JAPAN INTERNATIONAL COOPERATION AGENCY

PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THE KINGDOM OF THAILAND

THE STUDY ON MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT FOR LOWER CHAO PHRAYA RIVER BASIN IN THE KINGDOM OF THAILAND

VOLUME 3

SUPPORTING REPORT

JANUARY 1994

NIPPON JOGESUIDO SEKKEI CO., LTD.
PACIFIC CONSULTANTS INTERNATIONAL

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VOLUME 3 SUPPORTING REPORT

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PART 1

WATER POLLUTION CONTROL PLAN

1.1 Minutes of Meeting Exchanged between JICA Study Team and Thai Side

MINIUTES OF MEETING

ON

INCEPTION REPORT

FOR

THE STUDY

ON

MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT

FOR

LOWER CHAO PHRAYA RIVER BASIN

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

STEERING COMMITTEE OF THE THAI GOVERNMENT

AND

STUDY TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, MAY 15, 1992

P. Sutabutr

MR. PRAJAYA SUTABUTR
CHAIRMAN OF
STEERING COMMITTEE
PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THAILAND

MR. MASATOSHI MOMOSE
TEAM LEADER OF
JICA STYDY TEAM

The Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, dispatched the Study Team to the Kingdom of Thailand on April 30, 1992 to conduct "the Study on Master Planning for the Sewerage Development Project for Lower Chao Phraya River Basin" (hereinafter referred to as "the Study"), in accordance with the agreement on the Scope of Work for the Study between the JICA and the Public Works Department of the Ministry of Interior of the Kingdom of Thailand (hereinafter referred to as "PWD") on December 3, 1991.

A series of discussions were made on the Inception Report for the Study between the Study Team and officials concerned including the PWD, Pollution Control Department (PCD), Ministry of Science Technology and Environment, Department of Industrial Works (DIW), Department of Town and Country Planning (DTCP) and Royal Irrigation Department (RID).

The following are major items finally confirmed through discussions between the Study Team and Steering Committee organized by the Thai side both for implementation of the Study and countermeasures therefrom. The attendants for the joint meeting are listed in Appendix A.

1. Objective and Scope of Work for the Study

In accordance with the Scope of Work agreed between the JICA and the PWD, the objectives of the Study are as follows:

(1) Preparation of comprehensive basin-wide plan for water pollution control of the lower Chao Phraya river basin between Chainat and Nonthaburi

(2) Establishment of sewerage master plan for the selected eight (8) municipalities/sanitary districts with the target year of 2011

(3) Preparation of preliminary design of the sewerage system for the priority two (2) municipalities/sanitary districts with the target year of 2001

The Study in Thailand started on April 30, 1992 upon arrival of the Study Team and is scheduled to be completed by the end of next year through three-stage works including those in Japan and Thailand.

The Study area by the objective is as follows:

(1) Comprehensive Basin-Wide Planning for Water Pollution Control: The lower Chao Phraya river basin of about 5,200 km^2 between Chainat and Nonthaburi (beside Nonthaburi Provincial Office). Exact area size may be revised on the course of the Study.

(2) Master Plan of Sewerage System : The Master planning for the sewerage project will be done for the eight (8) municipalities/ sanitary districts covering Chainat, Singburi, Lopburi, Angthong, Pa Mok, Sena, Rang Sit and Bang Buathong.

The study area by municipality/sanitary district is that identified by the DTCP. However, the area for sewerage master planning and preliminary design is limited to present boundary of municipality/sanitary district in addition to the area planned by the DTCP to be expanded in the near future as shown in the land use map prepared by the DTCP. As a consideraton, isolated areas with a high population density within the DTCP planned area may be included in the sewerage master plan through discussions between the Study Team and the PWD.

The base year and target years for the planning purpose are agreed as shown below according to data availability and the target year of the Seventh National Economic and Social Development Plan.

Base year	:	1990 or 1991
Intermediate years	:	1996 and 2001
Final target year	:	2011

2. General Approach to The Project and Study Methodology

General approach to the main components of the Study was confirmed as proposed in the Inception Report. The following are the summary of them and agreed matters.

(1) Comprehensive Basin-Wide Planning for Water Pollution Control

The both parties agreed that it is timely and significant to prepare the plan covering concerned river basin and to show the effects of sewerage systems in the fact of initial stage of sewage works in Thailand.

The plan will be prepared for the rapidly urbanized/industrialized areas during last ten years due to expansion of Metropolitan Bangkok area in application of the methods developed in Japan, "Comprehensive Basin-Wide Planning for Water Pollution Control". However, some modifications of the approach may be required under some constraints and limitations. Accordingly, the Study will be made using simplified but practical methods in view of macrocosmic aspect.

Organic substances represented by BOD are major concern for the Study and water quality indicies for field measurements are those suggested in the Inception Report.

The study process and methods will also be arranged for the updating and modifications by the PWD in the future. In connection with future pollution analysis, basic factors such as run-off model, pollution load by pollution source and flow rate of the river at each checking point will be determined through discussions with related agencies.

(2) Master Plan of Sewerage System

Master plan of the sewerage systems will be prepared with an emphasis on the water pollution control of the Chao Phraya river. Utilization of existing drainage facilities including irrigation canals and street sewers will be taken into account in view of low cost construction and immediate effects provided by the sewerage systems. Accordingly, storm water run-off will be covered in the plan together with sanitary sewage collection and treatment. Alternative study on the wastewater treatment methods will be done to suit the conditions of Thailand. The existing/ on-going plans of the sewerage projects in the study basin will

be collected to reflect in the Master Plan. Communications with municipal authorities are also essential for the realization of the sewerage projects.

The plan will include environmental impact study against planned sewage works through the implementation of the projects.

(3) Preliminary Design of Sewerage Facilities

The plan and design will be prepared according to the Master Plan. In full utilization of existing drainage facilities, preliminary design of sewerage facilities will be made with the target year of 2001 for the identified area as described in the "Study area by the objective".

(4) Technology Transfer

Technology transfer will be done to the counterpart staff members through the course of this Study. Counterpart staff members including personnel in charge by related agency are shown in Appendix B.

A seminar on the study results will be conducted in Thailand at the beginning of November, 1993.

With reference to the implementation of the Study, deadlines of critical items to be provided by Thai side and determined by both parties are confirmed as follows :

(1) Provisions by the PWD on existing/on-going sewerage plan/designs such as those for Nonthaburi, Pathumthani and Ayutthaya : by the end of May, 1992

(2) Establishment on fundamentals for water pollution analysis including run-off model and subject flow rate at each checking point of the river : by the middle of July, 1992.

(3) Determination of master plan areas, trunk sewer routes and wastewater treatment plant/pump station sites : by the end of June, 1992

(4) Determination of service area for preliminary design of sewerage systems and locations with land area available for major sewerage facilities : by the end of February, 1993.

(5) Determination of wastewater collection and treatment methods : by the end of January, 1993.

3. Manner of Implementation of the Study

(1) Steering committee of the project

The Steering Committee of the Project is chaired by Mr. Prajaya Sutabutr, Deputy Director General, Public Works Department, Ministry of Interior consisting of representatives from major related agencies (refer to Appendix A). The committee will play an important role both for the implementation of the Study and project realization.

(2) Major agencies associated with the Study

The PWD is the leading counterpart agency for conduct of the Study coordinating with other major agencies concerned including the followings.

Agencies	Related Study Fields
PCD	- Environmental conservation law and regulations
	- Water pollution analysis
DIW	- Industrial development plan
	- Control of effluent discharged from factories
RID	- Subject flow rate of the river for future water pollution analysis
DTCP	- City planning : land use and population projection
DOH	- Sanitation improvement
Related Municipalities/ Sanitary Districts	- Sewered area
	- Land acquisition for major sewerage facilities

(3) Joint meeting of the Study Team and related agencies/ municipalities/sanitary districts concerned

An occasion for discussions and exchange of opinions between

the Study Team and agencies/municipalities/sanitary districts concerned upon completion of comprehensive basin plan for water pollution control; Interim Report (2), was requested by the PWD for smooth and fruitful implementation of the Project.

4. Undertaking of the Government of Thailand

The PWD provided the Study Team with office space and necessary office equipment at the SED building upon arrival of the Study Team and will make an arrangement for the office space for succeeding field work by the Study Team. To facilitate smooth conduct of the Study, PWD will also take necessary measures in cooperation with other relevant organizations as specified in the Inception Report.

Appendix A Attendants List for the Joint Meeting

Thai Side

Steering Committee

Mr. Prajaya Sutabutr (chairman)	Deputy Director General, Public Works Department
Mr. Sujin Channarong	Chief Engineer, Public Works Department
Mr. Vichan Vongvivat	Director, SED, Public Works Department
Mr. Thosporn Suddhajinda	Civil Engineer 8, SED, Public Works Department
Miss Srichada Muninto	General Admi. 5, Public Works Department
Mr. Tawee Pienchob	Pollution Control Dep., Ministry of Science Technology and Environment
Mr. Kosol Jairungsee	Department of Industrial Works
Mrs. Utai Sa-ngempong	Public Work Department
Mrs. Chariya Supranee	Public Work Department
Dr. Kreeta Soikeeree	Civil Engineer 5, SED
Mr. Tepchai Sere-umnoi	Civil Engineer 4, SED
Mrs. Premjit Homjunthananukula	Civil Engineer 4, SED

Japan side

Advisory committee

Mr. Kunio Ichimura (chairman)	Counselor, Japan Regional Development Corporation
Mr. Masatoshi Yamada (Sewerage Planning)	Deputy counselor, Planning and Design Division , Osaka Branch, Japan Sewage Work Agency

Embassy of Japan

Mr. Koichi Noguchi

JICA

Mr. Hidetaka Nishiwaki	Assitant Resident Representative, Thai Office
Mr. Jiro Inamura (Study Supervision)	Information and System Management Division, General Affairs Dep.

Study Team

Mr. Masatoshi Momose	Project Leader
Mr. Akio Takeuchi	Water Quality Conservation/ Sewerage Planning
Mr. Kenji Kawada	Water Quality Analysis
Mr. Khoji Nakogato	Survey
Dr. Chaisak Sripadungtham	Hydraulic/Hydrology

Appendix B Counterpart Staff Members and Personnel in charge by Related Agency

Agency	name	Related Field
PWD	Dr. Kreeta Soikeeree	Sanitary Engineering
	Mrs. Prenjit Homjunthanukula	Agricultural/Civil Engineering
	Mr. Seksom Chorungsarit	Civil Engineering
	Mr. Tepchai Sere-umnoi	Civil Engineering
PCD	Mr. Tawee Pienchop	Environment
DIW	Mr. Kosol Jairungsee	Industry
RID	Mr. Virat Khao-Uppatum	Irrigation
DTCP	Mr. Somsanguan	City Planning

Note : Personnel in charge of each municipality/sanitary district for the Study will be pointed out upon start of field survey of the Study Team.

MINUTES OF MEETING

ON

PROGRESS REPORT I

FOR

THE STUDY

ON

MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT

FOR

LOWER CHAO PHRAYA RIVER BASIN

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

STEERING COMMITTEE OF THE THAI GOVERNMENT

AND

STUDY TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, AUGUST 10, 1992

P. Sutabutr

MR. PRAJAYA SUTABUTR
CHAIRMAN OF
STEERING COMMITTEE
PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THAILAND

MR. MASATOSHI MOMOSE
TEAM LEADER
JICA STUDY TEAM

Stage I field work of the study on "Master Planning for Sewerage Development Project for Lower Chao Phraya Basin in the Kingdom of Thailand" started upon arrival of the JICA Study Team on 30 April 1992 and will be completed on 12 August 1992.

Stage I field work shall serve as the major basis for the comprehensive basin-wide water pollution control plan, which will be initially presented in the Stage I Interim Report and will be finalized during Stage II work. It shall also provide preliminary basis for the preparation of the sewerage master plan.

Progress Report I includes all essential data, and information and analyses in Stage I field work. The following are the major discussion items in the meeting between the Study Team and the Steering Committee, on Progress Report I. The attendants for the joint meeting are listed in Appendix A.

(1) The minutes (in Thai) of the 15 May 1992 meeting on the Inception Report was confirmed.

(2) Thereafter, the JICA Study Team presented and discussed the salient report items mainly covering the following.

1) Progress of Stage I Field Work
2) Intention and Composition of the Progress Report I
3) Briefing on the Contents of the Report
    3.1 Field measurement results
    3.2 Features of the Study Area and problem areas for the conservation of water quality in public water bodies

3.3 Framework and unit quality and quantity by pollution source

3.4 Methodology and fundamentals for water pollution analysis

3.5 Basics for sewerage planning

(3) Both sides basically agreed upon the contents of the Progress Report I and its utilization for the preparation of Interim Report I in Japan.

(4) Succeeding project requirements were discussed, as follows:

1) Aerial Photo Maps covering Bang Bua Thong and Rangsit

PWD will inform the study team on the availability of these maps, and if there is none necessary arrangements with a relevant agency in Thailand will be informed to the JICA Team.

2) Office Space for the 2nd Stage Field Work

The JICA Team mentioned that they would need office space for about 15 people from December to March. PWD indicated that they will make all arrangements.

3) Counterpart Training in Japan

Both sides agreed that finalization of a candidate trainee will be done within a week.

APPENDIX A

ATTENDANTS LIST FOR THE JOINT MEETING

THAI SIDE

1.	Mr. Prajaya Sutabutr	Deputy Director General, PWD
2.	Mr. Sujin Channarong	Chief Engineer, PWD
3.	Mr. Vichan Vongvivat	Director, SED, PWD
4.	Mr. Thossaporn Suddhajinda	Civil Engineer 8, SED, PWD
5.	Ms. Srichada Muninto	General Admin. 5, PWD
6.	Dr. Tawee Pienchalo	Pollution Control Department, MSTE
7.	Mr. Kosol Jairungsee	Department of Industrial Works
8.	Mr. Pornsak Jiwasuwan	Material and Reserach Div., PWD
9.	Ms. Wanida Bundopas	Ditto
10.	Ms. Uthai Sa-ngampong	Ditto
11.	Dr. Kreeta Sroikeeree	Civil Engineer 5, PWD
12.	Mr. Tepchai Seri-umnoy	Civil Engineer 4, SED, PWD
13.	Mr. Masayuki Hirabayashi	JICA Expert, SED, PWD

JAPAN SIDE

14.	Mr. Masatoshi Momose	JICA Study Team
15.	Mr. Takafumi Kiguchi	JICA Study Team

MINUTES OF MEETING

ON

INTERIM REPORT I

FOR

THE STUDY

ON

MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT

FOR

LOWER CHAO PHRAYA RIVER BASIN

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

STEERING COMMITTEE OF THE THAI GOVERNMENT

AND

STUDY TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, NOV. 11, 1992

P. Sutabutr

MR. PRAJAYA SUTABUTR
DIRECTOR GENERAL
PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THAILAND
CHAIRMAN OF STEERING COMMITTEE

MR. MASATOSHI MOMOSE
TEAM LEADER OF
JICA STUDY TEAM

T. Suddhajinda

MR. THOSAPORN SUDDHAJINDA
DEPUTY DIRECTOR
SANITARY ENGINEERING DEPT.
PUBLIC WORKS DEPARTMENT

MR. KUNIO ICHIMURA
COUNSELOR, JAPAN
REGIONAL DEV. CORP.
CHAIRMAN OF
ADVISORY COMMITTEE

The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Study Team to the Kingdom of Thailand on November 30, 1992 to conduct second field work for the study on "Master Planning for the Sewerage Development Project for Lower Chao Phraya River Basin" (hereinafter referred to as "The Study") in accordance with the agreement on the Scope of Work for the Study between the JICA and the Public Works Department of the Ministry of Interior of Thailand (hereinafter referred to as "PWD") on December 03, 1991.

A series of discussions were made on the Interim Report I between the Study Team and officials concerned in Thailand. The following are major items on the basin-wide water pollution control plan, explained by the Study Team and finally confirmed through discussions between the Study Team and Steering Committee organized by the Thai side. The attendants for the joint meeting are listed in Appendix A.

(1) Fundamentals for water pollution analysis including projected frame values, unit wastewater quantity and quality, and land use

(2) Present pollution analysis to come up with major factors to utulize for future pollution analysis; run-off model, and concentrated and run-off ratios

(3) Future pollution analysis under the assumptions of flow rates and assimilation capacity of rivers along the Chao Phraya river

(4) Required pollution load (BOD loading) to be reduced by pollution source

(5) Recommendations on the countermeasures for respective pollution sources to achieve water quality standards

The study results covering the total subject basin revealed future prospects of water quality (BOD) at established water quality checking points and critical areas requiring urgent countermeasures to reduce pollution load taking into account of different types of pollution sources. Although there are some assumptions in the course of pollution analysis, both parties confirmed of the overview through the future for basin-wide preservation of water quality covering different pollution sources, which are under the responsibilities of respective authorities concerned in Thailand. Conditions/assumptions in the study may be modified through Stage II field work, as required, to complete comprehensive basin-wide water pollution control plan in the Interim Report II.

In connection with sewerage master planning, both parties re-confirmed on the followings for implementation of Stage II work effectively and timely.

(1) Immediate conclusion of basic conditions for the sewerage planning referring to recommendations on the sewerage systems in Progress Report I

- Area coverage/boundary for planning purpose
- Wastewater treatment plant sites with available land area (especially for Bang Bua Thong and Rang Sit areas)
- Main sewer routes

(2) Determination of priority two (2) areas by the end of February, 1993 for preparation of preliminary design of sewerage systems

(3) Detailed discussions between DIW and PWD on the wastewater collection and treatment for the Rang Sit area in order to ensure comprehensive solution of water pollution therein.

Appendix A Attendants List at the Joint Meeting

Thai Side

Steering Committee

Mr. Sujin Channarong	Deputy Director Gen., PWD
Mr. Vichan Vongvivat	Director, SED, PWD
Mr. Thosaporn Suddhajinda	Deputy Director, SED, PWD
Dr. Kreeta Soikeeree	Civil Engineer 6, SED, PWD
Mr. Tepchai Sere-Umnoi	Civil Engineer 4, SED, PWD
Mr. Seksom Chorangsalid	Civil Engineer 5, SED, PWD
Mrs. Premjit Homjunthananukula	Civil Engineer 4, SED, PWD
Mr. Sakchai Sursyachanthrathong	Department of Ind'l. Works
Mr. Pornsak Chevasuwan	MRD
Mr. Koolkue Klankrong	Chai Nat, PWD
Mr. Ekavit Theeraporn	Nontha Buri, PWD
Mr. Santi Tantiveerasut	Lop Buri, PWD
Mr. Kitti Sirivichmaitree	Pathum Thani, PWD
Mr. Sirisak Vithayaudom	Ang Thong, PWD
Mr. Pimprai Ratanaprasatporn	Sing Buri, PWD
Mr. Aporn Thavisowan P.N.Si	Ayutthaya, PWD

Japan Side

Advisory Committee

Mr. Kunio Ichimura (Chairman)	Counselor, Japan Regional Development Corporation
Mr. Masatoshi Yamada	Deputy Counselor, Planning and Design Division, Osaka Branch, Japan Sewage Works Agency

JICA

Mr. Yoshiharu Yamada (Study Supervision)	Second Development Study Division, Social Development Study Department
Mr. Masayuki Hirabayashi	JICA Expert
Mr. Hidetaka Nishiwaki	JICA Thailand

Study Team

Mr. Masatoshi Momose	Project Leader
Mr. Akio Takeuchi	Water Quality Conservation/Sewerage Planning
Mr. Kenji Kawada	Water Quality Analysis
Mr. Koichi Nakazato	Survey
Dr. Chaisak Sripadungtham	Hydraulic/Hydrology

MINUTES OF MEETING
ON
PROGRESS REPORT II
FOR
THE STUDY
ON
MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT
FOR
LOWER CHAO PHRAYA RIVER BASIN
IN
THE KINGDOM OF THAILAND

AGREED UPON BETWEEN
STEERING COMMITTEE OF THE THAI GOVERNMENT
AND
STUDY TEAM OF
JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, MARCH 11, 1993

for Vichan Vongvivat

MR. PRAJAYA SUTABUTR
DIRECTOR GENERAL
PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THAILAND

MR. MASATOSHI MOMOSE
TEAM LEADER
JICA STUDY TEAM

Stage II field work of the study on "Master Planning for the Sewerage Development Project for Lower Chao Phraya Basin in the Kingdom of Thailand" started upon arrival of the JICA Study Team on 30 November 1992 and will be completed on 14 March 1993.

Progress Report II includes all essential data, information and results of analyses in the Stage II field work. The following are the major discussion items in the meeting between the Study Team and the Steering Committee, on the Progress Report II. The attendants for the joint meeting are listed in Appendix A.

(1) The JICA Study Team presented and discussed the salient report items mainly covering the following.

1) Progress of Stage II Field Work
2) Intention and Composition of the Progress Report II
3) Briefing on the Contents of the Report

(2) Both sides basically agreed upon the contents of the Progress Report II and its utilization for the preparation of Interim Report II in Japan.

(3) Through discussions by the both parties, the following are confirmed in major four (4) subjects.

1) Basin-Wide Water Pollution Control Plan

Some major conditions/assumptions are summarized in Section 4, Progress Report II. Interim Report II, for finalization of the plan, will be prepared under the methodology with conditions/assumptions which are presented both in Progress Report I and II.

2) Sewerage Master Plan

Sewerage Master Plan for the eight (8) municipalities/areas will be prepared according to the "preparatory work for sewerage master planning, Section 3, Progress Report II". Among major items as the basis for the planning, the following are essential.

a) Frame Values

Domestic (including business wastewater) and industrial wastewater was confirmed to be subjected sources. With regard to combined treatment of domestic and industrial wastewater, the practice shall be taken into account for only Rangsit area

based on the findings and future prospects on the locational arrangements of the factories. The industrial wastewater generated out of the municipality areas shall be treated under the management of the DIW. Thus, population and number of employees only for Rant Sit area are used for estimation of wastewater quantity and quality.

b) Sewerage Master Planning Area and Target Year

As previously agreed by the both parties, present municipality/S.D areas in addition to those to be expanded in the near future are subject areas for the target planning year of 2011.

c) Wastewater Collection Method

With an emphasis on the low cost construction to realize sanitation/water quality improvements on affordable service level in Thailand, combined wastewater collection method shall be employed. Intercepting sewers with accessories, intermediate pump stations and treatment plants are therefore designed.

d) Land Use

The information on present and future land use obtained from the DTCP is utilized as a base reference for distribution of wastewater quantity in the study area to make design of intercepting sewers.

e) Design Criteria and Conditions for Facility Design

i) Daily Average Wastewater Quality and Quantity

The study results on domestic wastewater quantity and quality by classified municipality shall be used for sewerage planning. For only Rang Sit area, discharged wastewater from existing factories will be considered as a constant one through the future.

ii) Daily Max. and Hourly Max. Wastewater

PWD standard shall be employed.

iii) Ground Water Infiltration

Twenty (20) percent of daily average wastewater will be employed

iv) Intercepting Capacity

JICA Study Team recommended to adopt one time of dry weather flow, referring to the study results on Bangkok Sewerage Master Plan and particular conditions on rainfall through the year.

After discussions by the parties from various kind of aspects to set up design capacity, three times peak dry weather flow was selected (present PWD's practice in view of quality of overflow wastewater during initial rainfall, and difference of material cost between one time and three times is minimal).

f) Wastewater Treatment Systems

From topographic features and land availability for the T.P. the following three (3) areas are recommended to have two sub-systems.

- Sing Buri
- Pa Mok
- Bang Bua Thong

The following are design wastewater flow for the proposed eleven (11) treatment plants.

