

# Environmental Monitoring Report

Semestrial Report from January to June, 2012  
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VIE: Phuoc Hoa Water Resources Project

Prepared by Institute of Coastal and Offshore Engineering for the Hydraulic Project  
Investment and Construction Management Board No.9 - Ministry of Agriculture and  
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## **CURRENCY EQUIVALENTS**

(as of 20 July 2012)

Currency Unit - Vietnam dong (VND)  
\$1.00 = VND 20,870

## **ABBREVIATIONS AND ACRONYMS**

ADB	Asian Development Bank
AFD	Agence Française de Développement
DARD	Department of Agriculture and Rural Development
DTPW	Department of Transport and Public Works
DOC	Department of Construction
DOF	Department of Finance-Pricing
DONRE	Department of Natural Resources and Environment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographical Information System
HCMC	Ho Chi Minh City
ICOE	Institute of Coastal and Offshore Engineering
ICMB9	Investment and Construction Management Board No.9
IDA	International Development Association (of the World Bank)
JBIC	Japan Bank for International Cooperation
MARD	Ministry of Agriculture and Rural Development
MONRE	Ministry of Natural Resources and Environment
PAF	Project Affected Families
PHWRP	Phuoc Hoa Water Resources Project “the Project”
RAP	Resettlement Action Plan
RFP	Request for Proposals
RPF	Resettlement Policy Framework
TOR	Terms of Reference
WB	World Bank

## **NOTES**

- The fiscal year (FY) of the Government of Vietnam and Ministry of Agriculture and Rural Development ends on 31 December. FY before a calendar year denotes the year in which the fiscal year ends, e.g., FY2011 ends on 31 December 2011.
- In this report, "\$" refers to US dollars.

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## **FOREWORD**

Phuoc Hoa Water Resources Project (Project) consists of two parts: Part A – Support for Institutional and Integrated Development, and Part B – Construction of Water Resources Infrastructure. Currently, the project has implemented a series of components including construction of the Headworks of Phuoc Hoa reservoir, Phuoc Hoa – Dau Tieng transfer canal, and Tan Bien irrigation Main Canal. These construction activities and their effect on the natural and hydrological conditions in the area have caused different negative and positive impacts to the environment. The aim of the Environmental Packages (Packages) is to collect environmental indicators regularly and other related issues, record and detect different impacts of the Project to the environment in order to adjust, overcome and mitigate any negative environmental impacts.

For the purpose of coordination, monitoring, and implementation of the EMP packages, this six-monthly progress report will summarize all activities and the implementation status of these Packages. The report will also orientate and guide in implementing the tasks of EMP packages as well as monitor and speed up the implementation progress of the tasks as in proposed schedules. In addition, the report also monitors the current situation in the project area and its vicinity, and develops the database for the environmental management programs of the Project. Meanwhile the report aims to ensure that project implementation can be made in compliance with the EMP and the Environmental Protection Law of Vietnam.

The six-monthly progress report is a basis for ICMB9 to upgrade their tasks of management and coordination and it also helps ADB and others to monitor the implementation status of the project as well as the concerned environmental changes.



## 1. Introduction

### 1.1. Phuoc Hoa Project Introduction

- (i) Phuoc Hoa Water Resources Project is funded jointly by the Asian Development Bank (ADB) and Agence Française de Développement (AFD) with a total amount in loans and Special Drawing Rights (SDR) equivalent to 217.27 million USD. The loans were agreed in 2 phases, for the 1st phase in 2003 and for the 2nd phase in 2011/2012. The closure dates are in 2014 and 2017 for ADB and AFD loans respectively.

All loans are summarized in the table below.

Loans	Amount (US\$ million)	Date		
		Approval	Signed	Effective
ADB loan	SDR 63.042 million equivalent to US\$ 90 million	27 November 2003	08 April 2004	23 August 2004
Two AFD loans	EUR 29.6 million equivalent to US\$ 2.270 million	20 November 2003	20 August 2004	20 August 2004
ADB loan supplemental	SDR 38.594 million equivalent to US\$ 60 million	27 May 2011	27 May 2011	30 September 2011
AFD loan supplemental	EUR 20 million equivalent to US\$ 25 million	25 May 2012	7 September 2012	7 September 2012
Total	217.27			

- (ii) The project objective is to provide additional water to Sai Gon River and Vai Co East River for agriculture development (with irrigation) and enhance current water sources supply in order to control salinity, domestic, municipal industrial water supply (DMI) to Ho Chi Minh City and neighbouring provinces. This project will use the approach of integrated development to increase agricultural production by enhancing effective and sustainable water resources management.
- (iii) The Project consists of two parts: Part A – Support for Institutional and Integrated Development, and Part B – Construction of Water Resources Infrastructure.
- (iv) The Project will support construction of the Phuoc Hoa barrage and transfer canal to convey water from the Be river to the existing Dau Tieng reservoir on the Saigon river. Under Phase 2, two new irrigation areas will be constructed: Tan Bien irrigation system in Tay Ninh province; and Duc Hoa irrigation system in Long An province. The ADB loans are financing the main infrastructure: Phuoc Hoa barrage, Phuoc Hoa – Dau Tieng transfer canal and the 2 main irrigation canals as well as project management costs. The AFD loans are financing infrastructure development of tertiary canals for the irrigation systems and support for the on-farm and social development

program (OSDP).

- (v) The executing agency (EA) is the Ministry of Agriculture and Rural Development (MARD), which originally provided overall management and coordination through its Central Project Office (CPO) based in Hanoi. In order to improve project management and coordination, from November 2006, MARD assigned the overall responsibility for project implementation to Investment and Construction Management Board No.9 (ICMB9) in Ho Chi Minh City (HCMC), and Departments of Agriculture and Rural Development (DARDs) of four provinces (Binh Duong, Binh Phuoc, Tay Ninh and Long An). ICMB9 provides an interface with the ADB and AFD, and is directly responsible for management and construction of the Phuoc Hoa Barrage, Phuoc Hoa – Dau Tieng transfer canal, and main canals for the two irrigation systems, and for transfer of infrastructure to Dau Tieng Irrigation management company (IMC) for management and operation. The role of ICMB9 is to provide overall management assistance and coordination, and to provide instruction to the DARDs and PPMBs with assistance of Black & Veatch International (BVI) Consultants.
- (vi) Project environmental management and Environmental Impact Assessment (EIA) study was prepared by Black & Veatch International (BVI) in September, 2001 (BVI 2001a) and approved by the Asian Development Bank (ADB) in March 2003 (ADB 2003a). In accordance with Vietnamese environmental law, a third EIA report (ENTEC 2007) was carried out in April 2005 by the Environmental Technology Centre (ENTEC), under contract (A41) to ICMB9 from 2005 - 2007. This EIA was revised and submitted to the Ministry of Natural Resources and Environment (MONRE) for approval in September 2007. MONRE approved the project EIA in early 2008.

As required by ADB, a follow-up Environmental Management Plan (EMP) for the Project was prepared by BVI in late 2006 – 2007 period (BVI 2007c). The EMP was approved by MARD and ADB in January 2008. The EMP documents provide details of the environmental management, monitoring and protection programmes.

## **1.2. Package OP4 Introduction**

### **1.2.1. The Scope of Works of OP4 Package comprises:**

- Overall management, co-ordination, supervision and monitoring of the Phuoc Hoa Water Resource Project environmental and EMP implementation programmes;
- Supervision and monitoring of environmental programmes and EMP implementation consultants and contracts;
- Collection, storage and distribution of EMP monitoring data, technical reports

and civil contracts or EMP techniques for project extension, providing the information of progress and budgets from EMP consultants and other Provincial sources, and presenting these data in accordance with an appropriate format;

- Carry out field surveys and keep contact with provincial governments and communities to inspect the environmental conditions in the project area and its vicinity as well as downstream areas in order to ensure that construction contracts, EMP and project activities are implemented in accordance with environmental laws, safeguards and signed agreements;
- Provide main information of the report and comments to ICMB9 regarding problems and solutions relating to the EMP implementation, EMP consultants' performance, environmental trends in the project area or within river basin of the project and environmental impacts from the project;
- Acting as a spokesman for the environmental aspect of the project and representing ICMB9 in general scope and official forums relating to ministerial, provincial levels and communities as well as media liaison;
- Provide six-monthly reports to ICMB9, MARD, ADB, AFD, MONRE, and local governments, PPCs in the project areas as well as organisations and individuals that are in charge of the above mentioned tasks. Environmental staffs, the environmental division of ICMB9, consultants and contractors must comply with environmental requirements of the Project.

#### 1.2.2. Specific Tasks of OP4 Package

- Understanding the existing and proposed Phuoc Hoa water resources project environmental management programme;
- Management, supervision and monitoring the work of EMP implementation contractors and contracts;
- Supervision and monitoring of EMP implementation programmes and environmental compliance;
- Supervision and monitoring of environmental outputs, environmental trends and project environmental impacts;
- Ministerial, provincial and public liaison;
- Reporting and data distribution.

## **2. Activities of OP4, BVI and ICMB9 in the first six months 2012**

### **2.1. Activities of OP4**

Based on the TOR, and in order to implement the tasks of coordination and supervision of EMP packages, OP4 consultant has carried out activities including meetings with EMP consultants, employer, donors, local authorities and others relating to relevant issues of the project as follows:

- On 28 March 2012, attended preliminary conference on the implementation result of environmental management plans of Phase I of the project with participation of representatives of ICMB9, BVI, OP4, EMP packages and local authorities within the project areas.
- On 28 March 2012, had a meeting with representatives of ICMB9, ADB and BVI regarding implementation status of EMP packages, outstanding issues and implementation plan in the coming time.
- On 12 June 2012, had a meeting with representatives of ICMB9, MT2, MT8, BVI regarding the procurement of package MT1, construction progress of monitoring station of package MT8 and the reforestation in semi-flooded area of package MT2.

In addition to aforementioned meetings, the OP4 consultant has also cooperated with relevant agencies to involve in field surveys in the project area and worked with local authorities. These activities are summarized in Table 1.

In accordance with each package's TOR, the review and assessment activities of implementation results of EMP packages through progress reports have also been carried out frequently.

### **2.2. Activities of ICMB9**

In the first six months of 2012, ICMB9 cooperated with BVI and OP4 consultants to carry out some main contents as follows:

- Overall management on the progress and implementation of EMP packages;
- Organized meetings with the relevant authorities in order to monitor, supervise and speed up the progress as well as to solve outstanding issues of EMP packages.
- Worked with local authorities regarding the implementation of packages MT2, MT8, MT7, MT4, and
- Inspected, evaluated and requested construction contractors to implement the Environmental Management Plan of the project seriously.

### **2.3. Activities of BVI**

The main activities of BVI consultant in the first six months of 2012 included:

- Supported ICMB9 in carrying out the management and implementation of EMP packages.
- Cooperated with OP4 Consultant to comment and assess the implementation results of EMP packages through their progress reports of consultants.
- Attended and organized meetings between the EMP consultants and local authorities.
- Cooperated with OP4 consultant to determine the structure of periodical environmental monitoring reports as well as the structure of the environmental database;
- Cooperated with ICMB9 and relevant environmental consultants such as MT2, MT4, MT7, MT8, OP4, and others to implement works as indicated in the Aide-Memoire of ADB dated 02 May 2012.
- Supported ICMB9 in preparing the documents for additional Packages that are going to be tendered such as MT1, MT9 and OP3.

**Table 2: Summary of contents and results of site surveys**

No.	Date	Cooperative units	Supervision & Survey contents	Supervision results
1	30/5/2012	Representatives of ICMB9, OP4 and MT7	<ul style="list-style-type: none"> <li>- Inspected the implementation of package MT7 at construction packages</li> <li>- Conducted site surveys on environmental condition at package 1A, 1B and 1C.</li> </ul>	<ul style="list-style-type: none"> <li>- Most of construction packages finished their activities and turned over the site.</li> <li>- A joint inspection along the transfer canal was made. It was found that a big volume of excavated material has not been levelled, especially in package 1C. This will be a cause of dust generation in the dry weather condition together with high traffic volume, and the excavated material will wash into the canal and vicinities when it is raining.</li> </ul>
2	31/5/2012	Representatives of ICMB9, OP4 and MT7	<ul style="list-style-type: none"> <li>- Inspected the implementation of package MT7 at construction packages</li> <li>- Conducted a site survey on environmental condition at package PH3</li> </ul>	<ul style="list-style-type: none"> <li>- The contractor finished their construction activities. Minor repairs for some structures are being made in order to be able to hand over the work to Tay Ninh Province.</li> <li>- According to the site surveys, the environmental condition at this package is quite good; construction waste was treated well by the contractor. However, due to the fact that the project has not been handed over to the management unit, a lot of garbage appeared at the trash rack of the aqueduct, especially branches of trees. Safety handrails of some culverts along the Tan Bien Main Canal were not installed; this will be dangerous for traffic participants.</li> </ul>
3	4/7/2012	Representatives of ICMB9, OP4 and MT2	<ul style="list-style-type: none"> <li>- Worked with DARD of Binh Phuoc Province and Nha Bich Commune</li> <li>- Conducted site surveys at some semi-flooded areas of Hamlet 6, Nha Bich Commune.</li> </ul>	<ul style="list-style-type: none"> <li>- According to representatives of the local people, now the local people wish to retain the existing vegetation in the semi-flooded area for productive use.</li> <li>- Some of the land plots were identified as semi-flooded areas, but so far, they are not flooded. Hence, some households used these areas to cultivate short-term crops.</li> <li>- At present, local people is building toilets along the perimeter of the reservoir, this problem will be a huge source of pollution affecting the water quality of the reservoir.</li> <li>- Moreover, at this time early stage of impoundment, most of the fish cannot migrate to downstream of the dam and they are remaining in the reservoir. This makes that quantity of fish suddenly increase. As a result, some people appeared in this area from outside who are fishing freely. This problem has not been managed by any agencies.</li> </ul>

### 3. Implementation of EMP packages in the first six months of 2012

#### 3.1. Package MT2

The contract agreement of Package MT2 was signed in April 2010. The consultant has carried out office works and field surveys. In the first six months of 2012, the consultant submitted the Quarterly reports I and II.

According to the TOR, package MT2 consists of two specific tasks: Tasks I: study on the Be river catchment protection; Tasks II: Phuoc Hoa reservoir reforestation and forest management programme. Each main task consists of detailed tasks. Base on the implementation results in the first six months, the implementation of the package MT2 can be assessed as follows:

Task I-A '**Erosion risk survey, report and data collection**': this task has been implemented early. Its data and maps (scale 1:50.000) were collected and processed respectively. Based on these data, the consultant initially identified potential erosion areas. Erosions along the Be river from upstream to downstream were presented in previous reports.

Task I-B '**Field survey of risk erosion sites**': after the dam was impounded was a suitable time to implement this task. Therefore, in December 2011, the consultant conducted field surveys for the erosion status of Be riverbanks in the downstream areas of the dam. In the first six months of 2012, the consultant also conducted site surveys and updated the erosion status in Be river.

Task I-C '**Catchment Protection Site Selection**': The consultant finished the forest GIS database.

Task I-D '**Scoping and Awareness Workshop**': in the first two quarters, the consultant did not hold workshops.

Task I-E '**Follow-up Planning Meetings and Workshops**': Although large-scale workshops were not held, discussions were made during the implementation.

Task I-F '**Species, Planting Configuration and Management Options**': this task is substantially completed. The set of criteria for the selection of trees for forestation is established. Trees that will be selected for the forestation include *Hopea odorata*; *Lagerstroemia loudoni*; *Dipterocarpus alatus*; *Dalbergia tonkinensis*; *Pterocarpus macrocarpus*, etc...;

Task I-G '**Nurseries and Plant Material Supply Review**': the consultant made contact with the seedling suppliers for the forestation.

Task I-H '**Development of Catchment Protection Investment Plans**': this task has been implemented by the consultant. However, some issues regarding the

forestation for catchment protection are arising, these issues will be presented in detail in the next part of the report.

Task I-I '**Development of Monitoring, Evaluation and Management Framework**': this task was carried out in the previous period. In the first six months of 2012, the consultant only reviewed and finalised the anti-erosion and reforestation framework.

Task II-A '**Nurseries & Plant Material Supply**': because some issues with the forestation for catchment protection are arising, this task is being suspended.

Task II-B '**Forest & Agro-forest Establishment**': is underway.

Task II-C '**Monitoring, Evaluation & Protective Management**': is underway.

Problems, causes, and remedial measures:

**Problem 1:** *Erosion downstream of Be River when the dam is impounded:*

The erosion of Be riverbanks downstream the dam no more occurred due to the previous eroded locations being covered by vegetation and the water flow is being discharged steadily as the designed capacity with 13 m<sup>3</sup>/s. The old erosion has not affected the land of the local people who living along riverbanks, nor the water quality in downstream areas. The consultant will continue to monitor the erosion situation when the water in the reservoir Phuoc Hoa will be conveyed to Dau Tieng reservoir through the transfer canal.

**Problem 2:**

Some areas with elevations between +42.90m and +44.00m are being flooded with varying frequencies. The survey results show that these semi-flooded areas are 10,800,086 m<sup>2</sup> equivalent to 1,086 hectares, according to the designers of HEC2. 66% of the total semi-flooded areas has 7-years old rubber trees. The acquired land areas are 19% and some of these are being used to plant rubber trees and fruit trees by the local people. The 14 % remaining areas are short-term crops and grass.

From the permanent-flooded areas upstream of the dam, a part of semi-flooded area equivalent to 15% is always submerged in the rainy season, 58% of this submerged area is the dead-rubber trees. These rubber trees died from the long-time submergence. The remaining areas are grass.

**Problem 3:** the reoccupation of project acquired land by the local communities for rubber tree plantation:

It is proposed that an inventory of existing status of vegetation in the semi-flooded areas will be made. This inventory should cover the re-encroached area by local people for rubber tree plantation. Based on this inventory, a proper solution of



vegetation improvement in semi-flooded areas and a proper protection and management approach for the reservoir will be proposed.

**Problem 4: *The forestation in semi-flooded area***

The local people encroached on land in the semi-flooded areas to plant rubber tree and fruit trees for their benefit. Therefore, they are indifferent to plant the protective forest. Since Phuoc Hoa semi-flooded area is close to farmers' owned land, it is very difficult to carry out the forestation without the participation of the local people.

Regarding above mentioned problems, the Employer already arranged a joint inspection to the sites with participation of the representatives of Binh Phuoc PPMB, ICMB9, Dau Tieng – Phuoc Hoa IMC, OP4, MT2 and BVI consultant on 4 July 2012. The inspection results show that most of the local people wanted to use these land areas for the cultivation of existing trees. According to the Mission's comment, this is a feasible solution, worthwhile to be considered. If the local people will be allowed to continue their rubber tree exploitation, then the areas of land to be reforested of this Package must be revised and submitted to ADB for approval.

**3.2. Package MT3**

The contract agreement of Package MT3 was signed on 21 September 2011 and the consultant has carried out his tasks as required in the consulting contract. The implementation status can be evaluated as follow:

Task 1 '***Understanding of the domestic water supply program for Be river basin and Duc Hoa area***' the consultant checked basic documents, collected data and maps of the project implementation area as well as collected basic maps of the Phuoc Hoa project.

Task 2 '***Investigation, choice of location and technology, and preparation of cost estimate for water supply station in Be river basin***'

The consultant investigated and preliminarily evaluated the water sources for the water treatment station. The consultant also analysed advantages and disadvantages and proposed to use groundwater for the beginning stage (capacity 200m<sup>3</sup>/day) instead of surface water as required in the TOR. The consultant also finished the feasibility study, basic design, detailed design, detailed cost estimate and technical parameters of the water supply station at Cay Truong commune (downstream area of be river).

