WATER QUALITY INITIATIVES

Nguyen Vu Huy, ME
The Office ofDong Nai River Basin Organization, Viet Nam

1 PRESSURES AFFECTING WATER QUALITY IN THE DONG NAI BASIN

The current and future pressures affecting water quality are listed in order of significance:

1. Institutional

   - Although the 1998 Law on Water Resources and subsequent under-laws provide for a high level of control to be exerted by the State in order to maintain the productivity and sustainability of water resources, enforcement is weak resulting in a general lack of effective control;
   - Individual provinces have made some progress in eliminating the worst polluters (e.g. by moving "dirty" industries to industrial parks) but the process is slow and is under-resourced.

2. Domestic Wastewater

   - Saigon river (upstream area): the estimated quantity of domestic wastewater discharged is forecast to increase from 61,000 m^3/day to 72,000 m^3/day in 2005; 146,000 m^3/day in 2010 and to 197,000 m^3/day (2020);
   - Dong Nai river (upstream area): the estimated quantity of domestic wastewater discharged is forecast to increase from 177,000 m^3/day (1999); to 213,000 m^3/day (2005); 397,000 m^3/day (2010); and to 598,000 m^3/day (2020).

3. Agricultural Runoff

   - The total amount of agricultural runoff discharged into upstream reaches of the Dong Nai and Saigon rivers is forecast to increase from an estimated 2,880,000 x 10^3 m^3/year in 1999 to about 4,670,000 x 10^3 m^3/year in 2010.

4. Wastewater from Small/Medium Enterprises & Industry (Outside Industrial Parks)

   - There are no pollution forecast estimates for enterprises/industries outside industrial parks. However, the impact created is likely to be more significant than industrial parks because they: (i) rarely build environmental considerations into their production processes/siting, (ii) are dispersed over the entire basin, and (iii) are difficult for the government to regulate.

5. Wastewater from Industrial Parks

   - Saigon river: increase in wastewater from Industrial Parks is estimated to be from 6,700 m^3/day (1999) to 255,000 m^3/day (2020);
   - Dong Nai river: increase in wastewater from Industrial Parks is estimated to be from 58,000 m^3/day (1999) to 380,000 m^3/day (2020).

2 STATE OF WATER QUALITY IN THE DONG NAI BASIN

There have been over a dozen studies on the quality of surface waters in the Dong Nai basin. Most studies were conducted for project or province-specific purposes, and therefore, it is not appropriate for the purposes of this report to make a comprehensive analysis. However, some generalisations can be made regarding the basic data as follows:

1. **Dissolved Oxygen (DO)** is an indicator of biological sustainability of a water body. If DO levels are low, then it is difficult for animals and plants to survive. Dong Nai river (upstream, at Tri An reservoir, and Song Be-Dong Nai junction, and from Hoa An to Dong Nai bridge) generally has a DO level of about 6 mg/l. This is considered to be the lowest acceptable DO value according to TCVN 5942 Category A. The Saigon river generally has a lower level of DO – often in the range of 5-6 mg/l. In general, levels of 5-6 mg/l are still acceptable for supporting biological activity, but DO levels vary considerably according to depth of water, flow rate of river, and flow/ebb of tide and other considerations.
2. **Biological Oxygen Demand (BOD)** is a simple indicator of decaying/dead organic pollution (and its oxygen consumption). BOD levels vary considerably with exact location (e.g. BOD levels near sugar processing factories can be several hundred mg/l). However, in general the BOD levels of both Dong Nai and Saigon rivers are slightly above the TCVN 5942 Category A standard of <4 mg/l, indicating that there is often a fair amount of organic pollution in both rivers.
3. **Chemical Oxygen Demand (COD)** is a simple indicator of industrial pollution (and its oxygen consumption). In the Dong Nai River, COD levels are often slightly below the TCVN 5942 Category A standard of 10 mg/l. In Saigon river (for example at Ben Than and Binh Phuoc bridge) COD levels typically range from 12 to 15 mg/l: this is 20-50% higher than the TCVN standard, indicating that there is often a significant amount of industrial pollution in both rivers.
4. **Nitrogen and Phosphorus** contamination are indicators of domestic and agricultural waste, as well as general indicators of the potential for eutrophication. Most of the Dong Nai and Saigon rivers have the potential to become eutrophied, often having total nitrogen >0.2 mg/l and total phosphorous >0.01 mg/l. [1]
5. **Coliform** contamination is an indicator of domestic and food processing waste. The concentration of coliform is quite high at some locations: 1.5 - 25 times higher than TCVN 5942 (Category A) for Hoa An, and 45 times higher than TCVN 5942 (Category A) at Ben Than and Thu Dau Mot. The consistently high results confirm that water sources are contaminated by domestic wastewater, making the water unsafe for domestic use, aquaculture and swimming.
6. **Pesticides:** For most rivers in the Dong Nai basin pesticide residues (mainly chlorinated organic pesticides) are found in low concentrations and less than the requirement of Vietnamese and WHO standards, especially at the intakes to water