Sewered Area	Treatment Plant	Design Capacity (m^3/d)
Chai Nat	Chai Nat T.P	7,400
Sing Buri	Sing Buri East T.P.	4,600
	Sing Buri West T.P.	9,500
Lop Buri	Lop Buri T.P.	20,600
Ang Thong	Ang Thong T.P.	4,600
Pa Mok	Pa Mok East T.P.	2,400
	Pa Mok West T.P.	2,100
Sena	Sena T.P.	3,200
Rangsit	Rangsit T.P.	75,800
Bang Bua Thong	Bang Bua Thong North T.P.	21,000
	Bang Bua Thong South T.P.	13,400

Preliminary recommendations on the wastewater treatment methods are as follows:

- Small scale and low treatment level : Chai Nat, Sing Buri

East and West, Lop Buri, Ang Thong, Pa Mok East and West, and Sena.

1) Stabilization Pond (SP)
2) Aerated Lagoon (AL)
3) Oxidation Ditch (OD)

- Large Scale and high treatment level : Rang Sit, and Bang Bua Thong North and South

1) Aerated Lagoon
2) Oxidation Ditch
3) Conventional Activated Sludge (AS)
4) Rotating Biological Contactor (RBC)

Wastewater treatment plant sites by study area are determined through the field work by the JICA Study Team and discussions with SED staff. In case that required land area is larger than potential area recommended by local government units at present, the sewerage plan shall show the requirements as a guide for local officials.

g) Construction Materials and Methods

Indigenous materials shall be considered for sewers, while imported ones may be necessary for mechanical and electrical equipment.

h) Cost Estimates

Cost functions will be established by sewer and treatment plant both for initial cost and O&M cost in use of updated information on the sewerage projects undertaken in Thailand.

i) Administration/Organization for Implementation of Sewerage Projects

Recommendations on both for the central government and local government units under established responsibilities in Thailand will be made referring to the findings through this field work.

j) Financial and Economic Study

Study on long-term average cost and financial requirements will be conducted referring to previous sewerage projects and collected data on financial status. While economic analysis

will be done to lead to the project justification.

3) Preliminary Design of Sewerage Systems

Bang Bua Thong North (about 4 km^2) and Rangsit areas (about 13 km^2) were selected for the design. The service areas to be covered are determined to ensure effective and practical provision of sewerage facilities to meet present and future land use.

Based on preliminary study on the treatment, area requirements for T.Ps are:

Subject Area	Land Area		
	Suggested by Local Officials	Required area in Technical View	
Bang Bua Thong North	3.2 ha	AL	8.8 ha
		OD	2.5 ha
Rangsit Area	4.5 ha	OD	9.1 ha
		AS	3.8 ha

Because of land availability and huge land acquisition cost in the areas, O.D method and A.S method will be employed for Bang Bua Thong North and Rangsit area, respectively.

Full cooperation from the municipality/S.D is a requisite to conduct topographic survey and boring test at the selected T.P sites during next field work. Investigations on the existing drainage facilities as well as additional leveling survey will also be conducted. In this connection the PWD shall make all arrangements to get concurrence from relevant authorities before start of next field work by JICA Study Team.

4) Manners of Preparation for Interim Report II

The report will consist of following two parts:

I: Comprehensive Basin-Wide Water Pollution Control Plan for the Lower Chao Phraya River Basin
II: Sewerage Master Plan for the Eight Municipalities/Areas

Sewerage Master Plan will be prepared consisting of four chapters as follows:

Chapter 1 Introduction
Chapter 2 Objective and Scope of the Study
Chapter 3 Basic Policy and Common Conditions to the Areas for Preparation of Sewerage Master Plan
Chapter 4 Sewerage Master Plan for Respective Municipalities/ Areas

5) Others

The PWD will ensure the room and other requirements for JICA Study Team to conduct next field work in Thailand.

APPENDIX A ATTENDANTS LIST FOR THE JOINT MEETING

THAI SIDE

Steering Committee

1. Mr.	Prajaya Sutabutr	Director General, PWD
2. Mr.	Sujin Channarong	Deputy Director Gen., PWD
3. Mr.	Vichan Vongvivat	Director, SED, PWD
4. Mr.	Thosaporn Suddhajinda	Deputy Director, SED, PWD
5. Dr.	Kreeta Soikeeree	Civil Engineer 6, SED, PWD
7. Mr.	Seksom Chorangsalid	Civil Engineer 5, SED, PWD
8. Mrs.	Premjit Homjunthananukula	Civil Engineer 4, SED, PWD
9. Mr.	Sakchai Sursyachanthrathong	Department of Ind'l. Works
10. Ms.	Nisakorn Kosittarat	Director, Water Quality Management Division, PCD
11. Mr.	Pornsak Chevasuwan	Scientist 5, Materials Reserch Division, PWD
12. Mr.	Koolkue Klankrong	Chai Nat, PWD
13. Mr.	Apichat Wongsarat	Sing Buri, PWD
14. Mr.	Santi Tantiveerasut	Lop Buri, PWD
15. Mr.	Sirisak Vithayaudom	Ang Thong, PWD
16. Mr.	Somnuk Chaiwnunporn	Ayutthaya, PWD
17. Mr.	Kitti Sirivichmaitree	Pathum Thani, PWD
18. Mr.	Masayuki Hirabayashi	JICA Expert, SED, PWD

JAPAN SIDE

Advisory Committee

1. Mr.	Masatoshi Yamada	Deputy Counselor, Planning and Design Division, Osaka Branch, Japan Sewage Works Agency

JICA Study Team

1. Mr.	Masatoshi Momose	Project Manager
2. Mr.	Masami Kondo	Sewage Treatment Planning
3. Mr.	Takafumi Kiguchi	Water Pollution Analysis

MINUTES OF MEETING

ON

INTERIM REPORT II

FOR

THE STUDY

ON

MASTER PLANNING FOR THE SEWERAGE DEVELOPMENT PROJECT

FOR LOWER CHAO PHRAYA RIVER BASIN

IN

THE KINGDOM OF THAILAND

AGREED UPON BETWEEN

STEERING COMMITTEE OF THE THAI GOVERNMENT

AND

STUDY TEAM OF

JAPAN INTERNATIONAL COOPERATION AGENCY

BANGKOK, JUNE 25, 1993

S. Channarong

MR. SUJIN CHANNARONG
DEPUTY DIRECTOR GENERAL
PUBLIC WORKS DEPARTMENT
MINISTRY OF INTERIOR
THAILAND
CHAIRMAN OF STEERING COMMITTEE

MR. MASATOSHI MOMOSE
TEAM LEADER OF JICA STUDY TEAM

Vichan Vongvivat

MR. VICHAN VONGVIVAT
DIRECTOR
SANITARY ENGINEERING DEPT.
PUBLIC WORKS DEPARTMENT

MR. KUNIO ICHIMURA
DIRECTOR, WATER QUALITY CONTROL DEPT.
PUBLIC WORKS DEPT.
MINISTRY OF CONSTRUCTION
CHAIRMAN OF ADVISORY COMMITTEE

The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Study Team to the Kingdom of Thailand on June 20, 1993 to conduct third work for the study on "Master Planning for the Sewerage Development Project for Lower Chao Phraya River Basin" (hereinafter referred to as "the Study").

A series of discussions were made on the Interim Report II between the Study Team and officials concerned in Thailand. The foollwing are major items on the basin-wide water pollution control plan, and draft sewerage master plans for the eight selected areas, which were discussed and finally agreed between the Study Team and Steering Committee organized by the Thai side. The attendants for the joint meeting are listed in Appendix B.

Basin-Wide Water Pollution Control Plan

(1) Fundamentals for water pollution analysis including projected frame values, unit wastewater quatity and quality, and land use.
(2) Present pollution analysis to come up with major factors to utilize for future pollution analysis; run-off model, and concentrated and run-off ratios.
(3) Future pollution analysis under the assumptions of flow rates and assimilation capacity of rivers along the Chao Phraya river.
(4) Required pollution load (BOD loading) to be reduced by pollution source.
(5) Recommendations on the countermeasures for respective pollution sources to achieve water quality standards.

The following are to be considered for finalization of the plan

- Industrial areas are located out of the municipalities according to current land use policy of the Local Governments.
- The review of reduction requirements of BOD load for livestock and fish pond will be made by the covered area of a water quality checking point.

S. Channarong

Sewerage Master Plan

(1) Basic policy and common conditions to the areas for preparation of sewerage master plan

- Previous studies relevant to sewerage project
- Water pollution status and future prospects in the lower Chao Phraya river basin
- Design conditions, assumptions and fundamentals for sewerage master planning

(2) Sewerage master plan for respective municipalities/ areas; Chai Nat, Sing Buri, Lop Buri, Ang Thong, Pa Mok, Sena, Rangsit and Bang Bua Thong
Both sides basiccally agreed upon the contents of the sewerage master plans and confirmed on the areas for succeeding preliminary design as shown below.

	Rangsit	Bang Bua Thong	
		North Area	South Area
M/P Area(Km^2)	33.3	6.70	8.94
pop.in 2011	154,000	56,900	22,700
WWTP Site(ha)	4.2 (A.S)	2.5 (A.S)	2.25(OD)
Preliminary Design			
Area (ha)	1,300	400	
pop.in 2011	76,400	42,300	

PWD will proceed the negotiation with land owner/s to purchase the land for the WWTP in Rangsit and Bang Bua Thong North areas.

Donation of Equipment

The Thai side requested that the equipment procured by JICA (listed in Appendix A) be donated to the Thai Side for further water quality survey after the completion of the Study. The Japanese Side took note of it and mentioned that they would convey the request to JICA Headquarters.

S. Channarong

Seminar on Technology Transter

The Thai side requested that a one-day seminar be held on the water pollution control plan and the sewerage master plans for the eight(8) areas when the JICA Study Team would visit Thailand for the porpose of explanation and discussion of the draft final report in late November or early December this year. The Japanese side took note of the request and mentioned that they would convey it to JICA Headquarters.

S. Chamarn

List of the Equipment

Appendix A

1. Personal Computer with Printer	2 sets
2. Portable type ph Meter with Accessories	2 units
3. Portable type DO Meter with Accessories	2 units
4. Portable type Water Quality Analysis Kit	1 unit
5. Water Quality Analysis Reagent and related tools	1 set

S. Channarong

APPENDIX B

Attendants List at the Joint Meeting

Thai side

Steering Committee

Mr. Sujin Channarong	Deputy Director General,PWD
Mr. Vichan Vongvivat	Director ,SED,PWD
Mr. Thossaporn Suddhajinda	Deputy Director,SED,PWD
Dr. Kreeta Soikeeree	Civil Engineer 6,SED,PWD
Mr. Seksom Chorangsarit	Civil Engineer 5,SED,PWD
Mrs. Premjit Homjunthananukula	Civil Engineer 4,SED,PWD
Miss Kalaya Suneesukkawattana	Civil Engineer 4,SED,PWD
Mr. Pornsak Jevasuwon	Scientist 5 ,MRD,PWD
Mr. Sakchai Suriyjantratong	DIW
Mrs.Nisakorn Kositratana	Director,WQMD,PCD
Mr. Sompong Bussabung	Chainat PWD
Mr. Santi Tantiveerasut	Lop Buri PWD
Mr. Surisak Vithayaudom	Ang Thong PWD
Mr. Aporn Thavisowan	Ayuttaya PWD
Mr. Kitti Sirivichmaitree	Pathum Thani PWD
Mr. Prapatsorn Malakarn	Pathum Thani PWD
Mr. Ekavit Theeraporn	Nonthaburi PWD

Japanese Side

Advisory Committee

Mr. Kunio Ichimura	Director,Water Quality Control Dep.,PWRI,MOC
Mr. Masatoshi Yamada	Deputy Councelor,Project Planning Dep.,JSWA

JICA

Mr. Yoshiharu Yamada	Staff, 2nd Development Study Division, Social Development Study Dep.,JICA
Mr. Yoshiharu Yoneyama	JICA Thailand
Mr. Junji Yokokura	JICA Thailand
Mr. Masayuki Hirabayashi	JICA Expert

Study Team

Mr. Masatoshi Momose	Project Leader
Mr. Akio Takeuchi	Water Quality Conservation/ Sewerage Plan
Mr. Hiroshi Shiraishi	Facilities Design

S. Channarong

Mr. Masami Kondo	Sewage Treatment Plan
Mr. Kouichi Nakazato	Topographic Survey

S. Channarry

Minutes of Meeting
on
Draft Final Report
for
The Study
on
Master Planning for the Sewerage Development Project
for
Lower Chao Phraya River Basin
in
The Kingdom of Thailand

Agreed upon between
Steering Committee of the Thai Government
and
Study team of
Japan International Cooperation Agency

Bangkok, November 30, 1993

S. Channarong

Mr. Sujin Channarong
Deputy Director General
Public Works Department
Ministry of Interior
Thailand

Mr. Masatoshi Momose
Team Leader of JICA Study Team

Vichan Vongvivat

Mr. Vichan Vongvivat
Director
Sanitary Engineering Dept.
Public Works Department

Mr. Kunio Ichimura
Director
Water Quality Control Dept.
Public Works Department
Ministry of Construction
Chairman of Advisory Committee

The Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Study Team to the Kingdom of Thailand on November 25, 1993 to discuss on Draft Final Report for the study on "Master Planning for the Sewerage Development Project for Lower Chao Phraya River Basin" (hereinafter referred to as "the Study").

A series of discussion was made on the Draft Final Report between the Study Team and officials concerned in Thailand. Of the three components of the Study, water pollution control plan and sewerage master plans for the eight areas were discussed and agreed by the both parties during the stage of Interim Report II. Preliminary design of the two areas, Rangsit and Bang Bua Thong was a focal component.

The Study Team and Steering Committee organized by the Thai side agreed on the design covering the followings:

- Area of first stage program for the year 2001
- Technical design criteria and sewage collection system
- Location and area requirements of treatment plant
- Capacity and unit treatment systems of the treatment plant
- Treatment method : Activated Sludge process and mechanical dewatering of sludge

Comments on the study reports from the Thai side to JICA Study Team, if any, will be informed to the Study Team in Japan by the end of December 1993 to finalize the reports. The attendants for the joint meeting are listed in Appendix A.

T. S

Appendix A Attendants List for the Joint Meeting

Thai Side

Steering Committee

Mr. Prajaya Sutabutr (Chairman)	Director General Public Works Department
Mr. Sujin Channarong	Deputy Director General Public Works Department
Mr. Siritan Pairojboriboon	Deputy Director General Pollution Control Dept. Ministry of Science Technology & Environment
Mr. Vichan Vongvivat	Director, SED Public Works Department
Mr. Thossaporn Suddhajinda	Deputy Director, SED Public Works Department
Mr. Sakchai Suriyajantathong	Dept of Industrial Works
Mr. Sirichai Songglod	Public Works Department
Dr. Kreeta Soikeeree	Civil Engineer 6, SED
Mr. Seksom Churangsarit	Civil Engineer 5, SED
Mr. Tepchai Sere-umnoi	Civil Engineer 5, SED
Mrs. Premjit Homjunthananukula	Civil Engineer 4, SED

Japan Side

Advisory Committee

Mr. Kunio Ichimura Chairman	Director, Water Quality Control Dept., PWRI, MOC
Mr. Masatoshi Yamada	Deputy Counselor, Project Planning Dept., JSWA

Embassy of Japan

Mr. Hiroshi Watanabe	

JICA

Mr. Yoshiharu Yoneyama	Assistant Resident Representative Thai Office
Mr. Masayuki Hirabayashi	JICA Expert, SED, PWD

Study Team

Mr. Masatoshi Momose	Project Leader
Mr. Akio Takeuchi	Water Quality Conservation & Sewerage Planning
Dr. Chaisak Sripadungtham	Hydraulic/Hydrology
Dr. Tatsuo Tsuchigane	Economist

6.1.1 Population Growth Rate and Population Projection

Table 6.1.1.1 Population Growth Rate of Provinces and Amphoes

PROVINCE / AMPHOE	Past Record				Average Annual Growth Rate (% p.a.)				
	1990	1985	1980	1970	'90–'85	'90–'80	'85–'80	'80–'70	'90–'70
Chai Nat	355,151	339,478	318,088	261,513	0.9	1.1	1.3	2.0	1.5
Muang Chai Nat	73,110	69,114	70,620	50,886	1.1	0.3	−0.4	3.3	1.8
Manorom	35,453	34,829	31,640	27,971	0.4	1.1	1.9	1.2	1.2
Wat Sing	45,154	42,478	42,679	35,453	1.2	0.6	−0.1	1.9	1.2
Sankhaburi	68,684	66,319	61,753	52,475	0.7	1.1	1.4	1.6	1.4
Sanphaya	52,888	51,785	47,515	41,375	0.4	1.1	1.7	1.4	1.2
Han Kha	79,862	74,953	63,861	53,353	1.3	2.3	3.3	1.8	2.0
Sing Buri	229,816	215,021	198,574	165,371	1.3	1.5	1.6	1.8	1.7
Muang Sing Buri	53,118	49,581	43,463	38,651	1.4	2.0	2.7	1.2	1.6
Khai Bang Rachan	30,180	27,516	25,633		1.9	1.6	1.4		
Tha Chang	16,059	15,313	14,575	12,636	1.0	1.0	1.0	1.4	1.2
Bang Rachan	38,984	35,418	32,333	45,835	1.9	1.9	1.8	−3.4	−0.8
Phrom Buri	25,925	24,942	26,112	20,372	0.8	−0.1	−0.9	2.5	1.2
In Buri	65,550	62,251	56,458	47,877	1.0	1.5	2.0	1.7	1.6
Lop Buri	704,432	695,992	571,713	463,933	0.2	2.1	4.0	2.1	2.1
Muang Lop Buri	251,391	234,442	192,780	146,045	1.4	2.7	4.0	2.8	2.8
Khok Samrong	81,119	133,518	118,436	107,009	−9.5	−3.7	2.4	1.0	−1.4
Chai Badan	86,280	101,462	85,208	69,621	−3.2	0.1	3.6	2.0	1.1
Tha Wung	50,628	49,617	43,469	39,613	0.4	1.5	2.7	0.9	1.2
Ban Mi	86,524	83,016	70,318	65,317	0.8	2.1	3.4	0.7	1.4
Phatthana Nikhom	53,467	50,003	44,190	36,328	1.3	1.9	2.5	2.0	2.0
Tha Luang	23,743	21,284	17,312		2.2	3.2	4.2		
Sra Bost	24,480	22,650			1.6				
K.A. Khok Chruen	23,788								
K.A. Lam Santhi	23,012								
K.A. Nang Muang									
Ang Thong	278,168	270,941	256,706	217,014	0.5	0.8	1.1	1.7	1.2
Muang Ang Thong	47,992	46,100	44,571	34,610	0.8	0.7	0.7	2.6	1.6
Chaiyo	22,730	22,466	22,336	17,261	0.2	0.2	0.1	2.6	1.4
Pa Mok	29,068	29,113	28,087	24,377	−0.0	0.3	0.7	1.4	0.9
Pho Thong	57,290	55,523	49,937	43,939	0.6	1.4	2.1	1.3	1.3
Wiset Chai Chan	68,078	66,941	65,227	59,298	0.3	0.4	0.5	1.0	0.7
Samko	17,443	16,678	15,032	12,362	0.9	1.5	2.1	2.0	1.7
Sawaengha	35,567	34,120	31,516	25,167	0.8	1.2	1.6	2.3	1.7
Ayutthaya	681,920	652,977	602,021	497,737	0.9	1.3	1.6	1.9	1.6
Muang Ayutthaya	120,102	115,107	99,620	76,658	0.9	1.9	2.9	2.7	2.3
Tha Rua	51,434	50,112	45,690	35,643	0.5	1.2	1.9	2.5	1.9
Nakhon Luang	32,918	31,477	27,164	24,505	0.9	1.9	3.0	1.0	1.5
Bang Zai	19,553	18,637	19,559	17,501	1.0	−0.0	−1.0	1.1	0.6
Bang Sai	43,838	41,838	39,770	33,549	0.9	1.0	1.0	1.7	1.3
Bang ban	34,599	34,043	32,707	28,494	0.3	0.6	0.8	1.4	1.0
Bang Pahan	36,649	35,420	33,050	25,579	0.7	1.0	1.4	2.6	1.8
Bang Pa-in	63,032	58,568	52,023	41,885	1.5	1.9	2.4	2.2	2.1
Ban Phraek	9,377	9,272	9,332	8,183	0.2	0.0	−0.1	1.3	0.7
Phak Hai	45,674	45,849	46,302	41,442	−0.1	−0.1	−0.2	1.1	0.5
Phachi	29,444	28,572	26,990	22,023	0.6	0.9	1.1	2.1	1.5
Maha Rat	23,373	22,965	21,222	18,351	0.4	1.0	1.6	1.5	1.2
Lat Bua Luang	32,632	30,072	28,172	21,772	1.6	1.5	1.3	2.6	2.0
Wang Noi	42,269	37,948	33,137	26,704	2.2	2.5	2.7	2.2	2.3
Sena	59,918	57,914	54,568	48,095	0.7	0.9	1.2	1.3	1.1
Uthai	37,108	35,183	32,715	27,353	1.1	1.3	1.5	1.8	1.5
Pathum Thani	448,431	384,713	319,674	233,861	3.1	3.4	3.8	3.2	3.3
M. Pathum Thani	90,272	76,076	59,238	46,104	3.5	4.3	5.1	2.5	3.4
Khlong Luang	78,817	66,153	66,849	37,271	3.6	1.7	−0.2	6.0	3.8
Thanyburi	82,325	68,795	57,657	38,358	3.7	3.6	3.6	4.2	3.9
Lat Lum Kaeo	35,211	32,874	27,672	23,500	1.4	2.4	3.5	1.6	2.0
Lam Luk Ka	82,831	67,118	48,381	37,141	4.3	5.5	6.8	2.7	4.1
Sam Khok	38,947	37,555	28,910	26,235	0.7	3.0	5.4	1.0	2.0
Nong Sua	40,028	36,142	30,967	25,252	2.1	2.6	3.1	2.1	2.3
Nonthaburi	652,462	504,424	369,777	269,067	5.3	5.8	6.4	3.2	4.5
Muang Nonthaburi	286,560	222,700	164,038	99,359	5.2	5.7	6.3	5.1	5.4
Bang Kruai	76,364	64,454	43,331	39,092	3.4	5.8	8.3	1.0	3.4
Sai Noi	33,657	31,124	24,713	23,364	1.6	3.1	4.7	0.6	1.8
Bang Bua Thong	63,572	43,304	34,530	30,550	8.0	6.3	4.6	1.2	3.7
Bang Yai	40,299	35,681	27,828	26,052	2.5	3.8	5.1	0.7	2.2
Pak Kret	152,010	107,161	75,337	50,650	7.2	7.3	7.3	4.1	5.6

