

INFORMATION ON PFR2 SUB-PROJECTS:

Appendix 1: Da Nang

Appendix 2: Hue

Appendix 3: Hai Phong

Appendix 4: Buon Ma Thuot

Appendix 5: Quang Tri

The second tranche of the Multitranche Financing Facility (MFF) Viet Nam Water Sector Investment Program would finance five water companies. Three are prepared with grant funding from the Water Financing Partnership Facility, managed by ADB for Danang, Hue and Hai Phong; one under proposed World Bank financing and reallocated to ADB for Buon Ma Thuot and one from the French bilateral cooperation for Quang Tri.

The water companies are finishing their Feasibility Study, currently at pre-feasibility study level; draft information is included for each water company in Appendix. ADB Project Team would appraise the sub-projects during the first semester of 2011, before proposing for considering financing under PFR2.

All projects are categorized Category B for Environment, A for Resettlement and C for Indigenous People, except Hue sub-project, categorized A, with a Ethnic Minority Development Plan prepared following the safeguard framework of the MFF. The second Tranche would be classified Enhanced Gender Mainstreaming.

ADB Project Team, January 2011

APPENDIX 1: PFR2 Sub-Project Da Nang

EXTRACT FROM FEASIBILITY STUDY DANANG WATER SUPPLY PROJECT

Prepared under Asian Development Bank (VIE-TA7144)

PROJECT SUMMARY

Sector Background

1. In recent years Da Nang city, like most of Vietnam, has achieved impressive economic growth and substantially reduced poverty levels. While this growth has generally led to increased living standards it has been accompanied by a high rate of migration from rural to urban areas and rapid urbanization with Da Nang city experiencing an urban growth rate of 2.6% per annum over the last decade. As a result the city has expanded well beyond the areas at present served by the Da Nang Water Supply Company (DAWACO) distribution network and treated water production capacity will soon be outstripped by the rapidly increasing demand from the population, commerce and industry. While commendable steps have been taken to reduce NRW in recent years it still stands at over 30% and absorbs funds which otherwise could be used to expand and improve the network.

2. DAWACO is a Public Service Enterprise operating under the Enterprise Law. Despite recent moves by the GoV to decentralize, the level of autonomy of water supply companies has been limited, particularly in respect of water supply tariffs which are generally set by the provincial PCs at levels which cover O&M costs but are insufficient to fully recover the costs of capital needed by the utility for development.

3. The sector is however now undergoing change in line with GoV's plans to move towards a more market oriented economy. In July 2007 the Central Government issued Decree 117/2007/ND-CP which requires all water companies to operate as commercial entities with full cost recovery, proposes formal contracts between owners and operators, and clarifies issues of asset ownership. At present GoV favors the establishment of one member limited liability entities as an interim stage along the WSC reformation process and DAWACO will take this step in the near future.

4. The Government's Orientation Plan for Development of Urban Water Supply to 2020 defines the policy and direction for the water sector, and stresses the importance of institutional reform as a key element in the development of a strong, efficient and sustainable water and sanitation sector. GOV Decision No 1929/QĐ-TTg on Approval of Water Supply Development Orientation for Urban and Industrial Areas in Vietnam to the year 2025 and vision to the year 2050 - sets out specific water supply development targets and objectives to the Year 2015, 2020 and 2025 including coverage levels, minimum per capita consumption levels and NRW targets.

Project Description

5. In March 2007 during the water financing conferences held in Hanoi, the Government of Vietnam requested the ADB for assistance to prepare the Da Nang Water Supply Project (DNWSP). The Project is proposed for funding under the Water Financing Partnership Facility managed by ADB and will provide a sustainable water supply for the city of Da Nang in the short and medium term and is also expected to develop infrastructure and promote Public Private Partnerships (PPPs) in line with ADB's country strategy and program for Vietnam. It will also contribute to Target 10 of the Millennium Development Goals (MDGs) which calls for signatory

countries to halve the population without sustainable access to safe drinking water and sanitation by year 2015.

6. **Project Objectives:** The overall objective of the Da Nang Water Supply Project is to improve the living conditions and health of the population in urban and peri-urban areas by expanding and improving the clean water production capacity and the distribution network coverage within the city.

7. **Project Outcomes:** The Project is expected to contribute to sustainable economic growth and improve the urban quality of life in Da Nang city through provision of accessible, equitable, and sustained water supply services. The expected outcomes are (i) improved and expanded access to safe and sustainable water supply services; (ii) increased public awareness of the importance of using safe water and reduced risk to public health; and (iii) improved management capacity of DAWACO and sustained service provision through adequate tariffs and cost recovery, and strengthened sector regulation.

8. **Project Components:** The Project will consist of five components designed to achieve the above objectives:

- i. Increased production capacity through:
 - Construction of a new 16 km raw water main from a new dam to be constructed on the Cu De river to a new water treatment plant in the North-west of the city.
 - Construction of the new 120.000 m³/day capacity new water treatment plant at Hoa Lien commune in Hoa Vang district.
- ii. Expansion of the network to serve all areas of the city and replacement of leaking pipes to reduce NRW.
- iii. New ICT equipment including further upgrades to the recently installed ERM system, GIS, hydraulic modeling and additional SCADA equipment will be provided.
- iv. Strengthening of DAWACO's management capacity and capability for operation and maintenance of the system
- v. Climate Change interventions including the following four sub components:
 - Water Conservation
 - Disaster Management
 - Energy Improvement
 - Improvement of Drinking Water quality to WHO Standards

9. **Institutional support program(ISP):** This four year program (Component 4) consists of a 10-point institutional strengthening plan to be implemented from 2011 to 2015 and designed to help DAWACO operate and manage its facilities more efficiently and reduce NRW from its current level of about 32% of production to 25% by the end of 2015. The support activities will include, but not be limited to, the improvement of DAWACO's GIS, SCADA and hydraulic modeling capability, further leakage reduction, improved water metering, and optimized asset management decisions. A similar program will be implemented during 2016-2025, to further reduce NRW to the national target level of 15%. In addition, DAWACO is expected to continue its in-house ISP. The ISP inputs will be provided through an operational management contract with an international company with a strong track record as a water utility operator.

Agencies Responsible for the Project.

10. In accordance with the Government's decentralization policy, DAWACO will be the Executing Agency (EA) responsible for the implementation of the Project. The DNPC will allocate

the counterpart funding, provide policy guidance, and monitor and evaluate project activities and after the loan effectiveness, will set up a PMU under DAWACO as the implementing agency.

11. A project steering committee (PSC) will be established in DNPC. Its main functions will be to advise PMU and to resolve matters that require interdepartmental coordination at the provincial level. The PSC will be chaired by a DNPC vice chair, and members will represent stakeholders, including, but not necessarily limited to, the provincial departments of finance, planning and investment, health, environment and natural resources, and construction and/or public works as well as mass organisations such as Womens Union.

Time Schedule for Project Implementation

12. It is estimated that the present Project covering the first stage of investment to be financed under a Multi-tranch Financing Facility (MFF) will be implemented over 5 years, commencing in mid 2011. To minimize delays, the PMU needs to be established and project consultants recruited by the start of the third quarter of 2011. Detailed design is scheduled for completion by early 2012, and construction is expected to commence at the start of 2013 and end three years later in December 2015. Land acquisition and resettlement will be conducted before construction starts. Consulting services for construction supervision, and institutional development and capacity building will be provided until the end of Year 5 (2015).

Location for Project Implementation

13. All of the Project activities will be undertaken within the boundaries of Da Nang city. The location of each of the main Project Components is shown on the location map (Figure 1.1) and is described below:

- i. **New Raw Water Pipeline.** The new raw water pipeline will extend a total distance of 16 km. along the Southern side of the Cu De river valley. It will start at the Song Bac dam which will be constructed by hydropower developer, GERUCO Song Con, and end at the new WTP site at Hoa Lien commune in Hoa Vang district. For its entire length the pipeline will be located in Hoa Vang district.
- ii. **Hoa Lien Water Treatment Plant.** A new 120,000 m³/day capacity water treatment plant will be constructed in Hoa Lien commune, Hoa Vang district. The plant location is at the North Western extremity of the city's urbanized area at the point where the Cu De river valley broadens out into the coastal plains. The site has already been approved by the DNPC.

Expansion of the Distribution Network. DAWACO's distribution network covers the six urban districts in Da Nang city: Hai Chau, Thanh Khe, Son Tra, Lien Chieu, Ngu Hang Son and Cam Le. Recently the network has also been extended into parts of the large rural district of Hoa Vang where recent urban development has taken place as the city expands towards the West. Hoa Vang comprises 75% of the land area of Da Nang and is mostly forest covered mountains.

Financial Sources for the Project

14. **Overview.** In accordance with the Orientation Plan for Urban Water Supply¹, which was recently approved by the Prime Minister, DAWACO plans to increase coverage of its water supply services from approximately 59% in 2009 to 95% in 2025, and to reduce non-revenue water (NRW) from about 32% to 15% during the same period. In order to achieve these

¹ Decision 1929/QD-TTg, dated 20 November 2009.

objectives, the company needs substantial investments to increase its existing production capacity (which will no longer be able to meet projected demand by mid-2012 onward) and in an institutional support program (ISP) to improve the management of its assets.

