiotox Index it should be simple to retrieve the cumulative impact assessment with consolidated data (spatial and temporal) in order to establish the environment-sustainability of the whole construction project.

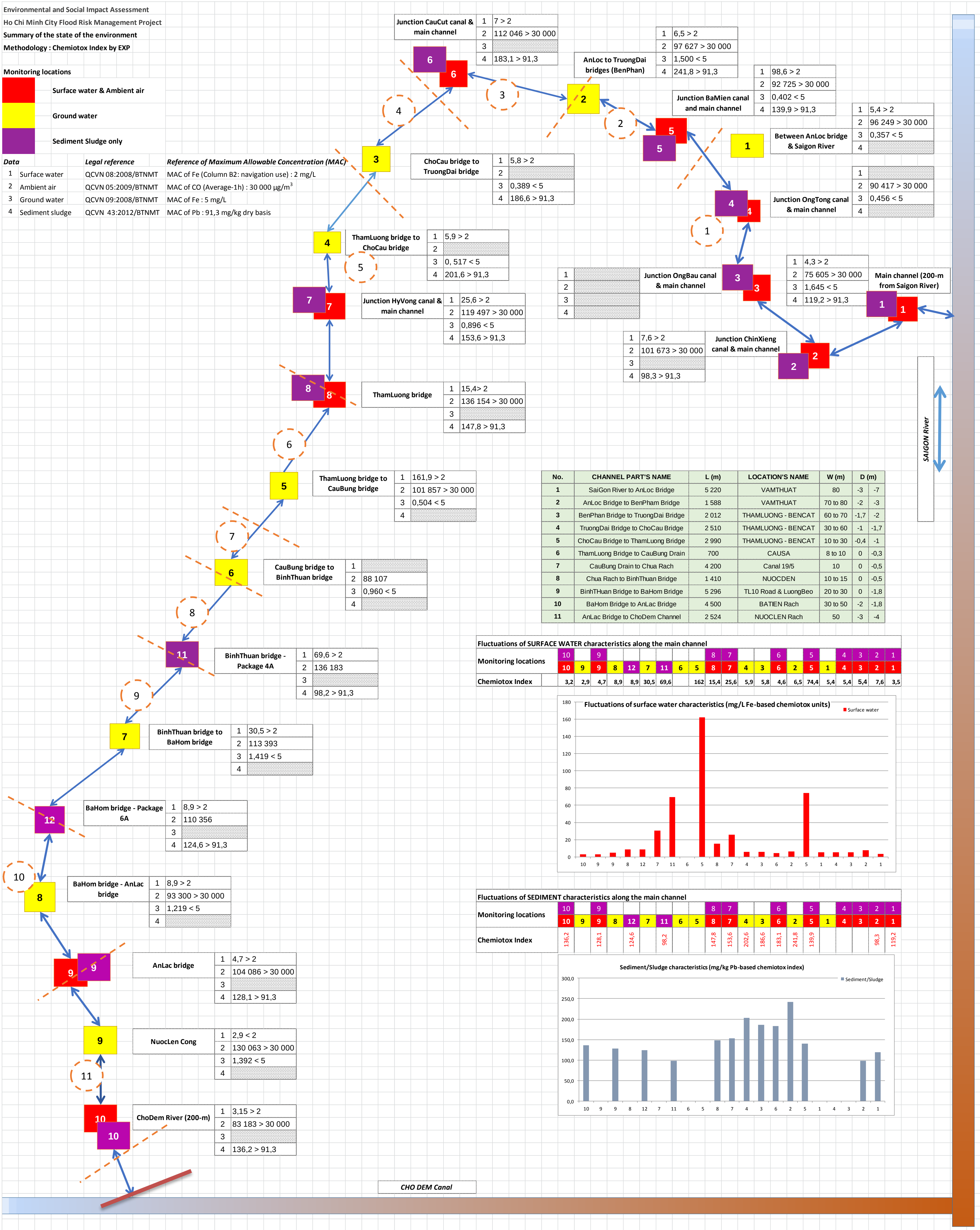
9.2.3.6. Cumulative Impact before 2012

The Figure 9.6 presented below summarize the results gathered from existing studies before 2012 for the sampling points agreed for the PPTA for HCMC Flood Control Program in channel Tham Luong – Ben Cat – Nuoc Len. Available data are compiled in the following model.

The graphic of the Figure 9.7 (Profile and plan views of the main channel) illustrates that contamination is at highest point at the Tham Luong Bridge and at junction of Hy Vong Canal and Tham Luong – Ben Cat – Nuoc Len channel. A build-up of pollutant contents should occur at the locations where the hydraulic tidal effects are the less important: at the central areas of the main channel. The total length of the main channel is 32 950 m. Depth varies from – 7.0 m (ref. sea level 0-m) at the junction of Saigon River to – 4.0 m at the junction with ChoDem Channel. Between BinhThuan Bridge and ThamLuong Bridge we face a very low depth varying from 0 to - 0,4 m.

At low tide, the central areas should act as a long settling canal favourizing the settlement of suspended solids and consequently the increase of bottom layers of sediments. Build-ups of persistent pollutants (heavy metals and other non biodegradable organis) should contibute to a cumulative environmental impact.

No.	CHANNEL PART'S NAME	L (m)	LOCATION'S NAME	W (m)	D (m)	
1	SaiGon River to AnLoc Bridge	5 220	VAMTHUAT	80	-3	-7
2	AnLoc Bridge to BenPham Bridge	1 588	VAMTHUAT	70 to 80	-2	-3
3	BenPhan Bridge to TruongDai Bridge	2 012	THAMLUONG - BENCAT	60 to 70	-1,7	-2
4	TruongDai Bridge to ChoCau Bridge	2 510	THAMLUONG - BENCAT	30 to 60	-1	-1,7
5	ChoCau Bridge to ThamLuong Bridge	2 990	THAMLUONG - BENCAT	10 to 30	-0,4	-1
6	ThamLuong Bridge to CauBung Drain	700	CAUSA	8 to 10	0	-0,3
7	CauBung Drain to Chua Rach	4 200	Canal 19/5	10	0	-0,5
8	Chua Rach to BinhThuan Bridge	1 410	NUOCDEN	10 to 15	0	-0,5
9	BinhTHuan Bridge to BaHom Bridge	5 296	TL10 Road & LuongBeo	20 to 30	0	-1,8
10	BaHom Bridge to AnLac Bridge	4 500	BATIEN Rach	30 to 50	-2	-1,8
11	AnLac Bridge to ChoDem Channel	2 524	NUOCLEN Rach	50	-3	-4



No.	CHANNEL PART'S NAME	L (m)	LOCATION'S NAME	W (m)	D (m)	
1	SaiGon River to AnLoc Bridge	5 220	VAMTHUAT	80	-3	-7
2	AnLoc Bridge to BenPham Bridge	1 588	VAMTHUAT	70 to 80	-2	-3
3	BenPhan Bridge to TruongDai Bridge	2 012	THAMLUONG - BENCAT	60 to 70	-1,7	-2
4	TruongDai Bridge to ChoCau Bridge	2 510	THAMLUONG - BENCAT	30 to 60	-1	-1,7
5	ChoCau Bridge to ThamLuong Bridge	2 990	THAMLUONG - BENCAT	10 to 30	-0,4	-1
6	ThamLuong Bridge to CauBung Drain	700	CAUSA	8 to 10	0	-0,3
7	CauBung Drain to Chua Rach	4 200	Canal 19/5	10	0	-0,5
8	Chua Rach to BinhThuan Bridge	1 410	NUOCDEN	10 to 15	0	-0,5
9	BinhThuan Bridge to BaHom Bridge	5 296	TL10 Road & LuongBeo	20 to 30	0	-1,8
10	BaHom Bridge to AnLac Bridge	4 500	BATIEN Rach	30 to 50	-2	-1,8
11	AnLac Bridge to ChoDem Channel	2 524	NUOCLEN Rach	50	-3	-4

Figure 9.6 Overall portrait of the state of environment before 2012.

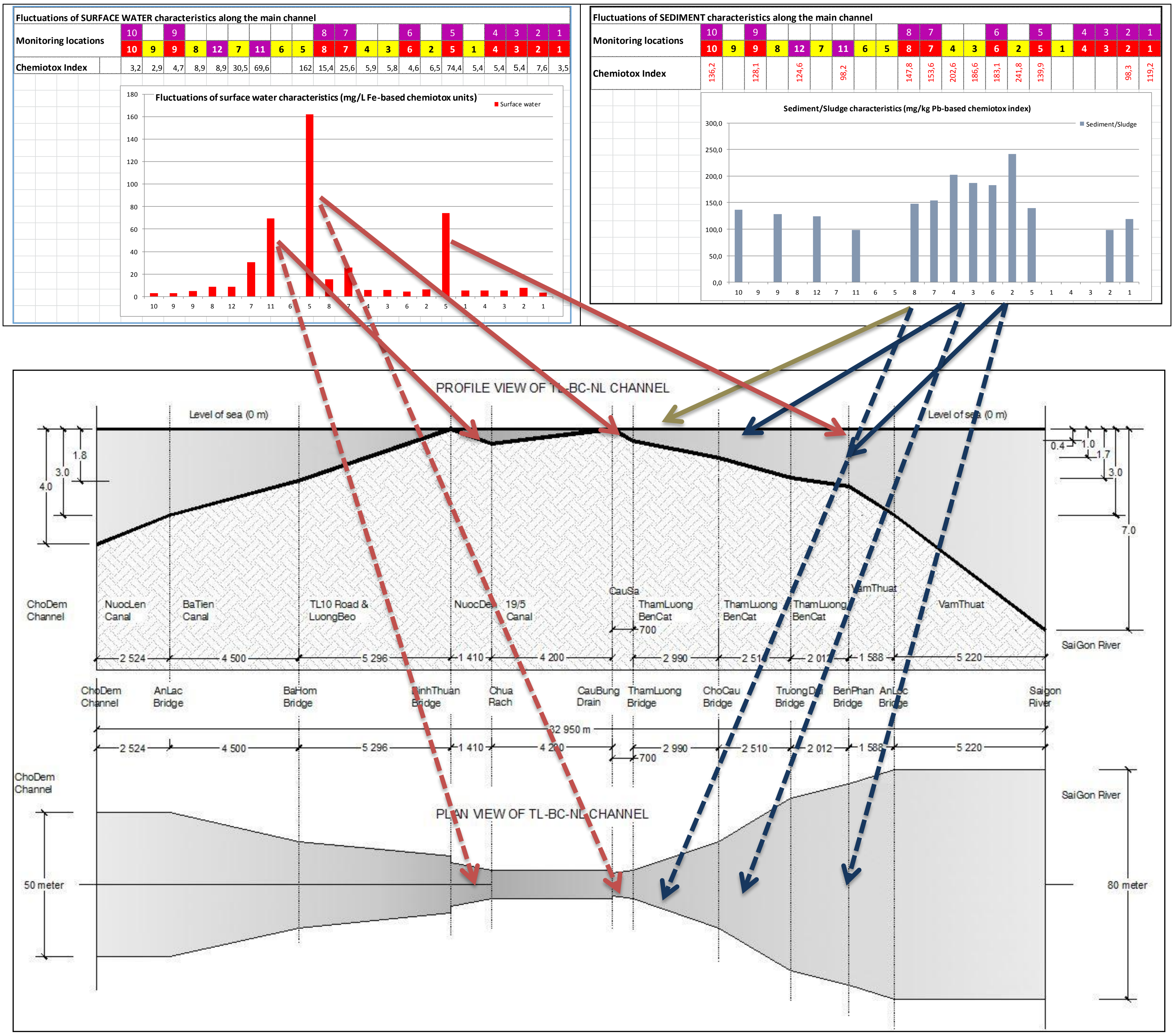


Figure 9.7 Illustration of build-up of pollutant contents in the center areas of the main channel.

9.3. Monitoring of present environmental conditions of VEC (in 2015)

The present environmental conditions of VEC (the state of the existing environment) have been consolidated by field monitoring campaigns completed in September 2015. This section present results screening of that campaign. Raw results will be gathered in the Appendices.

9.3.1. The surface water along the TL-BC-NL canal

Related to present surface water characteristics, data have been gathered from previous studies and reports (cf Figure 9.1) and analytical results from recent monitoring campaigns organized within the present mandate have been in-depth studied. The maximum allowable concentrations listed on the QCVN 08:2008/BTNMT (surface water) under the column B2 (fluvial navigation purposes) have been considered for the calculations of the toxicity factors FTOX related to each contaminant. The surface water has been characterized during the both conditions of low and high tide in order to understand the potential influence of hydraulic tidal effects. Traces of heavy metals have been largely analyzed (As, Cd, Pb, Cr, Cu, Zn, Fe and Hg). As usual, the MAC for the main contaminant Fe (2 mg/L) has been considered as reference for the calculation of FTOX. For instance, in the case of the contaminant Hg, the calculation is as follows:

$$F_{TOX\text{-}Hg} = \text{MAC of Fe / MAC of Hg} = 2 \text{ mg/L} / 0{,}002 \text{ mg/L} = 1\ 000$$

Several parameters have been discarded in the calculations of CHEMIOTOX UNITS. It can be explained as follow:

- The pH values are based on logarithm.
- Values of D.O. are random and depend on weather.
- TSS often depends on natural turbidity in VietNam.
- BOD_5 (20^oC) values depends only on biodegradable organics and are not representative in the case of cumulative environment impacts.
- Nutrients NO_3^- and SO_4^{2-} are not really toxics and would be discarded from the list of “hard” pollution parameters to be taken in consideration in the case of strongly-polluted urban channels.
- Cl^- is not so much present in polluted surface water in VietNam. It would be discarded to the profit of F^-.
- E. coli, Fecal & Total coliforms are certainly present in all the surface water in VietNam due to the general lack of wastewater treatment plants. Their cumulative effects in contaminated surface water are difficult for interpretation. We can just mention that presence is greater or not than the MACs in each case.

The Tables 9.3 to 9.9 summarize the results and conclusions found for the state of environment for surface water.

9.3.2. The sediment/sludge along the TL-BC-NL canal

Sediments have been largely monitored along the main channel. During the present mandate, EXP has focused on the potential effects of high and low tide, at some monitoring locations near the junction with Saigon River. The reference for Chemiotox calculations has been the QCVN 43:2012/BTNMT and the pollutant of reference is Pb. Its MAC is 91,3 mg/kg DW. A summary of results has been gathered on the Table 9.4. We can notice a build-up of concentrations at the locations where hydraulic tidal effects are the less important: central areas and in the deep layer of sediment.

9.3.3. The groundwater along the TL-BC-NL canal

The analytical results are compared to the MAC of QCVN 09:2008/BTNMT and the MAC of the parameter FeTOTAL: 5 mg/L has been taken in consideration for applying the Chemiotox Index methodology. The results are summarized on the Table 9.5. While most of the groundwaters are moderately contaminated, the first monitoring location (near the Saigon River, at Chin Xieng canal junction area) indicates a case of strong contamination by NH4-N and Fe. (See Table 9.5)

9.3.4. The soil along the TL-BC-NL canal

The soil along the main channel area is moderately contaminated by heavy metals. The reference is the QCVN: 03:2008/BTNMT and the MAC of Pb contaminant has been taken in consideration: 200 mg/kg DW. At several locations, the cumulative impact due the aimed heavy metals has demonstrated a value of Chemiotox Units greater than the MAC. Results are summarized in the Table 9.6.

9.3.5. The characteristics of ambient air along the TL-BC-NL canal

Characteristics of ambient air can be altered by both local traffic (TSP, CO & CO2, SO2, NO2, etc.) and emission for aquatic environment (mainly NH3, H2S and VOCs). Both QCVN related to the two series of contaminants are considered: QCVN 05:2013/BTNMT (average 1 hour) and QCVN 06:2009/BTNMT (average 1 hour). The well-known CO contaminant (MAC = 30 mg/m3) is taken in consideration for the calculations of Chemiotox Units. Results are summarized in the Table 9.7.

9.3.6. Plankton and Phytoplankton

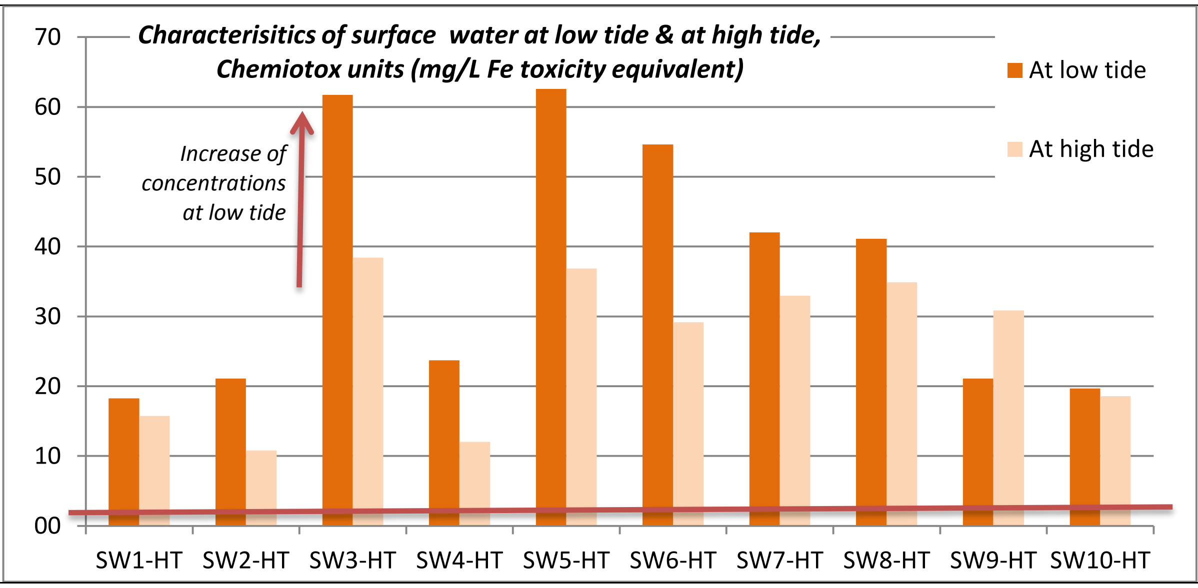
Biological inventories of plankton and phytoplankton have been organized in order to support the state of aquatic environment along the main channel. (See Table 9.8 and Table 9.9). Preliminary conclusions would be: in way of eutrophication.

