

RRP: THA 26227

ASIAN DEVELOPMENT BANK

**REPORT AND RECOMMENDATION
OF THE
PRESIDENT
TO THE
BOARD OF DIRECTORS
ON A
PROPOSED LOAN
TO THE
KINGDOM OF THAILAND
FOR THE
SAMUT PRAKARN WASTEWATER MANAGEMENT PROJECT**

November 1995

CURRENCY EQUIVALENTS (as of 31 October 1995)

Currency Unit	Baht (B)
B 1.00	\$0.039984
\$ 1.00	B25.01

For the calculations in this Report an exchange rate of B25.00 = \$1.00 has been used. This was the rate prevailing at the time of appraisal

ABBREVIATIONS

BMA	=	Bangkok Metropolitan Administration
BME	=	Benefit Monitoring and Evaluation
BMR	=	Bangkok Metropolitan Region
BOD	=	Biochemical Oxygen Demand
BOT	=	Build Operate and Transfer
DANCED	=	Danish Cooperation for Environment and Development
DO	=	Dissolved Oxygen
EIA	=	Environmental Impact Assessment
EIRR	=	Economic Internal Rate of Return
ICB	=	International Competitive Bidding
IEE	=	Initial Environmental Examination
IPP-CTT	=	Industrial Pollution Prevention and Clean Technology Transfer
MOSTE	=	Ministry of Science, Technology and Environment
MWA	=	Metropolitan Waterworks Authority
NEQA	=	National Environmental Quality Act
NGO	=	Nongovernment Organization
OECF	=	Overseas Economic Cooperation Fund – Japan
O&M	=	Operation and Maintenance
PCD	=	Pollution Control Department
PWA	=	Provincial Waterworks Authority
SPWPCU	=	Samut Prakam Water Pollution Control Unit
TA	=	Technical Assistance
WMA	=	Wastewater Management Authority

WEIGHTS AND MEASURE

ha	hectare
km	kilometer
km ²	square kilometers
m ³ /d	cubic meters per day
mg/l	milligram per liter

NOTES

- (i) The fiscal year of the Government ends on 30 September
- (ii) In this Report, "\$" refers to US dollars.

TABLE OF CONTENTS

	Page
LOAN AND PROJECT SUMMARY	ii
MAP 1: Bangkok Metropolitan Region	v
MAP 2: Samut Prakarn Wastewater Management Project	vi
I. THE PROPOSAL	1
II. INTRODUCTION	1
III. BACKGROUND	2
A. Water Supply and Wastewater Sectors	2
B. Government Policies and Plans	5
C. External Assistance to the Water Supply and Sanitation Sectors	6
D. Lessons Learned	6
E. The Bank's Sectoral Strategy	7
F. Policy Dialogue	7
IV. THE PROJECT	11
A. Rationale	11
B. Objectives and Scope	12
C. Technical Justification	13
D. Cost Estimates	14
E. Financing Plan	15
F. Implementation Arrangements	16
G. The Executing Agency	21
H. Environment and Social Measures	21
I. Policy Issues	22
V. PROJECT JUSTIFICATION	24
A. General	24
B. Economic and Financial Analyses	24
C. Subsidies	26
D. Environment	27
E. Social Dimensions	27
F. Risks	28
VI. ASSURANCES	28
VII. RECOMMENDATION	30
APPENDIXES	31

LOAN AND PROJECT SUMMARY

Borrower	:	Kingdom of Thailand
Project Description	:	The Project will develop wastewater management facilities in Samut Prakarn Province where water pollution because of the discharge of untreated domestic and industrial wastes poses serious environmental health risks and inhibits social development.
Classification	:	Primary - Environment Secondary - Human Development
Environmental Assessment	:	An initial environmental examination (IEE) was undertaken.
Rationale	:	The present sanitation and wastewater management facilities in Samut Prakarn Province, one of five provinces that comprise the Bangkok Metropolitan Region, are ineffective in dealing with the large wastewater flows generated by approximately 1.2 million residents and 4,000 factories. The result has been severe degradation in water quality and deterioration in public health as evidenced by the increase in the incidence of water and sanitation-related diseases. The severity of the problem led to the designation of Samut Prakarn Province as a pollution control area in 1994, which ensures it Government priority for funding for environmental improvements. Without the implementation of a comprehensive wastewater management program, further degradation of the environment and deterioration of public health will be inevitable. The development of centralized wastewater treatment facilities was determined to be the least-cost approach to wastewater management. The Project addresses the objectives of the Government for the sector. It will assist the Government in the implementation of policy reforms including the development of an industrial pollution prevention program, the development of cost recovery mechanisms for wastewater management, the strengthening of financial management, and the enforcement of pollution control regulations.
Objectives and Scope	:	The objective of the Project is to improve the quality of the environment, public health, and welfare in Samut Prakarn Province by providing modern, reliable, and cost-effective wastewater collection and treatment facilities for the most

developed urban and industrial districts in Samut Prakarn Province combined with a program to improve environmental monitoring and enforcement and a program on industrial pollution prevention and clean technology transfer (IPP-CTT).

The scope of the Project includes the construction of (i) wastewater collection systems including over 300 kilometers (km) of interception and collection sewers, 60,000 property connections, and associated pumping stations; (ii) central wastewater treatment including a 400,000 cubic meter/day (m³/d) aerated lagoon and a 125,000 m³/d aerated lagoon and associated disposal facilities; (iii) wastewater and effluent monitoring systems; (iv) industrial pollution prevention and clean technology transfer program; and (v) strengthening the capacity of Government agencies responsible for planning and implementing wastewater management projects.

Cost Estimates : The total cost of the Project is estimated at \$507 million equivalent, of which \$160 million is the foreign currency cost and \$347 million equivalent is the local currency cost.

Financing Plan	(\$ million)			
	Source	Foreign Exchange	Local Currency	Total Costs
	Bank	150.0	-	150.0
	Gov't.	10.0	347.0	357.0
	Total	160.0	347.0	507.0

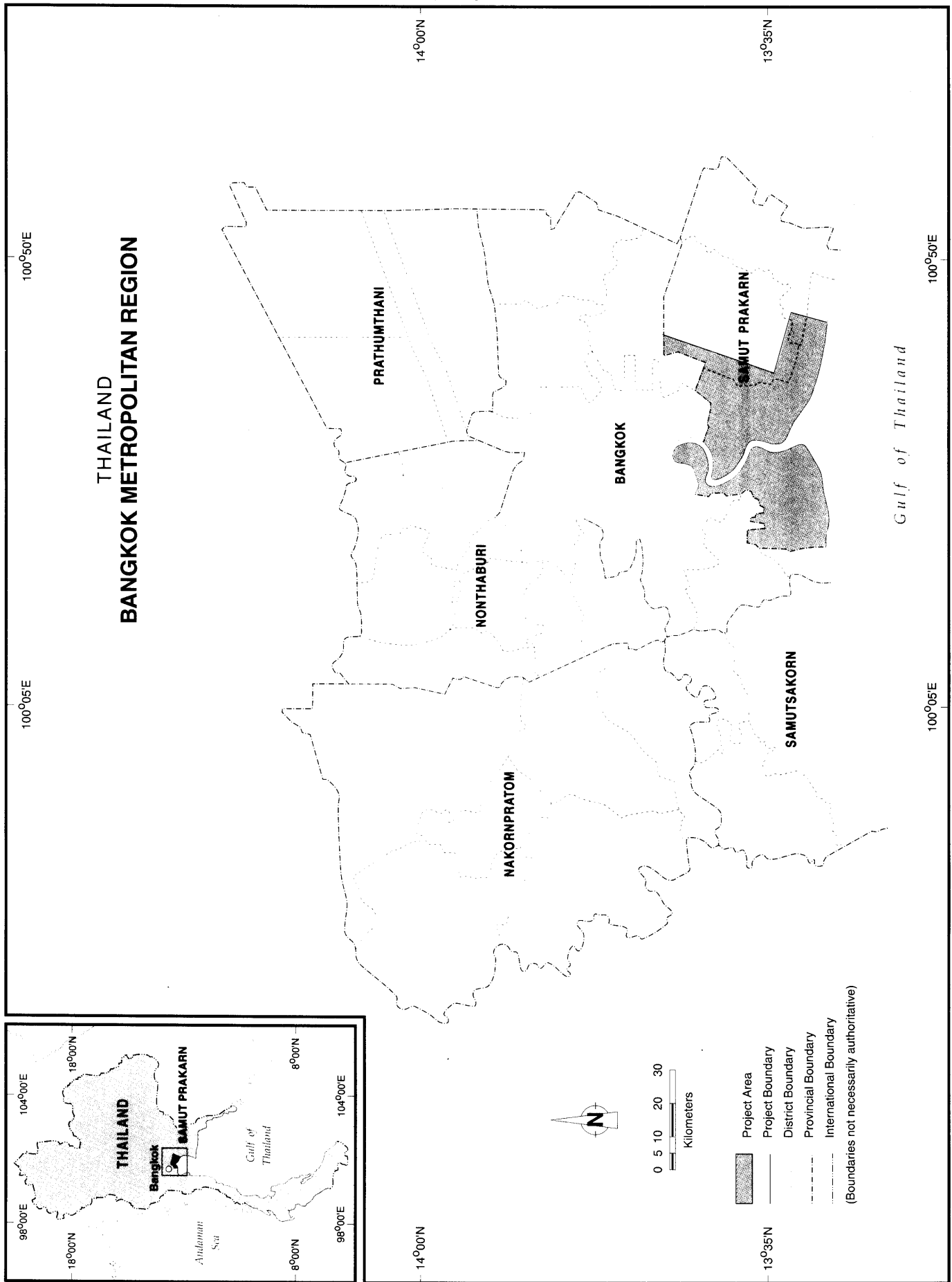
Loan Amount and Terms : \$150 million from the Bank's ordinary capital resources with interest determined in accordance with the Bank's variable lending rate system for US dollar loans with a term of 25 years including a grace period of 5 years, principal and interest to be paid semiannually.

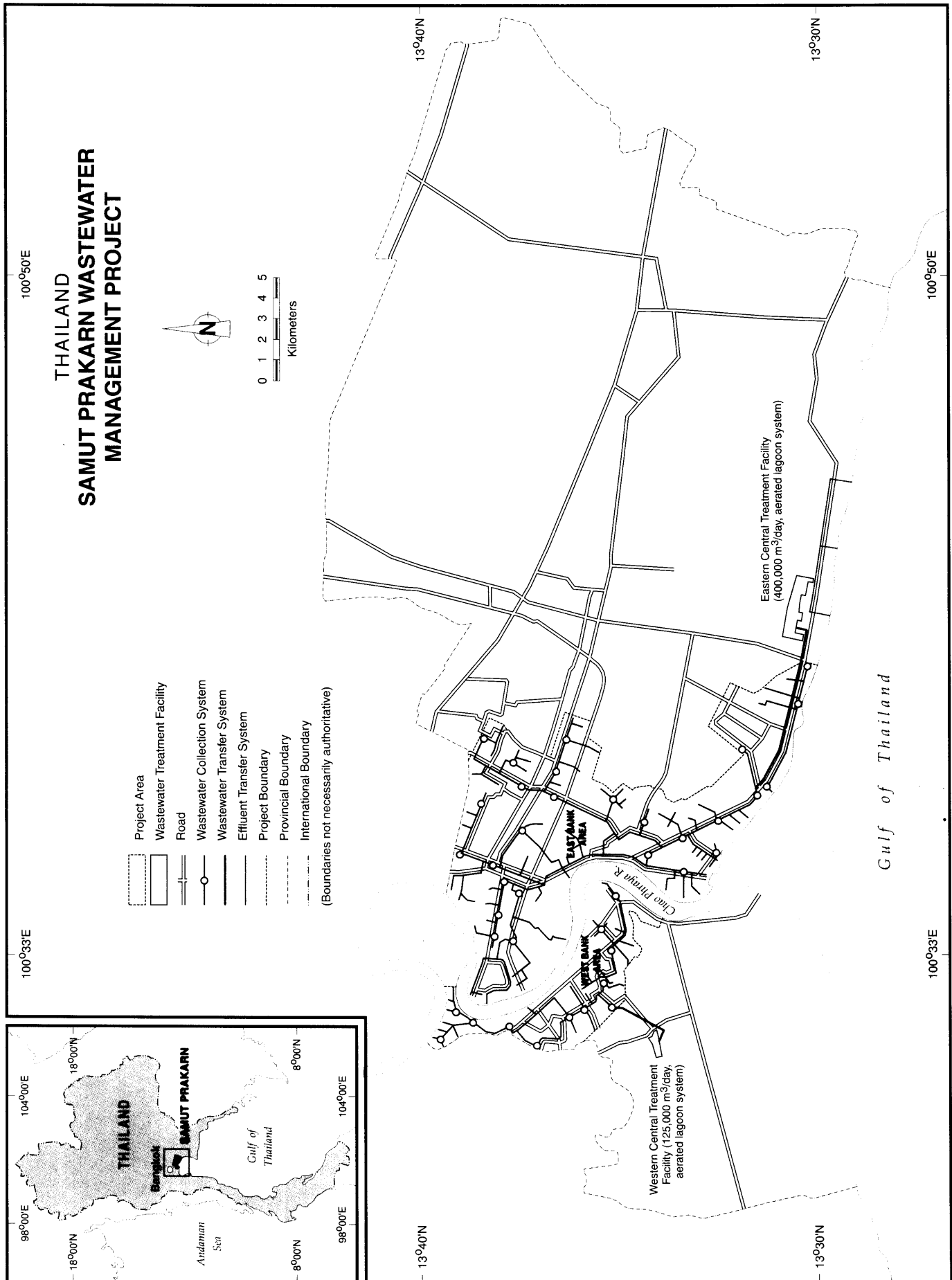
Period of Utilization : Until 31 December 2001

Executing Agency : Pollution Control Department/Ministry of Science, Technology, and Environment

Implementation Arrangements : The Pollution Control Department will establish the Samut Prakarn Water Pollution Control Unit, which will be responsible for implementation of the Project.

- Procurement** : The procurement of goods and services will be in accordance with the Bank's *Guidelines on Procurement*. International competitive bidding procedures will be followed for the two turnkey contracts for the design and construction of wastewater collection, treatment and disposal facilities; one procurement contract for operational, monitoring and control equipment, and another for equipment, training, and services for industrial pollution prevention.
- Consultancy Services** : The consultants will be selected in accordance with the Bank's *Guidelines on the Use of Consultants* for assistance in management of the Project and construction quality assurance requiring a total of 662 person-months of consulting services (200 person-months of international and 462 person-months of domestic experts).
- Estimated Project Completion Date** : 30 June 2001
- Project Benefits and Beneficiaries** : The Project represents a major step towards improving the quality of the environment within the area it covers, the lower reaches of the Chao Phraya River and the Upper Gulf of Thailand. The Project will provide an affordable, technically sound solution to current water pollution problems in Samut Prakarn Province and will substantially improve the wastewater services for communities and industries and will provide a noticeably cleaner environment. The Project will directly benefit about one million residents as well as businesses, industries, and institutions, that will benefit from the improvements in health and welfare arising from improvements in water quality and resource cost savings. The improvements in the aquatic ecology and the reduction in public health risks will also benefit a broad cross section of people residing in Samut Prakarn Province. The Project will be of particular benefit to women and low-income families who often live close to factories and in low-lying flood-prone areas and are most exposed to polluted waterways. The Project also represents the most cost-effective means of industrial pollution control. The estimated economic internal rate of return (EIRR) is 23 percent.





I. THE PROPOSAL

1. I submit for your approval the following Report and Recommendation on a proposed loan to the Kingdom of Thailand for the Samut Prakarn Wastewater Management Project.

II. INTRODUCTION

2. During the visit of the Country Programming Mission to Thailand in January 1993, the Government requested Bank assistance in planning a comprehensive wastewater management project in the heavily industrialized and rapidly urbanizing province of Samut Prakarn. The Bank approved technical assistance (TA) for this purpose in December 1993.¹ The feasibility study incorporated the results of the two previous Bank-financed TAs for environmental planning in Thailand.² The first TA was for an industrial pollution control study, which was completed in 1987, and highlighted the severity of industrial pollution in Samut Prakarn Province. The second TA, which was completed in 1993, confirmed the high priority of the need for water pollution control in Samut Prakarn and Bangkok and highlighted the need for an innovative, large-scale project to collect and treat both industrial and domestic wastewaters. The project preparatory TA, which was completed in March 1995, involved a feasibility study and detailed design for the Project. In addition to extensive consultation with local citizens, nongovernment organizations (NGOs), and industries during the course of the TA, Bank staff participated in two workshops at which interested parties were able to discuss the proposed Project. The final Project takes into consideration the concerns of the local people that were expressed during the workshops. The Fact-Finding Mission in April 1995 reviewed the feasibility study with the Government officials and initiated a discussion of issues related to the sector and the Project. The Appraisal Mission in June-July 1995 firmed up the scope, financing arrangements, and the implementation arrangements for the Project. The Mission also conducted policy dialogue on issues in the sector and reached an agreement with the Government on policies needed to enhance efficiency in the sector. This Report is based on the findings of the Bank Missions,³ the reports prepared by the Government and the Bank-financed consultants, and the information obtained from the Government at the central and the provincial levels.

¹ T.A. No. 2014-THA: *Wastewater Management and Pollution Control in Samut Prakarn*, for \$600,000, approved on 14 December 1993.

² T.A. No. 789-THA: *Samut Prakarn Industrial Pollution Control and Management*, for \$295,000, approved on 5 August 1986 and T.A. No. 1741-THA: *Environmental Rehabilitation*, for \$350,000, approved on 18 August 1992.

³ The Appraisal Mission included Mr. J. Warren Evans, Sr. Project Specialist (Environment)/Mission Leader; Mr. Charoen Bunchandranon, Sr. Project Engineer; Mr. W. D. Ferguson, Financial Analyst; Mr. Tae-Kyun Kwon, Programs Officer; Mr. E. Van de Walle, Economist; Ms. Karin Wentz, Counsel; and Mr. Xiaoyan Ye, Treasury Officer.

III. BACKGROUND

A. Water Supply and Wastewater Sectors

1. Water Supply

3. All of the urban communities in Thailand with a population of over 15,000 are served by piped water supplies and about 60 percent of the population has direct connections. In the smaller urban areas with populations ranging from 5,000 to 15,000, defined as towns, there are 800 towns, of which about 250 do not have a piped supply. The Ministry of Interior coordinates the provision of piped water supplies, which is provided through two state-owned enterprises and local governments: the Metropolitan Waterworks Authority (MWA) which serves part of the Bangkok Metropolitan Region (BMR);¹ the Provincial Waterworks Authority (PWA) which serves most of the urban areas outside the MWA service area; and the local municipal and sanitary district authorities, which control the water supply systems serving about 25 urban centers and 100 sanitary districts. In addition, about 200 concessions have been awarded to private developers to serve resorts, residential, and industrial estates. The MWA, established in 1967, currently provides service to about 6.1 million people, or about 77 percent of the population of its service area. The MWA is implementing an expansion program to raise its service coverage to over 90 percent of the population in Bangkok City, Nonthaburi, and Samut Prakarn by the year 2010 and has embarked on institutional improvements designed to commercialize its operations within five years. The PWA, established in 1979, currently serves about 5.7 million people in 280 provincial urban centers or about 60 percent of the total population for which it is responsible. The PWA is implementing an expansion plan to increase service coverage at the rate of at least 5 percent per annum. In 1994, PWA initiated a program to privatize selected municipal and regional waterworks.

4. The funds for the activities of MWA and PWA come from retained earnings, Government loans, and loans from the private sector and international assistance agencies. Recently, MWA financed over half of its investments and raised the balance of funds through local bond issues and loans from international assistance agencies. PWA financed about 20 percent of its investments from retained earnings and the remainder from bond issue and loans from international assistance agencies. Unlike MWA, the PWA still receives grants from the Government for selected waterworks expansion programs for which full cost recovery is not possible.

¹ The BMR comprises Bangkok City, administered by the Bangkok Metropolitan Administration, and the surrounding provinces of Samut Sakhon, Nakhon Pathom, Nonthaburi, Pathum Thani, and Samut Prakarn, which include extensive areas of dense residential and industrial development. The Metropolitan Waterworks Authority is responsible for the provision of piped water supply to Bangkok City and the adjoining provinces of Nonthaburi and Samut Prakarn.

2. Wastewater

5. Water supply and wastewater are often considered together as one social infrastructure sector. However, there are substantial differences between water supply and wastewater management. The funding and cost recovery for urban water supply and urban wastewater management are different because of the different priorities assigned to their development by developing countries, the availability of local expertise, the easy recognition of the benefits of water supply projects as compared to the more difficult and often delayed recognition of the benefits of wastewater management projects, the nature and distribution of the benefits, and the willingness of beneficiaries to pay for the development. In addition, while both urban water supply and urban wastewater management projects are capital intensive, the economic life of wastewater management facilities is often two to three times more than that of water supply projects. This affects the attractiveness of projects to governments and private investors. Because of the environmental benefits to the general population, most industrialized countries have considered sanitary sewerage as long-term public infrastructure (similar to storm sewers or streets) and many countries have not attempted to recover capital costs directly from households or businesses connected to a system. Most industrialized countries initiated large-scale urban wastewater management improvement programs in the 1960s to 1970s with much of the cost borne by the central government as grants to municipalities. However, developing countries have given priority to improvements in safe water supplies and have only recently emphasized the often severe problems caused by inadequate wastewater management. These priorities are understandable because the governments in developing countries were more aware of the public health effects of inadequate water supply compared with the adverse public health and environmental impacts of pollution until the impacts are severe and the costs of the solutions are very high. Even under these conditions, because of the lack of public awareness and the delays in the benefits of investments in wastewater management, beneficiaries are reluctant to pay the costs for an improved environment.

