

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
1.	Detailed Design of Wastewater Collection and Treatment Systems of Laern Chabang Industrial Estate	Laern Chabang Industrial Estate, Chon Buri, project area approx. 3,000 rais (480 ha).	<ul style="list-style-type: none"> <li>Detailed design of wastewater collection system. These system consists of HDPE pipe spiral type from 200 mm. Dia. up to 500 mm. dia. and prestressed concrete pipe ROCLA type from 600 m. dia. up to 1,000 mm. dia. Total length of the collection system is approximately 20 km.</li> <li>Detailed design of activated sludge process wastewater treatment plant with a capacity of 30,000 cu.m./day.</li> </ul>			✓				Apr.1988 to Nov. 1988	Industrial Estate Authority of Thailand	220.1
2.	Detailed Design Wastewater Collection and Treatment Systems for Thai Petrochemical Industry Public Co.,Ltd.	Amphoe Muang, Rayong	<ul style="list-style-type: none"> <li>Detailed design of wastewater collection system and pumping station.</li> <li>Detailed design of chemical treatment and activated sludge process wastewater treatment plant with a capacity of 2,728 cu.m./day.</li> </ul>			✓				Jan.1989 to June 1989	Thai Petrochemical Industry Public Co.,Ltd.	26.5
3.	Detailed Design of Wastewater Collection and Treatment Systems for Eastern Industrial Estate (Mab Ta Phut)	Tambon Mab Ta Phut, Amphoe Muang, Rayong, project area approx.1,500 rais (240 ha).	<ul style="list-style-type: none"> <li>Detailed design of wastewater collection system. <ul style="list-style-type: none"> <li>Use PVC, class PN 8.5 for pipe dia. from 200 to 300 mm.</li> <li>Use Extra class PVC pipe for pipe dia. from 350 to 400 mm.</li> <li>Total pipe length is about 20 km.</li> <li>The number of manholes are about 340 sets.</li> </ul> </li> <li>Detailed design of wastewater Treatment Plant <ul style="list-style-type: none"> <li>Wastewater treatment plant is activated sludge system with a capacity of 12,000 cu.m./day. Primary treatment system consists of pumping station, aerated grit chamber, equalization tank and neutralization tank. Secondary treatment system consists of aeration tank, sedimentation tank and chlorine contact tank. Sludge treatment system consists of sludge thickening and sludge disposal system.</li> </ul> </li> </ul>			✓				July 1990 to May 1991	ACT Consultants Co.,Ltd. Eastern Industrial Estate (Mab Ta Phut)	170.0
4.	Detailed Design of Wastewater Collection and Wastewater Treatment Systems for Rattanakosin Area	Rattanakosin Area, Bangkok, project area approx. 4.14 km <sup>2</sup>	<ul style="list-style-type: none"> <li>General study of the project area, economical and social studies. The details of work are: Land use identification, determination of the present population, dwellings and future trends, wastewater sources and flow rates identification and impact study on the construction of wastewater treatment plant.</li> <li>Detailed design for the construction of the combined sewerage system. The details of work are: Review the existing data, existing sewerage system data collection, set up a network of wastewater collection system, determine the route and invert elevation of the interceptors, determine the house connection points from buildings, preliminary design of the collection system, cost estimation, outline the construction schedule, and investment planning, detailed design for construction, prepare technical specifications, determine construction schedule and detailed cost estimation and detailed investment planning with capital expenditure and annual cost for operation and maintenance.</li> </ul>			✓	✓	✓		28 Sept.1990 to 27 Sept.1991	Bangkok Metropolitan Administration	862.0

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

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			<ul style="list-style-type: none"> <li>Detailed design for the construction of the sewage treatment plant. The details of work are: Review the existing data, identify the suitable treatment process, size of the unit treatment, equipments &amp; required facilities for the wastewater treatment plant, detailed survey of the proposed site for the treatment plant, preliminary design of the treatment plant, cost estimation, outline the construction schedule and investment planning, detailed design for construction, prepare technical specifications, prepare work schedule, detailed cost estimation and detailed investment planning with annual capital expenditure and annual cost for operation and maintenance and prepare tender documents. The treatment system is designed as two stage activated sludge with capacity 40,000 cu.m/day.</li> <li>Financial analysis of the Project and identification of the appropriate type of investment. The details of work are:               <ul style="list-style-type: none"> <li>Analyze the financial internal rate of return.</li> <li>Study and identify the appropriate source of funding.</li> </ul> </li> </ul>									
5.	Preliminary Study, Data Acquisition and Initial Data Processing for the Design and Construction of Bangkok Wastewater Project -Stage 1	Dusit, Phra Nakhon, Pom Prap Sattru Phai, Samphanthawong, Phaya Thai, Pathumwan, Ratchathewi and Huai Khwang District, Bangkok, project area approx. 38 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Determination of the existing population (1991) in the project area and predict the population in the year 2015.</li> <li>Determination of the existing (1991) average and peak sewage flows from commercial, industrial and domestic sectors in the project area and prediction of the flows in the year 2015.</li> <li>Study of the project area, especially, the flooding problem, and proposing the corrective measures for the water pollution problem.</li> <li>Study of the existing combined drainage conditions.</li> <li>Locating the probable routes of interceptors on the basis of collecting sewage from the existing sewerage system and outfalls to canals.</li> <li>Preliminary design and analysis of the proposed sewerage system to determine the approximate sizes of the interceptors which are capable of conveying the peak dry weather flows to the treatment plants and discharging the remainder to canals via the combined sewer overflow structures. The treatment system is designed as activated sludge process with a capacity of 450,200 cu.m/day.</li> <li>Calculation of the total hydraulic flows and organic loads, average and peak values, collected at the treatment plants for the years 1991 and 2015.</li> <li>Estimating the capital costs of the interceptor sewers, storm overflow structures, pumping stations as required for the proposed sewage collection system.</li> <li>Assisting in the estimation of the capital cost of the treatment plants.</li> <li>Produce the drawing showing project area, location of interceptors and location of treatment plants, as a basis for bidders to prepare their bids.</li> <li>Implement the soil investigation at both proposed sites of sewage treatment plants ie. Lumpini Park and Mitmaitree Road. The investigation consisted of the borings of 2 boreholes of 60 m. depth at each site.</li> </ul>		✓					23 Aug.1991 to 20 Dec.1991	Bangkok Metropolitan Administration	6,382.76