Task 3 '***Investigation, choice of location and technology, and preparation of cost estimate for water supply station for Duc Hoa area***' The consultant conducted site surveys. The consultant had meetings with relevant agencies such as DARD, Sub-Department of Water Resources, Water Supply and

Environmental Sanitation Centre of Long An province to get the agreement of the location for the water supply station in Tan My commune, Duc Hoa district, Long an province (this location is consistent with the TOR).

The water source, will be the Duc Hoa main canal (in accordance with TOR). However, the Duc Hoa main canal is not yet under construction; the canal section crossing the Tan My commune has not yet been constructed. Therefore, the consultant proposed that the construction of the Tan My water supply station should be carried out at the time of the construction of Duc Hoa main canal.

*In the first six months of 2012, the consultant worked with the local departments as follow:*

**Table 3: Some main activities of package MT3 in the first six months of 2012**

No.	Date	Contents/ Participants	Results/Meeting conclusion
1	11/01/2012	<ul style="list-style-type: none"> <li>- Identified location for the construction of water treatment station with capacity 50m<sup>3</sup>/day</li> <li>- Representatives of Tan My CPC, Hau Nghia DPC, ICMB9, Water Supply Centre of Long An and MT3 consultant</li> </ul>	The construction of water supply station with capacity 50m <sup>3</sup> /day at Tan My commune was agreed. The commune agreed to allocate the land for the construction of water supply station.
2	10/02/2012	<ul style="list-style-type: none"> <li>- Identified location for the construction of water treatment station with capacity 200m<sup>3</sup>/day</li> <li>- Representatives of Cay Truong CPC, the finance division, An Lac consulting company, ICMB9 and MT3 consultant</li> </ul>	The Cay Truong CPC proposed the location for construction of water supply station that is located in the area owned by the Binh Duong Rubber One Member Ltd., Co. The CPC also prepared the statement to Ben Cat DPC for consideration and approval.
3	08/03/2012	<ul style="list-style-type: none"> <li>- it was agreed to construct 1 water supply station with capacity 200m<sup>3</sup>/day for 1.000 residents living in centre of Cay Truong commune</li> <li>- The investment consists of 1 water supply station with capacity 200m<sup>3</sup>/day and 1 clean water pipeline system 1.2 km long from the water treatment station to Commune CPC.</li> <li>- Discussed on handing over, operation and management of water supply station when the construction activities will be</li> </ul>	Cay Truong CPC prepared the statement regarding the land allocation and submitted to Ben Cat DPC for consideration and approval.

	finished. - Representatives of Cay Truong CPC, ICMB9, BVI, MT3 consultant.	
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### Implementation results:

*Regarding the Domestic water supply system in Cay Truong commune, Ben Cat district, Binh Duong province, the following reports have been finished:*

- Feasibility Study;
- Design documents and drawings;
- Design cost estimate;
- Bidding documents (draft documents).

These reports were prepared by MT3 consultant, checked by consultants and submitted to ICMB9 in early July 2012.

*Regarding the Domestic water supply system in Tan My commune, Duc Hoa district, Long An province, the following reports have been finished:*

The choice of location for Duc Hoa water supply was delayed because the results of the meetings and decisions of the Long An MONRE and CPCs relating to land acquisition problems is awaited. However, MT3 Consultant has prepared the following reports:

- Feasibility Study (draft version);
- Design documents and drawings (draft version);
- Design cost estimate (draft version);
- Bidding documents (draft version);

### 3.3. Package MT4

The contract agreement of Package MT4 was signed in January 2010. At present, the MT4 consultant completed the Inception report, the first six-monthly report of 2010, the implementation report of 2010 (first temporary report), the first six-monthly report of 2011 and the annual report of 2011. The consultant has not yet submitted the first six-monthly report of 2012.

In the first six months of 2012, the consultant continued to implement the tasks as required in TOR but the progress of preparation and submission of reports was still slow. According to the TOR, package MT4 consists of 09 specific tasks. We, OP4 consultant assessed the implementation status up to now as follows:

Task I “***Understanding the proposed Be River and Phuoc Hoa fishery, Reservoir and Fish pass management program***”: this task has been implemented

early, the basic information was collected and analysed. Recently, the consultant has continued to update the statistic data of the fishery sector of Binh Duong and Binh Phuoc provinces in 2010 and 2011.

Task II “**Monitoring Hydrology and environmental flows management**”: This task has been done regularly and continuously. The main data was collected from the data of packages MT5 and MT6.

Task III “**Monitoring the fish pass construction**”: During the reporting phase, The MT4 consultant supervised and monitored the construction of the fish pass. Up to now, the construction of the fish pass was finished. In the first six months of 2012, the consultant conducted 2 field surveys in May and June respectively.

Task IV “**Establishment of Be River and Phuoc Hoa forest and fisheries association**”: This is one of the key tasks of the package. Based on the information from the consultant, after studying the legal basis and discussions with local authorities in the Project area, the establishment of this association would not be feasible. On 23 March 2012, the consultant held a meeting with leaders of Binh Duong and Binh Phuoc DARDs, Districts and relevant departments to discuss the establishment of Phuoc Hoa forest and fisheries association and the management of the fish pass of Phuoc Hoa reservoir. On 10 May 2012, the consultant held a meeting with representatives of Dau Tieng – Phuoc Hoa IMC (the meeting was held at Phuoc Minh commune, Duong Minh Chau district, Tay Ninh province) to discuss the operation process and the fishery regulations for Dau Tieng reservoir.

Task V “**Operation and Protection of Fish Pass**”: On 23 March 2012, the consultant conducted a field inspection to the fish pass and found that there were some people who were fishing in the fish pass. On 27 June 2012, the consultant conducted a field survey with their fishing equipment to make a check. However, during the field survey, the reservoir was being discharged, therefore the fish pass was empty. As a result, the activities for checking the fish population could not be made. However, there were still many people fishing downstream from the dam.

Task VI “**Phuoc Hoa reservoir fishery management plan**”: the main content of this task is to provide guidance for the Association/team so that the association/team will be able to manage, exploit, plan, and conserve Phuoc Hoa Reservoir fisheries resources. In the first six months of this year, because the reservoir has not been impounded for a long time, the submerged areas have not been stable. Therefore, the surveys for finding the breeding and feeding areas of fishes in the reservoir were not made completely. As a result, these breeding and feeding areas have not yet been shown accurately on the map of flooded area of the Phuoc Hoa reservoir. For these reasons, in the coming time, the consultant will survey these breeding and feeding areas carefully and show them on the map for the annual report of the year 2012.

Task VII ***“Social support and compensation for affected fishermen”***: Recently, the consultant has continued to collect further relevant information of Binh Duong province. According to MT4’s report, land acquisition and compensation were implemented quite well.

Task VIII ***“Management of Be River and lower Dong Nai fishery”***: The main contents of this task is to prepare fishery management plans and action plans for Be - Dong Nai Rivers basin. Recently, main activities were the collection of relevant documents/data collection, training for the aquatic resource protection and conducting field surveys, etc...

Task IX ***“Monitoring and evaluation of Be River fishery management program”***: the consultant is studying, aimed at understanding the fisheries management models of other provinces with a similar program so that the consultant will be able to apply these similar programs for the Be River basin in future.

In general, up to now, the remaining workload of package MT4 is still quite big. The progress of the organisation and implementation of this package have been delayed. The delay in submission of the reports for the year 2011 is an indication for the delay of this package. At the same time, the information on fishing activities in the Phuoc Hoa reservoir after its impoundment has not been updated sufficiently. As a result, the information on these issues, especially the information related to fishing activities of the local people in the upper areas of the reservoir have not been provided fully by the consultant.

In addition, according to the Aide Memoire of ADB dated 2 May 2012, the Mission requested MT4 consultant to prepare the fish pass operation and maintenance (O&M) manual and provide it to Phuoc Hoa – Dau Tieng IMC in order that the IMC will be able to operate the fish pass properly. As informed by MT4 consultant, the Phuoc Hoa Fisheries Association is under establishment and the preparation of the O&M manual for the fish pass is underway. MT4 Consultant and Phuoc Hoa – Dau Tieng IMC are discussing together the operation methodology of the fish pass. The field joint inspection with participation of ICMB9, MT4 consultant and BVI on 13 July 2012 found that the fish pass was being blocked; there were local people who are excavating fishponds in the semi-flooded area; there were some people from other provinces fishing with illegal tools (electric tackles). However, the Employer has not been provided any specific information on aforementioned issues.

### **3.4. Package MT5:**

Up to the end of June 2012, the consultant has monitored the water flow at 6 stages. The details of these measurements are presented in Table 3. The monitoring activities have been made seriously and sufficiently. These monitoring activities were consistent with current governmental norms and regulations and met the

requirements of the TOR. However, the submission of reports of MT5 consultant is still behind the schedule.

**Table 4: Monitoring stages of water flow of package MT5**

No.	Date		No. monitoring stations	Monitoring stations	Notes
	From	To			
1	17/10/2009	22/10/2009	6	From Q1 to Q6	
2	20/04/2010	25/04/2010	6	From Q1 to Q6	
3	7/10/2010	12/10/2010	6	From Q1 to Q6	
4	20/04/2011	25/04/2011	6	From Q1 to Q6	
5	13/10/2011	18/10/2011	6	From Q1 to Q6	Monitoring station Q5 was moved to upstream with a distance of 1.0 km as proposed by BVI.
6	23/04/2012	28/04/2012	8	From Q1 to Q8	Provided 2 additional monitoring stations at the fish pass and downstream of the dam.

**Table 5: Some main activities of package MT5 in the first six months of 2012**

No.	Date	Participants	Contents
1	28/03/2012	Representatives of the Employer is ICMB9; representatives of MT5 consultant is Southern Institute of Water Resources Research Representatives of OP4 consultant is Institute of Coastal and Offshore Engineering and representatives of BVI.	The general assessment of water flow differences; water flow capacity prior and post the impoundment; The preliminary forecast of the salinity intrusion potential in the dry season on the Sai Gon and Dong Nai rivers when the Phuoc Hoa reservoir will be put into operation; Discussion for the difficulties during the implementation. Finding the issues and solutions.

At present, the field surveys have been made as scheduled. The monitoring activities have been implemented in accordance with current governmental norms and regulations on the hydraulic monitoring and measurement. However, the preparation of monitoring result reports is still behind schedule. This affects the general schedule of the EMP packages because the monitoring data of this package will be used as a database for some important evaluations of packages MT2, MT4, MT6, OP4... The MT5 consultant explained that the reasons are the lack of elevation benchmarks or the elevation benchmarks are not located in the Phuoc Hoa reservoir areas. These problems affected the accuracy of monitoring results. Therefore, more time is needed for the correction of these data.

### **3.5. Package MT6:**

The contract agreement of package MT6 was signed in November 2009. Up to now, the consultant completed their Inception Reports and monitoring result reports in 2010 and 2011. The measurement and sampling activities at sites have been made timely.

In comparison with the TOR, most of the tasks have been implemented quite well such as providing additional monitoring locations for the operation stage, taking water samples at field sites, and analysing the quality of surface water, groundwater and industrial wastewater.

According to the TOR, in the third year of operation stage, the salinity-monitoring network will have some changes. For example, the consultant will not take water samples at streams of Be River such as Chon Thanh stream, Nuoc Trong stream and Giai stream (WQ2, WQ3, and WQ8).

Five additional monitoring locations are:

- Phuoc Hoa reservoir (WQ0);
- Beginning of transfer canal, near the Phuoc Hoa dam (WQ6);
- End of transfer canal, near the spillway of Dau Tieng dam (WQ7);
- End of Tan Bien main canal (WQ24);
- End of Duc Hoa main canal (WQ25).

Therefore, the surface water quality-monitoring network in the operation stage from 2012 include following stations:

- 6 stations in Be river: WQ0, WQ1, WQ4, WQ5, WQ9, WQ10;
- 4 stations in Dong Nai river: WQ11, WQ12, WQ13, WQ18;
- 6 stations in Sai Gon river: WQ14, WQ15, WQ16, WQ17, WQ19, WQ20;
- 3 stations in Vam Co Dong river: WQ21, WQ22, WQ23;
- 4 stations in the main canal system: WQ6, WQ7, WQ24, WQ25.

Contrary to the mentioned achievements, the MT6 consultant was not active in contacting and cooperating with local authorities. Therefore, the information of monitoring systems as well as monitoring data from local agencies was not mentioned in the reports of this package. Moreover, the preparation and submission of reports in 2011 as well as monitoring result reports in the first six months of 2012 were made very slowly.

Relating to the above-mentioned issues, we request that the MT6 consultant prepare and submit their report as soon as possible.

Based on the Aide Memoire of ADB dated 2 May 2012, the Mission requested that MT6 consultant should cooperate with DARDs in integrating and sharing the Project environmental monitoring results with other environmental monitoring programs in other rivers. The consultant implemented this task by integrating monitoring data of local agencies into the Project database.

### **3.6. Package MT7**

The contract agreement of package MT7 was signed in October 2008. Up to now, the MT7 consultant completed their reports including the fourth-quarterly report in 2008, the fourth-quarterly report in 2009, the fourth-quarterly report in 2010, the fourth-quarterly report in 2011 and the first six-monthly report in 2012.

According to TOR, Package MT7 consists of six specific tasks. The implementation of each task in the first six months of 2012 can be assessed as follows:

Task A '***To Propose a structure of quarterly environmental monitoring report for contractors***': This task was completed early by the consultant before implementing other tasks.

Task B '***To Propose the Supervision and Environmental Monitoring Schedule***': This task was already completed during the preparation of the inception report.

Task C '***Details of environmental Monitoring Programs for Contractors***': Five sub-tasks of this task have been implemented sufficiently in the first six months of 2012. However, as mentioned in previous reports, the Sub-task C3 "*To verify the construction contractor's monitoring results by taking water samples at the sites and analysing these samples independently*" was not carried out because none of the contractors did take samples to analyse environmental factors as required in the EMP. Regarding this problem, MT7 Consultant gave comments repeatedly to the Contractors and the Employer. However, this problem has not been resolved yet.

Task D '***Environmental monitoring implementation***': This task consists of seven sub-tasks. Most of these sub-tasks have been implemented well. In particular, sub-task D6 that is to assess the environmental awareness of contractors and propose necessary solutions. Through the reporting periods, the consultant has provided some solutions to enhance the environmental awareness for contractors and the results were evident.

Task E '***Report preparation***': the preparation and submission of reports has been sufficiently and timely. However, because monitoring activities have not been performed by the contractors seriously, most of the monitoring results that are reported in the quarterly reports of MT7 consultant are the results of their own observations, without the contractors' results.



Task F '**Operation Phase**': This task is "*before the construction will be finished, the consultant is to advise ICMB9 and PPMBs on the implementation of EMP requirements for the operation phase.*" Although, the Phuoc Hoa reservoir is now impounded and the dam is under operation, the consultant has not provided any necessary proposals and programs yet. Therefore, we suggest that the MT7 consultant should complete these tasks as soon as possible.

Regarding the issues that were mentioned in the Aide Memoire of ADB dated 2 May 2012. The MT7 consultant has acknowledged these issues and carried out the following activities:

- On 9 May 2012, MT7 consultant issued a letter No. 44 requesting ICMB9 to arrange a joint meeting with relevant contractors to solve the problems in packages 1C and 1D. On 29 May 2012, a site instruction was published by the MT7 consultant to request package 1C Contractor to carry out his environmental protection responsibility.
- ICMB9 sent a letter to HEC2 requesting them to propose a design and prepare cost estimates for erosion protection for package 1D. The proposal will be submitted to the MARD so that MARD can approve the proposed treatment and grant a budget for the implementation.
- Regarding Package 1C, ICMB9 sent an official letter to this contractor requesting him to finish his environmental works before 15 August 2012. If this contractor will not finish the works by this deadline, ICMB9 will hire another contractor to finish this work and the budget for the implementation will be taken from Package 1C.
- Furthermore, already in 2011, MT7 consultant sent a letter No. 129 dated 9 September 2011 to all construction contractors requesting them to implement the above-mentioned issues.

In general, most of tasks that were indicated in the TOR have been implemented by the MT7 consultant. At present, the construction activities of the first Phase of the Project are going to finish but serious environmental incidences have not occurred. This achievement is a joint effort of relevant stakeholders. However, the MT7 consultant is still requested to consider and resolve the above-mentioned issues.

### **3.7. Package MT8:**

The contract agreement of package MT8 was signed on 30 June 2011. At present, the Package MT8's contract is expired. However, the consultant has just finished the purchase of monitoring equipment and the selection of locations for the construction and installation of monitoring equipment on the Sai Gon, Dong Nai and Vam Co Dong rivers. The installation of salinity monitoring and water level measuring

equipment for the monitoring station in Sai Gon river (crossing Binh Duong area) have just finished. This monitoring station is under construction.

Since the consultant has not met the requirements of the proposed work schedule many times, we requested that MT8 consultant should prepare a detailed working program, increase the numbers of their staffs and implement contents as indicated in the consulting contract. The MT7 is requested to closely cooperate with the Employer, BVI, OP4 and local departments during the implementation.

- On 24 April 2012, representatives of ICMB9, BVI, and MT7 consultant worked with the management board of the Hydro-meteorological Forecasting Center of Long An province regarding the agreement for the installation of the salinity monitoring equipment in the Ben Luc station and sharing the information relating to monitoring activities.
- On 11 April 2012, representatives of ICMB9, BVI, and MT7 consultant worked with MONRE of Binh Duong province on an agreement of the locations for installation of monitoring equipment in Sai Gon river, so that these locations will be consistent with the provincial monitoring networks.

### **3.8. Package MT10**

Up to now, the tasks of package MT10 were finished.

## 4. Environmental management program at construction sites

### 4.1. Main construction activities at the sites

Up to the end of July 2011, all construction packages were completed. At present, the infrastructure construction related to the completion of the basin transfer of Phuoc Hoa Water Resources Project is substantially finished, including Headworks, transfer canal, management houses, operation road of head works.

**Table 6: Information of construction packages**

Information	Name of package				
	1A	1B	1C	1D	PH3
Contract award (commencement)	(3/2008)	9/2008 (10/2008)	10/2008 (11/2008)	8/2008 (12/2008)	12/2008 (5/2/2009)
Completion date of contract	24/06/2011, additional works: fences, roads in the project: 10/2011	6/2011	6/2011	6/2011	7/2011
Contract value (adjusted), billion VND	685	284 (280,244)	215 (301,862)	302 (274.6)	120 (149.2)

Sources: ICMB9

At present, the main remaining works of construction packages are the finishing works such as site clearance, levelling borrow pits, recovering the construction areas, removing camps.

Up to the end of Quarter II/2012, the project (construction packages 1A, 1B, 1C, 1D) has been handed over to the IMC Dau Tieng for 7 months (the handing over was made in December 2011). Packages 1A, 1B, 1D finished the site clearance. Package PH3 is carrying out repair works for handing over to the Tay Ninh IMC. Package 1C is carrying out repair works, levelling, removing disposal material. The environmental issues of the Project were dust, noise, spilled disposal soil due to levelling activities and hauling disposal material in package 1C.

### 4.2. Impacts were caused by construction activities

Unexploded Ordinance, Land Mines and Toxic Waste: The project sites was investigated and cleared by a subcontractor under the Ministry of Defence. Up to Quarter II/2012, the contractors have not found any unexploded ordinances, land mines or toxic waste during the excavation and/or site clearance.

Reinstatement of Temporary Working Areas: The contractors have reinstated temporary working areas as required in the Specification. In particular, Package 1C is levelling and transferring soil from the disposal areas located along the canal.