[1] There are no TCVN (Viet Nam Standard) or Ministry of Health standards for Total N and Total P for surface waters, so basic comparison with national standards is not possible for these parameters.

supply treatment plants. However, lab analysis of pesticides is relatively expensive and therefore not as well studied as simple indicators such as DO, BOD, and COD.

7. **Heavy metals** (Cd, Hg, Pb, Cr) also found in concentrations of less than TCVN limits (Pb, Cr) although one study found about 10% of Hg and Cd concentrations exceeding TCVN 5942-1995 Category A (i.e. more than 1 ug/l). This is not surprising, given that COD samples – a general indicator of industrial pollution, of which heavy metals are one contributing group – are often above TCVN standards.

8. **Phenol** is a toxic chemical compound with a probable lethal oral dose to humans of 50-500 mg/kg. Lower doses lead to numerous health problems. Laboratory analysis of phenol samples is very expensive and therefore this parameter is rarely sampled. However, of the few samples taken, most are within the TCVN 5942 Category A limit of 0.001 mg/l except samples taken at the Hoa An intake section. Thus it is likely that Hoa An domestic water is contaminated with phenol, although not enough data exist to determine the level of health risk of this contamination.

9. **Oil** is found frequently at water intake locations (especially at Ben Than and Hoa An). Even though concentrations are relatively low, the TCVN 5942 Category standard is "no oil", therefore the domestic water supply is considered to be contaminated with oil.

3 DONG NAI RBO INITIATIVES TO ADDRESS WATER QUALITY ISSUES

3.1 Identification of Water Quality Issues

Although many adverse water-related environmental impacts were identified by stakeholders, a dominant feature of the consultation was that all but one province saw pollution of surface water and groundwater sources as their primary concern. Stakeholder perceptions of the main issues and their effects are given in **Table 1**.

To this list may be added further concerns not obvious to stakeholders who were mainly from towns or dryland areas. These include progressive loss of wetlands and continued encroachment into mangrove areas, leading to loss of habitat and breeding grounds.

3.2 Water Quality "Theme Group"

The primary objective was to address three selected water quality issues and propose actions which the first formal meeting of the Dong Nai RBO in September 2003 could endorse. Nevertheless the Theme Group established a precedent for a formal RBO Water Quality Technical Working Group (see below). The issues addressed by the Water Quality Theme Group were:

- Strategy for water quality monitoring in areas of severe pollution;
- Proposal to merge the Saigon-Dong Nai Environmental Management Board with the Dong Nai RBO;
- Proposal for integration of groundwater management plans over the whole Dong Nai basin.