Table 6.1.1.2 Population Growth Rate of Provinces and Amphoes Based on UCR Data

Province / Amphoe	Area (km2)	Pop.Dens. 1987 (h./km2)	Past Record 1972	1982	1987	Growth Rate (% p.a.) '72-'82	'82-'87	'72-'87
Chai Nat	2,469.8	139.4	300,059	332,710	344,362	1.0	0.7	0.9
Muang Chai Nat	237.6	298.7	60,808	72,312	70,964	1.7	-0.4	1.0
Manorom	216.9	161.6	36,224	33,343	35,060	-0.8	1.0	-0.2
Wat Sing	583.6	73.9	44,233	44,145	43,152	-0.0	-0.5	-0.2
Sankhaburi	341.1	195.5	50,775	65,606	66,699	2.6	0.3	1.8
Sanphaya	219.5	235.3	48,146	49,704	51,658	0.3	0.8	0.5
Hankha	871.1	88.2	59,873	67,600	76,829	1.2	2.6	1.7
Sing Buri	822.5	267.6	193,164	206,066	220,066	0.6	1.3	0.9
Muang Sing Buri	112.4	452.9	43,812	45,914	50,899	0.5	2.1	1.0
Khai Bang Rachan	88.4	318.5	22,026	27,324	28,155	2.2	0.6	1.7
Tha Chang	34.3	451.5	15,992	15,055	15,507	-0.6	0.6	-0.2
Bang Rachan	190.5	193.6	29,062	33,597	36,894	1.5	1.9	1.6
Phrom Buri	82.5	304.0	27,537	25,092	25,078	-0.9	-0.0	-0.6
In Buri	314.3	202.1	54,735	59,084	63,533	0.8	1.5	1.0
Ang Thong	968.4	246.6	210,929	225,982	238,762	0.7	1.1	0.8
Muang Ang Thong	102.8	451.5	40,232	44,646	46,433	1.0	0.8	1.0
Chaiyo	72.3	309.8	21,005	22,092	22,404	0.5	0.3	0.4
Pa Mok	80.9	363.0	27,044	28,776	29,351	0.6	0.4	0.5
Pha Thong	219.4	257.1	47,280	49,574	56,404	0.5	2.6	1.2
Wiset Chai Chan	224.7	299.0	61,877	65,459	67,186	0.6	0.5	0.6
Samko	86.9	195.5	13,491	15,435	16,984	1.4	1.9	1.5
Sawaengha	181.3	192.2	31,312	32,511	34,861	0.4	1.4	0.7
Ayutthaya	2,556.6	116.6	257,180	279,367	297,988	0.8	1.3	1.0
Muang Ayutthaya	130.6	906.8	94,476	107,862	118,412	1.3	1.9	1.5
Tha Rua	106.2	479.6	40,318	48,593	50,929	1.9	0.9	1.6
Nakhon Luang	198.9	162.9	30,922	28,424	32,405	-0.8	2.7	0.3
Bang Sai	150.8	128.6	19,621	19,877	19,380	0.1	-0.5	-0.1
Bang Shai	219.7	195.1	39,014	40,780	42,862	0.4	1.0	0.6
Bang Ban	135.3	251.3	32,829	33,831	34,000	0.3	0.1	0.2
Bang Pahan	121.9	294.7	34,234	34,507	35,918	0.1	0.8	0.3
Bang Pa-in	229.1	265.4	48,134	54,459	60,806	1.2	2.2	1.6
Ban Phraek	39.1	237.5	9,124	9,605	9,282	0.5	-0.7	0.1
Phak Hai	189.0	243.3	47,857	47,298	45,989	-0.1	-0.6	-0.3
Phachi	104.5	278.5	27,053	28,344	29,103	0.5	0.5	0.5
Maha Rat	120.2	193.7	21,781	22,217	23,280	0.2	0.9	0.4
Lat Bua Luang	199.9	156.4	25,933	29,478	31,268	1.3	1.2	1.3
Wang Noi	219.2	182.2	32,588	34,995	39,946	0.7	2.7	1.4
Sena	205.6	286.2	54,091	56,542	58,833	0.4	0.8	0.6
Uthai	186.8	193.8	30,726	34,473	36,198	1.2	1.0	1.1
Lop Buri	6,199.8	116.2	572,340	664,972	720,591	1.5	1.6	1.5
Muang Lop Buri	565.6	434.3	188,181	227,801	245,656	1.9	1.5	1.8
Khok Samrong	982.5	119.2	129,872	118,350	117,145	-0.9	-0.2	-0.7
Chai Badan	1,253.0	83.7	86,224	95,492	104,897	1.0	1.9	1.3
Tha Luang	538.9	41.1	0	20,914	22,157		1.2	
Tha Wung	242.8	204.9	45,448	49,899	49,759	0.9	-0.1	0.6
Ban Mi	585.7	145.0	78,296	80,549	84,919	0.3	1.1	0.5
Pattana Nikom	517.0	100.2	44,319	51,316	51,813	1.5	0.2	1.0
Sa Boat	304.7	145.2	0	20,651	44,245		16.5	
Khok Charoen	317.1							
Lam San Thi	447.0							
Nang Muang	445.5							
TOTAL	13,017.0	140.0	1,533,672	1,709,097	1,821,769	1.1	1.3	1.2

Table 6.1.1.3 (1) Population Projection for Amphoe

Province / Amphoe	Past Record				Average Growth Rate (% p.a.)					Projection ('90–'85)			Projection ('90–'70)		
	1990	1985	1980	1970	'90–'85	'90–'80	'85–'80	'80–'70	'90–'70	1996	2001	2011	1996	2001	2011
Chai Nat	355,151	339,478	318,068	261,513	0.9	1.1	1.3	2.0	1.5	374,917	392,226	429,278	389,304	420,261	489,755
Muang Chai Nat	73,110	69,114	70,620	50,886	1.1	0.3	−0.4	3.3	1.8	78,211	82,733	92,577	81,506	89,235	106,961
Manorom	35,453	34,829	31,640	27,971	0.4	1.1	1.9	1.2	1.2	36,217	36,865	38,198	38,066	40,390	45,472
Wat Sing	45,154	42,478	42,679	35,453	1.2	0.6	−0.1	1.9	1.2	48,589	51,650	58,362	48,552	51,579	58,209
Sankhaburi	68,684	66,319	61,753	52,475	0.7	1.1	1.4	1.6	1.4	71,634	74,188	79,574	74,461	79,644	91,118
Sanphaya	52,888	51,785	47,515	41,375	0.4	1.1	1.7	1.4	1.2	54,243	55,398	57,783	56,930	60,534	68,440
Han Kha	79,862	74,953	63,861	53,353	1.3	2.3	3.3	1.8	2.0	86,179	91,823	104,245	90,135	99,699	121,978
Sing Buri	229,816	215,021	198,574	165,371	1.3	1.5	1.6	1.8	1.7	248,920	266,047	303,919	253,863	275,414	324,674
Muang Sing Buri	53,118	49,581	43,463	38,651	1.4	2.0	2.7	1.2	1.6	57,697	61,813	70,947	58,434	63,268	74,170
Khai Bang Rachan	30,180	27,516	25,633							30,180	30,180	30,180	30,180	30,180	30,180
Tha Chang	16,059	15,313	14,575	12,636	1.0	1.0	1.0	1.4	1.2	17,002	17,831	19,610	17,256	18,322	20,655
Bang Rachan	38,984	35,418	32,333	45,835	1.9	1.9	1.8	−3.4	−0.8	43,740	48,144	58,327	37,136	35,663	32,890
Phrom Buri	25,925	24,942	26,112	20,372	0.8	−0.1	−0.9	2.5	1.2	27,156	28,226	30,495	27,869	29,600	33,392
In Buri	65,550	62,251	56,458	47,877	1.0	1.5	2.0	1.7	1.6	69,740	73,436	81,426	72,029	77,914	91,168
Lop Buri	704,432	695,992	571,713	463,933	0.2	2.1	4.0	2.1	2.1	714,695	723,362	741,012	798,462	886,340	1,092,175
Muang Lop Buri	251,391	234,442	192,780	146,045	1.4	2.7	4.0	2.8	2.8	273,355	293,117	337,031	295,875	338,902	444,637
Khok Samrong	81,119	133,518	118,436	107,009	−9.5	−3.7	2.4	1.0	−1.4	44,609	27,102	10,004	74,651	69,656	60,647
Chai Badan	86,280	101,462	85,208	69,621	−3.2	0.1	3.6	2.0	1.1	71,029	60,401	43,678	92,016	97,085	108,078
Tha Wung	50,628	49,617	43,469	39,613	0.4	1.5	2.7	0.9	1.2	51,868	52,925	55,104	54,495	57,942	65,505
Ban Mi	86,524	83,016	70,318	65,317	0.8	2.1	3.4	0.7	1.4	90,930	94,772	102,951	94,139	100,994	116,239
Phatthana Nikhom	53,467	50,003	44,190	36,328	1.3	1.9	2.5	2.0	2.0	57,942	61,956	70,837	60,040	66,130	80,227
Tha Luang	23,743	21,284	17,312							23,743	23,743	23,743	23,743	23,743	23,743
Sra Bost	24,480	22,650								24,480	24,480	24,480	24,480	24,480	24,480
King A.Khok Chruen	23,788									23,788	23,788	23,788	23,788	23,788	23,788
King A.Lam Santhi	23,012									23,012	23,012	23,012	23,012	23,012	23,012
King A.Nang Muang										0	0	0	0	0	0
Ang Thong	278,168	270,941	256,706	217,014	0.5	0.8	1.1	1.7	1.2	287,095	294,753	310,687	299,677	318,866	361,009
Muang Ang Thong	47,992	46,100	44,571	34,610	0.8	0.7	0.7	2.6	1.6	50,365	52,432	56,824	52,937	57,445	67,645
Chaiyo	22,730	22,466	22,336	17,261	0.2	0.2	0.1	2.6	1.4	23,051	23,322	23,873	24,686	26,445	30,347
Pa Mok	29,068	29,113	28,087	24,377	−0.0	0.3	0.7	1.4	0.9	29,014	28,969	28,880	30,644	32,022	34,968
Pho Thong	57,290	55,523	49,937	43,939	0.6	1.4	2.1	1.3	1.3	59,485	61,378	65,347	62,037	66,291	75,695
Wiset Chai Chan	68,078	66,941	65,227	59,298	0.3	0.4	0.5	1.0	0.7	69,468	70,648	73,068	70,957	73,449	78,699
Samko	17,443	16,678	15,032	12,362	0.9	1.5	2.1	2.0	1.7	18,407	19,252	21,058	19,341	21,080	25,040
Sawaengha	35,567	34,120	31,516	25,167	0.8	1.2	1.6	2.3	1.7	37,385	38,970	42,346	39,456	43,020	51,142

Table 6.1.1.3 (1) Population Projection for Amphoe

Province / Amphoe	Past Record				Average Growth Rate (% p.a.)					Projection ('90–'85)			Projection ('90–'70)		
	1990	1985	1980	1970	'90–'85	'90–'80	'85–'80	'80–'70	'90–'70	1996	2001	2011	1996	2001	2011
Ayutthaya	681,920	652,977	602,021	497,737	0.9	1.3	1.6	1.9	1.6	718,350	750,191	818,168	749,469	810,843	949,082
Muang Ayutthaya	120,102	115,107	99,620	76,658	0.9	1.9	2.9	2.7	2.3	126,383	131,867	143,560	137,419	153,743	192,439
Tha Rua	51,434	50,112	45,690	35,643	0.5	1.2	1.9	2.5	1.9	53,067	54,466	57,378	57,416	62,929	75,594
Nakhon Luang	32,918	31,477	27,164	24,505	0.9	1.9	3.0	1.0	1.5	34,735	36,325	39,727	35,966	38,720	44,877
Bang Sai	19,553	18,637	19,559	17,501	1.0	−0.0	−1.0	1.1	0.6	20,712	21,730	23,918	20,214	20,782	21,967
Bang Sha	43,838	41,838	39,770	33,549	0.9	1.0	1.0	1.7	1.3	46,365	48,581	53,337	47,501	50,786	58,054
Bang Ban	34,599	34,043	32,707	28,494	0.3	0.6	0.8	1.4	1.0	35,278	35,854	37,035	36,674	38,498	42,422
Bang Pahan	36,649	35,420	33,050	25,579	0.7	1.0	1.4	2.6	1.8	38,180	39,505	42,294	40,824	44,664	53,463
Bang Pa–in	63,032	58,568	52,023	41,885	1.5	1.9	2.4	2.2	2.1	68,840	74,087	85,811	71,254	78,920	96,814
Ban Phraek	9,377	9,272	9,332	8,183	0.2	0.0	−0.1	1.3	0.7	9,505	9,612	9,831	9,768	10,106	10,819
Phak Hai	45,674	45,849	46,302	41,442	−0.1	−0.1	−0.2	1.1	0.5	45,465	45,291	44,948	47,026	48,183	50,583
Phachi	29,444	28,572	26,990	22,023	0.6	0.9	1.1	2.1	1.5	30,526	31,457	33,407	32,124	34,543	39,941
Maha Rat	23,373	22,965	21,222	18,351	0.4	1.0	1.6	1.5	1.2	23,872	24,296	25,167	25,132	26,699	30,132
Lat Bua Luang	32,632	30,072	28,172	21,772	1.6	1.5	1.3	2.6	2.0	35,993	39,057	45,990	36,844	40,767	49,909
Wang Noi	42,269	37,948	33,137	26,704	2.2	2.5	2.7	2.2	2.3	48,108	53,586	66,485	48,513	54,415	68,460
Sena	59,918	57,914	54,568	48,095	0.7	0.9	1.2	1.3	1.1	62,415	64,574	69,121	64,002	67,617	75,472
Uthai	37,108	35,183	32,715	27,353	1.1	1.3	1.5	1.8	1.5	39,558	41,722	46,412	40,664	43,886	51,116
Pathum Thani	448,431	384,713	319,674	233,861	3.1	3.4	3.8	3.2	3.3	538,972	628,239	853,576	545,151	641,507	888,322
Muang Pathum Thani	90,272	76,076	59,238	46,104	3.5	4.3	5.1	2.5	3.4	110,846	131,530	185,198	110,433	130,632	182,792
Khlong Luang	78,817	66,153	66,849	37,271	3.6	1.7	−0.2	6.0	3.8	97,253	115,871	164,481	98,672	118,989	173,034
Thanyaburi	82,325	68,795	57,657	38,358	3.7	3.6	3.6	4.2	3.9	102,118	122,201	174,995	103,522	125,301	183,566
Lat Lum Kaeo	35,211	32,874	27,672	23,500	1.4	2.4	3.5	1.6	2.0	38,236	40,954	46,984	39,752	43,981	53,836
Lam Luk Ka	82,831	67,118	48,381	37,141	4.3	5.5	6.8	2.7	4.1	106,615	131,574	200,391	105,365	128,760	192,287
Sam Khok	38,947	37,555	28,910	26,235	0.7	3.0	5.4	1.0	2.0	40,686	42,194	45,380	43,848	48,401	58,972
Nong Sua	40,028	36,142	30,967	25,252	2.1	2.6	3.1	2.1	2.3	45,247	50,112	61,467	45,960	51,571	64,929
Nonthaburi	652,462	504,424	369,777	269,067	5.3	5.8	6.4	3.2	4.5	888,519	1,149,281	1,922,848	851,067	1,062,031	1,653,807
Muang Nonthaburi	286,560	222,700	164,038	99,359	5.2	5.7	6.3	5.1	5.4	387,802	499,006	826,221	393,748	513,121	871,414
Bang Kruai	76,364	64,454	43,331	39,092	3.4	5.8	8.3	1.0	3.4	93,596	110,890	155,658	93,353	110,364	154,252
Sai Noi	33,657	31,124	24,713	23,364	1.6	3.1	4.7	0.6	1.8	36,970	39,979	46,751	37,552	41,140	49,378
Bang Bua Thong	63,572	43,304	34,530	30,550	8.0	6.3	4.6	1.2	3.7	100,775	147,941	318,834	79,203	95,127	137,225
Bang Yai	40,299	35,681	27,828	26,052	2.5	3.8	5.1	0.7	2.2	46,636	52,672	67,188	45,934	51,226	63,712
Pak Kret	152,010	107,161	75,337	50,650	7.2	7.3	7.3	4.1	5.6	231,246	328,027	660,056	211,378	278,217	481,981
TOTAL	3,350,380	3,063,546	2,636,533	2,108,496	1.8	2.4	3.0	2.3	2.3	3,730,248	4,079,504	4,879,178	3,849,732	4,322,259	5,448,431

Table 6.1.1.3 (2) Population Projection by Municipality

Province / Municipality	Area (km2)	Pop.Dens. 1990 (h./km2)	Past Record 1970	1980	1985	1990	Growth Rate (% p.a.) '80–'85	'85–'90	'80–'90	'70–'90	Projection ('80–'90) 1996	2001	2011	Projection ('70–'90) 1996	2001	2011
Chai Nat	8,061	2,255.6	13,329	17,854	19,624	18,182	1.9	−1.5	0.2	1.6	18,382	18,550	18,891	19,957	21,568	25,190
Muang Chai Nat	6,061	2,307.0	9,944	13,906	15,215	13,983	1.8	−1.7	0.1	1.7	14,029	14,068	14,146	15,489	16,866	20,001
Wat Sing	2,000	2,099.5	3,385	3,948	4,409	4,199	2.2	−1.0	0.6	1.1	4,357	4,494	4,779	4,479	4,727	5,265
Sing Buri	7,810	2,889.9	9,050	18,537	20,784	22,570	2.3	1.7	2.0	4.7	25,400	28,027	34,124	29,689	37,309	58,919
Muang Sing Buri	7,810	2,889.9	9,050	18,537	20,784	22,570	2.3	1.7	2.0	4.7	25,400	28,027	34,124	29,689	37,309	58,919
Lop Buri	15,750	3,252.3	35,711	42,511	53,540	51,223	4.7	−0.9	1.9	1.8	57,285	62,882	75,769	57,077	62,464	74,310
Muang Lop Buri	3,750	9,821.9	23,112	29,815	38,238	36,832	5.1	−0.7	2.1	2.4	41,812	46,472	57,410	42,359	47,593	60,080
Khok Samrong	12,000	760.2	8,353	8,507	9,447	9,122	2.1	−0.7	0.7	0.4	9,512	9,850	10,562	9,366	9,575	10,006
Ban Mi	3,000	12.0	4,246	4,189	5,855	5,269	6.9	−2.1	2.3	1.1	6,046	6,781	8,530	5,622	5,933	6,509
Ang Thong	15,750	1,288.4	15,871	19,843	20,579	20,293	0.7	−0.3	0.2	1.2	20,568	20,800	21,271	21,846	23,230	26,268
Muang Ang Tong	3,750	2,561.9	7,267	9,520	9,593	9,607	0.2	0.0	0.1	1.4	9,660	9,704	9,792	10,446	11,201	12,879
Pa Mok	12,000	890.5	8,604	10,323	10,986	10,686	1.3	−0.6	0.3	1.1	10,910	11,100	11,490	11,404	12,039	13,416
Ayutthaya	15,750	4,987.5	47,113	57,765	72,150	78,553	4.5	1.7	3.1	2.6	94,463	110,157	149,799	91,573	104,058	134,365
Muang Ayutthaya	3,750	17,597.6	37,213	47,189	59,214	65,991	4.6	2.2	3.4	2.9	80,700	95,432	133,456	78,365	90,431	120,424
Sena	12,000	383.9	4,640	4,209	4,867	4,607	2.9	−1.1	0.9	−0.0	4,864	5,088	5,570	4,597	4,589	4,573
Tombon Wat Sing	3,000	12.0	5,260	6,367	8,069	7,955	4.9	−0.3	2.3	2.1	9,092	10,163	12,698	9,006	9,987	12,282
Pathum Thani	7,100	1,690.4	4,365	6,254	12,618	12,002	15.1	−1.0	6.7	5.2	17,746	24,584	47,180	16,257	20,934	34,713
Muang Pathum Thani	7,100	1,690.4	4,365	6,254	12,618	12,002	15.1	−1.0	6.7	5.2	17,746	24,584	47,180	16,257	20,934	34,713
Nonthaburi	40,500	6,139.8	33,974	39,985	49,371	248,661	4.3	38.2	20.1	10.5	744,447	1,856,476	11,545,158	451,800	743,124	2,010,443
Muang Nonthaburi	38,900	6,126.1	27,465	32,425	40,350	238,307	4.5	42.6	22.1	11.4	788,662	2,138,057	15,713,615	455,663	782,048	2,303,625
Bang Bua Thong	1,600	6,471.3	6,509	7,560	9,021	10,354	3.6	2.8	3.2	2.3	12,504	14,634	20,042	11,901	13,365	16,857
TOTAL	113,721	3,970.1	159,413	202,749	248,666	451,484	4.2	12.7	8.3	5.3	729,882	1,089,167	2,425,370	616,990	800,401	1,346,998

Table 6.1.1.3 (3) Population Projection for Sanitary District

Province / Amphoe	Sanitary District	Area (km2)	Pop.Dens. 1990 (h./km2)	Past Record 1970	1980	1990	Growth Rate (% p.a.) '70–'80	'80–'90	'70–'90	Projection ('80–'90) 1996	2001	2011	Employed 1996	2001	2011
Chai Nat		11.662	2,066.5	14,360	19,592	24,100	3.2	2.1	2.6	27,289	30,266	37,230	23,074	24,059	25,909
Manorom	Kung Sam Phao	1.826	1,583.8		2,809	2,892		0.3		2,943	2,986	3,074	2,859	2,825	2,735
Sunphaya	Sunphaya	3.274	1,740.7		3,619	5,699		4.6		7,484	9,391	14,789	3,587	3,857	4,419
	Pho Nang Dum	0.770	3,324.7		2,507	2,560		0.2		2,592	2,620	2,675	2,786	2,900	3,117
Sanka Buri	Prake Sriracha	2.500	2,440.8		3,110	6,102		7.0		9,143	12,807	25,129	6,389	6,663	7,184
Hankha	Hankha	1.932	2,653.7		5,785	5,127		−1.2		4,769	4,489	3,979	5,709	5,028	6,660
	Samgam Thaboth	1.360	1,264.7		1,762	1,720		−0.2		1,695	1,675	1,635	1,744	1,786	1,794
Sing Buri		77.397	665.7	30,826	45,973	51,521	4.1	1.1	2.6	55,166	58,400	65,448	53,624	56,523	62,670
In Buri	InBuri	4.000	1,681.0		5,876	6,724		1.4		7,290	7,799	8,924	8,539	9,367	11,172
Bang Rachan	Sing	22.800	944.8		16,827	21,541		2.5		24,982	28,265	36,163	22,641	24,098	27,059
Prom Buri	Bang Nam Chaeo	23.000	339.1		8,205	7,799		−0.5		7,565	7,376	7,011	4,334	4,456	4,669
	Pak Bang	8.000	386.8		3,118	3,094		−0.1		3,080	3,068	3,044	3,267	3,352	3,479
Tha Chang	Thon Samo	18.097	475.0		9,342	8,596		−0.8		8,177	7,844	7,218	11,077	11,596	12,592
Kai Bang Rachan	Pho Sang Kho	1.500	2,511.3		2,605	3,767		3.8		4,700	5,652	8,173	3,765	3,754	3,698
Lop Buri		255.895	469.1	38,801	91,860	120,037	9.0	2.7	5.8	140,938	161,110	210,529	100,734	114,836	151,984
Muang Lop Buri	Khok Toom	150.000	163.7		27,598	24,559		−1.2		22,899	21,601	19,223	20,502	19,976	18,792
Khok Samrong	Nong Muang	8.000	1,936.3		10,940	15,490		3.5		19,084	22,709	32,153	10,935	12,750	17,188
	Sra Bost	6.000	1,215.2		6,501	7,291		1.2		7,810	8,271	9,276	8,908	9,968	12,370
Chai Badan	Chai Badan	16.100	1,633.6		15,617	26,301		5.4		35,958	46,664	78,589	4,728	5,025	5,527
	Lum Narai	12.600	2,090.8		17,662	26,344		4.0		33,261	40,393	59,574	38,250	47,678	73,465
Tha Luang	Ban Tha Luang	13.000	243.8		1,311	3,170		9.2		5,384	8,373	20,245	4,018	4,544	5,762
Tha Wung	Tha Wung	7.550	677.2		4,451	5,113		1.4		5,557	5,955	6,841	2,317	2,272	2,167
	Tha Khlong	5.950	448.6		2,736	2,669		−0.2		2,630	2,597	2,534	2,683	2,658	2,587
Phatthana Nikhom	P.N.	20.345	308.8		2,912	6,282		8.0		9,964	14,635	31,572	4,301	4,865	5,167
	Kang Sua Ten	16.350	172.4		1,932	2,818		3.8		3,534	4,268	6,226	4,092	5,100	7,859
Ang Thong		127.000	523.6	37,398	55,501	66,492	4.0	1.8	2.9	74,106	81,112	97,175	58,570	63,002	73,381
Chaiyo	Charakerong	12.200	1,054.7		3,849	12,867		12.8		26,543	48,531	162,237	11,225	12,697	16,097
	Ked Chaiyo	0.700	2,047.1		1,412	1,433		0.1		1,446	1,456	1,478	1,548	1,604	1,709
Pha Thong	Phothong	36.000	201.0		6,697	7,235		0.8		7,578	7,877	8,510	7,012	6,832	6,428
Wiset Chai Chan	San Chao Rong T.	12.500	1,618.5		15,712	20,231		2.6		23,544	26,717	34,401	12,253	14,090	18,475
	Bangchak	10.000	1,042.7		15,113	10,427		−3.6		8,345	5,932	4,783	10,208	9,945	9,356
Samko	Sam Kho	53.000	184.9		9,034	9,800		0.8		10,290	10,718	11,627	12,521	14,128	17,832
Sawaengha	Sawaengha	2.600	1,730.4		3,684	4,499		2.0		5,072	5,605	6,845	3,803	3,706	3,485