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No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
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6.	Preparation of Tender Documents for Turnkey Construction of Sewerage and Wastewater Treatment Plant for Phuket Municipality	Phuket Municipality, Phuket, project area approx. 12 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Preliminary design of the collection and treatment systems. The details of work are :               <ul style="list-style-type: none"> <li>- Survey the project area and the existing combines drainage system and produce the maps of 1 : 1000 scale.</li> <li>- Determine the population in the project area for the years 2002 and 2012 and the corresponding average and peak sewage flows.</li> <li>- Set up the criteria and the conceptual design for the drainage, wastewater collection, wastewater treatment systems and other related work.</li> <li>- Investigate the soil conditions at the proposed treatment plant site and along the interceptor along the interceptor routes.</li> <li>- Preliminary design of the wastewater collection system (approx. 20 km. long interceptors) and the wastewater treatment plant of 24,000 cu.m./day capacity with the expansion plan for upgrading to 36,000 cu.m./day.</li> <li>- Preliminary design for the improvement of existing drainage system.</li> <li>- Estimate the capital cost of the project and the annual cost of operation and maintenance.</li> </ul> </li> <li>● Prepare the contract and tender documents for the design, construction and operation of the project. The details of work are :               <ul style="list-style-type: none"> <li>- Study and refine the client's tender documents of similar projects.</li> <li>- Study the related laws, regulations and practices of turnkey construction project for the purpose of perfecting the tender documents.</li> <li>- Prepare detailed technical specifications.</li> <li>- Analyze and determine the necessary clauses in the contract and tender document.</li> </ul> </li> </ul>			✓		✓		18 Sept.1992 to 17 Feb.1993	Public Works Department	722.0
7.	Feasibility Study on Drainage and Wastewater Treatment Systems for Sakon Nakhon Municipality	Sakon Nakhon Municipality, Sakon Nakhon, project area approx. 54 km <sup>2</sup> .	<p><i>Master Plan</i></p> <ul style="list-style-type: none"> <li>● Develop a comprehensive master plan for sewerage, and sewage treatment systems in which the main elements of the relevant subjects are properly forecast and generally defined for implementation in successive phases to meet the present and future needs in the study area up to the year 2013 on the basis of technical and socio-economic considerations.</li> <li>● In particular, identify sewerage projection area, sewage collection system, and sewage treatment system, develop implementation program and explore possible sources of funds and incomes for construction, operation and maintenance.</li> <li>● Undertake studies and formulate recommendations concerning the proper organization to effectively and smoothly carry out the planning and designing, construction, operation, management and administration of the sewerage system plan.</li> <li>● Recommend high priority areas for implementation of sewerage system and interim measures for implementation of plan to be selected for Feasibility Study as urgent construction and rehabilitation project.</li> </ul>	✓	✓		✓	✓		29 Jan.1993 to 2 Oct.1993	Public Works Department	1,132.0

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No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)	
				MP	FS	DD	IEE	TF	EVA				
			<p><i>Feasibility Study</i></p> <ul style="list-style-type: none"> <li>● Formulate plans for immediate improvement of the sewerage, drainage and sewage treatment systems for the study area, and to evaluate the technical, financial and economic viability of the recommended programme. Examples of works are :               <ul style="list-style-type: none"> <li>- Topographic survey in selected areas.</li> <li>- Survey of existing drainage systems.</li> <li>- Investigation of sewage quality.</li> <li>- Analysis of existing drainage.</li> <li>- Formulation of improvement plans.</li> <li>- Preliminary designs and cost estimates.</li> <li>- Study the economic and financial evaluation including the development of tariff structures.</li> <li>- Study the organization and administration.</li> </ul> </li> <li>● Undertake the initial environment examination.</li> </ul>										
8.	Evaluation of Tender Documents for Turnkey Construction of Sewerage and Wastewater Treatment Plant for Phuket Municipality	Phuket Municipality, Phuket, project area approx. 12 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Set the criteria for examining the bid document.</li> <li>● Set the criteria for the technical consideration emphasizing in the method of the evaluation of the bid document which has been divided into 12 subjects. Score in each subject is the multiple and the qualitative of the tender document for the consideration.</li> <li>● Set the criteria for choosing the most appropriated bidder.</li> <li>● Examine and evaluate on a bid document of all the bidder by examining the performance of the bidder and evaluate on the technical.</li> <li>● Evaluate a bid document for the construction cost of the bidder who is in the criteria of the qualification of the bidder and the bid document for the technical in order to gain the most benefits to the public sector.</li> <li>● Support the Public Works Department for negotiating with the most appropriated bidder.</li> <li>● Prepare the report on the evaluation of the bid document.</li> <li>● Compare between the cost and the wastewater treatment service fee.</li> </ul>						✓	✓	7 Sept.1993 to 6 Dec.1993	Public Works Department	384.0
9.	Feasibility Study and Detailed Design of Drainage and Wastewater Treatment Systems for Songkhla Municipality	Songkhla Municipality, Songkhla, project area approx. 33 km <sup>2</sup>	<p><i>Master Plan and Feasibility Study</i></p> <ul style="list-style-type: none"> <li>● Survey the project area and the existing combined drainage system.</li> <li>● Determine the population in the project area for the year 2013.</li> <li>● Preliminary design for the improvement of existing drainage system.</li> <li>● Preliminary design for the improvement of the wastewater collection system and other related work.</li> <li>● Determine the amount of BOD loading for wastewater treatment plant design.</li> </ul>	✓	✓	✓	✓	✓			1 Oct.1993 to 25 Sept.1994	Public Works Department	1,934.9