Investment program. The PPTA Consultants have prepared a roadmap which provides additional production capacity for DAWACO in three stages² :

- i. Construction of Hoa Lien WTP and supporting infrastructure. To increase production capacity in the medium-term, DAWACO will construct a treatment plant in the district of Hoa Lien with an installed production capacity of 120,000 m³/day. To provide the plant with raw water, DAWACO will also construct a transmission main from Song Bac 2, a reservoir some 16 km west of Da Nang. This subproject also includes the rehabilitation and expansion of the distribution network, and will be completed by the end of 2015.
- ii. Construction of new Cau Do WTP Phase I. DAWACO considers the refurbishment of the existing Cau Do WTP as a temporary solution to its current capacity constraints, and intends to replace the plant by a new, more efficient WTP by the end of 2019. The new Cau Do WTP will have an installed capacity of 60,000 m³/day, and also obtain its raw water from the Cau Do river or Dong Nghe reservoir. The old Cau Do WTP will probably be decommissioned in the same year, so this subproject will result in a net increase of DAWACO's production capacity of (60,000-50,000=) 10,000 m³/day.
- iii. Construction of either new Cau Do WTP Phase II or Hoa Lien WTP Phase II. DAWACO may consider increasing the capacity of either of these WTPs to meet demand beyond 2025.

15. **Phasing of the program.** For the first stage investments, a detailed feasibility study has been prepared. Taken together, the above mentioned investments constitute "the Project". Stage two and stage three investments are referred to as "Future Investment Needs", and have not been analyzed in detail.

² To increase production capacity in the short term, DAWACO will refurbish the existing Cau Do WTP, which was decommissioned in 2008 because of high operating costs. This subproject will be completed by the end of 2012 but will not be part of the ADB loan. It will increase DAWACO's production capacity by about 50,000 m³/day (an increase of about 30% from the company's current capacity of 155,000 m³/day).

Key Features of Proposed Investment

Element	Cost Estimate (US\$ million) ^a	Year of Completion	Expected Outcome
The Project (2011-2015):			
1.1 Hoa Lien WTP and supporting infrastructure			
- Raw water main	13.7	2015	Flow capacity 240,000 m ³ /d
- Construction of Hoa Lien WTP Including ICT equipment	22.8	2015	Capacity increase 120,000 m ³ /d
- Expansion and rehabilitation of Distribution Network	37.0	2015	Piping for 40,000 new and 20,000 existing connections
- DED and construction supervision	3.4	2015	Proper execution of works
1.3 Institutional Support Program	4.5	2015	Reduction of NRW to 25%
Subtotal Stage I	81.4		
Future Investment Needs: (2016-2025):			
2.1 Construction of new Cau Do WTP Phase I	6	2019	Capacity increase 60,000 m ³ /d ^b
2.2 Expansion of new Cau Do WTP Phase II	6	> 2022	Capacity increase 120,000 m ³ /d
2.3 New Intake and Raw water pipeline	NA ^c	> 2025	Flow capacity 120,000 m ³ /d
2.4 Institutional Support Program	4	2025	Reduction of NRW to 15%
Subtotal Stage II	16		
TOTAL	≈ 100		

^a Not including interest during construction on ADB loan. Cost estimates for Future Investment Needs are highly indicative.

^b Net increase of 10,000 m³/day (as the existing Cau Do WTP will be decommissioned upon completion of construction of the new plant).

^c A new intake and transmission main will be required for the third stage but location and scope of work for these facilities will only be decided after completion of a new Water Resources study scheduled for 2013.

16. **Sources of funds.** The total costs of the proposed Project investments, which are estimated at \$81.4m (84.4 million including financing charges during implementation), will be financed from the following sources:

- Sub-loan financed from ADB's Multi-tranche Financing Facility (\$78.0m)
- ADB grant for the proposed energy efficiency program (\$2.0m)
- Government of Viet Nam (\$4.7m).
- DAWACO internal revenue (\$1.4m).

Future investments (Stages 2 and 3), which are in the order of \$15 million, are in principle eligible for financing from ADB's multi-tranche financing facility.

Funding Sources for The Project

Cost Item	Cost (\$ million)				
	ADB Subloan	ADB Grant	DA-WACO	GoV	TOTAL
Hoa Lien WTP and Supporting Infrastructure					
A. Raw water main					
1 Procurement and installation of pipeline	13.42				13.42
2 Compensation costs			0.24		0.24
B. Construction of Hoa Lien WTP					
1 Civil works and electrical systems	16.79				16.79
2 Equipment, incl. SCADA and GIS	4.01				4.01
3 Equipment for energy efficiency program		2.00			2.00
C. Distribution network					
1 Network expansion	33.10				33.10
2 Network rehabilitation (pipe replacement)	2.88				2.88
3 Compensation costs			0.98		0.98
D. DED and Construction Supervision ^a	3.38		0.05		3.43
Institutional Support Program (ISP) ^a					
1 Resettlement management	0.70				0.70
2 Independent auditing	0.20				0.20
3 Operational management contract (OMC)	3.00		0.10		3.10
4 Water conservation	0.13		0.01		0.14
5 Disaster management	0.25		0.02		0.27
6 Clean water to WHO standards program	0.13		0.01		0.14
Recurrent Costs			– ^b		– ^b
Financing Charges During Implementation				4.66	4.66
TOTAL	77.97	2.00	1.40	4.66	86.03
TOTAL excluding financing charges	77.97	2.00	1.40		81.37

Source: PPTA Consultant

^a DAWACO to provide office accommodation and transport

^b Project is not expected to incur an increase in recurrent costs during the implementation period, partly because of anticipated savings in energy costs, but mainly because recurrent costs are expected to increase after completion of the Hoa Lien WTP in 2016, after the Project implementation period.

APPENDIX 2: PFR2 Sub-Project Hue

EXTRACT FROM DRAFT FEASIBILITY STUDY HUE WATER SUPPLY PROJECT

Prepared under Asian Development Bank (VIE-TA7089)

Executive Summary

Project Description

The stated goal of the project is to increase water supply in Thua Thien Hue (TTH) province to cover over 75% of the population, from an estimated 50% coverage at present.

TTH province covers completely diverse areas including well developed urban areas, industrial zones, tourist resort areas, smaller towns and villages and large areas of sparsely populated rural and mountainous areas. The water demand, in particular the demand per capita, varies greatly throughout the province depending on the area.

The province consists of 8 Administrative Districts and 1 City (Hue City). For water supply purposes, 11 water supply areas have been defined within the province to cover the principal areas where most of the inhabitants live.

Water demand has been estimated for the next 10 years for each of the Administrative Districts of TTH province and Hue City by reference to the number of people in each of the 11 water supply areas for the years 2015 and 2020.

Phase 1 of the project will serve nearly 80% of the people in TTH province in 2015 and, following phase 2, 90% by 2020. Water demand, which was about 84,500 m³/d in 2009, is estimated to double between 2009 and 2015 and to be over three and half times more than 2009 levels by the year 2020.

The substantial investment in water supply facilities needed to meet these increased water demands will require strengthened management capability within HUEWACO, not only for the construction of facilities but also for the continued efficient operation and maintenance of the water supply works.

HUEWACO is already well managed as evidenced by the level of Non Revenue Water (NRW) which, at the current level below 20%, is already much lower than in other areas of Vietnam and is well within Government targets for 2010. However, in order to support HUEWACO and to strengthen management so that water supply operations are sustainable long term and so that HUEWACO can continue to limit NRW losses, there is an important element in the first phase of the project of costs to cover consultants for institutional reform, ISO Certification, Management Information Systems and SCADA systems (covering NRW).

The present Feasibility Study covers only phase 1 works planned to be constructed by year 2015. Financial and Economic analysis of phase 1 have determined that the project will provide full cost recovery with an FIRR of 7% and an EIRR (including assessed economic benefits) of 8.5% if the Average Tariffs shown are applied.

Projected Average Tariffs

Tariffs	2010	2011	2012	2013	2014	2015	2016	2017
Overall Average (VND / m3)	4,215	4,371	4,552	4,788	5,042	5,316	5,611	5,928
Tariff Increase (%)	10%	4%	4%	5%	5%	5%	6%	6%

Project Components and Costs

Cost Estimates - Investments Phase 1 to Year 2015 - US\$ Million, VND billion

No	LIST OF INVESTMENTS 2015	Foreign	Local	Total	Foreign	Local	Total
		Bn VND	Bn VND	Bn VND	Mil USD	Mil USD	Mil USD
A	Basic Costs	1,381.98	525.36	1,907.34	74.52	28.33	102.86
1	<i>Construction, expansion water treatment plants and networks</i>	948.31	272.88	1,221.19	51.14	14.72	65.85
2	<i>Connections for customers</i>	39.13	66.39	105.52	2.11	3.58	5.69
3	<i>Booster pumping stations</i>	-	13.62	13.62	-	0.73	0.73
4	<i>Land compensation and resettlement</i>	42.87	0.80	43.67	2.31	0.04	2.36
5	<i>Institutional and Management Reform</i>	142.82	-	142.82	7.70	-	7.70
6	<i>Support for project implementation</i>	60.51	32.60	93.11	3.26	1.76	5.02
7	<i>Taxes and fees</i>	-	139.08	139.08	-	7.50	7.50
8	<i>Financial fees during implementation</i>	148.33	-	148.33	8.00	-	8.00
B	Contingencies	124.09	52.54	176.62	6.69	2.83	9.52
C	Working capital	83.45	-	83.45	4.50	-	4.50
	TOTAL INVESTMENT(A+B+C)	1,589.52	577.90	2,167.42	85.72	31.16	116.88
	% TOTAL INVESTMENT		73%		73%	27%	

Project Responsible Agencies

The Executing Agency is the Thua Thien Hue People's Committee who have delegated responsibility primarily to the Thua Thien Hue Construction and Water Supply State One Member Limited Liability Company, HUEWACO. Other departments of TTH province (Departments of Planning and Investment, Finance, Construction, Transport and Natural Resources and Environment) are also involved in an advisory / monitoring capacity on behalf of the People's Committee.

TTH province PC is the Line Agency of the ODA Program and is responsible for the implementation of all projects in TTH province.