Work in public highway, inside and outside the sites: The contractors have complied with the National Standards in transporting materials on public highways.

However, Packages 1C and 1D are requested to remove the disposal soil on the roads for safety and erosion protection. These packages are also requested to install traffic signals and safety handrails in the whole project area.

Site drainage: Some drainage ditches need to be dredged and repaired (Packages 1B, 1C, 1D).

Sanitation and site facilities: The contractors have implemented sanitation activities as required in the specification.

The protection of the surrounding landscape: At present, contractors are carrying out finishing works in as advised by the MT7 consultant.

#### 4.3. Environmental monitoring results at the sites

##### 4.3.1. Air quality

###### a. Dust

The monitoring results of the air show that the average dust concentration was  $115 \mu\text{g}/\text{m}^3$ . It was substantially decreased compared to all quarters during the construction stage and lower than the standard. At intersection of construction access roads (these access roads are now the Operation and Maintenance (O&M) roads), the average dust concentration is  $115 \mu\text{g}/\text{m}^3$ , lower than Quarter IV/2011 ( $206 \mu\text{g}/\text{m}^3$ ), Quarter II/2011 ( $164 \mu\text{g}/\text{m}^3$ ), Quarter III/2011 ( $146 \mu\text{g}/\text{m}^3$ ).

The Infrastructure of Packages 1A and 1D were handed over to the Employer and they are now under the maintenance stage. PH3 contractor is repairing defects for handing over. The construction activities were completed. Therefore, dust pollution caused by construction activities does not occur [Table 6]

**Table 7: Average dust concentration values at packages**

No.	Monitoring locations	Quarter II/2010	Quarter III/2010	Quarter IV/2010	Quarter I/2011	Quarter II/2011	Quarter III/2011	Quarter IV/2011	Quarter I/2012	Quarter II/2012
		$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$	$\mu\text{g}/\text{m}^3$
1	Offices, worker's campus areas	214,2	150	136	202	142	108	146		70
2	The intersection of roads in construction sites	250	180	172	254	164	146	206	115	165
3	The construction sites	245	180	192	300	164	156	248	NA	NA
	<b>QCVN 05:2009/BTNMT</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>	<b>300</b>
	Analysis method	TCVN 5067 - 1995								

Source: Institute of Environment and Water Resources, 16 - 18/11/2011 and 29 - 31/5/2012

###### b. Noise

The monitoring results of noise of construction packages in transfer canal

show that the noise is in the range of 47,5 – 68,2 dBA, the highest noise was 53,5 dBA that occurred at the Suoi Tre aqueduct of the Package PH3. In general, the noise level meets the permitted standard. The noise decreased in comparison with the construction stage.

**Table 8: Monitoring results of noise at construction packages**

Contents	1B	1C	1D	PH3	Standard (dBA)
<b>Quarter II/2010</b>					<b>TCVN 5949-1998</b>
Office areas	63	59	62	60	75
Intersections of access roads	52	64	66	63	75
Construction sites	64	66	61	68	75
<b>Quarter III/2010</b>					<b>TCVN 5949-1998</b>
Office areas	58	56.7	55	60.3	75
Intersections of access roads	76	53.2	51.3	68.3	75
Construction sites	65	74.6	57.6	69.3	75
<b>Quarter IV/2010</b>					<b>TCVN 5949-1998</b>
Office areas	56	63	66	65	75
Intersections of access roads	57.3	50.9	69.4	68.8	75
Construction sites	54.9	69.3	70.1	64.3	75
<b>Quarter I/2011</b>					<b>QCVN 26:2010/BTNMT</b>
Office areas	63.5	54.5	59.8	59.1	70
Intersections of access roads	62.7	62.1	60.5	60.9	70
Construction sites	66.3	68.1	73.4	56.2	70
<b>Quarter II/2011</b>					<b>QCVN 26:2010/BTNMT</b>
Office areas	51.70	59.70	57.90	52.00	70
Intersections of access roads	62.80	57.20	60.80	69.10	70
Construction sites	68.50	58.90	63.30	77.30	70
<b>Quarter III/2011</b>					<b>QCVN 26:2010/BTNMT</b>
Office areas	62.7	64.6	60.3	68.4	70
Intersections of access roads	61.8	56.4	60.8	70.5	70
Construction sites	66.3	72.2	64.1	68.5	70
<b>Quarter IV/2011</b>					<b>QCVN 26:2010/BTNMT</b>
Office areas	60.4	59.6	54.0	59.3	70
Intersections of access roads	66.1	62.5	61.8	65.0	70
Construction sites	61.3	69.6	53.0	61.4	70
<b>Quarter I/2012</b>					
Intersections of access roads	48.1	47.5	53.4	53.5	70
<b>Quarter II/2012</b>					

Contents	1B	1C	1D	PH3	Standard (dBA)
Intersections of access roads	64.6	73.2	NA	48.1	70

Source: Institute of Environment and Water Resources 16 - 18/11/2011 and 29 - 31/5/2012

**Comparison of the monitoring results of dust and noise in 2005 versus the monitoring results in the first 6 months of 2012**

If we compare the monitoring results of the dust and noise at construction packages in the first 6 months of 2012 versus the monitoring results prior the construction stage in 2005, and compare these monitoring results versus the QCVN 05:2009/BTNMT (National Technical Regulation for surrounding air quality) and QCVN 26:2010/BTNMT (National Technical Regulation for noise), the compared results show that there were no significant changes [Table 8].

During the monitoring stages in quarter II/2012, the monitoring results of the air pollution (dust, noise) that were measured at surveyed locations show that most of these monitoring results satisfy the standard and the air pollution is subsided in comparison with the construction stage. However, during the execution of hauling the disposal material and levelling, water spraying activities are needed to mitigate dust pollution.

**Table 9: Comparison of the air condition at project areas in 2005 versus the air condition in the first six months of 2012**

No.	Contents	Reservoir areas			Canal alignment			Comparison of standards
		Results of 2005	Average results in Quarter I/2012	Average results in Quarter II/2012	Results of 2005	Average results in Quarter I/2012	Average results in Quarter II/2012	
1	Noise (dBA)	40 - 68	61.3	68.2	41 – 60	50.6	62.5	QCVN 26:2010/BTNMT (70 dBA)
2	Dust ( $\mu\text{g}/\text{m}^3$ )	181	140	180	174.5	112.5	152	QCVN 05:2009/BTNMT (300 $\mu\text{g}/\text{m}^3$ )

#### 4.3.2. Domestic water

The domestic water plays an important role for health of staffs and workers in construction sites. In the construction packages, the domestic water is supplied from groundwater in offices and worker camps; the depth of drilling well is from 25 to 50 m.

In the first six months of 2012, the activities to check domestic water quality were conducted at some domestic water management stations and package PH3. The pH indicator in the Package PH3 was 5,16 and E.Coli indicator in the domestic water at the domestic water management station in Package 1B was 2 CFU/100 ml; these indicators did not satisfy the standard. All remaining indicators satisfied the standard [Table 9].

**Table 10: Monitoring results of domestic water quality at construction packages in the first six months of 2012**

No	Indicators	Unit	Results				Level I QCVN 02:2009/ BYT
			1A (Site office)	1B (Site office)	PH3 (QI/2012)	PH3 (QII/2012)	
1	pH		7.11	7.42	5.6	5.16	6 - 8.5
2	Total hardness	mgCaCO <sub>3</sub> /l	244	200	13	11	350
3	Suspended Solid, SS	mg/l	KPH<0.5	1	1	NA	-
4	Clorua, Cl <sup>-</sup>	mg/l	3	4	4	3	300
5	Nitrate, NO <sub>3</sub> <sup>-</sup>	mg/l	KPH (<0.01)	KPH (<0.01)	KPH (<0.01)	KPH (<0.01)	-
6	Sulphate, SO <sub>4</sub> <sup>2-</sup>	mg/l	KPH<1	KPH<1	1	KPH<1	-
7	Man gan, Mn	mg/l	0.15	KPH (<0.02)	KPH (<0.02)	0.1	-
8	Total Fe	mg/l	0.09	KPH (<0.06)	0.13	0.1	0.5
9	E.Coli	CFU/100 ml	KPH (<1)	2	KPH (<1)	KPH (<1)	0
10	Total coliform	CFU/100 ml	41	17	27	6	50
Note: KHP: not found; NA: not analysed							

Source: Institute of Environment and Water Resources 16 - 18/11/2011 and 29 - 31/5/2012

**Comparison of groundwater status in 2005 with monitoring results in the first 6 months of 2012**

- At the site office of the Package 1B, the water quality is quite good because the groundwater was treated before using, especially the pH (7.42) in comparison with the pH (4.4-5.5) in September 2005. This show that the groundwater was improved in this package.
- The domestic water in the Package PH3 was pumped from the groundwater source and used without any treamant. Therefore, the pH content is quite low (5.16) and it was similar to the surveyed results in September 2005 (4.5-5.8). For the Mn and total Fe (Fe<sup>TS</sup>) contents, the microbial pollution indicators were lower than the those in September 2005, the remaining indicators remained unchanged [Table 10].

**Table 11: Comparison of monitoring results of groundwater in the first six months of 2012 versus those in 2005**

Monitoring stages	Results									
	pH	Hardness	TSS	Cl <sup>-</sup>	N-NO <sub>3</sub>	SO <sub>4</sub> <sup>2-</sup>	Mn	Total Fe	E. Coli	Total Coliform
Unit	-	mgCaCO <sub>3</sub> /l	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	CFU/100ml	MPN/100ml
Quarter I/2011	4.32-8.18	2-210	0.4-3	(4-9)	KPH-1.88	KPH	KPH-0.12	KPH-0.23	KPH-20	KPH-3.2 x 10 <sup>2</sup>
Quarter II/2011	4.52-7.98	3-199	<0.5-2	(3-11)	KPH-1.09	KPH	KPH	KPH-0.13	KPH-42	KPH-140
Quarter III/2011	4.2-7.81	1-178	<0.5-1	(3-4)	<0.01-1.09	KPH (< 1)	KPH (< 0.02)	KPH (< 0.06)	KPH (< 1)-31	KPH (< 1)-120
Quarter IV/2011	4.38-7.8	0.2-196	0.3-1	(4-7)	KPH (<0.01)-1.1	KPH (<1)-1	KPH (<0.02)	KPH (<0.06)-0.12	KPH (<1)-200	KPH (<1)-3.900
Quarter I/2012	5.6	13	1	4	KPH (<0.01)	1	KPH (<0.02)	0.13	KPH (<1)	27
9/2005 (EIA) Binh Duong province	4.4-5.4	3-25	-	(5-17)	0.1-1	KPH - 14	0.01-0.04	0.5-2	0	0-3
Quarter II/2012, 1B	7.42	200	1	4	KPH (<0.01)	KPH <1	KPH (<0.02)	KPH (<0.06)	2	17
9/2005 (EIA) Tay Ninh province	4.5-5.8	3-21	-	0.2-0.3	1-74	01-5	0.1-0.2	0.1-0.6	0	0
Quarter II/2012, PH3	5.16	11	NA	3	KPH (<0.01)	KPH <1	0.1	0.1	KPH (<1)	6
<b>Level I QCVN 02:2009/ BYT</b>	<b>6-8,5</b>	<b>350</b>	<b>-</b>	<b>300</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>0,5</b>	<b>0</b>	<b>50</b>
Notes: KPH: not found; NA: not analysed										

(Source: The environmental impact assessment report of Phuoc Hoa Water Resources Project, 2007, Table 3.93 and Table 3.97; The analysed results of groundwater quality in Binh Duong and Tay Ninh provinces and The monitoring results in Quarter II/2012 dated from 29- 31/5/2012, Institute for Water and Environment Research)

Most of indicators satisfied the standard of domestic water under the QCVN 02:2009/BYT in 2009 of the Ministry of Health. It is needed to be treated by neutralizing measures to increase the pH so that it can satisfy the standard (>6) before using.

#### 4.3.3. Surface Water

During the field survey, most water samples which were taken in Be river at Package 1A and Tan Bien Main Canal-package PH3 (Aqueduct) satisfied the



standard, except E.Coli indicator (200 CFU/100ml) at the aqueduct of Package PH3. In comparison with the Quarter I/2012, the analysed results of the surface water samples which were taken at Package 1A of Be river, the Tham Rot Bridge of Package 1C, the Drop structure of Package 1D and Suoi Tre aqueduct (Tan Bien Main Canal) show that only the E.Coli and Coliform indicators at package 1D were higher than the standard. The Physico-chemical indicators and pH content in the water source at the transfer canal are more stable than those at streams surrounding package 1C and Be River in package 1A respectively.

In particular, the pH content in water sources at the Packages 1A, 1D, PH3 was higher than the pH content in water source at natural streams. This shows that the drinking water quality in the project areas will be significantly improved if water from the transfer canal will be used in future [Table 11].

**Table 12: Surface water quality at some construction packages**

Indicators	Unit	1A	1A	1C	1D	PH3	PH3	QCVN 08:2008 /BTNMT
		Be river Quarter I/2012	Be river Quarter II/2012	Tham Rot stream Quarter I/2012	Drop structure, Quarter I/2012	TB main canal, Aqueduct, Quarter I/2012	TB main canal, Aqueduct, Quarter II/2012	
pH		7.26	6.89	5.61	6.84	6.37	6.41	5.5 - 9
COD	mgO <sub>2</sub> /L	3	2	3	3	1	13	30
SS	mg/L	1	5	22	23	34	24	50
Total oil	mg/L	KPH (<0.1)	NA	KPH (<0.1)	KPH (<0.1)	KPH (<0.1)	KPH (<0.1)	0.1
Total Fe	mg/L	1.93	0.5	1.5	0.54	1.21	1.4	2
E.Coli	CFU/ 100ml	3	40	18	500	20	200	100
Total Coliform	MPN/ 100ml	930	2,300	900	9,300	430	2,300	7,500
Notes: KPH: not found; NA: not analysed								

Source: Institute for Water and Environment Research, from 16 - 18/11/2011 and 29 - 31/5/2012

Up to the time of this field survey, the analysed results of water samples which were taken at the Package 1A on the Be river show that the surface water in Be river show a quite high pollution level of oil, iron and microorganism in comparison with the data indicated in the approved EIA.

The monitored and compared results show that the water quality of Be river (Reservoir area) contained microbial contaminated levels exceeding the allowable limit of ranks B1, A2 of the standard but not negatively affected the environment. The oil indicator was not changed significantly but the total Fe and E.Coli indicators were higher than the monitoring results in the previous quarters as well as higher than in the years 2003 to 2005.

Since the water quality of Be river at Phuoc Hoa reservoir area is not stable, the water quality monitoring activities need to be made continuously [Table 12].

**Table 13: Comparison of surface water monitoring results of Be river in the first six months of 2012 versus the results in the period 2003 - 2005**

Monitoring stages	Location	pH	COD	TSS	Total oil	Total Fe	E. Coli	Total Coliform
		-	mgO <sub>2</sub> /l	mg/L	mg/L	mg/L	MPN/100ml	MPN/100ml
March 2011	Downstream of 1A Dam	7.29	13	17	KPH	0.08-4.4	2.1	2 00
March 2012	Downstream of 1A Dam	7.26	3	1	KPH	1.93	3	930
May 2012	Downstream of 1A Dam	6.89	2	5	NA	0.5	40	2,300
2003	T3	6.1-7.2	5-7	27-44		0.05-0.2		
	T 7	5.7-6	8-10	288-918		2.2-4.5		
2004	T3	6.5-7.2	5-8	32-104		0.1-1.5		
	T 7	5.7-6.3	6-8	327-780		0.4-5.7		
September 2005	SBM 1-1	6.8	9	28	0	1.9	0	1,800
	SBM 1-2	6.9	8	35	0	2.2	0	1,500
	SBM 2-1	6.7	8	27	0.02	1.2	0	1,800
	SBM 2-2	6.7	7	42	0	2.3	0	2,200
QCVN 08:2008/BTNMT	Cột B1	<b>5.5-9.0</b>	<b>30</b>	<b>50</b>	<b>0.10</b>	<b>2</b>	<b>100</b>	<b>7,500</b>
	Cột A2	<b>6.0-8.5</b>	<b>15</b>	<b>30</b>	<b>0.02</b>		<b>50</b>	<b>5,000</b>

#### 4.3.4. Conclusions for monitoring and supervising environmental results at construction sites

##### ❖ Supervising the EMP activities by the construction contractors

In general, the environmental condition in the whole project has been improved now in comparison with the stage. The landscapes of the project make the project area more beautiful.

Attention must be paid to safety measures for local people and workers who are involved in the construction activities (traffic safety, electrical safety, barricades, signs of danger, dredging and repair of drainage ditches, etc.).

##### ❖ Status of environmental quality

In the first six months of 2012, the hauling of disposal soil of Contractor 1C caused a quite high dust concentration (280 µg/m<sup>3</sup>) at the site. The noise exceeded the allowable level (73.2 dBA). However, these problems occurred partially and temporarily.

The air quality (dust, noise) which was measured at areas with no construction activities satisfied the standard and the dust and noise conditions are lower than the monitoring results measured during the construction stage.

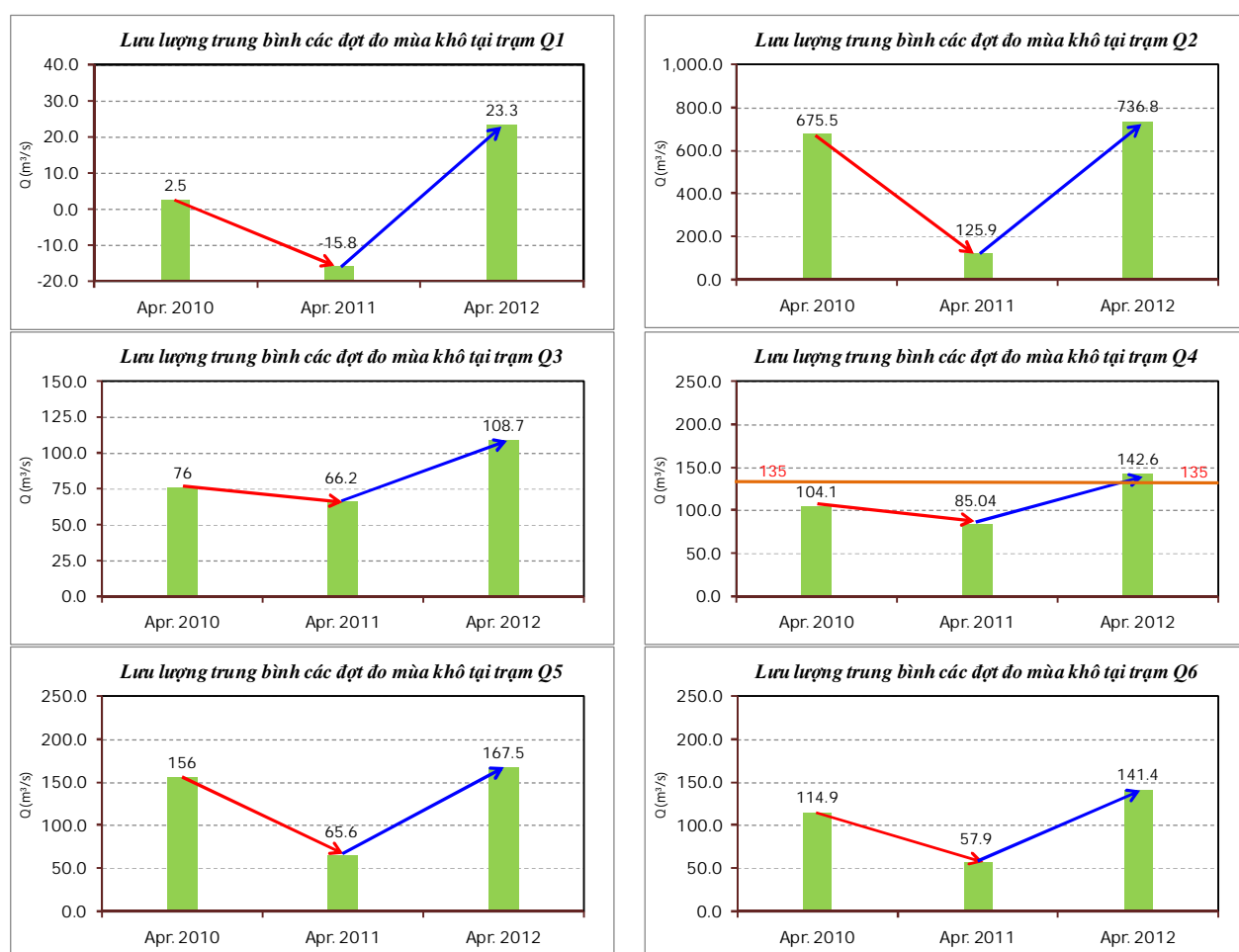
The surface water quality in the transfer canal and Be river is better and more stable than the water quality at streams in the surveyed areas. The landscape of the project has improved as well as the transport facilities of local people in the project area.