6. The pollution of water bodies from domestic, commercial, industrial and other sources has reached extreme levels in the BMR, which includes Samut Prakarn Province, and the other major urbanized and industrialized areas in the country. The present system of domestic and commercial wastewater disposal — cesspits and inadequately designed septic tanks for toilet wastes, and direct discharge of nontilet wastewater (sullage) — transfers most of the pollution loads directly to drains and watercourses. For the last ten years, the law has required that the most polluting categories of industrial wastewater be treated before discharge, but few meet effluent standards because of previously weak enforcement of pollution control regulations. As a result, the quality of receiving waters, particularly in urbanized and industrialized areas has been rapidly declining. Statistics of reported waterborne diseases show a rising trend in such areas, with dissolved oxygen levels reaching zero and waterborne pathogen and toxic substance concentrations far exceeding public health standards, while fishery yields have declined and the country's tourism industry has been adversely affected. The severely degraded water quality and aquatic ecological conditions in the Lower Chao Phraya River Basin and Upper Gulf of Thailand because of the water pollution loads from BMR affect millions of people.

7. The Government has recognized that the unsatisfactory trend in environmental degradation and the continued rapid expansion of the economy in Thailand will worsen the situation unless concerted action is taken. Beginning in the mid-1980s, the municipal governments in BMR and several other cities began to prepare and implement plans for

wastewater collection with centralized treatment schemes. A limited number of schemes are operational and a few others are at advanced stages of planning and construction. However, the effectiveness of the early schemes has been inadequate because of the limited service areas and budgetary constraints.

8. Under the Seventh National Economic and Social Development Plan for the period October 1992 to September 1996 (Seventh National Plan), the Government has implemented legal, institutional, and financial measures to control environmental pollution including water pollution. The key action has been the enactment of the Enhancement and Conservation of National Environmental Quality Act (NEQA) in 1992. Under NEQA, the former Office of the National Environment Board (a policy agency) was reorganized into three more functional entities under the Ministry of Science, Technology, and Environment (MOSTE): (i) the Office of Environmental Policy and Planning, responsible for policy determination and the administration of an Environment Fund established under the NEQA to provide grant and loan funding of pollution control schemes; (ii) the Office of Environmental Quality Promotion, responsible for education and information campaigns to mobilize public support for environmental protection and enhancement; and (iii) the Pollution Control Department (PCD), responsible for initiating action to implement pollution control projects, monitoring and enforcing the NEQA, and initiating legal action against polluters.

9. The NEQA gives MOSTE the power to establish pollution control areas where pollution problems have a severe impact on public health or adversely affect local and national economic interests. The designation as a pollution control area gives the responsible local government or specially designated agencies access to the Environment Fund, which was initially capitalized by the Government at B5,000 million (\$200 million). Financing from the Fund combined with parallel grants from the Government are used for the preparation and implementation of water pollution control schemes in the six pollution control areas established so far, viz., Phuket, Phi Phi Islands, Hat Yai, Pattaya, Songkhla, and Samut Prakarn. PCD is the agency in the Government responsible for identifying, developing, and implementing these schemes in association with the local provincial and municipal governments.

10. In parallel, the Bangkok Metropolitan Administration (BMA) is proceeding with construction of wastewater collection and centralized treatment plants serving a combined population of about 2.4 million persons in central Bangkok. The Government is providing grants to supplement the BMA's own funds in financing these projects. In addition, the Public Works Department continues to provide technical assistance to more than 50 urban areas and sanitary districts in the provinces to develop wastewater collection and treatment projects, although it is difficult to mobilize funds for these projects compared with the funding available for projects implemented by PCD in pollution control areas.

11. The majority of water pollution control schemes now being planned maximize the existing investment in combined drainage systems¹ by intercepting wastewater flows in the drainage systems. This is the most cost-effective way of initially reducing pollution significantly, although some partially polluted flows will still reach watercourses when the combined drainage systems overflow during storms. All the new housing and business development areas will be

¹ Combined drainage systems are sewer systems that are utilized for the drainage of both surface runoff from rainfall and of wastewater. Interceptor sewers are sewer pipes that collect flow from combined sewers and convey the wastewater and stormwater to a treatment facility. The interceptor prevents the discharge of untreated wastes to various receiving waters in the drainage system.

provided with separate sewerage and surface water drainage collectors while, ultimately, the interceptor systems will be replaced with the installation of separate sewers and the replumbing of properties to separate surface water and wastewater flows.

B. Government Policies and Plans

12. The Government's objective for wastewater management in the Seventh National Plan is to reduce pollution levels in the lower reaches and estuary of the Chao Phraya River; in coastal areas and tourist destinations; and in canals, ponds, and lakes in regional urban centers with critical water pollution problems. The Seventh National Plan proposes to achieve this objective by reducing water pollution generated by communities and industrial and agricultural activities as well as relocating pollution-generating industries to designated areas; enforcing effluent standards for buildings, livestock, and aquaculture farms; collecting water fees and levying effluent charges to encourage economical use of water; encouraging the use of clean or pollution-free technologies and waste recycling; and promoting the use of recycled water. Control measures are also being put in place to prevent additional effluent discharges into water courses with critical pollution problems such as controlling the construction and expansion of factories, supporting the establishment of industrial estates and zones, and separating the sewerage and stormwater drainage systems in newly developed industrial areas to increase the efficiency of pollution control. The Government is also actively supporting investment in construction of wastewater facilities for communities and industrial areas in BMR and regional urban centers; promoting the "polluter-pays-principle" to inform polluters that they will bear the costs of treatment and disposal of pollution; and strengthening the legislation, organization, administration, and management of the agencies responsible for controlling pollution. Nevertheless, the Government recognizes that it must provide most of the capital investment for sewers and wastewater treatment plants for the next few years, which is similar to the practice in many of the industrialized countries when massive investments for urban water pollution control were required to halt the severe degradation in their environments. The Government's long-term strategy is to encourage the private sector to participate in the financing and operation of wastewater management facilities, similar to the current efforts to privatize the electric power, telecommunications, and transport sectors.

13. Several significant institutional and financial initiatives are under way in Thailand. The regulations controlling discharge of wastewater at major sources are being strengthened under NEQA. Recently, PCD issued a regulation requiring large condominium complexes, department stores, hospitals, hotels, markets, private schools and universities, restaurants and shopping malls without access to piped wastewater collection systems to install onsite wastewater treatment facilities. The regulation, which took effect in early February 1995, is being actively monitored and enforced by inspection teams from PCD. The project planning and development capabilities of local governments are being strengthened by formation of joint project implementation units consisting of staff from PCD and the local government. These units are being established in each of the pollution control areas and in other areas in which major investments in wastewater management facilities are being made. Comprehensive effluent monitoring and enforcement programs are only now being implemented and the Government recognizes that capacity building will be required to ensure the effectiveness of these programs.

14. The recent establishment of the Wastewater Management Authority (WMA) within MOSTE by Royal Decree in August 1995 is an indication of the high priority the Government places on the implementation of wastewater management projects. The mandate of WMA is to undertake implementation and operation of wastewater management facilities

throughout BMR, regardless of administrative boundaries. Initially, PCD will provide the staff and supervise WMA, however, eventually it will be an independently managed institution with authority to undertake wastewater management developments as joint ventures with private sector investors. WMA-private sector joint ventures will be able to recover all the capital and operating costs of wastewater collection, treatment, and disposal facilities from beneficiaries.

C. External Assistance to the Water Supply and Wastewater Sectors

15. External assistance for water supply has included both technical assistance grants and project loans from multilateral and bilateral agencies. The Overseas Economic Cooperation Fund (OECF), Japan has supported the expansion of water supply through 12 projects. The Bank has supported the expansion of water supply through five projects including three under MWA (1973, 1979, and 1985), one under PWA (1994), and one for planning under the National Economic and Social Development Board (1982). The World Bank has supported the expansion of water supply through one project under MWA and one project under PWA. The United Kingdom provided financing for rehabilitating water supplies under local governments in 25 medium towns, implemented by the Public Works Department. Other sources of bilateral aid have been Denmark, Germany, and Italy.

16. Funding for wastewater management projects by external assistance agencies has been limited to a World Bank-financed Regional Cities Development Project in 1986, which included the construction of wastewater treatment plants in three regional cities. In addition, OECF has provided \$100 million for onlending from the Environment Fund for environment projects, which will include wastewater management. The Bank has provided three successive TAs related to wastewater management in Samut Prakarn. The first TA, approved in 1986, focused on controlling industrial pollution in Samut Prakarn, the second (1992) on financing the development of wastewater management and the third (1993) on the preparation of a feasibility study and preliminary design for the Project. The first two TA studies clearly established the high priority for wastewater management in Samut Prakarn and culminated in the definition of the objectives and scope for the third TA. Detailed information on external assistance is in Appendix 1.

D. Lessons Learned

17. The post evaluation findings of Bank-financed projects in Thailand indicate that most projects have generally been successful in contributing to economic and social development of the country. The generally successful rating of 85.7 percent for Bank-financed projects in Thailand compares favorably with the rating of 33.3 percent for other Group B countries and with 39 percent for Group C countries. Projects funded with external assistance have generally been implemented satisfactorily and remedial measures are usually taken quickly by executing agencies when problems occur. The Government's screening process for foreign financing has also helped in ensuring that executing agencies have the commitment and capability to implement the projects. The disbursement performance of Thailand has consistently been above the average for all developing member countries.

18. As is the case in other developing member countries, there have been cases in which implementation has been delayed because of the slow delivery of construction equipment, late completion of detailed design, problems with the acquisition of land and right-of-way, postponements in the recruitment and fielding of consultants, weaknesses in the executing agencies in the early stages of implementation, and poor coordination among

Government agencies. All such potential problems have been addressed by carefully planning the Project. Institutional strengthening and Project management components have been made integral Project components while information feedback mechanisms have been designed to bring problems to the attention of Government and Bank staff to facilitate rapid remedial action.

19. The Bank's involvement in the urban wastewater management sector has been limited to TAs. The lessons learned from the Bank-financed water supply projects are relevant to a limited extent. Probably the most relevant lesson is that delays in the initiation of works for projects can be avoided by advanced action to mobilize Project consultants and contractors. This lesson has been applied to this Project. The Government's experience with wastewater management projects is also limited to small-scale municipal projects. After the Public Works Department turned such wastewater facilities over to the municipality, the operation and maintenance has generally been inadequate because of lack of trained personnel and insufficient operating budgets. Cost recovery has been limited. These potential problems will be avoided under the Project by incorporating practical and mandatory cost recovery measures, encouraging public participation in industrial pollution prevention programs, providing extensive training for project management, and obtaining operation and maintenance services from the private sector.

E. The Bank's Sectoral Strategy

20. The focus of the Bank's operations in Thailand has changed during the last few years along with the Government's strategic social and economic objectives. Until recently, a large portion of the Bank assistance was for large-scale electric power and infrastructure development. The focus of the Bank's operations is now more on developing and upgrading physical infrastructure in the less developed regions of Thailand, developing human resources, and improving environmental management. This Project is the first one for the environment to be financed by the Bank in Thailand and, as such, has received substantial input from the Government and other multilateral and bilateral assistance agencies as well as Bank staff. The Government has demonstrated its intention to tackle environmental problems and has expressed a strong desire for a long-term program of Bank assistance for this endeavor.

21. The Bank's strategy in the sector in Thailand supports the Government's efforts to halt environmental degradation and to control pollution. It seeks to identify opportunities for investment in well-prepared and focused wastewater management projects and programs that incorporate appropriate and affordable technologies for the collection, treatment, and disposal of wastewater, which can be implemented efficiently and effectively. The Bank's role will be to catalyze innovation, policy change, and increased participation and investment in wastewater projects by the private sector. The emphasis will be on areas with severe water pollution problems that are detrimental to the health and well-being of the local population, the local and national economy, and the sustainability of development. The Bank's program for the sector has involved substantial policy dialogue. The Project is expected to be the first in a series of Bank-assisted environmental projects, to be implemented over the next several years, in areas that require considerable capital investments, as well as policy reform and capacity building, to halt the degradation of the environment.

F. Policy Dialogue

22. The Bank's policy dialogue with the Government about the sector has covered privatization, efficiency and effectiveness of operations, and institutional and financial

arrangements. While the dialogue originated with water supply, increasingly it has focused on wastewater management and environmental protection. During the last few years, assistance from the Bank has helped the Government identify appropriate institutional arrangements for wastewater management, and initiated a process that resulted in approval by the Cabinet to create the WMA. The policy dialogue during the processing of the Project focused on subjects related to the use of appropriate technologies for the effective collection, treatment, and disposal of urban domestic and industrial wastewater; combining efforts to enforce wastewater effluent standards with promotion of industrial pollution prevention measures¹ to reduce industrial wastes; the appropriate approaches to the financing and cost recovery of wastewater management projects; and strengthening institutional arrangements for wastewater management. Policy related actions to be undertaken by the Government were identified, discussed, and agreed as outlined in the Project Framework (see Appendix 2) and the following paragraphs.

1. Institutional Framework for Wastewater Management Planning and Operations

23. Until recently, the institutional framework for planning and operating wastewater management facilities in Thailand was complex and resulted in duplication of efforts and inefficiencies. During the last four years, the Government has carefully evaluated and significantly improved the sector's institutional framework with the result that MOSTE has been designated the lead ministry responsible for wastewater management. The establishment of pollution control areas has resulted in the clear demarcation of institutional responsibilities for planning and implementing wastewater management projects with planning and supervision as the responsibility of PCD/MOSTE. The Government, in recognition of the need to separate eventually the monitoring and enforcement functions of PCD from the operations of the facilities and in consideration of the limited capabilities at the provincial level for the operation of such facilities, has established WMA, which initially will be responsible for operation and maintenance of wastewater facilities in BMR. The PCD is now planning, with assistance from the Bank, to begin work in late 1995 to prepare a comprehensive water pollution control action plan for BMR,² which will set the stage for the WMA's initial activities. An important issue addressed under the Project was that the implementation arrangements for Samut Prakarn should be consistent with the Government's comprehensive plan for BMR and wastewater management. The analyses in the previous studies and for the present Project indicate that these plans will be consistent.

2. Cost Recovery for Wastewater Management Projects

24. The Government policy on financing pollution control projects is that the polluter pays. While the polluter-pays principle has been endorsed by numerous international environmental agencies, international development banks, and bilateral assistance agencies, developing (and many industrialized) countries have found the principle difficult to enforce. The Government has not been successful yet in its application of the polluter-pays principle, but it is determined to do so. In the case of the BMR, the application of the polluter-pays principle would require that all households, businesses, industries, and institutions that discharge wastewater

¹ Industrial pollution prevention measures reduce the creation of pollutants by product or process changes resulting in increased efficiency in the use of raw materials, water or other resources or through conservation. The industrial pollution prevention component is described in Appendix 3.

² T.A. No. 2303-THA: *Bangkok Metropolitan Region Wastewater Management Action Plan and Feasibility Study*, for \$600,000, approved on 9 March 1995.

should contribute a fair share to the capital investment and operation and maintenance (O&M) costs of the several wastewater management facilities that will be built during the next 10 to 15 years. In principle, the payment should be made whether or not a polluter is connected to a facility because all the polluters contribute to the gross pollution and will benefit from the overall public health and environmental benefits. Some of the financing options discussed were (i) financing the capital costs for wastewater management projects in BMR by levying an environment charge with the operation and maintenance of pollution control facilities covered by a separate cost recovery/revenue collection from residents and businesses within the service area of the facility, (ii) financing the capital costs through a subsidy from the central Government with operation and maintenance for the separate facilities covered by separate cost recovery/revenue collection systems, and (iii) financing all the capital costs by a joint venture of the Government and the private sector with full or partial cost recovery from residents and businesses in the service area. However, there is still very little experience in Thailand with cost recovery of wastewater management projects. Consequently, there is not a consistent approach to financing or cost recovery for wastewater management projects. Under these circumstances, the Government agreed with the Bank that there is an urgent need to establish a policy framework for the sector that would clearly define the financing and the related cost recovery and revenue collection measures, and operational subsidies. For the case of Samut Prakarn it was agreed that the PCD would develop an interim policy framework such as:

- (i) the goal of cost recovery will include the recovery of recurrent expenditures for the administration, operation, and maintenance as well as depreciation; consequently, the Government will need to determine the level of subsidies it will be prepared to provide in the event of a shortfall in operating revenues to recover fully the recurrent expenses;
- (ii) cost recovery (revenue billing) measures such as a flat rate charge for residential premises or a progressive block tariff based on estimates of pollution volumes for industrial/commercial premises, and specific measures for collecting the revenues need to be established; and
- (iii) whether to include all households, commercial, and industrial premises in Samut Prakarn (excluding low income households) or only those that are connected to the wastewater collection system needs to be clarified.

25. The Government agreed to include a condition in the Loan Agreement that requires the PCD to formulate a national policy and procedure for cost recovery of wastewater management. The interim draft policy will be formulated in 1999 at which time the results of a trial cost recovery program for the Project will be available. The policy will be finalized taking into account the experience gained and lessons learned from the trial cost recovery program and submitted for consideration by the Government by the completion of Project construction and full commissioning of Project facilities.

3. Pollution Prevention

26. Several studies have identified a large potential for industrial pollution prevention practices in Thailand. However, pollution prevention is still not widely practiced because of the inadequate enforcement of current effluent discharge standards, insufficient commitment by factory management to implement waste minimization and water conservation programs, and

limited local expertise in pollution prevention practices for a wide range of industries. With the implementation of centralized wastewater management projects that require the payment of a wastewater treatment charge, industry will become more motivated to implement waste minimization practices and to initiate in-plant water conservation programs. An advisory body will be established during the first year of implementation of the Project within PCD to provide technical assistance and support to industry to plan and implement a pollution prevention program covering waste minimization practices and water conservation measures, initially in the area covered by the Project and eventually as a national program. Government agencies are also being requested to increase their commitment to achieve more widespread enforcement of current effluent discharge standards and related environmental legislation, and to encourage industries to reduce wastewater generation through pollution prevention activities.¹

4. Private Sector Participation

27. Increasing the participation of the private sector in the provision of infrastructure and basic services has been the Government's policy since 1987. The Private Sector Participation Act of 1992 establishes the legal framework for privatization activities. In 1993, a Cabinet Resolution aimed at improving the performance of state-owned enterprises provided further guidance on commercialization and privatization as well as delineating performance criteria for determining which state enterprises could qualify for privatization. Numerous studies on privatization have been undertaken including a recently completed one on the privatization of water operations of PWA in Phuket and Patum Thani-Rangsit and one for MWA that evaluates the potential of privatizing the Mahasawat Treatment Plant.

28. The BMA recently attempted to implement wastewater management projects on a build, operate, and transfer (BOT) basis requiring an intensive level of involvement by the private sector. The tender was unsuccessful because of some concern and uncertainty by potential private sector investors and unfamiliarity by BMA towards this approach, which is new to the wastewater subsector in Thailand. Thus, substantial Government grants were made available for wastewater projects within BMA, in recognition of their high priority. After careful review, BMA decided to abandon, for the time being, the idea of private sector investment in these projects; instead, it invited interested contractors to bid for turnkey (design and build) contracts for the projects with the Government providing the investment capital. The successful bidder must design and build facilities that will meet the established performance criteria and must demonstrate this capability over an operating period of one year or more.

29. In considering the privatization options for Samut Prakarn, BMA's and PWA's experiences were evaluated. The Government and the Bank held extensive and detailed discussions about the potential for privatization and agreed that the turnkey approach would be the initial focus, with modifications as needed to accommodate the specific requirements of the Project. To ensure efficient implementation of the Project, it was agreed that (i) the operating contractors will be required to specify the level of working capital to be committed, to assure that cash shortages will not occur and interfere with operating performance; (ii) contracting will be considered for administrative functions, such as billing and collecting, as well as for operations and maintenance; and (iii) incentives will be highlighted, to encourage the contractor to exceed performance requirements. It is possible, for example, that wastewater treatment capacity will exceed the actual flows for many years. The contractor needs to be encouraged to

¹ On 3 November 1995 the Government approved a MOSTE proposal to make industrial effluent standards more stringent and to strengthen the role of PCD in enforcing such standards.

identify measures to increase plant utilization and to implement these measures, after obtaining approval.

IV. THE PROJECT

A. Rationale

30. Samut Prakarn Province, the area covered by the Project, is one of the six provinces that comprise BMR. It is situated southeast of Bangkok City and spans the Chao Phraya River between the southern boundary of the metropolis and the Gulf of Thailand. The location and the main facilities to be provided under the Project are shown in Map 1 and Map 2.