The Investment Owner under Decision 131 is HUEWACO - a State wholly-owned one-member Limited Liability Company (not equitized) to provide water supply services to the communities. HUEWACO will take responsibility for direct management and utilization of ODA and counterpart funds used to implement the project and to manage and use the resulting works after completion of the project.

A new PMU within HUEWACO will be established to manage the ADB Loan project. The PMU will be responsible for day-to-day project implementation and for overall management of the project, including consultant recruitment, procurement, land acquisition, monitoring of resettlement, stakeholder consultation, review and approval of detailed designs, review and approval of contract award, implementation of the physical works, quality assurance and monitoring of policy and institutional reforms.

The functions of the PMU will include:

- Overall day to day management and implementation of the ADB financed project as defined in the scope of work
- Provision of suitable staff to work closely with the consultants in all aspects of implementation and training,
- Facilitating meetings with other relevant agencies in TTH province wards and districts
- Arranging for approvals of design documents, cost estimates, construction drawings and bidding documents,
- Preparation of bidding plans and obtaining approvals,
- Construction planning, management and administration,
- Provision of training venues

There are various other committees involved in project implementation including a Community Advisory Committee and a Steering Committee. The Steering Committee will comprise officials from DPI, DOF, DOC, DOT and DONRE. The Steering Committee will meet quarterly and report to the TTH province PC and HUEWACO.

Project Funding

ADB will finance US\$85.72 million (US\$4.11 million Grant, US\$81.61 million Loan) representing 73% of the cost of the first phase of the project. The loan will have an amortization period of 25 years, including a grace period of 5 years, an interest rate determined in accordance with ADB's LIBOR-based variable lending facility plus a 0.2% margin.

The Government of Vietnam will re-lend the loan to HUEWACO at an Interest rate of 6.11% pa to cover administration/guarantee fees and foreign exchange risks, with similar repayment terms. The Government will assume the foreign exchange and interest rate variation risks for the loans.

The balance of Investment (VND 577.9 Billion = US\$31.16 million), representing 27% of the cost of the first phase of the project, will be provided from counterpart Vietnamese sources.

Financing Plan 2011-2015

Financing Plan	VND (Billion)			USD (Million)		
	FX	LC	Total	FX	LC	Total
ADB Loan	1,513.30	85.36	1,598.66	81.61	4.60	86.21
ADB Grant	76.22	66.39	142.60	4.11	3.58	7.69
GOV/HUEWACO - Equity	0	426.15	426.15	0	22.98	22.98
Total	1,589.52	577.90	2,167.42	85.72	31.16	116.88

APPENDIX 3: PFR2 Sub-Project Hai Phong

EXTRACT FROM DRAFT FEASIBILITY STUDY HAI PHONG WATER SUPPLY PROJECT

Prepared under Asian Development Bank (VIE-TA7151)

EXECUTIVE SUMMARY

Project Background and Framework

1. This TA is to assist Hai Phong Water Supply One Member Company to identify the needed improvements in the City's Water Supply System. Feasibility Study and Basic Design of the system improvements would be performed. The improvement in the water supply system would support the social, economic, and environmental development of the City, with specific reference to enhancing environmental protection and management, strengthening social safeguards, fostering organization development of HPWSCo, supporting trade and commerce, facilitating employment generation, and raising income levels in the project components area and the City as a whole.
2. The TA is being implemented in two phases. Phase I included the Water System Analysis, Supply and Demand Analysis, and the Identification of the needed system improvements. It was completed in June 2009. Currently, we are in Phase II of the project, which includes feasibility study and basic design of the needed system improvements, Economic/Financial Analysis, Environmental Assessment and Mitigation, Social Benefits/Impacts Assessment, Resettlement and Land Compensation Analysis, and Institutional Development Analysis and Improvement Plan.
3. The recent rapid development in the Social and Economic scene in the City of Hai Phong, demands for improvement of the City's Water Supply Infrastructure. It has resulted in new water supply demands for domestic, industrial and commercial uses. There is an immediate need to upgrade the system's capacity to serve the expanding population and growth in the city, as well as to connect up to the districts/wards which are not currently connected to the system.
4. Serving the water needs of the population is in particular important in the peri-urban areas, which currently relies on untreated and unsafe water sources. Providing reliable, clean, and continuous water supply (24 hours/day and 7 days/week) to the entire population of Hai Phong is a long-term goal which the Hai Phong Water Supply One Company (HPWSCo) is trying to meet progressively.
5. This project is also part of the overall scheme to meet the Millennium Development Goal of "halving" the portion of people without sustainable access to safe drinking water and basic sanitation, by 2015.
6. The overall effort of rehabilitating the Hai Phong Water Supply System was planned out in 2 phases. Objectives of Phase I was to rehabilitate and improve water supply system in urban center of the city. Phase I started in 1990s and will be finished in 2009 with the completion of the Kien An Water Supply Project, which is the last project on the rehabilitation of the old urban water supply system in Hai Phong city. Phase I consists of projects on rehabilitation and improvement of the urban water supply systems in Hai Phong funded by the Government of Finland, World Bank, and HPWSCo itself – Rehabilitation of water supply system in three urban districts of Hai Phong and Kien An district; Water Supply Project in Hai An district and a number of other small water supply projects in the area.

7. In the mean time, the rapid economic development and urbanization process in the city area, it is necessary to improve Haiphong water supply system in both production capacity and service area, which conceptualized Phase II – Upgrading and Expanding Water Supply System in Hai Phong city. The focus of Phase II would be on the improvement and rehabilitation water supply system in 5 urban districts.

Rationale

8. The Hai Phong water supply system was constructed in the early 20th century (1905). Due to long-term use, damages due to war, and aging technologies, the system had seriously degraded by the late 1980s and didn't serve its designated function at some parts of the system. Since 1990, the system and water supply facilities have been gradually rehabilitated and improved with support from investments from the government of Vietnam and other uni- and multi-lateral donor agencies. This overall effort of rehabilitating the Hai Phong Water Supply system was planned out in 2 phases. Phase I was to rehabilitate and improve the water supply system in the urban center of the city. Phase I started in 1990s and finished in May 2009 with the completion of the Kien An Water Supply Project, which is the last project on rehabilitation of the old urban water supply system in the City of Hai Phong. In this Phase, the main focus was the improvement and rehabilitation of the water supply system in 5 urban districts.

9. Other than the improvement of the water system in the 5 key urban districts, the water systems in other urban and peri-urban districts of the City are in great need of improvement, for the same reasons. In addition, the rapid economic development and urbanization process in the city results in continuously increasing water supply demands for the various sectors. Therefore, it is necessary to improve the Hai Phong water supply system in both production capacity and service area, which created the drivers for Phase II of the Hai Phong Water Supply System Upgrades and Expansion, of which this Rehabilitating and Upgrading Project of Haiphong Water Supply System - Stage II falls under.

10. The Project comprises 4 project components covering the water supply system in different parts of the City. 8 districts of the City will directly benefit from the improvement. Improved water supply to the population in the beneficiary districts would reduce the incidence of waterborne diseases and associated medical costs, provide communities more opportunities for economic activities, and give them increasing income for a sustainable society.

11. The Rehabilitating and Upgrading Project of Haiphong Water Supply System - Stage II builds on and further ADB's policy dialogue on providing safe and reliable drinking water to the underserved, maximizing water security and minimizing water-use conflicts, protection and pollution prevention, cost recovery for provision of water supply services (partly or full) with sustainable operation of utilities, public participatory approach and community participation, basic infrastructure facilities to support economic development, institutional development and capacity building, governance and anticorruption, sustainable growth and environmental management. institutional development and capacity building, utility/urban services management and sector/corporate governance, urban-rural poverty reduction and social protection, and equitable growth and narrowing urban-rural income gap.

12. Lessons learnt from the experience of ADB and other uni-and-multi-lateral donor agencies on urban water supply improvement projects, as well as from HPWSCO's use of foreign loans in other similar projects will be reviewed during project implementation and the relevant lessons will be incorporated to optimize the project design and to avoid the same mistakes made twice.

Proposed Project

13. This PPTA project, have preliminarily been set to include 4 core project components covering 4 areas within the City boundary of Hai Phong. They are:

- (1) **Construction of Water Supply System in Northern part of Cam River** - A new Northern part of Cam River Water Treatment Facility with initial capacity of 25,000 m³/day, 18km of transmission main, a new booster station, and 28,000 new connections (connections to be covered under a separate project);
- (2) **Construction of Kim Son Water Supply System** - A new Kim Son Water Treatment Facility with initial capacity of 25,000 m³/day, 21km of transmission main, and 16,000 new connections (connections to be covered under a separate project);
- (3) **Upgrading of An Duong Water Treatment Plant** - Rehabilitation and upgrading of the existing An Duong Water Treatment Facility to capacity of 200,000 m³/day, and 6km of pipeline; and
- (4) **Rehabilitation of Do Son Water Supply System and adjacent areas** - Rehabilitation and conversion of Do Son Water Treatment Facility into a pumping station, with 12km of transmission main and 19,000 new connections.

14. The 4 project components selected for this PPTA and the future loan implementation will support poverty reduction/pro-poor growth, support for women and children, employment generation, improvement of living and ecological environment, proactive approach to environmental management, and sustainable development. The Project also provides for institutional development and capacity building of HPWSCo for long-term efficient implementation, Operation, and Maintenance of the system.

15. This project will address the full cost recovery of tariffs to achieve long term financial sustainability of the improvements, which would also be critical to consider in carrying this project forward.

16. The total preliminary project investment cost as estimated is about US\$61.15 million. It is assumed that HPWSCo would borrow 74.7% of the project cost from ADB, and 25.3% from local sources. Within the local sources, it is expected that 21.56% would be borrowed from the Central/Provincial Government, while 78.44% would be from HPWSCo's self funds.