Table 9.3 Summary of results for surface water

Summary of results for Surface Water monitoring along the ThamLuong–BenCat–NuocLen channel
The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 08:2008/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the CHEMIOTOX model uses the MAC for the parameter Fe_{TOTAL}: 2 mg/L (column B2: case of fluvial transportation). According to the calculations: • At low tide, there is a build-up of the presence of contaminants if during this period, discharges of the

latter continue on a regular or permanent basis (e.g. continuous discharge (24/7) of the final effluent of the wastewater treatment plant of BinhHungHoa, 150 000 m^3/d, continuous free discharge of raw wastewater through combined domestic sewers, etc.)

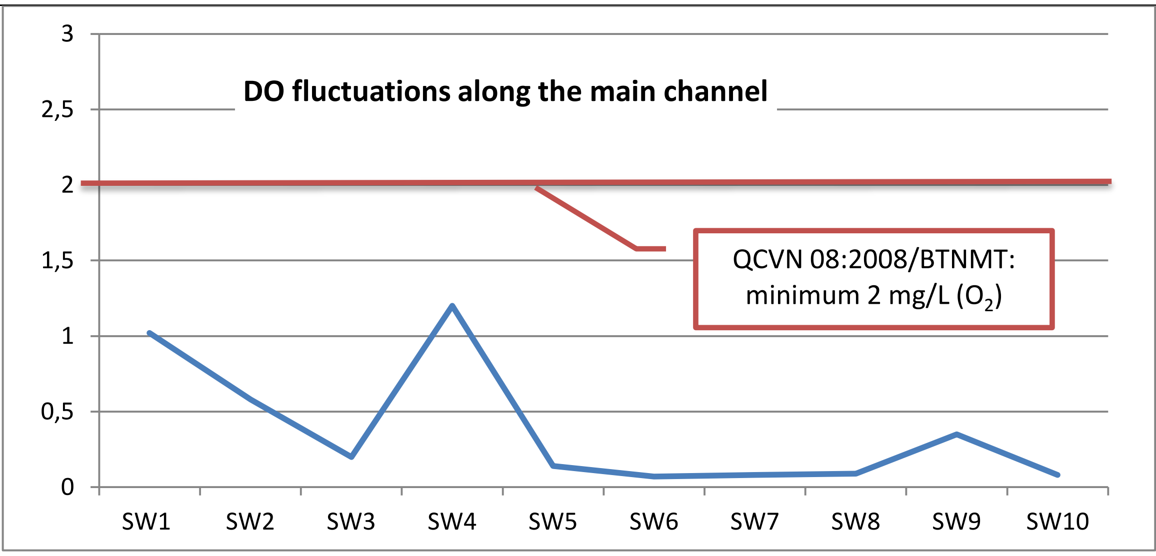
- Build-up of contaminants seems more higher at monitoring locations where hydraulic tidal effects would be less important (from OngBau Canal/SW3 to ThamLuong Bridge/SW8)
- From a managerial point of view, the cumulative effects on aquatic fauna (plankton) and flora (phytoplankton) would be far greater than the ones due to the sole MAC of 2 mg/L of Fe toxicity equivalent.



Summary of results for Surface Water monitoring along the ThamLuong–BenCat–NuocLen channel (cont'd)

Two main observations related to microbiological activities:

- Main contaminants should be biodegradable organics because the DO levels are very low in comparison with the recommended minimum of 2 mg/L (O_2).
- The presence of total coliforms is very high due to raw domestic wastewater discharge at several points. Contents in fecal coliforms should be very high accordingly.



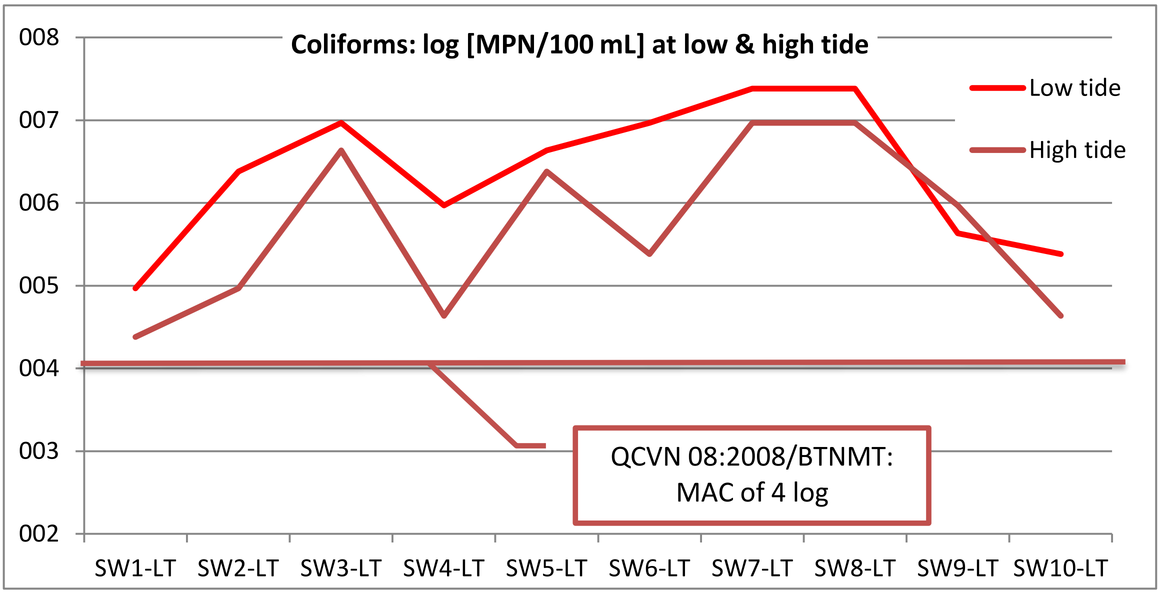
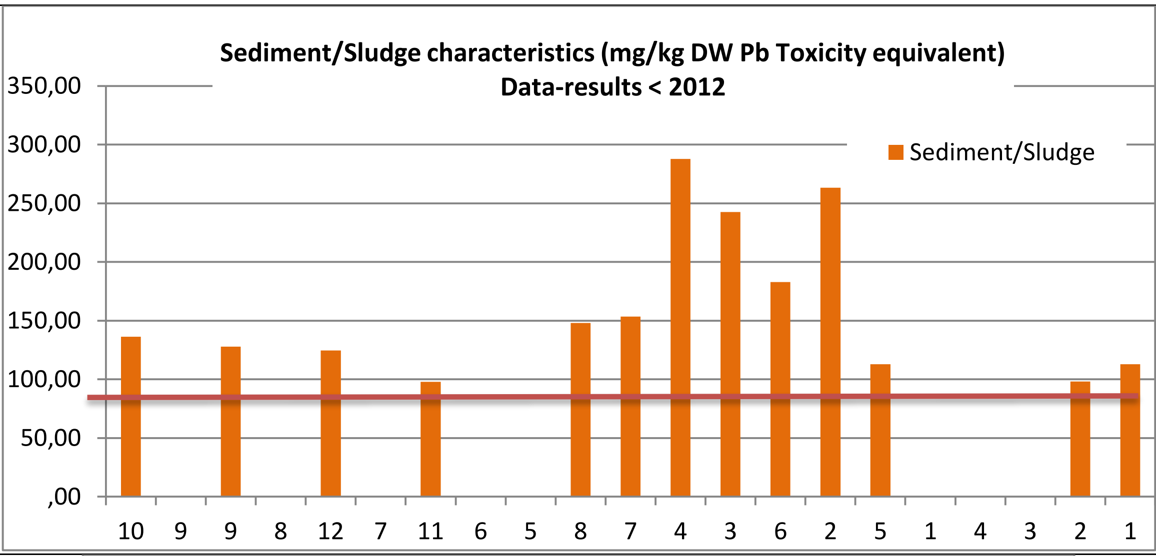


Table 9.4 Summary of results for sediment/sludge

Summary of results for Sediment/Sludge monitoring along the ThamLuong–BenCat–NuocLen channel

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 43:2012/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the CHEMIOTOX model uses the MAC for the parameter Pb_{TOTAL}: 91,3 mg/kg DW. According to the calculations:

- Along the main channel ThamLuong-BenCat-NuocLen, the results gathered during the previous project steps demonstrate a cumulative impact at the locations where hydraulic tidal effects would be less important.
- For a fixed area, three would be a progressive build-up of pollutants contents (heavy metals) at deep layers of sediment / sludge.
- The recent results indicate an absence of PAHs and pesticides in the sediments. There would be present under dissolved forms (in surface water).



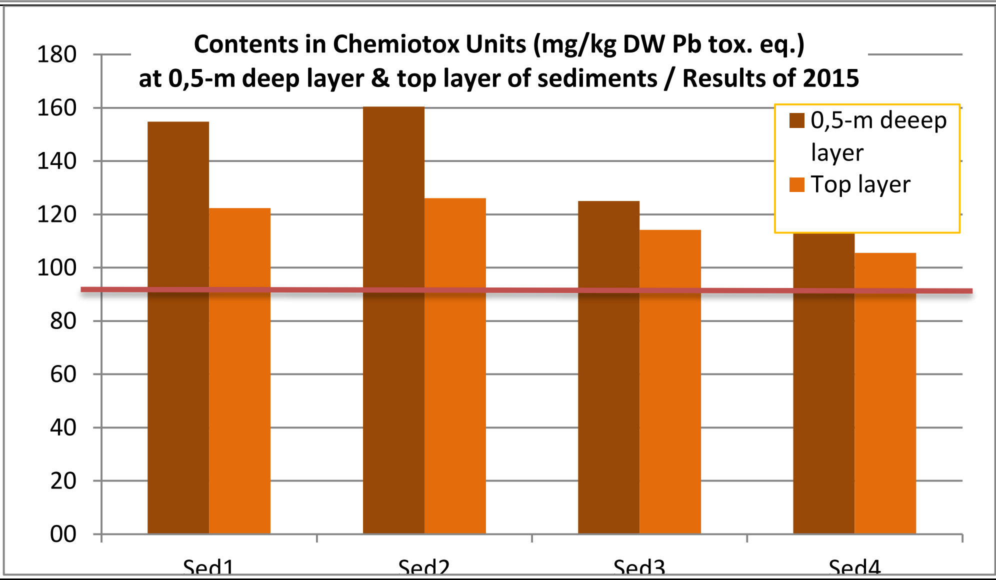
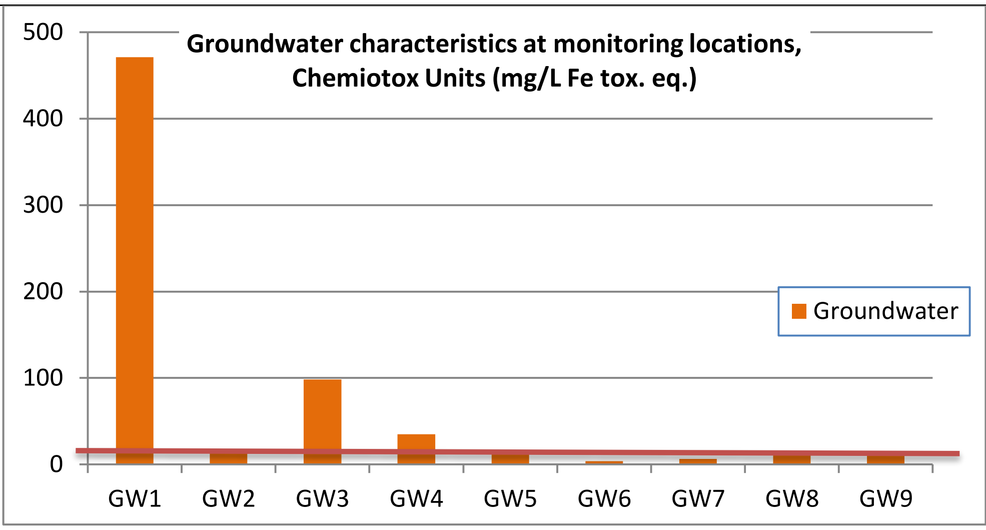


Table 9.5 Summary of results for groundwater

<table>
<tr><th>Summary of results for Groundwater monitoring along the ThamLuong–BenCat–NuocLen channel</th></tr>
<tr><td>The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 09:2008/BTNMT. For the assessment of the cumulative impact of most of all the considered contaminants, the CHEMIOTOX model uses the MAC for the parameter Fe_{TOTAL}: 5 mg/L. According to the calculations:
• There should be 2 monitoring locations where contamination of groundwater is very high (Chinh Xieng canal area, TrungDai to ChoCau area). The main pollutant would be NH_4-N and Fe.
• The pH would be often low (acid, less than 5,5)</td></tr>
<tr><td>
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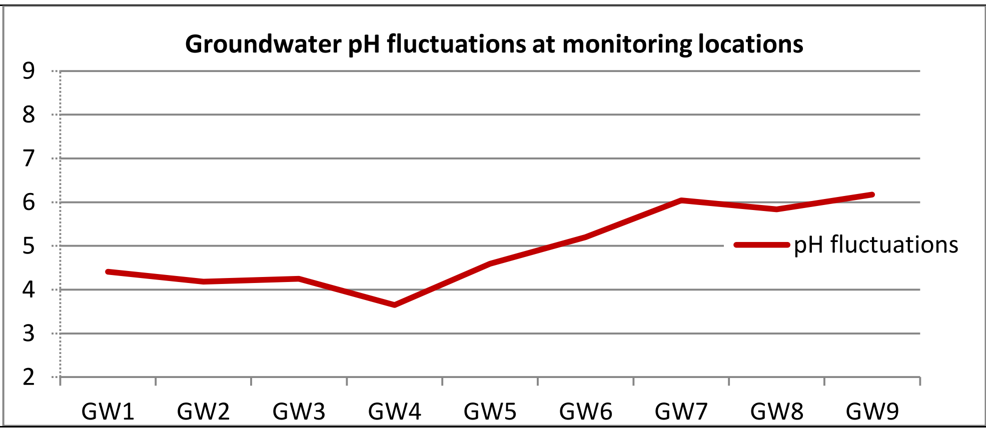
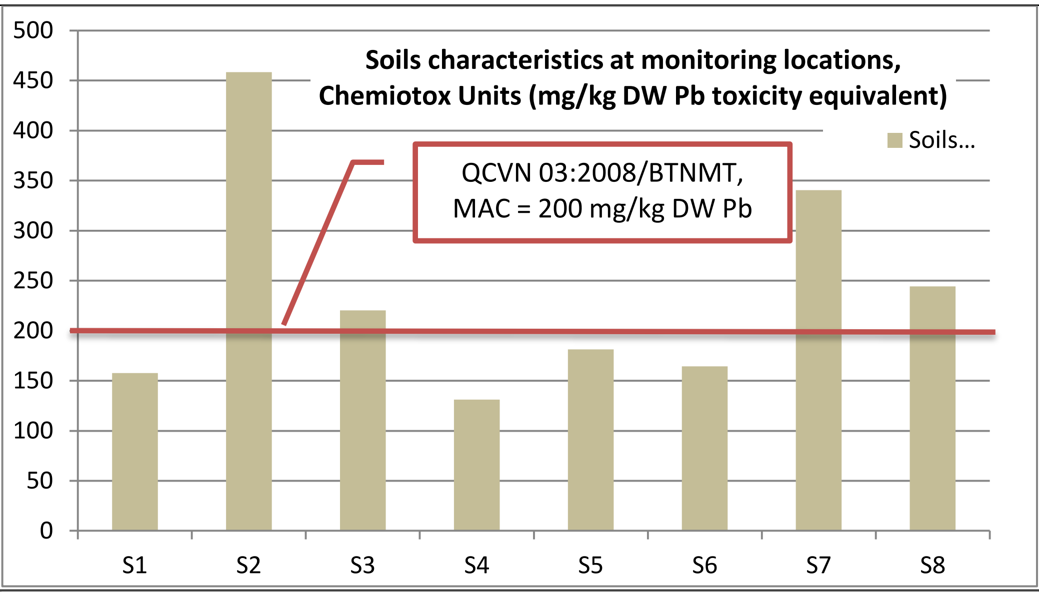
<tr><td>
</td></tr>
</table>

Table 9.6 Summary of results for soils

Summary of results for Soil monitoring along the ThamLuong–BenCat–NuocLen channel

The analytical results are compared to the maximum allowable concentrations (MAC) of QCVN 03:2008/BTNMT. For the assessment of the cumulative impact of the considered heavy metals, the CHEMIOTOX model uses the MAC for the parameter Pb_{TOTAL}: 200 mg/kg DW (commercial uses of land). According to the calculations:

- At almost 50% of monitoring locations the contents in aimed heavy metals are greater than 200 mg/kg DW Pb toxicity equivalent
- The use of sediment/sludge as cover soil without preliminary treatment would increase the contents in heavy metals