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No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>Estimate the capital cost of the project and the annual cost of operation and maintenance.</li> <li>Implementation plan and cost estimation for full phase of construction.</li> <li>Study the economic and financial evaluation including development of tariff structures.</li> <li>Study the organization and administration.</li> <li>Undertake the initial environmental examination.</li> </ul> <p><i>Detailed Design</i></p> <p>The work covered the detailed designs of drainage, wastewater collection, wastewater treatment systems and other related work, tender document preparation, cost estimation and construction schedule preparation.</p> <p>The detailed of the completed systems are as follows:</p> <ul style="list-style-type: none"> <li>Detailed design of wastewater collection system, consists of pipes range from 400 mm. to 1,200 mm at the length 18.65 km.</li> <li>Detailed design of an aerated lagoon with a capacity of 24,000 cu.m./day in 1<sup>st</sup> phase and 36,000 cu.m./day in 2<sup>nd</sup> phase.</li> </ul>									
10.	Detailed Design of Drainage and Wastewater Treatment Systems for Chon Buri Municipality	Chon Buri Municipality, Chon Buri, project area approx. 36 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Detailed design of drainage system, consists of pipe range from 600 to 1,200 mm, with total length of 3 km., and box culvert of 1.2 x 1.2 to 2 x 2 m. at the length of 1.2 km.</li> <li>Detailed design of wastewater collection system, consists of pipe range from 1,200 mm. to 1,750 mm at the length 5 km.</li> <li>Detailed design of two stage activated sludge wastewater treatment plant at capacity of 27,000 cu.m./day in 1<sup>st</sup> phase and 47,000 cu.m./day in 2<sup>nd</sup> phase</li> <li>Prepare technical specification and tender documents.</li> <li>Estimate the capital cost of the project and the annual cost of operation and maintenance.</li> </ul>			✓				1 Oct.1993 to 27 Jul.1994	Public Works Department	565.0
11.	Feasibility Study and Preliminary Design on Wastewater Collection and Treatment Systems for Maehongson Municipality	Maehongson Municipality, Maehongson, project area approx. 7.4 km <sup>2</sup>	<p><i>Master Plan and Feasibility Study</i></p> <ul style="list-style-type: none"> <li>Survey the project area and the existing combined drainage system.</li> <li>Study the socio-economic, Landuse and population in project area.</li> <li>Wastewater sources, characteristics and flowrate identification.</li> <li>Determine the population in the project area for the year 2014.</li> <li>Preliminary design for the improvement of existing drainage system.</li> <li>Preliminary design for the improvement of the wastewater collection system and other related work.</li> <li>Determine the amount of BOD loadings for wastewater treatment plant design.</li> <li>Preliminary design for the wastewater treatment system.</li> </ul>		✓		✓	✓		24 Aug.1994 to 15 Mar.1995	Maehongson Province	65.2

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				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>● Estimate the capital cost of the project and the annual cost of operation and maintenance.</li> <li>● Study the economic and financial evaluation.</li> <li>● Study the organization and administration.</li> <li>● Study the initial environmental examination.</li> </ul> <p><i>Preliminary Detailed Design</i></p> <ul style="list-style-type: none"> <li>● The work covered the preliminary designs of drainage, wastewater collection, wastewater treatment systems and other related work, including cost estimation and construction schedule preparation.</li> </ul> <p>The detailed of the completed systems are as follows:</p> <ul style="list-style-type: none"> <li>● Detailed design of drainage system, consists of pipes range from 600 to 1,200 mm. with total length of 2.25 km. and U-ditch range from 300-900 mm. at the length of 1.7 km.</li> <li>● Detailed design of wastewater collection system, consists of pipes range from 100 mm. to 400 mm.</li> <li>● Detailed design of activated sludge process wastewater treatment plant with a capacity of 4,650 cu.m./day.</li> </ul>									
12.	Detailed Design of Drainage and Wastewater Treatment Systems for Sakon Nakhon Municipality	Sakon Nakhon Municipality, Sakon Nakhon, project area approx. 19.25 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Review the feasibility reports on the following issues :               <ul style="list-style-type: none"> <li>- Land use identification.</li> <li>- Determination of the present population, dwellings and future trends.</li> <li>- Wastewater sources and flowrate identification.</li> <li>- Proposed routes for drainage and wastewater collection systems.</li> </ul> </li> <li>● Detailed design of the drainage and wastewater collection systems. The details of works are :               <ul style="list-style-type: none"> <li>- Review the existing data.</li> <li>- Existing sewerage system data collection.</li> <li>- Set up a network of wastewater collection system.</li> <li>- Determine the route and invert elevation of the interceptors.</li> <li>- Determine the house connection points from buildings.</li> <li>- Detailed design of drainage system, consists of pipes range from 600 mm. to 1,500 mm with total length of 18.0 km. and box culvert of 1.2x1.2 to 2.0x2.5 m. at the length of 6.7 km.</li> <li>- Detailed design of wastewater collection system, consists of pipes range from 400 mm. to 800 mm with total length of 7.0 km. and canal improvement.</li> <li>- Prepare technical specifications and detailed cost estimation.</li> </ul> </li> <li>● Detailed design of the wastewater treatment plant. The details of works are :               <ul style="list-style-type: none"> <li>- Identify the suitable treatment process, size of the unit treatment, equipments and required facilities for the wastewater treatment plant.</li> <li>- Detailed survey of the proposed site for the treatment plant.</li> </ul> </li> </ul>			✓				14 Sept.1994 to 10 July 1995	Public Works Department	410.0