31. Samut Prakarn Province occupies 1,004 square kilometers (km²), or approximately 13 percent of the area of BMR. The registered population of the province is about 935,000 persons, while an estimated 300,000 additional unregistered persons (mainly industry and construction workers) also reside in the area covered by the Project. The average annual population growth rate for the whole province is about 3.5 percent but it has exceeded 10 percent in some areas compared with the current national average rate of growth of less than 2 percent. About 70 percent of land in the province is used for agriculture, while the remaining 30 percent is used for residential, commercial, and industrial activities. More than 4,000 factories are located in the province, many of which are located on the banks of the Chao Phraya River. Further expansion of industry and related urban development is assured because of the strategic location of the province adjacent to Bangkok and along the major transportation corridor between the metropolis and the Eastern Seaboard Region where heavy industry is located. Moreover, a major new international airport will be constructed at Nong Nguhao, just northeast of the geographic center of the province. The airport is expected to become a major hub of future international freight shipments for the country and will further reinforce the ongoing development in the region.

32. The present sanitation facilities in Samut Prakarn Province are generally ineffective in handling the large wastewater flows now being generated from the urban districts in the province. Most communities rely on cesspits or septic tanks, which are generally inadequate or unsuited to the high density of development. Most of the effluent and sullage from septic tanks is discharged either to canals or to roadside drains. The existing drainage systems serve the most urbanized districts, but comprise flat-graded drains that were designed to convey rainwater to the canals. When it does not rain, these drains accumulate large quantities of septic wastewater.

33. Of the 757 major wastewater generating industries in the province, only about 230 operate in-house treatment facilities. The results of field inspections as part of the Bank-financed TA for the Project indicate that only about 10 factories in the east bank area produce effluent that regularly conforms with the Government's effluent standards. No factories in the west bank area appear to be meeting the standards.

34. No hazardous wastewater treatment and disposal facilities are presently operated in the province. PCD is now preparing to develop and implement hazardous waste management facilities within the province that will be compatible with the recommended wastewater strategy plan and will ensure minimal risk of discharge of hazardous materials into

the planned centralized wastewater collection and treatment system. The private sector has shown interest in developing hazardous waste management facilities in Samut Prakarn Province and in the adjacent industrialized provinces.

35. Water quality in the canals in the province has deteriorated to critically low levels, with large numbers of waterways exhibiting dissolved oxygen (DO) levels of zero. A DO level of at least 2 milligrams/liter (mg/l) is considered essential for the maintenance of aquatic ecology. Without effective pollution control, it is conceivable that most of the canals in Samut Prakarn Province could eventually become entirely septic. Water quality levels in the Chao Phraya River have steadily declined in recent years. Under low tide conditions, DO levels regularly fall to zero up to 20 kilometers (km) from the sea, while levels rarely exceed 1 mg/l at low flows for the lower 50 km reach of the river. Most of the beneficial uses of the water from the Chao Phraya River, except navigation, have now been lost. It has been estimated that over 60 percent of total pollution loads in the lower reaches of the river originate from canals on the immediate east and west banks in the BMR. A significant improvement in the water quality of the Chao Phraya River could be achieved if the pollution in the canals is reduced.

36. The development of a centralized wastewater collection and treatment system is compatible with the Government's policy for the sanitation sector and has been accorded high priority by declaring Samut Prakarn Province a pollution control area. Without the implementation of a comprehensive wastewater management program, further degradation of the environment and deterioration in public health will be inevitable and the economic development of the area will be slowed. The proposed Project represents the first phase of a long-term twenty-year development program to provide expanded wastewater collection and treatment facilities in Samut Prakarn Province. The Project will also assist the Government to implement policy reforms such as developing pollution prevention practices, strengthening financial management and institutionalizing cost recovery measures for wastewater management, and integrating the planning for public sanitation. The Project will also support the economic development of the province by reducing the need for expensive in-house industrial wastewater treatment facilities and by enhancing the environmental quality and the attraction of the province for the development of residential areas.

B. Objectives and Scope

37. The objectives of the Project are to improve environmental quality and public health and welfare in Samut Prakarn Province by providing modern, reliable, and cost-effective wastewater collection and treatment facilities for the most developed urban and industrial districts in the province combined with programs to improve environmental monitoring and enforcement, as well as industrial pollution prevention and clean technology transfer (IPP-CTT).

38. The Project comprises an extensive range of works and activities as described below:

- (i) **Wastewater Collection System** - design and construction of a wastewater interception and collection system comprising trunk sewers (about 90 km) and secondary sewers (about 200 km) on the east bank and on the west bank of the Chao Phraya River; property connections including replumbing of existing houses (approximately 60,000); rehabilitation of existing combined and separate sewers (about 25 km); lift and pumping stations within urban districts for wastewater conveyance (about 150); pumping mains for wastewater conveyance

from subcatchments within urban districts; terminal pumping stations for wastewater transfer to central treatment facilities on the east bank and on the west bank; force mains for wastewater transfer to central treatment facilities; and oxygen injection facilities at terminal pumping stations and key lift stations.

- (ii) **Wastewater Treatment and Disposal Facilities** - design and construction of central wastewater treatment facility, comprising a 400,000 cubic meters per day (m³/d) aerated lagoon system to service the area on the east bank; central wastewater treatment facility, comprising a 125,000 m³/d aerated lagoon system to service the area on the west bank; terminal pumping station at the eastern treatment facility for transfer of effluent to multiple shoreline outlets in the eastern district; and force mains for effluent transfer from the eastern and western central treatment facilities.
- (iii) **Wastewater and Effluent Monitoring** - provision of equipment and instrumentation for wastewater and effluent monitoring systems for both permanent and mobile sampling and testing facilities.
- (iv) **Industrial Pollution Prevention and Clean Technology Transfer** - establishment of a cell for promoting IPP-CTT within PCD through long-term advisory services, and initiation and demonstration of industrial pollution prevention measures in selected industries including at least one industry in food processing, textile and dyeing, paper manufacturing, metal plating, and chemicals. The IPP-CTT component is described more fully in Appendix 3.
- (v) **Capacity Building** - implementation of a staff training program incorporating overseas training for managers and senior technical and financial personnel, and local training for technicians involved in wastewater collection and treatment operations as well as the establishment of a local training center with programs for training trainers and supplied with modern training materials and equipment.

C. Technical Justification

39. During the course of the TA study a wide range of strategy planning options to develop an effective wastewater management program in Samut Prakarn Province have been identified and evaluated, ranging from localized solutions incorporating several small treatment facilities, to centralized solutions involving one or two large treatment facilities. Thirteen options were eventually selected and evaluated in detail for cost (by present cost analysis), environmental impact (by initial environmental evaluation), social impact (by rapid social assessment), and technical features. The option comprising two large central treatment plants servicing districts on each side of the Chao Phraya River was finally selected as the optimum long-term strategy because this option represents the least-cost solution in economic terms, can achieve the desired water quality objectives, has minimal negative environmental and social impact, involves minimal resettlement and is affordable.

40. The recommended strategy involves combining the collection and the treatment of industrial, domestic, commercial, and institutional wastewaters, and establishes minimum pretreatment standards for discharge of factory wastewaters to the new system. The strategy is based on maximum use of separate sewerage for treatment efficiency, with interceptor sewers proposed only within the existing densely developed districts where the construction of new

separate sewers would be very disruptive and costly. The two large central treatment facilities will comprise simple, low-cost, and reliable aerated lagoon processes, and will be situated in remote locations so as to have minimal impact on existing and future urban areas. The strategy will maximize the use of existing wastewater facilities serving the Bang Pli Industrial Estate and New Town. Two central treatment facilities are required for the Project, with nominal design capacities of 400,000 m³/d for the east bank and 125,000 m³/d for the west bank. Both treatment plants will be designed for secondary treatment to achieve effluent quality levels of 20 mg/l biochemical oxygen demand (BOD) and 30 mg/l suspended solids or better. The layout of the east bank treatment plant will take into consideration future expansion to a capacity of 575,000 m³/d, while the west bank treatment plant layout will take into consideration future augmentation to provide for advanced secondary treatment capacity to produce effluent quality of 4 mg/l BOD and 6 mg/l suspended solids. Subject to the results of further wastewater investigations, each treatment plant will be designed for a BOD loading of 400 mg/l.

41. Both treatment plants will be designed on the basis of a series of treatment processes comprising coarse screening plant, completely mixed aerated lagoons, partially mixed aerated lagoons, and maturation pond. The lagoons and maturation pond will be designed for average dry weather flows in the year 2015 with a minimum detention time of two days in the completely mixed aerated lagoons and maturation pond and 1.5-2.5 days in the partially mixed aerated lagoons. The wastewater collection and treatment components, detailed design criteria, and flow estimates are in Appendix 4.

42. The Project will service a total area of about 170 km². Approximately 600,000 people will be served representing about 60 percent of the total population in the province, while about 80 percent of industrial wastewaters will be collected. The facilities provided under the Project will be designed to be expanded to eventually provide wastewater facilities to about 1.6 million people (i.e. 75 percent of the future projected population) and about 95 percent of all industries in the province. The remaining industries are too remote to be serviced by the Project and will be required to treat wastewater using in-house facilities. The remaining households are also too remote to warrant connection to the collection system and will continue to utilize septic tanks for wastewater treatment (an acceptable approach in sparsely populated communities).

D. Cost Estimates

43. The total cost of the Project, including physical and price contingencies, taxes and duties is estimated at about \$507 million equivalent. The foreign exchange costs, including indirect foreign exchange costs, amount to \$160 million equivalent, which is about 32 percent of the total. The local costs, including taxes and duties, amount to \$347 million equivalent, or 68 percent of the total. In addition, the Government has allocated approximately \$38 million for system expansion planned for 2001 and contract operations of the facilities for two to three years. The cost estimates are summarized in Table 1 and the details are in Appendix 5.

Table 1: Summary of Cost Estimates^a
(\$ million)

Item	Foreign Exchange	Local Currency	Total
A. Base Cost			
1. Sewers, Connections and Force Mains	54.0	143.5	197.5
2. Lift/Pumping Stations	14.0	16.1	30.1
3. Central Wastewater Treatment	47.0	87.6	134.6
4. Operational, Monitoring, and Control	3.0	1.0	4.0
5. Consultants	5.0	5.3	10.3
6. Industrial Pollution Prevention	<u>7.0</u>	<u>3.0</u>	<u>10.0</u>
Subtotal (A)	130.0	256.5	386.5
B. Contingencies			
1. Physical ^b	12.0	21.7	33.7
2. Price ^c	<u>18.0</u>	<u>30.3</u>	<u>48.3</u>
Subtotal (B)	30.0	52.0	82.0
C. Taxes and Duties	<u>—</u>	<u>38.5</u>	<u>38.5</u>
Total (A+B+C)	160.0	347.0	507.0
Percent	32	68	100

^a March 1995 prices.

^b Physical contingencies applied are five percent for materials and equipment, ten percent for civil works and 15 percent for land acquisition and consultants.

^c Price contingencies have been applied at 2.2 percent for foreign exchange costs and five percent for local costs.

Source: Staff estimates.

E. Financing Plan

44. It is proposed that the Bank provide a loan in an amount of \$150 million from its ordinary capital resources to cover a portion of the foreign exchange costs of the Project including the direct and indirect foreign exchange costs of civil works, equipment, and consulting services. The Borrower will provide the balance of \$357 million as budgetary allocations from its own resources. Of the \$357 million Government financing, \$257 will be from the central budget and \$100 million will be from the Environment Fund. The OECF will provide cofinancing of \$70 million of the Environment Fund portion from an existing but unutilized OECF loan of \$100 million equivalent to the Environment Fund. A summary of the proposed financing plan is in Table 2.

45. The loan, which will be in US dollars, will include interest at the Bank's variable rate for loans under its US dollar facility and an amortization period of 25 years including a grace period of 5 years. The Borrower will be the Kingdom of Thailand.

Table 2: Proposed Financing Plan
(\$ million)

Source	Foreign Exchange	Local Currency	Total Costs	Percent
Bank	150	-	150	30
Government	10	347 ^a	357	70
Total	160	347	507	100

^a Equivalent to B8,675 million.

F. Implementation Arrangements

1. Project Execution

46. The Executing Agency for the Project will be the Pollution Control Department (PCD) in MOSTE. The Samut Prakarn Wastewater Pollution Control Unit (SPWPCU), has been established within PCD. It is being staffed with specialists from PCD, WMA, and the province, and will be responsible for the implementation of the Project. The SPWPCU organization structure is shown in Appendix 6. PCD and the Governor's Office of Samut Prakarn Province will jointly establish a Project Steering Committee within two months of loan effectiveness cochaired by the Governor of Samut Prakarn Province and the Director General of PCD. The consultants for the Project will assist in Project management and construction quality assurance.

2. Procurement

47. Contract packaging proposals have been developed for the Project. Two turnkey contracts are envisaged to be awarded through international competitive bidding (ICB) for construction of wastewater collection and transfer facilities, wastewater treatment and disposal facilities, and property connections and house replumbing in each of the east bank and west bank areas. Turnkey contracting is considered the most appropriate approach because it will (i) establish both the east bank and west bank systems from the upper to the downstream with the same design concept and equipment, which will improve operation and maintenance efficiency and reduce operation and maintenance costs; (ii) enable the contractor for the east bank system and the contractor for the west bank system to be responsible for the respective systems including the initial operation of the facilities, and (iii) reduce the cost by about 8 percent and the implementation period by about 15 months. The turnkey contractors will be responsible for operation and maintenance of the facilities constructed for the Project for three years following initial commissioning, until the completion of construction of secondary sewers and connections. One ICB contract is proposed to be awarded for the purchase of the operational, monitoring, and control equipment. A fourth ICB contract will cover the equipment,

services, and training for the IPP-CTT component. The contract packages are shown in Appendix 7.

3. Consulting Services

48. Consulting services will be obtained in one package, for assistance in management of the Project and quality assurance. The consultant will be selected in accordance with the Bank's *Guidelines on the Use of Consultants*. About 188 person-months of international experts and 462 person-months of domestic experts and technicians will be required. This equates to a team comprising from four to ten specialists (excluding technicians) depending on the stage of construction. The consulting package includes the preparation and delivery of formal and on-the-job training. In addition, an individual industrial pollution prevention expert will be required for a total of 12 person-months. The outline terms of reference and consulting services requirements are shown in Appendix 8. The requirement for consulting services has been discussed with the Government and represents the minimum input needed to implement the Project.

4. Implementation Schedule

49. The overall Project implementation period is 5.5 years. It is envisaged that implementation of the Project will proceed rapidly with the treatment facilities being partially commissioned in the third year of construction and 80 percent of the facilities operational after the fourth year. This schedule will be possible by having the major works carried out under parallel contracts covering the design and construction of the wastewater collection, transfer, treatment, and disposal facilities. Two relatively large areas of land will need to be acquired for the central treatment plants, although inquiries so far indicate there are no particular problems or undue delays anticipated that could affect the overall implementation schedule. The final two years of construction will involve the expansion of the sewer system. The Project is expected to be completed by the middle of year 2001. The implementation schedule for the Project is in Appendix 9.

5. Project Trial Cost Recovery Program

50. The trial cost recovery program for the Project will be implemented by PCD over a two year period after initial commissioning of treatment facilities.¹ The trial cost recovery program is considered essential to establish awareness of Project benefits and willingness to pay, particularly since the Project will be the first large-scale wastewater management investment in Thailand with a cost recovery program and will set the stage for future efforts at cost recovery for environmental projects. The program is timed to coincide with the improvements in environmental quality which will result from the initial commissioning of Project treatment plants. The initial phase of the program will incorporate and further develop results of the Bank-financed TA which included an evaluation of the alternative tariff structures and of billing and collection systems. Once the tariff structure has been identified, the level of user charges consistent with this structure will need to be determined. In order to determine these

¹ The Danish Cooperation for Environment and Development (DANCED) has agreed to provide technical assistance to PCD for the trial cost recovery program and to strengthen enforcement mechanisms in parallel with the Project, based upon terms of reference developed by the Bank Mission. The Bank will periodically review technical aspects of the DANCED TA in conjunction with Project review missions.

tariff requirements, a series of preliminary cost recovery scenarios will be established. Each scenario will incorporate a distinct set of realistic cost recovery targets. Based on affordability analysis during the TA study these scenarios may include coverage of only administrative, operating, and maintenance expenses or coverage of administrative, operating and maintenance expenses plus recovery of selected percentages of depreciation of the Project which could be used to finance future expansion costs. The revenue requirements associated with each scenario will be determined over a ten year forecast period on the basis of projected operating and maintenance expenses. These projections for expenses will be developed after a review of the actual operating and maintenance expenses incurred over the initial period of operation. The user charges associated with each cost recovery scenario can then be determined on the basis of these revenue requirements. After an evaluation of user charges in terms of affordability, willingness to pay, and subsidy requirements, the cost recovery scenario most consistent with these criteria will be identified and adopted for implementation. The billing and collection systems designs and implementation will be determined by the tariff structure design.

6. Operation and Maintenance

51. Experience with the operations and maintenance of wastewater systems is limited in Thailand. Therefore, the preliminary design prepared for the Project has focused on providing modern, simple, reliable components that require minimal experience in operations and maintenance. Nevertheless, extensive staff training courses will need to be implemented to ensure that the facilities provided under the Project are properly operated and maintained. To ensure adequate operation and maintenance of the facilities, the turnkey contractors will be responsible for operation and maintenance after commissioning of the facilities until the middle of 2001. During this initial three year period of operations, the turnkey contractors will be responsible for training staff of the operating entity identified by the Government (most likely to be WMA), which will then take over the operations of the Project. It is expected that the day-to-day operations of the Project facilities will be contracted to qualified operators in the private sector. In addition, under the Project, external training will be provided for the key staff of the Project who will be responsible for middle and upper level management.

7. Wastewater Monitoring and Enforcement

52. In conjunction with the Project, a range of measures have been developed to provide early environmental benefits both within the areas covered by the Project and in communities that are too remote to be serviced by the Project. These measures include: strengthening the ongoing wastewater monitoring and enforcement program to ensure industries and other major sources of water pollution comply with current discharge standards; requiring small- and medium-scale industries, which do not operate pretreatment facilities, to dispose of their wastewater by road tanker to existing and new central treatment facilities until the new wastewater collection systems are installed; and implementing and enforcing regulations to ensure all wastewater collection facilities in the new urban and industrial developments are constructed as separate sewerage systems in lieu of the current common practice of building less efficient combined sewerage systems.

8. Land Acquisition and Rights

53. The new wastewater collection sewers and transfer mains, and most pumping stations, will be constructed within road reserves or on Government-owned land. About 12

pumping stations (out of the 150) will need to be constructed on about 2.5 hectares (ha) of privately owned land that will be purchased as part of the Project. The sites for the pumping station have been selected so that no resettlement will be required. Two large land sites totaling about 300 ha will be acquired for the central treatment facilities. Two large areas of land, one on the east bank and one on the west bank, have been identified as suitable general locations for the treatment facilities because these areas are generally uninhabited and are old paddy fields abandoned because of salinization of the soil. These areas comprise individual privately-owned land plots that will be acquired for the Project. Both general areas have been selected to avoid the need for resettlement. When the exact sites are selected, if it is not possible to acquire land with no inhabitants, the Government will submit a resettlement plan, satisfactory to the Bank, covering the households affected by land acquisition.¹

54. The PCD will provide the prequalified bidders for the two turnkey contracts with a shortlist of nominated land subcontractors that have a demonstrated ability to provide the required land. The bidders for the turnkey contracts may associate with one of the nominated subcontractors. The bids will include detailed description of the land to be acquired by the bidder or the bidder's nominated subcontractor, if selected, including descriptions of the location, use and current ownership status of land to be acquired for the Project. The selected turnkey contractor or nominated subcontractor will be responsible for land acquisition to be completed within nine months after signing turnkey contracts. The land titles will be consolidated and transferred to the Government as one plot for the treatment facilities on the east bank and one plot for the treatment facilities on the west bank of Chao Phraya River.

9. Midterm Review

55 A comprehensive midterm review will be carried out after major contracts have been awarded and detailed design for the first stage of construction has been completed; this is envisaged to be about two years after the loan becomes effective. The purpose of the review will be to evaluate the actual progress, implementation procedures, procurement methodology, benefit, monitoring and evaluation (BME) activities, and the performance of the project management and quality assurance consultants. Following the review, corrective measures as appropriate will be introduced to remedy any identified weaknesses in the implementation of the Project.

10. Reports, Accounts and Audits

56 The PCD will provide the Bank with quarterly progress reports on the implementation of the Project. Within three months of physical completion of the Project, the PCD will prepare and submit to the Bank a project completion report on the implementation and initial operation of the facilities provided under the Project. Accounts and records will be maintained in such a manner to facilitate identification of sources of funds and expenditures incurred on the Project. The PCD will maintain an adequate accounting system and will prepare a set of financial statements including an income statement and a balance sheet. All the accounts and financial statements will be audited by auditors acceptable to the Bank, and submitted to the Bank within nine months of the end of the fiscal year.