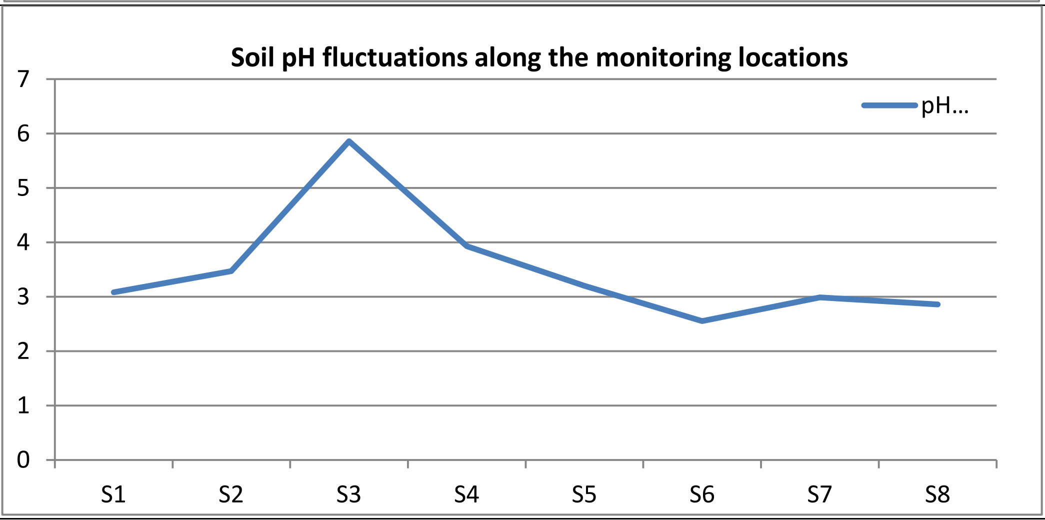
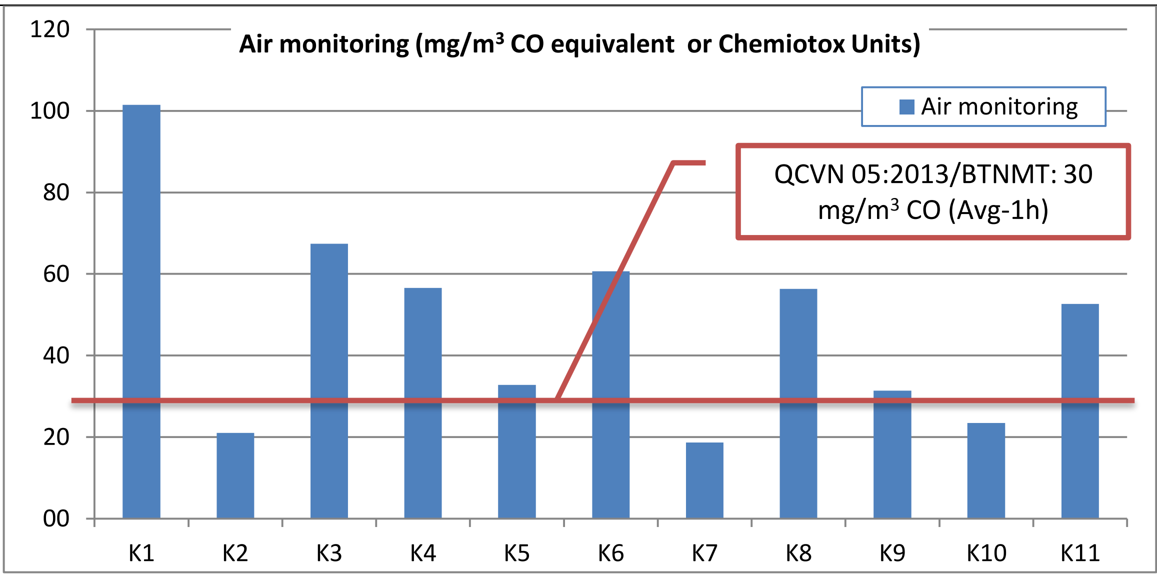


Table 9.7 Ambient Air Quality

Summary of results for Ambient air monitoring along the ThamLuong–BenCat–NuocLen channel
Monitoring activities have focused on air contaminants aimed by QCVN 05:2013/BTNMT, QCVN 06:2009/BTNMT and QCVN 26:2010/BTNMT. Detailed results shown low levels of air contaminants (NH_3, H_2S and VOCs) due to the anaerobic biodegradation within the main water receiving body. Local traffic seems be the main cause of monitored results: TSP, NO_2, SO_2, CO & Pb. For measuring the cumulative impact, the MAC of CO has been considered. At the majority of monitoring locations, the MAC of 30 mg/m^3 CO (Avg-1h) is largely overpassed.



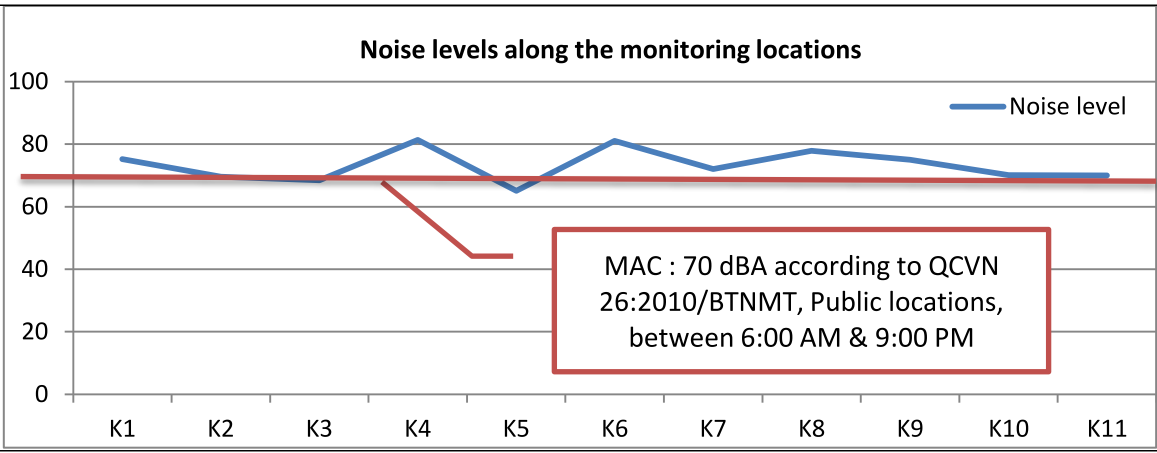


Table 9.8 Plankton counting

Summary of results for Plankton counting along the ThamLuong–BenCat–NuocLen channel
The direct Plankton counting (biological inventory) in surface water indicates a living water receiving body including microbiological pathogen species from protozoa to larva. Biodegradable organic matters should be abundant to allow such living conditions. The over-polluted ChoDem canal should contribute to an increase on plankton population at high tide while the less polluted Saigon River contribute to the dilution of identified microorganism species.

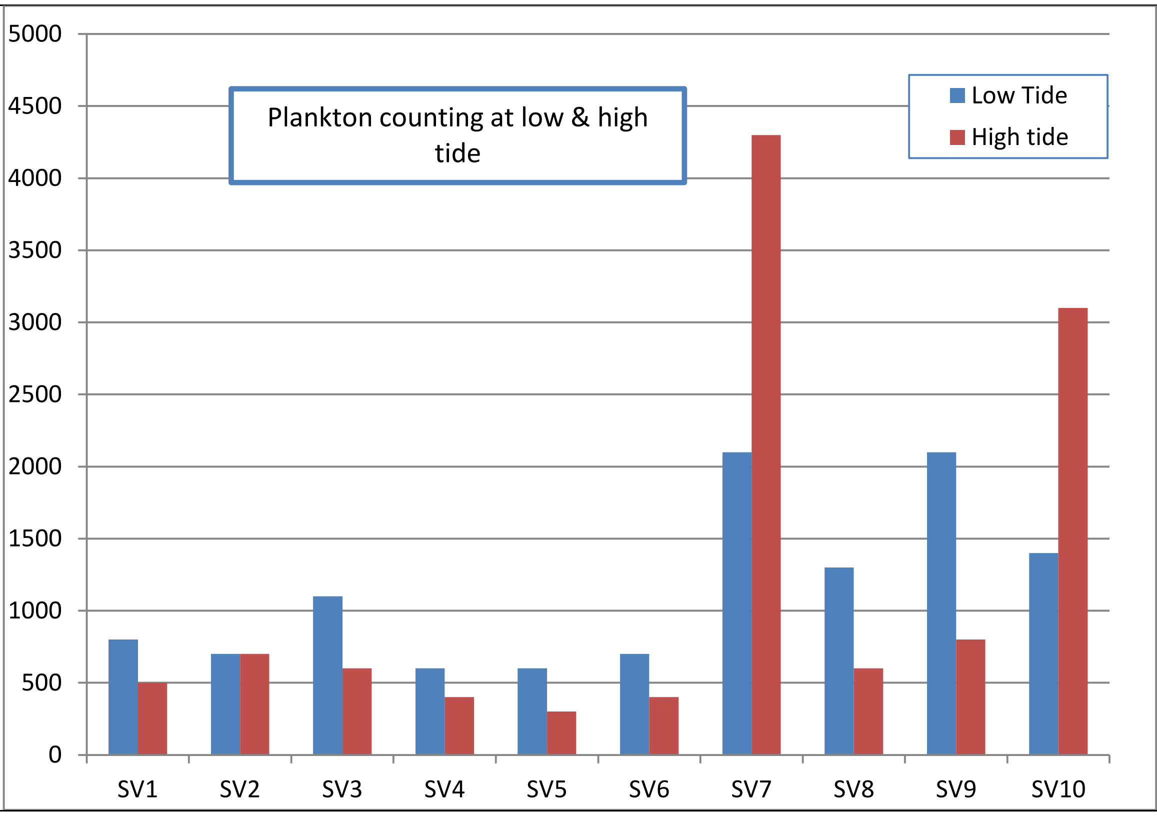
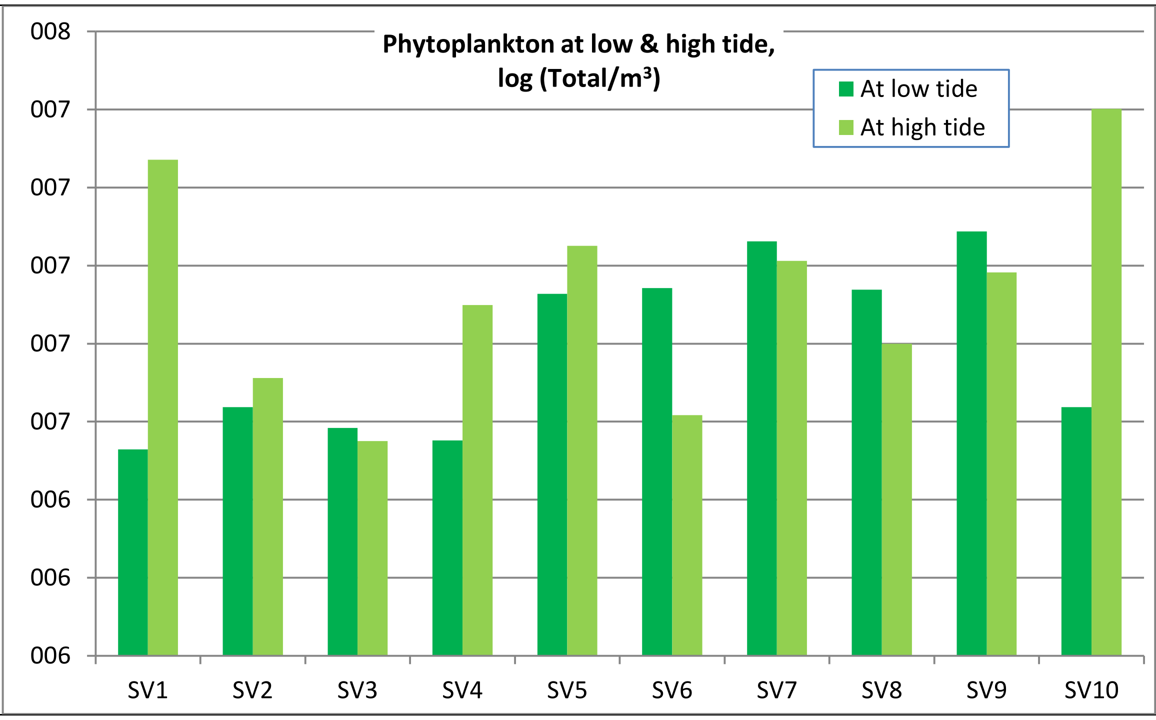


Table 9.9 PhytoPlankton counting

Summary of results for Phytoplankton counting along the ThamLuong–BenCat–NuocLen channel
The conditions of eutrophication seem gathered along the main channel. Microalgae seem abundant, probably due high contents in nutrients (N & P) coming with discharge of domestic wastewater.


9.3.7. Cumulative impact in 2015

In order to avoid duplicate, the field monitoring activities have focused in areas where previous studies had not sufficient results. The Figure 9.8 presents the areas where recent monitoring activities have gathered results.

Again lab results confirm a build-up of pollutant concentrations in the central areas where we should observe a low level of hydraulic tidal effects (Figure 9.9). Unfortunately, the recent monitoring activities have not gathered detailed data (contents in heavy metals and other non-biodegradable organics) allowing a numeric quantitative comparison with data gathered before 2012. But we can observe that the pollutant contents gradually increase in the deeper layer of sediments.

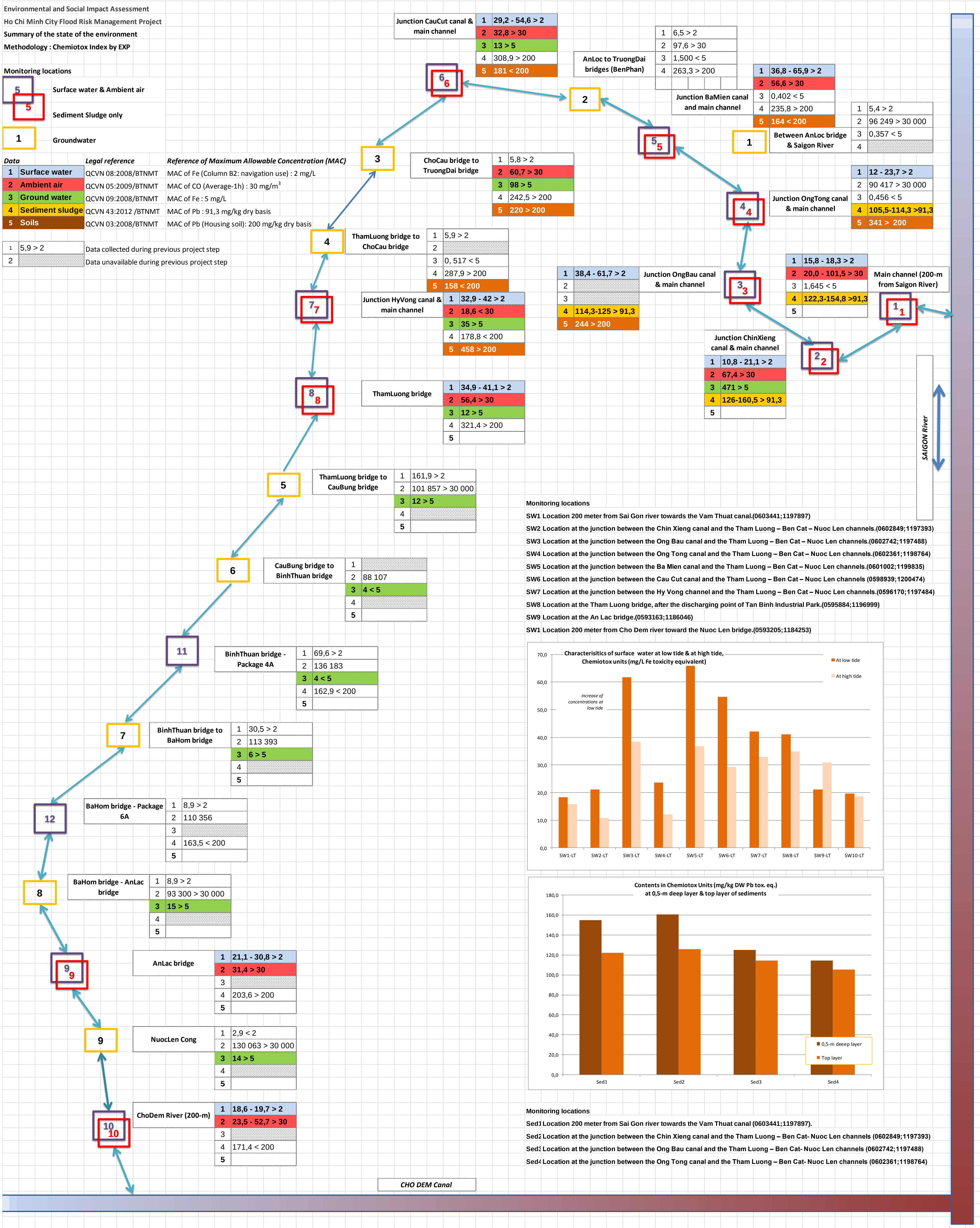


Figure 9.8 Overall portrait of the state of environment in 2015.