## 5. Water Environment

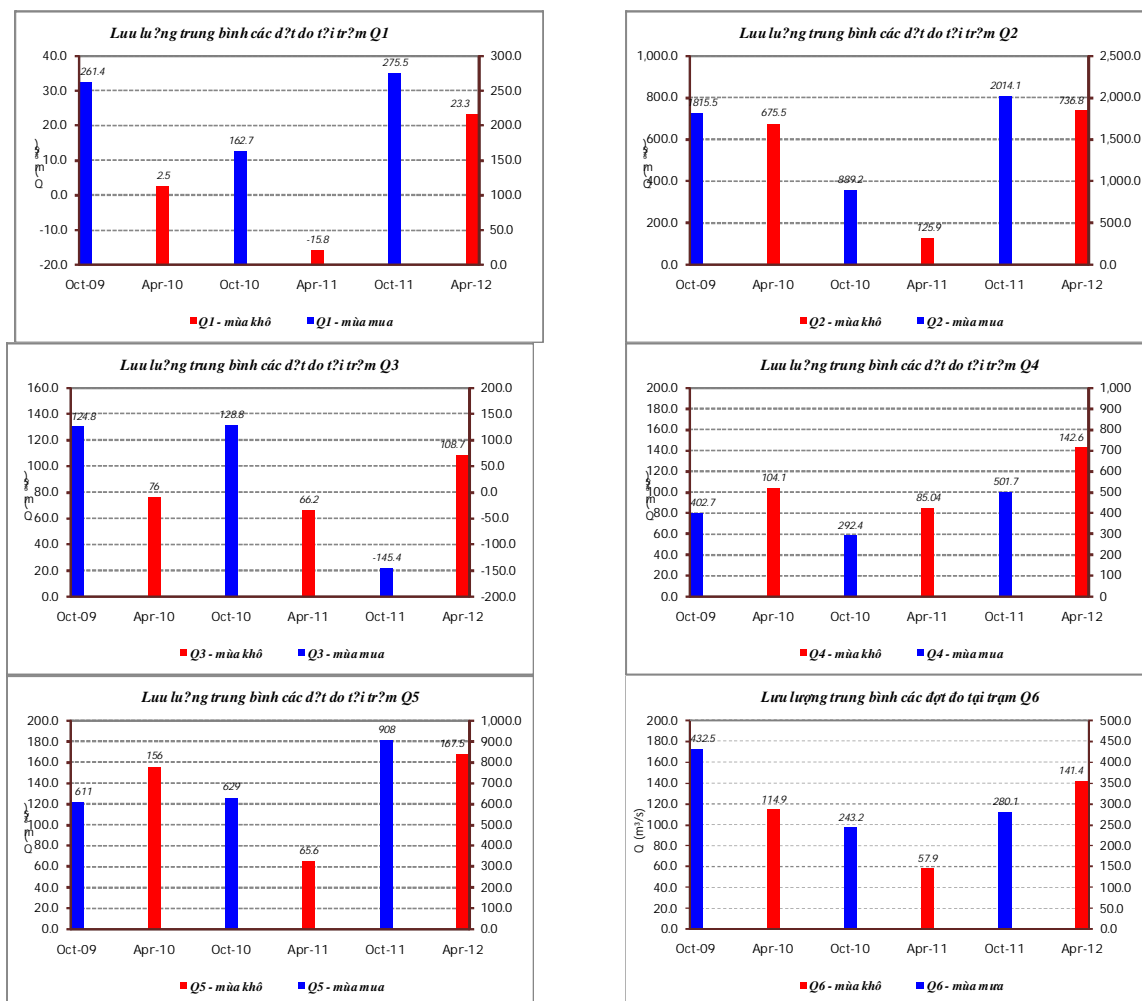
### 5.1. Changes of the water flow and erosion status at riverbanks

#### 5.1.1. Changes of the water flow

Through 3 monitoring stages in the dry seasons (April) of the years 2010, 2011 and 2012, the monitoring results show that the average water flow in the dry season of 2011 was lower than that in 2010 at all monitoring stations. In April 2011, the average water flow measured in Be river at confluence with Tri An was lower than the average water flow for many years at the same time during the implementation of the Phuoc Hoa project. The monitoring results in April 2012 show that the water flow at monitoring locations Q1 to Q6 were higher than in the same period of 2011. These flows were also higher than the monitored flows in 2009.



**Figure 1: Changes of the water flow at monitoring stations in 2010, 2011 and 2012**



**Figure 2: Changes of the average water flow at monitoring stations through 6 monitoring stages**

### **Changes of the water flow upstream Phuoc Hoa dam**

The monitoring results of the station Q4 (Nha Bich bridge) in the upstream area of the Phuoc Hoa dam in 2010, 2011 and 2012 show that:

- In the dry season: The average water flow (Q) and water level (H) that were measured in dry season of the year 2011 were lower than the same period of the year 2010. In the dry season of the year 2012, the water flow measured at the station Q4 was higher than in the years 2010 and 2011.
- In the rainy season: The water flow and water level measured in the year 2011 were much higher than in the year 2010.

Since there was a low rainfall in 2010, the water levels in Srock Phu Mieng and Can Don hydropower plants were lower than in 2009. In order to maintain the power supply during the dry season of 2011, the release of above-mentioned reservoirs was less than in 2010. There were floods in the upstream areas in 2011 while the rainfall from August to October was higher than 2010. Besides the discharges used for producing electricity, there were a discharges for safety purposes. This made the water flow and water level at monitoring stations increase

significantly over the same period of 2010.

**Change of the water flow downstream the Phuoc Hoa dam and its vicinities**

The monitoring data of station Q5 (station Q5 is located downstream of the dam) show that in October 2011 the average water flow was 1.5 time higher than the water flow at the same period in 2010. Up to April 2012, the Phuoc Hoa – Dau Tieng transfer canal has not been operated yet. The fish pass had a limited operation because the gate of intake was not operated and is being repaired. Beyond the discharge needed for environmental safety, Phuoc Hoa dam discharged through the spillway (Labyrinth weir and opened gates No.2 and 4). Therefore, if we ignore the change of water flow because station Q5 was transferred to upstream area, it can be found that the Phuoc Hoa reservoir has not affected the water flow downstream of the Be River.

For rivers near the project area, the water flow in the dry season of 2011 was lower than that in 2010. Especially, in the station Q2 in Dong Nai river, the average water flow measured in April 2011 was only approximately 20% compared to the same period in 2010. However, due to the increase in rainfall, flood discharge and water flow from upstream areas, the average monitoring water flow results in October 2011 were higher than those in 2010. The water flow in the dry season in 2012 at these stations was also higher than in the same periods in 2011 and 2010.

**Preliminary forecast on the salinity intrusion possibility in the dry season on Dong Nai and Sai Gon rivers**

The salinity intrusion depends on several factors: tidal regime from downstream, fresh water capacity from upstream; water supply for DMI in downstream areas. Based on the measured data of water flow in rivers, we can provide some preliminary assessments of the relationship between fresh water from upstream and salinity intrusion in the Saigon and Dong Nai rivers.

- In 2011, the water flow from upstream to downstream areas in the dry season was lower than that in 2010. Therefore, the salinity intrusion in 2011 was more serious than 2010.
- The water flow in rainy season of 2011 was greater than in the years 2010 and 2009. Therefore, the salinity intrusion in dry season in 2012 is less serious than in the previous 2 years.

**5.1.2. The status of riverbanks erosion**

Based on the previous field survey, there were 09 minor eroded locations. Up to now, these old erosions are stable and new erosion locations have not been found. The natural vegetation along both sides of the river was overgrown and stable.

For downstream areas, there were 66 eroded locations 4 days after the dam had been impounded due to slides caused by groundwater pressure. So far these erosions have been stable and new erosions did not occur. Vegetation on both sides of the river is growing stably.

#### 5.1.3. Changes of the vegetation around the reservoir area (semi-flooded area)

The land surface in the semi-flooded area is being covered by various types of vegetation: the seven years old rubber trees were retained by local people to take full advantage of production. The vegetation is growing stably and covering ground well. Some local people are using land in the semi-flooded area to cultivate short-term crops such as Cassava, Paddy. Some areas are being encroached by local people for rubber tree plantation. These rubber trees are now from 01 to 02 years old. The remaining area is small and covered by vegetation.

Some local people are changing the natural terrain of the land by filling their land boundary; this problem needs attention and should be prevented because it could potentially cause erosion. Risks of water resources pollution caused by farming practises using pesticides, bags and bottles of pesticides, redundant chemical fertilizers washed into the water. Wastewater, garbage and toilets of households who are living near the reservoir could affect the water resources. Therefore, there is a need to improve the awareness of local people who are living in the semi-flooded area and increase the vegetation-covered areas in the plantation areas of local people.

### 5.2. Changes of the water quality

#### 5.2.1. Surface water quality

##### ❖ Be river basin:

There are 5 monitoring locations: Nha Bich (WQ01), Phuoc Hoa dam (WQ04), Phuoc Hoa bridge (WQ05), Ma Da (WQ09), Downstream of Be river (WQ10), Phuoc Hoa reservoir (WQ00).

#### **Monitoring results in the first six months of 2012**

- Value of pH was stable in the range from 6.8 – 7.2.
- Value of salinity was low, equivalent to salinity in nature and not higher than 0.03 g/l.
- Value of TSS at stations WQ1, WQ2 in the upstream of the dam fluctuated in the range 70-80 mg/l. However, the value of TSS adjacent to the dam downstream area was immediately decreased to 48 mg/l.
- The content of nutrients is trending changeable as same as content of TSS with an quite low content in the upstream area.
- Dissolved oxygen values (DO) at monitoring locations in Be river were greater

than 4 mg/l, in accordance with the standards for protection of aquatic life as required 38:2011/BTNMT (National technical regulation on Surface Water Quality for protection of aquatic life). The DO in the upstream areas of the reservoir is 4-6mg/l, in the reservoir it dropped to 2.8 mg/l and increased to 6.9 mg/l at the downstream side of the dam.

- Although the reservoir is impounded, the content of nutrients in the reservoir is very low, BOD<sub>5</sub> values are lower than 4mg/l equivalent to level A of the standard-QCVN 08:2008 for domestic water. The field survey results show that many vegetation are submerged but the decomposition process has not yet taken place, leaves still retain on many dead trees and body of trees have not been seared or rot. Therefore, the organic matter content has not increased at this time in Be river.
- Total oil value in the range from 0.01–0.03 mg/l, the values of content of heavy metals as Copper, Lead and cadmium are low, equivalent to the normal content of natural metals in the surface water.
- The highest value of Coliform does not exceed 250 MPN/100 ml.

#### **Comparison with the standard QCVN 08:2008/BTNMT**

The water quality in Be river was quite good, equivalent to the water resource Range **A1 – A2 under the standard QCVN 08:2008** (it is good for domestic water supply, aquatic conservation and other demands which need a lower water quality). The impact of Phuoc Hoa dam construction to TSS content only occurred clearly at the downstream area.

#### **Comparison of monitoring results through the years**

- Value of pH is stable and not significant different in comparison with that in April of 2010 and 2011.
- Value of TSS in April 2012 was different to 2010 and 2011. Monitoring results at stations in the upstream of dam such as WQ1, WQ4 were not significantly different to monitoring results in 2010 and 2011. These results were not similar with the forecast in EIA report that the content of TSS will increase 15–2.0 times in the early stage of the impoundment. While the content of TSS at stations WQ9 and WQ10 downstream of Phuoc Hoa reservoir increased 1.5 to 2 times in comparison with values in the upstream area. [Figure 4].
- There were no significant differences in the content of nutrients in comparison with 2010 – 2011.
- The DO values at monitoring stations in Be river were similar to the forecast of EIA report. The DO value in the Phuoc Hoa reservoir significantly decreased in the early stage of Impoundment. In addition, the DO value



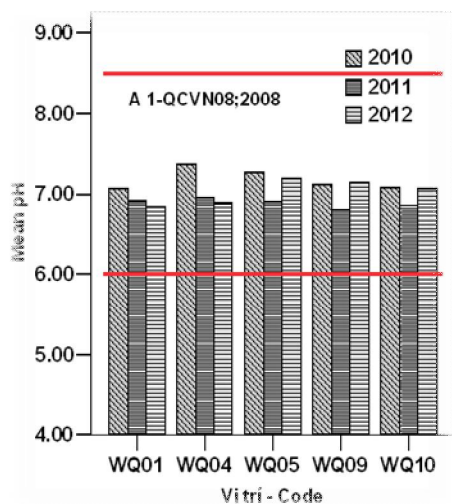
increased at the downstream of the dam since the difference in height is 10 meters from the spillway surface to the water surface of downstream area of Be river. This created a significant disturbance and increases the DO value compared to the reservoir area [Figure 7].

- Comparing of monitoring results in April of 2010, 2011 and 2012 versus the monitoring results in March 2003 at the Hieu Liem port (WQ10), downstream of Be river at the junction with Dong Nai river [Table 13], it shows that there are no significant differences in the absolute values of monitoring parameters in these periods.

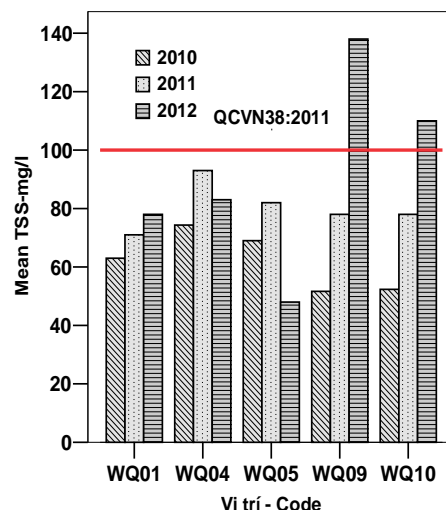
**Table 14: Comparison of monitoring data in April 2012 with the data before project implementation**

No.	Monitoring indicators	3/2003 (*)	4/2010	4/2011	4/2012	A2 - QCVN 08:2008
1	TSS (mg/l)	44	55	78	138	30
2	PO <sub>4</sub> <sup>3-</sup> (mg/l)	0.018	0.04	0.054	0.05	0.2
3	NO <sub>3</sub> <sup>-</sup> (mg/l)	0,4	0.04	0.36	0.8	5
4	DO (mg/l)	6	6.2	6.25	5.8	5
5	COD (mg/l)	7	2.5	1.95	3.28	15

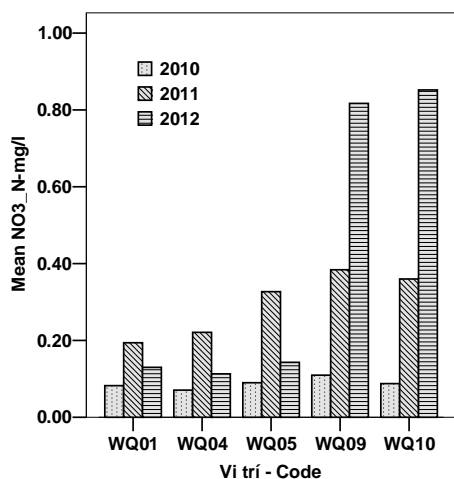
Source: Southern Institute of Water Resources Research, Phuoc Hoa EIA report, 2007



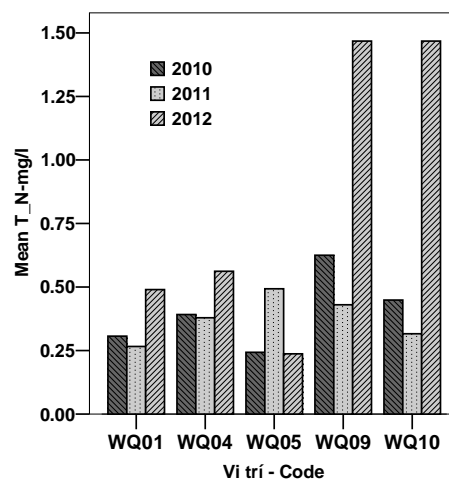
**Figure 3: pH value in Be river, April of 2010, 2011, 2012**



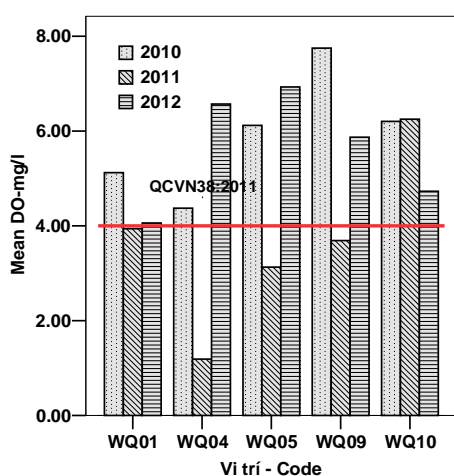
**Figure 4: TSS value in Be river, April of 2010, 2011, 2012**



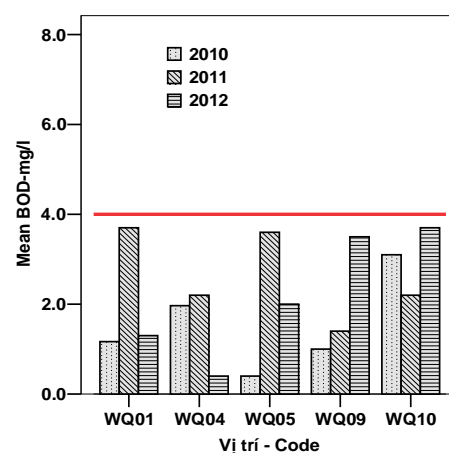
**Figure 5: NO<sub>3</sub><sup>-</sup> value in Be river, April of 2010, 2011, 2012**



**Figure 6: T- N value in Be river, April of 2010, 2011, 2012**



**Figure 7: DO value in be river, April of 2010, 2011, 2012**



**Figure 8: BOD<sub>5</sub> value in Be river, April of 2010, 2011, 2012**

❖ Dong Nai River:

The monitoring stations in Dong Nai river are located in the downstream area of Tri An reservoir (WQ11), Bien Hoa city (WQ12), downstream area of Hoa An bridge (WQ13), Nhon Trach area (WQ18) and before the junction with Sai Gon river at Nha Be district (WQ19).