17. HPWSCo is the Executing Agency (EA) for this PPTA. A Project Leading Group (PLG) and a Project Management Unit (PMU) have been established. HPWSCo and the TA consultants work closely with the local government agencies and stakeholders to ensure success of the PPTA and the future implementation work, with a view to achieving the benefits that the project would bring to the population in the area.

18. Post PPTA, it is planned that the subsequent project will be implemented over a total period of 7 years, with June 2011 to June 2012 for the detailed technical design, while bidding for the 3 construction packages would span from June 2012 to April 2016. The implementation of the 4 project components would be from June 2013 to May 2018.

Project Benefits, Impacts, Assumptions and Risks

Social Assessment and Safeguards

19. This project spans eight urban and peri-urban districts within the City of Hai Phong. Ultimately, it will benefit a population of about 1,000,000 and approximately 220,000 connections with sustainable access to safe drinking water on an around-the-clock basis. The project will be directly responsible for providing almost 60,000 new household connections. All four project components, through new and rehabilitated water treatment plants and transmission/distribution network, will enable HPWSCo to connect up more unserved households and improve the quality and quantity of water to existing connected households, businesses, and industrial zones.

20. Through the project's new and rehabilitated connections and HPWSCo increased capacity, the project will reduce the vulnerability of poor households to unnecessary hardship, illness, and disease, while improving the overall health and environment of the City of Hai Phong City. The project also contributes to Viet Nam's achievements of the UN Millennium

Development goals (particularly Target 10 related to sustainable access to safe drinking water, but also other poverty-related target indicators), the country's 5-Year Socio-economic Development Plan, and ADB's Country Partnership and Strategy.

21. Some negative impacts are expected as a result of the project. This project qualifies as "Category A" because of the significant number of people for which agricultural land will be acquired from to build the new two water treatment plants and booster pumping stations in Northern part of Cam River and Kim Son project component areas. The other two project components of Do Son and An Duong do not involve negative social impacts on people as there will be no land acquisition; all rehabilitation and conversion work is done on land that is either currently used by these existing water treatment plans or is within the walled property of the plant and not being used by others or even unofficially permitted for other uses. The issues at Northern part of Cam River and Kim Son project components will be addressed through separate planning documents that outline mitigation measures and proper compensation and resettlement.

22. The Social Development Strategy for the project involves four main components: (i) capacity building of the EA's Customer Relations Department and key stakeholders; (ii) consultation and participation; (iii) education, information, and communication, which calls specifically for the use of behavioral change communication; and (iv) possibly an output-based aid component. The strategy focuses on increasing connection rate of poor and vulnerable households to ensure equitable benefits from the project and also focuses on improving general hygiene awareness.

Resettlement

23. The project qualifies as "Category A" because of the significant number of people (approximately 1,200) for which agricultural land will be acquired from to build the two new water treatment plants and booster pumping stations in the Northern Cam River and Kim Son project component areas. The resettlement-associated impacts and mitigation measures are addressed, in detail, in a separate planning document. The other two project components of Do Son and An Duong do not involve negative social impacts on people as there will be no land acquisition; all rehabilitation and conversion work is done on land that is either currently used by these existing WTPs or is within the walled property of the plant and not being used by others or even unofficially permitted for other uses. All transmission mains and pipelines are aligned according to existing rights of way (beneath exist roads).

Financial Aspects

24. The financial analysis of the Project and its project components have been based on cost estimates included in the Feasibility Study and Basic Design Reports. Examination of the EA's financial position to assess its ability to provide counterpart funds for the implementation of the project, cover O&M costs of the improvements, and to repay the ADB loan; plus examination of central/provincial government's finances to provide funds for counterpart contributions to project costs are being conducted under this project.

25. Meetings have been held with the EA's Accounting and Financial Department. Cost estimates have been completed based on the Basic Design of the project components. Financial analysis of the project components and the financial management assessment of HPWSCo have been completed as well.

26. The preliminary project investment cost is estimated to be about US\$61.15 million. The project is envisaged to be funded up to 74.7% by way of a loan provided by ADB to the Government of Viet Nam. The balance of the Project cost will be met by the HPWSCo self funds (19.8%) and the Central/Provincial Government (5.5%).

27. From the initial analysis of the FIRR and WACC, it has been shown that for 4 project components and overall project, the FIRRs are greater than WACCs. Hence, this indicates that the projects are financially viable. From the sensitivity analysis, the FIRR was most sensitive to a

reduction in incremental revenues derived from the water tariffs. Tariff revenues may be lower than that forecast as a result of a failure to increase tariffs to the proposed levels, which may arise from a limited willingness to pay and/or a lower rate of connection to the piped water system than assumed.

28. From the preliminary analysis of the current tariff levels and structures, and the projected funding requirements for the project components to be implemented, tariff increases and new tariff structures have been developed and are proposed to be implemented every three years beginning in 2009.

Economic Aspects

29. The economic analysis covers both the Project as a whole, and the individual key project components. For the Project as a whole, the analysis covers the rationale for public intervention; the goals of the investment plan, and the general design of the plan, including selection criteria for project components. The economic analysis then evaluates the typical key project components relative to the selection criteria, focusing on the least-cost analysis. During the design of the project components, alternative locations, layout, alignment, and specifications for the improvements will be considered within the project area.

30. Preliminary economic analysis for the 4 project components have been completed. Preliminary economic assessment models were prepared for the 4 project components. Technical alternatives considered for the project components have been reviewed and the least cost options were determined. The least-cost analysis ensures that each project component is optimally designed both to meet the goals of the project component and does not involve unnecessary extra costs.

31. The economic viability of each project component were determined using the economic internal rate of return (EIRR) as the principal quantitative measuring tool. The EIRR were estimated by comparison of “with- project component” and “without-project component” scenarios. The overall project has a EIRR of 17.93%, while the individual project components have their EIRRs at 12.44-24.04%. This indicates that the overall project as well as the project components are all considered economically viable with the calculated EIRR higher than 12%, the social discount rate as prescribed by ADB.

32. While a sensitivity analysis was done to the EIRR, it was shown that the Project was most sensitive to delays in project completion. The net economic benefits of the Project to the poor are being compared against the net economic benefits of the Project to the economy with a poverty impact ratio of 0.43.

33. The gains and losses to different stakeholders of the Project are determined by the difference between financial and economic benefits and costs (at a discount rate of 12 percent). These gains and losses in part compensate for each other with the net gain being positive and equal to the economic NPV, which is D391,457 billion for the overall Project.

Environmental Aspects

34. Based on the findings of the IEEs for the four project components, the classification of the Project as Category “B” is confirmed under the ADB Guidelines. The adverse impacts that will arise from the implementation of all project components will generally be minor, or moderate for a few of them; and measures to mitigate them can be provided and instituted without difficulty. For Category “B” projects, the ADB requires IEEs for each project component be prepared.

35. On the Vietnamese Government side, Environmental Protection Commitment Documents are needed for three out of the four project components (Kim Son, Northern part of Cam River, and Do Son), which are classified as category “II”. While a full EIA is needed for the An Duong project component due to its capacity expanding beyond 50,000 m³/day, and is considered a category “I” under the Vietnamese regulations.

36. In line with ADB requirements, 4 Initial Environmental Examinations (IEEs) and Environmental Management Plans (EMPs) have been prepared for the 4 project components and are presented herewithin.

37. The TA Consultants in coordination with the EA and local government agencies will organize and conduct public consultation activities, including on-site consultation with affected communities within the project component areas. The consultation workshops will allow the area residents voice their concerns and the TA consultants answer any questions they might have on the project. These face-to-face meetings would allow the TA consultants fine-tune the environmental management and mitigation plan, if needed, of which customarily fits the needs of the area residents.

38. *Project Benefits, potential impact, and mitigation measures:* The operation of the proposed project components, will bring about numerous socio-economic benefits that will far outweigh all aforementioned adverse impacts: i) improved, convenient access by residents and social and economic activities to reliable supply of safe, potable water in both the urban center and peri-urban areas; ii) enhanced environmental sanitation and public health (with 24-hour supply of safe potable water); and iii) induced urban development and socio-economic growth in the suburban areas leading to the opening up of income and employment opportunities and improvement of the local economy of Hai Phong.

39. The project will apply technologies that are deemed feasible and sustainable in developing countries. More importantly, these are technologies that the HPWSCo is highly familiar with. The IEEs have revealed that: i) the inherent features of the project component sites do not pose any significant constraints; ii) it is unlikely for the Project to cause significant, irreversible adverse impacts on the environment; iii) the adverse impacts that will potentially arise will generally be minor to moderate, and significant for a few; iv) the measures to mitigate adverse impacts can be provided and instituted without difficulty through proper engineering design and environment-friendly management of construction activities and operation; v) the adverse impacts will be greatly offset by the benefits that will be derived from the Project; and vi) full environmental benefits may be obtained from the Project with efficient environmental management and monitoring, prior to construction, during construction and during operation.

Institutional Aspects

40. The objective of institutional development for the Executing Agency (EA) is to ensure that the organization will have the capacity to implement the Project, and to operate and maintain all the project components efficiently so that the project benefits can be sustained in the long term. It is anticipated that institutional development will also enhance the overall capability of the EA and in the future implementation and management of the project project components.

41. The institutional analysis involves a review of the overall project implementation arrangement and the key project implementation tasks to comply with Vietnam practices and ADB procedures in regards to project management, procurement of works and equipment, financial management, environmental management and social safeguards. The organizational structure and capacity of the EA to plan, implement, and maintain the project project components were assessed, and a separate procurement capacity assessment was also conducted. The governance and management systems for water supply systems in the City of Hai Phong and Vietnam as a whole have also been reviewed. Institutional development needs have been identified and a capacity building programme with the corresponding Terms of Reference (TOR) for the parallel implementation of improvements in the future have been formulated.