Table 1 : Stakeholder Perceptions of Key Water Resources Issues

ISSUE	EFFECT
Pollution of water sources (including: domestic wastewater, industrial wastewater, solid waste, fertilizers, pesticides, nitrates)	– Reduction in agricultural yields, including rice production – Contaminated crops sold in markets – Fish and animals poisoned – Loss of a variety of traditional species (fish, shrimp) – Unpleasant smells – Contamination and shortage of clean water for domestic use – Public health risks and increasing incidence of skin disease – Increasing cost of supplying clean water – Impact on ethnic minorities in remote areas, particularly increase in women's diarrhoeal diseases – Conflicts within communities – Early depletion of resources – Waste disposal has become increasing problem in cities – Impact on sustainable economic development – Existing systems cannot cope with new pollution, and problem is growing faster than capacity to deal with it
Over-exploitation and contamination of groundwater	– Communities having only seasonal access to groundwater resources for domestic use and irrigation – Communities having to find alternative water sources – Increased cost of treatment for groundwater for domestic supply – Adverse effect on socio-economic development – Exacerbates saline intrusion
Acidity (due to uncontrolled cultivation of acid sulphate soils)	– Unpleasant for domestic use – Fish kills and reduced agricultural productivity – Adverse impact on public (particularly women's) health
Failure to identify the extent of water pollution	– Problem may be much larger than previously thought – Authorities not equipped to deal with the problem

3.3 Water Quality Technical Working Group

Working Groups and activities (e.g. workshops) were designed to promote the concept prior to formalisation of the RBO through issue of working regulations. All the main issues surrounding water quality in the basin, its continuing decline and problems associated with enforcing existing legislation were discussed freely at the preparatory workshop on 5 March 2004. With specific regard to how the Dong Nai RBO could help to resolve these issues, the main matters addressed at the workshop are given in **Table 2.**

Table 2 : DNRBO Water Quality Working Group Preparatory Workshop

Working Group Targeted	Main Activities
DNRBO Working Group for Water Quality	- Introduction to concept and working methods of DNRBO and Working Groups - Current water quality problems in DNRB and continuing deterioration - Need for DNRBO Strategy for Water Quality Improvement - Importance of reliable and representative data collection and dissemination, and of appropriate criteria for assessment - Proposals for a Water Quality Sub-project - Identification of DNRBO priority tasks related to Water Quality Improvement

Continuing concerns expressed at the meeting over water quality in the basin confirmed that the RBO Working Group for Water Quality was seen as an important vehicle to take forward technical and planning work relating to water quality in the Dong Nai basin. At the present, the Office of the Dong Nai RBO is engaged in confirming membership of a small unit of approximately 10 RBO members drawn from DoNRE and DARD within the basin to form the Working Group.

3.4 Strategy for Water Quality Improvement in the Dong Nai Basin

As part of the DNRBO assistance to the Working Group in developing planning guidelines (as the first steps towards a "Basin Plan") the Office of DNRBO drafted a DNRBO Outline Strategy for Water Quality Improvement in the Dong Nai basin. Review of the document (which was only a first draft) was one of the first tasks of the Water Quality Working Group.

3.4.1 Water Quality Improvement Strategy – Proposed Goal

The strategy's goal is stated as to:

> "Lead an inclusive, transparent, and functional multi-stakeholder regional water quality planning process"

Although broad in scope, the goal is intended as a clear target to promote cooperation between stakeholders in making a positive impact on the serious water quality problems in the Dong Nai basin.

Three principal objectives are identified as a means of attaining the above goal, and these are summarised below.

3.4.2 Water Quality Objective No. 1

The first proposed objective is to: "*Develop a collaborative and transparent process for identifying water quality issues in the Dong Nai River Basin (DNRB).*"

- Identify stakeholders that have vested interests in DNRB water quality;
- Establish practical and transparent procedures to include stakeholders, especially those who are vulnerable (poor, ethnic minorities, etc) and empower them to present their views;
- Importance of information inputs (quantitative data, qualitative data, cultural information) to guide the identification and prioritisation of issues.
- Develop transparent methods for conflict resolution and strive to build consensus.

3.4.3 Water Quality Objective No. 2

The second proposed objective is to: "*Provide timely, accurate, and representative information on water quality in the Dong Nai River Basin to the Dong Nai River Basin Organisation.*"

- Design data collection programmes to satisfy stakeholder interests (see Objective 1);
- Maximise the use of secondary data (i.e. existing information) from stakeholders;
- Develop and steer sub-projects to collect new data to fill specific data gaps;
- Assure quality of secondary and primary data used;
- Establish transparent, rigorous and accessible reporting schedules and formats for reporting results to DNRBO and stakeholders.