**Monitoring results in the first six months of 2012**

- pH values are stable and fluctuate between 6.3 and 7.8.
- the water resource in the upstream area of Dong Nai River has quite low EC values, equivalent to salinity from 0.03 – 0.05 g/l. The water resource in the downstream area of Dong Nai river from Nhon Trach (WQ18) to Nha Be (WQ19) was strongly affected by the tide resulting in salinity intrusion, especially at the beginning of the dry season. In April 2012, salinity values measured at the spring tide in station WQ18 was 0.5 g/l and in Nha Be 1.3 g/l.
- Nutrient and organic contents were low at monitoring stations in the upstream

area of the Dong Nai river, the T-N value fluctuated from 0,2- 0,4 mg/l, T-P value from 0.01 – 0.20 mg/l, COD value from 1-4 mg/l, BOD<sub>5</sub> value from 1-3 mg/l. The lowest value of DO that was measured at the downstream area of the Tri An reservoir with oxygen content 3 mg/l in the dry season.

- In the dry season of 2012, the amount of Coliform in the upstream area of the Dong Nai river was low, fluctuating from 100 – 2,500 MPN/100ml. In Nhon Trach, the highest amount of Coliform measured was 2,500MPN/100ml in April 2012.
- The content of heavy metal measured at monitoring stations was low, Pb value was in the range from 0.001 – 0.007 mg/l, Cd value from 0.0001 – 0.0019 mg/l.

#### **Comparison with the standard QCVN 08:2008/BTNMT**

In general, the water quality of upper Dong Nai River is good at monitoring stations equivalent to the Rank **A1 and A2 of the standard QCVN 08:2008**. The salinity intrusion in the downstream areas has decreased in 2012. At monitoring periods in April 2012, there was not any significant change in the Dong Nai River's water quality that could have been affected by the Phuoc Hoa reservoir.

#### **Comparison of monitoring results through the years**

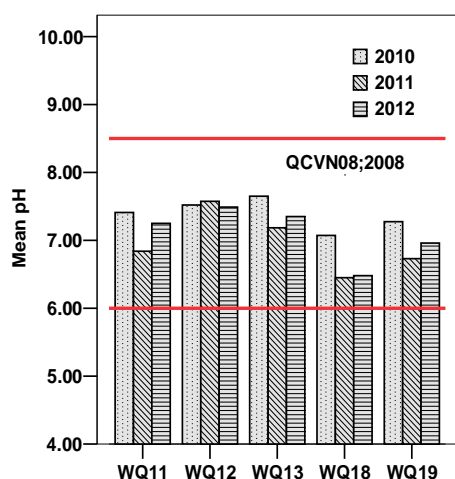
- At monitoring stations, the pH values were stable and not significantly different among monitoring stations as well as at the same monitoring periods through the years 2010, 2011 and 2012
- The salinity was much lower than the at same periods of 2010 and 2011. This achievement resulted from the weather. In 2012, the rainy season came early with a high rainfall together with the discharge from Tri An reservoir that increased the water source downstream of Dong Nai river and decreased the salinity intrusion compared to previous years. [Figure 10].
- The changes of some parameters which were measured in Dong Nai river in 2010, 2011 and 2012 were similar to the monitoring results of the national monitoring system as well as the results of the water resources sector conducted in this area. These changes could be caused by the Social-Economic activities in the downstream areas such as navigation, sand exploitation and climate change as rainfall, tide and the raising of sea water.
- Monitoring results of package MT6 show that the operation of Phuoc Hoa reservoir did not affect the water quality in Dong Nai river in 2012.
- Comparison between monitoring results in April 2012 with March 2003 at the WQ12 (Tan Mai) which located before Rach Cat bridge about 300m in the Dong Nai river [Table 14] shows that there were no significant difference on

the absolute value of parameters measured among these periods, except the COD content measured in March 2003 which was 4 times higher than in April 2010 and 6 times higher than in April 2011 and April 2012. The reason was that the sampling location in 2003 was located in Tan Mai fish-breeding village, therefore, the water quality was affected by the wastewater from the fish-breeding village.

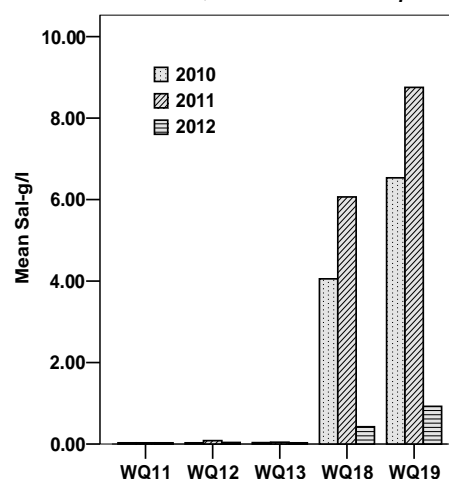
**Table 15: Comparison of monitoring data in April of the years 2010, 2011 and 2012 with the data before project implementation in March 2003**

No.	Monitoring indicators	3/2003 (*)	4/2010	4/2011	4/2012	A2 QCVN 08:2008
1	TSS (mg/l)	61	56	69	22	30
2	PO <sub>4</sub> <sup>3-</sup> (mg/l)	0.016	0.03	0.032	0.02	0.2
3	NO <sub>3</sub> <sup>-</sup> (mg/l)	0.01	0.09	0.593	0.84	5
4	DO (mg/l)	5	5.2	5.46	5.6	5
5	COD (mg/l)	12	3	2	1.8	15

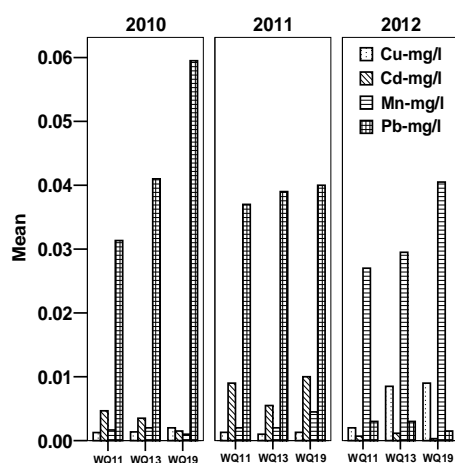
Source: Southern Institute of Water Resources Research, Phuoc Hoa report, 2007



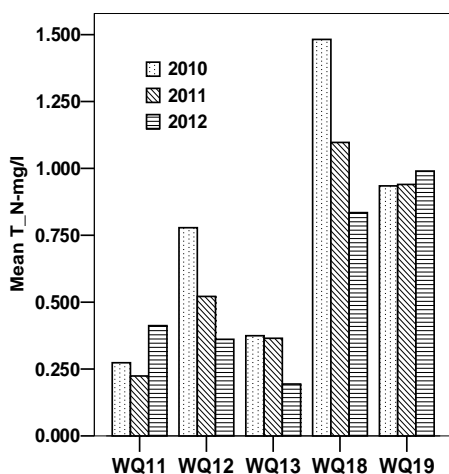
**Figure 9: pH value in Dong Nai river, April of the years 2010, 2011 and 2012**



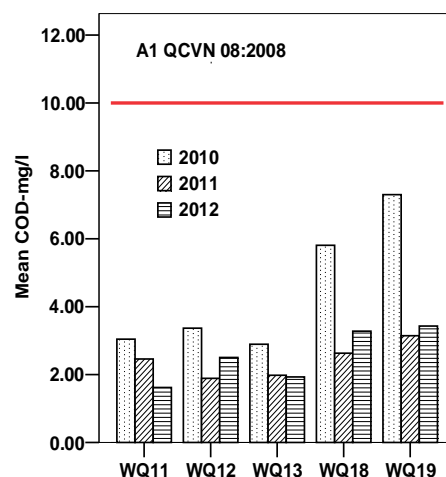
**Figure 10: Salinity in Dong Nai river, April of the years 2010, 2011 and 2012**



**Figure 11: Heavy metal in Dong Nai river, April of the years 2010, 2011 and 2012**



**Figure 12: T-N value in Dong Nai river, April of the years 2010, 2011 and 2012**



**Figure 13: COD value in Dong Nai river, April of the years 2010, 2011 and 2012**

#### ❖ Sai Gon River:

Monitoring stations in Sai Gon river located at the Ben Than water treatment plant in Cu Chi district (WQ14), the confluence with Thi Tinh river (WQ15), Dau Tieng township in Binh Duong province (WQ16) and downstream of Sai Gon river in Tan Thuan (WQ17).

#### **Monitoring results in the first six months of 2012**

- pH value was stable and fluctuated between 6.0 and 7.5.
- The content of main ions was substantially stable in the West Canal, Ben Than, Binh Duong province. The section of Sai Gon River crossing Ho Chi Minh City area is affected by tide causing salinity intrusion in the dry season. This affects the domestic water supply and irrigation in April of the years 2010 and 2011. The salinity measured in Tan Thuan (WQ17) was 5 g/l. In 2012, the salinity intrusion decreased at Dong Nai river, the salinity measured at Tan Thuan was 0.3 g/l, this result substantially decreased from that in the same periods of previous years.
- TSS content fluctuated from 28 – 70 mg/l in the dry season, the nutrient content value at stations WQ14 and WQ 15 crossing Cu Chi and Thi Tinh with values of T-N and T-P was 1.4 mg/l and 0.6 mg/l respectively. While the nutrient content in downstream areas was lower, T-N value was 0.7 mg/l and T-P value was 0.16 mg/l at the station in Tan Thuan.
- The content of organic matter was quite low; at monitoring stations in Sai Gon river, the BOD<sub>5</sub> values were all lower than 4 mg/l, COD values were lower than 7 mg/l.

#### **Comparison with the standard QCVN 08:2008/BTNMT**

Water at stations WQ15 and 16 were similar to the standard **QCVN 39:2011**

in accordance with water resources specification. Water at stations WQ14 and WQ17 were similar to the rank **B2 under the standard QCVN 08:2008** in accordance with navigation purpose.

### **Comparison of monitoring results through the years**

- pH value was stable and not significantly different to the years 2010 and 2011.
- Nutrient contents at stations WQ14 and WQ15 in Cu Chi and Thi Tinh respectively were higher than those in 2010 and 2011. While the nutrient contents in the downstream areas were lower than the same periods of 2010 and 2011.
- Similar to nutrients, the content of organic matters at monitoring stations in the downstream of Sai Gon river in April 2012 were lower than the same periods of 2010 and 2011.
- There was a significant difference of Coliform amount among the monitoring stations. The highest amounts, measured at Tan Thuan and Ben Than, were 4,300 and 2,400 MPN/100ml respectively. These amounts were much higher than those in Thi Tinh and Dau Tieng.
- The metal contents were low at 04 monitoring stations, the Cd content fluctuated from 0.001 – 0.003 mg/l, Pb content fluctuated from 0.001- 0.009 mg/l, Cu content fluctuated from 0.001-0.014mg/l.
- Comparison monitoring results in April of the years 2010, 2011 and 2012 with those in March 2003 at the station WQ14, Ben Than, Cu Chi district in the Sai Gon river [Table 15], it shows that there were no significant differences in the absolute value of parameters measured between the 2 periods, except the  $\text{PO}_4^{3-}$  content measured in April 2012 was 10 – 15 times higher than in March 2003.

The monitoring results in Sai Gon river in the dry season of 2012 show that the water quality was affected by wastewater from urban areas, industrial parks and agriculture. Especially in the downstream areas, they were affected by the areas of Ho Chi Minh city and Binh Duong province causing organic microbiological pollution. Based on the monitoring results of the national environmental monitoring system and water quality monitoring results of the Directorate of Water Resources, it shows that the water quality in Sai Gon river has decreased from 2001 to 2011. However, in the dry season of 2012, the water quality is trending better than in 2010 and 2011.

The monitoring results of package MT6 show that activities of building Phuoc Hoa dam have not affected to water quality in Sai Gon river.

**Table 16: Comparison of monitoring data in April 2012 and the data before the implementation of the project**

No.	Monitoring indicators	3/2003 (*)	4/2010	4/2011	4/2012	A2 QCVN 08:2008
1	TSS (mg/l)	72	51	62	<b>22</b>	<b>30</b>
2	PO <sub>4</sub> <sup>3-</sup> (mg/l)	0.003	0.05	0.04	<b>0.02</b>	<b>0.2</b>
3	NO <sub>3</sub> <sup>-</sup> (mg/l)	0.6	0.9	0.825	<b>0.84</b>	<b>5</b>
4	DO (mg/l)	5	4.5	5.12	<b>5.6</b>	<b>5</b>
5	COD (mg/l)	5	6.15	4.6	<b>1.8</b>	<b>15</b>

Source: Southern Institute of Water Resources Research, Phuoc Hoa EIA report, 2007

❖ Vam Co Dong River:

Monitoring stations in Vam Co Dong river located at Ben Da in Chau Thanh district, Tay Ninh province (WQ21), Tra Cu in Duc Hoa district, Long An province (WQ22), Ben Luc in Long An province, at the junction with Xang canal (WQ23).

**Monitoring results in the first six months of 2012**

- pH value in Vam Co Dong river fluctuated from 6.6 – 7.2. Particularly in Ben Luc, Long An, the pH value was 5.6.
- The salinity intrusion in Vam Co Dong river was not substantially. In April, the highest salinity measured in Duc Hoa was 0.3 g/l, and Ben Luc was 0.7g/l [Figure 15].
- TSS value was low, and the highest value measured with 100 mg/l at Ben Da (WQ21) in April 2012.
- In April 2012, the T-N value at Chau Thanh and Tra Cu were 1.09 mg/l and 0.97 mg/l respectively, these values are higher than the water source in West canal and Xang canal [Figure 17].
- The content of other nutrients such as NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup> and T-P have the same situation.
- The content of organic matter was low, the COD content was less than 8 mg/l, COD in West canal in Chau Thanh district and Ben Luc areas was very low, and the COD just increased after the junction with Xang canal.
- The amount of Coliform was low in the dry season, the highest value measured was 230 MPN/100ml.
- The content of Iron and Aluminum in the Vam Co Dong river was low, the highest total iron concentration was 1.8 mg/l and Aluminum was 0.086 mg/l.

**Comparison of monitoring results through the years**

- Comparison between monitoring results in April of the years 2010, 2011 and

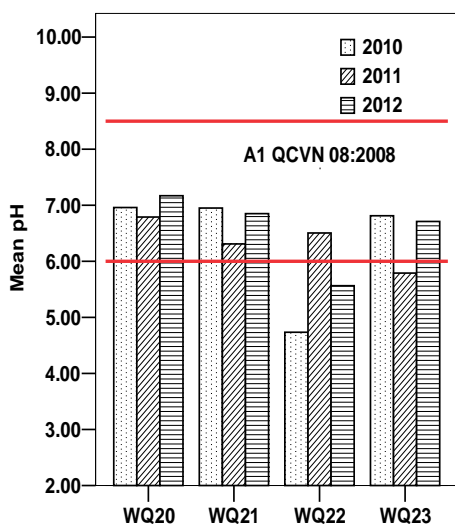
2012 with March 2003 at the station WQ23 in the beginning of Xang Lon canal of Vam Co Dong river [Table 16] shows that there were no significant differences in the absolute value of parameters measured among the 2 periods; values of  $\text{PO}_4^{3-}$ ,  $\text{NO}_3^-$  and COD indicators were higher than in March 2003.

- Above results are also similar with monitoring results of the water quality measured by local agencies and the Directorate of Water Resources. In the dry season of 2012, the upstream area was less affected by salinity intrusion, the area from Go Dau to Ben Luc was affected by waste from Go Dau industrial park in Ben Luc, Long An Province that increase the risk of the organic pollution and decrease the water use capacity which was limited in Vam Co Dong river.
- There was no relation between the water quality in Vam Co Dong river and the activities of building Phuoc Hoa dam in April 2012.

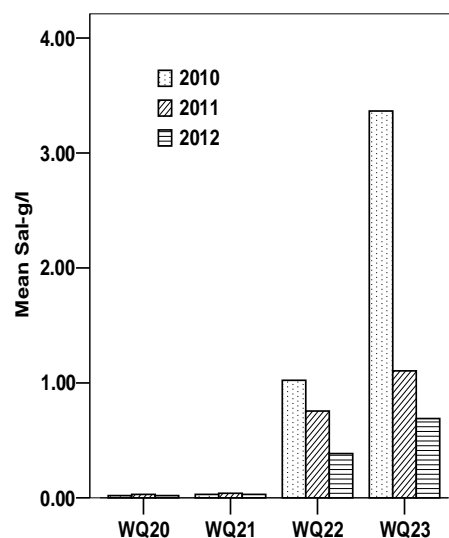
**Table 17: Comparison of monitoring data in April 2012 and the data before the implementation of Phuoc Hoa project**

No.	Monitoring indicators	3/2003 (*)	4/2010	4/2011	4/2012	A2 QCVN 08:2008
1	TSS (mg/l)	164	70	72	22	30
2	$\text{PO}_4^{3-}$ (mg/l)	0.002	0.03	0.012	0.02	0.2
3	$\text{NO}_3^-$ (mg/l)	0.4	0.7	0.78	0.84	5
4	DO (mg/l)	6	4.5	4.2	5.6	5
5	COD (mg/l)	8	6	6.7	1.8	15

Source: Southern Institute of Water Resources Research, Phuoc Hoa EIA report, 2007

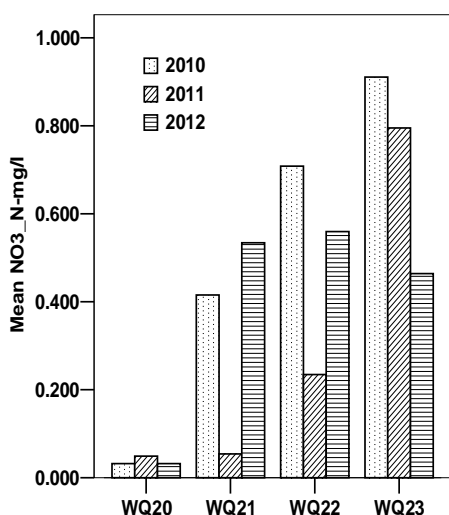


**Figure 14: pH value in Vam Co Dong river, April of the years 2010, 2011, 2012**

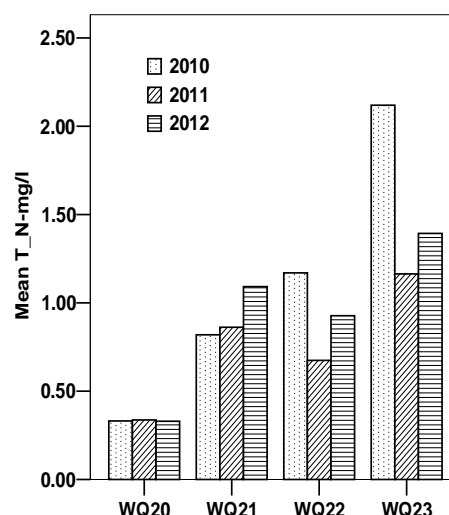


**Figure 15: Salinity in Vam Co Dong, April of the years 2010, 2011, 2012**

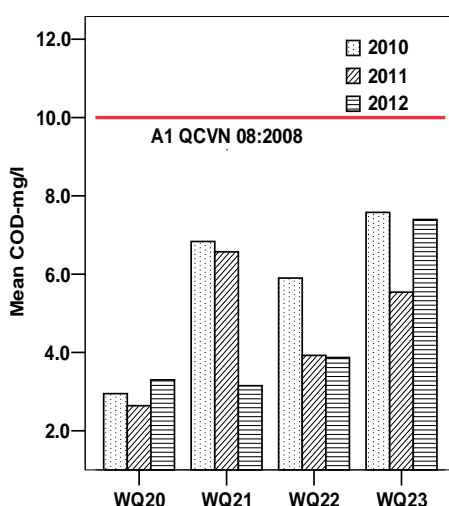




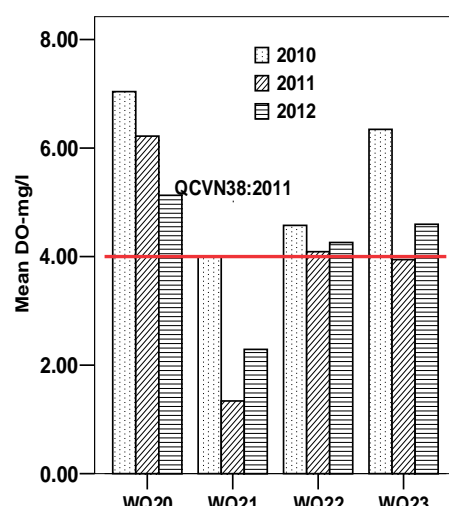
**Figure 16: NO<sub>3</sub><sup>-</sup> value in Van Co Dong river, April of the years 2010, 2011, 2012**



**Figure 17: T-N value in Vam Co Dong river, April of the years 2010, 2011, 2012**



**Figure 18: COD value in Vam Co Dong river, April of the years 2010, 2011, 2012**



**Figure 19: DO value in Vam Co Dong river, April of the years 2010, 2011, 2012**

#### 5.2.2. Groundwater quality:

6 wells were measured in Binh Phuoc province (BP) including GW 1, 2, 3, 4, 7 and 8. The three wells in Binh Duong province were measured including GW5, 6 and 9; the three wells in Tay Ninh province were measured including GW13, 14 and 15. And also the three wells the National Lo Go – Xa Mat Forest were measured including GW10, 11 and 12.