¹ It is not considered practical to prepare the compensation and resettlement plan until detailed design is completed. It is not possible to confirm locations required until that stage of the Project. The Project has identified suitable sites for land acquisition that minimize resettlement.

11. Community Participation and Environmental Health Actions

57 Extensive community participation has played a key role in each step of the conceptual and feasibility planning of the Project. The designation of Samut Prakarn Province as a pollution control area resulted from public complaints and discussions on the degrading environmental quality. The preparation of the feasibility study involved consultation with individual households, local community, business, industry, and government leaders, and NGOs. Two public seminars have been convened to discuss the objectives, scope, costs, cost recovery, and implementation arrangements for the Project. The results of the consultation efforts were carefully incorporated in the formulation of the Project.

58 To continue the involvement of the community that was initiated during the planning of the Project about operational issues, a customer relations subunit will be established within SPWPCU within three months of loan effectivity to keep the community informed about activities related to the Project. This subunit will work closely with the Provincial Health Division in Samut Prakarn Province, which has a health education group comprising several staff whose role is essentially to instruct health workers on how to deliver health messages including improving the health and sanitary conditions. The provincial authority of Samut Prakarn is using appropriate mass media and communication channels, to inform the community about the principal objectives of the Project and the proposed general locations for treatment facilities, main pumping stations, service area and expansion plans, and cost recovery plans. Prior to the actual start of the construction works, the turnkey contractors will be required to inform the affected population.

12. Benefit Monitoring and Evaluation

59 To ensure that the wastewater management facilities are efficiently operating at the envisaged service levels, and that the target groups are realizing the anticipated benefits from the development, a BME program is included under the Project. The BME program will (i) monitor the implementation performance of the Project, which will mainly deal with the timely realization of physical and other components of the Project, (ii) monitor the operations performance of the Project, mainly in terms of area and population connected to the collection system, operation and maintenance performance, and level of cost recovery achieved; and (iii) evaluate the performance during and after implementation of the Project. Ultimately, the results of the BME program will be incorporated into an evaluation exercise, which will be undertaken after an extended period of operation of the facilities. The baseline conditions will be established at the time of commissioning of the treatment facilities. The design, development, and commissioning of the BME system will be carried out with assistance of the Project consultants, but its maintenance will be the responsibility of a management information systems (MIS) subunit to be established within the SPWPCU. Assistance to the MIS subunit will be part of services required to be provided by the consultants. The MIS subunit will organize the collection, presentation, and analysis of data on (i) production, level and standard of service (number and location of connections, water quality, and consumer complaints); (ii) financial operations (revenue and expenditure); and (iii) relevant public health conditions including morbidity from waterborne and sanitation-related diseases. The BME information system design will be based on the Bank's *Benefit, Monitoring and Evaluation Handbook* and carefully tailored to meet the conditions in the area covered by the Project. Reports will be produced monthly for the management of the SPWPCU and quarterly for the PCD. The PCD will provide the Bank with the information produced under the BME program in the first quarterly report for each year.

G. The Executing Agency

60. The Executing Agency for the Project will be the PCD. Institutional constraints and unclear lines of authority among the various Government agencies have been major reasons for the lack of progress in the 1970s and the 1980s in controlling pollution in Samut Prakarn Province. However, designation of Samut Prakarn Province as a pollution control area in 1994 placed it under the responsibility of PCD and made it feasible to establish the special institutional arrangements needed for ensuring the institutional soundness of the wastewater management Project. The institutional resources of Samut Prakarn Province, including the provincial government as well as the municipalities and sanitary districts, are presently not sufficient to manage the proposed Project, hence such resources will need to be strengthened by the central Government, especially PCD. The SPWPCU will be established within PCD to streamline the operations relating to the Project and thereby facilitate efficiency during the critical period of construction and operation. The Project will be used as an opportunity to train WMA staff by seconding them to the SPWPCU for the duration of the construction of the Project. The joint staffing of SPWPCU by PCD, WMA and the provincial government of Samut Prakarn, combined with the assistance of the consultants and the initial operations by the turnkey contractors and eventual operations by private sector contractors, will result in optimum operational efficiency and technology transfer.

61. The PCD is one of three departments in MOSTE, responsible for carrying out its environmental operations. The PCD is responsible for: (i) proposing national policies and planning for pollution control; (ii) proposing environmental quality criteria and emission and effluent standards; (iii) formulating management and action plans as well as measures for pollution prevention, control, and mitigation; (iv) monitoring, inspecting and reporting on the status of pollution; (v) developing systems, models, and methods that are suitable for practical application in air and water quality management, noise control, and hazardous waste management; (vi) taking legal action for the enforcement of pollution control regulations under NEQA; (vii) processing and acting upon pollution complaints; and (viii) performing other duties as specified by law or authorized by MOSTE or the Cabinet. The PCD consists of the Office of the Director General and five divisions including (i) Water Quality Management Division, (ii) Air and Noise Quality Management Division, (iii) Legal Petitions and Complaints Division, (iv) Pollution Management Coordination Division, and (v) Toxic Substance and Solid Waste Management Division. PCD presently employs about 350 professional staff and has plans to grow to about 1,100 staff, and has demonstrated its ability to implement policy directives from the Government. Since PCD assumed responsibility for environmental improvement projects in designated pollution control areas the projects are progressing satisfactorily and the level of enforcement of environmental regulations has improved.

H. Environment and Social Measures

62. An initial environmental examination (IEE) was carried out for each of the 13 wastewater strategy options to compare the (i) siting of treatment facilities, (ii) layout of sewers and effluent pipelines, (iii) process and structural design, (iv) construction, (v) system operation, and (vi) effluent and sludge disposal. The IEE showed that the centralized treatment option selected for the Project will result in the minimum adverse environmental impacts. The rapid social assessments of the options showed that the negative impacts associated with centralized strategy options will be considerably less than other options involving localized treatment facilities situated within or in close proximity to urban districts. In social terms, the major difference between the options is in the degree of negative impact from the acquisition of land

for the treatment facilities and the subsequent relocation of residents, and from the disruptions caused by construction of the treatment facilities and the laying of sewers and pressure pipelines. Although less land areas would be required to be purchased for the localized facilities, the number of people who will need to be relocated would be substantially greater because these sites are situated in urbanized areas. The construction and operation of treatment facilities in these areas would have considerable negative social impact on residents. In contrast, the negative impacts associated with the purchase of land in nonurban areas for the larger centralized facilities and the related construction and operation of treatment facilities will be substantially less. Accordingly, the centralized option involving the siting of treatment facilities in nonurban areas is preferred in terms of minimizing the negative impacts of an improved wastewater system.

63. An environmental impact assessment (EIA) was prepared for the Project. The key conclusions and recommendations of the EIA are as follows: (i) the interventions by the Project will not cause any significant adverse impacts on the environment; (ii) the impacts related to the requirement for land for wastewater treatment plants and the land acquisition process are more long term and will be mitigated by adequate compensation; and (iii) the interference with utilities during construction of the sewers is the most significant impact, however it is temporary and will be minimized by appropriate engineering and construction controls. Thus, the EIA concluded that the environmental benefits of the Project far outweigh any adverse impacts.

64. A detailed social impact assessment was prepared for the recommended centralized option. About 300 ha of land will be required for the two centralized treatment facilities. There are no informal settlements on the land and there is very little land available for rent. Thus, there will be no land users relocated who do not receive compensation through a fair market price paid for the land. The Project requires large trunk sewers, the laying of which will cause disruptions in already heavily congested urban areas. The contractors will be required to reduce the disruptions by working at night and by utilizing "no dig" technologies (such as pipe jacking) to construct pipelines under the roads and canals. A policy of informing the public through the print and radio media about the disruptions due to major roadworks will also help to reduce them. Finally, the treatment of the wastewater itself will generate a certain level of pollution in the form of noxious odors from aeration lagoons and wastewater storage areas, and noise pollution arising from the operation of the treatment facilities. The sites and design criteria proposed for the treatment facilities and surrounding grounds on both the east bank and the west bank have been chosen so as to minimize the effects of pollution on the residents of Samut Prakarn Province. The sites are away from current or planned residential areas; however, eventually, there will probably be some urban encroachment, particularly around the site on the west bank. Therefore, treatment facilities have been designed to minimize noise and air pollution.

I. Policy Issues

1. Establishment of the SPWPCU

65. It was recognized at the beginning of the planning for the Project that a strong implementation unit would be required, for both the construction and the initial operations of the facilities provided under the Project. Several options were carefully reviewed such as establishing a project management unit in the Governor's office in the Samut Prakarn Province or in PCD, or delaying the implementation of the Project until WMA could take responsibility for

the Project, among others. It was agreed that the need for the Project was too urgent and the time frame too long for these approaches and that the best approach would be to establish SPWPCU within PCD with staff from PCD, WMA, and the provincial government of Samut Prakarn. The SPWPCU is structured to operate independently with the Director General of PCD responsible for the day-to-day implementation and with guidance from the Project Steering Committee.

66. The successful implementation of the Project will depend on the continued cooperation of the public and industries in Samut Prakarn Province. So far the Project has received strong support from the local community. This cooperation is essential to maximize the environmental and public health benefits from the Project by improving community and family hygiene. It is important in facilitating cost recovery. Thus, the Government agreed that PCD will establish a subunit within SPWPCU to be responsible for customer relations for the Project and to obtain the commitment from the beneficiaries to pay tariffs and to promote environmental health education and thereby enhance the benefits of the Project.

67. The Industrial Pollution Prevention and Clean Technology Transfer (IPP-CTT) component of the Project is the first adequately funded attempt to encourage industry to shift from using its existing inefficient and highly polluting practices to modern, efficient, clean technologies. The support from the Project will have to be cost-saving oriented to convince industries to make the capital expenditure required for this shift. To provide the necessary guidance and support to industries, PCD will establish a subunit within SPWPCU solely responsible for the IPP-CTT program. Eventually the IPP-CTT services should generate revenue from industry that will cover the operational costs of the overall activities of the IPP-CTT program. Upon completion of the construction of the Project in 2001, PCD will incorporate the IPP-CTT subunit, which will assume a national role then.

2. Tariffs and Revenue Collection

68. The general agreement on cost recovery is described in para. 24. Specific issues related to the Project include the minimum tariff, tariff structure, and collection measures. The PCD and the Mission have reached general agreement on structuring and tariff levels for industry and commerce. During the course of the feasibility study and the preparations for the Project, the tariff and revenue collection practices of other countries in the region and of several industrialized countries were reviewed. The most common practice is not to collect wastewater management fees from households but rather to finance capital and operation and maintenance costs through tax revenues. In some countries, there is a surcharge on the water bill to cover environmental costs. In other countries, there is a wastewater management or environmental charge based on the number of toilets in the building. The Government and Mission held discussions with MWA to explore the possible inclusion of a surcharge on water supply bills, however, only about 20 percent of the households and businesses are serviced by piped water supply at the present time. The charge based on number of toilets is considered to be equitable and to have potential application for the Project, however, the fee and a workable collection system must be developed and, most important, a willingness to pay must exist which will evolve with the recognition of the Project benefits. Thus, it was agreed that a trial cost recovery study would be undertaken after the benefits of the Project begin to accrue to develop pragmatic approach to cost recovery. The optimum and most practical method to collect revenue from industry and households will be determined upon the completion of the trial cost recovery study.

V. PROJECT JUSTIFICATION

A. General

69 The Project will provide a cost-effective, affordable and technically sound solution to the current wastewater pollution problem in Samut Prakarn Province. It will substantially improve the wastewater services for communities and industries, and will provide a noticeably cleaner environment. It will also improve community health by reducing the risk of exposure to wastewater and consequent health problems and will benefit women in particular, because it will reduce the effort, time, and costs involved in caring for those who are sick in the family, particularly children. The Project will particularly benefit the poor and low-income families who often live close to factories and in low-lying or flood-prone areas and who are often exposed to polluted waterways. The Project represents a major step towards improving the environment within Samut Prakarn Province, the lower reaches of the Chao Phraya River, and the upper part of the Gulf of Thailand. It will reduce the costs and enhance the benefits for agricultural and aquaculture industries. It also represents the most cost-effective solution for industrial water pollution control and will encourage economic investment in the province.

B. Economic and Financial Analyses

1. Economic Analysis

70 The economic analysis of the Project included, (i) an evaluation of 13 technically feasible alternatives, which confirmed that the alternative selected for the Project represents the least-cost solution in economic terms, (ii) an estimation of the incremental economic costs, (iii) an identification and a valuation of the major economic benefits, (iv) a benefit-cost analysis on a "with" and "without" the Project basis, and (v) a sensitivity analysis. The least-cost analysis was based on a comparison of economic costs over a period of 35 years beginning 1995 and included both the investment costs and the operating expenses. The economic costs and benefits have been estimated in border prices in domestic currency. The financial values have been converted into economic values by using a standard conversion factor and specific shadow prices for skilled and unskilled labor.

71 The economic benefits from the Project will arise from (i) avoided costs for industrial relocation, (ii) savings in health care costs, (iii) avoided annual losses in paddy output, (iv) savings for households in septic tank desludging, (v) savings for factory operators by avoiding the need for investments in-plant treatment facilities and increases in operating expenditures, and (vi) an increase in residential land values. These benefits have been estimated on a conservative basis. The benefits attributable to the Project that could not be estimated and therefore were not included in the economic internal rate of return (EIRR) calculations include (i) environmental improvements from improvements in water quality, (ii) increased industrial and commercial land values, (iii) commercial value of wastewater sludge saleable as fertilizer or fill material and of treated effluent for use as cooling water by industry, and (iv) increased commercial value of fishery, aquaculture, and orchard output.

72 The calculation of EIRR was based on a comparison of incremental economic costs and economic benefits "with" and "without" the Project. The life of the Project was assumed to be 35 years. The economic benefits comprised cost savings and other benefits noted earlier.

The total of these benefits for any given year was deducted from the economic costs to yield the net benefit. The EIRR is estimated at 23 percent. The detailed economic analysis is presented in Appendix 10.

73 Sensitivity tests have been carried out on the economic analysis that confirms that the EIRR is robust with changes in the major parameters. An increase in capital costs by 10 percent would reduce the EIRR to 20 percent, while a decrease in benefits by 10 percent would reduce the EIRR to 19 percent. A combination of these two scenarios would reduce the EIRR to 16 percent, while a one year delay in Project implementation would reduce the EIRR to 17 percent.

2. Financial Analysis

a. Project Financing and Institutional Arrangements

74 The Project will be financed entirely by the Government through the Environment Fund and budgetary allocations. Although the Bank will provide a loan for \$150 million to the Government to cover most of the foreign exchange costs of the Project, the Government will bear the interest costs and exchange risks. Thus, the PCD will not be responsible for the debt service payments. This financing arrangement allows the revenues collected over and above the operating and maintenance costs to be used by the operating entity for future expansion programs.

b. Cost Recovery Target, Tariff Structure, and Affordability

75 The initial cost recovery goal for the Project is to generate sufficient revenue from service charges to cover the operating and maintenance costs plus depreciation by the year 2005, when the projected wastewater treatment volumes will be about 70 percent of the capacity of the Project. If this level of cost recovery is achieved, it will eliminate the need for operational subsidies and will establish the principle that all activities (including normal household functions) that produce wastewater can contribute to the cost of wastewater collection and treatment. The annual operating expenses are projected to be about \$26 million for the targeted year and depreciation is projected to be about \$14 million. Thus, the total cost recovery target for 2005 is \$40 million.

76 An indicative tariff structure has been developed to achieve this target in 2005 as shown in Appendix 11. The households in the area covered by the Project are expected to be charged at a flat rate, while the industries, commercial establishments, and institutions will be charged according to the volume of the wastewater produce. The indicative tariffs have incorporated the concept of cross-subsidization and are structured progressively so that entities that generate higher volumes of wastewater will be charged at progressively higher tariffs. The progressive tariff structure will also encourage water conservation. At the initial stage, all the industries will be charged on the basis of the volume of wastewater without regard to pollution load. In the future, when sufficient data on pollution loads have been collected from industries, differential tariffs for the different categories of industries will be adopted.

77 The affordability of a wastewater tariff to domestic users depends on how much of their income the tariff represents. In water supply and sanitation projects, the service is generally considered affordable if tariffs range from 3 percent to 5 percent of household monthly income. Survey data on distribution of monthly family income in Samut Prakarn Province revealed that 20

percent of the families have incomes below B5,000/month (\$200); and the median monthly income was estimated to be B9,000 (\$360). For purposes of financial projections the Bank and PCD have agreed in principle to a flat rate wastewater charge of about B100 (\$4) per month in 2005. The rates will be adjusted based on the results of the trial cost recovery program. It is estimated that the wastewater charges will represent less than 1 percent of monthly household income for the large majority of households. The combined water and wastewater tariff is estimated to represent a maximum of 3.5 percent of monthly household income, which is within the limits of household affordability. It is possible that the proposed wastewater tariff of B100/month in 2005 may not be affordable to the poorest households (an estimated 5 percent of the total number of households) even after allowing for a real income increase of 2.5 percent annually. These households will be cross-subsidized under the industrial tariff schedule or will be subsidized directly by the Government.

c. Financial Projections

78 Based on this cost recovery target and tariff structure, financial projections have been prepared for the Project. The proposed tariffs are based on affordability and the experience of the Government in introducing new tariffs and, more important, in increasing tariffs. Nevertheless, the operating income from the Project will improve steadily over the projection period with the expansion of the collection base. By the year 2005, the Project will generate sufficient revenues to cover the operating and maintenance costs plus depreciation expense. With the accumulated funds from depreciation, the operating entity will be able to finance expansion programs of about B 315 million annually by the year 2005.

C. Subsidies

79. The Project will be the first wastewater management project in Thailand to have a significant level of cost recovery. Indeed, one of the policy objectives of the Project is to help the Government pioneer a program for revenue generation within wastewater management project service areas to ensure that the facilities can be adequately operated and maintained and necessary expansions constructed when required without having to rely on external financing or subsidy. This will be accomplished under the proposed Project. However, a longer-term and much more difficult goal is to finance the construction of such facilities without relying on Government budgetary allocation or subsidy. As previously noted, the application of the polluter-pays principle for the Project and future wastewater management projects in BMR means that all the residents, businesses, and any other polluters should pay their fair share of such improvements and will enjoy the environmental benefits whether or not they are serviced by one of the systems. The establishment of an appropriate national policy and implementation procedure to address this issue will be an output of the Project after experience is gained from the Project's cost recovery program which will be the first such program in Thailand. Until then, and for the Project, the capital cost of wastewater management will be financed by Government budgetary allocations, similar to streets or public schools, and the operation and maintenance and expansion of the facilities will be financed by revenues from the Project. While the Project will require a significant subsidy from the Government, which is justified because the benefits from the Project are environmental and health-related in nature and to a large extent accrue to the urban poor — the segment of the population most vulnerable to environmental risks related to the discharge of untreated wastewater and waterborne diseases. The urban poor will be targeted as the primary beneficiaries of subsidies arising under tariff structures which will incorporate cross-subsidies in industries that pay the greatest charge for the service. One of the

objectives of the trial cost recovery program is to help design a feasible tariff structure that will ensure equity as well as transparency.

80. The Government recognizes that a subsidy for a particular project involves the redistribution of national wealth in favor of a particular region, which may or may not be justified economically, given its limited resources. The Government has determined that this will be necessary in the short-term to initiate urgent actions to address environmental degradation and has given priority to the Project to receive such subsidy. However, by identifying the Project as the first large-scale wastewater management investment with a cost recovery program, the Government and the Bank will benefit from the results of Project implementation in terms of being able to assess the long-run viability of undertaking such projects without any subsidies.

D. Environment

81 Samut Prakarn Province is growing rapidly because of its proximity to Bangkok and its strong industrial base. Over the next 20 years, the province is forecast to have the second highest population growth rate among all the provinces in Thailand, at 3 percent per annum. The construction of the proposed Second Bangkok International Airport will be another factor that will contribute to this rapid growth. The high rates of population growth combined with the already high population densities (20,000 persons per km² in the highly urbanized areas) and the large industrial sector will place increasing pressure on the already deteriorating environment. The concern at the national level about the deterioration of the environment in Samut Prakarn Province is evidenced by the designation of province as a pollution control area in 1994. At the community level, the concern is evidenced by the findings of the socioeconomic survey carried out under a Bank-financed TA. About 70 percent of respondents considered that polluted canal water had some unfavorable impact on them and their families, and a similar percentage considered that treatment was required for both factory and domestic wastewater.

82 The collection and treatment of domestic and industrial wastewater in the area covered by the Project will restore the minimum DO level to one considered acceptable for maintaining aerobic conditions and aquatic life in tropical conditions (2.0 to 3.0 mg/l) in the canal waters. The improvement in the quality of water in the Chao Phraya River will reduce the level of pollutants, including heavy metals, discharged into the coastal zone of the Chao Phraya River estuary, which has shown elevated levels of heavy metals and pesticides in both the seawater and the sediments. The reduction in the level of polluted water reaching the canals and the Chao Phraya River will improve the quality of life of those living near the waterways. The improvements in the disposal of industrial and domestic wastewater will also improve the quality of life of those living near the factories. The Project will also contribute to an improvement in the beneficial uses of the waterways, such as for freshwater fisheries and aquaculture, water transport (by reducing obstruction by vegetation in canals), and use of water for industrial purposes.