Table 6.1.1.3 (3) Population Projection for Sanitary District

Province / Amphoe	Sanitary District	Area (km2)	Pop.Dens. 1990 (h./km2)	Past Record 1970	1980	1990	Growth Rate (% p.a.) '70–'80	'80–'90	'70–'90	Projection ('80–'90) 1996	2001	2011	Employed 1996	2001	2011
Ayutthaya		204.686	868.0	73,158	143,390	177,677	7.0	2.2	4.5	202,069	224,934	278,719	181,873	202,613	237,281
Muang Ayutthaya	Ayutthaya	8.400	1,280.4		9,411	10,755		1.3		11,652	12,456	14,235	12,780	14,456	18,327
Tha Rua	Tha Luang	2.500	5,597.6		7,586	13,994		6.3		20,207	27,445	50,628	19,061	22,848	32,529
Nakhon Luang	Nakhon Luang	4.313	1,703.7		5,605	7,348		2.7		8,644	9,897	12,975	8,532	9,330	11,065
Bang Sai	Bang Sai	5.570	1,171.6		6,097	6,526		0.7		6,798	7,033	7,528	6,289	6,127	5,764
Bang Shai	Bang Shai	35.000	295.9		8,318	10,356		2.2		11,811	13,179	16,408	12,341	13,422	1,572
Bang Ban	Bang Ban	7.127	1,410.7		8,793	10,054		1.3		10,896	11,651	13,322	12,149	13,429	16,271
Bang Pahan	Bang Pahan	5.980	916.4		3,589	5,480		4.3		7,064	8,729	13,328	7,956	9,752	14,521
Bang Pa-in	Ban Laen	12.786	1,176.3		9,084	15,040		5.2		20,353	26,189	43,360	11,475	13,660	19,190
	Pra Intracha	1.200	3,027.5		3,940	3,633		-0.8		3,460	3,323	3,064	4,031	4,248	4,675
	Ban Sang	9.800	263.1			2,578							3,205	3,625	4,595
Ban Phraek	Ban Phrake	8.000	354.4		2,674	2,835		0.6		2,936	3,023	3,205	2,613	2,546	2,395
Phak Hai	Phak Hai	19.530	1,181.1		24,108	23,066		-0.4		22,463	21,972	21,022	14,381	14,794	15,517
	Lad Chado	15.530	617.1		9,110	9,584		0.5		9,880	10,134	10,661	10,607	11,158	12,244
Phachi	Khoke Muang	5.000	1,303.0		5,095	6,515		2.5		7,551	8,538	10,918	6,655	6,651	6,583
Maha Rat	Maha Rat	5.840	474.8		2,386	2,773		1.5		3,035	3,272	3,802	2,971	3,038	3,151
Lat Bua Luang	Lat Bua Luang	3.800	573.9		1,752	2,181		2.2		2,487	2,775	3,455	2,135	2,080	1,957
Wang Noi	Lamtasao	19.500	568.7		10,121	11,090		0.9		11,715	12,263	13,438	16,973	20,250	27,725
Sena	Hua Wiang	20.690	947.3		13,677	19,600		3.7		24,323	29,117	41,727	10,202	11,306	13,762
	Chao Chet	10.690	981.7		9,148	10,494		1.4		11,395	12,204	14,000	13,071	14,805	18,831
Uthai	Uthai	3.430	1,100.6		2,896	3,775		2.7		4,426	5,053	6,587	4,446	5,088	6,608
Pathum Thani		171.238	1,139.9	48,019	113,083	195,187	8.9	5.6	7.3	270,821	355,803	614,134	220,872	247,601	290,025
Muang Pathum	Bang Luang	3.900	1,306.7		2,560	5,096		7.1		7,702	10,867	21,633	5,872	6,694	8,034
Sam Khok	Bang Tuei	7.290	1,156.2		5,874	8,429		3.7		10,468	12,540	17,995	8,729	9,079	9,832
Lat Lum Kaeo	Rahaeng	18.220	303.4		3,864	5,528		3.6		6,853	8,197	11,727	6,227	6,967	8,211
Thanyaburi	Prachatipat	20.800	2,232.0		21,675	46,426		7.9		73,323	107,311	229,851	53,732	61,344	73,097
	Thanyaburi	30.780	868.1		15,659	26,720		5.5		36,820	48,097	82,071	30,925	35,306	42,070
	Sanunrak	38.400	309.9		8,775	11,900		3.1		14,287	16,637	22,562	13,773	15,724	18,736
Lam Luk Ka	Khu Kot	12.475	2,483.7			30,984							34,903	38,963	45,408
	Lam Luk Ka	11.453	609.0		5,428	6,975		2.5		8,107	9,190	11,810	7,857	8,771	10,222
	Lam Sai	3.640	1,277.7		4,756	4,651		-0.2		4,589	4,538	4,438	5,239	5,849	6,816
Klong Laung	Klong Luang	10.500	4,463.8		42,967	46,870		0.9		49,380	51,574	56,259	51,816	56,947	65,353
Nong Sua	Nong Sua	13.780	116.7		1,525	1,608		0.5		1,660	1,705	1,797	1,799	1,957	2,246
Nonthaburi		57.279	3,106.8	15,368	73,322	177,957	16.9	9.3	13.0	302,945	471,959	1,145,473	192,835	221,536	294,826
Muang Nonthaburi	Bang Srimuang	6.360	2,741.8			17,438							18,464	19,749	22,842
Kruai	Wat Chalow	6.429	4,965.5		18,240	31,923		5.8		44,663	59,087	103,412	4,648	4,958	5,853
	Bang Kruai												28,821	30,772	36,470
Bang Yai	Bang Yai	8.900	1,115.6		3,759	9,929		10.2		17,783	28,902	76,341	4,642	5,296	6,429
	Bang Muang												5,777	7,733	9,388
Pak Kret	Pak Kret	34.590	3,365.6		50,328	116,415		8.7		192,543	292,838	677,372	127,064	150,402	210,727
Sai Noi	Ratniyom	1.000	2,252.0		995	2,252		8.5		3,676	5,531	12,515	2,419	2,626	3,117
	TOTAL	905.157	49,734.5	128,965	542,721	812,971	15.5	4.1	9.6	1,029,803	1,323,063	2,350,050	831,582	930,270	1,136,076

Table 6.1.1.3 (4) Population Projection for Saraburi Province by UCRS

Name of Amphoe	Area	Pop.Dens. 1987	Past Record			Growth Rate (% p.a.)			Projection (Growth Rate '72–'87)		
	(km2)	(h./km2)	1972	1982	1987	'72–'82	'82–'87	'72–'87	1996	2001	2011
Saraburi Province											
Muang Saraburi	503.8	235.9	88,942	130,710	118,866	3.9	−1.9	2.0	141,458	155,816	189,051
Kaeng Khoi	871.1	79.7	59,251	68,800	69,423	1.5	0.2	1.1	76,346	80,487	89,453
Don Phunt	65.6	95.9	7,988	6,299	6,292	−2.3	−0.0	−1.6	5,453	5,036	4,295
Ban Mo	279.0	165.8	40,921	43,076	46,259	0.5	1.4	0.8	49,790	51,868	56,285
Phra Phutthabat	324.6	145.1	59,353	46,498	47,100	−2.4	0.3	−1.5	40,998	37,957	32,535
Muak Lek	752.5	79.8	28,757	51,418	60,052	6.0	3.2	5.0	93,411	119,397	195,066
Wihan Daeng	228.8	136.6	27,340	28,485	31,245	0.4	1.9	0.9	33,851	35,391	38,686
Saohai	125.1	203.6	25,926	26,300	25,498	0.1	−0.6	−0.1	25,245	25,105	24,828
Nong Khae	293.8	257.6	58,427	76,505	75,736	2.7	−0.2	1.7	88,494	96,489	114,711
Nong Saeng	97.4	162.4	14,365	15,331	15,820	0.7	0.6	0.6	16,763	17,311	18,461
Nong Don	34.9	385.6	13,919	13,122	13,459	−0.6	0.5	−0.2	13,190	13,043	12,754
Total	3,576.6	142.5	425,189	506,544	509,750	1.8	0.1	1.2	585,000	637,899	776,125
UCR without Saraburi	13,017.0	171.4			2,231,250				2,394,976	2,554,751	2,850,102
UCR TOTAL	16,593.6	165.2			2,741,000				2,979,976	3,192,650	3,626,227

8.3 Investigation on Industrial Wastewater

Water quality and effluent volume discharged from ten factories in the study area were investigated. The examination results are to be utilized for the calculation of unit pollution load and analysis of treatment efficiency.

(1) Subject factories

The subject factories were selected based on existing data and through discussions with DIW. The factors considered are summarized below.

1) Type of factories and distribution status of the factories in the study area

According to the DIW report, "Data of Potential and Water Quality in Main Rivers and Major Factories that Discharge The Wastewater, Dec.,1990" covering the area between Nakhon Sawan and Nonthaburi, the major types of industry are food (70%), textile, ceramic and paper. About 50% of the total number of the factories are located in Pathumthani and Nonthaburi provinces.

2) Factories shall be water intensive and discharge wastewater with mainly organic substances.

3) Some factories that have heavy metals discharge.

Under the above conditions, various factories in the two provinces were selected: food, 4; paper, 2; ceramic, 1; steel rolling, 1; dyeing, 1; and washing, 1, as shown in Table 8.3.1.

TABLE 8.3.1 SUBJECT FACTORIES SELECTED

Location	No.	Type of Industry
PATHUM THANI	P-1	Food (Chicken)
	P-2	Food (Brewing)
	P-3	Paper
	P-4	Ceramic
	P-5	Steel Rolling
NONTHA BURI	N-1	Food (Soft Drink)
	N-2	Food (Ice Cream)
	N-3	Paper
	N-4	Dyeing
	N-5	Washing

(2) Water sampling time and frequency

Sampling was started at 9:00 in the morning and was finished by 18:00 in the afternoon (June 16 and 17, 1992). Samples were taken at an interval of three hours for each factory.

(3) Water sampling and measurement of effluent volume

Since all factories selected have wastewater treatment facilities, effluents from the treatment plants (TP) were collected, while influents to the TP for five factories were also taken for examination.

Effluent volume was measured during wastewater sampling. Table 8.3.2 shows the sampling points and the manner of flow measurement.

TABLE 8.3.2 SAMPLING POINTS AND MANNER OF FLOW MEASUREMENT

No.	Wastewater Sampling Point		Method of Mesurement of Effluent Volume
	STP Influent	Discharge Box	
P-1	STP Influent	Discharge Box	Water Level and Velocity at Discharge Box
P-2	-	Measuring Quantity Box	Water level at triangle weir of Measuring Quantity Box
P-3	Flow Equalization Tank	STP Effluent	Unit Straige Volume of Flow Equalization Tank
P-4	TP Influent Channel	F.S.T. Effluent	Water Level and Velocity at TP Influent Channel
P-5	-	Discharge Box	Same as P-3
N-1	Flow Equalization Tank	F.S.T. Effluent	Same as P-4
N-2	-	Discharge Box	Meter Reading of Water Supply Flow Meter
N-3	-	Discharge Box	Same as P-3
N-4	Flow Equalization Tank	F.S.T Effluent	Water Level and Velocity at Discharge Channel
N-5	-	Discharge Channel	Same as P-3

(4) Number of samples and indices for water quality examination

Total number of samples:

TP influent 15 samples (3 samples/factory x 5 factories)
TP effluent 30 samples (3 samples/factory x 10 factories)

Water quality indices are shown in Table 8.3.3 while the examination methods are shown in Table 8.3.4.

TABLE 8.3.3 WATER QUALITY INDICES

No.	TP Influent	TP Effluent
P-1	A	B
P-2		B + C
P-3	A	B
P-4	A	B + C
P-5		B + C
N-1	A	B
N-2		B
N-3		B
N-4	A	B + C
N-5		B

Indices

A : BOD, SS

B : Water Temp., pH, DO, BOD, COD, SS, Cl^-, NH_4-N, NO_3-N, SO_4^{2}, Coliform Group.

C : As, Cd, T-Cr, Cu, T-Hg, Mn, Pb, Zn

All analysis methods followed the "Standard Methods for the Examination of Water and Wastewater", 1985, 16th edition, American Public Health Association, as indicated in the table below.

TABLE 8.3.4 METHODS OF WATER & WASTEWATER QUALITY ANALYSIS

Parameters	Analysis Methods	
Suspended Solids	209.C	Total suspended solids dried at 103-105^{o}C
Alkalinity	403	Alkalinity
Chloride	407.A	Argentometric Method
Sulfate	426.C	Turbidimetric Method
Nitrate	418.C	Cadmium Reduction Method
Ammonia	417.A&D	Preliminary Distillation and Titrimetric Method
DO	421.B	Azide Modification
BOD	507	Oxygen Demand (Biochemical)
COD	508.A	Open Reflux Method
Coliform	908.D	Multiple-tube fermentation technique for members of the coliform group (estimation of bacterial density)
Zn, Cr^{+6}, Cu,	302.E	Preliminary Digestion by Nitric and Sulfuric Acid
Cd, Pb, Mn	303.A	Metals by atomic absorption spectrometer
As	303.E	Determination of Arsenic and Selenium by Conversion to their Hydrides by Sodium Borohydride Reagent and Aspiration into an Atomic Absorption Atomizer
Hg	303.F	Determination of Mercury by the Cold Vapor Technique

(5) Results of the Investigations

1) Basic information on the factories

Major factories located in the nine provinces between Nakhon Sawan and Nonthaburi are summarized in Table 8.3.5.

TABLE 8.3.5 NUMBER OF FACTORIES BY TYPE OF INDUSTRY

Type of Industry	Number of Factories	Composition (%)
Food	88	67.7
Fiber	14	10.7
Ceramic	11	8.5
Paper	9	6.9
Cloth	2	1.5
Washing	2	1.5
Rubber	1	0.8
Steel Rolling	1	0.8
Chemical	1	0.8
Machine	1	0.8
Total	130	100

Data source: DIW

It may be concluded that the primary water pollution source in the area was wastewater discharged from the food industry in its characteristic in terms of organic substances and water consumption.

The following summarizes relevant information on the ten selected factories that were investigated through interviews and questionnaire survey.

Number of employee : max. number is 1,200 for a food production company, others are in the range of 160 to 800.

Working duration a day : 8:00 - 16:00 (8 hours), 3 factories
3 shift operation for 24 hours, 9 factories.

Factory area : varying sizes

Wastewater effluent volume : paper industry, 6,500-7,000 m^3/d and food (brewing), 3,000 m^3/d (similar volume as as those reported DIW)

Table 8.3.6 shows the detailed information collected.

2) Wastewater treatment system

It was noticed during investigation that generally the treatment plants constructed by the factories are being operated under good conditions by the operators. Wastewaters generated from the production process and the employees' discharge were commonly mixed and treated except for the factories in ceramic and steel rolling.

There were two kinds of treatment method employed; biological treatment (i.e., activated sludge(AS)), and chemical treatment (alum coagulation and sedimentation). Table 8.3.7 summarizes the treatment processes by each factory.

The treatment facilities included either an equalization tank (before TP) and a pond (after TP) for flow adjustment purposes. Two factories had sludge dewatering equipment, while others had sludge drying beds. Dried sludge was usually disposed out-side the factory's premises.

3) Quality and quantity of influent to TP (generated wastewater)

The results of examination on five factories (4 types of industry) are indicated in Table 8.3.8 and the following is a summary of findings by index.

pH : 7-8 (neutral to weak alkali) - food (chicken) paper and ceramic
9 (strong alkali) - food (soft drink) and dyeing

TABLE 8.3.6 OUTLINE OF 10 FACTORIES

No.	Type of Industry	Number of Employee (persons)	Working System		Production Amount (B/year)	Products	Site Area (m2)	Raw Materials	Water Supply (Actual) (m3/day)	Drain. Quan. (Actual) (m3/day)	Drain. Quan. (DIW data) (m3/day)
			shift	hr./day							
P-1	Food (Chicken)	1200	1	8	500,000,000	Frozen Chicken	26,475	Chicken	650-750	650-750	600
P-2	Food (Brewing)	800	3	24	-	Whisky, Alchohol	192,000	Sugar, rice	6,000	3,000	2,400
P-3	Paper	248	3	24	155,000,000	Kraft paper	128,000	Piece of paper	-	-	2,000
P-4	Ceramic	-	-	-	-	Ceramic	-	Clay. Koolin	-	-	800
P-5	Steel Rolling	195	3	24	-	Steel Wire for Prestressed Concrete	46,000	High Canbon Piano Wire Rod	430	170	100
N-1	Food (Soft Drink)	260	1	8	125,141,684	Soft drink, Pure water	14,400	Sugar, Citric acid, Concentrated orange juice	450	400	400
N-2	Food (Ice Cream)	600	2	16	300,000,000	Water, Ice, Ice-Cream	8,424	Sugar, skim, milk powder, glucose syrup, vegetable fat, Milk fat	250	100	100
N-3	Paper	290	3	24	-	Pulp, News paper	47,200	Pulp. News paper, Used paper	-	6,500-7,000	3,000
N-4	Dyeing	430	3	24	200,000,000	Woven, Knitted Clothes	19,200	Nylon, Polyester	800	600	1,000
N-5	Washing	163	1	8	40,000,000	-	12,800	Cl, lime, alum, Soap, Detergent NaOH, Salt, Stone	200-400	200-400	100
N-6	Food (Soft Drink)										
N-7	Noodle										

TABLE 8.3.7 WASTEWATER TREATMENT PROCESS

No.	Methods	Process
P-1	Activated Sludge + Poud	Bar Screen -> Grease/Oil Separator -> Equalization Tank -> Aeration Tank -> Clarifier -> Oxidation Pond -> Effluent
P-2	Activated Sludge	Equalization Tank -> 1st Stage High Rate Aeration Tank -> 2nd Stage Aeration Tank -> Sedimentation Tank -> Effluent
P-3	Aeration	Filter -> No.1 Aeration Tank -> No.2 Aeration Tank -> Storage Pond ($64,000m^2$) -> Effluent -> Recycle
P-4	Chemical	Equalization Tank -> Coagulation Tank -> Sedimentation Tank -> Effluent -> Recycle
P-5	pH Control + Chemical	Equalization Tank -> pH Control Tank -> Coagulation Tank (Alum) -> Sedimentation Tank -> Effluent
N-1	Activated Sludge + Poud	Equalization Tank -> Aeration Tank -> Sedimentation Tank Urea, Phosphate
N-2	Biofilter + Activated Sludge	Screen -> Primary Sedimentation Tank -> Grease Separator Biofilter -> Aeration Tank -> Sedimentation Tank -> Polishing Pond -> Effluent
N-3	Chemical	Storage Tank -> Screen -> Coagulation Tank -> Sedimentation Tank -> Aeration Tank -> Filter -> Effluent
N-4	Chemical	Equalization Tank -> Coagulation Tank -> Sedimentation Tank -> Aeration Tank -> Effluent Alum
N-5	Activated Sludge	Equalization Tank -> Aeration Tank -> Sedimentation Tank -> Effluent

Table 8.3.8 Wastewater Quality and Quantity: Generated

No.	Item Time (unit)	Flow Rate (m3/hr.)	pH	BOD (mg/l)	SS (mg/l)
P-1 (Chicken)	9:00-10:30	62.3	7.5	870	720
	12:00-13:30	62.7	7.5	1,350	1,140
	15:00-16:30	61.8	7.4	1,050	1,070
	Weighted Avg.	-	7.5	1,091	977
	Pollution Load	498.4	-	543.6	486.8
P-3 (Paper)	9:00-10:30	80.1	6.4	1,020	1,975
	12:00-13:30	79.0	7.5	1,450	1,515
	15:00-16:30	75.0	7.3	1,080	1,260
	Weighted Avg.	-	7.1	1,184	1,591
	Pollution Load	1,872.8	-	2,218.0	2,979.1
P-4 (Ceramic)	9:00-10:30	116.3	7.6	127	45,190
	12:00-13:30	50.2	8.1	140	331
	15:00-16:30	100.5	8.0	120	383
	Weighted Avg.	-	7.8	127	19,890
	Pollution Load	712.0	-	90.3	14,161.9
N-1 (Soft Drink)	9:00-10:30	45.0	8.9	407	75
	12:00-13:30	43.8	9.4	393	72
	15:00-16:30	44.0	9.2	288	113
	Weighted Avg.	-	9.2	363	87
	Pollution Load	354.1	3.2	128.5	30.7
N-4 (Dyeing)	9:00-10:30	53.9	7.1	117	33
	12:00-13:30	53.9	9.0	212	63
	15:00-16:30	56.2	9.1	107	83
	Weighted Avg.	-	8.4	145	60
	Pollution Load	1,312.8	11.0	190.1	78.8

* unit of Pollution Load is kg/day.

BOD : 1,184 mg/l - paper; chicken - 1,091 mg/l; food (brewing) - 363 mg/l; and ceramic and dyeing - 100-200 mg/l

SS : Same level as BOD - chicken and paper; quite lower level than BOD - soft drink and dyeing

4) Quality and quantity organic substances of effluent from TP

Effluent quality and quantity are summarized in Table 8.3.9 (wastewater combined from production process and employees' water use).

The following is a summary of findings on the effluent by factory.

Effluent volume : Fluctuation of flow rate through the operation of TP was minimal in any factory.
Effluent volume measured responses inquired in questionnaires during this investigation, and the report by DIW were almost the same in any factory.

Effluent standard : According to the standard established by DIW, all factories fall under the regulation; BOD 20-60 mg/l

a) No. P-1 (Chicken)

- frozen chicken production
- wastewater included blood, heat treatment water and washing water of chicken, BOD and SS, 1,000 mg/l (generated)
- activated sludge treatment method
- effluent :
  pH 7.8 and BOD 24 mg/l were below effluent standards (BOD-60 mg/l).