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No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>- Detailed design of waste stabilization pond with a capacity of 8,200 cu.m./day.</li> <li>- Prepare technical specifications and tender documents.</li> <li>- Detailed cost estimation.</li> </ul>									
13.	Detailed Design of Drainage and Wastewater Treatment Systems for Nonthaburi Municipality (Rattanaithabate Area)	Nonthaburi Municipality, Nonthaburi, project area approx. 38.5 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Review feasibility study report</li> <li>● Detailed design of wastewater collection system and canal improvement for 10 existing canals.</li> <li>● Detailed design of 8 drainage pump stations.</li> <li>● Detailed design of wastewater lift stations and CSOs.</li> <li>● Detailed design of activate sludge wastewater treatment plant, capacity of 130,000 cu.m./day. and combined with biological nitrogen and phosphorus system.</li> <li>● Preparing of tender documents, contract documents, construction plan and operation and maintenance manual.</li> </ul>			✓				30 Sept.1995 to 24 Sept.1996	Public Works Department	3,200.0
14.	A Feasibility Study of BMA Wastewater User Charge	Bangkok	<ul style="list-style-type: none"> <li>● Study characteristics of municipal wastewater including wastewater quantity and characteristics from individual sources.</li> <li>● Identify the cost of wastewater collection and treatment systems.</li> <li>● Estimate the cost of wastewater management including operation and maintenance cost.</li> <li>● Review existing Thai and foreign regulations and policies.</li> <li>● Evaluate socio-economic issues by means of attitude survey.</li> <li>● Study alternatives of wastewater user charge collection.</li> <li>● Study wastewater user charge collection systems successfully used in other countries.</li> <li>● Review the existing tariff collection system of other utility agencies.</li> <li>● Define the user classes.</li> <li>● Determine the design criteria for calculating the charge rates for various user classes.</li> <li>● Propose a method of user charge collection which includes procedures, collection and management.</li> <li>● Recommend improvements for administrative and managerial institutions; regulations to be applied by government and private sectors; and user charge collection.</li> <li>● Recommend a suitable organization to manage the wastewater collection and treatment systems.</li> <li>● Hold a public hearing workshop.</li> <li>● Recommend an implementation plan for the user charge collection programme which will also evaluate the financial status at various stages of the programme.</li> <li>● Develop a computer models to determine cost of services and the cash flow situation.</li> <li>● Develop a public relations plan for public involvement implementing BMA requirements.</li> </ul>				✓		29 July 1997 to 22 May 1998	Bangkok Metropolitan Administration	-	

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No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
15.	Detailed Design of Wastewater Collection and Treatment Systems for Phuket Pollution Control Area, Patong Municipality	Patong Municipality, Phuket, project area approx. 16.4 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Study the number of populations and the wastewater quantity and quality.</li> <li>Review the reports and study the appropriated alternatives of the drainage, wastewater collection and treatment systems.</li> <li>Detailed design of the drainage, wastewater collection and treatment systems.</li> <li>Prepare the cost estimation, the budget of the project and the tender documents.</li> <li>Determine the managerial and administrative organization of the drainage, wastewater collection and treatment systems.</li> <li>Determine the tariff rate of the wastewater collection and treatment systems from various user classes in order to collect the appropriated user charge.</li> <li>Undertake the initial impact of the environmental examination.</li> <li>Study on recycled method of the wastewater treated for the other activities.</li> <li>Provide technical advice during the project construction and operation stages.</li> </ul> <p>The detailed of the completed systems are as follows</p> <ul style="list-style-type: none"> <li>Detailed design of drainage system, consists of pipes range from 400 to 1,500 mm. with total length of 6.6 km., and box culvert of 1.8 x 1.5 to 1.8 x 1.8 m. at the length of 2.6 km. and canals improvement.</li> <li>Detailed design of 12 drainage pump stations and a wastewater lift station.</li> <li>Detailed design of activated sludge process wastewater treatment plant with a capacity of 6,850 cu.m./day.</li> </ul>			✓	✓	✓		29 Aug.1997 to 29 May 1998	Phuket Province	650.0
16.	Feasibility Study and Preliminary Design on Wastewater Collection and Treatment Systems for Buayai Municipality	Buayai Municipality, Ratchasima, area approx. 10.63 km <sup>2</sup> Nakhon project	<ul style="list-style-type: none"> <li>Survey the project area and the existing combined drainage system.</li> <li>Study the socio-economic, landuse and population in project area.</li> <li>Wastewater sources, characteristics and flow rate identification.</li> <li>Determine the population in the project area for the year 2017.</li> <li>Preliminary design for the improvement of existing drainage system.</li> <li>Preliminary design for the improvement of existing wastewater collection system and other works.</li> <li>Determine the amount of BOD loadings for wastewater treatment plant design.</li> <li>Preliminary design for the wastewater treatment system.</li> <li>Development of wastewater tariff structures.</li> <li>Estimate the capital cost of the project and the annual cost of operation and maintenance.</li> <li>Economical and financial evaluation.</li> </ul>		✓		✓	✓		3 Sept.1997 to 13 Nov.1998	Buayai Municipality	196.12