42. HPWSCo currently has a twinning program with the Yarra Valley Water Utility in Victoria, Australia through an ADB-funded water utilities partnership program, and another twinning arrangement with the Kitakyushu Waterworks through the Japan International Cooperation Agency (JICA) partnership program. Those programs will assist the HPWSCo to develop its expertise and capacity in several areas. The Capacity Building work to be carried out under this ADB project will complement these 2 twinning programs already in place and bring HPWSCo to another level.

43. This institutional assessment has found that HPWSCO's reputation as one of the country's leading water supply companies is well founded. It clearly is a well run mature company. HPWSCO is fulfilling successfully its mandate from the HPPC. It has a knowledgeable, well educated, motivated executive team and a capable middle management. The company enjoys a stable workforce; and although overstaffed, most employees participate in ongoing training programs to strengthen the skills required to fulfill their position responsibilities. HPWSCO is compliant with national water quality standards. It plays an active role in professional associations. Its organizational competencies are reflected in the consistently high marks it receives in customer satisfaction surveys.

44. Based on this assessment, it is concluded that there are no major institutional or organizational capacity barriers that would prevent HPWSCO from satisfactorily constructing and managing the planned ADB-funded assets.

45. The company has many of the essential policies, practices and systems in place to meet its existing operating requirements; however, HPWSCO could strengthen its operations by upgrading its current policies, practices and systems; exploiting available technology, and enhancing the company's human capital through a comprehensive training plan. The proposed Performance Improvement Plan (PIP) described in Supplementary Appendix 6 seeks to address this broad goal. It is recommended that the company review, refine and implement the proposed PIP.

Project Risks and Mitigation Measures

46. Where appropriate, conventional engineering designs with proven records of reliable performance are adopted for the system improvements, for which there should not be any unexpected difficulties or problems. The major engineering risks are related to geotechnical and subsurface issues. The current TA Consultants and the consultant during project implementation will support the EA to ensure that major engineering risks will be handled properly.

47. The following risks could affect timely implementation, economic viability and realization of benefits of the Project:

- (a) With 4 project components located in different districts/wards of the City, create a special need for proper coordination to avoid delays and ensure consistency during the design, bidding, and implementation phase;
- (b) Failure to implement institutional strengthening for effective project implementation and management;
- (c) Lack of proper Operations & Maintenance of project facilities;
- (d) Major amendments and changes to the master plans in the project component districts/wards;
- (e) Delay in the provision of counterpart funding;
- (f) Failure to establish or increase water tariffs to meet cost recovery targets, and
- (g) Unforeseen land acquisition and resettlement issues, which could constrain the efficient implementation of the project works and restoration of livelihoods of APs.

48. Risks (a), (b) and (c) will be mitigated through provision of institutional capacity building for the EA and project component districts/wards with support of the loan implementation consultant. Risk (d) will be mitigated by synchronization of the project design and implementation schedules with other projects planned. Risks (e) and (f) will be mitigated through covenanted assurances from the project component district/ward governments on the provision of counterpart funding and on regular tariff reviews and increases. Risk (g) will be mitigated by strengthening of the internal monitoring and supervision by the EA and project component district/ward

governments, and by engagement of a qualified external agency to monitor and evaluate resettlement.

49. Environmental risks include (a) that the city/districts will not identify drinking water source protection zones in order to avoid the legal obligation to manage and monitor pollution sources; and (b) that the additional volumes of wastewater created as a consequence of the provision of new water supply will not be properly managed and create pollution problems for downstream surface and groundwater resources. Risk (a) will be mitigated through covenanted assurances from the EA and District/Ward governments on the establishment of water source protection zones. Risk (b) will be mitigated through assurances, covenants and other avenues; and that wastewater collection and treatment measures appropriate to the location, scale of development, and resources of the city/district authorities will be provided.

Specific Assurances

50. Assurances that will be incorporated into the legal documentation of the Loan and Project Agreements cover engineering and technical issues, design and construction quality and management, O&M of Water Supply Systems, implementation and institutional arrangements, training, counterpart funding, tariffs and cost recovery, financial management, financial performance, change in ownership, governance and anticorruption, employment and labor standards, gender and social inclusion, women participation, public awareness and education, poverty and social development strategy, land acquisition and resettlement, and environment.

APPENDIX 4: PFR2 Sub-Project Buon Ma Thuot

EXTRACT FROM TECHNICAL REPORT SECOND VIETNAM URBAN WATER SUPPLY DEVELOPMENT PROJECT - DAK LAK SUB-PROJECT - BUON MA THUOT

Prepared under World Bank

Introduction

Buon Ma Thuot city is the capital of Dak Lak province in the Central Highlands of Vietnam. The city is the administrative, economic, social and cultural center of the province and is the regional hub of the Central Highlands. It is a center of trade, plays a key role in national security and defense, and is a human resource training center for the Central Highlands and Central Coast areas.

Buon Ma Thuot City is located on Highway 14 which links it with Pleiku, Kontum, and Da Nang (400km) to the north, and with Dak Nong, Binh Phuoc, Binh Duong and Ho Chi Minh City (350km) to the southwest. National Highways 26 and 27 link Buon Ma Thuot City to Nha Trang City (198km) and Da Lat City (193km) respectively.

Buon Ma Thuot City's economy has grown rapidly since the mid-1980's. The city's economy and population are expected to grow steadily over the next 10 years. The Socio-economic Development Plan for Buon Ma Thuot City to 2025 envisages that the city will become a modern Class 1 City by 2015. In order to meet this objective, substantial investment will be required to improve and expand the city's technical infrastructure. In particular, the city's water supply system is unreliable and is unable to meet the city's demand for safe, piped water. Inadequate groundwater supply in the dry season poses a major constraint to the continuing socio-economic development of the city.

The objective of the proposed Buon Ma Thuot Sub-project is to improve the living conditions and economic potential of residents and create favorable conditions for socio-economic development of Buon Ma Thuot City. This objective will be achieved by improving and expanding the existing piped water supply system to meet the city's forecast water demands to 2020. The sub-project will also assist the city to fulfill its role as a provincial center, and gain Class 1 city status.

Key Indicators of Buon Ma Thuot Water Supply System, 2008

Parameter	Units	Value
Water Production	m ³ /day	34,849
Water Sales	m ³ /day	24,586
Domestic Consumption	m ³ /day	18,536
Non-revenue Water (NRW)	%	29
WTP Capacity	m ³ /day	49,000
WTP Utilization	%	71
Total Connections	No	38,005
Domestic Connections	No	36,807
Ratio Total/Domestic Connections	No	1.03
Town Population	No	329,290
Service Area Population	No	329,290

Parameter	Units	Value
Persons Served	No	176,670
Coverage for Town	%	54
Domestic Consumption	L/capita/day	105
Staff	No	243
Staff/1000 Connections	No	6.4

Note:

1. Source: Technical and Finance Departments of PWSC, 2008 data.
2. In dry periods, the groundwater sources can only supply 40% of their combined production capacity.

Necessity for Investment

Buon Ma Thuot's piped water supply services are unable to meet the city's growing demand for clean piped water. The city's two groundwater sources have 49,000m³/day combined capacity and produced an average of 35,000m³/day in 2008. However, in dry years (e.g. 2003 and 2005), the output of the PWSC's groundwater system falls to only 19,500-20,300 m³/day in the driest months, causing water shortages throughout the city. Water shortages have occurred at the end of the dry season in every year since 2003.

In 2008, household coverage was only 54% due to inadequate production capacity in dry years and the limited extent of the distribution network which covers about 77% of the urban wards and 12% of the communes. Only four communes (out of eight communes) have access to WSC piped water. Households in three outer communes (representing 8% of the total households in the city) have access to rural water supply schemes.

About 38% of households in Buon Ma Thuot are forced to water from less safe and less reliable sources such as drilled or dug wells. The increasing use of groundwater for irrigation is having adverse impacts on household wells, which often dry up in the dry season.

The population of Buon Ma Thuot City is expected to grow steadily over the next 10 years as a result of natural growth and in-migration encouraged by continuing economic growth in all sectors. Based on the consultant's estimates, Buon Ma Thuot faces an increasing gap between dependable piped water supply capacity and water demand. By 2020, the supply-demand gap is expected to reach 35,000 m³/day (i.e. 70,000-35,000 m³/day) in years having average rainfall and 50,000m³/day in drought conditions.

Substantial Investment is required urgently in new raw water facilities, treatment capacity, water transmission and distribution network to address the rapidly widening supply-demand gap and minimize water shortages that occur in most years. The proposed sub-project investment in water supply infrastructure is needed to improve living conditions and health profiles of the urban residents and create favorable conditions for economic development. It will support the role of Buon Ma Thuot City as the economic, industrial, administrative and service center of Dak Lak province and the regional center of the Central Highlands provinces. It will also assist Buon Ma Thuot to achieve its development objective of becoming a Class 1 City by 2015.

The Buon Ma Thuot sub-project is also expected to improve the financial sustainability and operational efficiency of the PWSC by expanding the customer base, building capacity and adopting appropriate cost-recovery mechanisms and tariffs.

Investment Form and Scale

Sub-project Objective

The overall objective of the Buon Ma Thuot sub-project is to improve the living conditions, health and economic potential of residents, and enhance the role of the city as the economic, administrative and service center of Dak Lak province. The specific objectives are to improve access, quality and reliability of piped water supply of Buon Ma Thuot city and meet its forecast water demands to 2020.

These objectives will be achieved by:

- developing a new raw water source, constructing a new water treatment plant and water transmission mains, and expanding the existing distribution network, and;
- strengthening the capacity of the provincial water supply company to make its operations more efficient and sustainable.