Table 8.3.9 Water Quality Analysis of Industrial Wastewater

Type of Industry	St. No.	Water Quality (mg/l) Influent BOD	Influent SS	Effluent BOD	Effluent SS	Pollution Load (kg/day) Influent BOD	Influent SS	Effluent BOD	Effluent SS	Removal Efficiency (%) BOD	SS
Food Chicken	P-1	1,091	977	24.5	150	543.6	486.8	12.2	74.6	97.8	84.7
Food Brewing	P-2	–	–	30.7	20	–	–	50.4	32.7	–	–
Food Soft Drink	N-1	363	87	3.9	21	128.5	30.7	1.4	7.3	98.9	76.2
Food Ice Cream	N-2	–	–	187.5	57	–	–	21.0	6.4	–	–
Paper	P-3	1,184	1,591	37.5	53	2,218.0	2,979.1	70.3	99.5	96.8	96.7
Paper	N-3	–	–	111.8	29	–	–	695.8	183.5	–	–
Ceramic	P-4	127	19,890	2.1	7	90.3	14,161.9	1.5	5.3	98.3	100.0
Steel Rolling	P-5	–	–	1.6	1	–	–	0.4	0.3	–	–
Dyeing	N-4	145	60	28.6	35	190.1	78.8	37.5	46.5	80.3	41.0
Washing	N-5	–	–	22.2	19	–	–	2.1	1.9	–	–

Type of Industry	St. No.	Water Supply (m3/d)	W.W. Quantity (m3/d)	Produc. Amount (MB/y)	No. of Employee (person)	Site Area (m2)	Unit BOD Load per P.A. (g/d/MB)	per Emp. (g/d/p)	per Area (g/d/m2)
Food Chicken	P-1	700	700	500	1,200	26,475	2.979	1.241	0.056
Food Brewing	P-2	6,000	3,000		800	192,000			
Food Soft Drink	N-1	450	400	125	260	14,400	2.816	1.354	0.024
Food Ice Cream	N-2	250	100	300	600	8,424			
Paper	P-3			155	248	128,000	39.205	24.503	0.047
Paper	N-3		6,750		290	47,200			
Ceramic	P-4								
Steel Rolling	P-5	430			195	46,000			
Dyeing	N-4	800	600	200	430	19,200	2.604	1.211	0.027
Washing	N-5	300	300	40	163	12,800			

SS 150 mg/l was almost the same as the standard. No_3-N 5 mg/l was detected which showed the effect of biological treatment processes

b) No. P-2 (Brewing)

- distillation wine production : raw materials include sugar and rice
- wastewater included high concentrations of organic substances
- two stage activated sludge treatment method
- effluent : effluent standards were met, COD value was about 20 times that of BOD but the reason was not clear.

c) No. P-3 (Paper)

- draft paper production using old paper
- wastewater included high concentration of BOD (1,200 mg/l_ and SS(1,600 mg/l)
- mechanical aeration method
- effluent quality was quite below the standards

d) No. P-4 (Ceramic)

- ceramic production : raw materials include clay and kaolin.
- wastewater looked muddy and consisted of inorganic substances
- coagulation and sedimentation method
- effluent quality was quite below the standards

e) No. P-5 (Steel Rolling)

- processed steel production
- wastewater had high acidity (inorganic substances with heavy metal)
- coagulation and sedimentation method after pH control
- BOD and SS in the effluent were of low concentrations and pH was neutral

f) No.N-1 (Soft Drink)

- soft drink and drinking water production
- wastewater was mainly from washing of bottles, raw wastewater had a high pH from use of alkali detergent (max. pH 9.1)
- activated sludge treatment method (urea and phosphate were added in the aeration tank)
- effluent quality standards were met (pH 7.8, BOD 3.9 mg/l and SS 21 mg/l), but coliform group was quite high at 92 x 10^4 - 24 x 10^5 MPN/100 ml (maybe from discharges from toilet facilities)

g) No.N-2 (Ice Cream)

- ice cream production : raw materials were sugar, milk and glucose and fat.
- wastewater included high concentration of organic substances with high fat content
- activated sludge method in provision of biofilter as a pre-treatment
- effluent quality standards : SS was below the standard (42-69 mg/l, while BOD 95-225 mg/l was above beyond the standard value of 60 mg/l. Inadequate activated sludge control maybe one of the reasons for this result. Coliform group in the order of 10^6 MPN/100 ml was also detected.

h) No.N-3 (Paper)

- paper pulp production
- wastewater came from various facilities (washing, dewatering, etc) and effluent volume was more than 6,000 m^3/d
- mainly coagulation and sedimentation method supplemented by aeration and filter
- effluent quality standards : BOD (89-148 mg/l) was above standard value, while pH and SS standards were met

i) No. N-4 (Dyeing)

- textile production : dye stuffs and bleaching powder were used in the process
- wastewater comprised of decomposable substances resulting in high concentrations of COD.
- coagulation and sedimentation (coagulant was alum)
- effluent quality standards were met (COD was about 100 mg/l under proper operation of TP)

j) No. N-5 (Washing)

- washing of clothes : detergent and bleaching powder were used.
- wastewater included high concentrations of organic substances
- activated sludge treatment method
- effluent quality standards were met (BOD 17-25 mg/l and SS 15-26 mg/l)

5) Heavy metals in the effluent for TP

Examination of heavy metals was included for four factories (brewing, ceramic, steel rolling and dyeing) covering As, Cd, Cr, Cu, Hg, Mn, Pb and Zn. Table 8.3.10 presents the examination results.

The results showed that heavy metal contents in the effluent were of the same level regardless of the type of industry. The ranges of quality by index are as follows:

Table 8.3.10 Heavy Metals of Industrial Wastewater (Effluent)

Station No. P-2 (Brewing)

ITEM / TIME UNIT	Flow Rate (m3/hr.)	As (ug/l)	Cd (mg/l)	Cr (Total) (mg/l)	Cu (mg/l)	Hg (Total) (ug/l)	Mn (mg/l)	Pb (mg/l)	Zn (mg/l)
9:00-10:30	72.8	2.4	0.002	0.02	0.110	0.48	0.14	0.02	0.22
12:00-13:30	66.2	2.5	0.002	0.02	1.000	0.47	0.11	0.03	0.29
15:00-16:30	66.2	1.3	0.002	0.02	0.110	0.48	0.12	0.01	0.22
Weighted Avg.	-	2.1	0.002	0.02	0.397	0.48	0.12	0.02	0.24
Total Loading	1,641.6	3.4	3.3	32.8	651.9	782.7	203.3	32.8	398.2

Station No. P-4 (Ceramic)

ITEM / TIME UNIT	Flow Rate (m3/hr.)	As (ug/l)	Cd (mg/l)	Cr (Total) (mg/l)	Cu (mg/l)	Hg (Total) (ug/l)	Mn (mg/l)	Pb (mg/l)	Zn (mg/l)
9:00-10:30	116.3	6.0	0.004	0.02	0.003	0.42	0.20	0.16	0.42
12:00-13:30	50.2	4.9	0.004	0.02	0.007	0.55	0.36	0.24	0.43
15:00-16:30	100.5	6.8	0.003	0.02	0.004	0.53	0.33	0.17	0.43
Weighted Avg.	-	6.1	0.004	0.02	0.004	0.49	0.28	0.18	0.43
Total Loading	712.0	4.3	2.6	14.2	2.9	345.9	198.7	127.3	303.1

Station No. P-5 (Steel Rolling)

ITEM / TIME UNIT	Flow Rate (m3/hr.)	As (ug/l)	Cd (mg/l)	Cr (Total) (mg/l)	Cu (mg/l)	Hg (Total) (ug/l)	Mn (mg/l)	Pb (mg/l)	Zn (mg/l)
9:00-10:30	10.8	2.1	0.005	0.04	0.007	0.57	0.20	0.05	0.13
12:00-13:30	9.2	2.4	0.006	0.05	0.006	0.60	0.27	0.06	0.23
15:00-16:30	9.7	3.5	0.002	0.02	0.003	0.61	0.13	0.01	0.07
Weighted Avg.	-	2.7	0.004	0.04	0.005	0.59	0.20	0.04	0.14
Total Loading	237.6	0.6	1.0	8.7	1.3	140.7	47.2	9.5	33.6

Station No. N-4 (Dyeing)

ITEM / TIME UNIT	Flow Rate (m3/hr.)	As (ug/l)	Cd (mg/l)	Cr (Total) (mg/l)	Cu (mg/l)	Hg (Total) (ug/l)	Mn (mg/l)	Pb (mg/l)	Zn (mg/l)
9:00-10:30	53.9	1.8	0.003	0.02	0.006	0.62	0.02	0.03	0.21
12:00-13:30	53.9	1.6	0.002	0.01	0.003	0.56	0.02	0.02	0.23
15:00-16:30	56.2	<1	0.004	0.01	0.005	0.56	0.02	0.05	0.21
Weighted Avg.	-	1.1	0.003	0.01	0.005	0.58	0.02	0.03	0.22
Total Loading	1,312.8	1.5	4.0	17.4	6.1	761.1	26.3	44.1	284.3

Note: unit for Total Loading is g/day

Indices below Standards

As < 1-6.8 μg/l, Cd 0.002-0.006 mg/l, Cr 0.01-0.05 mg/l, Mn 0.02-0.36 mg/l, Hg 0.42-0.62 μg/l, Zn 0.07-0.43 mg/l

Indices almost the same as the standard/above standard

Cu 1.0 mg/l (at No. P-2) and Pb 0.16-0.24 mg/l (at No. P-4).

Concentrations of heavy metals in the effluent of the steel rolling factory were below the standards. Moreover, three factories discharged some heavy metals above the standards, as follows:

Brewing : Cd, Cr, Cu, P6 and Zn
Ceramic : Cd, Pb and Zn
Dyeing : Cd, Pb and Zn

9.4 Computation for Present Pollution Analysis

Table 9.4.1 Quantity of Domestic Wastewater by Land Use Type (1992)

(unit: m3/day)

Province / Amphoe	Noi River						Lop Buri River						Pasak River						Main River (Up. Up. Part, R0–R1)					
	Total Quantity	Class A	Class B	Class C	Class C'	Rural Commuy	Total Quantity	Class A	Class B	Class C	Class C'	Rural Commuy	Total Quantity	Class A	Class B	Class C	Class C'	Rural Commuy	Total Quantity	Class A	Class B	Class C	Class C'	Rural Commuy
Chai Nat	5,884	0	0	0	765	5,119	0	0	0	0	0	0	0	0	0	0	0	0	3,705	0	2,690	0	0	1,015
** Muang Chai Nat	770	0	0	0	0	770	0	0	0	0	0	0	0	0	0	0	0	0	3,705	0	2,690	0	0	1,015
* Sankhaburi	4,632	0	0	0	765	3,867	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanphaya	482	0	0	0	0	482	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sing Buri	10,478	0	0	0	4,454	6,024	2,134	0	0	0	0	2,134	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	903	0	0	0	0	903	438	0	0	0	0	438	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	3,075	0	0	0	467	2,608	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	1,865	0	0	0	1,322	543	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	4,357	0	0	0	2,665	1,692	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	242	0	0	0	0	242	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	36	0	0	0	0	36	1,696	0	0	0	0	1,696	0	0	0	0	0	0	0	0	0	0	0	0
Lop Buri	0	0	0	0	0	0	34,956	0	10,604	0	3,221	21,141	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Lop Buri	0	0	0	0	0	0	28,239	0	10,604	0	2,590	15,045	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	97	0	0	0	0	97	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	4,354	0	0	0	631	3,723	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	2,276	0	0	0	0	2,276	0	0	0	0	0	0	0	0	0	0	0	0
Ang Thong	18,962	0	0	0	4,821	14,141	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	1,527	0	0	0	0	1,527	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	665	0	0	0	0	665	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	5,622	0	0	0	886	4,736	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	6,397	0	0	0	2,645	3,752	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	1,171	0	0	0	809	362	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	3,580	0	0	0	481	3,099	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ayutthaya	15,767	0	993	0	9,237	5,537	4,091	0	0	0	1,526	2,565	12,554	0	0	1,144	4,456	6,954	0	0	0	0	0	0
** Muang Ayutthaya	275	0	0	0	0	275	257	0	0	0	0	257	2,338	0	0	0	1,433	905	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	5,802	0	0	1,144	2,040	2,618	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	153	0	0	0	0	153	3,330	0	0	0	983	2,347	0	0	0	0	0	0
* Bang Sai	1,308	0	0	0	795	513	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sahi	2,611	0	0	0	1,429	1,183	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Ban	1,847	0	0	0	1,387	460	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	1,831	0	0	0	837	994	458	0	0	0	0	458	0	0	0	0	0	0
* Bang Pa-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	774	0	0	0	330	444	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	5,029	0	0	0	3,000	2,029	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	1,076	0	0	0	361	715	616	0	0	0	0	616	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	4,597	0	993	0	2,627	1,077	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saraburi	0	0	0	0	0	0	318	0	0	0	0	318	2,639	0	0	0	0	2,639	0	0	0	0	0	0
Don Phunt	0	0	0	0	0	0	178	0	0	0	0	178	354	0	0	0	0	354	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	1,482	0	0	0	0	1,482	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	140	0	0	0	0	140	803	0	0	0	0	803	0	0	0	0	0	0
Total	51,091	0	993	0	19,277	30,821	41,509	0	10,604	0	4,749	26,156	15,193	0	0	1,144	4,456	9,593	3,705	0	2,690	0	0	1,015

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

(...cont'd)

Table 9.4.1 Quantity of Domestic Wastewater by Land Use Type (1992) (cont'n)

(unit: m3/day)

Province / Amphoe	Main River (Upper Part, R1–R2)						Main River (Middle Part, R2–R3)						Main River (Lower Part, R3–R4)						Total Quantity	Municipalities (Urban)			Sanitary Districts (Sub-urban)	Rural Community
	Total Quantity	Class A	Class B	Class C	Class C'	Rural Community	Total Quantity	Class A	Class B	Class C	Class C'	Rural Community	Total Quantity	Class A	Class B	Class C	Class C'	Rural Community		Class A	Class B	Class C		
Chai Nat	6,605	0	0	0	753	5,852	0	0	0	0	0	0	0	0	0	0	0	0	16,195	0	2,690	0	1,518	11,987
** Muang Chai Nat	1,379	0	0	0	0	1,379	0	0	0	0	0	0	0	0	0	0	0	0	5,855	0	2,690	0	0	3,165
* Sankhaburi	392	0	0	0	0	392	0	0	0	0	0	0	0	0	0	0	0	0	5,024	0	0	0	765	4,259
* Sanphaya	4,834	0	0	0	753	4,081	0	0	0	0	0	0	0	0	0	0	0	0	5,316	0	0	0	753	4,563
Sing Buri	12,791	0	3,647	0	1,904	7,240	0	0	0	0	0	0	0	0	0	0	0	0	25,403	0	3,647	0	6,358	15,398
** Muang Sing Buri	5,322	0	3,647	0	0	1,675	0	0	0	0	0	0	0	0	0	0	0	0	6,663	0	3,647	0	0	3,016
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,075	0	0	0	467	2,608
* Tha Chang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,865	0	0	0	1,322	543
* Bang Rachan	112	0	0	0	0	112	0	0	0	0	0	0	0	0	0	0	0	0	4,469	0	0	0	2,665	1,804
* Phrom Buri	2,436	0	0	0	923	1,513	0	0	0	0	0	0	0	0	0	0	0	0	2,678	0	0	0	923	1,755
* In Buri	4,921	0	0	0	981	3,940	0	0	0	0	0	0	0	0	0	0	0	0	6,653	0	0	0	981	5,672
Lop Buri	845	0	0	0	0	845	0	0	0	0	0	0	0	0	0	0	0	0	35,811	0	10,604	0	3,221	21,986
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28,239	0	10,604	0	2,590	15,045
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	97	0	0	0	0	97
* Tha Wung	845	0	0	0	0	845	0	0	0	0	0	0	0	0	0	0	0	0	5,199	0	0	0	631	4,568
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,276	0	0	0	0	2,276
Ang Thong	8,714	0	3,027	0	1,560	4,127	0	0	0	0	0	0	0	0	0	0	0	0	27,676	0	3,027	0	6,381	18,268
** Muang Ang Thong	3,786	0	1,697	0	0	2,089	0	0	0	0	0	0	0	0	0	0	0	0	5,313	0	1,697	0	0	3,616
* Chaiyo	2,533	0	0	0	1,560	973	0	0	0	0	0	0	0	0	0	0	0	0	2,533	0	0	0	1,560	973
** Pa Mok	2,395	0	1,330	0	0	1,065	0	0	0	0	0	0	0	0	0	0	0	0	3,060	0	1,330	0	0	1,730
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,622	0	0	0	886	4,736
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,397	0	0	0	2,645	3,752
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,171	0	0	0	809	362
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,580	0	0	0	481	3,099
Ayutthaya	27,132	22,522	0	0	0	4,610	6,631	0	0	0	1,594	5,037	7,892	0	0	0	478	7,414	74,067	22,522	993	1,144	17,293	32,115
** Muang Ayutthaya	23,606	22,522	0	0	0	1,086	1,394	0	0	0	0	1,394	0	0	0	0	0	0	27,872	22,522	0	0	1,433	3,917
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,802	0	0	1,144	2,040	2,618
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,483	0	0	0	983	2,500
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	467	0	0	0	0	467	1,775	0	0	0	795	980
* Bang Sai	0	0	0	0	0	0	17	0	0	0	0	17	1,956	0	0	0	0	1,956	4,584	0	0	0	1,428	3,156
* Bang Ban	1,217	0	0	0	0	1,217	586	0	0	0	0	586	0	0	0	0	0	0	3,650	0	0	0	1,387	2,263
* Bang Pahan	1,454	0	0	0	0	1,454	0	0	0	0	0	0	0	0	0	0	0	0	3,753	0	0	0	837	2,916
* Bang Pa-In	0	0	0	0	0	0	4,590	0	0	0	1,594	2,996	1,255	0	0	0	478	777	5,845	0	0	0	2,072	3,773
* Ban Phraek	195	0	0	0	0	195	0	0	0	0	0	0	0	0	0	0	0	0	969	0	0	0	330	639
* Phak Hai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,029	0	0	0	3,000	2,029
* Maha Rat	658	0	0	0	0	658	0	0	0	0	0	0	0	0	0	0	0	0	2,350	0	0	0	361	1,989
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	2,087	0	0	0	0	2,087	2,087	0	0	0	0	2,087
*** Sena	0	0	0	0	0	0	0	0	0	0	0	0	2,127	0	0	0	0	2,127	6,824	0	993	0	2,627	3,204
Uthai	0	0	0	0	0	0	44	0	0	0	0	44	0	0	0	0	0	0	44	0	0	0	0	44
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	42,797	26,256	0	0	2,489	14,052	42,797	26,256	0	0	2,489	14,052
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	12,339	4,302	0	0	684	7,353	12,339	4,302	0	0	684	7,353
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	4,138	0	0	0	1,072	3,066	4,138	0	0	0	1,072	3,066
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	3,690	0	0	0	733	2,957	3,690	0	0	0	733	2,957
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	7,592	7,592	0	0	0	0	7,592	7,592	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	4,999	4,999	0	0	0	0	4,999	4,999	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	10,039	9,363	0	0	0	676	10,039	9,363	0	0	0	676
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	91,801	82,661	0	0	0	9,140	91,801	82,661	0	0	0	9,140
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	44,937	43,348	0	0	0	1,589	44,937	43,348	0	0	0	1,589
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	894	0	0	0	0	894	894	0	0	0	0	894
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	13,020	10,975	0	0	0	2,045	13,020	10,975	0	0	0	2,045
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	32,950	28,338	0	0	0	4,612	32,950	28,338	0	0	0	4,612
Saraburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,957	0	0	0	0	2,957
Don Phut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	532	0	0	0	0	532
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,482	0	0	0	0	1,482
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	943	0	0	0	0	943
Total	56,087	22,522	6,674	0	4,217	22,674	6,631	0	0	0	1,594	5,037	142,490	108,917	0	0	2,967	30,606	316,707	131,439	20,961	1,144	37,260	125,903

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

Table 9.4.2 Generated BOD Load of Domestic Wastewater by Land Use Type (1992)

(unit: kg/day)

Province / Amphoe	Noi River						Lop Buri River						Pasak River						Main River (Up. Up. Part, R0–R1)					
	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy
Chai Nat	3,165	0	0	0	339	2,826	0	0	0	0	0	0	0	0	0	0	0	0	1,429	0	868	0	0	561
** Muang Chai Nat	425	0	0	0	0	425	0	0	0	0	0	0	0	0	0	0	0	0	1,429	0	868	0	0	561
* Sankhaburi	2,474	0	0	0	339	2,135	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanphaya	266	0	0	0	0	266	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sing Buri	5,303	0	0	0	1,977	3,326	1,179	0	0	0	0	1,179	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	498	0	0	0	0	498	242	0	0	0	0	242	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	1,647	0	0	0	207	1,440	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	887	0	0	0	587	300	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	2,117	0	0	0	1,183	934	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	134	0	0	0	0	134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	20	0	0	0	0	20	937	0	0	0	0	937	0	0	0	0	0	0	0	0	0	0	0	0
Lop Buri	0	0	0	0	0	0	15,473	0	2,371	0	1,430	11,672	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Lop Buri	0	0	0	0	0	0	11,827	0	2,371	0	1,150	8,306	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	54	0	0	0	0	54	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	2,335	0	0	0	280	2,055	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	1,257	0	0	0	0	1,257	0	0	0	0	0	0	0	0	0	0	0	0
Ang Thong	9,947	0	0	0	2,140	7,807	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	843	0	0	0	0	843	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	367	0	0	0	0	367	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	3,008	0	0	0	393	2,615	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	3,246	0	0	0	1,175	2,071	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	559	0	0	0	359	200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	1,924	0	0	0	213	1,711	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ayutthaya	7,450	0	292	0	4,101	3,057	2,093	0	0	0	678	1,415	5,295	0	0	478	1,978	3,839	0	0	0	0	0	0
** Muang Ayutthaya	152	0	0	0	0	152	142	0	0	0	0	142	1,136	0	0	0	636	500	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	2,822	0	0	478	906	1,445	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	84	0	0	0	0	84	1,732	0	0	0	436	1,296	0	0	0	0	0	0
* Bang Sai	636	0	0	0	353	283	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sai	1,287	0	0	0	634	653	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Ban	970	0	0	0	616	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	920	0	0	0	371	549	258	0	0	0	0	258	0	0	0	0	0	0
* Bang Pa-in	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	392	0	0	0	147	245	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	2,452	0	0	0	1,332	1,120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	555	0	0	0	160	395	340	0	0	0	0	340	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	2,053	0	292	0	1,166	595	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Bang Sua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Saraburi	0	0	0	0	0	0	175	0	0	0	0	175	1,457	0	0	0	0	1,457	0	0	0	0	0	0
Don Phunt	0	0	0	0	0	0	98	0	0	0	0	98	196	0	0	0	0	196	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	818	0	0	0	0	818	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	77	0	0	0	0	77	443	0	0	0	0	443	0	0	0	0	0	0
Total	25,865	0	292	0	8,557	17,016	19,920	0	2,371	0	2,108	14,441	7,752	0	0	478	1,978	5,296	1,429	0	868	0	0	561

Note: "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary districts within the basin.