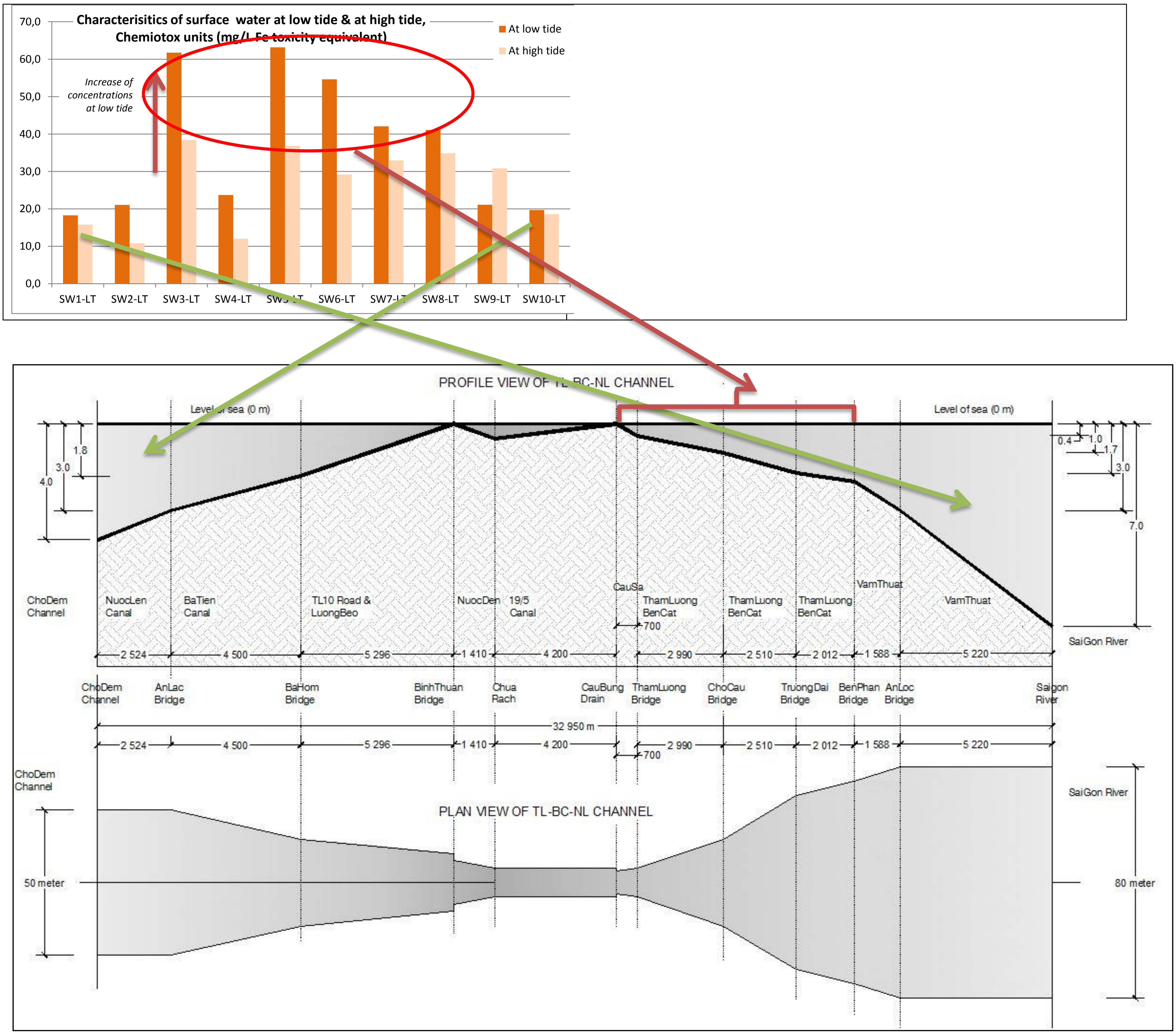


Figure 9.9 Illustration of build-up of pollutant contents in the center areas of the main channel.

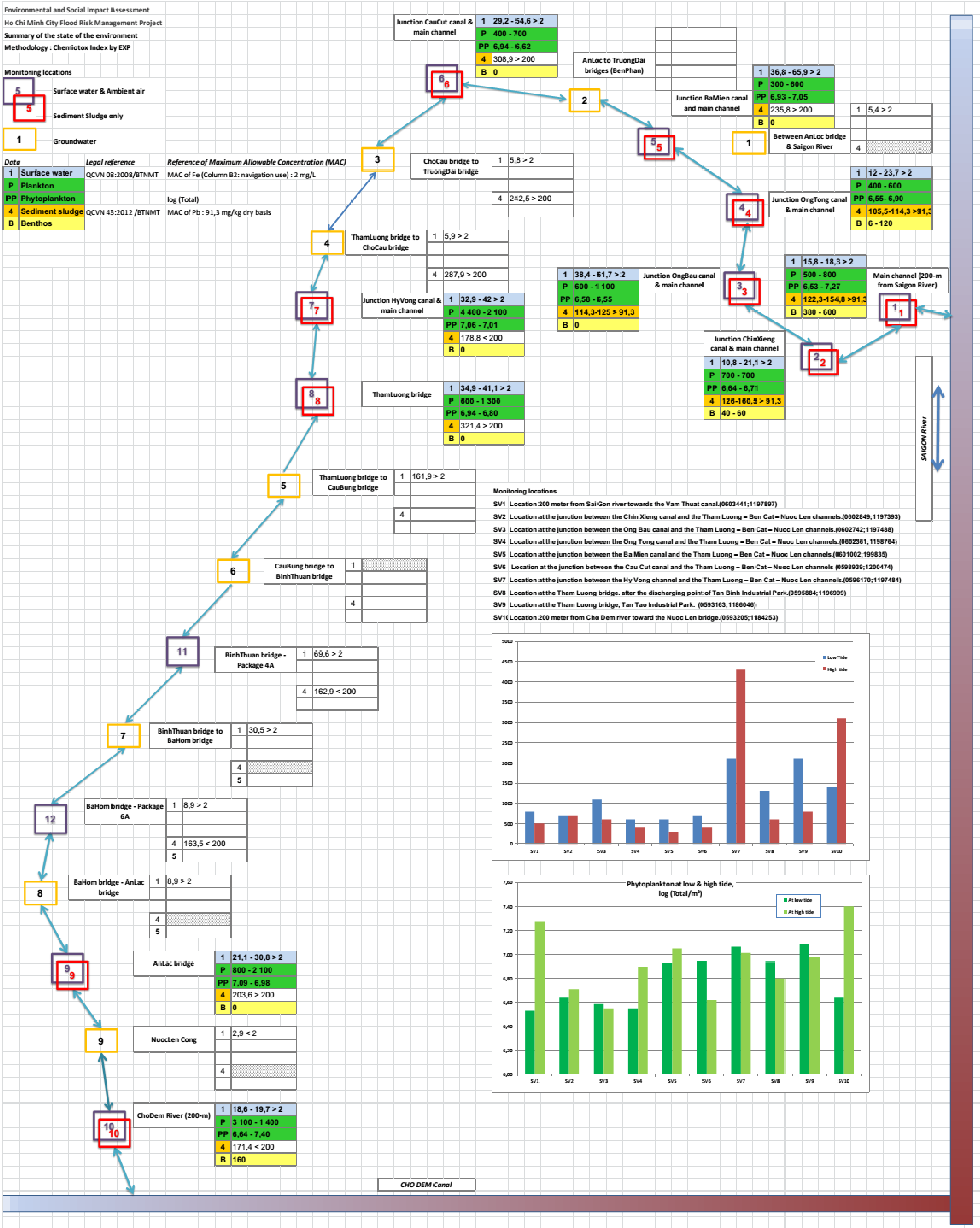
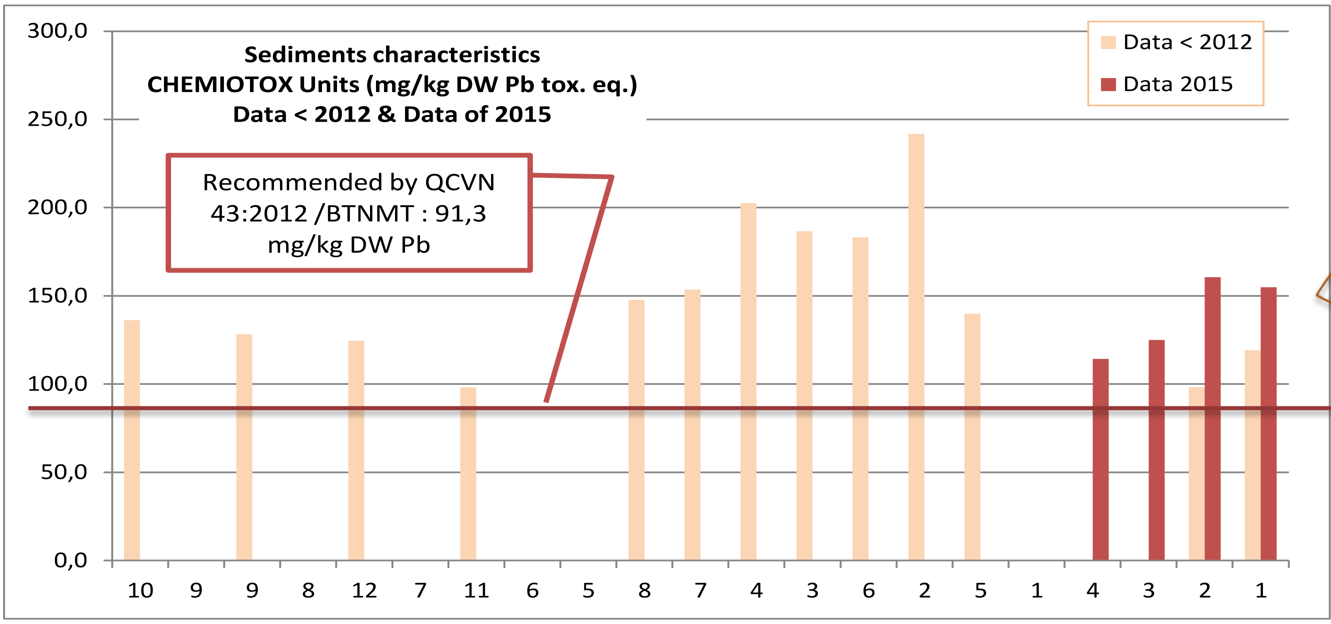


Figure 9.10 Overall portrait (plankton and phytoplankton) of the state of environment in 2015.

9.3.8.2 Increase of eco-toxic contents in Sediments / Settled sludge

Monitoring locations in 2015 for sediments characterization		< 2012	2015
Sed1	Location 200 meter from Sai Gon river towards the Vam Thuat canal (0603441;1197897).	119,2	154,8
Sed2	Location at the junction between the Chin Xieng canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602849;1197393)	98,3	160,5
Sed3	Location at the junction between the Ong Bau canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602742;1197488)	-	125,0
Sed4	Location at the junction between the Ong Tong canal and the Tham Luong – Ben Cat- Nuoc Len channels (0602361;1198764)	-	114,3



Fluctuations of SEDIMENT characteristics along the main channel

Monitoring locations	10		9							8	7			6		5		4	3	2	1
	10	9	9	8	12	7	11	6	5	8	7	4	3	6	2	5	1	4	3	2	1
Chemiotox Index	136,2		128,1		124,6		98,2			147,8	153,6	202,6	186,6	183,1	241,8	139,9				98,3	119,2

Figure 9.12 Increase in Chemiotox Units in the sediments/settled sludge.

The sediments/settled sludge in the main channel come from a cumulative effect of the sedimentation of total suspended solids (TSS). In the present case, it should be due to the pollutant solids discharged from urban areas (including stand-alone industries), effluents of industrial parks and surely various run-off rainwater materials. The recent (2015) lab chemical characterization of sediments within two different layers has shown a progressive build-up of Chemiotox Units (mg/kg DW Pb tox. Eq.) in the deeper layer. The comparison between previous (before 2012) and recent results at the same monitoring locations (relatively deeper bottoms) has indicated a general progressive build-up of pollutant contents. At lower deeps in the central areas, it should be more cumulative effects and build-up of Chemiotox Units despite an absence of recent planned monitoring activities. The sedimentation phenomena are more important in the lower-depth sections of the main channel.

9.3.8.3 Summary of current situation (2015) of water pollution in the project area

The original VietNamese release of the Feasibility Study Report has described in impressive terms the state of the aquatic environment of the main channel. Let us try to translate these sentences that remain significant for the qualtitative description of the current situation, in addition to what the use of Chemiotox Index methodology intents to quantify.

"As well for the other areas within the City, the pollution of the environment due to savage garbage disposal along the channel, uncontrolled discharge of wastewater, emanation of nauseaous biogas becomes an urgent issue while the occurrence of "dead" canals is more than probable.

The different sections of the ThamLuong-BenCat-NuocLen channel receive wastewaters from the North and West areas, mainly from plants, industrial enterprises, small industries and a part of domestic wastewaters. The industrial parks in the NorthWest include textiles factories (ThanhCong & ThangLoi), chemical manufacturers (TanBinh, HocMon Rubber), food processing plants (ViFon, ThienHuong, TuongAn Vegetable Oil), liqor and alcohol processing plants, leather, paper, etc. Thousand of inahbitants get used to directly discharge solid wastes and wastewaters into various canals.

The surrounding inhabitants along NuocDen Canal (BinhHunhHoa A Ward, BinhTan District) are suffering day after day while garbage are floating on the surface waters and along the embankments. It is not rare to see floating corpses of animals. Smell is so nauseaous during sunny or rainy days: flies, insects, … and they infect food.

9.4. Predict the cumulative impact of project development in 2035

The whole investment project comprises 2 components:

- *Component 1: Integrated management of urban flood risk*. Within this component one can expect an improvement of the capacity of environmental management by the implementation of environmental monitoring locations that will allow direct and rapid flows of information on the fluctuating quality of the environment (air and surface water) in order to implement adequate mitigation measures.
- *Component 2*: *Priority flood risk reduction interventions.* This component includes:
    - Construction of 2 tidal sluice gates at the end of VAMTHUAT and NUOCLEN canals in order to control tidal inflows;

- Improving the whole THAMLUONG - BENCAT - NUOCLEN Channel system through dredging works and embankment construction in order to improve its ability to discharge flood waters at the safe level of frequency of 10 years;
- Construction of the main interceptor system in GOVAP District;
- Construction and improvement of a primary and secondary combined sewer system for reaching the appropriate safety level, and construction of the secondary interceptor system in GOVAP District

9.4.1. Wastewater Collection, Drainage and Sanitation

With rapid population growth and improvement of functional infrastructure, HCMC will be challenged with environmental pollution. The major sources of pollution would directly discharge untreated wastewater or partially treated wastewater to canals, creeks and rivers. The population growth in the zone of influence could increase the densities of all district up to 136 people per hectare which could result in population of 2 000 000 inhabitants or more. The wastewater flow will generate pollution in the drainage network and at the end into the ThamLuong-BenCat-NuocLen Channel.

The wastewater flow generated from factories outside the industrial parks is ranged from 30 to 40 000 m3/day, in which 2.4 tons of pollutant suspended solids are comprised. Total flow of wastewater generated from industrial parks such as TanTao, TanBinh, VinhLoc A, TanThoiHiep is estimated to be more than 32 000 m3/day. This flowrate can potentially contribute about 6.4 tons of pollutant suspended solids into ThamLuong Canal if the discharged wastewater could meet allowable standards.

Within the limits of GoVap District, the common technical solution to the drainage of domestic wastewater for the City is using combined or separated drainage system for both run-off rainwater and domestic wastewater collection, depending on the stages of urbanization, economic conditions and environmental sanitation. Box culverts, manholes and pumping stations will deserves the collection and the transfer to the planned wastewater treatment plant (a built-transfer project) that will be located at AnPhuDong Ward, District 12, close to the Saigon River.

The main projected interceptor would collect and transfer the mixed wastewater from HyVong Canal area (deserving the TanSonNhat Airport) to the ChinXieng area, close to the location planned for the construction of the tidal sluice gate (VamThuat). Collected wastewater will be pumped to the planned treatment plant (AnPhuDong Ward). The final treated effluent would be discharged at a location downstream the tidal sluice gate or directly into the Saigon River current flow.

According to internal regulations of industrial parks, raw wastewaters discharged by industries should be treated (first step) separately by preliminary and primary processes prior to their pumping towards the centralized secondary treatment for a second “finishing” step in order to be compliant with the maximum allowable concentrations of QCVN 24:2009/BTNMT. Then the final effluent would be legally discharged into the main channel.

In the South-West area, a call for investment has been planned for the implementation of canal dredging projects and construction of a centralized wastewater treatment ("Nha May Xu Ly Nuoc Thai, Tay SaiGon"). With this expected project the coverage for wastewater collection and drainage component will be limited to 9 urban districts: District 12, GoVap, BinhThanh, TanBinh, TanPhu, BinhTan, BinhChanh, HocMon, and District 8.

For determining the impact due to the increase in population within the 9 covered districts, let us propose to assess a scenario for only one phase with the hypothesis of 139,5 person/ha as density in the horizon of 2035.

9.4.2. Divided basins for sanitation

In the existing studies of "Current Situations", the Consultant already assessed and described in detail the divided drainage basins as well as existing drainage directions. For deserving the design works, it is necessary to determine boundaries of drainage basins first. As proposed in feasibility study, it is recommended by the Consultant to divide the zone of influence into 9 large drainage basins. Table 8.10 presents surface of each basins in zine of influence but this is not the whole area of these districts

Table 9.10 District Area

No	District	Total area (ha)
1	District 12	3 083.4
2	Go Vap District	1 915.7
3	Tan Binh District	525.1
4	Tan Phu Disrict	1 706.5
5	Binh Tan District	1 445.6
6	Hoc Mon District	1 526.1
7	Binh Chanh District	4 589.1
8	District 8	93.3
9	Binh Thanh District	142
	Total	**14 899**

Source: Feasibility Study report, 2015.