E. Social Dimensions

83 The Project will improve the welfare of the general population by reducing public health risks and improving environmental quality. The lowest-income households, many living in low-lying, flood-prone areas and along the sides of the heavily polluted canals and around factories and construction sites where they are employed as unskilled labor, will be primary beneficiaries. These families are currently being exposed to a heavily polluted environment and unsatisfactory sanitary conditions, which explains the above average incidence of water-borne diseases, especially diarrhea, in Samut Prakarn Province. The Project will reduce the volume of

domestic wastewater stagnating around dwellings and of industrial wastewater stagnating around factories and decrease the spread of wastewater under flood conditions. Therefore, the poor will directly benefit from these environmental improvements, which will be reflected in a significant reduction in the incidence of water-borne diseases and infections. The public health education campaigns under the Project will focus on poor households that are concentrated in wastewater-prone locations. These households will benefit the most from the improvements in the health of family members, which will decrease their private health care expenditures and will enhance their earning potential by enabling them to work more days and to achieve higher productivity. Many poor families live in informal settlements around construction sites and factories and are at present not provided with adequate sanitation facilities. Although sewer connections to households in such temporary settlements are not part of the design of the Project, community participation and public campaigns will urge construction contractors and factory owners to improve the sanitary conditions by providing an adequate collection and disposal system for domestic wastewaters.

84 In Samut Prakarn Province, as in Thailand generally, women have an important role in both earning income and running the household. In almost all of the households interviewed, one or more of the women in the households worked full-time and earned income. About 40 percent operated businesses from their house, of which half were managed by women. While high and some middle-income families may be able to hire domestic help, there is little assistance for women in the low-income households, thus domestic chores tend to take up much of women's nonworking time. The lack of internal plumbing and kitchen facilities means that washing and food preparation often has to be done outside, which increases the level of exposure to pathogens. The installation of household connections, the improvements in water quality, and the public health education campaigns under the Project, will decrease the sanitation hazards faced by many women.

F. Risks

85 The major risks related to the Project are (i) delays in acquisition of land required for central treatment facilities, (ii) delays in construction of trunk sewers and collectors in congested areas from traffic control-related restrictions, and (iii) delays in implementing the cost recovery program and consequent shortfalls in financial returns. The risk of delay in land acquisition has been minimized by selecting remote, generally uninhabited land with limited development potential as sites for the central treatment facilities. The risk of delays in construction has been minimized by requiring contractors to prepare detailed construction programs, taking into account the traffic and related constraints, to ensure maximum flexibility so that the overall work will be maintained on schedule. The potential for delays in implementing the cost recovery program will be minimized by providing parallel technical assistance (DANCED) to assist SPWPCU to design a cost recovery system, implementing it on a trial basis and carrying out the related public education campaigns.

VI. ASSURANCES

86 The Government and the Executing Agency have given the following assurances, in addition to the standard assurances, which have been incorporated in the legal documents.

1. Land Acquisition

87 All land required for the central wastewater treatment systems will be acquired within nine months of the signing of turnkey contracts for such systems. In the event that the turnkey contractors are unable to acquire all land required, Government expropriation procedures will be initiated. In the event that resettlement and compensation are required following such land acquisition, a resettlement and compensation plan will be submitted to the Bank for its approval.

2. Project Steering Committee

88 PCD and the Governor's office in Samut Prakarn Province will jointly establish the Project Steering Committee within two months of loan effectiveness. The membership of the Project Steering Committee will include representatives of relevant Government departments, local industry organizations, and NGOs.

3. Cost Recovery and Tariffs

89 The PCD will take all necessary steps to establish tariffs and an associated revenue collection system to meet the targets described in para. 90. The PCD will prepare appropriate wastewater tariff schedules for industrial and commercial premises within six months of commissioning of treatment plants. A two-year cost recovery trial program will be undertaken after commissioning of treatment plants. The cost recovery program will be fully implemented immediately following completion of Project construction and full commissioning of the Project facilities (based on the results of the trial).

90 PCD or another Project-operator designated by the Government will be required to generate sufficient operating income from its tariffs and charges within four years from completion of Project construction to recover fully (i) its recurrent expenditures on administration and operation and maintenance and (ii) annual depreciation. By the date which Project facilities are fully operable (expected to be late 2001), the tariff levels will be adequate to meet recurrent expenditures and no less than 50 percent of the annual depreciation. By the third year of full operations of Project facilities, the tariff levels will be adequate to meet the recurrent expenditures and no less than 75 percent of the annual depreciation. The accumulated operating income will be reinvested in the expansion of the facilities in the area covered by the Project. Any shortfall in the annual income generated to meet these cost recovery targets will be met fully by the Government from budgetary allocations.

4. National Cost Recovery Policy

91 The PCD will submit a proposal to the National Environment Board for a national wastewater management cost recovery policy and procedures no later than six months of completion of construction and commissioning of Project facilities.

5. Compliance with Standards

92 The PCD will establish an appropriate regulatory framework and monitoring program to ensure that facilities provided under the Project and the industries within the area it covers meet the effluent water quality standards.

VII. RECOMMENDATION

93 I am satisfied that the proposed loan would comply with the Articles of Agreement of the Bank and recommend that the Board approve the loan of \$150 million to the Kingdom of Thailand for the Samut Prakarn Wastewater Management Project, from the Bank's ordinary capital resources, with interest to be determined in accordance with the Bank's pool-based variable lending rate system for US dollar loans and with an amortization of 25 years, including a grace period of 5 years and such other terms and conditions as are substantially in accordance with those set forth in the draft Loan Agreement presented to the Board.

MITSUO SATO
President

16 November 1995

APPENDIXES

Number	Title	Page	Cited On (page, para.)
1	External Assistance for Urban Water Supply and Wastewater Management	32	6,16
2	Project Framework	33	7,22
3	Industrial Pollution Prevention and Clean Technology Transfer (IPP-CTT) Program	34	12,38
4	Components, Design Criteria, and Flow Estimates for the Project	39	14,41
5	Cost Estimates	45	14,43
6	Samut Prakarn Water Pollution Control Unit (SPWPCU) Organization Plan	46	16,46
7	Indicative Procurement Packages	47	16,47
8	Consultant Terms of Reference	48	17,48
9	Summary of Implementation Schedule	53	17,49
10	Economic Analysis	54	24,72
11	Financial Analysis	62	25,76

SUPPLEMENTARY APPENDIXES

(available on request)

A	Benefit Monitoring and Evaluation
B	Socioeconomic Survey
C	Water Quality
D	Industrial Data and Factory Surveys
E	Initial Environmental Examination

EXTERNAL ASSISTANCE FOR URBAN WATER SUPPLY AND WASTEWATER MANAGEMENT

Item	Beneficiary Agency	Amount (\$ million)	Year Approved
I. Loan Project Assistance		<u>999.7</u>	
A. Overseas Economic Cooperation Fund (OECF)		<u>623.2</u>	
1. First Bangkok Water Supply	MWA	35.0	1979
2. Second Bangkok Water Supply	MWA	45.8	1984
3. Third Bangkok Water Supply	MWA	42.8	1986
4. Fourth Bangkok Water Supply	MWA	75.0	1989
5. Fifth Bangkok Water Supply	MWA	169.7	1992
6. Chiang Mai Water Supply	PWA	6.5	1977
7. Khon Kaen Water Supply	PWA	10.8	1986
8. Four Provincial Cities Water Supply	PWA	4.0	1987
9. Nakhon Ratchasima Water Supply Expansion	PWA	16.1	1987
10. Provincial Cities Water Supply	PWA	70.0	1991
11. Three Provincial Cities Water Supply Expansion	PWA	47.5	1992
12. Environment Fund	MOSTE	100.0	1993
B. The Bank		<u>260.0</u>	
1. No. 137-THA: Bangkok Water Supply	MWA	19.6	1973
2. No. 443-THA: Second Bangkok Water Supply	MWA	68.0	1979
3. No. 618-THA: Songkhla Lake Basin Planning	NESDB	3.0	1982
4. No. 735-THA: Third Bangkok Water Supply	MWA	130.9 ¹	1985
5. No. 1326-THA: Chonburi Water Supply	PWA	38.5	1994
C. World Bank		<u>105.0</u>	
1. Bangkok Water Supply	MWA	55.0	1974
2. Provincial Water Supply	PWA	40.0	1980
3. Regional Cities (Wastewater Management Component)	PWD	10.0	1986
D. Overseas Development Administration (ODA), UK		<u>60.0</u>	
1. Medium Towns Water Supply	PWA	60.0	1993
II. Technical Assistance and Other Grants		<u>29.1</u>	
1. Japan International Cooperation Agency (JICA)		9.0	Varies
2. Germany		7.5	Varies
3. Italy		3.9	Varies
4. United Nations Development Programme (UNDP)		3.3	Varies
5. Bank ²		3.9	Varies
6. ODA		1.0	Varies
7. Denmark		0.5	Varies
Total		<u>1077.3</u>	

NESDB: National Economic and Social Development Board

PWD: Public Works Department

¹ The amount disbursed was \$49.5 million. An amount of \$81.4 million was cancelled because of high interest costs.

² Includes TA Nos. 499-THA: Songkhla Lake Basin Planning for NESDB, for \$400,000, approved on 21 December 1982; 619-THA: Bangkok Flood Control Management for PWD, for \$317,000, approved on 03 August 1984; 657-THA: Provincial Towns Water Supply for PWA, for \$350,000, of which \$250,000 was provided by Switzerland, approved on 26 December 1984; 741-THA: Fourth Bangkok Water Supply for MWA, for \$75,000, approved on 31 December 1985; 858-THA: Water Supply and Sanitation Sector Profile for PWA, for \$75,000, approved on 26 February 1987; 877-THA: Control of Nonrevenue Water in Provincial Water Supplies for PWA for \$340,000, approved on 20 May 1987; 1109-THA: Accelerated Water Supply and Sewerage Program for NESDB, for \$380,000, approved on 16 January 1989; 1685-THA: Small Towns Water Supply for PWD, for \$85,000, approved on 02 April 1992; 1741-THA: Environmental Rehabilitation for MOSTE, for \$350,000, approved on 18 August 1992; 1907-THA: Privatization of Water Supply Operations for PWA, for \$317,000, approved on 02 July 1993; and 2014-THA: Wastewater Management and Pollution Control in Samut Prakarn, for \$600,000, approved on 14 December 1993.

Project Framework

Design Summary	Measurable Indicators	Method of Verification	Risks/Assumptions
1. Goal Sustained improvement in public health and environmental quality	Reduction in the incidence of waterborne disease rates; renewed fisheries production; financial indicators for institutions operating the facilities	Public health data Field monitoring Project audit	Government maintains environmental protection as a high priority
2. Objective a. To reduce human exposure to waterborne diseases and hazardous wastes and improve environment.	Number of people with reduced exposure; percentage of those at poverty level; expected change in dissolved oxygen levels; changes in levels or concentrations of other pollutants	Benefit, Monitoring and Evaluation (BME) Review missions Project Completion Report/ Project Performance Audit Report (PCR/PPAR)	Public education campaign is implemented to improve public health/hygiene - establish Customer Relations subunit of Samut Prakarn Water Pollution Control Unit (SPWPCU) by June 1996
b. Establish sustainable mechanisms for the operation and maintenance of the facilities	Operational or treatment unit costs; expected cost recovery levels	System monitoring	Operation and maintenance is contracted to qualified firm. Trial cost recovery program leads to effective cost recovery policy and practice (1998-2000)
3. Output a. Improved wastewater effluent quality	Comparison of current treated and untreated volumes and concentrations with expected discharges after project (biochemical oxygen demand, chemical oxygen demand, etc.); number of industries with pretreatment	BME Review missions PCR/PPAR	Facilities are operated and maintained properly (by private sector contractors)
b. Improved operations	Number of officials trained; number of industries receiving assistance		Officials trained stay at posts; industries invest in and apply new technologies
4. Activities a. Construct collection and treatment facilities	East Bank collection, treatment and disposal facilities (\$235 million); West Bank collection, treatment and disposal facilities (\$90 million); Operational, monitoring and control equipment (\$4 million); Equipment and services for IPP-CTT (\$10 million); Consulting services (\$10 million)	Project management team supported by consultants monitor progress	Government allocates necessary budget and makes timely releases. Turnkey contractors unable to acquire land - government expropriates (within 6 months of contract).
b. Trial cost recovery program	Cost recovery policy adopted by Government by completion of Project construction	SPWPCU assisted by consultants undertake program immediately following early commissioning of treatment plants	Government provides necessary support for establishing tariffs and collecting revenues.
c. Capacity building (including clean	Training - (\$2 million)		Staff are released from duties for

INDUSTRIAL POLLUTION PREVENTION AND CLEAN TECHNOLOGY TRANSFER (IPP-CTT) PROGRAM

A. Background

1. The purpose of the industrial pollution prevention (IPP) program is to reduce the sources of pollution. It includes practices that reduce or eliminate the creation of pollutants by increasing efficiency in the use of raw materials, energy, water or other resources, or by protecting natural resources through conservation. Two general methods of reducing the source will be used in the industrial pollution prevention program — change the product and change the processes which reduces the volume and toxicity of wastes and end-products during their life cycle and at disposal. The reduction of sources requires modifications in equipment, technology, processes, or procedures; the reformulation or redesign of products; the substitution of raw materials; and improvements in housekeeping, maintenance, training, and inventory control. Clean technology aims at products design and manufacturing processes that use less raw materials, energy, and water; generates less or no wastes; and recycles waste as useful material in a closed system.

2. The Industrial Pollution Prevention and Clean Technology Transfer (IPP-CTT) Program to be initiated in Samut Prakarn Province as part of the Project and extended nationwide, will help the Government meet national environmental objectives and coincides with industry's interests. Businesses will have economic incentives to reduce the toxicity and the volume of the waste they generate as the pollution control regulations become more stringently enforced. Experience in many industrialized countries demonstrates that reducing wastes provides upstream benefits because it reduces the ecological damage caused by the extraction of raw materials and the release of pollutants during the preproduction processing of raw materials. Experience increasingly shows that companies with an effective IPP program are often the lowest cost producers and, as a result, have a significant competitive edge. The costs per unit produced will drop as pollution prevention measures reduce liability risks and operating costs. Furthermore, IPP program enhances a company's public image, improves public health, and generates overall environmental benefits.

B. Scope of Work

3. A Project pollution prevention team comprising SPWPCU staff and IPP-CTT contractors will work with industry specific pollution prevention teams to implement the IPP-CTT component of the Project which will include:

1. Pollution Prevention Feasibility Studies For Representative Industries

4. The contractors for IPP-CTT component will provide software, hardware, analysis, training, and expertise to carry out IPP feasibility studies in participating industries. The studies will include the analyses described below.

- a. **Technical Feasibility Analysis** - technical feasibility analysis requires comprehensive knowledge of pollution prevention techniques, vendors, relevant manufacturing processes, the resources, and limitations of the facility. It will

determine which technical alternative is the most appropriate for the specific industry or process.

- b. **Environmental Feasibility Analysis** - The environmental feasibility analysis weighs the advantages and disadvantages of each option on the environment. Most housekeeping and direct efficiency improvements have the obvious advantages. Some options require a thorough environmental evaluation, especially if they involve changes in product or processes or the substitution of raw materials. The environmental option of pollution prevention is rated relative to the technical and economical options according to the criteria that are most important to the specific facility. The criteria may include reduction in waste quantity and toxicity, risk of transfer to other media, reduction in waste treatment or disposal requirements, reduction in raw material and energy consumption, impact of alternate input materials and processes, and low operating and maintenance costs.
- c. **Economic Feasibility Analysis** - The economic feasibility analysis of pollution prevention alternatives examines the incremental costs and savings that will result from each pollution prevention option. Typically, pollution prevention measures require some investment on the part of the operator, whether in capital or operating costs. The purpose of economic feasibility analysis is to compare those additional costs to the savings (or benefits) of pollution prevention.
- d. **Institutional Feasibility Analysis** - The institutional analysis is concerned with evaluating the strengths and weaknesses of the company's involvement in the implementation and the operation of investment in pollution prevention projects. It includes, for example: staffing profiles, task analysis, definitions of responsibility, skill levels, processes, procedures, information systems for decision-making, and policy positions on pollution prevention priorities.

2. Industrial Facility Pollution Prevention Plan

5. After completion of representative feasibility studies, the IPP-CTT component pollution prevention plan will be developed for participating industries. The contractor under the IPP-CTT component will be required to train pollution prevention teams in the participating industries. The responsibility for pollution prevention rests with key representatives from maintenance, production, environment, health and safety, purchasing, shipping and receiving, legal and engineering departments, and plant and executive managers. The participating industries will be required to authorize the pollution prevention team access to the necessary information about the facility and waste streams being analyzed as outline below.

- a. **Data Collecting and Analyzing (Site Reviews)** - An information base will be established in order to quantify to the extent possible the following:
 - (i) the composition and quantity of the waste streams and emissions generated in the process;
 - (ii) from which production processes or treatments do these waste streams and emissions originate;

- (iii) which waste materials and emissions fall under environmental regulations;
 - (iv) what raw materials and input materials in the company or production process generate these waste streams and emissions;
 - (v) how much of a specific raw or input material is found in each waste stream;
 - (vi) what quantity of materials are lost in the form of volatile emissions;
 - (vii) are any unnecessary waste materials or emissions produced by mixing materials which could otherwise be reused with other waste materials;
 - (viii) which good housekeeping practices are already in force in the company to limit the generation of waste materials; and
 - (ix) what process controls are already in use to improve process efficiency.
- b. **Data Analysis** - A material balance for a given substance will reveal the quantities lost to emission or to accumulation in equipment. Simplified mass balances will be developed for each of the important waste-generating operations to identify sources and to understand the origins of each waste stream. Despite the limitations, material balances are essential to organize data, identify gaps, and estimate waste emissions. The result of data collecting and analyzing activities is a catalog of waste streams that provides a description of each waste, including quantities, frequency of discharge, composition, cost of management, and other important information. The pollution prevention team will also collect data on the facility itself, including process design, raw materials, production data, operating costs, environmental reports and permits, as well as company policies and organizational information. The contractor for the IPP-CTT component will assist the Samut Prakarn Water Pollution Control Unit (SPWPCU) and the pollution prevention teams to develop pollution prevention questionnaires. An IPP questionnaire is essential to collect and coordinate all necessary data and guide the pollution prevention team through the analysis. Pollution prevention questionnaires accomplish two purposes: (i) compile all the pertinent information about the facility and the processes of concern into one source; and (ii) familiarize the pollution prevention teams (especially outside members) with both the processes to be examined and the types of data required. The questionnaires will be prepared for each specific industry and they need to specify what operations will be reviewed as well as help guide a pollution prevention team through a plant or process area visit.
- c. **Identifying Pollution Prevention Opportunities** - Waste streams and unit processes will be prioritized to determine which should be examined first. When establishing priorities for pollution prevention, all of the input and output will should be ranked. The tasks include:

- (i) Assessing and identifying opportunities
 - (ii) Identifying reduction options
 - (iii) Determining Costs - once the full costs of the waste streams are determined, an economic analysis of each specific pollution prevention project can be conducted. This analysis will provide management information on the costs and benefits associated with the technologies so they can decide whether it is economically feasible to proceed with implementation. Certain benefits, such as reduced long-term liability for environmental degradation, reduced worker exposure to toxic chemicals, and improved community relations, will be difficult to quantify.
- d. Education and Training - An education and training plan for industrial multimedia pollution prevention may be divided into technical and nontechnical areas. Technical areas include products, processes, recycling, and reuse. Nontechnical areas include educational programs and dissemination of information, incentives and disincentives, economic costs and benefits, sociological and human behavioral trends, and management strategies. Cross-disciplinary training will be available for professionals to understand the importance of multimedia pollution prevention principles and strategies.
- e. Proposing a Pollution Prevention Plan - The pollution prevention teams will be responsible for developing a plan to implement pollution prevention measures. The plan will include all the ideas developed by the team such as: the statement of support from management; the pollution prevention team's organizational structure; the organizational guidelines and statement of purpose; the methods for fostering participation by all employees; the process flow diagram and materials balances; the material tracking system and possible technology transfer; the specific pollution prevention goals and projects; the procedures, criteria and schedule for implementation; the support for research and development if necessary; the structure of an incentive/reward program; and the requirements for employee training.

3. Implementation of Pollution Prevention Plan

6. The final selection by SPWPCU of IPP projects will depend on the willingness of participating industries to fund and implement the improvements. Within each industry the selection will generally rely on the hierarchy for waste reduction that emphasizes the reductions in more than one source; the results of the waste reduction assessment; the availability of specific clean technologies or procedural applications; a qualitative assessment of technical and economic feasibility; institutional feasibility; and other considerations. The selected IPP projects should be flexible enough to accommodate possible alternatives or modifications. The pollution prevention team will provide background and support work, and assist to address potential problems in implementing projects.

7. Two basic procedures for screening waste reduction options are: (i) an informal evaluation involving a consensus of team members to pursue selected options, which works well for a facility with only a few waste streams or for a team with only a few members; and (ii) a more structure evaluation in which each of the options is compared against the criteria important to the company.