#### **Comparison of monitoring results between the first six months of 2012 and results through the previous years**

- In the April 2012, 04 months after the inauguration of Phuoc Hoa project, the water level from upstream areas of the dam to Nha Bich Bridge was raising, flooding many areas along the river and some streams in Nha Bich area.
- According the EIA report, the increase of water level in upstream area of dam

will positively affect the increase of groundwater level in the dry season by 2-4 m. The increase depends on the distance to the reservoir. Downstream of dam to the confluence with the Be river and Done Nai river, the groundwater level in dry season was expected to decreased by 1-2 m.

- However, the monitoring results of in April 2012 show that the groundwater level in Nha Bich and Hieu Cam communes increased compared to those in 2010 and 2011. However, the increase was not so much, only from 5-20 cm [Figure 20]. In the dry seasons of 2011 and 2012, there were no significant changes of groundwater levels downstream of the dam in Hieu Liem commune. The groundwater level has not changed in Binh Duong Province, Tay Ninh Province and the Lo Go – Xa Mat National Park. The changes of water level upstream and downstream areas need to be monitored. For Duc Hoa irrigation area, the impact of the Phuoc Hoa dam cannot be assessed because the construction activities have not been implemented.

Now follow the evaluation results of chemical composition of water that were found in April 2012 in the Binh Duong, Binh Phuoc and Tay Ninh Provinces:

- Low pH value (<5.5), did not meet the standard QCVN-09. Particularly in Duc Hoa, Long An and Ho Chi Minh city, the pH value in wells was in the range from 6.5 -7.0.
- Salinity intrusion did not appear in monitored wells, salinity was lower than 0.2 g/l. Particularly, wells in Long An showed salinity higher than 0.5 g/l [Figure 22].
- Content of nutrients was quite low, phosphate value was less than 0.1 mg/l. There was only 1 well in Duc Hoa irrigation area, Long An with value of 0.3 mg/l [Figure 23].
- The content of Fe was quite low in almost wells at 4 monitoring stations, the highest value measured at GW10 was 0.815 mg/l in Duc Hoa irrigation area in April 2012 [Figure 24].
- Coliform appeared in all wells; the highest value of Coliform measured at GW 04 in Phu Giao, Binh duong was 4,300 MPN/100ml.
- The heavy metal content was many times lower than the Standard QCVN 09:2008 and a clear change of concentration has not been found through monitoring periods.

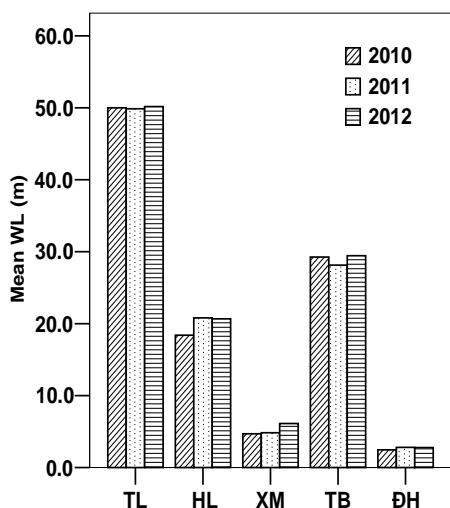


Figure 20: Height of groundwater in April 4

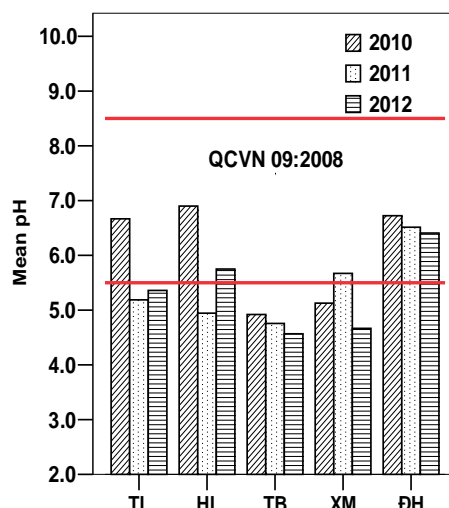


Figure 21: pH content in groundwater in April

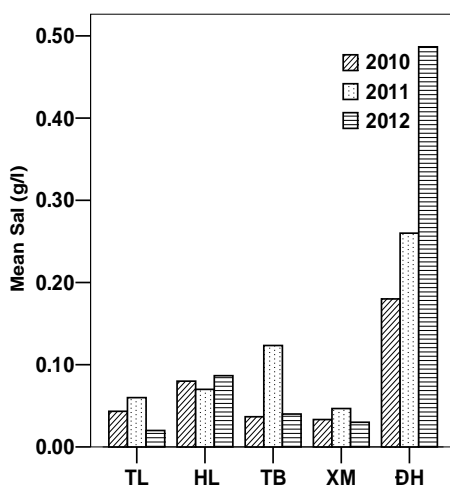


Figure 22: Salinity in groundwater

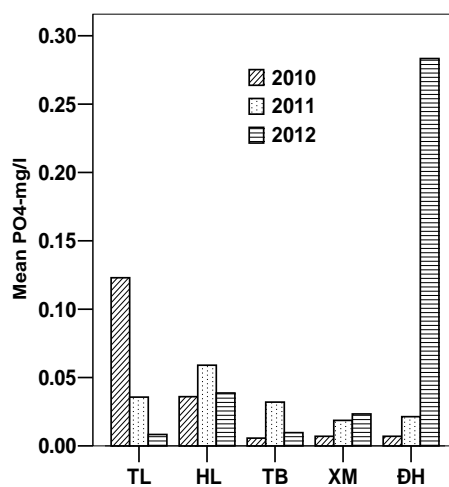


Figure 23: Phosphate content in groundwater

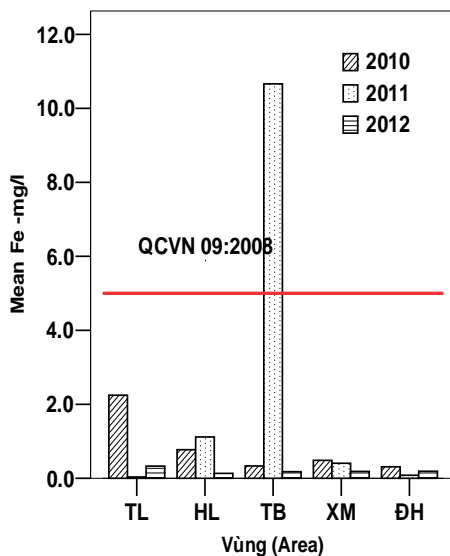


Figure 24: Fe content in groundwater

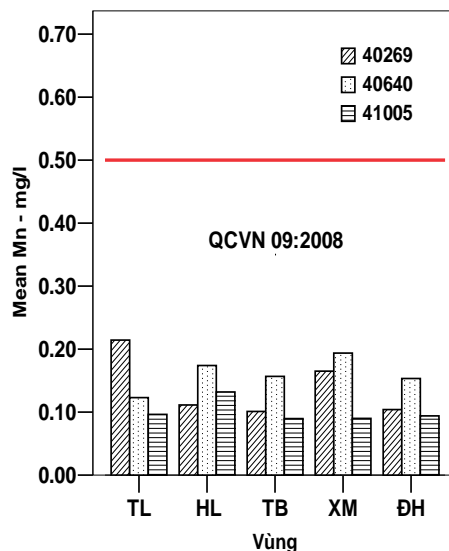


Figure 25: Mn content in groundwater

In comparison with the standard QCVN 09:2008/BTNMT:

Monitoring results show that most of chemical and physical compositions

were stable through the years and these results are *consistent with the groundwater standard QCVN 09:2008*. These results are also similar with the EIA report of Binh Phuoc Province. There were some changes of the chemical and physical compositions and water levels in 2010, 2011 and 2012. However, these changes were not affected by the operation of the Phuoc Hoa dam.

#### **Comparison of monitoring results with the results before implementation of the project:**

Comparison of data for the chemical and physical composition of groundwater in 2005 with 2010, 2011 and 2012 in Nha Bich commune, Chon Thanh District, Binh Phuoc Province show that there were no significant change of chemical and physical composition; values of Mn and Nitrate were lower than in 2005. Only the amount of Faecal Coliform was higher than 2005 at all wells [Table 17].

**Table 18: Comparison of monitoring data in April 2012 with the data before the implementation of project**

No.	Monitoring indicators	2005 (*)	2010	2011	2012	QCVN:09
1	TSS (mg/l)	6.3	6.0	6.3	<b>5.4</b>	<b>5.5 – 8.5</b>
2	PO <sub>4</sub> <sup>3-</sup> (mg/l)	10	0.04	0.05	<b>0</b>	<b>15</b>
3	NO <sub>3</sub> <sup>-</sup> (mg/l)	1.0	5.3	1.0	<b>0.786</b>	<b>5</b>
4	DO (mg/l)	0.2	0.1	0.05	<b>0.096</b>	<b>0.5</b>
5	COD (mg/l)	0	0	90	<b>0</b>	<b>0</b>

Source: Southern Institute of Water Resources Research, Phuoc Hoa EIA report, 2007

#### **5.2.3. Water quality of Duc Hoa irrigation area:**

Monitoring results of **surface** water quality parameters in Duc Hoa – Long An compared to the Rank B1 of the standard QCVN 08:2008/BTNMT are as follow:

- The pH values of monitored water samples ranged from 2.73 to 6.15. Comparison of these values with Rank B1 of the standard QCVN 08:2008/BTNMT shows that most of the samples *did not meet the standard*. The pH values of these samples ranges from 2.73 to 5.24. This means the surface water in this area was contaminated by alum.
- The NO<sub>3</sub><sup>-</sup> content in water samples varied from 0 to 17.02 mg/l. Among 12 monitored samples, there were 4 samples containing NO<sub>3</sub><sup>-</sup> content *0.7 to 1.5 times higher in comparison with Rank B1 of Standard QCVN:08*. This shows that NO<sub>3</sub><sup>-</sup> pollution appeared in the surface water at these locations.
- Total nitrogen content in monitored samples varied from 6.37 to 31.15 ppm. Total phosphorus content in monitored samples changed from 0 to 3.16 ppm. The highest value measured in sample W10, especially the content of phosphorus did not appear in sample W7.

- Total Fe content found at monitored locations fluctuates from 0.45 to 6.61 mg/l. In comparison with the standard QCVN, it shows that 11 out of 12 analyzed water samples the values of Fe content *exceeded 1.0 to 4.0 times the standard*. Usually, Fe rarely exists in the surface water. The Fe content in this area exceeded the standard because the soil in this area was contaminated by alum, the soil developed on the land underlying alkaline materials.
- $\text{Al}^{3+}$  content that was found at monitoring locations varied from 0.09 to 5.17 mg/l. There were significant change of  $\text{Al}^{3+}$  content among monitored locations. The  $\text{Al}^{3+}$  content found at some monitoring locations is seriously higher than at other locations. These locations are W4, W10 with the  $\text{Al}^{3+}$  content varying from 4.64 to 5.17 mg/l.

Monitoring results of **groundwater** quality parameters that were found in Duc Hoa District, Long An Province were compared to Rank B1 of the standard QCVN 09:2008/BTNMT as follows:

- pH values that were found in the groundwater samples varies from 5.61 to 7.85. All pH values that were found in 6 groundwater samples satisfy the *requirement of the QCVN 09:2008/BTNMT*. Sample G3 was slightly infected by acid sulphate.
- The results of the groundwater samples taken from the wells of 6 households show that  $\text{NO}_3^-$  content varied from 0.32 to 2.16 mg/l. All water samples satisfy the QCVN standard for groundwater quality.
- Total Nitrogen content varied from 1.81 to 11.58 mg/l. The lowest value was found in the sample G2. The highest value was found in the sample G4.
- Fe content varied from 0.05 to 5.64 mg/l. The lowest value was found in water sample G6, and the highest value was found in the water sample G1. In comparison with the standard QCVN 09:2008/BTNMT, the results show the total Fe content that found in the sample G1 exceeds the standard. These results were compared with the rank II of the standard QCVN 02:2009/BYT and it was found that 3 out of 6 water samples contain Fe exceeding 1.2 to 10 times the standard for domestic water quality.
- The results of the  $\text{Al}^{3+}$  content found in the 06 groundwater samples taken from the monitoring areas show that  $\text{Al}^{3+}$  content fluctuates from 0 to 4.31 mg/l. There is no standard of the  $\text{Al}^{3+}$  content for the comparison of the groundwater, but the Aluminum is toxic to human health.

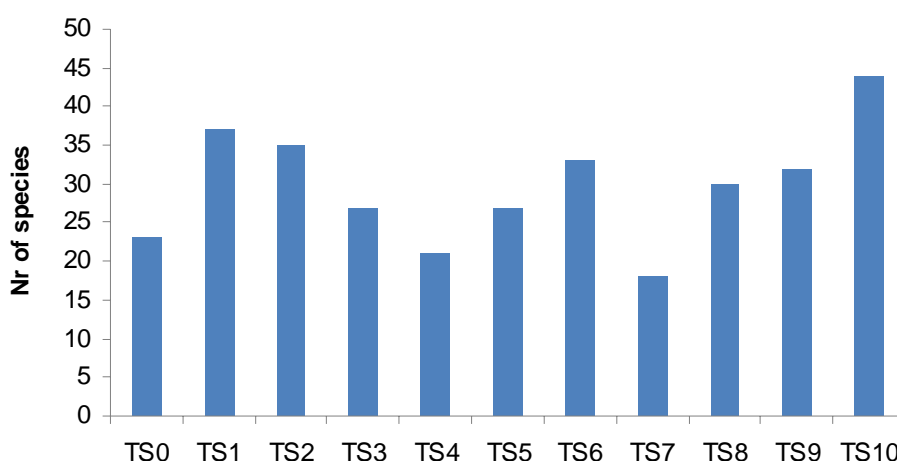
## 6. Biodiversity

### 6.1. Aquatic biodiversity

#### 6.1.1. Fishes and shrimps

The monitoring results show that there are 105 species of fish and 01 *Macrobrachium rosenbergii* belonging to 11 orders, 30 families and 81 varieties. The dominant orders are *Cypriniformes* with 50 species (47.17%), *Perciformes* with 23 species (21.7%), *Siluriformes* with 18 species (16.98%). In contrast, 04 orders have only 01 species (0.94%) such as *Anguilliformes*, *Caridaemes*, *Osteoglossiformes* and *Tetraodontiformes*. The remaining orders contain from 2 to 4 species (1.89 - 3.77%) [Figure 26].

Within the 105 that were found at the field sites, 03 species appear in the Vietnam's Red Book at the VU level (Vulnerable). These special species need to be conserved, including *Anguilla marmorata*, *Cirrhinus microlepis*, *Hemibagrus filamentus*, (Vietnam's Red Book, 2007).



**Figure 26: Changes in the fish species composition found at the monitoring stations (in Nr of species)**

The changes of the fish composition found at the monitoring stations are shown in Figure 26. The highest number of species was found at the station TS10: 44 species (41.5%). The number of species that was found at the station TS1 is 37 (34.9%). The numbers of species that were found at the stations TS2, TS6, TS9 are 35, 33, and 32 (equivalent to 33%, 31.1%, 30.2%) respectively. In contrast, the lowest number of species, found at the station TS7, is 18 species (17%). The numbers of species that were found at the remaining stations fluctuate from 21 - 30 (equivalent to 21.7 - 28.3% of total species).

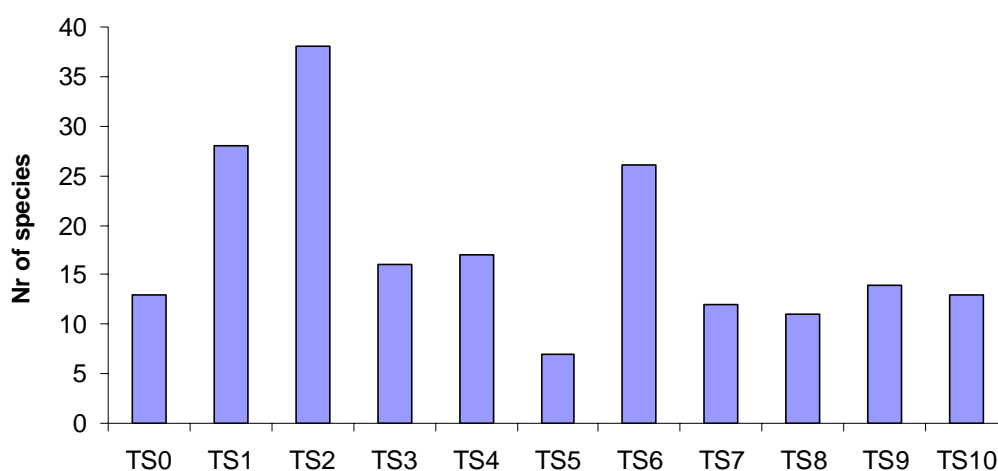
#### 6.1.2. Phytoplankton

In April 2012, the monitoring results at 11 monitoring stations show that the phytoplankton consists of 06 phyla with 86 species. Among them, the Bacillariophyceae phylum contains the highest quantity with 41.86% (36 species).