9.4.3 Wastewater standard and capacity calculation

9.4.3.1 Demography

The population distribution in Ho Chi Minh City is uneven. Regarding the growth rate of population, while the natural growth rate reaches approximately 1.07%, the mechanical growth rate amounted to 2.5%. Immigration status in the city continues to grow in recent years. Since 1999 up to now, the population of 8 districts within the city is decreasing while the population of *suburban districts and newly-setup districts grew rapidly. The mechanical increase of the city's population is going strongly and difficult to control as indicated in BINHCHANH: population increasing per year was ever up to 30,000 people, equivalent to the population of one commune.* (ref: FS Study 2012)

In 2007 the estimated population of Ho Chi Minh City was over 6.5 million, growing at around 2.9% per year. It is forecasted that the Study Area population will reach over 13.8 million by 2025, with 10 million people in HCMC. Most of the population growth is projected to happen in outer areas (the urban fringe, suburban and other outlying communities), while the inner core areas are projected either to decrease their populations (in high density areas) or increase moderately (in medium/low density areas). (Ref: Preparing the Ho Chi Minh City Metro Rail System Project, ADB, Project number 39500, Feb 2010)

At the United Nations Conference on Trade and Development conference (on Investment Policy Review 2007), it was noted that a new airport and training and research facilities will be built outside Ho Chi Minh City. As a population growth scenario, we are assuming that the airport will be delocalized and that districts will be constructed with new development. With a population growth of 2.5%, total population of zone of influence should reach 2 000 000 latest 2038. We will assume that density will equalized at the average density of 139.5 persons per hectare. The table 9.11 represent population forecast in each district (zone of influence only) for year 2035 with that density.

Table 9.11 Population forecasted to 2035 as follows

No.	District	Number of wards	Area	Population 2015	Actual Density	Population 2035
			(ha)	(persons)	(person/ha)	Density 139,5
1	District 12	10	3 083,4	181 127	59	**430 134**
2	Go Vap	11	1 915,7	313 798	161	**308 427**
3	Binh Thanh	1	142	19 624	138	**19 809**
4	Tan Binh	1	525,1	37 244	71	**73 251**
5	Tan Phu	7	1 706,5	218 843	128	**238 056**
6	Binh Tan	10	1 445,6	199 316	131	**201 661**
7	Binh Chanh	3	4 589,1	29 670	7	**640 179**
8	Hoc Mon	5	1 526,1	99 574	65	**212 890**
9	District 8	1	93,3	9 054	97	**13 015**
	Total: 9 districts	**49**	**14 899**	**1 108 250**	**74**	**2 137 426**

9.4.3.2. Calculation of wastewater flows

Within the Phase I (to 2035), the Project aim at limiting the wastewater at these figures and propose Design References for 2035 as:

- Flow of domestic wastewater: 180 L/capita/day in 2035.
- Flow of wastewater from Industries, Commerce and Institutional (ICI): 30% $Q_{domestic}$;
- Irregular coefficient of day max: $K_{DAY\text{-}MAX}$ = 1,25;
- Known flow from two industrial zones will be added separately.

9.4.3.3 Assessment of Domestic Wastewater Flows

The next table represent the volume of wastewater that should be produced in 2035 in each district and that may be collected.

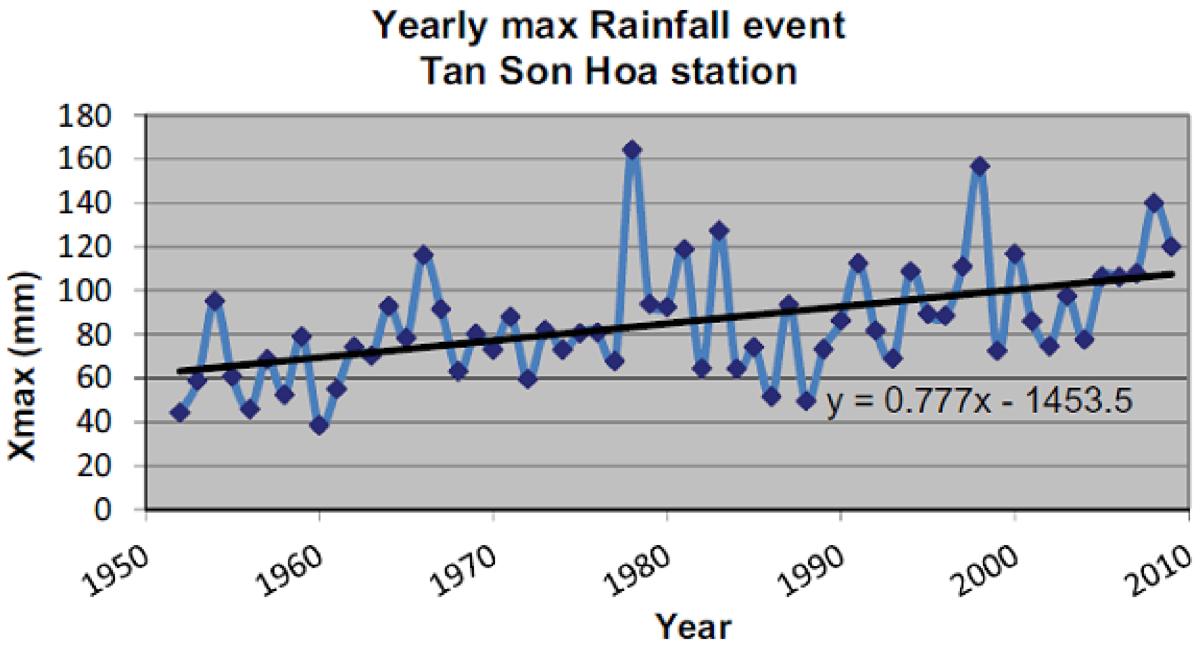
Table 9.12 Expected Flow of Wastewater

No.	District	Population 2035	Discharge m^3	ICI	Total
		Density 139,5	**180 L/pers/day**	**30%**	**m^3/day**
1	District 12	430 134	77 424	23 227	100 651
2	Go Vap	308 428	55 517	16 655	72 172
3	Binh Thanh	19 809	3 566	1 070	4 635
4	Tan Binh	73 251	13 185	3 956	17 141
5	Tan Phu	238 057	42 850	12 855	55 705
6	Binh Tan	201 661	36 299	10 890	47 189
7	Binh Chanh	640 179	115 232	34 570	149802
8	Hoc Mon	212 891	38 320	11 496	49 816
9	District 8	13 015	2 343	703	3 046
	Total: 9 districts	**2 119 598**	**384 737**	**115 421**	**500 158**

The calculated flow of wastewater indicates a volume of 500 000 m^3/day of wastewater in 2035 that may be discharged directly or indirectly in the THAMLUONG-BENCAT-NUOCLEN Channel system. This flow would be the parameter for pumping stations and treatment plant for residential sector. Over this, feasibility studies identified an industrial zone discharging up to 40 000 m^3/day and a second industrial zone discharging at 32 000 m^3/day. To evaluate the cumulative impact of zone of influence on the canal, we will assume that the potential pollution measured in term of DBO_5 will be equal to Suspended Solids discharged into the canal. So Suspended Solids (SS) will be the indicator to measure the cumulative impact of project development. Then we will propose a revision of the model for 2035.

9.4.3.3. Calculation of Storm water

Table 9.13 Rainfall intensity increase as observed at HCMC



According to this trend y = 0.777x – 1 453.5, the maximum intensity will be 128 mm/hour in 2015. The impermeable surface have increase from 30% to 40 % in HCMC (source: Vo Le Phu and Luu Dinh Hiep, Faculty of Environment Ho Chi Minh City University of Technology) which reflect the actual situation. In practice the impermeability factor should be 60% in a mix commercial-residential development in 2015 if mitigation measures are not applied. The simplified approach with the SCS (Soil Conservation Service) may be used to calculate overall the maximum hourly volume of water to fill the Tham Luong Ben Cat Nuoc Len Channel system in 2035:

$$Q = (I-0,2*S)^2 / (I+0,8*S)$$

With:

S = 25 400 / CN-254

CN = 86 (2015)

CN = 92 (2035)

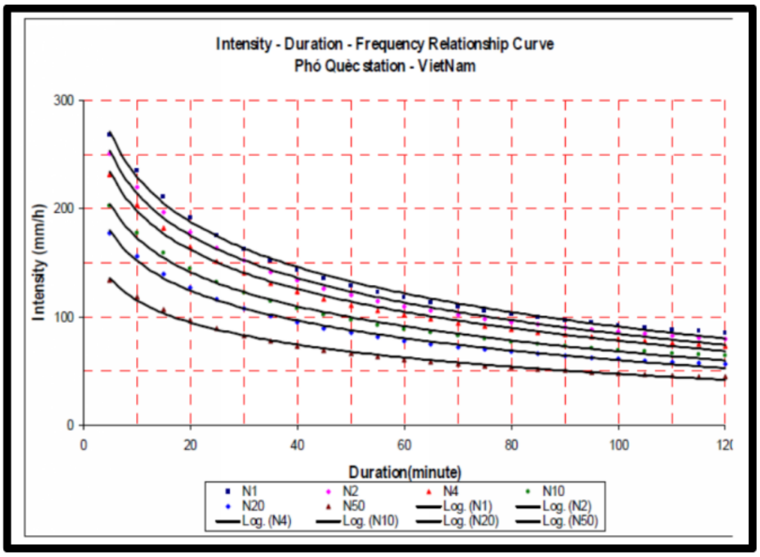
Period of return 1 year

Time 90 minutes

I = 50

These calculations show an increase of daily runoff of 16% in comparison of rainfall statistics in 2015.

Expected rainfalls (mm/hr) have been assessed for each district. Storm water flows are calculated as shown into Table 9.14.



Source :

Tran Thuc, Dang Quang Thinh, Huynh Lan Huong, Phung Thu Trang

Table 9.14 Rainfall estimation in each district (2015-2035)

STORMWATER			**2015**	**2018**	**2035**
Q = (I–0,2xS)x2 / (I+0,8xS)			**CN = 86**	**CN = 86**	**CN = 92**
		S	**41,3488372**	**41,3488372**	**22,0869565**
		Q	**28,6913232**	**28,6913232**	**36,9023787**
			Q	**Q**	**Q**
			In 2015	**In 2018**	**In 2035**
No.	**District**		**SCS flow (m^3/d)**	**SCS flow (m^3/d)**	**SCS flow (m^3/d)**
1	District 12	3 083,4	88 467	88 467	113 785
2	Go Vap	1 915,7	54 964	54 964	70 694
3	Binh Thanh	142,0	4 074	4 074	5 240
4	Tan Binh	525,1	15 066	15 066	19 377
5	Tan Phu	1 706,5	49 962	49 962	62 694
6	Binh Tan	1 445,6	41 476	41 476	53 346
7	Binh Chanh	4 589,1	131 667	131 667	169 349
8	Hoc Mon	1 526,1	43 786	43 786	56 317
9	District 8	93,3	2 677	2 677	3 443
	Total of 9 districts	**15 026,8**	431 139	431 139	554 525

The Table 9.14 is presenting assessment for daily flow in each district if all the outfalls are captured and drained to the man channel TL-BC-NL.

Table 9.15 Potential sanitary hydraulic load discharged into the channel ThamLuong-BenCat-NuocLen

			Year 2015	Year 2018	Year 2035
			120 L/pers.-day	120 L/pers.-day	180 L/pers.-day
No.	**District**	**Area**			
		ha	m^3/day	m^3/day	m^3/day
1	District 12	3 083,4	21 735	23 365	77 424
2	Go Vap	1 915,7	37 656	40 480	55 517
3	Binh Thanh	142,0	2 355	2 531	3 566
4	Tan Binh	525,1	4 469	4 804	13 185
5	Tan Phu	1 706,5	26 261	28 231	42 850
6	Binh Tan	1 445,6	23 918	25 712	36 299
7	Binh Chanh	4 589,1	3 560	3 827	115 232
8	Hoc Mon	1 526,1	11 949	12 845	38 230
9	District 8	93,3	1 086	1 168	2 343
	Total: 9 districts	**15 026,8**	**132 990**	**142 964**	**384 737**

9.4.3.4. Wastewater Treatment Design Criteria

Even if certain existing evaluation methods in Vietnam indicate that domestic effluent includes a content of 35 gram per person per day of DBO_5 and TSS, we are forecasting that in 2035 Vietnamese population will reach international standard discharges and the characteristics of raw domestic affluents (before treatment) will reach the average values that are gathered in Table 9.16

Table 9.16 Domestic Wastewater Affluents in 2035

Criteria		**Unit**	**Quality of Input Wastewater**
Phase 1 2035	BOD_5	mg/L (O_2)	236.0
	COD	mg/L (O_2)	380.0
	SS	mg/L	320.0
	Total Nitrogen	mg/L (N)	30.0
	Total Phosphorus	mg/L (P)	6.3

According to the FS Report and other various documents related to the project areas, the implementation of wastewater treatment plants have been planned (at AnPhuDong, District 12, near the Saigon River, 131 000 m^3/d – Nha May Xu Ly Nuoc Thay Binh Tan, 150 000 m^3/d, etc). If implemented, the final effluents of these plants should be compliant with the related regulations.

Table 9.17 Treated Wastewater Quality criteria 2011

No	**Criteria of Analysis**	**Unit**	**Input**	**QCVN 40:2011 and**	**QCVN 40:2011 and QCVN 14:**

				QCVN 14: 2008 (col. A)	2008 (col. B)
1	PH		7,02	5-9	5-9
2	Total suspended solids (SS)	mg/L	320	50	100
3	COD	mg/L (O_2)	280	75	150
4	BOD5	mg/L (O_2)	186	30	50
5	Total N	mg/L (N)	40	30	50
6	Total P	mg/L (P)	6,3	6	10
8	Total Coliform	MPN/100ml	9 250	3 000	5 000

The Table 9.17 shows the criteria that the Consultant will use in 2015 for selection of treatment technological chain and preparation of basic design for the projects as proposed in TCVN. If these criteria are not changed treatment technologies should perform to reach these targets. In the FS column B is proposed as a target for industrial zone and column A is proposed for residential zone.

9.4.3.4. Storm water contamination

Urban storm water runoff has been the subject of intensive research since the inception of the Water Quality Act of 1965 in USA. The most comprehensive study of urban runoff was NURP, conducted by EPA between 1978 and 1983. NURP was conducted in order to examine the characteristics of urban runoff and similarities or differences between urban land uses, the extent to which urban runoff is a significant contributor to water quality problems nationwide, and the performance characteristics and effectiveness of management practices to control pollution loads from urban runoff (US EPA 1983).

Table 9.18 Pollutant Criteria for Storm Water

BOD_5, mg/L (O2)	10	COD, mg/L (O_2)	73
TSS, mg/L	101	Total Lead, µg/L	144
Total Copper, µg/l	33	Total Zinc, µg/L	135
TKN, Total Kjeldahl Nitrogen, µg/L	1 900	Nitrate + Nitrite, µg/L	736
Total Phosphorus, µg/L	383	Soluble Phosphorus, µg/L	143

9.4.4. Combined discharge of wastewater and storm water into ThamLuong-BenCat-NuocLen Channel system

The Table 9.19 determine the quantity of wastewater and drainage solids to be discharged into the channel system in 2015, in 2018 if WWTPs are in operation and in 2035 if WWTP are built to support population increase. Table 9.20 shows the potential of increase of SS in 2035.

Table 9.19 Maximum Daily Loads (TSS) from storm water run-off and final effluent of WWTP

No.	District	2015	2018	2035	2015	2018	2035
		Storm water			Wastewater		

		kg/day	kg/day	kg/day	kg/day	kg/day	kg/day
1	District 12	8 847	4 423	5 869	6 955	1 168	3 871
2	Go Vap	5 496	2 748	3 535	12 050	2 024	2 776
3	Binh Thanh	407	204	262	754	127	178
4	Tan Binh	1 507	753	969	1 430	1 430	659
5	Tan Phu	4 896	2 448	3 149	8 404	8 404	2 143
6	Binh Tan	4 148	2 074	2 667	7 654	120	181
7	Binh Chanh	13 167	6 583	8 467	1 139	1 139	5 762
8	Hoc Mon	4 379	2 189	2 816	3 824	3 824	1 916
9	District 8	268	134	172	348	348	117
	Total: 9 districts	43 114	21 557	27 726	42 557	18 583	17 603

Table 9.20 Total Maximum Daily Load (TSS)

No.	District	2015	2018	2035
		kg/day	**kg/day**	**kg/day**
1	District 12	15 802	5 592	9 560
2	Go Vap	17 546	4 772	6 311
3	Binh Thanh	1 161	330	440
4	Tan Binh	2 937	2 937	1 628
5	Tan Phu	13 300	13 300	5 291
6	Binh Tan	11 801	11 801	4 482
7	Binh Chanh	14 306	14 306	14 229
8	Hoc Mon	8 202	8 202	4 732
9	District 8	615	615	289
	Total: 9 districts	78 137	54 321	45 330

The Table 9.20 illustrates the cumulative impact (kg per day of DBO_5 or Suspended Solids) of load that may be discharged in the channel system if WWTP are in operation. This situation suggests that in 2035 all the projected WWTPs will be in operation. According to this hypothesis, there would be some 132 079 tons of dry sludge in the channel in 2035. The volume of sludge may be 3 301 987 m3 at 4% dryness. The figure 8.13 represents the volume of Channel after dredging the channel assuming that bottom will be at -4 meter and top average water level will be at +1 meter over the sea level. Total effective volume of channel will be 6 060 612 m3. This indicates that the canal will filled with up to 55% if no sludge is removed within 20 years.

To evaluate the contamination of channel, it will be divide in three sections

1) From ChoDem River to Bridge BaHom Bridge: 1 273 100 m^3
2) From BaHom Bridge to Bridge ChoCau Bridge: 2 189 700 m^3
3) From Cho CauBridge to Saigon River: 2 597 812 m^3

The Section 1 will receive 50% of discharge from BinhTan District, District 8 and part of District Huyen BinhChanh and certain parts of Section 2.