(....cont'd)

Table 9.4.2 Generated BOD Load of Domestic Wastewater by Land Use Type (1992) (cont'n)

(unit: kg/day)

Province / Amphoe	Main River (Upper Part, R1 – R2)						Main River (Middle Part, R2 – R3)						Main River (Lower Part, R3 – R4)						Total Generated BOD	Municipalities (Urban)			Sanitary Districts (Sub-urban)	Rural Community
	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy	Total Gen' BOD	Class A	Class B	Class C	Class C'	Rural Commuy		Class A	Class B	Class C		
Chai Nat	3,565	0	0	0	334	3,231	0	0	0	0	0	0	0	0	0	0	0	0	8,159	0	858	0	673	5,618
** Muang Chai Nat	761	0	0	0	0	761	0	0	0	0	0	0	0	0	0	0	0	0	2,615	0	868	0	0	1,747
* Sankhaburi	217	0	0	0	0	217	0	0	0	0	0	0	0	0	0	0	0	0	2,691	0	0	0	339	2,352
* Sanphaya	2,587	0	0	0	334	2,253	0	0	0	0	0	0	0	0	0	0	0	0	2,853	0	0	0	334	2,519
Sing Buri	6,208	0	1,365	0	846	3,997	0	0	0	0	0	0	0	0	0	0	0	0	12,690	0	1,365	0	2,823	8,502
** Muang Sing Buri	2,290	0	1,365	0	0	925	0	0	0	0	0	0	0	0	0	0	0	0	3,030	0	1,365	0	0	1,665
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,647	0	0	0	207	1,440
* Tha Chang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	887	0	0	0	587	300
* Bang Rachan	62	0	0	0	0	62	0	0	0	0	0	0	0	0	0	0	0	0	2,179	0	0	0	1,183	996
* Phrom Buri	1,245	0	0	0	410	835	0	0	0	0	0	0	0	0	0	0	0	0	1,379	0	0	0	410	969
* In Buri	2,611	0	0	0	436	2,175	0	0	0	0	0	0	0	0	0	0	0	0	3,566	0	0	0	436	3,132
Lop Buri	466	0	0	0	0	466	0	0	0	0	0	0	0	0	0	0	0	0	15,939	0	2,371	0	1,430	12,138
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11,627	0	2,371	0	1,150	8,306
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	54	0	0	0	0	54
* Tha Wung	466	0	0	0	0	466	0	0	0	0	0	0	0	0	0	0	0	0	2,801	0	0	0	280	2,521
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,257	0	0	0	0	1,257
Ang Thong	4,202	0	1,232	0	692	2,278	0	0	0	0	0	0	0	0	0	0	0	0	14,149	0	1,232	0	2,832	10,085
** Muang Ang Thong	1,756	0	603	0	0	1,153	0	0	0	0	0	0	0	0	0	0	0	0	2,599	0	603	0	0	1,996
* Chaiyo	1,229	0	0	0	692	537	0	0	0	0	0	0	0	0	0	0	0	0	1,229	0	0	0	692	537
** Pa Mok	1,217	0	629	0	0	588	0	0	0	0	0	0	0	0	0	0	0	0	1,584	0	629	0	0	955
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,008	0	0	0	393	2,615
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3,246	0	0	0	1,175	2,071
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	559	0	0	0	359	200
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,924	0	0	0	213	1,711
Ayutthaya	7,222	4,676	0	0	0	2,546	3,490	0	0	0	708	2,782	4,305	0	0	0	212	4,093	30,855	4,676	292	478	7,677	17,732
** Muang Ayutthaya	5,276	4,676	0	0	0	600	770	0	0	0	0	770	0	0	0	0	0	0	7,476	4,676	0	0	636	2,164
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,829	0	0	478	906	1,445
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,816	0	0	0	436	1,380
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	258	0	0	0	0	258	894	0	0	0	353	541
* Bang Sai	0	0	0	0	0	0	10	0	0	0	0	10	1,080	0	0	0	0	1,080	2,377	0	0	0	634	1,743
* Bang Ban	672	0	0	0	0	672	324	0	0	0	0	324	0	0	0	0	0	0	1,866	0	0	0	616	1,250
* Bang Pahan	603	0	0	0	0	603	0	0	0	0	0	0	0	0	0	0	0	0	1,981	0	0	0	371	1,610
* Bang Pa-In	0	0	0	0	0	0	2,362	0	0	0	708	1,654	641	0	0	0	212	429	3,003	0	0	0	920	2,083
* Ban Phraek	108	0	0	0	0	108	0	0	0	0	0	0	0	0	0	0	0	0	500	0	0	0	147	353
* Phak Hai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,452	0	0	0	1,332	1,120
* Maha Rat	363	0	0	0	0	363	0	0	0	0	0	0	0	0	0	0	0	0	1,258	0	0	0	150	1,008
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	1,152	0	0	0	0	1,152	1,152	0	0	0	0	1,152
** Sena	0	0	0	0	0	0	0	0	0	0	0	0	1,174	0	0	0	0	1,174	3,227	0	292	0	1,156	1,769
Uthai	0	0	0	0	0	0	24	0	0	0	0	24	0	0	0	0	0	0	24	0	0	0	0	24
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	16,804	7,941	0	0	1,106	7,757	16,804	7,941	0	0	1,106	7,757
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	5,303	940	0	0	304	4,059	5,303	940	0	0	304	4,059
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	2,169	0	0	0	476	1,693	2,169	0	0	0	476	1,693
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	1,958	0	0	0	326	1,632	1,958	0	0	0	326	1,632
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	2,421	2,421	0	0	0	0	2,421	2,421	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	1,594	1,594	0	0	0	0	1,594	1,594	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	3,359	2,986	0	0	0	373	3,359	2,986	0	0	0	373
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	27,182	22,137	0	0	0	5,045	27,182	22,137	0	0	0	5,045
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	12,486	11,609	0	0	0	877	12,486	11,609	0	0	0	877
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	493	0	0	0	0	493	493	0	0	0	0	493
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	4,066	2,939	0	0	0	1,129	4,066	2,939	0	0	0	1,129
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	10,135	7,589	0	0	0	2,546	10,135	7,589	0	0	0	2,546
Saraburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,632	0	0	0	0	1,632
Don Phunt	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	294	0	0	0	0	294
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	818	0	0	0	0	818
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	520	0	0	0	0	520
Total	21,663	4,676	2,597	0	1,872	12,518	3,490	0	0	0	708	2,782	48,291	30,078	0	0	1,318	16,895	127,410	34,754	6,128	478	16,541	69,509

Note; "**" refers to Amphoes that have a municipality within the basin.
"*" refers to Amphoes that have sanitary district/s within the basin.

Table 9.4.3 Discharged BOD Load of Domestic Wastewater by Land Use Type (1992)

(unit: kg/day)

Province / Amphoe	Noi River	Municipalities				Rural	Lop Buri River	Municipalities				Rural	Pasak River	Municipalities				Rural	Main River (R0–R1)	Municipalities				Rural
	Total	Class A	Class B	Class C	Sanitary Districts	Communities	Total	Class A	Class B	Class C	Sanitary Districts	Communities	Total	Class A	Class B	Class C	Sanitary Districts	Communities	Total	Class A	Class B	Class C	Sanitary Districts	Communities
Chai Nat	2,838	0	0	0	306	2,532	0	0	0	0	0	0	0	0	0	0	0	0	1,291	0	788	0	0	503
** Muang Chai Nat	381	0	0	0	0	381	0	0	0	0	0	0	0	0	0	0	0	0	1,291	0	788	0	0	503
* Sankhaburi	2,219	0	0	0	306	1,913	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sanphaya	238	0	0	0	0	238	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sing Buri	4,763	0	0	0	1,782	2,981	1,056	0	0	0	0	1,056	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Sing Buri	447	0	0	0	0	447	217	0	0	0	0	217	0	0	0	0	0	0	0	0	0	0	0	0
* Khai Bang Rachan	1,477	0	0	0	187	1,290	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Chang	798	0	0	0	529	269	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Rachan	1,903	0	0	0	1,066	837	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Phrom Buri	120	0	0	0	0	120	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* In Buri	18	0	0	0	0	18	839	0	0	0	0	839	0	0	0	0	0	0	0	0	0	0	0	0
Lop Buri	0	0	0	0	0	0	13,911	0	2,162	0	1,289	10,460	0	0	0	0	0	0	0	0	0	0	0	0
*** Muang Lop Buri	0	0	0	0	0	0	10,642	0	2,162	0	1,036	7,444	0	0	0	0	0	0	0	0	0	0	0	0
Khok Samrong	0	0	0	0	0	0	48	0	0	0	0	48	0	0	0	0	0	0	0	0	0	0	0	0
* Tha Wung	0	0	0	0	0	0	2,095	0	0	0	253	1,842	0	0	0	0	0	0	0	0	0	0	0	0
Ban Mi	0	0	0	0	0	0	1,126	0	0	0	0	1,126	0	0	0	0	0	0	0	0	0	0	0	0
Ang Thong	6,923	0	0	0	1,928	5,995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Ang Thong	755	0	0	0	0	755	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Chaiyo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Pa Mok	329	0	0	0	0	329	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pho Thong	2,697	0	0	0	354	2,343	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Wiset Chai Chan	2,914	0	0	0	1,058	1,856	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Samko	503	0	0	0	324	179	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sawaengha	1,725	0	0	0	192	1,533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ayutthaya	6,700	0	265	0	3,695	2,740	1,880	0	0	0	611	1,269	5,654	0	0	431	1,782	3,441	0	0	0	0	0	0
** Muang Ayutthaya	136	0	0	0	0	136	127	0	0	0	0	127	1,021	0	0	0	573	448	0	0	0	0	0	0
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	2,542	0	0	431	816	1,295	0	0	0	0	0	0
* Nakhon Luang	0	0	0	0	0	0	76	0	0	0	0	76	1,554	0	0	0	393	1,161	0	0	0	0	0	0
* Bang Sai	572	0	0	0	318	254	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Sai	1,156	0	0	0	571	585	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Ban	783	0	0	0	555	228	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Bang Pahan	0	0	0	0	0	0	827	0	0	0	335	492	232	0	0	0	0	232	0	0	0	0	0	0
* Bang Pa-In	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Ban Phraek	0	0	0	0	0	0	352	0	0	0	132	220	0	0	0	0	0	0	0	0	0	0	0	0
* Phak Hai	2,204	0	0	0	1,200	1,004	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Maha Rat	0	0	0	0	0	0	498	0	0	0	144	354	305	0	0	0	0	305	0	0	0	0	0	0
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Sena	1,849	0	265	0	1,051	533	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Uthai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
*** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sara Buri	0	0	0	0	0	0	157	0	0	0	0	157	1,305	0	0	0	0	1,305	0	0	0	0	0	0
Don Phut	0	0	0	0	0	0	88	0	0	0	0	88	175	0	0	0	0	175	0	0	0	0	0	0
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	733	0	0	0	0	733	0	0	0	0	0	0
Nong Don	0	0	0	0	0	0	69	0	0	0	0	69	397	0	0	0	0	397	0	0	0	0	0	0
Total	23,224	0	265	0	7,711	15,248	17,004	0	2,162	0	1,900	12,942	6,959	0	0	431	1,782	4,746	1,291	0	788	0	0	503

Note: "*" refers to amphoes that have a municipality within the basin.
"**" refers to amphoes that have sanitary district/s within the basin.

(...cont'd)

Table 9.4.3 Discharged BOD Load of Domestic Wastewater by Land Use Type (1992) (cont'n)

(unit: kg/day)

Province / Amphoe	Main River (R1–R2) Total	Municipalities Class A	Class B	Class C	Sanitary Districts	Rural Communities	Main River (R2–R3) Total	Municipalities Class A	Class B	Class C	Sanitary Districts	Rural Communities	Main River (R3–R4) Total	Municipalities Class A	Class B	Class C	Sanitary Districts	Rural Communities	Total Discharged BOD	Municipalities (Urban) Class A	Class B	Class C	Sanitary Districts (Sub-urban)	Rural Community
Chai Nat	3,196	0	0	0	301	2,895	0	0	0	0	0	0	0	0	0	0	0	0	7,325	0	788	0	607	5,930
** Muang Chai Nat	682	0	0	0	0	682	0	0	0	0	0	0	0	0	0	0	0	0	2,354	0	788	0	0	1,566
* Sankhaburi	194	0	0	0	0	194	0	0	0	0	0	0	0	0	0	0	0	0	2,413	0	0	0	306	2,107
* Sanphaya	2,320	0	0	0	301	2,019	0	0	0	0	0	0	0	0	0	0	0	0	2,558	0	0	0	301	2,257
Sing Buri	5,580	0	1,237	0	761	3,582	0	0	0	0	0	0	0	0	0	0	0	0	11,399	0	1,237	0	2,543	7,619
** Muang Sing Buri	2,066	0	1,237	0	0	829	0	0	0	0	0	0	0	0	0	0	0	0	2,730	0	1,237	0	0	1,493
* Khai Bang Rachan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,477	0	0	0	187	1,290
* Tha Chang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	798	0	0	0	529	269
* Bang Rachan	55	0	0	0	0	55	0	0	0	0	0	0	0	0	0	0	0	0	1,958	0	0	0	1,066	892
* Phrom Buri	1,118	0	0	0	369	749	0	0	0	0	0	0	0	0	0	0	0	0	1,238	0	0	0	369	869
* In Buri	2,341	0	0	0	392	1,949	0	0	0	0	0	0	0	0	0	0	0	0	3,198	0	0	0	392	2,806
Lop Buri	418	0	0	0	0	418	0	0	0	0	0	0	0	0	0	0	0	0	14,329	0	2,162	0	1,289	10,878
** Muang Lop Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10,542	0	2,162	0	1,036	7,444
Khok Samrong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48	0	0	0	0	48
* Tha Wung	418	0	0	0	0	418	0	0	0	0	0	0	0	0	0	0	0	0	2,513	0	0	0	253	2,260
Ban Mi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,126	0	0	0	0	1,126
Ang Thong	3,780	0	1,114	0	624	2,042	0	0	0	0	0	0	0	0	0	0	0	0	12,703	0	1,114	0	2,552	9,037
** Muang Ang Thong	1,579	0	546	0	0	1,033	0	0	0	0	0	0	0	0	0	0	0	0	2,334	0	546	0	0	1,788
* Chaiyo	1,106	0	0	0	624	482	0	0	0	0	0	0	0	0	0	0	0	0	1,106	0	0	0	624	482
** Pa Mok	1,095	0	568	0	0	527	0	0	0	0	0	0	0	0	0	0	0	0	1,424	0	568	0	0	856
* Pho Thong	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,697	0	0	0	354	2,343
* Wiset Chai Chan	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,914	0	0	0	1,058	1,856
* Samko	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	503	0	0	0	324	179
* Sawaengha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,725	0	0	0	192	1,533
Ayutthaya	6,567	4,284	0	0	0	2,283	3,132	0	0	0	638	2,494	3,860	0	0	0	191	3,669	27,793	4,284	265	431	9,917	15,896
** Muang Ayutthaya	4,822	4,284	0	0	0	538	690	0	0	0	0	690	0	0	0	0	0	0	6,796	4,284	0	0	573	1,939
** Tha Rua	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,542	0	0	431	816	1,295
* Nakhon Luang	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,630	0	0	0	393	1,237
* Bang Sai	0	0	0	0	0	0	0	0	0	0	0	0	231	0	0	0	0	231	803	0	0	0	318	485
* Bang Sai	0	0	0	0	0	0	9	0	0	0	0	9	968	0	0	0	0	968	2,133	0	0	0	571	1,562
* Bang Ban	602	0	0	0	0	602	290	0	0	0	0	290	0	0	0	0	0	0	1,675	0	0	0	555	1,120
* Bang Pahan	720	0	0	0	0	720	0	0	0	0	0	0	0	0	0	0	0	0	1,779	0	0	0	335	1,444
* Bang Pa-in	0	0	0	0	0	0	2,121	0	0	0	638	1,483	576	0	0	0	191	385	2,697	0	0	0	829	1,868
* Ban Phraek	97	0	0	0	0	97	0	0	0	0	0	0	0	0	0	0	0	0	449	0	0	0	132	317
* Phak Hai	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,204	0	0	0	1,200	1,004
* Maha Rat	326	0	0	0	0	326	0	0	0	0	0	0	0	0	0	0	0	0	1,129	0	0	0	144	985
Lat Bua Luang	0	0	0	0	0	0	0	0	0	0	0	0	1,033	0	0	0	0	1,033	1,033	0	0	0	0	1,033
** Sena	0	0	0	0	0	0	0	0	0	0	0	0	1,052	0	0	0	0	1,052	2,901	0	265	0	1,051	1,585
Uthai	0	0	0	0	0	0	22	0	0	0	0	22	0	0	0	0	0	0	22	0	0	0	0	22
Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	15,175	7,227	0	0	996	6,952	15,175	7,227	0	0	996	6,952
** Muang Pathum Thani	0	0	0	0	0	0	0	0	0	0	0	0	4,772	860	0	0	274	3,638	4,772	860	0	0	274	3,638
* Sam Khok	0	0	0	0	0	0	0	0	0	0	0	0	1,945	0	0	0	429	1,517	1,946	0	0	0	429	1,517
* Lat Lum Kaeo	0	0	0	0	0	0	0	0	0	0	0	0	1,756	0	0	0	293	1,463	1,756	0	0	0	293	1,463
* Thanyaburi	0	0	0	0	0	0	0	0	0	0	0	0	2,202	2,202	0	0	0	0	2,202	2,202	0	0	0	0
* Lam Luk Ka	0	0	0	0	0	0	0	0	0	0	0	0	1,450	1,450	0	0	0	0	1,450	1,450	0	0	0	0
* Khlong Luang	0	0	0	0	0	0	0	0	0	0	0	0	3,049	2,715	0	0	0	334	3,049	2,715	0	0	0	334
Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	24,708	20,186	0	0	0	4,522	24,708	20,186	0	0	0	4,522
** Muang Nonthaburi	0	0	0	0	0	0	0	0	0	0	0	0	11,372	10,586	0	0	0	786	11,372	10,586	0	0	0	786
Bang Yai	0	0	0	0	0	0	0	0	0	0	0	0	442	0	0	0	0	442	442	0	0	0	0	442
** Bang Bua Thong	0	0	0	0	0	0	0	0	0	0	0	0	3,892	2,680	0	0	0	1,012	3,892	2,680	0	0	0	1,012
* Pak Kret	0	0	0	0	0	0	0	0	0	0	0	0	9,202	6,920	0	0	0	2,282	9,202	6,920	0	0	0	2,282
Sara Buri	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,462	0	0	0	0	1,462
Don Phut	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	263	0	0	0	0	263
Ban Mo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	733	0	0	0	0	733
Nong Don	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	466	0	0	0	0	466
Total	19,541	4,284	2,351	0	1,686	11,220	3,132	0	0	0	638	2,494	43,743	27,413	0	0	1,187	15,143	114,894	31,697	5,566	431	14,904	62,296

Note: "**" refers to amphoes that have a municipality within the basin.
"*" refers to amphoes that have sanitary district/s within the basin.

Table 9.4.4 Industrial Wastewater Quantity by Sub-area (1992)

Province / Amphoe	Area (km2)			Population in 1992			Breakdown of Population and IWW Quantity by Sub-area												IWW Quantity Out of Basin	Total IWW Quantity (m3/day)
							Noi River		Lop Buri River		Pasak River		Main R. (R0-R1)		Main R. (R1-R2)		Main R. (R2-R3)		Main R. (R3-R4)			
	Admin. Total	Within Basin	Out of Basin	Admin. Total	Within Basin	Out of Basin	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty		
Chai Nat	861.7	147.0	714.7	118,213	47,594	70,619	6,025	283	0	0	0	0	25,203	889	14,366	507	0	0	0	0	2,491	4,169
Muang Chai Nat	255.4	147.0	108.4	72,957	47,594	25,363	6,025	283	0	0	0	0	25,203	889	14,366	507	0	0	0	0	894	2,573
Wat Sing	606.3	0.0	606.3	45,256	0	45,256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,596	1,596
Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	1,086	4,566	527	0	0	0	0	40,831	4,714	0	0	0	0	0	6,327
Muang Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	1,086	4,566	527	0	0	0	0	40,831	4,714	0	0	0	0	0	6,327
Lop Buri	2,133.8	606.7	1,527.1	434,050	240,031	194,019	0	0	240,031	4,260	0	0	0	0	0	0	0	0	0	0	3,443	7,703
Muang Lop Buri	565.6	426.8	138.8	267,289	215,307	51,982	0	0	215,307	3,821	0	0	0	0	0	0	0	0	0	0	923	4,744
Khok Samrong	982.5	17.5	965.0	75,827	1,013	74,814	0	0	1,013	18	0	0	0	0	0	0	0	0	0	0	1,328	1,345
Ban Mi	585.7	162.4	423.3	90,934	23,711	67,223	0	0	23,711	421	0	0	0	0	0	0	0	0	0	0	1,193	1,614
Ang Thong	183.8	182.9	0.9	77,304	76,959	345	22,636	2,309	0	0	0	0	0	0	54,123	5,473	0	0	0	0	35	7,817
Muang Ang Thong	102.9	102.0	0.9	48,288	47,943	345	15,904	1,608	0	0	0	0	0	0	32,039	3,240	0	0	0	0	35	4,883
Pa Mok	80.9	80.9	0.0	29,016	29,016	0	6,932	701	0	0	0	0	0	0	22,084	2,233	0	0	0	0	0	2,934
Ayutthaya	442.4	435.7	6.7	236,244	235,002	1,242	39,967	8,046	2,678	539	71,407	14,375	0	0	82,590	16,626	14,524	2,924	22,157	4,460	588	47,558
Muang Ayutthaya	130.6	130.6	0.0	123,553	123,553	0	2,867	577	2,678	539	20,894	4,206	0	0	82,590	16,626	14,524	2,924	0	0	0	24,872
Tha Rua	106.2	105.2	0.0	52,192	52,192	0	0	0	0	0	50,513	10,169	0	0	0	0	0	0	0	0	338	10,507
Sena	205.6	198.9	6.7	60,499	59,257	1,242	37,100	7,469	0	0	0	0	0	0	0	0	0	0	22,157	4,460	250	12,179
Pathum Thani	829.2	202.4	626.8	360,099	219,134	140,965	0	0	0	0	0	0	0	0	0	0	0	0	219,134	47,598	0	47,598
Muang Pathum Thani	120.2	120.2	0.0	96,546	96,546	0	0	0	0	0	0	0	0	0	0	0	0	0	96,546	12,761	0	12,761
Thanyaburi	112.1	8.7	103.4	88,858	39,957	48,901	0	0	0	0	0	0	0	0	0	0	0	0	39,957	11,745	0	11,745
Lam Luk Ka	297.7	6.0	291.7	89,749	26,308	63,441	0	0	0	0	0	0	0	0	0	0	0	0	26,308	11,863	0	11,863
Khlong Luang	299.2	67.5	231.7	84,946	56,323	28,623	0	0	0	0	0	0	0	0	0	0	0	0	56,323	11,228	0	11,228
Nonthaburi	262.4	247.7	34.7	556,654	440,670	115,984	0	0	0	0	0	0	0	0	0	0	0	0	440,670	27,065	0	27,065
Muang Nonthaburi	77.0	42.3	34.7	318,579	202,595	115,984	0	0	0	0	0	0	0	0	0	0	0	0	202,595	15,490	0	15,490
Bang Bua Thong	116.4	116.4	0.0	68,406	68,406	0	0	0	0	0	0	0	0	0	0	0	0	0	68,406	3,326	0	3,326
Pak Kret	69.0	69.0	0.0	169,669	169,669	0	0	0	0	0	0	0	0	0	0	0	0	0	169,669	8,249	0	8,249
Sara Buri	1,993.3	0.0	1,993.3	314,968	0	314,968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	57,049	57,049
Muang Sara Buri	503.8	0.0	503.8	124,852	0	124,852	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22,614	22,614
Kaeng Khoi	871.1	0.0	871.1	69,790	0	69,790	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12,641	12,641
Phra Phutthabat	324.6	0.0	324.6	41,582	0	41,582	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7,532	7,532
Nong Khae	293.8	0.0	293.8	78,744	0	78,744	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14,263	14,263
Total	6,839.0	1,934.8	4,904.2	2,152,332	1,314,190	838,142	80,231	11,724	247,275	5,326	71,407	14,375	25,203	889	191,910	27,320	14,524	2,924	661,961	79,123	63,606	205,286