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				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>● Organization and administration study</li> <li>● Initial environmental examination</li> </ul> <p>The detailed of the completed systems are as follows :</p> <ul style="list-style-type: none"> <li>● Preliminary design of drainage system, consists of pipes range from 600 to 1,200 mm. with total length of 23.8 km.</li> <li>● Preliminary design of wastewater collection system, consists of pipes range from 300 mm. to 600 mm. with total length of 14.75 km.</li> <li>● Preliminary design of 5 pump stations and CSO's</li> <li>● Preliminary design of waste stabilization pond with a capacity of 4,000 cu.m./day.</li> </ul>									
17.	Feasibility Study on User Charge and Institution for Local Authorities with Wastewater Treatment and Solid Waste Disposal Systems	23 areas in 20 provinces of Thailand	<ul style="list-style-type: none"> <li>● Study characteristics of municipal wastewater and solid waste including quantity and characteristics from individual sources.</li> <li>● Identify the cost of wastewater collection and treatment systems and estimate the cost of wastewater management.</li> <li>● Identify the cost of solid waste collection and disposal systems and estimate the cost of solid waste management.</li> <li>● Review existing Thai and foreign regulations and policies concerning wastewater and solid waste user charge.</li> <li>● Evaluate socio-economic issues by means of attitude survey.</li> <li>● Study alternatives of user charge collection.</li> <li>● Study user charge collection systems successfully used in other countries.</li> <li>● Review the existing tariff collection system of other utility agencies.</li> <li>● Define the user classes</li> <li>● Determine the design criteria for calculating the charge rates for various user classes.</li> <li>● Propose a method of user charge collection which includes procedures, collection and management.</li> <li>● Recommend improvements for administrative and managerial institutions; regulations to be applied by government and private sectors; and user charge collection.</li> <li>● Recommend a suitable organization to manage the user charge collection.</li> <li>● Hold a public hearing workshop.</li> <li>● Recommend an implementation plan for the user charge collection programme which will also evaluate the financial status at various stages of the programme.</li> <li>● Develop a computer models to determine cost of services and the cash flow situation</li> <li>● Develop a public relation plan for public involvement.</li> </ul>					✓		27 July 1998 to 29 Oct.1999	Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment	-

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18.	Study on Biofilter for Deodorization of Fish Mill Factory and Wastewater Treatment Plant	Bangkok, Samutsakhon	<ul style="list-style-type: none"> <li>● Data collection and data analysis               <ul style="list-style-type: none"> <li>- To collect and analyze the data about sources of odor, toxicity, odor threshold, odor test, deodorization system and odor standards in Thailand and foreign countries.</li> <li>- To collect and analyze the data about existing deodorization systems in Thailand for domestic wastewater treatment plants and fish mill factories.</li> </ul> </li> <li>● Model construction and experiment               <ul style="list-style-type: none"> <li>- To establish configuration of biofilter model from data collection.</li> <li>- To coordinate with one domestic wastewater treatment plant and one fish mill factory to use as experimental sites.</li> <li>- To construct biofilter models for experiment at the wastewater wastewater treatment plant and one fish mill factory.</li> <li>- To conduct the experiment and study efficiency of the models</li> </ul> </li> <li>● Proposal of design criteria, design procedure and operation and maintenance methodology               <ul style="list-style-type: none"> <li>- To propose design criteria of biofilter.</li> <li>- To propose operation and maintenance methodology.</li> <li>- To prepare typical drawing of biofilter.</li> <li>- To propose biofilter patterns for commercial work.</li> <li>- To propose recommendations for further study.</li> </ul> </li> <li>● Preparation of the manual</li> </ul>							24 May 1999 to 10 Apr. 2001	Pollution Control Department		
19.	Detailed Design of Wastewater Collection and Treatment Systems for Phuket Pollution Control Area, Karon Municipality	Karon Municipality, Phuket, project area approx. 7.28 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Study the number of populations and the wastewater quantity and quality.</li> <li>● Review the reports and study the appropriated alternatives of the drainage, wastewater collection and treatment systems.</li> <li>● Detailed design of the drainage, wastewater collection and treatment systems.</li> <li>● Prepare the cost estimation, the budget of the project and the tender documents.</li> <li>● Determine the managerial and administrative organization of the wastewater drainage, collection and treatment systems.</li> <li>● Determine the tariff rate of the wastewater collection and treatment systems from various user classes in order to collect the appropriated user charge.</li> <li>● Undertake the initial impact of the environmental examination.</li> <li>● Study on recycled method of the wastewater treated for the other activities.</li> <li>● Provide technical advice during the project construction and operation stages.</li> <li>● Study the expansion of continuing project.</li> </ul>			✓	✓	✓			2 Jul.1999 to 24 Apr.2000	Phuket Province	393.9