The Section 2 will receive discharge from HocMon District, 50% of District 12, 50% of BinhTan District, TanPhu District, TanBinh District with the catchment of BinhHungHoa WWTP. The treatment plant uses aerated lagoon and stabilization pond technology to treat wastewater from nearby NuocDen canal. NuocDen canal has an area of 785 ha and population in the area is around 120 000 (1999). The canal also receives untreated wastewater from surrounding industrial activities, creating black colour and bad odour in the surface water with the following values for the physico-chemical parameters: SS 250 mg/L, BOD5 200 mg/L (O2), COD 300 mg/L (O2), NH4/NH3-N 25 mg/L (N), and pH 6.5 - 7 (Smet et al.,2006). It will also receive effluents of 2 industrial zones

The Section 3 will receive 50% of District 12, GoVap District and part of BinhThanh District.

Four scenarios will be evaluated.

1) Rainy Season after modifications occurring in 2018
2) Dry Season after modifications occurring in 2018
3) Rainy Season in 2035 expecting that all WWTP will be completed.
4) Dry Season in 2035 expecting that all WWTP will be completed.

According to rainfall statistic 85% of rain is falling from May to October and 15% from December to April.

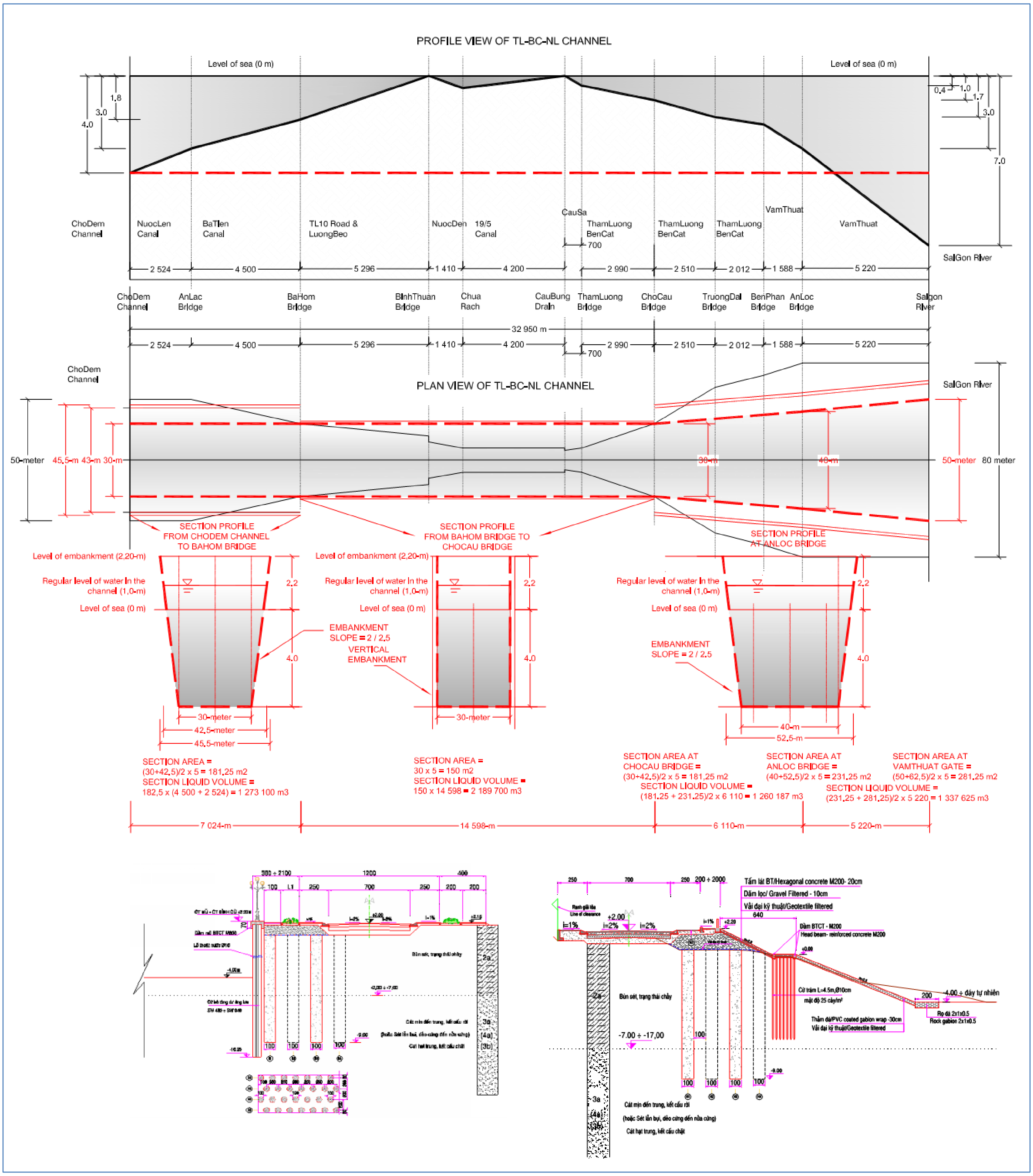


Figure 9.13 Illustration of dredging and embankment construction works.

Table 9.21 Assessment of pollutant contents based on conventional parameters

	TSS				COD				BOD_5			
	Dry	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**	**Dry**	**Wet**
	2018+		**2035**		**2018+**		**2035**		**2018+**		**2035**	
	mg/L				mg/L (O_2)				mg/L (O_2)			
1	91	25	96	52	137	38	144	78	55	15	58	31
2	99	40	96	52	148	60	144	78	59	24	58	31
3	54	27	98	55	81	40	147	82	33	16	59	33

The channel may become an anaerobic pond inn these conditions. During the dry seasons, according some suggestions listed in the FS Report, the sluice gates remain closed in order (at least for 4 months) to preserve the water body at an aimed level for the purposes of fluvial navigation. Dilution of receiving water body would be not sufficient to decrease the pollutant contents. As earlier mentioned, dredging & embankment construction works will modify the hydraulic volumes of the three sections of the main channel. Calculations taking in consideration an increase in population (and pollution discharge into sewerage networks) and an achievement of wastewater treatment plants would allow assessing the pollutant contents in terms of CHEMIOTOX UNITS in the three sections of the main channel as follow:

Table 9.21 Assessment of pollutant contents based on Chemiotox units

	2018		**2035**	
	Dry Seasons	**Wet Seasons**	**Dry Seasons**	**Wet Seasons**
	CHEMIOTOX UNITS (mg/L Fe Tox. Eq.)			
Section 1: ChoDem Channel (or NuocLen Sluice Gate) to BaHom Bridge	70,0	19,4	73,5	39,8
Section 2: BaHom Bridge to ChoCau Bridge	75,6	30,6	73,5	39,8
Section 3: ChoCau Bridge to Saigon River (or VamThuat Sluice Gate)	41,4	20,4	75,1	41,9

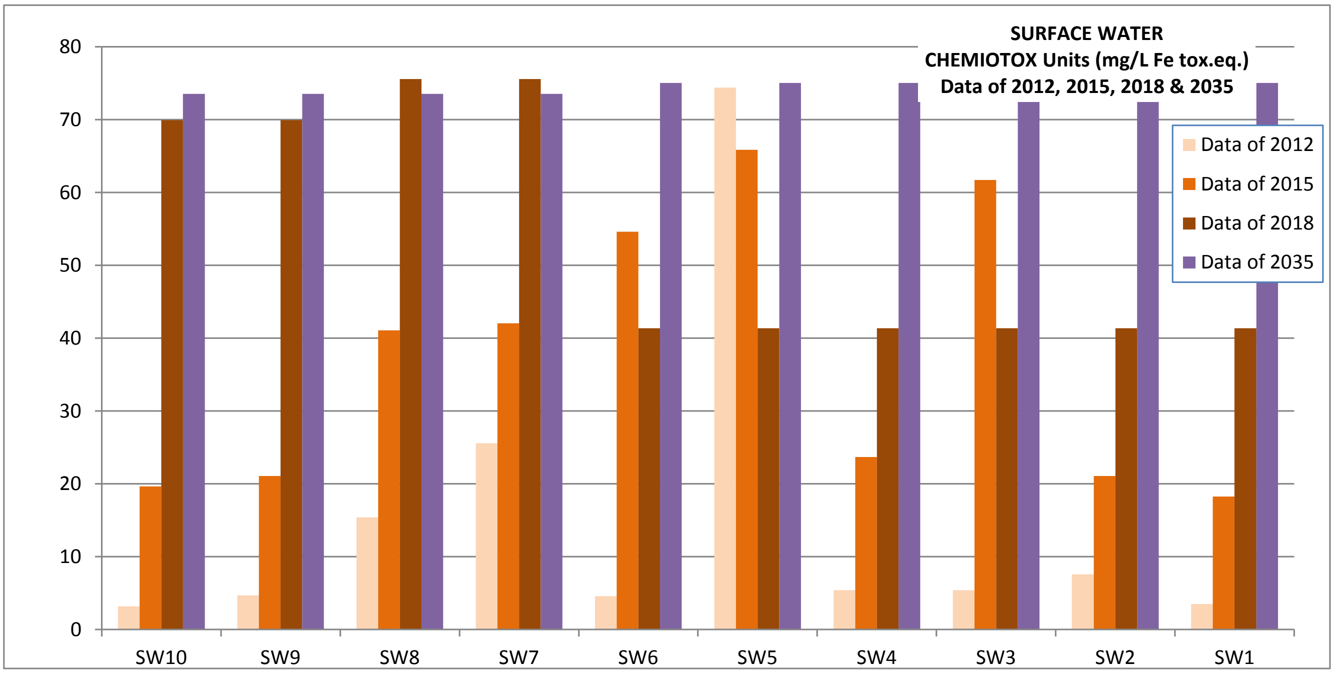


Figure 9.14 Potential general increase in pollutant contents assessed with Chemiotox Units.

The following figures are presenting the schematic of drainage and WWTP organization.

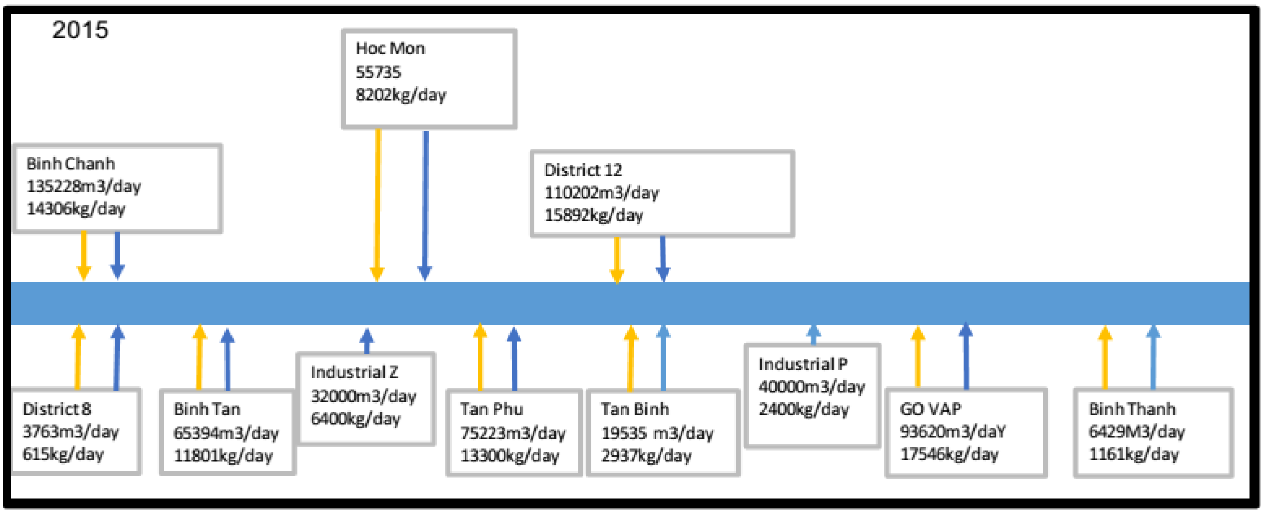


Figure 9.15 Illustration of discharges along the main channel in 2015.

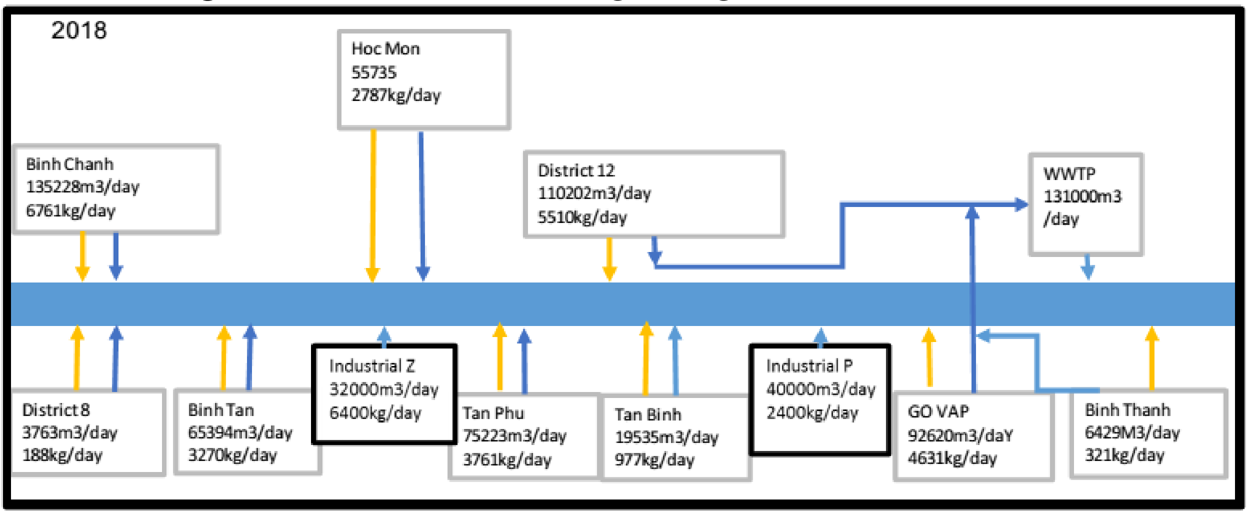


Figure 9.16 Illustration of discharges along the main channel in 2018.

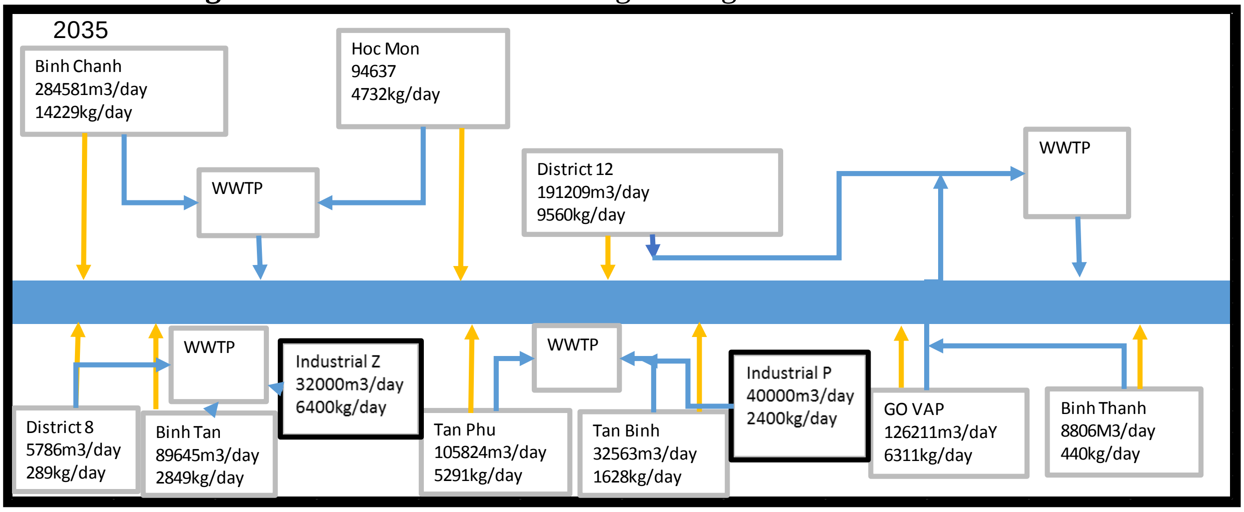


Figure 9.17 Illustration of discharges along the main channel in 2035.

FS also proposes two important mitigation measures that could improve the environmental situation:

1) Constructing a retention pond at GOVAP park (available in the planning of control reservoir in HCMC) and to propose size of the reservoir to reduce water level in main canal and reduce inundation for the basin at the head route, nearby SaiGon River (mainly AnPhuDong Ward, Thanh Xuan Ward - District 12.
2) Constructing TanTao retention pond for climate change by 2100.

These two measures would have a direct impact to reduce and eliminate contamination coming from stormwater. Mitigation measures like application of Low Impact Development Technologies would also reduce the loads. In these cases the loads would be limited to the contamination due to final effluents of wastewater treatment plants. The WWTP of BinhHungHoa is already in operation and its final effluent is discharged into NUOCDEN Canal.

9.5. Linked Ancillary Projects

9.5.1. Summary of projects

Following table presents a summary of current and future projects whose impacts can be negative, neutral or positive to the factors identified previously. Each project is described with status, status of EIA, detail of EMP, cumulative impact assessment and screening of linked project.