3.4.4 Water Quality Objective No. 3

The third proposed objective is to: "*Seek and promote opportunities to integrate results of monitoring reports into stakeholder planning documents and procedures.*"

Under this objective the outline strategy should be guided by three fundamental principles:

1. That there should be significant participation from those that hold a stake in the basin's water quality. The list of stakeholders includes local agencies, provincial agencies, national agencies, the private sector, and non-government bodies (e.g. mass organisations), and action should facilitated through the RBO.

2. That the strategy should be implemented in three components: (i) data collection; (ii) data analysis and reporting; and (iii) environmental planning. These components are iterative – i.e. progress made on one component will guide implementation of the next component, with effective environmental planning feeding back into the cycle with improved data collection etc.

3. Anticipating that resources available to establish the RBO will be initially limited, the first steps in data collection are likely to be modest, but later iterations should increase the level of effort. Again, the degree of success will rely in commitment from stakeholders, from government and/or external organisations.

3.4.5 Adoption of Outline Strategy

It is intended that the outline strategy should be discussed by the DNRBO Water Quality Working Group as one of their first tasks. After review by the Planning and Finance Working Group, the approved strategy should then be submitted to the next plenary meeting of the DNRBO for endorsement.

3.5 Sub-Project for Water Quality Improvement

Consultation with water quality and environmental specialists within the basin was carried out followed by a desk study of possible projects. The "long list" was then reduced to a shortlist of five feasible and desirable project components. The second initiative was to probe the opinions of stakeholders attending provincial workshops to ascertain the types of intervention which would be most effective with regard to improving water quality. Results were reviewed and assembled into a first draft sub-project at the end of 2004. However, it subsequently took several months before the

draft could be discussed with relevant stakeholders and redrafted into an acceptable format.

3.5.1 Sub-Project Goal, Purpose, and Objectives

The goal of the sub-project is to support the sustainable use of water resources in the lower Dong Nai river basin. The purpose is to improve the ability of planning processes to promote sustainability in the use of surface and groundwater resources in the basin. The sub-project has two principal objectives which are:

(i) to improve information co-ordination between agencies responsible for surface and groundwater monitoring in the Dong Nai basin; and
(ii) to disseminate an improved understanding of the current and projected surface and groundwater quality characteristics of the Dong Nai basin to relevant stakeholders.

3.5.2 Guiding Principles

As with the overall Water Quality Improvement Strategy, a number of guiding principles were identified and these are:

- The sub-project will identify water quality issues that need further data in order to make informed regional-level water quality management decisions;
- The sub-project will strive to involve a range of stakeholders to identify what information is required for effective planning;
- The sub-project will work with stakeholders to build on existing data, and thereafter to support the expansion of data collection as required for effective planning; and
- The sub-project will provide rigorous and objective answers for planners within a timeframe and format that is useful for stakeholders.

3.5.3 Geographic Scope

This project will ultimately cover five provinces and one city as follows: (1) a downstream "core-use area" of HCMC and the provinces of Dong Nai and Binh Duong (also referred to as the Saigon - Bien Hoa area). This area contains Vietnam's largest urban area; it is highly industrialised, although the fringes of the area are rural and used primarily for agriculture; and (2) an upstream "influence area" of Binh Phuoc, Tay Ninh, and Lam Dong provinces. This area is primarily rural, with agriculture and hydropower being the most influential water resources sub-sectors. Upland regions of the influence area also contain national parks and other environmentally sensitive areas. In total, the sub-project area spans 31,620 square kilometers and over 11 million people.