Sub-project Service Area

The existing service area covers parts of all 13 urban wards and 4 communes. The proposed sub-project service area will extend the service area to all 8 communes, including 4 communes to the south, southeast and southwest of the city center that have no PWSC piped water at present.

Identification of Water Demand

Water demand forecasts for the proposed service area were prepared by estimating the various components of demand – domestic, commercial, small scale industry, and public use, based on Standard No TCXDVN 33-2006.

Domestic water consumption forecasts were based on population projections, per capita consumption and coverage targets. Forecast consumption of commercial, small scale industry and public facilities were calculated as a % of domestic consumption.

Buon Ma Thuot City's annual population growth rate in 2004-08 was about 1.28%, comprising natural and physical growth rates of 1.18% and 0.1% respectively. The Revised General Construction Plan for Buon Ma Thuot to 2025 uses overall urban growth rates of 2.9% per year and physical urban growth rates of 1.8%. The growth rates adopted by the Master Plan appear to be somewhat high for a city such as Buon Ma Thuot and are more than double the city's historical growth rates. Following discussion with the PWSC, it was agreed to base the population forecasts on the Y2008 population and growth rate extrapolated from historical data, in order to avoid the possibility of overinvestment in the water system and associated high tariffs. Therefore the population forecasts were based on Y2008 city population of 329,290, and average annual population growth rate of 1.28%.

As Buon Ma Thuot is striving to become a Class I city by 2015, water consumption standards for various sectors in the city were based generally on standards for Class I city in TCXDVN 33-2006. Also local conditions were taken into account to identify appropriate water consumption levels and avoid overinvestment without effectiveness.

Required Water Supply Capacity

The required water supply capacity for Buon Ma Thuot City is 70,000m³/day by year 2020. The assessed yield of the existing PWSC bores and artesian wells for planning purposes is 35,000m³/day. Therefore it is proposed to construct a new water supply scheme for Buon Ma Thuot City with 35,000m³/day capacity using raw water from a surface source. The existing distribution network will be rehabilitated and expanded.

Technical Proposal

Arrangement of Water Treatment Plant and Transmission Pipelines

The intake structure will be located on the Srepok riverbank in Quynh Ngoc 1 hamlet, Ea Na Commune, about 6km upstream of Buon Kop Dam spillway. The proposed site has a straight riverbank, stable slope, and good geological conditions, with relatively flat topography. It is a convenient site for constructing the intake structure and raw water pump station. At this location, the elevation of the maximum, minimum and average water level are estimated to be + 415m, + 411m and + 412m respectively, and the bank level is about + 420m elevation.

The intake will comprise a concrete structure with trashrack. Raw water will be conveyed by a short length of gravity pipeline to the raw water pumping station constructed on the riverbank, with three submersible pumps (2 duty and 1 standby). It is recommended that the intake and pumping station would be designed for development in two stages. The building and civil works would be designed and constructed for Stage 2 with 70,000 m³/day capacity, while mechanical and electrical equipment would be installed for Stage 1: 35,000 m³/day capacity. This would enable the intake and pumping station to be easily duplicated in future to 70,000 m³/day total capacity without causing damage or disruption to the operating facilities.

A 5km long DN700 (PN10) HDPE raw water transmission pipeline will deliver up to 35,000m³/day of raw water from the pumping station to the WTP. The pipeline route would be installed in the corridors of the existing Quynh Ngoc hamlet road and Provincial Road No.2.

Water Treatment Plant

The proposed WTP will be constructed on elevated land in Tan Lap hamlet, Ea Na commune, Krong Ana District, about 5km north of the raw water intake site. The selected site belongs to Tan Lap commune and is under cultivation. About 1.5 ha of land would be acquired, sufficient to construct Stage 1 and Stage 2 WTPs with 70,000m³/day total capacity.

The 35,000m³/day water treatment plant will be designed to supply treated water quality complying with the water quality standards of Ministry of Health Circular No. 04/2009/TT-BYT and Decision No QCVN 01:2009/BYT, the National Technical Regulation on Drinking Water Quality.

The raw water from Srepok River will require chemical dosing, coagulation, sedimentation, filtration and chlorination. The recommended process is shown in Option 1: Figure 4-1. This process is modern, cost-effective, relatively simple to operate, and is becoming widely used in provinces throughout Vietnam. PWSC staff will require capacity building for operation and control of the new WTP. A 1,500 m³ capacity treated water reservoir will be constructed at the WTP site, with top water level +466m elevation.

Transmission and Distribution Network

The distribution network will be divided into three zones as follows:

- Zone 1 – will be supplied by the groundwater sources. It will include the northern wards, parts of the southern wards and communes in the north, northwest and northeast of the city;
- Zone 2 – will be supplied by the booster pumping station. It will include parts of the southern wards, and the communes in the southwest and southeast of the city;
- Zone 3 –will be supplied by gravity from the gravity transmission main between the WTP and booster pumping station. It will include four communes in the south of the city.

The boundaries between Zone 1 and Zone 2 may change from time-to-time, depending on the quantity of water available from the groundwater sources.

Treated Water Gravity Transmission Main from WTP to City

A 13.5km long gravity transmission main will be constructed to deliver treated water from the treated water reservoir to the city. It will comprise:

- a 7km long DN700-HDPE transmission main along provincial road No.2 to Dong Tam junction, followed by;
- a 6.5km long DN600-HDPE gravity transmission main to the booster pumping station located in Ea Tam Ward of Buon Ma Thuot City. The final section of gravity transmission main will supply up to 32,000m³/day to the reservoir at the booster pumping station. (i.e. 35,000m³/day less 3,000m³/day for offtakes).

The following branch pipelines from the transmission main will supply treated water to the southern communes:

- A DN150 branch pipeline from the DN700 gravity transmission main near Dong Tam junction will supply up to 1,500m³/day to Hoa Phu and Hoa Xuan communes;
- One DN150 and two DN100 offtakes from the DN600 gravity transmission main will supply up to 1,500 m³/day to Hoa Khanh and Ea Kao communes

Booster Pumping Station and Reservoir

The booster pumping station and reservoir will be constructed near the Buon Ma Thuot radio station in Group 6, Quarter 11, Ea Tam Ward. The concrete storage reservoir will have 5,000 m³ capacity, with top water level at elevation + 410 m. The booster station will have three pumps (2 duty and 1 standby), sized to supply the peak hourly design flow.

Transmission and Distribution Network

The booster station will pump directly into the transmission and distribution network. 1.3km of DN600-DI transmission main and 4.7km of DN500-DI distribution pipeline will be constructed from the booster pumping station to connect with the existing pipeline along Mai Hac De street (the elevation at the connection point is about + 464 m, and the residual pressure is from 15m to 20 m)

Distribution pipelines will be designed to meet the peak hourly demand, with minimum residual pressure of 10m at the extremity of the distribution network.

Distribution pipes will be installed along both sides of main streets and along alleys to convey water to residential areas. To minimize land acquisition and compensation, pipelines will be installed in footpaths or along the roadside at 0.7m-1.0m depth subject to local conditions. Fire hydrants will be installed on distribution pipes of DN100-150 at 300m maximum intervals.

SCADA System

A SCADA (Supervisory Control and Data Acquisition) will be used to monitor and control the water supply system. The PWSC's existing SCADA system will be relocated to a new control center that will be established at the booster pumping station site.

Scope of Water Supply System Development

Intake Facilities and Raw Water Pipeline:

- Construct raw water intake and 2 raw water intake pipelines between the Srepok riverbank intake and the raw water pumping station. The pipelines will be designed for

Stage 2 with 70,000m³/day capacity. Features of each pipeline are: DN700, L = 100m, V = 1.26 m/s, i = 1.66‰ .

- Construct raw water pump station civil works for 2 stages with 70,000m³/day capacity. Install pumps and other mechanical and electrical equipment for Stage 1 only, with 35,000m³/day capacity. Install 3 submersible pumps (2 duty and 1 standby). Capacity of each pump is Q = 730 m³/h, H = 75m. Pump elevation is +410m, water level of WTP mixing tank is at elevation +475m.
- Construct DN700-HDPE raw water transmission pipeline, 5km long, with capacity 35,000m³/day. V = 0.75m/s, q = 405/s, H = 75m, i = 1.66‰
- Construct 1km power line (from 22kV line) and 630kVA transformer station.