Table 9.17 Cumulative impacts

1. Project Name	DA PHUOC SOLID WASTE TREATMENT COMPLEX
Description	Scope of work: The Da Phuoc Solid Waste Treatment Complex near Ho Chi Minh City is Vietnam's largest solid waste processing complex. This project was developed, and is currently operated, by Vietnam Waste Solutions (VWS) of Ho Chi Minh City and California Waste Solutions (CWS) of California. This Complex is located in Da Phuoc Commune, Binh Chanh District, Ho Chi Minh City. Capacity of the Complex is currently 10,000 tons per day designed to collect whole domestic solid waste generated by Ho Chi Minh City and partly solid waste collection from Long An province. The complex is planned on an area of 128.22 ha that includes administrative office (0.2%), domestic waste treatment factory (6.64%), industrial waste and hazardous waste treatment factory (1.41%), technical infrastructures (5.08%), green field and utilities (0.21%), high-tech landfill including four cells (68.91), green trees and grass cover (5.48%) and internal roads and yards (12.06%). A sanitary landfill sheet included seven layers: stone drainage layer, geotextile layer, HDPE layer, geotextile layer, stone drainage layer, geotextile layer and vegetative soil Waste treatment processing: Waste collected from Ho Chi Minh city and Long An province will be transported to the Da Phuoc landfill. Then, waste is

	compressed by the Compactors and removed odor with Posi-Shell. After waste is filled to fixed height, waste will be covered with waterproof HDPE. Relationship with the HCMC – FRM project: The Da Phuoc Landfill will receive all the dredged materials and construction waste from the demolition process, construction process and dredging process during pre-construction phase, construction phase and operation phase of six components.
Status	The project has entered operation with a capacity of 10,000 tons solid waste per day
Status of EIA	The EIA of the project with capacity of 3,000 tons per day has been approved by DONRE of Ho Chi Minh City in accordance with a Decree No. 132/QĐ-TNMT dated on 18th April 2005. Following the approval of HCM PC to upgrade from 3,000 tons per day to 10,000 tons per day, the EIA for upgraded capacity was approved in 2015.
Detail of EMP	*Mitigation measure to treat leachate wastewater and storm water:* The complex currently has a wastewater treatment complex with a capacity of 4,280 m^3 per day. Three wastewater treatment plants were constructed in this complex, including two leachate wastewater treatment plants (280 m^3/day and 1,000 m^3/day) and one storm water treatment plant (3,000 m^3/day). Following the treatment, the wastewater of the first two meets QCVN 25:2009/BTNMT (column B1) and QCVN 40:2011/BTNMT (column B) (in accordance with a Decree No. 541/QĐ-TNMT-QLTN dated on 1st June 2012 about extending a license of discharging the treated wastewater to receiving stream) and of the third meets QCVN 25:2009/BTNMT (column B1) (in accordance with a Decree No. 926/QĐ-TNMT-QLTN dated on 4th September 2012 by MONRE about extending a license of discharging the treated wastewater to receiving stream). Following increasing up to 10,000 tons of solid waste per day, total capacity will be increased from 4,280 m^3 per day to 4,510 m^3 per day. In this case, the leachate wastewater treatment plant will be upgraded to meet the increased capacity. *Mitigation measure to treat gas emission from landfill:* Gas emissions from landfill revenues are collected by spaced vertical wells. All the collected gas is flared. *Mitigation measures to treat odor and pathogens microorganisms:* In addition to the daily soil cover layer to prevent odors, spraying is also done regularly, especially during the time after the rain. In addition, planting of trees is also done to create buffer areas. Limitations of the residents scavenging and require workers to user PPE when working at the landfill.
Assessment of cumulative impact	Given the Complex has now received a half of 10,000 tons of solid waste per day, it still has enough area and capacity to receive the solid waste generated from the HCM – FRM project. Therefore, negative cumulative impact is assessed to be minimal. WW is discharged in Nga Cay creek which do not directly reach the channel TL-BC-NL.
OP 4.12: Screening	The Da Phuoc landfill is to accommodate sludge from dredging operation to be

of linked project	supported by HCM – FRM project. This is existing landfill built 10 years ago and it will not require any further civil works or any involuntary land acquisition. Therefore it is noted that this is not considered as linked project, but is considered as ancillary activities.
2. Project Name	**THAM LUONG BEN CAT WASTEWATER TREATMENT PLANT**
Description	The project of wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len, phase 1, with a total capacity of 131,000 m^3 per day. It is scoped in a project "Wastewater collection system and wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len", where the Prime Minister approved a pre-feasible study regarding to a document No. 1131/CP-CN dated on 13^{th} August 2014 and investment policy under forms of Building and Transfer (BT) regarding to a document No. 383/QĐ-UBND-DT dated on 8^{th} October 2010. The catchment area where wastewater will be collected for treatment by the Tham Luong Ben Cat WWTP is of 5,141 ha of District 12, Go Vap District and Binh Thanh District. It is located at An Phu Dong Ward, District 12, Ho Chi Minh City. Diagram of wastewater treatment technology processing: Wastewater from sewage system ⇒ Screen bar ⇒ Sand sediment tank ⇒ Selector ⇒ C-Tech (biological tank) ⇒ UV disinfaction tank ⇒ Lagoon ⇒ Discharge to Vam Thuat River using pump. In addition to those major treatment units, the WWTP also comprise of units to treat gas and sludge (sludge holding tank, belt press, gas collection and treatment). Following treatment, treated wastewater will meet QCVN 40: 2011/BTNMT (column A).
Status	The project is under construction and expected to be completed on May 2017.
Status of EIA	The EIA of project has been approved by the local authority (DONRE) of Ho Chi Minh City. Below is a summary of impact evaluation for each project components: Waste water treatment plant: - Location is An Phu Dong Ward, District 12, Ho Chi Minh City. Point for discharge is Vam Thuat River and the treated wastewater will meet the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge. - Option technology is Sequencing Batch Reactor. The treatment is activated sludge. - Per EIA, most of the negative environmental impacts are short-term and mitigated. Mitigation measures have been properly proposed in EMP, including institutional arrangement for environmental management, monitoring and capacity building program. Total estimated cost for EMP is as follow: Cost for environmental protection works during construction period is 640,000,000 VND. Cost for environmental protection works during operation period is 408,000,000 VND.

	Cost for environmental quality monitoring program in the first year operation is 42,126,332 VND. (Source: The EIA report of WWTP project 2015) Community consultation has been conducted during project preparation. Most of the participants raised their concerns on compensation prices, construction-caused disturbance and pollution generated during construction and operation phase and requested PMU to comply with the mitigation measures proposed.
Detail of EMP	Proposed mitigation measures on approved EIA report of WWTP project are : Mitigation measures to treat sludge out of WWTP processing: Sludge out of WWTP processing will be treated by following process: Activated sludge ⇒ sludge holding tank ⇒ Sludge pump⇒ Centrifuge ⇒ Fertilized or disposed to landfill. Controlling the treated wastewater quality out of WWTP: According to an approved decision of an EIA report by Ho Chi Minh City People's Committee - Department of Natural Resources and Environment (DONRE), quality of treated wastewater must satisfy the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge. Environmental monitoring program also included in the EIA report.
Assessment of cumulative impact	Impacts will be positive as wastewater from Tham Luong Ben Cat WWTP will be treated prior to discharge. However, if the discharge cannot be monitored well in term of treatment performance, it can cause negative impacts to receiving streams. Sludge will accumulate in the channel and will have to be removed.
OP 4.12: Screening of linked project	The project has been constructed to collect the domestic wastewater generated from local community located in the Tham Luong ben Cat Nuoc Len Catchment. It is scoped in a project "Wastewater collection system and wastewater treatment plant for a catchment of Tham Luong Ben Cat Nuoc Len" and constructed to serve the outcomes of project component 4. Therefore, it is considered as a linked project.
3. Project Name	**TAN TAO INDUSTRIAL PARK**
Description	Tan Tao IP is located in Binh Tan District, Ho Chi Minh City with total area of 380.15ha. It was established on 30th November 1996 following a Decision 906/TTg and 978/QĐ-MT. In 2008, Tan Tao Investment Industry Corporation constructed a WWTP, which has a capacity of 3,000 m3 per day for extension of Tan Tao IP, and completed that in 2010. This WWTP for Tan Tao IP extension was provided completion certification issued a documents No. 171/BQL-KCN-HCM-QLMT dated 14/01/2010. In addition, DONRE of Ho Chi Minh City also issued a document No. 373/GP-TNMT-QLTN dated 23rd April 2012 to provide a discharge license where the project can discharge 3,000 m^3 of wastewater per day to receiving stream. This flowrate together with flowrate of the original Tan Tao IP contribute to generate up to 12,000 m^3 per day. Major industry sectors invested in this IP comprise of textile, leather, rubber,

	plastic, mechanics, electronics, wood, food. Regarding to document No. 137/CV-ITACO-10, all investors must ensure the wastewater generated from their factories must meet the parameters concentration developed by Tan Tao IP owner before discharging to the central wastewater treatment plant in Tan Tao IP. Currently, approximate 107 business sectors has invested in Tan Tao IP and contribute a total of wastewater flow ranged from 2,300 to 2,400 m^3 per day. Wastewater following pretreatment stage undertaken in each factory is permitted to discharge to central wastewater treatment plant of Tan Tao IP for further treatment to meet the QCVN 40: 2011/BTNMT (Column B). Treated wastewater effluent then enters to sewage system to discharge to Nuoc Len Creek, which is connected to Cho Dem River and Vam Co Dong River.
Status	The project has entered operation, where a WWTP was constructed with a capacity of 12,000 m^3 per day.
Status of EIA	The EIA of project has been approved by the local authority (DONRE) of Ho Chi Minh City.
Detail of EMP	The business sectors must commit to preliminary treat raw wastewater to meet the influent discharge requirement of central WWTP of Tan Tao IP. Mitigation measures to treat wastewater generated from factories in Tan Tao IP: Tan Tao IP (Original): Wastewater from sewage system ⇒ Collection tank ⇒ Screen bar ⇒ Equalization Tank ⇒ Aeration tank (biological tank) ⇒ Clarifier ⇒ Discharge to Nuoc Len Creek Tan Tao IP (Extension): Wastewater from sewage system ⇒ Collection tank ⇒ Fine screen ⇒ Equalization Tank ⇒ Neutralization tank ⇒ Coagulation and flocculation tank ⇒ Physical sedimentation tank ⇒ Mutech tank (activated sludge) ⇒ Disinfection tank ⇒ Discharge to Nuoc Len Creek According to the approved decision of the EIA report by Ho Chi Minh City People's Committee - Department of Natural Resources and Environment (DONRE), quality of treated wastewater must satisfy the Viet Nam environmental standard of type A, QCVN 40: 2011/BTNMT (column A) before discharge.
Assessment of cumulative impact	Negative cumulative impact is assessed to be minimal as the WWTP can accommodate wastewater generated from factories located in Tan Tao IP to meet QCVN 40: 2011/BTNMT (column A) before discharge. However, if the discharge cannot be monitored well in term of treatment performance, it can cause negative impacts to receiving streams.
OP 4.12: Screening of linked project	This is existing landfill established at nearly 20 years ago and it will not involve any further civil works or any involuntary taking of land. Therefore it is noted that this is not considered as linked project.

9.5.2. Screening of cumulative impacts generated from linked/ancillary projects

In order to estimate the significance of the impacts generated from linked/ancillary projects on the projects, scoring need to be undertaken for each key factors defined in Section 1. There are six key factors that can be directly or indirectly affected from linked/ancillary projects. Rules are proposed in order to classify the significance of those impacts, including (+) imply for positive impacts and (-) imply for negative impacts and scores 0, 1,2 and 3 referred as negligible, minor, medium and significance. Overall score of each key factor is presented in Table 9.18. The overall scores for key factors indicates that water quality, aquatic ecology and air quality are the most affected key factors given they are directly influenced by the performance of linked wastewater treatment plant and the WWTPs located within the catchment. Groundwater is considered to be affected by the water quality of the Canal. However, the baseline indicates that there are in non-proportional relationship between the surface water quality and groundwater quality, but this in somehow can be affected with the significant change of surface water quality. Therefore, it is of slightly lower score than the first three key factors. The public health is of the most concern as it is directly closely affected by the environment factors. For business development, following completion of the project, the local community will have more options to develop their business along the upgraded Canal. However, their business opportunities can be threaten if water quality of the Canal is affected negatively from low quality of effluent discharge from the contributors.

Table 9.18 Screening of cumulative impacts generated from linked/ancillary projects

Key factor	Development Activities in Study Area				Overall Score
	DAPHUOC SOLID WASTE TREATMENT COMPLEX	THAMLUONG-BENCAT WASTEWATER TREATMENT PLANT	TAN TAO INDUSTRIAL PARK	TANBINH INDUSTRIAL PARK	
Water quality	+2	±3	±3	±3	±3
Aquatic ecology	+1	±3	±3	±3	±3
Air Quality	+1	±3	±3	±3	±3
Groundwater	+1	±2	±2	±2	±2
Public health	0	±3	±3	±3	±3
Business development	0	±2	±2	±2	±2

9.6. Design mitigation measures

9.6.1. Objectives

The main goal of the in the Tham Luong Ben Cat Nuoc Len Channel restoration is to restore the degraded reservoir to a level that can be permanently sustained through protection and conservation. The water quality target should be in accordance with the quality of natural water and without stresses that cause degradation, i.e. with a good ecosystem health, long-term stability and sustainability. On the other hand the time needed to reach the restoration target depends first of all on the residence time (RT), the shorter the RT, shorter will be the time to restore the reservoir. It's especially true for a shallow channel.

The water quality management of the channel must be at first oriented to control eutrophication and the external factors causing the increase of nutrient load. Restoration program is also oriented to enhance the biodiversity of the channel. Fortunately, in the last decade, many good experiments have been realized and many solutions are now available to control the eutrophication by minimizing the nutrient inflows from the point sources and from the non-point sources (NPS).

9.6.2. Cumulative impact from wastewater and drainage water pollution

Wastewater treatment engineering design has to bring solutions for the 3 issues with equal emphasis: odour removal, main influent treatment and sludge disposal. Referring to the results obtained in the previous section, we can conclude that by installing barriers at each end of the channel, it will become a closed tank. Previously the rising and falling tide of the Saigon River and Cho Dem River had a washing effect and allow a dilution of pollution in the channel. Tests show that the central portion of the channel is much more contaminated than the remainder of the channel. By closing the channel, this washing effect will disappear.

To reduce contamination of what will become a closed container, we believe that mitigation measures are necessary.

As mitigation measures we recommend to:

1) Use the category A standard or more quality standard for discharging to the channel

2) Install the outfalls of WWTP at east side of Van Thuat sluice gate.

3) Develop districts with green infrastructure

4) Develop a strategic sanitation and drainage plan at a local scale.

9.6.3. Green Infrastructure

PMU should propose a strategic sanitation and drainage plan with Green Infrastructure. PMU should establish what level of sanitation exists in each district, in terms of facilities, in terms of institutions and in terms of the people's perspectives and the level of service expected. PMU should proposed green approach in designing services. By introducing Green Infrastructures the quality of storm water will be improved by a pre-filtration effect. LID (Low Impact Development) measures are proposed.

LID is a multi-barrier approach that uses features at the lot, neighborhood, and watershed level to maintain the on-site water balance (Gyurek, 2009). The proposed plan must integrate this multi-barrier approach to reduce the water footprint in the development. This involves:

Designing strategies to provide quantity and quality control and enhancement of groundwater recharge (through infiltration of runoff into the soil), retention or detention of runoff for permanent storage or for later release, and pollutant settling and entrapment (by conveying runoff slowly through vegetated swales and buffer strips or small wetlands). (Gyurek, 2009)

In the proposed approach, all LID features are introduced to maximize water quality. The concept includes features such as rain gardens, bio-retention, and bio-swales. To integrate all systems, it is necessary to protect canals on-site and to link all parts of the system with that water body as the core.

LID Features are local infrastructures. There are numerous features to consider in the layout of a LID, with features typically selected and arranged according to the topography and landscape of the site. The LIDC proposes that the following features be incorporated into design.

9.6.3.1. Rain Gardens

Rain Gardens enhance local water quality by allowing water to be filtered naturally by soil instead of being piped untreated into large bodies of water (LIDC 2011). A rain garden is a landscaped garden in a shallow depression that receives the storm water from nearby impervious surfaces, thereby recharging it (Dussailsant 2004). Beyond its environmental use, rain gardens provide attractive landscaping and a natural habitat for birds, bees, and butterflies, while encouraging environmental stewardship and community pride (LIDC 2011).

9.6.3.2. Street Storage

Street storage refers to the technology of temporarily storing storm water (in densely populated urban areas) on the surface — on- and off-street — and, as needed, below the surface, close to the source (Carr, Esposito & Walsh 2000). The use of street storage and catchment basins reduces the rate of runoff entering storm sewer systems, reducing the required minimum size of water mains conveying storm water pipes (LIDC 2011).

9.6.3.3. Bio-Retention

Bio-retention is an alternative to runoff treatment, acting on storm water before it is discharged into waterways (Hsieh & Davis 2003). A landscaped island containing a curb inlet drains a large area or street, channeling rainwater through a small pipe into a municipal storm drain system. Bio-retention consists of porous media layers that can remove pollutants by infiltrating runoff through mechanisms that include adsorption, precipitation, and filtration (Hsieh & Davis 2003).

9.6.3.4. Permeable Pavements

Permeable pavement systems restore soil infiltration functions in the urban landscape. These systems are mainly composed of porous pavement systems in parking areas (LIDC). Permeable pavements offer one solution to the problem of increased storm water runoff and the decreased stream water quality associated with automobile usage (Brattebo & Booth 2003). Permeable pavements with reservoir structures consisting of concrete paving stones offer the possibility for decentralized, sustainable storm water management and source control in urban areas. Runoff from streets and parking areas with low traffic densities can be infiltrated to support groundwater recharge and to reduce hydraulic stress in sewer systems. Infiltration can help to return the urban water cycle to its natural condition, increasing the level of groundwater (Dierkes et al. 2002).

9.6.3.5. Vegetated Roof Cover

Green roofs (roofs with a vegetated surface and substrate) provide ecosystem services in urban areas, including improved storm water management, better regulation of building temperatures, reduced urban heat island effects, and increased urban wildlife habitat (Oberndoofer et al. 2007). The use of vegetation on a rooftop as an alternative to traditional roofing materials is an increasingly utilized example of GI practice. The vegetation and growing media perform a number of functions that improve environmental performance, including absorption of rainfall, reduction of roof temperatures, improvement in ambient air quality, and the provision of urban habitat (Carter & Keeler 2007).