The dominant species of the algae phylum is classified by the following rank:

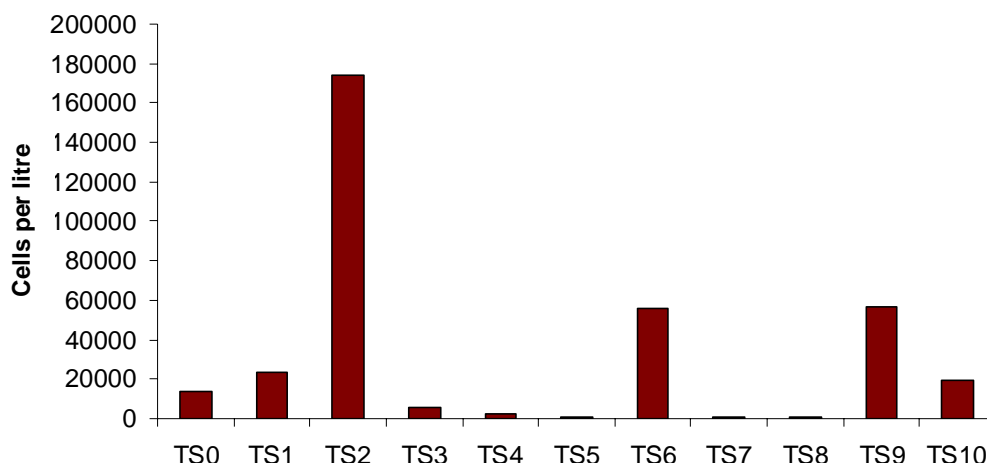
- The phylum *Bacillariophyta*: 36 species (41.86%)
- The phylum *Chlorophyta*: 27 species (31.40%)
- The phylum *Cyanophyta*: 16 species (18.60%)
- The phylum *Euglenophyta*: 3 species (3.49%)
- The phylum *Dinnophyta*: 2 species (2.33%)

Through 11 monitoring stations, the most diverse algal species was found at the station TS2 with 38 species (44.19%). The number of algal species found at the station TS1 is 28 (32.56%). The number of algal species were found at the station TS6 is 26 species (30.23%). Algal species found at the remaining stations varied from 12 to 17 species, equivalent to 12.79 to 19.77% of the total species.



**Figure 27: Change of of the algae at the monitoring stations (in Nr of species)**

The fluctuation of the Algae density that was found at the monitoring stations is shown in Figure 28. The highest density of phytoplankton that was found at the station TS2 with 174,225 cells/litre (49.34%). The density that was found at the station TS9 is 56,570 cells/liter (16.02%). The density that was found at the station TS6 is 55,950 cells/litre (18.84%). In contrast, the 3 stations with the lowest number of algae density are stations TS8, TS5 and TS7. The algae density found in the remaining stations varied from 2,515 cells/litre (1.52%) to 23,455 cells/litre (6.64%).



**Figure 28: Variables of the algae density at the monitoring stations (in cells per litre)**

From analyzed results of the algae density at the same level in water samples, it found that in more than 50% of all stations heavy organic pollution appeared, these stations are TS0, TS1, TS2, TS6, TS9 and TS10. In which, the highest score measured at stations TS2 and TS1 with 49 and 47 marks respectively. Water in stations TS3 and TS4 appeared the mild organic pollution. Remaining stations (TS5, TS7 and TS8) did not show the pollution but the possibility of pollution could occur since the phenomenon of algal blooms through the Palmer index, 1969. [Table 18].

**Table 19: Rate of marks of algae density appeared at the monitoring stations**

Station	TS0	TS1	TS2	TS3	TS4	TS5	TS6	TS7	TS8	TS9	TS10
<b>Points</b>	22	47	49	17	17	10	28	12	10	20	23
<b>Assessed</b>	+++	+++	+++	++	++	+	+++	+	+	+++	+++

Notes:

+++ Heavy organic pollution  
 ++ Mild organic pollution  
 + Possibility of pollution

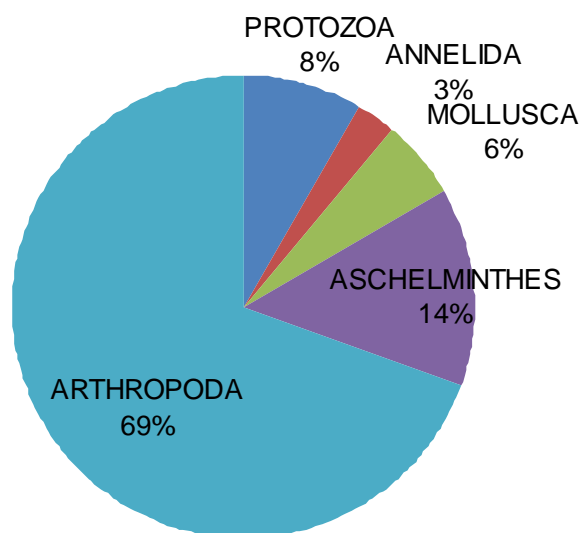
Source: Monitoring results in April 2012 – Package MT6 – Phuoc Hoa project

### 6.1.3. Zooplankton

The analysed results of 11 monitoring stations show that the zooplankton consists of 36 species of 05 phyla. The *Arthropoda* contains the highest number of species with 25 species (69.44%), The *Aschelminthes* contains 5 species (13.89%) with common species such as *Bosmina longirostris*, *Bosminopsis deitersi*, *Ceriodaphnia rigaudi*.... The *Copepoda* contains 16 species (44.44%) with common species such as *Mesocyclops leuckarti*, *Microcyclops varicans*, *Thermocyclops hyalinus* ..., The *Ostracoda* contains 2 species (5.56%), the *Decapoda* contains 1 species (2.78%); the *Aschelminthes* contains 05 *Rotatoria* species (13.89%); the *Protozoa* contains 03 species (8.33%); the *Mollusca* contains 2 species (5.56%). The *Polychaeta* of the *Annelida* only contains 1 species (2.78%).

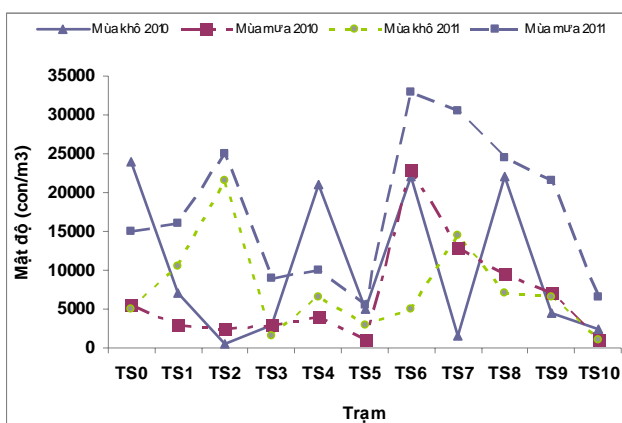


The species composition fluctuated slightly at monitoring stations. The highest number of species that was found at the station TS2 is 17 species (47.22%), the station TS7 with 14 species (38.89%), the station TS9 with 11 species (30.56%). In contrast, the lowest number of species that was found at stations TS5 and TS8 is 5 species (13.89%). There were no significant differences of species at remaining stations, which varied from 8 to 10 species (22.22% - 27.78%) [Figure 29].



**Figure 29: Composition of zooplankton species**

Similar to the species composition, individual zooplankton density at monitoring stations appeared slight changes. The highest density appeared at station TS2 with 32,500 individuals/m<sup>3</sup> (26.32%), and station TS9 with 15,000 individuals/m<sup>3</sup> (12.15%). There was no significant difference of zooplankton composition at remaining monitoring stations, which varied from 6,000 to 12,000 individuals/m<sup>3</sup> (4.86% - 9.07%) [Figure 30].

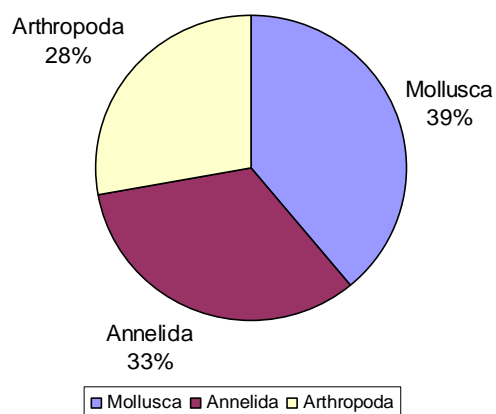


**Figure 30: Variables of zooplankton density fluctuations at monitoring stations in 2010 and 2012**

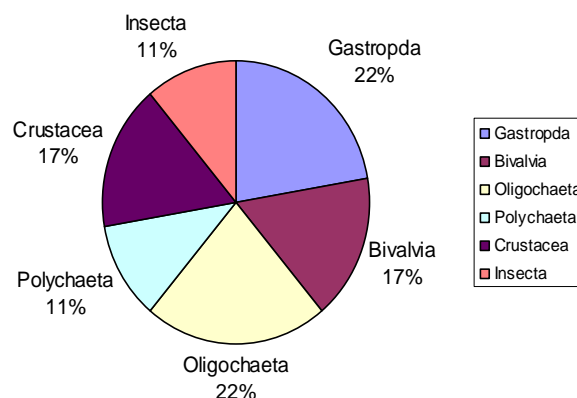
#### 6.1.4. Zoobenthos

The zoobenthos found at monitoring station included 18 species belonging to 06 classes of 03 phyla. The Mollusca contained the highest number of 07 species (39%), the Annelida contained 6 species (33%) and the lowest number was Arthropoda with 5 species (28%) [Figure 31].

The highest number of species found at station TS9 is 10 species (55.6%). The numbers of species found at stations TS2, TS8, TS10 and TS3 are 09, 08 and 07 species respectively (50.0%, 44.4%, and 38.9%). The lowest number of species found at stations TS5 and TS7 are 03 species (16.7%). Number of species in remaining stations varied from 4-5 species (22.2 - 27.8%) [Figure 32].

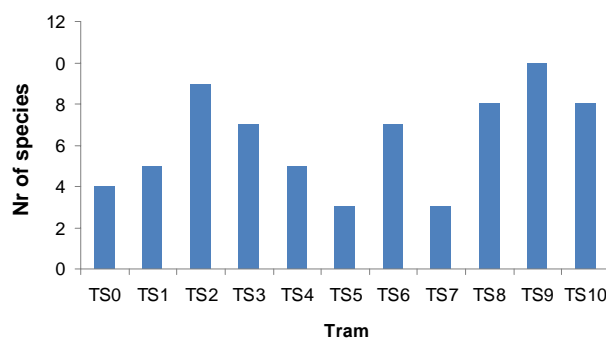


**Figure 31: Percentage of zoobenthos composition at all monitoring stations (classed by phylum)**

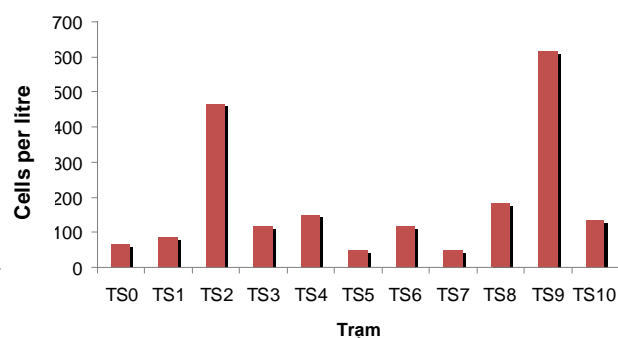


**Figure 32: Percentage of zoobenthos composition at all monitoring stations (classed by class)**

The Benthic density was not distributed equilaterally through monitoring stations. The highest density was found at station TS9 with 617 individuals/m<sup>2</sup> (30.3%) and the density at station TS2 is 467 individuals/m<sup>2</sup> (23%). The lowest Benthic density was found at stations TS5 and TS7 with 50 individuals/m<sup>2</sup> (2.46%). The density of remaining stations varied from 67 - 183 individuals/m<sup>2</sup> (3.28 - 9.02%).



**Figure 33: Variables of zoobenthos species at monitoring stations (in Nr of species)**



**Figure 34: Variables of zoobenthos density at monitoring stations (in individuals per m<sup>2</sup>)**

#### 6.1.5. Fishery productivity in Be River

##### ❖ Binh Duong province:

Based on the data of DARD of Binh Duong Province in 2010, the fishery productivity increased twice in comparison with 2003 (235 tons) and increased 4 times in comparison with 1996 (152 tons). In the Tan Uyen District, the fish production was caught in Dong Nai River and Da Ban Reservoir (55%); In Thuan An District, the fishery production was caught on Sai Gon river (14%). In Phu Giao and Ben Cat Districts, the fishery production was caught in Be and Thi Tinh rivers (11%), in Dau Tieng district, the fishery production was caught in Dau Tieng and Can Nom reservoirs (4-5%).

Aquaculture productivity in 2010 was nearly 18 times higher than that in 2003

(302 tons) and increased approximately 29 times compared to 1996 (189 tons). However, in comparison with the years 2007-2009, the productivity decreased strongly. During the last 3 years (2007-2010) the production has not changed significantly. The production data of 2011 was not updated.

**Table 20: Fisheries development situation in Binh Duong province**

No.	Indicators	Unit	2007	2008	2009	2010
1	Aquaculture					
	- Area	Ha	469	495	517	398
	- Productivity	Ton	4059	4559	4906	5381
2	Fishing	Ton	518	468	536	280
3	Total output	Ton	4577	5027	5442	5661

Source: Binh Duong DARD

Currently, the Economic Division of DARD is managing fisheries activities in Binh Duong province. At district level, the management unit is the district Economic Division and the Commune People's Committee directly manages households.

❖ Binh Phuoc province:

Based on the annual report of the Binh Phuoc DARD, the total fisheries productivity in the whole province has increased over the years for both fishing and aquaculture sectors until 2009 [Table 16]. Total fisheries production was 643 tons and aquaculture productivity 7078 tons in 2009. Since 2010, however, fishing and aquaculture productivity have decreased.

The statistics show that between 2007 and 2009 the area of fish cultivation increased by 9%; the aquaculture output rose by 17%; Fisheries output rose nearly 16%, but the productivity of later years has decreased gradually. Fishing in pond and cage are the main types. In 2011, there were 126 cages, a decrease 2010 with 133 cages.

**Table 21: Fisheries development situation in Binh Phuoc province**

No.		Unit	2007	2008	2009	2010	2011
1	Aquaculture						
	- Area	Ha	2118	2229	2496	2295	2113
	- Productivity	Ton	5269	6102	7078	6393	6052
2	Fishing	Ton	488	559	643	412	357
3	Total output	Ton	5757	6661	7721	6926	6409

Source: Binh Phuoc DARD

It is not similar to Binh Duong Province: the Fisheries Division – Binh Phuoc DARD takes the responsibility to manage fisheries activities, support technologies to fishermen and plays a role as an advisory unit for the DARD on the fishery aspect in the whole provincial area. The fishing activities are managed by the Commune People's Committees.

**Status of fishery resources in the Phuoc Hoa reservoir and downstream**

**of the dam:** Due to the fact that Phuoc Hoa reservoir is a reservoir with the open ecosystem, the species composition in the reservoir and along Be river did not changed too much. In the temporary report, the consultant presented surveyed species and updated the survey data of package MT6 by seasons that were presented in the six-monthly report and previous annual reports.

**The situation of fisheries and aquaculture sectors in upstream reservoir and reservoir areas:**

Fishing sector: At present, the local government has not yet conducted an inventory of the numbers of fishery households and the fishing output in the reservoir. Based on the survey results, the consultant MT4 found that many fishermen came from other provinces. These fisherman used many types of fishing gear such as fishing nets, fishing rods, fishing spears and even electrical tackles. This problem has not been addressed by the local government. These fishermen even caught fishes in the fish pass (this information was given by the local people). The government agencies should take action to prevent the exploitation of fish in the fish pass. In addition, the fishing by electric shocks must be prevented.

Aquaculture sector: At present, there are 2 fishing cages in Tan Thanh Communes along the Be river. In Binh Phuoc Province, some households living in the semi-flooded area are digging fishponds spontaneously (Hamlet 2, Minh Thanh Commune).

**6.1.6. General conclusion for the aquatic fauna**

The phytoplankton consists of 06 phyla, in which the Bacillariophyta alga contains the highest number of species with 36 species (41.86%). The zooplankton contains 05 phyla, in which the Arthropoda contains the highest number of species with 25 species (69.44%).

The benthic species consist of 03 phyla with 06 classes. The fish and shrimp composition consists of 150 fish species and 1 *Macrobrachium rosenbergii* in 11 orders, 30 families and 81 varieties. The most dominant order is *Cypriniformes* with 50 species (47.17%). 03 species appear in the Vietnam's Red Book at the level VU (Vulnerable). These special species need to be conserved, including *Anguilla marmorata*, *Cirrhinus microlepis*, *Hemibagrus filamentus*. There were no significant changes in species composition through the surveys.

The monitoring results that were found at the surveyed locations show that the construction of Phuoc Hoa project has not affected the aquatic fauna.

**6.2. Terrestrial biodiversity**

At the moment, packages MT1 and MT2 have tasks relating to the terrestrial biodiversity. However, package MT1 consultants have not yet been mobilized. As

indicated in the TOR, package MT2 only concentrates on investigating the vegetation in Phuoc Hoa Reservoir catchment. The monitoring data will be used in designing the forestation program in the catchment area.

The monitoring results collected and produced by the Package MT2 were presented in the previous report as well as in their progress reports. Based on the monitoring results of this package, it can be included that there were no significant changes of the vegetation in the Phuoc Hoa reservoir catchment.

The information of the fauna will be updated, based on the implementation results of package MT1 in the coming time.

## **7. Soil condition**

### **7.1. Assessment of monitoring results in the Duc Hoa irrigation area in 2012**

#### **7.1.1. Soil**

Similar to previous years, soil condition at monitored areas contained a high acid content. The  $\text{pH}_{\text{H}_2\text{O}}$  values at monitoring sites varied from 3.27 to 4.84 in April 2012.

Most of the soil samples appeared to have high or very high organic content. The total organic carbon content of soils varied from 0.35% to 7.15%. Most of the soil samples contained low protein content, from 0% to 0.53%. Total P content is low.

Total Fe content in the soil at the monitored locations varied from 854 to 2,469 ppm.  $\text{Al}^{3+}$  content in soil ranged from 147 to 876 ppm.  $\text{SO}_4^{2-}$  content in the soil at monitored locations varied from 0 to 0.47%.

#### **7.1.2. Soil solution**

Measurement results of pH in water samples show that the soil in monitored areas contains a high acidic content. The pH values varied from 2.64 to 3.21. Total N content in the soil solution varied from 10.46 to 89.17 ppm. Total P content in soil solution varied from 2.56 ppm to 9.42 ppm.

Total Fe content varied from 60,23 to 876 ppm. Value of  $\text{Al}^{3+}$  in soil solution varied from 32 to 175 ppm. And  $\text{SO}_4^{2-}$  content in the soil solution varied from 159 to 321 ppm at monitored locations.

### **7.2. Comparison of monitoring results through the years**

In comparison with 2010 and 2011, the monitoring results of acidic soil in April 2012 negligibly changed with only minor differences: (i) Total P content in soil was found in most of samples; and (ii)  $\text{SO}_4^{2-}$  content was not found in some samples of the monitored locations. These are samples S21 and S63, which were measured in April 2012. This status is similar to the same period of 2011. The remaining monitoring indicators remained unchanged.

### **7.3. Levels, trends and causes of pollution**

The chain of the monitoring data from 2010 to date shows that there were no significant changes of the soil and water quality in Duc Hoa area. Up to April 2012, construction activities have not yet been started in the Duc Hoa area. Therefore, the impact of project to the environment in this area cannot be assessed.

## **8. Environment Awareness**

### **8.1. Environment Awareness of contractors**

Up to the end of June 2012, construction activities were completed. The contractors have sanitized the sites methodically. As a result, the Project was not affected by any serious pollution. Thus, it can be concluded that the environmental protection awareness of the construction contractors was quite good and greatly improved compared to the first stage of construction.

### **8.2. Environment Awareness of resident's community**

As indicated in previous reports, it can be said that environment awareness in the local communities is not so good. In addition, package MT2 reported the encroachment of the local people on the land that was acquired for the forestation to protect the Phuoc Hoa Reservoir catchments. This issue will cause obstruction affecting the forestation implementation in the coming time with increased the erosion in the catchment as a result.

Recently, a new issue that arose related to the awareness of environmental protection is that after the impoundment of Phuoc Hoa reservoir, many people living around the reservoir area built toilets inside the reservoir. Moreover, there is fishing in the reservoir by forbidden tackles using electrical shock.