3.5.4 Organisational Arrangements

Implementing Agency for the sub-project is expected to be MoNRE. Specific assistance from DNRBO will be required as follows:

- Technical issues will be managed by DNRBO Water Quality Working Group;
- Financing issues will be managed by Planning and Finance Working Group;

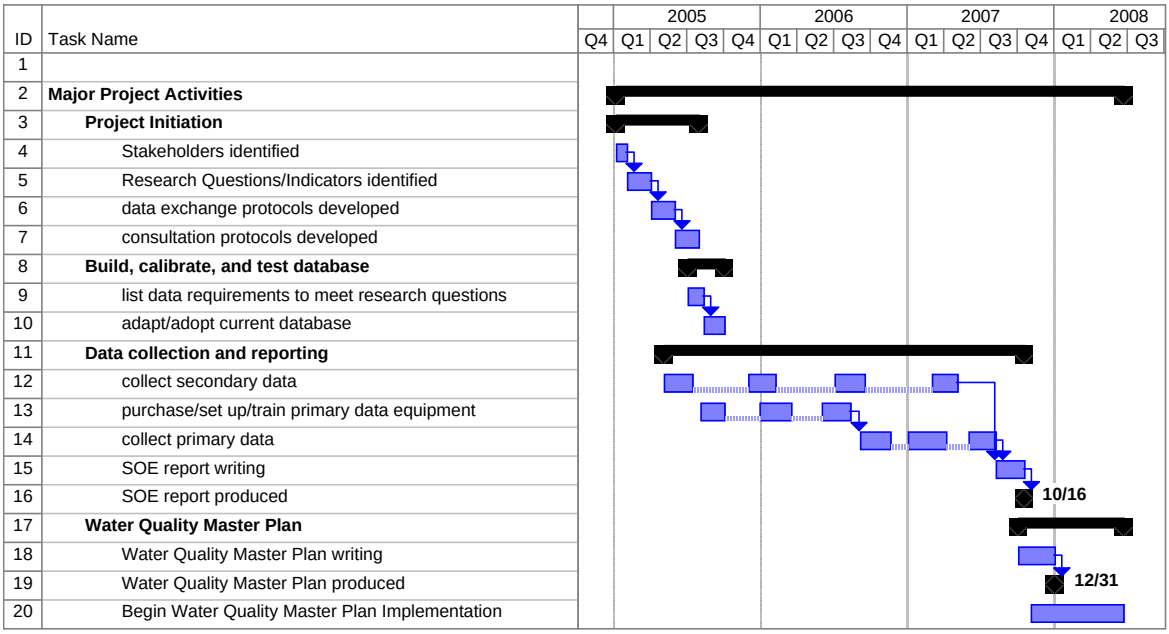
- Integrating results into provincial plans will be managed by provincial representatives operating through the Planning and Finance Working Group.

3.5.5 Beneficiary Participation and Contribution

The project will require high-level support – from the Prime Minister's Office if necessary – to facilitate the inter-agency co-operation agreements that are prerequisite to implementing the sub-project. MoNRE's contribution is expected to be human resources support and co-ordination from VEPA's Regional Data Centre in HCMC. Stakeholder contributions will be: (i) providing secondary data collected by stakeholders; and (ii) providing human resources to collect new project-specific primary data.

3.5.6 Implementation Schedule

The project will be implemented over a period of 42 months as outlined below:



3.5.7 Project Costs

The estimated overall cost of the sub-project is expected to be US$ 2.64 Million, made up as follows:

Table 3 : Tentative Costs for Water Quality Sub-Project

Component	US$	Comment
A. Civil works	nil	
B. Equipment & facilities	492,000	Includes equipment for sampling & analysis
C. Consultants	1,867,000	International & national
D. Ops & Maintenance	76,000	Equipment, vehicles & offices
E. Administration	88,000	
F. Physical contingencies	25,000	
G. Price contingencies	96,000	
Total	2,644,000	

3.5.8 Project Implementation

The next step is for the sub-project to be reviewed by the DNRBO Water Quality Working Group, as one of their first tasks following their formation. The Consultant also expects to receive initial comments from ADB prior to revision and finalising. Much is expected to depend on the source of finance (assumed at present to be a loan) and ongoing change in the institutional environment for state management of water resources.

3.6 Criteria for Water Quality and Salinity Control

With increasing and competing demands on water resources, planning for sustainability requires there to be a clear set of technical criteria to assist in reversing water quality decline in the lower basin.

The Office of the DNRBO proposed a criteria for water quality and salinity control. A step-by-step approach to developing criteria for water quality and salinity control is proposed. A summary of four proposed steps is provided below.