8. Once an IPP project has been selected, further detailed investigation or change in product composition may be required. For example, it may be necessary to implement new or existing technologies or to identify raw material alternatives. At this point, the contractor IPP-CTT will assist the participating industries to contact other facilities, vendors, trade associations, government agencies, and publications for ideas.

9. Implementation of a pollution prevention project will generally follow the procedures established by each company for implementing any new procedure, modifying any process, or changing any equipment. Implementing a major pollution prevention project typically involves several steps:

- (i) preparing a detailed design,
- (ii) preparing a construction bid package and equipment specifications,
- (iii) selecting construction staff and purchasing materials,
- (iv) installing new equipment,
- (v) training personnel,
- (vi) starting operations, and
- (vii) monitoring and evaluating performance.

4. Measuring Pollution Prevention Progress

10. Pollution prevention progress will be monitored by reviewing the amount of pollutants that would have been released annually from a facility if the preventive action had not been taken. In reality, very limited data are available that can be used to measure the progress in prevention. Many factors contribute to reductions in pollutant releases, including increased waste treatment as well as decreased production. Therefore, progress should be measured by factoring in current production rates. However, the ability to determine normal production quantities is often the most difficult aspect of measurement.

11. The IPP-CTT contractor will, therefore, assist SPWPCU and the participating industries to identify the specific objective, resource availability, and proper monitoring mechanisms. If the industrial plant has the appropriate resources, measuring pollution prevention will develop an understanding about the relationship between wastes and the manufacturing process.

COMPONENTS, DESIGN CRITERIA, AND FLOW ESTIMATES FOR THE PROJECT

Table 1: Summary of Project Components and Design Criteria

Component	Area	Description	Project	Expansion Targets	
			I (1995-2003)	(2003-2008)	(2009-2015)
Wastewater flow	West Bank	Household wastewater, m ³ /d	40,000	55,000	75,000
		Industrial wastewater, m ³ /d	40,000	45,000	50,000
		Total	80,000	100,000	125,000
	East Bank	Household wastewater, m ³ /d	120,000	235,000	350,000
		Industrial wastewater, m ³ /d	130,000	185,000	225,000
		Total	250,000	420,000	575,000
Wastewater typical characteristics	West Bank	BOD ₅ , mg/l	400	370	350
	East Bank	BOD ₅ , mg/l	400	350	300
Wastewater collection & transfer	West Bank	Area, km ² (cumulative)	30	50	50
		Pipe sizes, m diameter	0.15 - 1.50	0.15 - 0.80	0.15 - 0.30
		Pipe length, m			
	East Bank	Area, km ² (cumulative)	120	340	460
		Pipe sizes, m	0.15 - 2.25	0.15 - 1.50	0.15 - 1.50
		Pipe length, m			
Wastewater treatment	West Bank	Configuration	centralised	(ap)	(ap)
		Process	aerated lagoon	(ap)	(ap) upgraded
		Location	Nai Khlong Bang Pakot	(ap)	(ap)
		Required land area, rai	350	(ap)	(ap)
	East Bank	Configuration	centralised	(ap)	(ap)
		Process	aerated lagoon	(ap) expanded	(ap)
		Location	Bang Pu Mai		
		Required land area, rai	1,550	(ap)	(ap)
Effluent typical characteristics	West Bank	BOD ₅	20	(ap)	4
		Suspended Solids	30	(ap)	6
	East Bank	BOD ₅	20	(ap)	25
		Suspended Solids	30	(ap)	(ap)
Effluent receiving environment	West Bank		canals	(ap)	(ap)
	East Bank		coast	(ap)	(ap)
Beneficiaries	Total	Population served	600,000	1,100,000	1,600,000
		% population covered	60	70	75
		% industrial wastewater	80	90	95

Notes

Biochemical Oxygen Demand, milligram per liter

(ap): as in previous phase

Table 2: Summary of Major Project Components

Component Description	Amount/Capacity	
	East Bank	West Bank
Wastewater Collection		
Trunk Sewers	64 km (0.30 - 2.25 m dia)	28 km (0.30 - 1.50 m dia)
Secondary Sewers	185 km (0.15 - 0.25 m dia)	18 km (0.15 - 0.25 m dia)
Property Connections	50,000 no.	10,000 no.
Sewer Rehabilitation	20 km	5 km
Lift/Pumping Stations	119 no. (up to 6.60 m ³ /sec capacity)	30 no. (up to 2.40 m ³ /sec capacity)
Pumping Mains	16.5 km (up to 1.6 m dia)	1.5 km (up to 1.0 m dia)
Wastewater Transfer		
Terminal Pumping Stations	1 no. (7.60 m ³ /sec capacity)	1 no. (2.88 m ³ /sec capacity)
Force Mains	8.5 km (2.20 m dia)	2.3 km (1.40 m dia)
Wastewater Treatment	Aerated lagoon system (400,000 m ³ /day capacity)	Aerated lagoon system (125,000 m ³ /day capacity)
Effluent Transfer/Disposal		
Pumping Station	1 no. (4.50 m ³ /sec capacity)	-
Force Main	10.5 km (2.00/1.50 m dia)	0.5 km (1.20 m dia)
Discharge Location	Coast	canals

Table 3: Wastewater Generation Factors for Domestic Flows

Residential Type	Factor (as a percentage of per capita water consumption)
High density	0.80
Medium density	0.75
Low density	0.70

Table 4: Infiltration Factors for Sewerage Systems

Type	Factor (as a percentage of per capita wastewater generation)
Combined sewerage	1.30
Separate sewerage	1.05

Table 5: Population Factors for Domestic Flows

Residential Type	Factor (as a percentage of per capita water consumption)
High density	1.10
Medium density	1.10
Low density	1.05

Table 6: Domestic Flows: Per Capita Design Flows

Residential Type	Sewerage Type		Per Capita Flow (lpcd) ¹		
	Combined	Separate	1995	2005	2015
Western Region ²					
High density	•	•	285	295	305
			230	240	250
Medium density	•	•	235	245	255
			190	200	210
Low density	•	•	175	185	195
			140	150	160
Eastern Region ³					
High density	•	•	230	260	285
			185	210	230
Medium density	•	•	195	215	235
			155	175	190
Low density	•	•	155	175	190
			125	140	155

Notes: 1. Flows have been rounded to the nearest 5 lpcd, and represent average dry weather flow for particular catchments.

2. Includes District Pra Pradaeng, District Muang Samutprakarn and Subdistrict Prasamuedi.

3. Includes District Bang Pli and District Bang Bo.

Table 7: Per Capita Domestic Loads

Parameter	Per Capita Load (gm/c/day)		
	1995	2005	2015
Biochemical Oxygen Demand	48	49	50
Chemical Oxygen Demand	100	110	120
Ammonia	6	6	6
Organic Nitrogen	4	4	4
Phosphate	3	3	3

Note: These estimates are for permanent population but include an allowance for contribution from the temporary urban population. Wastewater concentrations emanating from residential areas vary considerably depending on the conveyance system (combined or separate sewerage) and the resultant effect of groundwater infiltration and long detention periods which are particularly evident in the existing combined sewers. For the purposes of design of wastewater treatment facilities, the following parameters are considered appropriate for wastewater emanating from residential areas under dry weather conditions.

Table 8: Wastewater Parameters from Domestic Sources

Category	Season		Parameters (mg/l)		
	Dry	Wet	BOD	COD	SS
Combined Sewerage System	•		150	250	100
		•	60	120	30
Separate Sewerage System	•	•	220	450	200

BOD = Biochemical Oxygen Demand

COD = Chemical Oxygen Demand

SS = Suspended Solids

Note: The above parameters apply for wastewater flows occurring during dry weather conditions in both wet and dry seasons. The effect of wet weather on wastewater flows is accounted for by applying peaking factors to the average dry weather flows.

Table 9: Commercial/Institutional Wastewater Factors

Sewerage Type	Factor
Combined	1.04
Separate	0.84

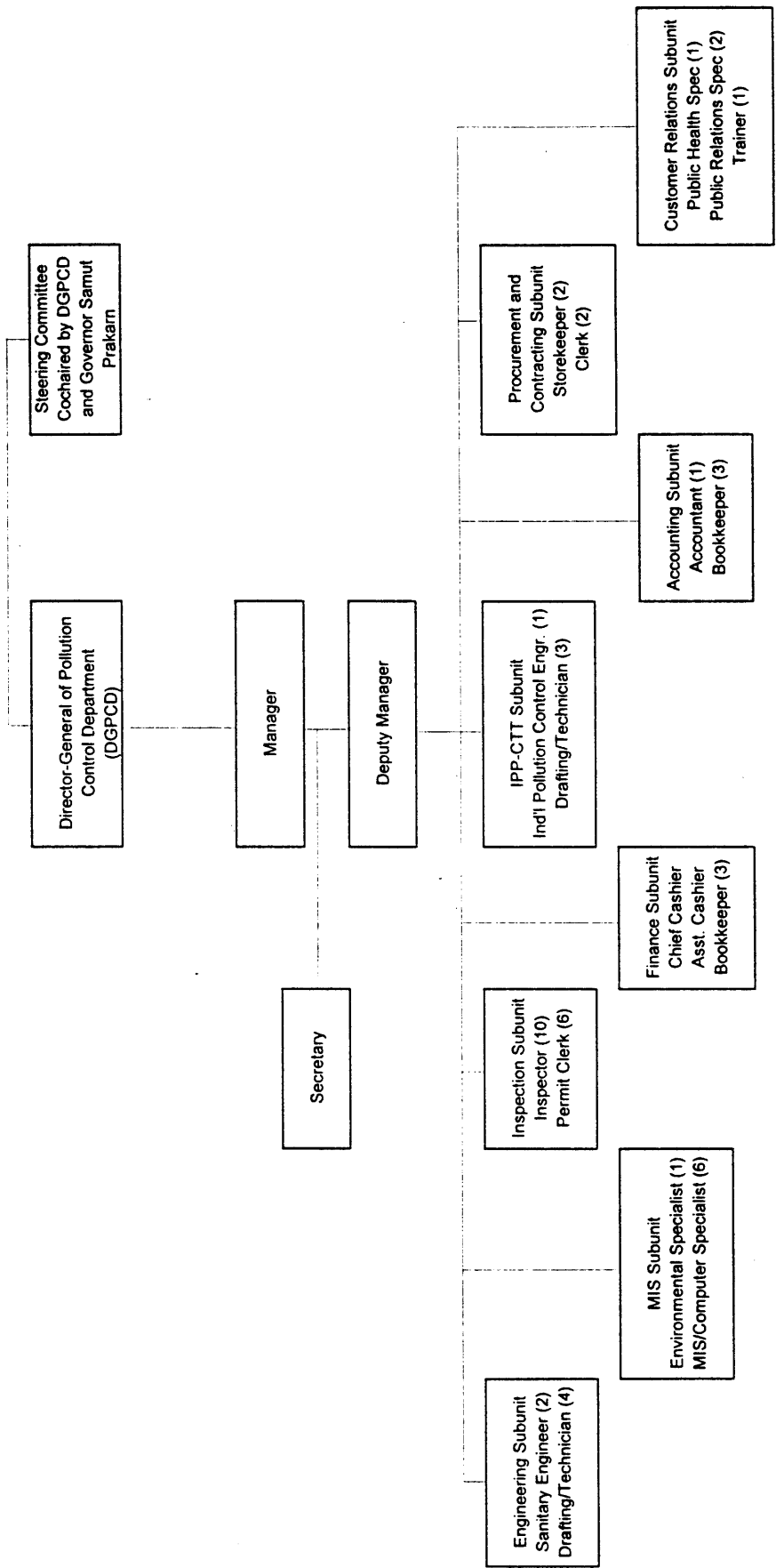
Table 10: Commercial/Institutional Flows: Unit Design Flows

Category	Sewerage Type		Unit Flow (lpcd) ¹		
	Combined	Separate	1995	2005	2015
Western Region ²					
Flat/condominium (high rise) (liters/day)	•	•	345	355	365
			275	285	295
Hotel (liters/day)	•	•	1795	1810	1820
			1450	1460	1470
Commercial Center	•	•	260	260	260
			210	210	210
Market (liters/day)	•	•	110	115	115
			90	90	90
Restaurant (liters/day)	•	•	240	250	260
			190	200	210
Hospital (liters/day)	•	•	1040	1040	1040
			840	840	840
School	•	•	20	20	20
			15	15	15
Temple	•	•	295	305	310
			240	250	255
Eastern Region ³					
Flat/condominium (high rise) (liters/day)	•	•	260	290	310
			210	235	250
Hotel (liters/day)	•	•	1040	1150	1250
			840	920	1010
Commercial Center	•	•	210	210	210
			170	170	170
Market (liters/day)	•	•	100	100	100
			85	85	85
Restaurant (liters/day)	•	•	210	220	230
			170	175	185
Hospital (liters/day)	•	•	830	860	885
			670	700	715
School	•	•	20	20	20
			15	15	15
Temple	•	•	210	220	230
			170	175	185

COST ESTIMATES
(\$ million)

	East Bank		West Bank		Foreign Costs	Local Costs	Total Costs
	Foreign Costs	Local Costs	Foreign Costs	Local Costs			
A. Collection and Treatment					115.0	247.2	362.2
1. Sewers, Connections, and Force Mains	39.0	102.5	15.0	41.0			
2. Lift/Pumping Stations							
a. Land	-	2.0	-	0.5			
b. Civil	2.0	8.0	1.0	2.6			
c. Mechanical & Electrical	<u>8.0</u>	<u>2.5</u>	<u>3.0</u>	<u>0.5</u>			
Subtotal	10.0	12.5	4.0	3.6			
3. Central Wastewater/Treatment Facilities							
a. Land	-	31.2	-	3.7			
b. Civil	20.0	20.0	5.0	9.0			
c. Mechanical & Electrical	<u>17.0</u>	<u>15.7</u>	<u>5.0</u>	<u>8.0</u>			
Subtotal	37.0	66.9	10.0	20.7			
B. Operational, Monitoring & Control Equipment					3.0	1.0	4.0
C. Consultants					5.0	5.3	10.3
D. Industrial Pollution Prevention					7.0	3.0	10.0
E. Contingencies							
1. Physical					12.0	21.7	33.7
2. Price					18.0	30.3	48.3
F. Taxes and Duties					=	<u>38.5</u>	<u>38.5</u>
Total					160.0	347.0	507.0

SAMUT PRAKARN WATER POLLUTION CONTROL UNIT (SPWPCU) ORGANIZATION PLAN



INDICATIVE PROCUREMENT PACKAGES

Package	Component	Procurement Method	Value (\$'000)
A	East Bank Collection, Treatment and Disposal Facilities (excluding land)	ICB (turnkey)	235,000
B	West Bank Collection, Treatment and Disposal Facilities (excluding land)	ICB (turnkey)	90,000
C	Operational, Monitoring and Control Equip.	ICB/IS	4,000
D	Equipment and Services for IPP-CTT	ICB/IS	10,000
E	Consulting Services	ICB	10,000

ICB = International Competitive Bidding

IS = International Shopping

CONSULTANT TERMS OF REFERENCE

A. Background

1. The Project comprises two separate sewerage and centralized sewage treatment systems, one serving the east bank area of the Chao Phraya River in Samut Prakarn Province, the other serving the west bank area. In total, there will be about 350 kilometers (km) of sewers, 150 pumping stations, and two wastewater treatment plants. PCD will award two turnkey contracts for construction and for the first three years' operation, for each of the facilities on the east bank and on the west bank.

2. PCD will employ consultants from a member country of the Bank to assist in the implementation of the Project and to supervise the two proposed turnkey contracts.

B. Objectives

3. The objectives of the consulting services will be to assist PCD and SPWPCU in the implementation of the Project. Initially, the appointed consultant will assist in the evaluation of turnkey bids, make recommendations on appointment of contractors, and prepare contracts and, subsequently, administer the contracts and supervise construction on site.

C. Scope of Work

4. The consultant's detailed tasks will include, but not be limited to:

1. Appointment of Turnkey Contractors

- (i) Prepare evaluation criteria for turnkey bids for review and approval by PCD/SPWPCU and the Bank.
- (ii) Attend to queries from bidders during bid stage.
- (iii) Evaluate bids received, including detailed design proposals, seek clarification from bidders where necessary, and prepare and submit detailed report to PCD, SPWPCU, and the Bank with recommendations for award of contracts.
- (iv) Assist as required in negotiations with bidders.
- (v) Assist in preparing turnkey contracts and securing Bank approval.
- (vi) Assist in executing contracts with selected contractors.

2. Contract Administration and Supervision of Construction

5. Assist PCD and SPWPCU on all aspects of administering contracts for construction of the works, and provide daily supervision of construction at site. Tasks will include but will not be limited to the following:

- (i) Liaise with other National, Provincial and Local government agencies having an interest in the Project.
- (ii) Examine and approve contractors' construction scheduling and any amendments required as the work proceeds.
- (iii) Monitor and report on physical progress and financial disbursements.
- (iv) Check that all permanent works are constructed in accordance with the approved design, and that materials incorporated into the permanent works comply with the contract specifications.
- (v) Examine and approve contractors' proposed temporary works and construction methods, including compliance with workers' health and safety provisions in the contract.
- (vi) Examine and approve contractors' proposals for maintaining public health, safety and welfare in the vicinity of the works.
- (vii) Arrange for source inspection, witness testing and approval of plant and equipment to be incorporated into the permanent works.
- (viii) Check and approve contractors' measurements of completed work, and certify progress payments and final payments to contractors.
- (ix) Advise on requests for variation orders and prepare and issue such variation orders after approval by PCD/SPWPCU.
- (x) Advise on any difficulties encountered during implementation and propose solutions to them.
- (xi) Evaluate and recommend on any claims submitted by contractors.
- (xii) Check and approve operation and maintenance manuals submitted by contractors.
- (xiii) Supervise acceptance tests of completed works and installed plant and equipment and issue acceptance certificates.

D. Reporting

6. The consultants will prepare and submit the following reports:

- (i) Turnkey bid evaluation criteria, one month after commencement of services.

- (ii) An Inception Report one month after commencement of services.
- (iii) Detailed monthly progress reports on all aspects of implementation of the Project and logistical details of the consultant's inputs, immediate past, present, and immediate future work plan.
- (iv) Detailed report on evaluation of turnkey bids received including recommendations on award, three months after receipt of bids.
- (v) As and when required, reports on proposed variation orders, contractors' claims, or any substantive contractual disputes requiring decisions by PCD and SPWPCU.
- (vi) A final report one month before completion of services summarizing the consultant's overall achievements, inputs, milestones in Project implementation, and any outstanding matters.
- (vii) A project completion report on the execution and initial operation of facilities provided under the Project following the Bank's format.

E. Inputs and Time Frame

7. The proposed duration of consultant services is 54 months, beginning about April 1996.
8. Professional and technical expertise required will include: (i) senior sanitary engineers with extensive experience in the implementation of turnkey wastewater collection and treatment projects; (ii) sanitary and civil engineers with experience in: turnkey bidding and evaluation procedures; reviewing and approving sewerage and sewage treatment scheme designs; and, administration of implementation of sewerage and sewage treatment projects, especially turnkey contracts; (iii) senior resident engineers, resident engineers, inspectors of works, and quantity surveyors, experienced in site supervision of construction of wastewater collection and treatment projects.

F. Terms of Reference for IPP-CTT Specialist (12 person-months over a 24 month period)



















































































































9. An individual consultant with expertise in industrial process/IPP will assist the IPP-CTT subunit of SPWPCU to prepare and undertake the IPP-CTT component of the Project. The consultant tasks will include, but not necessarily limited to the following.
 - (i) Review and evaluate any current or planned IPP projects through discussions with the Industrial Estate Authority of Thailand, the Ministry of Industry, and industry organizations.

- (ii) Categorize existing types of industries in Samut Prakarn Province as to suitability for waste minimization through IPP.
- (iii) Prepare guidelines for preparation of IPP prefeasibility studies and train SPWPCU counterparts in the application of the guidelines.
- (iv) Select ten individual industries of varying types and assist SPWPCU staff to prepare prefeasibility studies for IPP projects in these industries.
- (v) Propose a basic industrial audit system and describe associated software development required to be developed.
- (vi) Assist the SPWPCU to prepare bid documents and related evaluation criteria, specifications, etc. for the Project IPP-CTT, including identification of facilities, hardware, software, training and clearinghouse mechanisms.
- (vii) Assist the SPWPCU to evaluate candidate bidders and negotiate with the selected bidder.
- (viii) Provide periodic advisory review of the IPP-CTT component implementation.
- (ix) In addition to the reports described above, prepare a trip report after each input summarizing activities completed and recommending, in detail, tasks to be carried out by SPWPCU as the continuing work to be carried out until the consultant's next input.