Water Treatment Plant - 35,000 m³/day:

- Construct 3 mechanical flocculation tanks: Detention time 20 minutes. Capacity of each tank is 180 m³, dimension of each tank is W x L = 5m x 9m, usable depth is H = 4m. Each basin will provide three stages of flocculation, with gradients equivalent to the following: G1 = 60 s⁻¹, G2 = 45 s⁻¹, G3 = 25s⁻¹.
- Construct 3 lamellar sedimentation tanks. Dimension of each tank is W x L x H = 5m x 20m x 4,5m. The detention time is 60 minutes; working load is 8 m³/ h.m². Flushing of sedimentation tank is automatic.
- Construct 4 rapid filter tanks: The average filtering speed v = 6m³/ h.m², strengthen filtering speed v = 9,5m³/ h.m², filtering total area is 50 x 4 = 200 m², the depth of sand filter material is H=1,3 m (quartz sand);
- Construct backwashing facilities: Backwash pump: 1 pump (flow: 24 m³/ h.m²) Q = 1.200 m³/h, H = 10m. Backwash blower: 1 blower (60 m³/ h.m²) Q = 3000 m³/h, H = 4m.
- Construct treated water reservoir, with capacity W = 1,500 m³. Dimension of the tank A x B x H = 20m x 20m x 3.8m.
- Build chemical house: The chemical house will be combined with lime and alum storage house. Building dimensions are 18m x 9m. Alum mixing tank: (2 tanks), capacity of each tank is W = 6m³, 2 alum dosing pumps Q = 1m³/h, H = 20m. Lime mixing tank (2 tanks), capacity of each tank is W = 6m³, 2 lime dosing pumps Q = 1m³/h, H = 20m.
- Construct chlorine house, dimensions 16m x 8m. Install 2 chlorinators of 0-4kg/hr (1 duty and 1 standby); 3 chlorine cylinders each of 1 ton capacity; water for chlorination ejector is supplied from service water pumps. In order to integrate service water of lime and alum system, install 3 service water pumps: Q=3m³/hr, H=35m.
- Construct sludge settling ponds: (for settling and drying): 3 ponds each with dimension of 12mx28m, and 1.5m deep.
- Install backwash recycle system: It will include a concrete recycle tank with dimension 7mx7mx3.5m. Water will be recycled by a submersible pump to the WTP flow receiving and distribution tank.
- Install SCADA system for monitoring and control of the WTP, pumping stations and pipe network

Gravity Treated Water Transmission Main:

- Construct gravity treated water transmission main: 7km long DN700-HDPE and 6.5km DN600—HDPE from WTP to the booster pumping station in the city;
- Construct DN150 branch pipeline at Dong Tam junction with offtakes to supply up to 1,500m³/day to Hoa Phu and Hoa Xuan communes;

- Construct one DN150 and two DN100 branch pipelines from the DN600 gravity transmission main to supply up to 1,500 m³/day to Hoa Khanh and Ea Kao communes.

Booster Pumping Station

- Construct 5,000m³ reservoir at booster pumping station site. Reservoir dimensions are A x B x H = 40m x 32m x 4m, with 2 compartments.
- Construct booster station: install 4 pumps, 3 working pumps, 1 standby pump (equipped with VSD). Capacity of each pump is Q = 625 m³/h (Khour = 1.5), H = 70m.

Transmission and Distribution Mains

HDPE pipes Class PN10 are recommended for large transmission pipes outside the urban area (13.5 km) and for pipes with diameter ≤ 300 (183 km). DI pipes with cement mortar lining are recommended for DN500 transmission mains within the urban area (6 km).

Quantities of New Transmission and Distribution Pipes

Pipe Type and Diameter	Unit	Length
HDPE – DN700 transmission	m	7,000
HDPE – DN600 transmission	m	6,500
DI – DN600 transmission	m	1,300
DI – DN500	m	4,700
HDPE - DN300	m	2,000
HDPE - DN200	m	8,000
HDPE - DN150	m	53,000
HDPE - DN100	m	80,000
HDPE - DN50-90	m	40,000
TOTAL		202,500

Land Use Demand and Compensation

The intake structure, raw water pump station and auxiliary works (such as access road, transformer station, fences gates, guardhouse, internal roads) will be located on about 1,000 m² of land on the riverbank, near Quynh Ngoc sand bank, Quynh Ngoc 1 hamlet, Ea Na commune in Krong Ana district. The site is uncultivated public land and no land acquisition will be required. Compensation may need to be paid for sand that has been stockpiled temporarily on the riverbank for use in other areas.

The raw water transmission pipeline between the raw water pump station and WTP will be installed in the technical corridors of existing roads. The transmission pipeline from the WTP to the city will be installed in the corridor of the west belt road which is under construction.

The water treatment plant will be developed on about 15,000m² (1.5 ha) of private land in Tan Lap hamlet, Ea Na commune, Krong Ana district. The topography of this area is flat and even, and is convenient for construction work. Most of this site is agricultural land which is used for corn and coffee cultivation. There are no buildings or structures on the site. Compensation will be required for loss of land, crops and trees.

The booster pumping station, reservoir and auxiliary works will be constructed on 3,000 m² of private land area belonging to people in Group 6, Quarter 11, Ea Tam ward. The topography of this area is flat and even. The site is used for growing coffee and has one small temporary guard house. Compensation will be required for loss of land, coffee crops and one temporary structure.

To minimize compensation and land acquisition, most transmission main and distribution pipelines will be installed on public land in footpaths or road corridors

Total land area required for the water supply sub-project is 19,000 m² including 1,000m² of public land. It will be necessary to acquire 18,000m² of private land.

Cost Estimate and Capital Investment

Summary of Cost Estimates

The total estimated direct cost of the Buon Ma Thuot Sub-project is US\$ 19.82 million (equivalent to VND 357 billion) excluding consultants, PPMU costs, CPU costs and contingencies. The estimated overall investment cost is US\$25.87 million (equivalent to VND 466 billion)³. The estimated direct cost per unit of new capacity is US\$566/m³/day (equivalent to VND 10.19 million /m³/day).

³ Based on exchange rate of US\$1.00=18,000VND in September 2009.

Preliminary Cost Estimate for Buon Ma Thuot Sub-project

No	Item	Unit	Quantity	Rate US\$	Amount incl tax US\$000's
1	Raw Water Facilities				3,600
	Raw water intake & pumping station (35,000m ³ /day)	Sum	1	1,230,000	1,230
	Power supply - transformers, cables, controls	Sum	1	100,000	100
	HDPE - DN640 raw water transmission pipeline	m	5,000	454	2,270
2	Water Treatment Plant (35,000m³/day)				2,747
	Flow distribution tank	Sum	1	95,000	95
	Flocculators & sedimentation tank	Sum	1	730,000	730
	Rapid sand Filter	Sum	1	710,000	710
	Reservoir (1,500m ³)	Sum	1	235,000	235
	Chemical house	Sum	1	135,000	135
	Admin house	Sum	1	50,000	50
	Backwash water recycle tank, sludge drying bed	Sum	1	172,000	172
	Backwash water pumping station	Sum	1	160,000	160
	Gate, fence, internal road	Sum	1	210,000	210
	Power supply - transformers, cables, controls, SCADA	Sum	2	250,000	250
3	Booster Pumping Station				1,186
	Reservoir (5,000m ³)	Sum	1	654,000	654
	Booster pumping station	Sum	1	357,000	357
	Ancillary works and internal roads	Sum	1	40,000	40
	Power supply - transformers, cables, controls	Sum	1	135,000	135
4	Transmission and Distribution				12,220
	HDPE - DN700 transmission main	m	7,000	454	3,178
	HDPE - DN600 transmission main	m	6,500	314	2,041
	DI - DN600 transmission main	m	1,300	454	590
	DI - DN500 distribution main	m	4,700	337	1,584
	HDPE - DN300	m	2,000	75	150
	HDPE - DN200	m	8,000	48	384
	HDPE - DN150	m	53,000	33	1,749
	HDPE - DN100	m	80,000	21	1,680
	HDPE - DN 50-90	m	40,000	10	400
	Hydrants DN100	set	200	1,200	240
	Service connections including meters	No	2,800	80	224
5	Land Acquisition and Compensation				69
	Intake and raw water pump station	Sum	1		10
	Water treatment plant	Sum	1		37
	Transmission and distribution pipelines	Sum	1		10
	Reservoir and booster pumping station	Sum	1		12
	Sub total A: (1+2+3+4+5)				19,822
6	Project Management Costs				885
	PPMU Operating Costs	Sum			261
	PPMU Equipment	Sum			15
	Project Preparation, Design and Supervision	Sum			535
	Other Costs ⁴	Sum			74
	Subtotal B: Base Costs (A+6)				20,707
7	Contingencies				5,162
	Physical Contingencies (10%)				2,071
	Price Contingencies				3,092
8	Total Estimated Sub-project Cost(B+7)				25,870

Notes:

Above estimate includes taxes and duties estimated at US\$2.32 million.

"Other costs" include topographic & geotechnical surveys.

APPENDIX 5: PFR2 Sub-Project Quang Tri Province

EXTRACT FROM Pre-feasibility study of the water enhancement project in Quang Tri province (Dong Ha, Trieu Phong, Gio Linh and Cam Lo districts),

Prepared under French bilateral cooperation

SUMMARY

This report presents the pre-feasibility study of the water enhancement project in Quang Tri province.

It follows on from the last Monitoring Committee meeting in Paris in December 2009 on the study's Master Plan phase, and includes recommendations and the Consultant's visit to Dong Ha at the end of February 2010 so as to finalise the study.

CURRENT CONDITION OF THE WATER SUPPLY SYSTEM IN DONG HA

The water supply network in Dong Ha provides drinking water to the town of Dong Ha (category 3 provincial town) and to some small neighbouring towns (Cua Viet and Gio Linh) with a total population of approx. 97,000 inhabitants (16,848 household connections).

The Dong Ha water supply system has two water treatment plants:

- The Tan Luong treatment plant, whose design capacity is 15,000m³/day and which uses surface water from the Vinh Phuoc River.
- The Gio Linh treatment plant, whose design capacity is 15,000m³/day and which uses ground water from the Gio My boreholes (there are 11 in total).

At present, average production is 21,000m³/day (14,000m³/day at the Tan Luong treatment plant and 7,000m³/day at the Gio Linh treatment plant) and it has been planned that the Gio Linh plant's production gradually increases to reach its design capacity in order to meet increasing water demand.

The Vinh Phouc water intake and Tan Luong treatment plant were built in 1977 and both the civil engineering structures and the equipment are in bad condition. However, despite some operating difficulties, the treated water complies with the quality criteria as defined by the Ministry of Health.

The Gio My boreholes and Gio Linh treatment plant were built in 2005 and both the civil engineering structures and the equipment are in good condition. The ground water coming from the boreholes is of good quality and the treatment plants' process mainly consists of removing the iron content. The treated water complies with the quality criteria as defined by the Ministry of Health.