3.6.1 Step 1: Assign Water Bodies to Water Quality Grades

The first step is to assign the main uses of surface water in the Dong Nai basin into categories. In line with previous proposals, these are termed "Grades" (Grade A, Grade B, Grade C). Once grades are established, sample reaches of river are assigned to each grade. Initially, the river reaches can be large and general geographic units (e.g. reaches of several hundred kilometers in length); however, over time, reaches will be divided into more and smaller geographic units.

As most river reaches are multi-use, grades are assigned based on the reach's most sensitive water use. However, in assigning grades, common sense should prevail: low numbers of users requiring high quality in an otherwise low grade area might not be accommodated. Similarly, common sense would need to be applied to upstream-downstream situations, normally requiring negotiation between stakeholders. Ultimately, it is only through negotiation that stakeholders and government agencies can become clear on the uses of water bodies – and inter alia – the standards that should be prescribed to those areas (**Table 3**).

Table 3 : Proposed Grades and Example Areas

Water Quality	Purpose of Water Use	Example River Areas
Grade A	• Domestic water supply • Recreation, • Nature conservation • Capture fisheries • Aquaculture	From the damp of Tri An reservoir to Long Binh bridge
Grade B	• Industrial water supply	From Long Binh bridge to Den Do cross section
Grade C	• Irrigation • Waterborne transportation	All rivers in Duc Hoa District, Long An province All rivers within 2 km of Saigon port.

3.6.2 Step 2: Select Environmental Parameters

TCVN 5942 was used as the basis for proposing a draft set of parameters and standards for the different Grades. Additional parameters were adopted from Ministry of Health standards and other sources.

The draft set of parameters and standards contains some basic differences as compared with TCVN 5942 and previous proposals, and these may be summarised as:

- Oxygen-related parameters (DO, BOD5, COD) are less strict that TCVN 5942;
- Heavy metal parameters tend to have limits less strict than TCVN 5942;
- Some standards (e.g. suspended solids) have natural background levels as a standard;
- A number of new parameters are added. Of most practical importance are faecal coliform, Nitrogen, Chlorine, Phosphorus, and colour.

3.6.3 Step 3: Standardise Data Interpretation Methods

TCVN standards for air and water do not give guidance as to how data should be interpreted against their quantitative standards. For example, if a standard for total coliform in a Category A water body is 5000 MPN, it is currently not clear if this means:

(i) all data points in the data set must be below 5000 MPN; or
(ii) the arithmetic mean of data set must be below 5000 MPN; or
(iii) the arithmetic mean plus or minus one standard deviation must be below 5000 MPN, or
(iv) a certain percentage of data points must be below 5000 MPN.

Based on experience with national datasets in recent years, the Office of DNRBO has suggested that compliance should be based on a certain percentage (e.g. 80% - 90%) of data points being within the standard proposed. This method of interpretation is both practical and more rigorous than alternative methods based on arithmetic means. As well as giving a clearer picture of how the entire data set fits within a parameter's standards, it is also easy for agencies with little statistical training to calculate and report on this option.

3.6.4 Step 4: Standardise the Grade Evaluation Process

To evaluate whether or not a water body's environmental parameter of interest is achieving its quantitative standard, the following conditions must be met:

1. The body of water must be assigned a resource grade (Grade A, B, or C). The grade should be selected based on the water quality requirements of the water body's main uses. If a water body has multiple uses, the grade should be selected on the body's most environmentally-sensitive use.

2. The body of water must be sampled such that the data points adequately represent the range of environmental conditions that occur. In particular, sampling needs to account for both temporal (e.g. tidal, seasonal) and spatial (e.g. depth, width) variations affecting the water body.

3. 85% of data results must be within the standard proposed so that the monitoring agency can confirm that the parameter of interest meets the water quality criterion for its assigned grade.

3.6.5 Application of Criteria

Being only draft proposals of the Office of DNRBO, it is intended that the criteria should be discussed by the DNRBO Water Quality Working Group as one of their first tasks. The implications of the technical working group's recommendations would subsequently be reviewed by the Planning and Finance W,orking Group before submitting the criteria to the next plenary meeting of the DNRBO for endorsement.