ESTIMATED CONSULTANT REQUIREMENTS
(Person-months)

	Total Person-months
A. Foreign Consultants	
Project Manager	54
Environmental Engineer (2)	32
Sewerage Engineer	34
Financial Adviser	17
Structural Engineer	16
Mechanical Engineer	19
Electrical Engineer	12
Ind. Pollution Engineer	16
Subtotal	200
B. Domestic Consultants	
Deputy Project Manager	62
Construction Inspectors	132
Environmental Engineer	54
Sewerage Engineer	24
Structural Engineer	16
Mechanical Engineer	16
Electrical Engineer	16
Industrial Pollution Engineer	42
Industrial Survey Staff	100
Subtotal	462

SUMMARY OF IMPLEMENTATION SCHEDULE

Component	1995	1996	1997	1998	1999	2000	2001
Prepare Turnkey Bid and Contract Document/ Prequalification of Contractors Recruit Supervising Consultant Turnkey Contract Awards	  						
Capital Works Program							
Design and Construct West Bank Facilities				   	  	 	
Design and Construct East Bank Facilities				   	  	 	
Preliminary Commissioning of East Bank Treatment Plant				   	  	 	
Preliminary Commissioning of West Bank Treatment Plant				   	  	 	
Contract Operation and Maintenance				   	  	 	
Industrial Pollution Prevention & Clean Technology Transfer				   	  	 	
Consulting Services & Training							
Project Management				   	  	 	
Construction Supervision				   	  	 	
Training				   	  	 	
Pilot Cost Recovery Study				   	  	 	
Technical Assistance							
Strengthening Regulatory and Cost Recovery Mechanism				   	  	 	

ECONOMIC ANALYSIS

A. Introduction

1. The benefits that were not valued and included in the calculation of the economic internal rate of return (EIRR) included: (i) environmental improvements from improved water quality in the canals, the Chao Phraya River and the coastal waters of the Chao Phraya River estuary (Upper Gulf); (ii) increased industrial/commercial land values, and (iii) commercial value of wastewater sludge saleable as fertilizer or fill material and use of treated effluent as cooling water by the industry. No attempt was made to estimate the value of improvements in the biological environment or to estimate the commercial value of fishery and aquaculture output attributable to the Project. In the "without" the Project situation, biological values are expected to further decrease, and freshwater fishery/aquaculture and coastal fisheries will deteriorate further. The nonvalued environmental benefits attributable to the Project include the avoided reduction in commercial value of fishery and aquaculture products. On the other hand, an attempt has been made to value the environmental improvements resulting from improvements in community health benefits (reduction in health hazards), higher aesthetic and recreational values and a cleaner home environment (reflected in increased residential land values). The EIRR is underestimated because it should also include the incremental environmental values and other incremental benefits that were not valued, but which are likely to have a significant impact on the economic viability of the Project.

B. Benefits

1. Valuation of health benefits

2. Valuation of health benefits is difficult and no attempt was made to generate primary data to estimate primary health benefits (savings in health care expenditure, wages lost and resulting from decreased death rate) attributable to the Project. However, it was possible to use empirical findings from a feasibility study for a similar project in a large urbanized area. In this similar project, it was found that nondiscounted primary health benefits were slightly higher than the estimated land value increases. For the proposed Project, the assumptions used in estimating land value increases and health conditions are roughly the same as for the reference project. Assuming that reductions in health hazards, as a result of the Project, would be approximately the same in both the proposed and reference project, the nondiscounted total primary health benefits for the proposed Project are estimated at about B6.6 billion or, assuming equal distribution over the period 2001-2030, about B220 million annually, starting in year 2001.

2. Estimation of Agricultural Benefits

3. The deterioration in the water quality deterioration in Samut Prakarn Province has adversely affected agricultural output such as paddy, fruit orchards, and aquaculture. In the "without" the Project situation, water pollution will increase and the value of agricultural output is expected to be reduced further. In the "with" the Project situation, the water quality will be gradually improved and this will have a positive impact on agricultural output and its commercial value. These are tangible economic benefits and should be considered in the economic analysis

of the proposed Project. Because of the lack of data no attempt will be made to estimate the incremental economic benefits from the increase in agricultural output/values of fruit orchards and aquaculture.

4. However, based on studies by the Office of Agriculture in Samut Prakarn Province, it is possible to value the economic benefits from the incremental gains in paddy production. Losses in paddy output because of poor water quality are estimated to be equivalent to B400/hectare/year. Given that about 10,000 hectares (ha) of paddy fields are affected by water pollution, the economic damage is presently estimated to be about B4 million a year. "Without" the Project, this economic loss will increase further from losses in productivity and larger areas of paddy fields affected. It is assumed that these losses will increase to about B8 million annually within two decades.

5. In estimating the economic benefits from avoided losses in paddy output and value, it is assumed that all gains will be realized over the period 1998-2017 at the rate of 5 percent per year. Thus, the incremental agricultural benefits attributable to the Project are expected to be B4 million in year 1998 and increase to B8 million in year 2017 and remain constant thereafter.

B4 million/year - loss in value of paddy

			<u>avoided loss</u>
	1996-1997	no value increase	
13 years	1998-2010	50 percent value increase	50 percent
10 years	2011-2020	50 percent value increase	50 percent

3. Cost savings and land value increases

a. Cost savings to households

6. Household connection costs are included in the cost of the Project. Therefore, incremental economic benefits resulting from the connection, should be included as well in the economic analysis. These benefits, among others, consist of avoided annual septic tank desludging costs (B500/household/year).

7. During implementation of the Project, a total of 60,000 connections are needed to be carried out, about 10,000 connections annually over the period 1998-2003. The avoided desludging cost will increase from B5 million in 1998 to B30 million in 2003.

8. During the next phases an estimated 30 percent of 60,000 households, i.e., 20,000 households, are expected to connect to a separate sewer. About 1,000 households will be connected annually over the period 2011-2030. This will increase the annual economic benefits because of avoided desludging from B30.5 million in 2011 to B40 million in 2030.

b. Industrial relocation cost savings

9. In the "without" the Project scenario, and assuming enforcement of industrial pollution abatement standards as prescribed by the National Environmental Quality Act (NEQA), it

is estimated that about 300 industries, i.e., 10 percent of the total number of industries in Samut Prakarn Province, would have to relocate because of space limitations to build on-site industrial wastewater treatment facilities. Industries which need to be relocated from the high density population areas to industrial estates outside the urban area, also will have to invest in treatment facilities to achieve effluent discharge standards. It is estimated that the cost of industrial relocation alone would be about B3 billion, or B10 million on the average per industry. The economic cost from closing down of some factories because industries cannot finance the relocation cost, is also not included. Under the "without" the Project scenario, it is assumed that industrial relocation would start in 2001 and last until 2010. The relocation cost is estimated at B300 million annually over this period.

10. In the "with" the Project scenario, industrial relocation for those industries will not be needed as no or only minimal treatment of factory wastewaters would be required. The avoided industrial relocation cost is an economic benefit. Other economic benefits, which have not been estimated, include the avoided economic cost of closing down of some factories.

c. Factory resource cost savings

11. Economic benefits from an improved centralized wastewater collection and treatment system arise from savings in resources. Factory resource cost savings will occur if the new system of centralized wastewater treatment proves less costly than the industrial on-site facilities required to treat industrial wastewaters to pollution abatement standards. A detailed analysis was undertaken to compare the costs to factories of on-site versus central treatment. Based on technological data per type of industry and per size class average total costs in baht/m³ and average total costs in baht per population equivalent were estimated for the two options "on-site treatment" and "centralized treatment" proposed in the current project.

12. A comparison of the average costs for the two options showed that the average costs of on-site treatment ranges are generally three to seven times higher than the average costs of the centralized option under the Project. Resource cost savings arise from economies of scale associated with both land and capital investments and in the operation of the treatment facilities. The average cost savings are generally higher for small and medium-sized factories. For factories producing larger flows and/or loads, the average cost savings are less. Cost savings for food processing industries will be less because of the requirement for pretreatment of any wastewaters with a biochemical oxygen demand (BOD) of greater than 1,000 mg/l. It may also be the case that some factories will retain their (existing) on-site treatment facilities rather than connect to the centralized system, provided the discharged wastewaters meet effluent discharge standards. No resource cost savings will be realized by these factories.

13. The factory resource cost savings generated by the Project are estimated as the difference in costs comparing the with and without project situations. The average cost of on-site treatment per population equivalent is about B1,000 ("without" the Project situation). In the "with" the Project situation industries must provide their own connection to the sewerage system, the cost of which is estimated at about B100 per population equivalent. Therefore, factory cost savings are estimated approximately at B900 per population equivalent. In the without-project situation, these resources would need to be put into on-site treatment facilities and they can therefore be considered as a benefit from which the costs can be deducted to obtain the net

benefits arising from the Project. The estimate of resource cost savings has been applied to the wastewater collected and treated by the Project, measured in terms of pollution load.

d. Increase in residential land values

14. Residential land prices in the densely populated east bank areas of Samut Prakarn Province currently range between B5.0 and B8.1 million per ha. It is plausible to assume that residential land values will increase as a result of environmental improvements brought about by the project. For the purposes of the economic analysis only residential land that will be sewered under the Project, is attributed an annual increase of value assumed to be 5 per cent. This assumption is comparable to expected increases in land values in similar projects in large urbanized areas.

15. The estimation of the residential land value increases is based on the following data and period: (i) land area (km²) of serviced area equal to 170 in 1996-2000 increasing by 220 in 2001-2005 and 120 in 2006-2015; (ii) average land value per km² of B3,126 million in 1996-2000 and B4,126 million in 2001-2015; and (iii) land value increases are assumed to take place in the periods 1997-2000, 2001-2005 and 2009-2013.

16. Land in the densely populated urban areas has been given an average value of B5 million per ha and land in the more outlying areas has been given an average value of B0.3 million per ha, based on estimates of the rent earning capacity of the land. Based on these data and assumptions, the increase in residential land value is estimated to be B990 million annually over the period 1997-2000, B300 million annually over the period 2001-2005, and B180 million annually over the period 2009-2013.

17. While land served by interceptors, particularly near the waterways, is likely to yield some benefit associated with improved water quality and a reduction in noxious odors. The extent of this benefit will be influenced by other factors such as flows into the waterways from outside the project area and the amount of solid waste in the waterways. These benefits have not been estimated and therefore not included in the analysis of the EIRR. Furthermore, no attempt has been made to estimate increases in industrial and commercial land values resulting from the activities under the Project.

e. Benefits not valued

18. Benefits that were not valued include sale of wastewater sludge as fertilizer or fill material; use of treated effluent as cooling water by the industry; increase in industrial land values; and improvements in freshwater fishery and aquaculture, as a result of the improvements in the water quality of the Chao Phraya River. These benefits are expected to be significant. Community health profiles are also expected to improve but these benefits have been valued using empirical data from a similar project. Improved canal water quality, an environmental benefit which has several subcomponents, including: (i) higher aesthetic/recreational value, (ii) improved public health profiles, and (iii) enhanced residential land values. No attempt has been made to value the first item. The reduction in pollution loads (heavy metals) in the coastal zone of the Chao Phraya River estuary will thereby reduce the heavy metals in seafood and reduce further damage to coastal fisheries. Higher productivity of fruit orchards and higher commercial values.

C. Economic Costs

19. The economic costs of capital works and system operation and maintenance have been computed based on the following:

- (i) price contingencies (domestic inflation) have been excluded;
- (ii) physical contingencies are included, as they represent a real change in costs to society;
- (iii) import duties and taxes are considered as transfer payments and excluded.

20. Investment costs have been broken down in foreign costs and local labor and materials components. The following conversion factors have been used: (i) standard conversion factor = .90; (ii) shadow price unskilled labor = .7 and (iii) shadow price skilled labor = 1.

21. The asset life assumed for the various capital components of the project are as follows: (i) civil works and sewer rehabilitation: 50 years; (ii) mechanical engineering equipment, force mains: 20 years; (iii) trunk sewers, collectors, connectors: 80 years; (iv) operating and monitoring equipment: 15 years. The analysis has been done for a period of 35 years from 1995 with assets having a life less than 35 years being replaced as required. Assets still in use at the end of the 35 years are given a residual value based on their remaining life.

22. Operating expenses have also been adjusted for duties and taxes, the main one being the duty on fuel (about 30 percent).

23. Land cost has been valued in terms of opportunity cost, i.e., what it could earn in the next best alternative use. On the east bank, land is currently used for paddy production and given its flood prone status, this use is likely to continue. The opportunity cost for the east bank treatment site is estimated at B11,900 per ha times the value of paddy produced per ha per year, which is B4,500 baht/ha. On the west bank, the site is currently used for aquaculture but eventually, due to urban encroachment, it could be used for residential purposes. The opportunity cost for the west bank site is calculated as (i) value of aquaculture foregone = B31,250 per ha times 56 ha times 0.5 plus (ii) residential rental value which is equal to B531,250 per ha times 56 ha times 0.5. It is assumed that 50 percent of the area would have been for aquaculture use and 50 percent for residential purposes. The residential figure is based on an approximation of middle class medium density housing of 94 households per ha.

D. Benefit Cost Analysis

24. The EIRR analysis was based on a comparison of incremental economic cost with incremental economic benefits. The net benefit flow represents the net contribution to economic welfare and was estimated on a "with" and "without" the Project basis. The life of the Project was assumed to be 35 years. In estimating economic benefits, financial revenues from the Project have been excluded from the analysis. Economic benefits comprised cost savings and other benefits. The total of these benefits for any given year was deducted from the economic costs to yield the net benefit. The estimated EIRR is 23 per cent and the net present value at 12 percent equal to about B4019 million. Had expected wastewater tariff been added to the economic

benefits, a methodology using the gross benefit estimation model applied in water supply projects, the EIRR would increase to 37 percent.

E. Sensitivity analysis

25. Capital costs are incurred early in the project life and the EIRR is therefore sensitive to changes in these costs. If capital costs increase by 25 percent, the EIRR drops to 16 percent. A reduction in factory resource cost savings by 25 percent has a similar impact on the EIRR. If either health benefits or avoided relocation costs are decreased by 50 percent, the EIRR would drop to 22 percent. It is sometimes argued that health benefits are largely reflected in increased residential land values and incorporation of both benefit categories in the EIRR analysis results in at least potential double counting. If health benefits are excluded altogether from the B/C analysis, the EIRR is 21 percent. As several economic benefits were not valued, because of lack of data or intangibility, the economic rate of return is believed to be an underestimation of the true EIRR.

EIRR ANALYSIS OF SAMUT PRAKARN WASTEWATER MANAGEMENT PROJECT

Year	Economic Costs				Economic Benefits							Total Benefits		Net Benefits
	A	B	C	D	Cost Savings			Other Benefits				K	L	
					E	F	G	H	I	J				
1995		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996		461.0	7.0	468.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-468.0
1997		2155.2	68.0	2223.2	0.0	0.0	0.0	0.0	0.0	990.0	0.0	990.0	990.0	-1233.2
1998		2312.0	114.0	2426.0	5.0	0.0	352.0	0.0	0.0	990.0	0.4	990.0	1347.4	-1078.6
1999		2103.2	203.0	2306.2	10.0	0.0	703.0	0.0	0.0	990.0	0.8	990.0	1703.8	-602.4
2000		634.4	425.0	1059.4	15.0	0.0	1055.0	0.0	0.0	990.0	1.2	2061.2	2061.2	1001.8
2001		1235.2	283.0	1518.2	20.0	300.0	1266.0	220.0	220.0	330.0	1.6	2137.6	2137.6	619.4
2002		1804.0	361.0	2165.0	25.0	300.0	1477.0	220.0	220.0	330.0	2.0	2354.0	2354.0	189.0
2003		2035.2	396.0	2431.2	30.0	300.0	1828.0	220.0	220.0	330.0	2.4	2710.4	2710.4	279.2
2004		761.6	446.0	1207.6	30.0	300.0	2039.0	220.0	220.0	330.0	2.8	2921.8	2921.8	1714.2
2005		673.6	492.0	1165.6	30.0	300.0	2080.0	220.0	220.0	330.0	3.2	2963.2	2963.2	1797.6
2006		90.4	508.0	598.4	30.0	300.0	2100.0	220.0	220.0	0.0	3.6	2653.6	2653.6	2055.2
2007		84.0	539.0	623.0	30.0	300.0	2231.0	220.0	220.0	0.0	4.0	2785.0	2785.0	2162.0
2008		175.2	555.0	730.2	30.0	300.0	2297.0	220.0	220.0	0.0	4.4	2851.4	2851.4	2121.2
2009		1260.0	571.0	1831.0	30.0	300.0	2363.0	220.0	220.0	180.0	4.8	3097.8	3097.8	1266.8
2010		1594.4	587.0	2181.4	30.0	300.0	2428.0	220.0	220.0	180.0	5.2	3163.2	3163.2	981.8
2011		1447.2	635.0	2082.2	30.5	0.0	2438.0	220.0	220.0	180.0	5.6	2874.1	2874.1	791.9
2012		675.2	666.0	1341.2	31.0	0.0	2559.0	220.0	220.0	180.0	6.0	2996.0	2996.0	1654.8
2013		652.0	698.0	1350.0	31.5	0.0	2681.0	220.0	220.0	180.0	6.4	3118.9	3118.9	1768.9
2014		104.8	714.0	818.8	32.0	0.0	2742.0	220.0	220.0	0.0	6.8	3000.8	3000.8	2182.0
2015		100.0	730.0	830.0	32.5	0.0	2803.0	220.0	220.0	0.0	7.2	3062.7	3062.7	2232.7
2016		77.6	730.0	807.6	33.0	0.0	2803.0	220.0	220.0	0.0	7.6	3063.6	3063.6	2256.0
2017		81.6	730.0	811.6	33.5	0.0	2803.0	220.0	220.0	0.0	8.0	3064.5	3064.5	2252.9
2018		85.6	730.0	815.6	34.0	0.0	2803.0	220.0	220.0	0.0	8.0	3065.0	3065.0	2249.4
2019		89.6	730.0	819.6	34.5	0.0	2803.0	220.0	220.0	0.0	8.0	3065.5	3065.5	2245.9
2020		94.4	730.0	824.4	35.0	0.0	2803.0	220.0	220.0	0.0	8.0	3066.0	3066.0	2241.6
2021		99.2	730.0	829.2	35.5	0.0	2803.0	220.0	220.0	0.0	8.0	3066.5	3066.5	2237.3
2022		104.0	730.0	834.0	36.0	0.0	2803.0	220.0	220.0	0.0	8.0	3067.0	3067.0	2233.0
2023		108.8	730.0	838.8	36.5	0.0	2803.0	220.0	220.0	0.0	8.0	3067.5	3067.5	2228.7
2024		114.4	730.0	844.4	37.0	0.0	2803.0	220.0	220.0	0.0	8.0	3068.0	3068.0	2223.6
2025		120.0	730.0	850.0	37.5	0.0	2803.0	220.0	220.0	0.0	8.0	3068.5	3068.5	2218.5
2026		126.4	730.0	856.4	38.0	0.0	2803.0	220.0	220.0	0.0	8.0	3069.0	3069.0	2212.6
2027		132.8	730.0	862.8	38.5	0.0	2803.0	220.0	220.0	0.0	8.0	3069.5	3069.5	2206.7
2028		139.2	730.0	869.2	39.0	0.0	2803.0	220.0	220.0	0.0	8.0	3070.0	3070.0	2200.8
2029		146.4	730.0	876.4	39.5	0.0	2803.0	220.0	220.0	0.0	8.0	3070.5	3070.5	2194.1
2030		-2042.4	730.0	-1312.4	40.0	0.0	2803.0	220.0	220.0	0.0	8.0	3071.0	3071.0	4383.4

EIRR : 23.57%

B = Incremental capital costs measured in border price equivalents.

C = Incremental operating costs, in economic terms.

D = Incremental capital and operating costs (B+C).

E = Cost savings to households (avoided annual desludging costs) of B500/year/household. In year 2011-2030, an estimated 1,000 households will connect to the sewer system annually, resulting in cost savings.

F = Avoided relocation costs of industries of B300 million annually over the period 2001 until 2010.

G = Factory resource cost savings based on Table S5.

H = Health benefits estimated at B220 million annually over the period 2001-2030.

I = Increase in residential land values, estimated at 5 percent annually based on assumptions in Table S5.