9.6.3.6. Bioswales

Bioswales are broad ditches with gentle slopes. Swales are vegetated open channels designed to accept sheet flow runoff and convey it in a broad shallow flow. Swales are used to reduce storm water volume through infiltration, improve water quality through vegetative and soil filtration, and reduce flow velocity by increasing channel roughness (Lukes & Kloss 2008). Bioswales can take many forms. Generally, bioswales can be contained in approximately one per cent of the land area draining into them. Since bioswales are linear, they work well along impermeable surfaces such as roads and sidewalks (Wahl 2009).

9.6.3.7. Rainwater Harvesting

Rainwater harvesting, which involves the collection of rainwater from impervious surfaces and storing it for later use, is a technique that has been used for millennia. Although, rainwater harvesting has not been widely employed in industrialized societies, which rely primarily on centralized water distribution systems, with the increasing recognition of the need to address the problems of limited water resources and storm water pollution, and the emergence of green building design, the role of rainwater harvesting in water supply is being reassessed (Kloss 2009).

9.6.3.8. Tertiary treatment

In addition to the site sizing to physically accommodate future treatment plant extensions, it is necessary for the designer to include provisions to deal with the future expansion and /or process changes. Onsite sewage additional treatment should be designed such that their capacity can be increased and/or parallel facilities constructed without the need for major disruption of plant operation. The layout and sizing of channels and plant piping should be such that additional treatment units can be added in the future or increases in loading rates can be accommodated hydraulically. The location of buildings and tanks should allow for the location of the next stages of expansion. Buffer areas should be provided.

Treatment beyond the norm of secondary or equivalent level for various watersheds may be necessary due to limited assimilation capacity and/or critical downstream uses being made of the water receiving body. Some sewage treatment plants are required to meet more stringent effluent quality requirements than associated with secondary treatment. The receiving water-based effluent requirements are incorporated into the A and B QCVN 40:2011 and QCVN 14:2008 of BTNMT, as effluent compliance limits with appropriate effluent quality objectives in terms of concentrations and loadings. Depending on the effluent requirements, there are a number of suitable alternative sewage treatment processes that can be considered. In this case to mitigate impact of load discharged into the main channel, a tertiary treatment should be added to the proposed process.

Granular media filters may be used as an advanced treatment process for the removal of residual TSS and Total-P from secondary effluent. Filters may be necessary where effluent concentrations of less than 15 mg/L of TSS and/or 0,5 mg/L of Total-P need to be achieved. A pre-treatment process such as chemical coagulation and sedimentation or other acceptable process should precede the granular media filter units where effluent suspended solids requirements are less than 10 mg/L.

In this case, provision for continuous backwashing up flow sand filters should be planned to eliminate suspended solids in the effluent of WWTP. This will improve largely water quality in the Channel.

ANNEX 10

SUMMARY OF DUE DILIGENCE REPORT ON THAM LUONG-BEN CAT WASTEWATER TREATMENT PLANT PROJECT (PHASE 1); SUMMARY OF DUE DILIGENCE REPORT ON DRAINAGE SYSTEM AND WATER ENVIRONMENT IMPROVEMENT OF THE THAM LUONG-BEN CAT-NUOC LEN MAIN CANAL PROJECT (PHASE 1)

10.1. Summary Of Due Diligence Report On Tham Luong - Ben Cat Wastewater Treatment Plant Project (Phase 1)

The Government of Vietnam (GoV) requested a loan from the World Bank (WB) for the implementation of Ho Chi Minh City Flood Risk Management Project (HCMCFRMP). Under support of the WB, an integrated flood risk management approach for Ho Chi Minh City (HCMC) is established to continually improve drainage systems, flood control and environmental sanitation for the City, where a focal point will be a catchment of Tham Luong-Ben Cat-Nuoc Len canal.

According to WB's requirements, resettlement caused by non-Bank-financed activities which are critical to the design or performance of Bank project requires due diligence (DD) by the Bank[7]. Activities causing resettlement are usually contemporaneous with the Bank investment. To address the fact that these activities are not part of the WB project, the Bank applies a DD approach. Following such policy requirements, the national project, Tham Luong-Ben Cat Wastewater Treatment Plant (WWTP) Project (hereinafter referred to as the Project) was identified as a link activity associated to the HCMC FRMP financed by WB. Therefore, a due diligence review (DDR) was conducted in October 2015 for this Project.

The main purpose of this DDR is to verify whether the land acquisition was implemented in accordance with the laws and regulations of the GoV, and to identify the gaps between the regulations of the GoV and actual implementation. Furthermore, the DDR will assess the present living standards as well as the level of livelihood restoration of the affected people (APs) after land acquisition by the projects. In case, these due diligences conclude that the APs lack of sustainable livelihood resources, additional support and rehabilitation measures to restore and improve the incomes and living standards of the APs will be proposed to ensure that the outcomes of the project in line with the policy objectives of the WB as described in the OP 4.12.

A number of research methods are carried out for the purpose of the DDR including desk review, in-depth interview, group discussion, questionnaire survey, and field visit. Information presented in the DDR are largely obtained from interviews of persons knowledgeable about the land acquisition process of the two abovementioned national projects, including 7 affected households (AHs) and 8 representatives of the local authorities, particularly from the District Compensation, Assistance, and Resettlement Boards (DCARBs) and People's Committees at ward/commune level. Desk review of detailed measurement survey (DMS) records and approved compensation plans of the AHs augmented information gathered in the interviews.

The Tham Luong-Ben Cat WWTP is located at the Residential Group No. 2 in An Phu Dong Ward, District 12, Ho Chi Minh City. The WWTP has a total area of 55,549.2 m^2 with the design capacity of 131,000 m^3 a day-night in the first phase and 250,000 m^3 a day-night when

[7] According to the Bank's OP 4.12 on Involuntary Resettlement, OP 4.12 applies to the projects that in the judgment of the Bank are (a) directly and significantly related to the Bank-assisted project; (b) necessary to achieve its objectives as set forth in the project documents; and (c) carried out, or planned to be carried out, contemporaneously with the project (Para. 4).

completed. The civil work of the Project was commenced on April 26 2015 and is expected to be completed in the first quarter of 2017.

According to the initial engineering design, the construction of the WWTP would require an aggregate 136,119 m^2 of land belonging to 241 households, including 67 households in the Phase 1 and 174 households in the Phase 2. In April 2015, the WWTP planning was adjusted by reducing the plant area to 55,549.2 m^2 including 23,173.7 m^2 for the plant campus in the Phase 1 and 32,375.5 m^2 in the Phase 2. Accordingly, the number of PAHs have reduced to 67 households including 22 households in the Phase 1 and 45 households in the Phase 2.

The key findings of the DDR for the Tham Luong-Ben Cat WWTP Project are as follows:

1. The land acquisition and compensation payment process was carried out since 2010. The compensation, assistance, and resettlement of the Project complied with the 2013 Land Law and its associated decrees as well as the local decisions and policies issued by Ho Chi Minh City People's Committee at that time, particularly Decision No. 35/2010/QD-UBND on compensation, assistance, and resettlement in the area of HCMC. However, to date, only less than half of the total number of PAHs have received compensation (30 households including 18 AHs of the Phase 1 and 12 AHs of the Phase 2) while 29 households still refuse to receive compensation (4 AHs of the Phase 1 and 25 AHs of the Phase 2). For the remaining eight households in the Phase 2, their compensation payment decisions are yet to be issued by the local government.

2. Among the reasons for the outstanding issues related to compensation and resettlement are the overlap in planning in the project area together with loose land management of the local authorities and non-transparent, unofficial land transactions among households, which contributed to hindering the land acquisition process. Particularly, the overlapping and adjustment of planning have led to more complicated issues since several households already received compensation and resettlement land at the relocation site although they are no longer affected by the Project.

3. Low compensation rates, although based on independent valuation, did not meet the market prices. In fact, even the compensation plus the whole assistance package (relocation allowance, life stability support, etc.) together with preference in purchasing resettlement houses (for legal users) could not meet the market prices for residential land in the area. This is the main reason why several households refuse to receive compensation.

4. Information disclosure and consultation meetings were conducted for several times during the project implementation process with the local authorities and residents in the project area. However, during the design and planning process, there was no information provided for the APs. Similarly, the dissemination activities were mostly one-way and focused on regulations and policies applied by the Project. Information related to other supports such as income restoration program was not provided for the APs. Therefore, although there are available funds targeting the poor and APs whose land is acquired in the area, the interviewed APs are not aware of them.

5. In the project area, land-based livelihood is not the main source of income of the PAHs. The number of households dependent on agriculture in this area is rather small, only accounting for about 5% of the total households in An Phu Dong. Therefore, the acquisition of productive land did not severely affect the PAHs' incomes. Although the annual household income of the interviewed households shows a slight increase; when being asked about changes in living standards, 100% of the respondents assess that their living standards are worse than pre-project level. Furthermore, their access to public services is also worse. This can be explained by two main reasons: (i) only two out of seven interviewed households have received compensation while the rest still refuse; and (ii) inflation rate in the recent years has made people's lives more difficult in general. Nevertheless, it cannot be denied that the low compensation and assistance rates have not enabled the APs to make decisive changes in their lives.
6. Lastly, there is no formal policy regarding monitoring in the regulation of Vietnam. As a result, there is no monitoring mechanism for the project impacts and restoration of income and living standards of the APs. Information related to the relocated households who already moved out of An Phu Dong Ward as well as their restoration ability cannot be assessed as the Ward PC and Fatherland Front or WU do not have information related to them. The 15 PAHs of the Phase 1 have moved out of An Phu Dong Ward and thus not being able to meet these households has limited a deeper assessment of project's impacts on livelihoods as well as income restoration level of the APs.

A corrective action plan is proposed for the abovementioned shortcomings vis-à-vis the resettlement policies and regulations of the government and the way the DCARB carried out land acquisition since 2010.

10.2. Summary Of Due Diligence Report On Drainage System And Water Environment Improvement Of The Tham Luong-Ben Cat-Nuoc Len Main Canal Project (Phase 1)

The Government of Vietnam (GoV) requested a loan from the World Bank (WB) for the implementation of Ho Chi Minh City Flood Risk Management Project (HCMCFRMP). Under support of the WB, an integrated flood risk management approach for Ho Chi Minh City (HCMC) is established to continually improve drainage systems, flood control and environmental sanitation for the City, where a focal point will be a catchment of Tham Luong-Ben Cat-Nuoc Len canal.

According to WB's requirements, resettlement caused by non-Bank-financed activities which are critical to the design or performance of Bank project requires due diligence (DD) by the Bank[8]. Activities causing resettlement are usually contemporaneous with the Bank investment. To

[8] According to the Bank's OP 4.12 on Involuntary Resettlement, OP 4.12 applies to the projects that in the judgment of the Bank are (a) directly and significantly related to the Bank-assisted project; (b) necessary to achieve its objectives as set forth in the project documents; and (c) carried out, or planned to be carried out, contemporaneously with the project (Para. 4).

address the fact that these activities are not part of the WB project, the Bank applies a DD approach. Following such policy requirements, the national project, Drainage System and Water Environment Improvement of the Tham Luong-Ben Cat-Nuoc Len Main Canal Project (hereinafter referred to as the Project) is identified as associated to the HCMFRMP financed by WB. Therefore, a due diligence review (DDR) was conducted in October 2015 for this Project.

The main purpose of this DDR is to verify whether the land acquisition was implemented in accordance with the laws and regulations of the GoV, and to identify the gaps between the regulations of the GoV and actual implementation. Furthermore, the DDR will assess the present living standards as well as the level of livelihood restoration of the affected people (APs) after land acquisition by the projects. In case, these due diligences conclude that the APs lack of sustainable livelihood resources, additional support and rehabilitation measures to restore and improve the incomes and living standards of the APs will be proposed to ensure that the outcomes of the project in line with the policy objectives of the WB as described in the OP 4.12.

A number of research methods are carried out for the purpose of the DDR including desk review, in-depth interview, group discussion, questionnaire survey, and field visit. Information presented in the DDR are largely obtained from interviews of persons knowledgeable about the land acquisition process of the two abovementioned national projects, including questionnaire survey with 211 affected households (AHs) and interviews with 28 representatives of the local authorities, particularly from the District Compensation, Assistance, and Resettlement Boards (DCARBs) and People's Committees at ward/commune level. Desk review of detailed measurement survey (DMS) records and approved compensation plans of the AHs augmented information gathered in the interviews.

The Project consists of the dredging of an aggregate 32,714 meters of canal and rehabilitation and construction of 134 sewers. The overall objective of the Project is to drain runoff water and prevent flooding for residential areas, industrial zones, urban development, green space, and garden house with the total basin area of 14,900 hectares. The project area covers 17 wards and two communes belonging to eight districts of HCMC, namely District 8, Binh Tan, Tan Phu, Tan Binh, District 12, Go Vap, Binh Thanh, and Binh Chanh. The Project's phase 1 requires the acquisition of an aggregate 1,534,600 m^2 belonging to 3,212 households and 46 organizations. By land use, these comprise 309,527 m^2 of residential land (20.1%); 238,822 m^2 of specially used land (15.6%), and 986,251 m^2 of agricultural land (64.3%). Among the total PAHs, 1,342 households are fully affected, thus have to relocate; of which, 654 households are eligible for resettlement entitlements while 391 households are deemed ineligible. The remaining 1,870 households are partially affected; of which, 498 households are affected on a part of their houses and have sufficient remaining area to reorganize (including production establishment/business households).

The key findings of the DDR for the Tham Luong-Ben Cat-Nuoc Len Canal Project are as follows:

1. To date, land acquisition activities in three districts, namely Binh Chanh, Tan Phu, and Binh Thanh have been completed while the rest including Binh Tan, Tan Binh, District 12, and Go Vap have not been finished. Of the total 3,212 households, 2,937 households, accounting for 91.4%, have received compensation and handed over site to the Project. 268 AHs, or 8.3%, have not handed over site although 44 of them have already received compensation. The compensation for 212 households who refuse to receive compensation were deposited into bank accounts while the remaining 12 households (0.3%) are waiting for compensation payment decisions to be issued by the local government.
2. Land acquisition and compensation process of the Project has been carried out since 2002 and thus undergone two revisions of the Land Law in 2003 and 2013. The compensation, assistance, and resettlement of the Project are assessed as compliant with the 1993 and 2003 Land Laws and their associated decrees as well as the local decisions and policies issued by Ho Chi Minh City People's Committee at that time. Particularly, the City's Directive No. 08/2002/CT-UBND has issued an important milestone, April 22 2002, which can be considered as the "cut-off date", to decide the eligibility of the APs for compensation for their affected houses and structures.
3. Land acquisition and compensation activities of the Project are significantly delayed. Specifically, the compensation plans for the AHs were prepared in 2002 and compensation rates applied were issued in 1995. Then the compensation rates were adjusted one time in 2005 and remained the same until now. Such policy adjustments are only made when there are too many complaints and objections from the APs to receive compensation and hand over site to the Project. However, even these adjustments are not carried out in a timely manner. Several recommendations of the DCARBs were proposed since 2007; however, after 7 years, until 2014 did the City PC approve these proposals.
4. The resettlement site (RS), particularly Vinh Loc B, is not acceptable to several AHs. The selection of the RS was not decided by the APs but implemented according to the city's planning. Vinh Loc B RS in Vinh Loc Commune, Binh Chanh District, was developed comprising 30 apartment buildings to arrange resettlement for the city's projects involved land acquisition. However, the design of resettlement apartments is not suitable to the large-size households and the use of corrugated iron roofs are not suitable to the weather. Moreover, the RS is too far with little opportunity for economic development. Therefore, the PAHs do not want to receive houses in the RS and refuse to hand over site although they already received compensation. For those that were arranged to relocate here, the majority of them live in other places while letting other people use or lease their allocated apartments. Moreover, the RS of the Project does not meet a principle stipulated in the Government's Decree No. 22/1998, which is the principle of equivalent value.
5. Information disclosure and consultation meetings were conducted for several times during the project implementation process with the local authorities and residents in the project area. However, during the design and planning process, there was no information provided for the APs. Similarly, the dissemination activities were mostly one-way and focused on regulations and policies applied by the Project. Information related to other supports such as

income restoration program was not provided for the APs. Therefore, although there are available funds targeting the poor and APs whose land is acquired in the area, the interviewed APs are not aware of them.

6. There are several outstanding complaints related to the Project. A total 687 written complaints have been sent to the DCARBs; of which, 419 cases, or 61%, were resolved while 268 complaints (39%) are yet to be solved. Most of the complaints lodged by APs are related to (i) low compensation rates for affected land; and (ii) legal status of land.
7. In the project area, land-based livelihood is not the main source of income of the PAHs. The number of households dependent on agriculture in this area is rather small. Therefore, the acquisition of productive land do not severely affect the income and livelihoods of the AHs. Like other national projects, the post-resettlement monitoring is not conducted as there is no regulation as well as allocated budget for monitoring income restoration of the APs.
8. Accumulated impacts are identified for 25 households who are affected by both Phase 1 and Phase 2 of this Project. Hence, special attention needs to be given to these households, particularly in restoring their living standards.

Although the compensation, assistance, and resettlement activities of the Project are in compliant with the national laws and government's regulations, it is not a good practice due to the outstanding issues and delays of the Project, which is costly because the Project is not completed and causes adverse social impacts. Hence, a corrective action plan is proposed for the abovementioned shortcomings vis-à-vis the resettlement policies and regulations of the government and the way the DCARBs carried out land acquisition since 2002. These corrective actions must be completed by the end of June 2016 at the latest.

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