In order to solve the aforementioned issues, the project needs more practical activities to help raise awareness of the need for environmental protection in community, besides what environmental packages have been implemented up to date.

## **9. Conclusions and Recommendations**

### **9.1. Conclusions**

#### **9.1.1. The natural and social environments**

The natural environment was not negatively affected by the project.

As indicated in the EIA report, the DO decreased in the reservoir in the early stage of the impoundment because of the decomposition dead trees and solid waste in the reservoir. The DO increased in the downstream area of the dam because of the aeration from the water falling for a height of about 10m from the spillway to the downstream water surface level. The field surveys also found that many plants in the reservoir have not been decomposed. The water quality in Phuoc Hoa reservoir is quite good, equivalent to the water source type A of the standard QCVN 08:2008.

In the rivers system, in April of this year, the salinity intrusion decreased abundantly compared to previous years. At Nha Be in the Dong Nai River, the measured salinity is only about 1.5 g/l. At the Tan Thuan in Sai Gon river, the measured salinity was 0.3 g/l because rainy season came early this year and a big volume of water was discharged from Tri An and Dau Tieng reservoir. The salinity in Vam Co Dong River was also lower than in 2011.

Based on the monitoring results and the information that was provided by EMP packages and ICMB9, social issues related to the environment have not occurred in the project area. However, the problems of land occupation in the semi-flooded area, the construction of toilets inside the reservoir and the illegal fishing need to be addressed because these problems will not only seriously affect the water quality but also the total natural environment.

#### **9.1.2. EMP packages**

Package MT2: Based on the implementation results in comparison with the TOR of the consultancy contract, MT2 consultant has implemented the contract in accordance with required schedule and proposed workloads. During the implementation, the consultant also cooperated with ICMB9 and the local governments, especially the Departments of Binh Duong, Binh Phuoc provinces in order to achieve the best results. Based on mentioned issues, we recommend that the consultant write an official letter specifying issues and necessary technical proposals and send this to the Employer and relevant agencies for the implementation.

Package MT3: Based on the implementation results in comparison with the TOR of the consultancy contract up to now, the implementation of this package is behind schedule. However, this delay comes from many objective reasons such as the change of the location for the construction of the water supply stations, time



wasted in coordinating with local government to choose a new location and waiting for agreement of the employer and donors. In general, implemented quantities and quality is consistent with the requirement of project.

Package MT4: as mentioned in previous reports, during the implementation, the MT4 consultant was not active in coordinating with other EMP packages in order to collect necessary monitoring data for the use of the Package. This problem made delay in preparing progress reports and affected the general schedule of the EMP.

Package MT5: The consultant implemented their works timely but the submission of reports is still delayed. The submission of reports needs to be improved.

Package MT6: in the first six months of 2012, the consultant implemented well the requirements as indicated in the consulting contract. However, the six-monthly monitoring report of 2012 was not submitted timely.

Package MT7: At present, construction packages 1A, 1B, 1C, PH3 were completed. Therefore, the package MT7 should prepare the final report and submit this to the Employer.

Package MT8: In general, the consultant already implemented the main contents of the package. The construction and installation of the water supply stations has started. The MT8 is requested to speed up the progress because the implementation of this package is too late. This affects the EMP of the project.

#### 9.1.3. Advantages, disadvantages and outstanding issues:

##### ***Advantages:***

The implementation of all EMP packages is consistent with the requirements of the proposed schedule and contents. These results have the following advantages:

- Selected consultants are capable and have experiences in implementing the tasks of the package.
- Enthusiastic support from local authorities, agencies, and local people.
- Cooperation, sharing, and support among EMP consultants.
- Coordination and timely supports from ICMB9 in all cases to assist consultant in implementing their works.

##### ***Disadvantages:***

In the first half of 2012, besides the above-mentioned advantages, the EMP tasks had certain difficulties as follows:

- Contractors do not have any staffs that have a background with

environmental education, only pluralities. Therefore, the compliance with commitments and the implementation of contents related to environmental protection have not really been done well. Some outstanding issues have not been resolved (as will be mentioned below)

- For EMP packages, only 9 out of 14 packages are under the implementation but the workload is still quite big. In addition, each package implements different missions at different times. Therefore, the coordination between these packages is very difficult.
- The area of Phuoc Hoa reservoir is very large and located in different provinces. Therefore, it was very hard to find out the problems after the reservoir has been impounded.

***Outstanding issues:***

The outstanding issues indicated in previous reports have been solved by consultants. However, there are still some outstanding issues as follows:

- Submission of progress reports and providing information to Employer and supervision consultant on the implementation status of packages is still slow. This affects the data collection of the OP4 consultant. In addition, the consultants did not provide fully 03 sets of reports including hardcopy and CD Rom.
- After having comments from OP4 and BVI consultants, the revision and resubmission of reports to the Employer have not been made promptly.
- During the implementation, the consultants did not inform the detailed working programs to the local government, the Employer and the supervision consultant.
- During the implementation, the consultants did not provide the information of the project implementation to the local government.

## **9.2. Recommendations**

### **9.2.1. General recommendations for EMP packages**

- The consultants should submit the inception report with three full sets (hard copy and CD Rom).
- Relevant agencies should resolve outstanding issues as mentioned in this report immediately.
- The consultants should take the initiative in delivering and sharing the data with other packages.
- The consultants must comply with the deadline for the submission of reports

as required in the TOR. The consultant should also summarise EMP packages implementation results in the middle and the end of the year.

- The consultants need to provide the detailed working plans to the local government during the implementation.
- For packages MT4, MT5 and MT6: the 6-monthly progress reports must be submitted immediately 10 days after the completion day (for example, the first 06 monthly report of 2012 must be submitted before 10 June 2012).

#### 9.2.2. Recommendation for each EMP packages

- ✓ For package MT2: at present, the MT2 consultant needs to propose a proper method for the forestation in the semi-flooded area as soon as possible. The proposal mentioned in section 3.1 needs to be endorsed by ADB, the Employer, local government and local people. The consultant could propose new methods as long as the new method is consistent with the technical requirements, actual condition and the TOR regarding the protection of catchments and surface erosion.
- ✓ For package MT3: The MT3 consultant continues to implement next activities on the basis of the TOR. The consultant should provide the contents and working plans to the Employer. Firstly, the design documents of the Duc Hoa water supply station should be finished. The consultant is requested to speed up the progress of the package because the package is being implemented very slowly. This delay affected the general schedule of the Project.
- ✓ For package MT4: The MT4 consultant needs to recheck all tasks of the Package. Since the Phuoc Hoa reservoir has been impounded, the fisheries management programs need to be prepared as well as the fisheries management team/association needs to be also established. In addition, operation and management manuals for the fish pass should be published as soon as possible so that Phuoc Hoa – Dau Tieng IMC can implement the fisheries management well, as mentioned in the Aide Memoire of ADB Mission on 2 May 2012.

In addition, the consultant needs to speed up the submission of reports. It is needed to actively collect and summarize data from EMP packages and in contact with local governments. The progress report should be submitted before 7 September 2012.

- ✓ For packages MT5: Similar to the Package MT4, the submission of reports of the Package MT5 is still behind the schedule. Therefore, the MT5 consultant is requested to submit their reports before 7 September 2012.

- ✓ For package MT6: The MT6 consultant should continue to update the information and provide the necessary monitoring data so that the environmental condition in the Project areas can be reflected timely. The submission of reports should be improved so that this problem will not affect the general schedule of the Project.
- ✓ For package MT7: The MT7 consultant is requested to submit the final report of the Package in September 2012. The consultant should also propose the EMP for the operation stage.
- ✓ For package MT8: the consultant should inform the implementation status, and provide a schedule of the detailed completion deadlines of each item of the Package and send this schedule to the Employer before 10 September 2012.

## REFERENCES

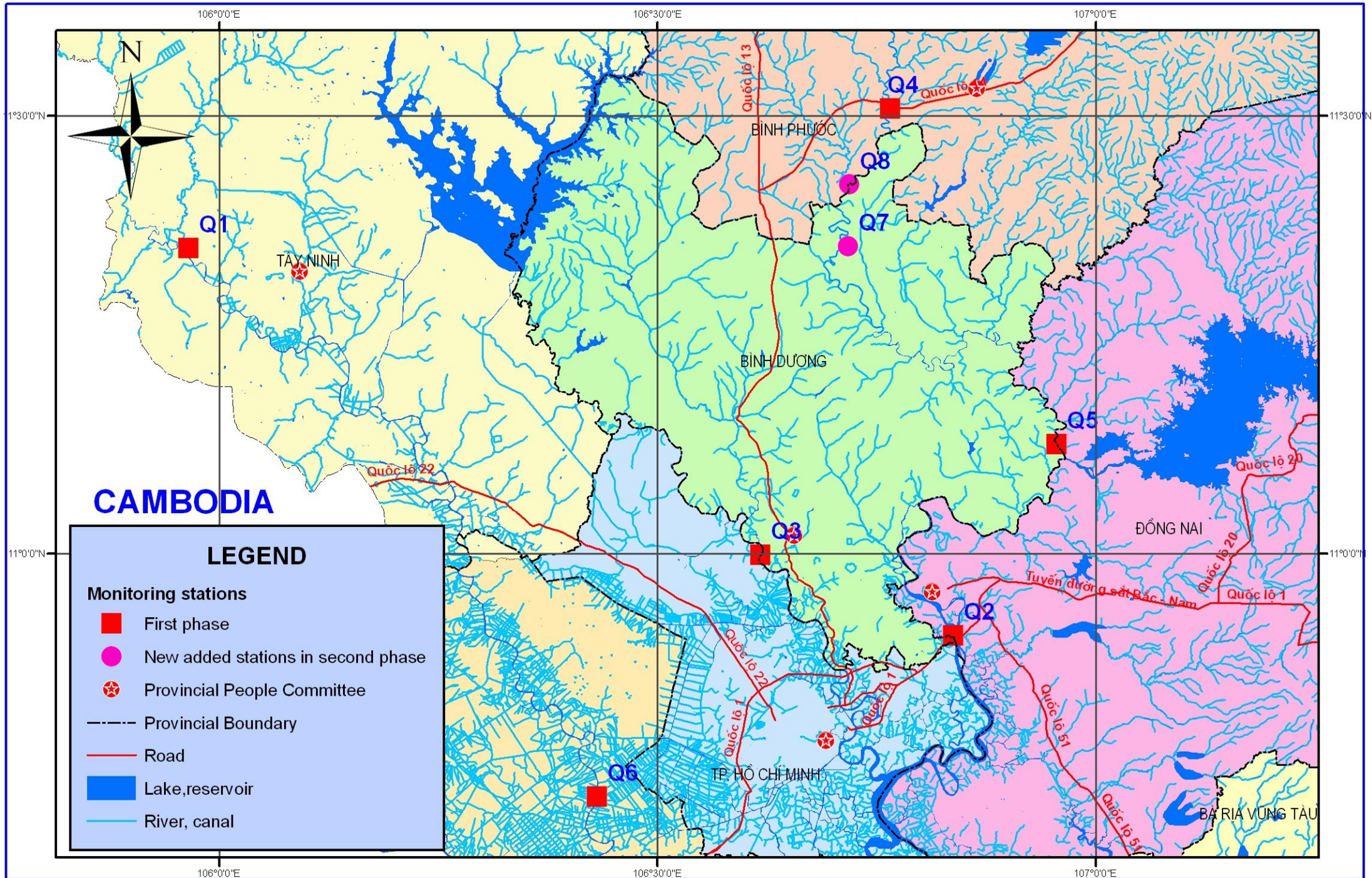
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## **Annexes: Maps**



# PHUOC HOA WATER RESOURCES PROJECT

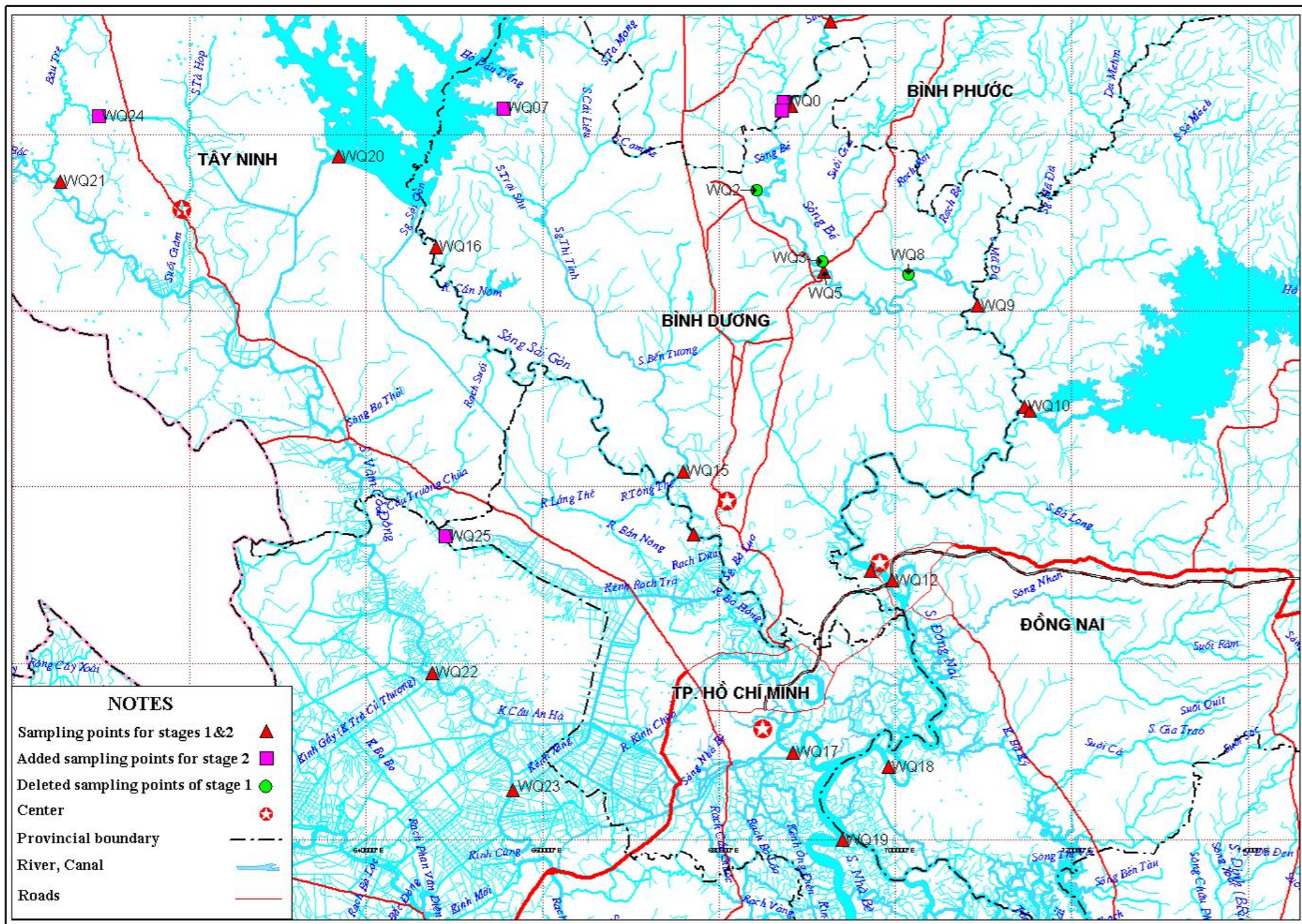
## MAP OF FLOW MONITORING STATIONS





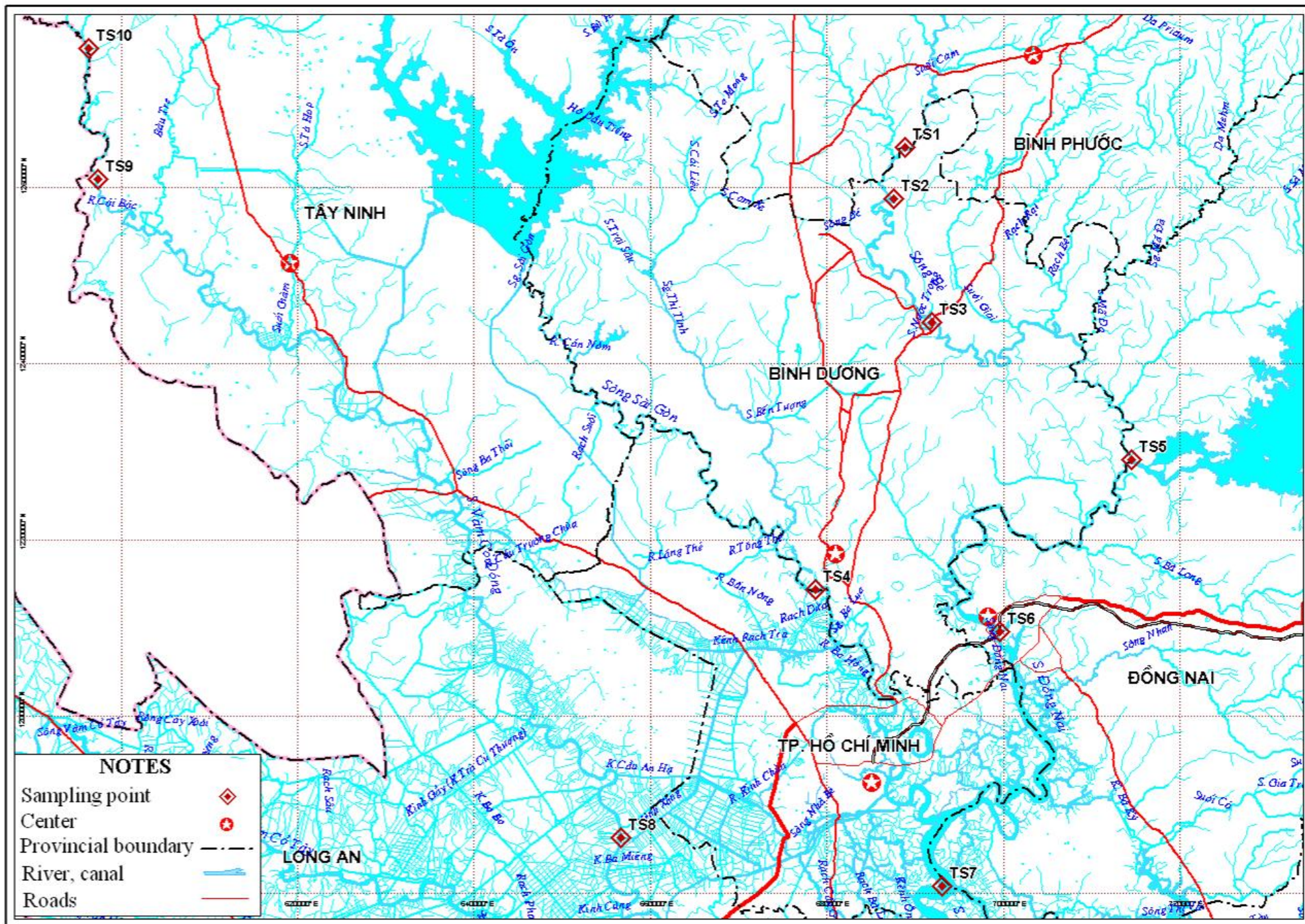
# PHUOC HOA WATER RESOURCES PROJECT

## SAMPLING MAP FOR SURFACE WATER MONITORING





**PHUOC HOA WATER RESOURCES PROJECT  
SAMPLING MAP FOR AQUATIC BIOLOGY MONITORING**





## Roads



**PHUOC HOA WATER RESOURCES PROJECT  
SAMPLING MAP FOR ACID SULPHATE SOIL MONITORING**