The Dong Ha water supply network also includes the Song booster pumping station which enables service pressure to be maintained in the town of Dong Ha at peak times and to supply the town of Cua Viet. The Song booster pumping station was built at the same time as the Gio Linh treatment plant, in other words in 2005, and is in good condition.

The Dong Ha water distribution network was mainly built between 1977 and 1984 and, despite partial rehabilitation works having been carried out since 2003, it is still in bad condition with a

physical water loss rate of more than 45%. The pipelines, whose diameters are greater than or equal to 100mm (DN100 to DN500), are estimated to have a total length of 78km. In general, information on the distribution network is not widely known, whether it be detailed data on the pipelines (diameter, material, age, condition, etc.) or its operation (flow measurements, loss rates per area, etc.).

STUDY OF THE WATER DEMAND

The demographic forecast is based on two growth hypotheses:

- High hypothesis:
 - For Dong Ha: 3.45% growth rate from 2009 until 2020, then 3.00% until 2030
 - For the rest of the project area: 1.10% growth rate
- Low hypothesis:
 - For Dong Ha: 2.50% growth rate from 2009 until 2020, then 2.00% until 2030
 - For the rest of the project area: 1.10% growth rate

The project area had a population of 201,482 inhabitants in 2007, and it should reach 251,000 to 264,500 inhabitants in 2020 and 292,000 to 324,500 inhabitants in 2030. The water demand forecast is based on household consumption hypotheses from the year 2010 onwards on the basis of 150 litres/inhabitant/day in Dong Ha and 100 litres/inhabitant/day in the rest of the project area. It is also based on water loss rates being gradually reduced to 24% in 2020 and 20% in 2030.

Total water demand should reach 61,000 to 64,300m³/day in 2020 and 68,000 to 75,000m³/day in 2030.

DONG HA WATER SUPPLY ENHANCEMENT PROJECT

The Dong Ha water supply enhancement project consists in building a new system to increase water production and spread out the supply area, and rehabilitating the existing structures.

The project phasing is based in two main hypotheses:

- Commissioning the Quat Xa production unit in 2014.
- Abandonment of the Tan Luong production unit in 2020.

The relation between the forecast water demand and the capacity of all the various production units enabled the following stages to be determined:

- 2009-2014:

Until the commissioning of the Quat Xa production unit is completed, the supply area will remain limited to Dong Ha and its already-supplied surrounding areas such as Gio Linh and Cua Viet. Water demand will reach approx. 20,000m³/day in 2014 and will be met by progressively increasing production in the Gio My boreholes.

- 2014-2020:

In 2014, the expansion of the supply area will suddenly increase water demand, whereas total design production capacity will reach 60,000m³/day with the commissioning of a 30,000m³/day production unit in Quat Xa.

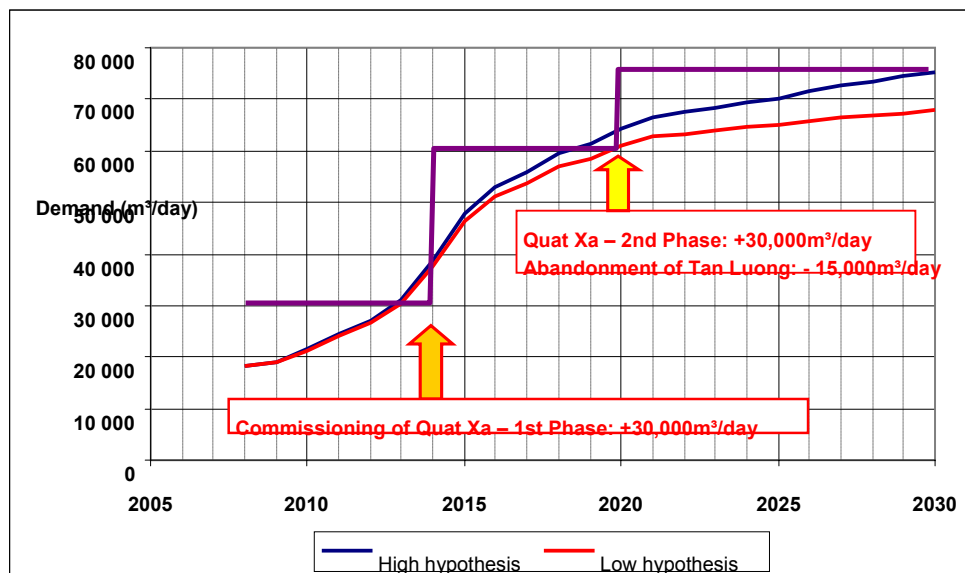
With the Tan Luong and Gio Linh treatment plants working to full capacity (15,000m³/day each), total production (60,000m³/day) could meet water demand in the project area until 2018 in the case of the high demographic growth hypothesis or 2019 in the case of the low hypothesis.

■ 2020-2030:

It is not realistic, though, to consider commissioning a second production unit in Quat Xa before 2020, i.e. six years after the first one. In the event of the Tan Luong treatment plant thus being abandoned, the double production capacity in Quat Xa would enable water demand to be met at least until 2030 (high demographic growth hypothesis).

The project phasing is presented in the chart below which shows the progression of demand according to the forecast hypotheses and the mobilisation of production capacities.

Chart: Progression of demand and project phasing



Description of the structures and investment costs

The structures include the following components:

New construction works

■ 1st phase

Quat Xa water intake and raw water pumping station

Quat Xa treatment plant for a capacity of 30,000m³/day

Primary network: 52km with diameters ranging from DN250 to DN800 mm

Secondary network: 152.6km with diameters ranging from DN100 to DN250 mm

Tertiary network: an initial construction stage of the tertiary network will be carried out including 250km of HDPE pipelines with diameters ranging from DE63 to DE110 mm

■ 2nd phase

Expansion of the Quat Xa raw water pumping station

Expansion of the treatment plant for an additional capacity of 30,000m³/day

Creation or strengthening of the distribution pumping system as well as strengthening storage capacities

Tertiary network: construction of 90km with diameters ranging from DE63 to DN110 mm

Rehabilitation works

These works will be completely carried out in the 1st phase.

They will involve replacing distribution pipelines and repair works on several of the Tan Luong production system structures; they are programmed by the Water Company.

The following was proposed to complete this programme:

- Integrate the rehabilitation of 25 additional kilometres of distribution network in order to improve the system's performance.
- Incorporate repair works on existing production structures in order to ensure that the Tan Luong system's operating conditions are satisfactory until the year 2020.

The total investment amount for both phases is 31.9 million Euro and is summarised in the table below.

Table: Investment amounts

NAME	1 st Phase	2 nd Phase	Total
NEW CONSTRUCTION WORKS	22,748,541	6,483,062	29,231,603
Quat Xa water intake	220,000	60,000	280,000
Quat Xa treatment plant	5,040,000	3,986,500	9,026,500
Primary, pumping and storage pipeline network	8,769,666	1,200,000	9,969,666
Secondary network	5,908,507		5,908,507
Tertiary network	2,810,368	1,236,562	4,046,930
REHABILITATION WORKS	2,643,250		2,643,250
Tan Luong production system	1,000,000		1,000,000
Distribution network rehabilitation	1,643,250		1,643,250
Total:	25,391,791	6,483,062	31,874,853
		Rounded up to:	31,900,000

FINANCIAL AND ECONOMIC ANALYSIS

The objective of this analysis is to examine the project's feasibility and to identify the measures with which it can be strengthened.

It is based on a comparison made between the "without project" situation and the "with project" situation enabling the project's capital to be determined.

A forecast model was created for the period 2009-2030. It includes financial flows according to their main components: operating products, operating costs and investments. These components are linked to the different physical parameters describing the system's development over the forecast period.

Financial analysis hypotheses

Hypotheses were given on the development of a certain number of factors or key variables.

Operating products

Operating products depend on tariffs. The hypothesis involving an increase by 10% of the tariff in market values was made for the forecast period, which is a careful hypothesis.

Operating costs

Operating costs (excluding personnel) were calculated using the physical variables which generate them (for example, energy, volumes of treated water, etc.) and by applying the corresponding unit prices. The latter were presumed to be stable in market values (or in other words, followed inflation).

As regards personnel, a controlled increase in personnel was taken into account by integrating reasonable gains in productivity.

Investments

The investments were programmed so as to meet changes in demand.

Results and comments

In these hypotheses, the financial internal rate of return is positive and at 3.2% (forecast made with constant values).

Measures to improve this result could come from the following:

- **Greater tariff increase**

The sensitivity analysis shows that increasing the tariff by 30% would raise the rate of return to 6.4%. However, such an increase is probably not applicable for the time being. On the other hand, it could be gradually introduced in the medium- and long-term if favourable economic growth trends remain.

- **Subsidy mechanisms**

Increasing the tariff by 10%, combined with a 20% investment subsidy, would allow a rate of return of 6.4% to be achieved.

The search for financing, part of which includes a subsidy, would be justified by the project's context.

The project will allow, by the year 2030, an additional population of 200,000 to 220,000 inhabitants to be supplied, in other words **two thirds of those living in suburban or sparsely-populated rural areas**. This situation creates cost overruns linked to the network's expansion, for example.

It should be noted that the factors penalising the project's feasibility can be found in the 2nd phase. This means an investment of 30,000m³/day of capacity combined with the abandonment of the Tan Luong production system (-15,000m³/day), which thus reduces the effective capacity gain to no more than 15,000m³/day.

Economic analysis

The economic analysis was carried out by transforming financial flows into economic flows by applying standard conversion factors. It leads to an internal rate of return that is similar to that found for the financial analysis.

Nevertheless, this rate misses out a set of advantages which, even though difficult to evaluate, are no less real and suffice to justify the project's economic feasibility. This includes, in particular:

- health advantages, particularly in areas where the population does not have a network and uses unsafe water sources,
- a general improvement in living conditions.