Table 9.4.5 Generated BOD of Industrial Wastewater by Sub-area (1992)

Province / Amphoe	Area (km2)			Population in 1992			Breakdown of Population and Generated BOD (kg/day)												Gene'd BOD Out of Basin	Total Gene'd BOD (kg/day)
	Admin. Total	Within Basin	Out of Basin	Admin. Total	Within Basin	Out of Basin	Noi River Pop'n	Noi River Qt'ty	Lop Buri River Pop'n	Lop Buri River Qt'ty	Pasak River Pop'n	Pasak River Qt'ty	Main R. (R0-R1) Pop'n	Main R. (R0-R1) Qt'ty	Main R. (R1-R2) Pop'n	Main R. (R1-R2) Qt'ty	Main R. (R2-R3) Pop'n	Main R. (R2-R3) Qt'ty	Main R. (R3-R4) Pop'n	Main R. (R3-R4) Qt'ty		
Chai Nat	861.7	147.0	714.7	118,213	47,594	70,619	8,025	362	0	0	0	0	25,203	1,136	14,366	647	0	0	0	0	3,183	5,328
Muang Chai Nat	255.4	147.0	108.4	72,957	47,594	25,363	8,025	362	0	0	0	0	25,203	1,136	14,366	647	0	0	0	0	1,143	3,288
Wat Sing	606.3	0.0	606.3	45,256	0	45,256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,040	2,040
Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	1,319	4,566	641	0	0	0	0	40,831	5,728	0	0	0	0	0	7,688
Muang Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	1,319	4,566	641	0	0	0	0	40,831	5,728	0	0	0	0	0	7,688
Lop Buri	2,133.8	606.7	1,527.1	434,050	240,031	194,019	0	0	240,031	4,462	0	0	0	0	0	0	0	0	0	0	3,607	8,069
Muang Lop Buri	565.6	426.8	138.8	267,289	215,307	51,982	0	0	215,307	4,003	0	0	0	0	0	0	0	0	0	0	956	4,959
Khok Samrong	982.5	17.5	965.0	75,827	1,013	74,814	0	0	1,013	19	0	0	0	0	0	0	0	0	0	0	1,391	1,410
Ban Mi	585.7	162.4	423.3	90,934	23,711	67,223	0	0	23,711	441	0	0	0	0	0	0	0	0	0	0	1,250	1,690
Ang Thong	183.8	182.9	0.9	77,304	76,959	345	22,636	1,651	0	0	0	0	0	0	54,123	3,912	0	0	0	0	25	5,588
Muang Ang Thong	102.9	102.0	0.9	48,288	47,943	345	15,904	1,150	0	0	0	0	0	0	32,039	2,316	0	0	0	0	25	3,491
Pa Mok	80.9	80.9	0.0	29,016	29,016	0	6,932	501	0	0	0	0	0	0	22,084	1,596	0	0	0	0	0	2,097
Ayutthaya	442.4	435.7	6.7	236,244	235,002	1,242	39,967	6,199	2,678	415	71,407	11,076	0	0	82,590	12,811	14,524	2,253	22,157	3,437	453	36,645
Muang Ayutthaya	130.6	130.6	0.0	123,553	123,553	0	2,867	445	2,678	415	20,894	3,241	0	0	82,590	12,811	14,524	2,253	0	0	0	19,165
Tha Rua	106.2	106.2	0.0	52,192	52,192	0	0	0	0	0	50,513	7,835	0	0	0	0	0	0	0	0	250	8,096
Sena	205.6	198.9	6.7	60,499	59,257	1,242	37,100	5,755	0	0	0	0	0	0	0	0	0	0	22,157	3,437	193	9,384
Pathum Thani	829.2	202.4	626.8	360,099	219,134	140,965	0	0	0	0	0	0	0	0	0	0	0	0	219,134	25,032	0	25,032
Muang Pathum Thani	120.2	120.2	0.0	96,546	96,546	0	0	0	0	0	0	0	0	0	0	0	0	0	96,546	6,711	0	6,711
Thanyaburi	112.1	8.7	103.4	88,858	39,957	48,901	0	0	0	0	0	0	0	0	0	0	0	0	39,957	6,177	0	6,177
Lam Luk Ka	297.7	6.0	291.7	89,749	26,308	63,441	0	0	0	0	0	0	0	0	0	0	0	0	26,308	6,239	0	6,239
Khlong Luang	299.2	67.5	231.7	84,946	56,323	28,623	0	0	0	0	0	0	0	0	0	0	0	0	56,323	5,905	0	5,905
Nonthaburi	282.4	247.7	34.7	556,654	440,670	115,984	0	0	0	0	0	0	0	0	0	0	0	0	440,670	14,333	0	14,333
Muang Nonthaburi	77.0	42.3	34.7	318,579	202,595	115,984	0	0	0	0	0	0	0	0	0	0	0	0	202,595	6,203	0	6,203
Bang Bua Thong	116.4	116.4	0.0	68,406	68,406	0	0	0	0	0	0	0	0	0	0	0	0	0	68,406	1,761	0	1,761
Pak Kret	89.0	89.0	0.0	169,669	169,669	0	0	0	0	0	0	0	0	0	0	0	0	0	169,669	4,369	0	4,369
Sara Buri	1,993.3	0.0	1,993.3	314,968	0	314,968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	39,214	39,214
Muang Sara Buri	503.8	0.0	503.8	124,852	0	124,852	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15,544	15,544
Kaeng Khoi	871.1	0.0	871.1	69,790	0	69,790	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,689	6,689
Phra Phutthabat	324.6	0.0	324.6	41,582	0	41,582	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,177	5,177
Nong Khae	293.8	0.0	293.8	78,744	0	78,744	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9,804	9,804
Total	5,639.0	1,934.8	4,904.2	2,152,332	1,314,190	838,142	80,231	9,531	247,275	5,518	71,407	11,076	25,203	1,136	191,910	23,099	14,524	2,253	661,961	42,802	46,482	141,897

Table 9.4.6 Discharged BOD of Industrial Wastewater by Sub-area (1992)

Province / Amphoe	Area (km2)			Population in 1992			Breakdown of Population and Discharged BOD (kg/day)												Disc'd BOD Out of Basin	Total Disc'd BOD (kg/day)
							Noi River		Lop Buri River		Pasak River		Main R. (R0-R1)		Main R. (R1-R2)		Main R. (R2-R3)		Main R. (R3-R4)			
	Admin. Total	Within Basin	Out of Basin	Admin. Total	Within Basin	Out of Basin	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty	Pop'n	Qt'ty		
Chai Nat	861.7	147.0	714.7	118,213	47,594	70,619	8,025	183	0	0	0	0	25,203	576	14,366	328	0	0	0	0	1,615	2,703
Muang Chai Nat	255.4	147.0	108.4	72,957	47,594	25,363	8,025	183	0	0	0	0	25,203	576	14,366	328	0	0	0	0	580	1,668
Wat Sing	606.3	0.0	606.3	45,256	0	45,256	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1,035	1,035
Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	670	4,566	325	0	0	0	0	40,831	2,908	0	0	0	0	0	3,903
Muang Sing Buri	112.4	112.4	0.0	54,800	54,800	0	9,403	670	4,566	325	0	0	0	0	40,831	2,908	0	0	0	0	0	3,903
Lop Buri	2,133.8	606.7	1,527.1	434,050	240,031	194,019	0	0	240,031	2,270	0	0	0	0	0	0	0	0	0	0	1,834	4,104
Muang Lop Buri	565.6	426.8	138.8	267,289	215,307	51,982	0	0	215,307	2,036	0	0	0	0	0	0	0	0	0	0	491	2,527
Khok Samrong	982.5	17.5	965.0	75,827	1,013	74,814	0	0	1,013	10	0	0	0	0	0	0	0	0	0	0	707	717
Ban Mi	585.7	162.4	423.3	90,934	23,711	67,223	0	0	23,711	224	0	0	0	0	0	0	0	0	0	0	636	860
Ang Thong	183.8	182.9	0.9	77,304	76,959	345	22,836	853	0	0	0	0	0	0	54,123	2,021	0	0	0	0	13	2,886
Muang Ang Thong	102.9	102.0	0.9	48,288	47,943	345	15,904	594	0	0	0	0	0	0	32,039	1,196	0	0	0	0	13	1,803
Pa Mok	80.9	80.9	0.0	29,016	29,016	0	6,932	259	0	0	0	0	0	0	22,084	824	0	0	0	0	0	1,083
Ayutthaya	442.4	435.7	6.7	236,244	235,002	1,242	39,967	3,193	2,678	214	71,407	5,705	0	0	82,590	6,598	14,524	1,160	22,157	1,770	233	18,873
Muang Ayutthaya	130.6	130.6	0.0	123,553	123,553	0	2,867	229	2,678	214	20,894	1,669	0	0	82,590	6,598	14,524	1,160	0	0	0	9,870
Tha Rua	106.2	106.2	0.0	52,192	52,192	0	0	0	0	0	50,513	4,035	0	0	0	0	0	0	0	0	134	4,170
Sena	205.6	198.9	6.7	60,499	59,257	1,242	37,100	2,964	0	0	0	0	0	0	0	0	0	0	22,157	1,770	99	4,833
Pathum Thani	829.2	202.4	626.8	360,099	219,134	140,965	0	0	0	0	0	0	0	0	0	0	0	0	219,134	13,177	0	13,177
Muang Pathum Thani	120.2	120.2	0.0	96,546	96,546	0	0	0	0	0	0	0	0	0	0	0	0	0	96,546	3,533	0	3,533
Thanyaburi	112.1	8.7	103.4	88,858	39,957	48,901	0	0	0	0	0	0	0	0	0	0	0	0	39,957	3,252	0	3,252
Lam Luk Ka	297.7	6.0	291.7	89,749	26,308	63,441	0	0	0	0	0	0	0	0	0	0	0	0	26,308	3,284	0	3,284
Khlong Luang	299.2	67.5	231.7	84,946	56,323	28,623	0	0	0	0	0	0	0	0	0	0	0	0	56,323	3,108	0	3,108
Nonthaburi	282.4	247.7	34.7	556,654	440,670	115,984	0	0	0	0	0	0	0	0	0	0	0	0	440,670	7,549	0	7,549
Muang Nonthaburi	77.0	42.3	34.7	318,579	202,595	115,984	0	0	0	0	0	0	0	0	0	0	0	0	202,595	4,320	0	4,320
Bang Bua Thong	116.4	116.4	0.0	68,406	68,406	0	0	0	0	0	0	0	0	0	0	0	0	0	68,406	928	0	928
Pak Kret	89.0	89.0	0.0	169,669	169,669	0	0	0	0	0	0	0	0	0	0	0	0	0	169,669	2,301	0	2,301
Sara Buri	1,993.3	0.0	1,993.3	314,968	0	314,968	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20,189	20,189
Muang Sara Buri	503.8	0.0	503.8	124,852	0	124,852	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,003	8,003
Kaeng Khoi	871.1	0.0	871.1	69,790	0	69,790	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4,473	4,473
Phra Phutthabat	324.6	0.0	324.6	41,582	0	41,582	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2,665	2,665
Nong Khae	293.8	0.0	293.8	78,744	0	78,744	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5,047	5,047
Total	6,839.0	1,934.8	4,904.2	2,152,332	1,314,190	838,142	80,231	4,899	247,275	2,809	71,407	5,705	25,203	576	191,910	11,855	14,524	1,160	681,961	22,495	23,884	73,384

Table 9.4.7 Livestock Wastewater Quantity by Sub-area (Buffaloes, 1992)

Province / Amphoe	Area (km2)			Number of Buffaloes (head)	Buffaloes W.W. Quantity (m3/day)	Breakdown by Sub-area (m3/day)							Buffaloes W.W. Out of Basin (m3/day)
	Admin. Total	Within Basin	Out of Basin			Noi River	Lop Buri River	Pasak River	Main R. (R0-R1)	Main R. (R1-R2)	Main R. (R2-R3)	Main R. (R3-R4)	
Chai Nat	2,469.7	624.3	1,845.4	22,000	1,980	228	0	0	41	231	0	0	1,479
Muang Chai Nat	255.4	147.0	108.4	2,275	205	27	0	0	41	49	0	0	87
Manorom	225.6	0.0	225.6	2,010	181	0	0	0	0	0	0	0	181
Wat Sing	606.3	0.0	606.3	5,401	486	0	0	0	0	0	0	0	486
Sankhaburi	354.8	249.0	105.8	3,161	284	181	0	0	0	18	0	0	85
Sanphaya	228.3	228.3	0.0	2,034	183	19	0	0	0	164	0	0	0
Hankha	799.3	0.0	799.3	7,120	641	0	0	0	0	0	0	0	641
Sing Buri	822.5	822.5	0.0	2,500	225	94	30	0	0	101	0	0	0
Muang Sing Buri	112.4	112.4	0.0	342	31	9	4	0	0	18	0	0	0
Khai Bang Rachan	88.4	88.4	0.0	269	24	24	0	0	0	0	0	0	0
Tha Chang	34.4	34.4	0.0	105	9	9	0	0	0	0	0	0	0
Bang Rachan	190.5	190.5	0.0	579	52	49	0	0	0	3	0	0	0
Phrom Buri	82.5	82.5	0.0	251	23	2	0	0	0	20	0	0	0
In Buri	314.3	314.3	0.0	955	86	1	26	0	0	60	0	0	0
Lop Buri	6,199.8	849.5	5,350.3	16,100	1,449	0	188	0	0	10	0	0	1,250
Muang Lop Buri	565.6	426.8	138.8	1,469	132	0	100	0	0	0	0	0	32
Khok Samrong	982.5	17.5	965.0	2,551	230	0	4	0	0	0	0	0	226
Chai Badan	1,253.0	0.0	1,253.0	3,254	293	0	0	0	0	0	0	0	293
Tha Luang	538.9	0.0	538.9	1,399	126	0	0	0	0	0	0	0	126
Tha Wung	242.8	242.8	0.0	631	57	0	47	0	0	10	0	0	0
Ban Mi	585.7	162.4	423.3	1,521	137	0	38	0	0	0	0	0	99
Pattana Nikom	517.0	0.0	517.0	1,343	121	0	0	0	0	0	0	0	121
Sa Boat	304.7	0.0	304.7	791	71	0	0	0	0	0	0	0	71
Khok Charoen	317.1	0.0	317.1	823	74	0	0	0	0	0	0	0	74
Lam San Thi	447.0	0.0	447.0	1,161	104	0	0	0	0	0	0	0	104
Nang Muang	445.5	0.0	445.5	1,157	104	0	0	0	0	0	0	0	104
Ang Thong	968.4	888.2	80.2	6,100	549	397	0	0	0	106	0	0	45
Muang Ang Thong	102.9	102.0	0.9	648	58	24	0	0	0	34	0	0	1
Chaiyo	72.3	72.3	0.0	455	41	0	0	0	0	41	0	0	0
Pa Mok	80.9	80.9	0.0	510	46	15	0	0	0	31	0	0	0
Pho Thong	219.4	212.4	7.0	1,382	124	120	0	0	0	0	0	0	4
Wiset Chai Chan	224.7	189.3	35.4	1,415	127	107	0	0	0	0	0	0	20
Samko	86.9	50.0	36.9	547	49	28	0	0	0	0	0	0	21
Sawaengha	181.3	181.3	0.0	1,142	103	103	0	0	0	0	0	0	0
Ayutthaya	2,556.6	1,907.5	649.1	23,900	2,151	386	119	320	0	183	191	406	546
Muang Ayutthaya	130.6	130.6	0.0	1,221	110	6	6	28	0	37	32	0	0
Tha Rua	106.2	106.2	0.0	993	89	0	0	89	0	0	0	0	0
Nakhorn Luang	198.9	198.9	0.0	1,859	167	0	10	157	0	0	0	0	0
Bang Sai	150.7	119.3	31.4	1,409	127	55	0	0	0	0	0	46	26
Bang Shai	219.7	219.7	0.0	2,054	185	71	0	0	0	0	1	113	0
Bang Ban	135.3	135.3	0.0	1,265	114	28	0	0	0	58	28	0	0
Bang Pahan	121.9	121.9	0.0	1,140	103	0	38	16	0	49	0	0	0
Bang Pa-In	229.1	189.1	40.0	2,142	193	0	0	0	0	0	128	31	34
Ban Phraek	39.1	39.1	0.0	366	33	0	25	0	0	8	0	0	0
Phak Hai	189.0	189.0	0.0	1,767	159	159	0	0	0	0	0	0	0
Phachi	104.5	0.0	104.5	977	88	0	0	0	0	0	0	0	88
Maharat	120.1	120.1	0.0	1,123	101	0	39	30	0	32	0	0	0
Lat Bua Luang	199.9	136.9	63.0	1,869	168	0	0	0	0	0	0	115	53
Wang Noi	219.2	0.0	219.2	2,049	184	0	0	0	0	0	0	0	184
Sena	205.6	198.9	6.7	1,922	173	67	0	0	0	0	0	101	6
Uthai	186.8	2.5	184.3	1,746	157	0	0	0	0	0	2	0	155
Pathum Thani	1,525.9	485.5	1,040.4	7,900	711	0	0	0	0	0	0	226	485
Muang Pathum Thani	120.2	120.2	0.0	622	56	0	0	0	0	0	0	56	0
Sam Khok	95.0	95.0	0.0	492	44	0	0	0	0	0	0	44	0
Lat Lum Kaeo	188.1	188.1	0.0	974	88	0	0	0	0	0	0	88	0
Thanya Buri	112.1	8.7	103.4	580	52	0	0	0	0	0	0	4	48
Lam Luk Ka	297.7	6.0	291.7	1,541	139	0	0	0	0	0	0	3	136
Klong Laung	299.2	67.5	231.7	1,549	139	0	0	0	0	0	0	31	108
Nong Sua	413.6	0.0	413.6	2,141	193	0	0	0	0	0	0	0	193
Nonthaburi	622.3	273.6	348.7	1,600	144	0	0	0	0	0	0	63	81
Muang Nonthaburi	77.0	42.3	34.7	198	18	0	0	0	0	0	0	10	8
Kruai	57.4	0.0	57.4	148	13	0	0	0	0	0	0	0	13
Bang Yai	96.4	25.9	70.5	248	22	0	0	0	0	0	0	6	16
Bang Bua Thong	116.4	116.4	0.0	299	27	0	0	0	0	0	0	27	0
Pak Kret	89.0	89.0	0.0	229	21	0	0	0	0	0	0	21	0
Sai Noi	166.1	0.0	166.1	428	43	0	0	0	0	0	0	0	43
Sara Buri	3,576.6	186.3	3,390.3	16,900	1,521	0	11	68	0	0	0	0	1,442
Muang Sara Buri	503.8	0.0	503.8	2,381	214	0	0	0	0	0	0	0	214
Kaeng Khoi	871.1	0.0	871.1	4,116	370	0	0	0	0	0	0	0	370
Don Phunt	65.6	65.6	0.0	310	28	0	9	19	0	0	0	0	0
Ban Mo	279.0	93.7	185.3	1,318	119	0	0	40	0	0	0	0	79
Phra Phutthabat	324.6	0.0	324.6	1,534	138	0	0	0	0	0	0	0	138
Muak Lek	752.5	0.0	752.5	3,556	320	0	0	0	0	0	0	0	320
Wihan Daeng	226.8	0.0	226.8	1,081	97	0	0	0	0	0	0	0	97
Saohai	125.1	0.0	125.1	591	53	0	0	0	0	0	0	0	53
Nong Khae	293.8	0.0	293.8	1,388	125	0	0	0	0	0	0	0	125
Nong Saeng	97.4	0.0	97.4	460	41	0	0	0	0	0	0	0	41
Nong Don	34.9	27.0	7.9	165	15	0	2	10	0	0	0	0	3
Total	18,741.8	6,037.4	12,704.4	97,000	8,730	1,105	348	388	41	632	191	695	5,329

Table 9.4.8 Livestock Wastewater Generated BOD by Sub-area (Buffaloes, 1992)