J = Increase in value of paddies (agricultural benefits)

K = Total economic benefits (E+F+G+H+I+J)

L = Net Benefit (K-D)

SENSITIVITY ANALYSIS OF SAMUT PRAKARN WASTEWATER MANAGEMENT PROJECT

Year	Net Flows Base Case	A Capital Cost (+25%)	B Relocation Benefits (-50%)	C Health Benefits (-50%)	D w/o Health Benefits	E Factory RCS (-25%)	F Inc'd land values & Factor RCS=B	G Combined A and B	H Combined A and C	I Combined A and E	J Combined A, B, and C	K Combined A,B,C, and E
1995	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1996	-468.0	-583.3	-468.0	-468.0	-468.0	-468.0	-468.0	-583.3	-583.3	-583.3	-583.3	-583.3
1997	-1233.2	-1772.0	-1233.2	-1233.2	-1233.2	-1233.2	-1233.2	-1772.0	-1772.0	-1772.0	-1772.0	-1772.0
1998	-1078.6	-1656.6	-1078.6	-1078.6	-1078.6	-1078.6	-1078.6	-1656.6	-1656.6	-1656.6	-1656.6	-1656.6
1999	-602.4	-1128.2	-602.4	-602.4	-602.4	-602.4	-602.4	-1128.2	-1128.2	-1128.2	-1128.2	-1128.2
2000	1001.8	843.2	1001.8	1001.8	1001.8	1001.8	1001.8	843.2	843.2	843.2	843.2	843.2
2001	619.4	310.6	619.4	399.4	399.4	399.4	399.4	310.6	310.6	310.6	310.6	310.6
2002	189.0	-262.0	189.0	39.0	39.0	39.0	39.0	-262.0	-262.0	-262.0	-262.0	-262.0
2003	279.2	-229.6	279.2	129.2	129.2	129.2	129.2	-229.6	-229.6	-229.6	-229.6	-229.6
2004	1714.2	1523.8	1714.2	1604.2	1604.2	1604.2	1604.2	1523.8	1523.8	1523.8	1523.8	1523.8
2005	1797.6	1629.2	1797.6	1687.6	1687.6	1687.6	1687.6	1629.2	1629.2	1629.2	1629.2	1629.2
2006	2055.2	2032.6	2055.2	1905.2	1905.2	1905.2	1905.2	2032.6	2032.6	2032.6	2032.6	2032.6
2007	2162.0	2141.0	2162.0	2052.0	2052.0	2052.0	2052.0	2141.0	2141.0	2141.0	2141.0	2141.0
2008	2121.2	2077.4	2121.2	2011.2	2011.2	2011.2	2011.2	2077.4	2077.4	2077.4	2077.4	2077.4
2009	1266.8	951.8	1266.8	1156.8	1156.8	1156.8	1156.8	951.8	951.8	951.8	951.8	951.8
2010	981.8	583.2	981.8	831.8	831.8	831.8	831.8	583.2	583.2	583.2	583.2	583.2
2011	791.9	430.1	791.9	681.9	681.9	681.9	681.9	430.1	430.1	430.1	430.1	430.1
2012	1654.8	1486.0	1654.8	1544.8	1544.8	1544.8	1544.8	1486.0	1486.0	1486.0	1486.0	1486.0
2013	1768.9	1605.9	1768.9	1658.9	1658.9	1658.9	1658.9	1605.9	1605.9	1605.9	1605.9	1605.9
2014	2182.0	2155.8	2182.0	2072.0	2072.0	2072.0	2072.0	2155.8	2155.8	2155.8	2155.8	2155.8
2015	2232.7	2207.7	2232.7	2122.7	2122.7	2122.7	2122.7	2207.7	2207.7	2207.7	2207.7	2207.7
2016	2256.0	2236.6	2256.0	2146.0	2146.0	2146.0	2146.0	2236.6	2236.6	2236.6	2236.6	2236.6
2017	2252.9	2232.5	2252.9	2142.9	2142.9	2142.9	2142.9	2232.5	2232.5	2232.5	2232.5	2232.5
2018	2249.4	2228.0	2249.4	2139.4	2139.4	2139.4	2139.4	2228.0	2228.0	2228.0	2228.0	2228.0
2019	2245.9	2223.5	2245.9	2135.9	2135.9	2135.9	2135.9	2223.5	2223.5	2223.5	2223.5	2223.5
2020	2241.6	2218.0	2241.6	2131.6	2131.6	2131.6	2131.6	2218.0	2218.0	2218.0	2218.0	2218.0
2021	2237.3	2212.5	2237.3	2127.3	2127.3	2127.3	2127.3	2212.5	2212.5	2212.5	2212.5	2212.5
2022	2233.0	2207.0	2233.0	2123.0	2123.0	2123.0	2123.0	2207.0	2207.0	2207.0	2207.0	2207.0
2023	2228.7	2201.5	2228.7	2118.7	2118.7	2118.7	2118.7	2201.5	2201.5	2201.5	2201.5	2201.5
2024	2223.6	2195.0	2223.6	2113.6	2113.6	2113.6	2113.6	2195.0	2195.0	2195.0	2195.0	2195.0
2025	2218.5	2188.5	2218.5	2108.5	2108.5	2108.5	2108.5	2188.5	2188.5	2188.5	2188.5	2188.5
2026	2212.6	2181.0	2212.6	2102.6	2102.6	2102.6	2102.6	2181.0	2181.0	2181.0	2181.0	2181.0
2027	2206.7	2173.5	2206.7	2096.7	2096.7	2096.7	2096.7	2173.5	2173.5	2173.5	2173.5	2173.5
2028	2200.8	2166.0	2200.8	2090.8	2090.8	2090.8	2090.8	2166.0	2166.0	2166.0	2166.0	2166.0
2029	2194.1	2157.5	2194.1	2084.1	2084.1	2084.1	2084.1	2157.5	2157.5	2157.5	2157.5	2157.5
2030	4383.4	2201.5	4383.4	4163.4	4163.4	4163.4	4163.4	2201.5	2201.5	2201.5	2201.5	2201.5
NPV(12%)	4019.10	1935.30	3589.70	3570.20	3121.30	1544.6	2107.2	1505.90	1486.40	539.20	1057.00	-1417.50
EIRR (5)	23.57	16.10	22.19	22.41	21.21	16.74	17.98	15.13	15.18	10.79	14.21	8.87

(million Bahts)

FINANCIAL ANALYSIS

A. Tariff Structure

1. Domestic Tariff

1 Domestic wastewater production is directly related to household water consumption and application of the "polluter-pays" principle would favor a wastewater tariff schedule charging users proportionate to their actual water consumption. However, charging a flat rate across all households in Samut Prakarn Province is the only practical way of collecting wastewater tariffs from the population. The reasons for and advantages of levying a flat-rate user charge are as follows.

- (i) Wastewater management and pollution control is a new area where public involvement will be of major importance and its responsibility is best assumed by a separate facility operator who will directly collect wastewater tariffs from household and nonhousehold polluters. It would be practically difficult to design a billing system which would combine tariffs for both water consumption and wastewater production. This would require one central authority responsible for water supply services delivery and wastewater management services. This institutional setup does not appear to be feasible since the Metropolitan Waterworks Authority only services about 20 percent of the households at the present time.
- (ii) The option of charging a flat wastewater tariff on rate is a flexible and practical way of collecting pollution abatement charges. First, it is possible to charge a flat rate across all households, irrespective of (a) whether they have a sewer connection or not and (b) when they will be connected to the sewer system. All households generate wastewater and they can therefore be required to contribute to wastewater management costs.
- (iii) There are several ways of incorporating equity considerations into the design of the flat-rate scheme. First, it is possible to recover the wastewater tariff from and property owners only, and not from the lower-income families who tend to be tenants. Second, it is initially possible to defer payment of household wastewater charges. Third, the flat rate can be initially low and be gradually increased to achieve full cost recovery and can incorporate concepts such as a flat rate for each toilet in a house or a flat rate per square meter of floor space.
- (iv) As people get more and more aware about environmental issues and the need for environmental protection measures, the flat rate can be gradually increased to achieve specific cost recovery objectives by a targeted date, e.g., 2005.

2 It is recognized that affordability and willingness to pay of the public are two important issues in designing a tariff structure for wastewater management. The proposed flat rate changes on household will start at a very low level. The initial plan for the trial program period is to charge households B10 per household per month in 1998 and B20 in 1999. Starting 2000, the

charges on households will be B30 per household per month, and progress by B10 each year up to the year 2005, when the rate will reach B100 per household per month.

3 This conservatively designed tariff structure for the households shall bring the concern over the willingness to pay and affordability of the public to the minimum, since the above proposed flat rate charges on households are negligible compared with the median household income of B9,000 per month in the project area in 1995. The slow increase in the charges over the 8 year period provide sufficient allowance for the public to get used to the concept of paying for wastewater treatment.

2. Tariff Structure for Industries, Commercial Establishments and Institutions

4 The tariff structure below is considered adequate in achieving the basic objectives of (i) meeting the cost recovery target, (ii) charging progressively higher tariffs on high-volume wastewater producers to encourage water conservation, and (iii) providing cross-subsidization so that small users of the system can afford to pay. Following the "polluter-pays" principle, the tariffs for the industries should ideally be further classified according to concentrations of pollution generated by each type of industry. Because of the lack of data at this stage, the illustrative tariff schedules described in Table 1 for industries are based on the assumption that wastewater from all industries has the same average level of pollutant concentration. Over time Samut Prakarn Water Pollution Control Unit (SPWPCU) shall be able to assess industrial pollutant load in each type of industry and charge that industry accordingly to gain the full benefit of the "polluter-pays" principle. In the early years, however, tariffs somewhat along the lines shown below will likely be required.

Table 1: Illustrative Tariff Schedules for the SPWPCU in 1999, baht/m³

Consumption m ³ /month	Commercial	Industrial Consumption, m ³ /month	Industrial Tariff
0-10	1.9	0-50	3.1
11-20	2.1	51-100	3.4
21-30	2.3	101-200	3.7
31-50	2.6	201-500	4.2
51-80	3.5	501-1,000	5.6
81-120	4.3	1,001-3,000	7.1
121-200	5.2	3,001-5,000	8.5
Over 200	6.1	Over 5,000	9.9

Industries, commercial establishments and institutions will be required to connect to the wastewater collection system within a specified time period and they will have to pay up front the individual connection costs. Although connection will generally be affordable for medium-sized and larger entities, connection costs may be a potential constraint for smaller ones. For those smaller entities, finance will be available through the Industrial Finance Corporation of Thailand. The key to ensuring that industries connect to the system is not likely to be affordability but rather the level of enforcement of environmental standards.

B. Revenue Collection Systems

5 Ideally, the revenue system for implementation of the wastewater charges in Samut Prakarn Province could be integrated with the existing revenue system of the Metropolitan Waterworks Authority (MWA) and become a surcharge on the water bills of premises located in the service area. However, MWA services have been extended to only about 20 percent of the residents in the area and very few of the industries. MWA is actively engaged in the expansion of its facilities in the province, and in the long term it would be more likely to be feasible to establish close linkages between the two billing systems and thereby improve the efficiency of both systems.

6 Most of the industries in the Province and some of the residences use groundwater as their source of water supply. The Department of Mineral Resources regulates groundwater abstraction through a system of licensing; it also issues bills for groundwater usage, based primarily on estimated quantities pumped. While the MWA and Department of Mineral Resources databases may be of some use in the development of a wastewater billing system, it appears it will be necessary to construct the wastewater billing system database from data obtained directly from field surveys to be undertaken during implementation of the Project.

7 One of the more difficult tasks in the design of the revenue system is to determine how best to incorporate provisions in the billing process that will minimize account delinquencies and bad debts. The threat of termination of water service in the event of nonpayment of water charges would normally provide sufficient motivation to the bill payers. However, it does not appear likely that a wastewater billing system can be implemented in the near future which combines wastewater and water billing, and alternative means for assuring payment of amounts billed must be found. This issue will be addressed during the detailed design of the revenue system during 1998 and early 1999 and will likely involve making payment of the wastewater charges a precedent for continuation of licensed activities (for commercial establishments and industries) and to make the wastewater bill a part of another, more readily enforceable bill for residential properties. A pilot test of the proposed tariff will be conducted within the Samut Prakarn province with a view of testing the general suitability of the tariffs and revenue collecting system.

C. General Assumptions

8. The domestic inflation rate and the foreign inflation rate are assumed to be 5 percent per annum and 2.2 percent per annum, respectively, throughout the projection period. The baht/\$ exchange rate is assumed to remain constant at B25=\$1.00 over the period covered by the Project.

D. Financial Projections

9. Tariffs are set at the levels to be able to meet the Project cost recovery targets while at the same time are affordable to the households, commercial establishments and industries. Because of the lack of sufficient database and enforcement mechanism, it would be difficult in the early years to collect wastewater charges from households on the basis of actual wastewater generations. Therefore, a flat rate will be charged and this rate will increase each

year till it reaches B100 per household per month in 2005. It is assumed, however, by the year 2005, the Project operating entity will be able to build up the needed database and collect revenues from households based on actual measurement.

10. In 1998, when the Project is completed and the trial revenue collection starts, the average tariff for industries will be about B8.0 per cubic meter (m^3) of wastewater discharged and the average tariff for commercial establishments and institutions will be about B4.0 per m^3 of wastewater discharged. The tariffs will be adjusted at an annual rate of about 5 percent at two-year intervals. This adjustment compares conservatively with the average real growth rate of the economy (9.9 percent, 1989-1993) and the projected domestic inflation rate (5 percent).

11. The financial projections have made the following assumptions: the Project will be able to serve about 60 percent of the population of the Samut Prakarn Province; and bad debts will be 15 percent of receivables from households and 1 percent from industries, commercial establishments and institutions. The projections also assumes that the operating entity will absorb the cost of value added tax (VAT) for the whole projection period. However, it is possible that in the later years of operations, the cost of VAT might be passed onto polluters and therefore further improve the financial position of the Project operations. It is also understood that the Government will provide up front B250 million cash as working capital in addition to the Project costs.

TABLE 2:

INCOME STATEMENT

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
In Thousand Baht										
Service Area Population - 000	988221	1015990	1044539	1073891	1104000	1141205	1179663	1219418	1260512	1302992
Population Served	0.0%	0.0%	6.0%	12.7%	19.5%	25.8%	37.0%	42.5%	47.9%	53.0%
Wastewater Flow - Million M3	0	0	18	46	68	82	97	111	122	134
Average Tariff per M3 of Water Sales	N/A	N/A	6.23	6.48	6.92	6.61	6.42	6.29	6.78	6.72
Tariff Rev's Fr Industries & Comm	0	0	127181	339429	537179	613704	694006	765784	892482	942602
Fiat Rate Charges on Households	0	0	14836	30505	47042	64662	83551	103640	142844	184572
Less Provision for Bad Debts	0	0	-3497	-7970	-12428	-15836	-19473	-23204	-30351	-37112
Less Value Added Tax (7%)	0	0	-9941	-25895	-40895	-47486	-54429	-60860	-72473	-78902
TOTAL OPERATING REVENUES	0	0	128579	336069	530897	615044	703656	785361	932502	1011160
OPERATING EXPENSES										
Personnel	5000	15750	68822	110563	118413	133584	143681	155797	167923	179381
Power	0	0	35280	64903	84484	98264	112485	126439	139787	153907
Contractual Services	0	0	11576	24659	30571	34163	38125	42492	47304	52604
Materials and Supplies	0	0	18522	39455	48914	54661	61000	67988	75687	84166
Insurance, Legal & Audit	1000	3500	3675	7456	8803	9369	9957	10569	11206	11868
Oil and Fuel	0	4410	4862	11085	18364	26786	40777	50997	62137	74444
Office Supplies, Services and Rent	1000	10500	11576	13371	15443	17837	20601	23795	27483	31743
Utilities and Revenue System Expense	1000	6000	6300	13679	21583	29982	43469	51775	60081	68553
TOTAL OPERATING EXPENSES	8000	40160	160614	285170	346576	404646	470096	529852	591607	656665
INCOME BEFORE DEPRECIATION	-8000	-40160	-32035	50899	184322	210397	233560	255509	340895	354495
Depreciation	0	0	40000	176725	264325	287950	295950	303950	311950	319950
Non-cash Expenditures	0	0	0	0	0	0	0	0	0	0
OPERATING INCOME	-8000	-40160	-72035	-125826	-80003	-77553	-62390	-48441	28945	34545
Operational Interest	0	0	0	0	0	0	0	0	0	0
Other Income and Expenses (net)	0	2000	1880	1713	1491	1204	840	387	-170	-849
NET INCOME	-8000	-38160	-70155	-124113	-78512	-76349	-61550	-48054	28774	33696
Bonus to Directors and Employees	0	0	0	0	0	8015	8621	9348	10075	10763
RATIOS AND COMPARATORS										
Ave. Expenses/M3 of Wastewater - Bah	N/A	N/A	8.8	6.2	5.1	4.9	4.9	4.8	4.8	4.9
Working Ratio	N/A	N/A	125%	85%	65%	66%	67%	67%	63%	65%
Operating Ratio	N/A	N/A	156%	137%	115%	113%	109%	106%	97%	97%
Rate of Return on Assets	N/A	N/A	-2.6%	-1.6%	-0.7%	-0.6%	-0.5%	-0.4%	0.2%	0.3%

TABLE 3: **STATEMENT OF SOURCES AND APPLICATIONS OF FUNDS**

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
SOURCES OF FUNDS:										
Income before depreciation	-8000	-40160	-32035	50899	184322	210397	233560	255509	340895	354495
Other income (net)	0	2000	1880	1713	1491	1204	840	387	-170	-849
User's Contributions (Charges for new connections)	36750	63617	91985	139127	202826	0	0	0	0	0
Gross Internal Cash Generation	28750	25457	61830	191739	388639	211601	234400	255896	340724	353646
Operational Grants	0	0	0	0	0	0	0	0	0	0
Environment Fund Contributions/Equity	622095	2422722	2747752	398920	7908	0	0	0	0	0
Government Budgetary Allocations	0	2173191	2428771	1386320	487321	0	0	0	0	0
BORROWING										
Environment Fund Loan	0	0	0	0	0	0	0	0	0	0
TOTAL BORROWING	0	0	0	0	0	0	0	0	0	0
TOTAL SOURCES OF FUNDS	650845	4621370	5238353	1976979	883868	211601	234400	255896	340724	353646
APPLICATIONS OF FUNDS:										
Samut Prakarn Wastewater Project	622095	4595913	5176523	1785240	495229	0	0	0	0	0
Interest Capitalized	0	0	0	0	0	0	0	0	0	0
Other Capital Projects	0	0	0	0	0	0	0	0	0	0
Post-Project Expansion	0	0	0	0	0	316875	316875	316875	316875	316875
Invest to become defer. expenses	0	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXPENDITURES	622095	4595913	5176523	1785240	495229	316875	316875	316875	316875	316875
Amortization	0	0	0	0	0	0	0	0	0	0
Operational Interest	0	0	0	0	0	0	0	0	0	0
TOTAL DEBT SERVICE	0	0	0	0	0	0	0	0	0	0
Bonuses to Directors & Employees	0	0	0	0	0	8015	8621	9348	10075	10763
Working Capital Needs (Excl. Cash)	-45370	-294718	-16329	324385	144204	34877	22992	23509	35632	25723
Other Assets/Liabilities Changes	50000	0	0	0	0	0	0	0	0	0
TOTAL APPLICATIONS OF FUNDS	626725	4301195	5160194	2109625	639433	359767	348487	349732	362582	353361
CASH INCREASE OR DECREASE (-)	24120	320175	78159	-132646	244435	-148166	-114088	-93836	-21858	286

TABLE 4: BALANCE SHEET

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
In Thousand Baht										
Fixed Assets in Operation	0	0	5500000	10938000	12508000	12828000	13148000	13468000	13788000	14108000
Accumulated Depreciation	0	0	40000	216725	481050	769000	1064950	1368900	1680850	2000800
NET FIXED ASSETS	0	0	5460000	10721275	12026950	12059000	12083050	12099100	12107150	12107200
WORK IN PROGRESS	622095	5218008	4894531	1241771	167000	163875	160750	157625	154500	151375
Cash	250000	570175	648333	515687	760122	611955	497868	404032	382174	382459
Accounts Receivable	0	0	21215	55451	87598	101482	116103	129585	153863	166841
Inventories	0	25000	39128	83348	103331	115472	128863	143624	159888	177801
Other Current Assets	10000	10500	11025	11576	12155	12763	13401	14071	14775	15513
Advances to Contractors	50000	229796	258826	89262	24761	15844	15844	15844	15844	15844
TOTAL CURRENT ASSETS	310000	835470	978528	755325	987967	857517	772079	707155	726543	758458
TOTAL ASSETS	932095	6053478	11333059	12718371	13181917	13080392	13015879	12963880	12988193	13017033
Accounts Payable	78242	576899	656702	240265	82698	63888	67815	71400	75106	79009
Other Current Liabilities	27128	28484	29909	31404	32974	34623	36354	38172	40080	42084
Current Matur. Long-Term Debt	0	0	0	0	0	0	0	0	0	0
Customer Deposits	0	15904	24513	38076	55904	7219	10467	12467	14467	16507
TOTAL CURRENT LIABILITIES	105370	621287	711124	309745	171576	105731	114636	122039	129653	137601
Other Liabilities	0	0	0	0	0	0	0	0	0	0
Long-Term Debt (net)	0	0	0	0	0	0	0	0	0	0
TOTAL LIABILITIES	105370	621287	711124	309745	171576	105731	114636	122039	129653	137601
Assets Revaluation Surplus	0	0	0	0	0	0	0	0	0	0
Retained Earnings	0	-38160	-108315	-232428	-310941	-395305	-465476	-522878	-504179	-481245
Capital	826725	5470351	10730250	12641055	13321282	13369966	13366718	13364718	13362718	13360678
TOTAL EQUITY	826725	5432191	10621935	12408626	13010341	12974661	12901242	12841840	12858539	12879433
TOTAL EQUITY AND LIABILITIES	932095	6053478	11333059	12718371	13181917	13080392	13015879	12963880	12988193	13017033
Current Ratio	2.9	1.3	1.4	2.4	5.8	8.1	6.7	5.8	5.6	5.5
# Days Accounts Receivable	N/A	N/A	60	60	60	60	60	60	60	60