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
			<p>The detailed of the completed systems are as following :</p> <ul style="list-style-type: none"> <li>● Detailed design of drainage system, consists of pipes range from 600 to 1,500 mm. with total length of 8.8 km., and U-ditch range from 600 - 1,500 mm. at the length of 10.5 km. and canals improvement.</li> <li>● Detailed design of wastewater collection system, consists of pipes range from 400 mm. to 800 mm. with total length of 7.5 km.</li> <li>● Detailed design of pump stations, CSO's and lift station.</li> <li>● Detailed design of bio-filter activated sludge wastewater treatment plant with a capacity of 6,000 cu.m./day in 1<sup>st</sup> phase and 10,000 cu.m./day in 2<sup>nd</sup> phase.</li> </ul>									
20.	Feasibility Study of Khlong Toey Wastewater Treatment Project	Bangkok (covering 7 districts which are Khlong Toey (100%), Wattana (100%), Suan Luang (57%), Phra Kanong (100%), Bang Na (79%), Huay Kwang (20%), Ratchathewi (2%)), project area approx. 71.0 km <sup>2</sup>	<ul style="list-style-type: none"> <li>● Establish Design Criteria <ul style="list-style-type: none"> <li>– Analyze drainage and road network.</li> <li>– Analyze geotechnical conditions.</li> <li>– Utilize existing/planned land use data.</li> <li>– Develop population projections.</li> <li>– Project domestic/industrial water use.</li> <li>– Project per capita wastewater flows and BOD Loads.</li> <li>– Estimate Infiltration/inflow.</li> <li>– Set planning horizon, design flows/loads.</li> <li>– Establish design criteria for wastewater treatment plant, effluent disposal and sludge handling/disposal.</li> </ul> </li> <li>● Identify Wastewater Alternatives <ul style="list-style-type: none"> <li>– Define drainage/wastewater catchments.</li> <li>– Evaluate alternative treatment plant sites.</li> <li>– Prepare conceptual designs for wastewater treatment alternatives.</li> <li>– Conduct IEE of wastewater collection and treatment alternatives.</li> <li>– Compare resettlement requirements of alternatives.</li> </ul> </li> <li>● Compare Costs/Economics/Finance of Alternatives <ul style="list-style-type: none"> <li>– Estimate construction and O&amp;M costs.</li> <li>– Compare economical alternatives and select the preferred alternative.</li> <li>– Analyzed finances of preferred alternative.</li> <li>– Prepare Feasibility Study Report.</li> <li>– Prepare Environmental Baseline Data.</li> </ul> </li> <li>● Prepare Socio-Economic Studies.</li> <li>● Prepare Preliminary Designs. <ul style="list-style-type: none"> <li>– Preliminary process design of WWTP.</li> <li>– Preliminary hydraulic design of WWTP.</li> <li>– Preliminary control diagram of WWTP.</li> <li>– Layout/sections/details of WWTP and Effluent Disposal</li> </ul> </li> <li>● Prepare Preliminary Design Report.</li> </ul>		✓		✓			10 Feb.2000 to 9 Dec.2001	BMA (PTC perform as Thai Consultants of Camp Dresser & McKee International Inc.)	9,294.0

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
21.	Practical Training On Environmental Management: Under Southern Frontier Provinces Development Plan	Songkhla, Yala, Satun, Narathiwat, Pattani	<ul style="list-style-type: none"> <li>Editing of handbook of environmental management:               <ul style="list-style-type: none"> <li>Management, pricing and collecting of tariff of wastewater and solid waste managing service</li> <li>Wastewater management</li> <li>Solid waste management</li> <li>Public relation related to environmental, management and pollution control</li> </ul> </li> <li>Training of officers from municipality from 5 southern frontier provinces</li> </ul>							31Mar. 2000 to 14 Sept. 2000	Pollution Control Department	-
22.	Detailed Design of Wastewater Collection and Treatment Systems for Nakhon Sithamarat Municipality	Nakhon Sithamarat Municipality, Nakhon Sithamarat, project area approx. 22.56 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Study the number of populations and the wastewater quantity and quality.</li> <li>Review the reports and study the appropriated alternatives of the drainage, wastewater collection and treatment systems.</li> <li>Detailed design of the drainage, wastewater collection and treatment systems.</li> <li>Prepare the cost estimation, the budget of the project and the tender documents.</li> <li>Determine the managerial and administrative organization of the drainage, wastewater collection and treatment systems.</li> <li>Determine the tariff rate of the wastewater collection and treatment systems from various user classes in order to collect the appropriated user charge.</li> <li>Undertake the initial impact of the environmental examination.</li> </ul> <p>The detailed of the completed systems are as following:</p> <ul style="list-style-type: none"> <li>Detailed design of wastewater collection system, consists of pipes range from 400 mm. to 1,000 mm. with total length of 24.85 km</li> <li>Detailed design of pump stations, CSO's and lift station</li> <li>Detailed design of waste stabilization pond with a capacity of 33,700 cu.m/day in 1<sup>st</sup> phase and 66,400 cu.m/day in 2<sup>nd</sup> phase.</li> </ul>			✓	✓	✓		17 Aug.2000 to 29 May 2001	Nakhon Sithamarat Municipality	1,507.9
23.	Detailed Design of Wastewater Collection And Treatment Systems for Nakhon Ratchasima Municipality, Phase 2	Nakhon Ratchasima Municipality, Nakhon Ratchasima, project area approx. 19.2 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Review the reports and study the appropriated alternatives of the drainage, wastewater collection and treatment systems.</li> <li>Detailed design of the drainage, wastewater collection and treatment systems.</li> <li>Prepare the cost estimation, the budget of the project and the tender documents.</li> </ul> <p>The detailed of the completed systems are as following:</p> <ul style="list-style-type: none"> <li>Detailed design of drainage and wastewater collection systems, consists of pipes range from 600 mm. to 1,200 mm. and box culvert range from 1.20x1.20 m. to 2.50x2.50 m. with total length of 29.54 km</li> <li>Detailed design of pump stations, CSO's and lift station</li> <li>Detailed design of waste stabilization pond – activated sludge process wastewater treatment plant with a capacity of 70,000 cu.m/day</li> </ul>			✓	✓	✓		16 Jan. 2001 to 6 Aug.2001	Nakhon Ratchasima Municipality	738.0