Province / Amphoe	Area (km2)			Number of Buffaloes (head)	Buffaloes Generated BOD (kg/day)	Breakdown by Sub-area (kg/day)							Buffaloes BOD Out of Basin (kg/day)
	Admin. Total	Within Basin	Out of Basin			Noi River	Lop Buri River	Pasak River	Main R. (R0-R1)	Main R. (R1-R2)	Main R. (R2-R3)	Main R. (R3-R4)	
Chai Nat	2,469.7	624.3	1,845.4	22,000	14,080	1,622	0	0	292	1,645	0	0	10,521
Muang Chai Nat	255.4	147.0	108.4	2,275	1,456	196	0	0	292	350	0	0	618
Manorom	225.6	0.0	225.6	2,010	1,286	0	0	0	0	0	0	0	1,286
Wat Sing	606.3	0.0	606.3	5,401	3,457	0	0	0	0	0	0	0	3,457
Sankhaburi	354.8	249.0	105.8	3,161	2,023	1,290	0	0	0	129	0	0	603
Sanphaya	228.3	228.3	0.0	2,034	1,302	136	0	0	0	1,165	0	0	0
Hankha	799.3	0.0	799.3	7,120	4,557	0	0	0	0	0	0	0	4,557
Sing Buri	822.5	822.5	0.0	2,500	1,600	670	211	0	0	719	0	0	0
Muang Sing Buri	112.4	112.4	0.0	342	219	61	30	0	0	128	0	0	0
Khai Bang Rachan	88.4	88.4	0.0	269	172	172	0	0	0	0	0	0	0
Tha Chang	34.4	34.4	0.0	105	67	67	0	0	0	0	0	0	0
Bang Rachan	190.5	190.5	0.0	579	371	350	0	0	0	20	0	0	0
Phrom Buri	82.5	82.5	0.0	251	160	16	0	0	0	145	0	0	0
In Buri	314.3	314.3	0.0	955	611	4	182	0	0	426	0	0	0
Lop Buri	6,199.8	849.5	5,350.3	16,100	10,304	0	1,340	0	0	72	0	0	8,892
Muang Lop Buri	565.6	426.8	138.8	1,469	940	0	709	0	0	0	0	0	231
Khok Samrong	982.5	17.5	965.0	2,551	1,633	0	29	0	0	0	0	0	1,604
Chai Badan	1,253.0	0.0	1,253.0	3,254	2,082	0	0	0	0	0	0	0	2,082
Tha Luang	538.9	0.0	538.9	1,399	896	0	0	0	0	0	0	0	896
Tha Wung	242.8	242.8	0.0	631	404	0	331	0	0	72	0	0	0
Ban Mi	585.7	162.4	423.3	1,521	973	0	270	0	0	0	0	0	704
Pattana Nikom	517.0	0.0	517.0	1,343	859	0	0	0	0	0	0	0	859
Sa Boat	304.7	0.0	304.7	791	506	0	0	0	0	0	0	0	506
Khok Charoen	317.1	0.0	317.1	823	527	0	0	0	0	0	0	0	527
Lam San Thi	447.0	0.0	447.0	1,161	743	0	0	0	0	0	0	0	743
Nang Muang	445.5	0.0	445.5	1,157	740	0	0	0	0	0	0	0	740
Ang Thong	968.4	888.2	80.2	6,100	3,904	2,826	0	0	0	755	0	0	323
Muang Ang Thong	102.9	102.0	0.9	648	415	167	0	0	0	244	0	0	4
Chaiyo	72.3	72.3	0.0	455	291	0	0	0	0	291	0	0	0
Pa Mok	80.9	80.9	0.0	510	326	107	0	0	0	219	0	0	0
Pho Thong	219.4	212.4	7.0	1,382	884	856	0	0	0	0	0	0	28
Wiset Chai Chan	224.7	189.3	35.4	1,415	906	763	0	0	0	0	0	0	143
Samko	86.9	50.0	36.9	547	350	202	0	0	0	0	0	0	149
Sawaengha	181.3	181.3	0.0	1,142	731	731	0	0	0	0	0	0	0
Ayutthaya	2,556.6	1,907.5	649.1	23,900	15,296	2,741	844	2,277	0	1,304	1,361	2,885	3,884
Muang Ayutthaya	130.6	130.6	0.0	1,221	781	45	42	200	0	263	230	0	0
Tha Rua	106.2	106.2	0.0	993	635	0	0	635	0	0	0	0	0
Nakhorn Luang	198.9	198.9	0.0	1,859	1,190	0	71	1,119	0	0	0	0	0
Bang Sai	150.7	119.3	31.4	1,409	902	389	0	0	0	0	0	324	188
Bang Shai	219.7	219.7	0.0	2,054	1,314	502	0	0	0	0	7	805	0
Bang Ban	135.3	135.3	0.0	1,265	809	199	0	0	0	412	199	0	0
Bang Pahan	121.9	121.9	0.0	1,140	729	0	272	111	0	346	0	0	0
Bang Pa-In	229.1	189.1	40.0	2,142	1,371	0	0	0	0	0	909	222	239
Ban Phraek	39.1	39.1	0.0	366	234	0	177	0	0	57	0	0	0
Phak Hai	189.0	189.0	0.0	1,767	1,131	1,131	0	0	0	0	0	0	0
Phachi	104.5	0.0	104.5	977	625	0	0	0	0	0	0	0	625
Maharat	120.1	120.1	0.0	1,123	719	0	281	212	0	226	0	0	0
Lat Bua Luang	199.9	136.9	63.0	1,869	1,196	0	0	0	0	0	0	819	377
Wang Noi	219.2	0.0	219.2	2,049	1,311	0	0	0	0	0	0	0	1,311
Sena	205.6	198.9	6.7	1,922	1,230	475	0	0	0	0	0	715	40
Uthai	186.8	2.5	184.3	1,746	1,118	0	0	0	0	0	15	0	1,103
Pathum Thani	1,525.9	485.5	1,040.4	7,900	5,056	0	0	0	0	0	0	1,609	3,447
Muang Pathum Thani	120.2	120.2	0.0	622	398	0	0	0	0	0	0	398	0
Sam Khok	95.0	95.0	0.0	492	315	0	0	0	0	0	0	315	0
Lat Lum Kaeo	188.1	188.1	0.0	974	623	0	0	0	0	0	0	623	0
Thanya Buri	112.1	8.7	103.4	580	371	0	0	0	0	0	0	29	343
Lam Luk Ka	297.7	6.0	291.7	1,541	986	0	0	0	0	0	0	20	967
Klong Laung	299.2	67.5	231.7	1,549	991	0	0	0	0	0	0	224	768
Nong Sua	413.6	0.0	413.6	2,141	1,370	0	0	0	0	0	0	0	1,370
Nonthaburi	622.3	273.6	348.7	1,600	1,024	0	0	0	0	0	0	450	574
Muang Nonthaburi	77.0	42.3	34.7	198	127	0	0	0	0	0	0	70	57
Kruai	57.4	0.0	57.4	148	94	0	0	0	0	0	0	0	94
Bang Yai	96.4	25.9	70.5	248	159	0	0	0	0	0	0	43	116
Bang Bua Thong	116.4	116.4	0.0	299	192	0	0	0	0	0	0	192	0
Pak Kret	89.0	89.0	0.0	229	146	0	0	0	0	0	0	146	0
Sai Noi	186.1	0.0	186.1	478	306	0	0	0	0	0	0	0	306
Sara Buri	3,576.6	186.3	3,390.3	16,900	10,816	0	78	485	0	0	0	0	10,253
Muang Sara Buri	503.8	0.0	503.8	2,381	1,524	0	0	0	0	0	0	0	1,524
Kaeng Khoi	871.1	0.0	871.1	4,116	2,634	0	0	0	0	0	0	0	2,634
Don Phunt	65.6	65.6	0.0	310	198	0	66	132	0	0	0	0	0
Ban Mo	279.0	93.7	185.3	1,318	844	0	0	283	0	0	0	0	560
Phra Phutthabat	324.6	0.0	324.6	1,534	982	0	0	0	0	0	0	0	982
Muak Lek	752.5	0.0	752.5	3,556	2,276	0	0	0	0	0	0	0	2,276
Wihan Daeng	228.8	0.0	228.8	1,081	692	0	0	0	0	0	0	0	692
Saohai	125.1	0.0	125.1	591	378	0	0	0	0	0	0	0	378
Nong Khae	293.8	0.0	293.8	1,388	888	0	0	0	0	0	0	0	888
Nong Saeng	97.4	0.0	97.4	460	295	0	0	0	0	0	0	0	295
Nong Don	34.9	27.0	7.9	165	106	0	12	70	0	0	0	0	24
Total	18,741.8	6,037.4	12,704.4	97,000	62,080	7,859	2,473	2,762	292	4,495	1,361	4,944	37,894

Table 9.4.9 Livestock Wastewater Quantity by Sub-area (Cattle, 1992)

Province / Amphoe	Area (km2)			Number of Cattle (head)	Cattle W.W. Quantity (m3/day)	Breakdown by Sub-area (m3/day)							Cattle W.W. Out of Basin (m3/day)
	Admin. Total	Within Basin	Out of Basin			Noi River	Lop Buri River	Pasak River	Main R. (R0-R1)	Main R. (R1-R2)	Main R. (R2-R3)	Main R. (R3-R4)	
Chai Nat	2,469.7	624.3	1,845.4	53,700	4,833	557	0	0	100	565	0	0	3,611
Muang Chai Nat	255.4	147.0	108.4	5,553	500	67	0	0	100	120	0	0	212
Manorom	225.6	0.0	225.6	4,905	441	0	0	0	0	0	0	0	441
Wat Sing	606.3	0.0	606.3	13,183	1,186	0	0	0	0	0	0	0	1,186
Sankhaburi	354.8	249.0	105.8	7,715	694	443	0	0	0	44	0	0	207
Sanphaya	228.3	228.3	0.0	4,964	447	47	0	0	0	400	0	0	0
Hankha	799.3	0.0	799.3	17,380	1,564	0	0	0	0	0	0	0	1,564
Sing Buri	822.5	822.5	0.0	32,600	2,934	1,229	387	0	0	1,318	0	0	0
Muang Sing Buri	112.4	112.4	0.0	4,455	401	112	54	0	0	235	0	0	0
Khai Bang Rachan	88.4	88.4	0.0	3,504	315	315	0	0	0	0	0	0	0
Tha Chang	34.4	34.4	0.0	1,383	123	123	0	0	0	0	0	0	0
Bang Rachan	190.5	190.5	0.0	7,551	680	642	0	0	0	37	0	0	0
Phrom Buri	82.5	82.5	0.0	3,270	294	29	0	0	0	265	0	0	0
In Buri	314.3	314.3	0.0	12,457	1,121	7	333	0	0	781	0	0	0
Lop Buri	6,199.8	849.5	5,350.3	176,700	15,903	0	2,067	0	0	112	0	0	13,724
Muang Lop Buri	565.6	426.8	138.8	16,120	1,451	0	1,095	0	0	0	0	0	356
Khok Samrong	982.5	17.5	965.0	28,002	2,520	0	45	0	0	0	0	0	2,475
Chai Badan	1,253.0	0.0	1,253.0	35,712	3,214	0	0	0	0	0	0	0	3,214
Tha Luang	538.9	0.0	538.9	15,359	1,382	0	0	0	0	0	0	0	1,382
Tha Wung	242.8	242.8	0.0	6,920	623	0	511	0	0	112	0	0	0
Ban Mi	585.7	162.4	423.3	16,693	1,502	0	417	0	0	0	0	0	1,086
Pattana Nikom	517.0	0.0	517.0	14,735	1,326	0	0	0	0	0	0	0	1,326
Sa Boat	304.7	0.0	304.7	8,684	782	0	0	0	0	0	0	0	782
Khok Charoen	317.1	0.0	317.1	9,038	813	0	0	0	0	0	0	0	813
Lam San Thi	447.0	0.0	447.0	12,740	1,147	0	0	0	0	0	0	0	1,147
Nang Muang	445.5	0.0	445.5	12,697	1,143	0	0	0	0	0	0	0	1,143
Ang Thong	968.4	888.2	80.2	36,500	3,285	2,378	0	0	0	635	0	0	272
Muang Ang Thong	102.9	102.0	0.9	3,878	349	141	0	0	0	205	0	0	3
Chaiyo	72.3	72.3	0.0	2,725	245	0	0	0	0	245	0	0	0
Pa Mok	80.9	80.9	0.0	3,049	274	90	0	0	0	185	0	0	0
Pho Thong	219.4	212.4	7.0	8,269	744	721	0	0	0	0	0	0	24
Wiset Chai Chan	224.7	189.3	35.4	8,469	762	642	0	0	0	0	0	0	120
Samko	86.9	50.0	36.9	3,275	295	170	0	0	0	0	0	0	125
Sawaengha	181.3	181.3	0.0	6,833	615	615	0	0	0	0	0	0	0
Ayutthaya	2,556.6	1,907.5	649.1	34,900	3,141	563	173	468	0	268	279	593	797
Muang Ayutthaya	130.6	130.6	0.0	1,783	160	9	9	41	0	54	47	0	0
Tha Rua	106.2	106.2	0.0	1,450	130	0	0	130	0	0	0	0	0
Nakhorn Luang	198.9	198.9	0.0	2,715	244	0	15	230	0	0	0	0	0
Bang Sai	150.7	119.3	31.4	2,057	185	60	0	0	0	0	0	67	39
Bang Sha	219.7	219.7	0.0	2,999	270	103	0	0	0	0	1	165	0
Bang Ban	135.3	135.3	0.0	1,847	166	41	0	0	0	85	41	0	0
Bang Pahan	121.9	121.9	0.0	1,664	150	0	56	23	0	71	0	0	0
Bang Pa-In	229.1	189.1	40.0	3,127	281	0	0	0	0	0	187	46	49
Ban Phraek	39.1	39.1	0.0	534	48	0	36	0	0	12	0	0	0
Phak Hai	189.0	189.0	0.0	2,580	232	232	0	0	0	0	0	0	0
Phachi	104.5	0.0	104.5	1,427	128	0	0	0	0	0	0	0	128
Maharat	120.1	120.1	0.0	1,639	146	0	58	43	0	46	0	0	0
Lat Bua Luang	199.9	136.9	63.0	2,729	246	0	0	0	0	0	0	168	77
Wang Noi	219.2	0.0	219.2	2,992	269	0	0	0	0	0	0	0	269
Sena	205.6	198.9	6.7	2,807	253	98	0	0	0	0	0	147	8
Uthai	166.8	2.5	164.3	2,550	229	0	0	0	0	0	3	0	226
Pathum Thani	1,525.9	485.5	1,040.4	10,700	963	0	0	0	0	0	0	306	657
Muang Pathum Thani	120.2	120.2	0.0	843	76	0	0	0	0	0	0	76	0
Sam Khok	95.0	95.0	0.0	666	60	0	0	0	0	0	0	60	0
Lat Lum Kaeo	188.1	188.1	0.0	1,319	119	0	0	0	0	0	0	119	0
Thanya Buri	112.1	8.7	103.4	786	71	0	0	0	0	0	0	5	65
Lam Luk Ka	297.7	6.0	291.7	2,088	188	0	0	0	0	0	0	4	184
Klong Laung	299.2	67.5	231.7	2,098	189	0	0	0	0	0	0	43	146
Nong Sua	413.6	0.0	413.6	2,900	261	0	0	0	0	0	0	0	261
Nonthaburi	622.3	273.6	348.7	3,400	306	0	0	0	0	0	0	135	171
Muang Nonthaburi	77.0	42.3	34.7	421	38	0	0	0	0	0	0	21	17
Kruai	57.4	0.0	57.4	314	28	0	0	0	0	0	0	0	28
Bang Yai	96.4	25.9	70.5	527	47	0	0	0	0	0	0	13	35
Bang Bua Thong	116.4	116.4	0.0	636	57	0	0	0	0	0	0	57	0
Pak Kret	89.0	89.0	0.0	486	44	0	0	0	0	0	0	44	0
Sai Noi	186.1	0.0	186.1	1,017	92	0	0	0	0	0	0	0	92
Sara Buri	3,576.6	186.3	3,390.3	63,400	5,706	0	41	256	0	0	0	0	5,409
Muang Sara Buri	503.8	0.0	503.8	8,931	804	0	0	0	0	0	0	0	804
Kaeng Khoi	871.1	0.0	871.1	15,441	1,390	0	0	0	0	0	0	0	1,390
Don Phunt	65.6	65.6	0.0	1,163	105	0	35	70	0	0	0	0	0
Ban Mo	279.0	93.7	185.3	4,946	445	0	0	149	0	0	0	0	296
Phra Phutthabat	324.6	0.0	324.6	5,754	518	0	0	0	0	0	0	0	518
Muak Lek	752.5	0.0	752.5	13,339	1,201	0	0	0	0	0	0	0	1,201
Wihan Daeng	228.8	0.0	228.8	4,056	365	0	0	0	0	0	0	0	365
Saohai	125.1	0.0	125.1	2,218	200	0	0	0	0	0	0	0	200
Nong Khae	293.8	0.0	293.8	5,208	469	0	0	0	0	0	0	0	469
Nong Saeng	97.4	0.0	97.4	1,727	155	0	0	0	0	0	0	0	155
Nong Don	34.9	27.0	7.9	619	56	0	6	37	0	0	0	0	13
Total	18,741.6	6,037.4	12,704.4	411,900	37,071	4,726	2,669	723	100	2,897	279	1,033	24,642

Table 9.4.10 Livestock Wastewater Generated BOD by Sub-area (Cattle, 1992)

Province / Amphoe	Area (km2)			Number of Cattle (head)	Cattle Generated BOD (kg/day)	Breakdown by Sub-area (kg/day)							Cattle BOD Out of Basin (kg/day)
	Admin. Total	Within Basin	Out of Basin			Noi River	Lop Buri River	Pasak River	Main R. (R0-R1)	Main R. (R1-R2)	Main R. (R2-R3)	Main R. (R3-R4)	
Chai Nat	2,469.7	624.3	1,845.4	53,700	34,368	3,959	0	0	714	4,015	0	0	25,680
Muang Chai Nat	255.4	147.0	108.4	5,553	3,554	477	0	0	714	854	0	0	1,508
Manorom	225.6	0.0	225.6	4,905	3,139	0	0	0	0	0	0	0	3,139
Wat Sing	606.3	0.0	606.3	13,163	8,437	0	0	0	0	0	0	0	8,437
Sankhaburi	354.8	249.0	105.8	7,715	4,937	3,149	0	0	0	316	0	0	1,472
Sanphaya	228.3	228.3	0.0	4,964	3,177	333	0	0	0	2,844	0	0	0
Hankha	799.3	0.0	799.3	17,380	11,123	0	0	0	0	0	0	0	11,123
Sing Buri	822.5	822.5	0.0	32,600	20,864	8,736	2,755	0	0	9,373	0	0	0
Muang Sing Buri	112.4	112.4	0.0	4,455	2,851	794	386	0	0	1,672	0	0	0
Khai Bang Rachan	88.4	88.4	0.0	3,504	2,242	2,242	0	0	0	0	0	0	0
Tha Chang	34.4	34.4	0.0	1,363	873	873	0	0	0	0	0	0	0
Bang Rachan	190.5	190.5	0.0	7,551	4,832	4,569	0	0	0	264	0	0	0
Phrom Buri	82.5	82.5	0.0	3,270	2,093	208	0	0	0	1,885	0	0	0
In Buri	314.3	314.3	0.0	12,457	7,973	51	2,369	0	0	5,553	0	0	0
Lop Buri	6,199.8	849.5	5,350.3	176,700	113,088	0	14,702	0	0	793	0	0	97,593
Muang Lop Buri	565.6	426.8	138.8	16,120	10,317	0	7,785	0	0	0	0	0	2,532
Khok Samrong	982.5	17.5	965.0	28,002	17,921	0	319	0	0	0	0	0	17,602
Chai Badan	1,253.0	0.0	1,253.0	35,712	22,855	0	0	0	0	0	0	0	22,855
Tha Luang	538.9	0.0	538.9	15,359	9,830	0	0	0	0	0	0	0	9,830
Tha Wung	242.8	242.8	0.0	6,920	4,429	0	3,635	0	0	793	0	0	0
Ban Mi	585.7	162.4	423.3	16,693	10,684	0	2,962	0	0	0	0	0	7,721
Pattana Nikom	517.0	0.0	517.0	14,735	9,430	0	0	0	0	0	0	0	9,430
Sa Boat	304.7	0.0	304.7	8,684	5,558	0	0	0	0	0	0	0	5,558
Khok Charoen	317.1	0.0	317.1	9,038	5,784	0	0	0	0	0	0	0	5,784
Lam San Thi	447.0	0.0	447.0	12,740	8,154	0	0	0	0	0	0	0	8,154
Nang Muang	445.5	0.0	445.5	12,697	8,126	0	0	0	0	0	0	0	8,126
Ang Thong	968.4	888.2	80.2	36,500	23,360	16,910	0	0	0	4,516	0	0	1,935
Muang Ang Thong	102.9	102.0	0.9	3,878	2,482	1,001	0	0	0	1,459	0	0	22
Chaiyo	72.3	72.3	0.0	2,725	1,744	0	0	0	0	1,744	0	0	0
Pa Mok	80.9	80.9	0.0	3,049	1,951	639	0	0	0	1,312	0	0	0
Pho Thong	219.4	212.4	7.0	8,269	5,292	5,124	0	0	0	0	0	0	169
Wiset Chai Chan	224.7	189.3	35.4	8,469	5,420	4,566	0	0	0	0	0	0	854
Samko	86.9	50.0	36.9	3,275	2,096	1,206	0	0	0	0	0	0	890
Sawaengha	181.3	181.3	0.0	6,833	4,373	4,373	0	0	0	0	0	0	0
Ayutthaya	2,556.6	1,907.5	649.1	34,900	22,336	4,003	1,232	3,325	0	1,905	1,987	4,214	5,671
Muang Ayutthaya	130.6	130.6	0.0	1,783	1,141	66	62	292	0	384	336	0	0
Tha Rua	106.2	106.2	0.0	1,450	928	0	0	928	0	0	0	0	0
Nakhorn Luang	198.9	198.9	0.0	2,715	1,738	0	104	1,634	0	0	0	0	0
Bang Sai	150.7	119.3	31.4	2,057	1,317	569	0	0	0	0	0	474	274
Bang Shai	219.7	219.7	0.0	2,999	1,919	733	0	0	0	0	10	1,176	0
Bang Ban	135.3	135.3	0.0	1,847	1,182	290	0	0	0	602	290	0	0
Bang Pahan	121.9	121.9	0.0	1,664	1,065	0	398	163	0	505	0	0	0
Bang Pa-In	229.1	189.1	40.0	3,127	2,002	0	0	0	0	0	1,328	324	349
Ban Phraek	39.1	39.1	0.0	534	342	0	259	0	0	83	0	0	0
Phak Hai	189.0	189.0	0.0	2,580	1,651	1,651	0	0	0	0	0	0	0
Phachi	104.5	0.0	104.5	1,427	913	0	0	0	0	0	0	0	913
Maharat	120.1	120.1	0.0	1,639	1,049	0	410	309	0	330	0	0	0
Lat Bua Luang	199.9	136.9	63.0	2,729	1,746	0	0	0	0	0	0	1,196	550
Wang Noi	219.2	0.0	219.2	2,992	1,915	0	0	0	0	0	0	0	1,915
Sena	205.6	198.9	6.7	2,807	1,796	694	0	0	0	0	0	1,044	59
Ulhai	186.8	2.5	184.3	2,550	1,632	0	0	0	0	0	22	0	1,610
Pathum Thani	1,525.9	485.5	1,040.4	10,700	6,848	0	0	0	0	0	0	2,179	4,669
Muang Pathum Thani	120.2	120.2	0.0	843	539	0	0	0	0	0	0	539	0
Sam Khok	95.0	95.0	0.0	666	426	0	0	0	0	0	0	426	0
Lat Lum Kaeo	188.1	188.1	0.0	1,319	844	0	0	0	0	0	0	844	0
Thanya Buri	112.1	8.7	103.4	785	503	0	0	0	0	0	0	39	464
Lam Luk Ka	297.7	6.0	291.7	2,088	1,336	0	0	0	0	0	0	27	1,309
Klong Laung	299.2	67.5	231.7	2,098	1,343	0	0	0	0	0	0	303	1,040
Nong Sua	413.6	0.0	413.6	2,900	1,856	0	0	0	0	0	0	0	1,856
Nonthaburi	622.3	273.6	348.7	3,400	2,176	0	0	0	0	0	0	957	1,219
Muang Nonthaburi	77.0	42.3	34.7	421	269	0	0	0	0	0	0	148	121
Krual	57.4	0.0	57.4	314	201	0	0	0	0	0	0	0	201
Bang Yai	96.4	25.9	70.5	527	337	0	0	0	0	0	0	91	247
Bang Bua Thong	116.4	116.4	0.0	636	407	0	0	0	0	0	0	407	0
Pak Kret	89.0	89.0	0.0	486	311	0	0	0	0	0	0	311	0
Sai Noi	186.1	0.0	186.1	1,017	651	0	0	0	0	0	0	0	651
Sara Buri	3,576.6	186.3	3,390.3	63,400	40,576	0	294	1,820	0	0	0	0	38,462
Muang Sara Buri	503.8	0.0	503.8	8,931	5,716	0	0	0	0	0	0	0	5,716
Kaeng Khoi	871.1	0.0	871.1	15,441	9,883	0	0	0	0	0	0	0	9,883
Don Phunt	65.6	65.6	0.0	1,163	744	0	248	496	0	0	0	0	0
Ban Mo	279.0	93.7	185.3	4,946	3,165	0	0	1,063	0	0	0	0	2,102
Phra Phutthabat	324.6	0.0	324.6	5,754	3,683	0	0	0	0	0	0	0	3,683
Muak Lek	752.5	0.0	752.5	13,339	8,537	0	0	0	0	0	0	0	8,537
Wihan Daeng	228.8	0.0	228.8	4,056	2,596	0	0	0	0	0	0	0	2,596
Saohai	125.1	0.0	125.1	2,218	1,419	0	0	0	0	0	0	0	1,419
Nong Khae	293.8	0.0	293.8	5,208	3,333	0	0	0	0	0	0	0	3,333
Nong Saeng	97.4	0.0	97.4	1,727	1,105	0	0	0	0	0	0	0	1,105
Nong Don	34.9	27.0	7.9	619	396	0	45	261	0	0	0	0	90
Total	18,741.8	6,037.4	12,704.4	411,900	263,616	33,608	18,982	5,145	714	20,601	1,987	7,349	175,229