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)	
				MP	FS	DD	IEE	TF	EVA				
24.	Improvement of Construction Drawing, Technical Specification Preparation and Cost Estimation of Drainage and Wastewater Collection Systems for Songkhla Municipality	Songkhla Municipality, Songkhla, project area approx. 33.08 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Review the reports and study the appropriated alternatives of the drainage, wastewater collection and treatment systems.</li> <li>Detailed design of the drainage, wastewater collection and treatment systems.</li> <li>Prepare the technical specification, cost estimation, the budget of the project and the tender documents.</li> </ul> <p>The detailed of the completed systems are as following:</p> <ul style="list-style-type: none"> <li>Detailed design of drainage and wastewater collection systems, consists of pipes range from 600 mm. to 1,200 mm. and box culvert range from 1.20x1.20 m. to 2.00x1.50 m. with total length of 5,960 m.</li> <li>Detailed design of pump stations, CSO's and lift station</li> <li>Detailed design of oxidation pond wastewater treatment plant with the treatment capacity of 36,000 cu.m./day.</li> </ul>			✓					1 Aug. 2001 to 26 Nov. 2001	Songkhla Municipality	225.6
25.	The Assessment of the Appropriate Alternatives for the Samut Prakam Wastewater Collection and Treatment Systems Project	Approximately 127 km <sup>2</sup> with the service area in Samut Prakan Province.	<ul style="list-style-type: none"> <li><b>Review &amp; Analysis of Relevant Data</b> In order to ensure that the study covered all unclear matters and issues of concern in technical, engineering, environmental, and economical aspects, the study, analysis and assessment on the technical and environmental impact.</li> <li><b>Inspection and Evaluation of the Construction Contract</b> The process commenced with data gathering, reviews, analyses, field surveys and inspection of the collection system and WWTP including the development of mathematical models for simulating the operation of the collection system and the WWTP.</li> <li><b>Development of Alternatives, Establishment of Criteria and Ranking of Alternatives</b> The development of alternatives, establishment of criteria and ranking of alternatives for the Samut Prakan Pollution Control Zone Wastewater Collection System &amp; Treatment Plant Turnkey Project considered all project issues and problems which were of concern as identified by stakeholders in every sector, and then analyzed them for improved clarification and to develop alternatives and criteria.</li> <li><b>Technical Hearing and Stakeholders Participation</b> This study was structured to receive the comments from experts/specialists in various fields as well as stakeholders from groups residing within the project area. The results from the hearings were integrated with the study results to provide a more complete study.</li> </ul>		✓		✓				9 Mar. 2004 to 21 Sep. 2005	Pollution Control Department	-

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
26.	Bang Sue Environmental Education and Conservation Project, Bangkok	Bang Sue District and parts of Chatuchak, Dusit and Phayathai Districts, Bangkok project area approx. 20.7 km <sup>2</sup>	<ul style="list-style-type: none"> <li>Feasibility Study The services include: (i.) field investigations, (ii.) assemble, review and assessment of all relevant reports, databases and studies necessary for the design of wastewater collection and treatment systems, (iii.) conduct environmental baseline surveys, (iv.) undertake socioeconomic and attitudinal surveys of the public toward the Project, (v.) define design criteria, (vi.) identify and evaluate wastewater collection and treatment process alternatives, (vii.) carry out preliminary design and conduct capital and O&amp;M costs estimates of the preferred alternative, (viii.) conduct financial and economic analysis and prepare project implementation plan.</li> <li>Detailed Design Works The services include (i.) carry out site reconnaissance and surveys; including topographical surveys, soil investigation, existing infrastructure, land acquisition and properties affected by the Project, (ii.) define detailed-design criteria, (iii.) carry out detailed design drawings for construction, (iv.) prepare capital and O&amp;M cost estimates, (v.) prepare project implementation plan, and (vi.) liaison with involved government agencies and private organizations/individuals for construction permissions.</li> <li>Services During Appointment of Contractors Using Electronic Bidding Method The services include (i.) assist in appointing construction contractors, (ii.) prepare bidding documents for electronic bidding, (iii.) assist as required for administration during electronic bidding process, (iv.) assist in negotiations with selected bidder, and (v.) prepare construction contracts.</li> </ul>	✓	✓	✓	✓	✓	✓	21 Dec.2005 to 8 Apr.2007	Bangkok Metropolitan Administration	4,584.78
27.	Feasibility Study of Improvement and Expansion of Wastewater Pattaya Collection and Treatment Systems	Na-Klua, North, Central and South Pattaya areas which covers an area of approximately 29.32 km <sup>2</sup>	<p><i>Feasibility Study</i></p> <ul style="list-style-type: none"> <li>Review the study and detailed-design of the Pattaya Pollution Control Zone Wastewater Collection and Treatment System Report undertaken by PCD.</li> <li>Collect the necessary data and physical survey for evaluated capacity of the drainage and collection system.</li> <li>Study the drainage, wastewater collection and treatment system, socio-economic problem, and health problem.</li> <li>Analysis meteorology, hydrology and hydraulic data.</li> <li>Survey data such as topography, soil investigation, land use, trend trespass lets off the drainage, existing wastewater collection and treatment system, pumping station and method for construction of improvement and expansion drainage and wastewater system.</li> <li>Analysis and offer the construction guideline of improvement and expansion drainage and WWTP system in study area.</li> <li>Preliminary Design of construction of improvement and expansion drainage and WWTP system for each alternatives and cost estimates.</li> </ul>		✓	✓	✓	✓		14 Dec. 2006 to 7 Sept.2007	Pattaya City	947.99

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>Compare financial, socio-economic, environmental and engineering alternatives.</li> <li>To offer the implementation plan and responsible party.</li> <li>To carry out the feasibility study report and relevant documents.</li> </ul> <p><i>Detailed Design</i></p> <ul style="list-style-type: none"> <li>Review the project of Pattaya Pollution Control Zone of drainage and wastewater collection and treatment system which be constructed and had been operated.</li> <li>Detailed design for construction of improvement and expansion of Pattaya drainage collection and WWTP system.</li> <li>To determine the detailed-design standard under standard of department of city planning or in-house standard are which be accepted , in case of, have no standard in the country follow to other acceptable standard in the foreign country, which must appropriate the state of Thai and area state for the construction</li> <li>Detailed-design by consider to powerful engineering, powerful architecture, saving, suitable construction method and operation and maintenance.</li> <li>Cost estimates.</li> <li>To carry out the framework project by device the promise of construction to agree with budget administer and construction period.</li> <li>To carry out the bidding document under regulation and standard of government agencies.</li> </ul>									
28.	The Design of Improvement and Expansion of Wastewater Collection and Treatment Systems at Soi Wat Bun Kanchanaram, Pattaya	Jomtein Beach and the Na Jomtein municipal district to Soi Na Jomtein 4	<p><i>Feasibility Study</i></p> <ul style="list-style-type: none"> <li>Review the study and detailed-design of the Pattaya Pollution Control Zone Wastewater Collection and Treatment System Report undertaken by PCD.</li> <li>Collect the necessary data and physical survey for evaluated capacity of the drainage and collection system.</li> <li>Study the drainage, wastewater collection and treatment system, socio-economic problem, and health problem.</li> <li>Analysis meteorology, hydrology and hydraulic data.</li> <li>Survey data such as topography, soil investigation, land use, trend trespass lets off the drainage, existing wastewater collection and treatment system, pumping station and method for construction of improvement and expansion drainage and wastewater system.</li> <li>Analysis and offer the construction guideline of improvement and expansion drainage and WWTP system in study area.</li> <li>Preliminary Design of construction of improvement and expansion drainage and WWTP system for each alternatives and cost estimates.</li> <li>Compare financial, socio-economic, environmental and engineering alternatives.</li> </ul>		✓	✓	✓	✓		2 May 2007 to 27 Dec.2007	Pattaya City	939.27

### The Consultant's Project Experience in the Feasibility Study, Detailed Design and Tariff Study of Wastewater Collection and Treatment Systems (cont.)

No.	Project Name	Project Area	Project Description	Type of Project						Project Duration	Client	Project Cost (MB)
				MP	FS	DD	IEE	TF	EVA			
			<ul style="list-style-type: none"> <li>To offer the implementation plan and responsible party.</li> <li>To carry out the feasibility study report and relevant documents.</li> </ul> <p><i>Detailed Design</i></p> <ul style="list-style-type: none"> <li>Review the project of Pattaya Pollution Control Zone of drainage and wastewater collection and treatment system which be constructed and had been operated.</li> <li>Detailed design for construction of improvement and expansion of Pattaya drainage collection and WWTP system.</li> <li>To determine the detailed-design standard under standard of department of city planning or in-house standard are which be accepted, in case of, have no standard in the country follow to other acceptable standard in the foreign country, which must appropriate the state of Thai and area state for the construction</li> <li>Detailed-design by consider to powerful engineering, powerful architecture, saving, suitable construction method and operation and maintenance.</li> <li>Cost estimates.</li> <li>To carry out the framework project by device the promise of construction to agree with budget administer and construction period.</li> <li>To carry out the bidding document under regulation and standard of government agencies.</li> </ul>									
29.	Min Buri Wastewater Treatment Project (Feasibility Study and Detailed Design)	Min Buri and Saen Saep Sub-District, Min Buri District, Bangkok The project area was adjusted from 2.85 km <sup>2</sup> per the TOR to 2.93 km <sup>2</sup> and the future expansion area from 23 km <sup>2</sup> per the TOR to 29.76 km <sup>2</sup> .	<ul style="list-style-type: none"> <li><b>Feasibility Study</b> The scope of the feasibility study comprises: the review of master plan study report and relevant reports, field investigations and environmental surveys, socio-economic and public attitudinal survey, define design criteria, evaluate wastewater collection and wastewater treatment systems alternatives and identify suitable systems for preliminary design and conduct capital and O&amp;M costs estimates of the preferred alternative, and conduct financial and economic analysis and prepare project implementation plan.</li> <li><b>Detailed Design Works</b> The scope of works include: carry out site reconnaissance and surveys; including topographical survey, soil investigation, and surveys of existing infrastructure, land and properties within the construction area, define detailed-design criteria, carry out detailed design and prepare drawings for construction, prepare capital and O&amp;M cost estimates, and prepare project implementation plan.</li> <li>Prepare bidding documents for electronic bidding</li> </ul>	✓	✓	✓	✓	✓		19 Jan 2012 to 13 July 2012	Bangkok Metropolitan Administration	560.3 (FS) 446.9 (DD)

Remarks : MP : Master Plan

IEE: Initial Environmental Examination

FS : Feasibility Study

TF : Wastewater Tariff Study and Organization &amp; Administration Study

DD : Detailed Design and Tender Documents Preparation

EVA : Evaluation of Tender Documents