JAPAN INTERNATIONAL COOPERATION AGENCY

THE REPUBLIC OF INDONESIA
DIRECTORATE GENERAL OF HUMAN SETTLEMENTS
MINISTRY OF PUBLIC WORKS

BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR THE CONSTRUCTION OF
YOGYAKARTA SEWAGE TREATMENT PLANT
IN
THE REPUBLIC OF INDONESIA

JANUARY 1993

PACIFIC CONSULTANTS INTERNATIONAL

PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a basic design study on the Project for the Construction of Yogyakarta Sewage Treatment Plant and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team headed by Mr. Masashi Kono, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs and constituted by members of Pacific Consultants International (Inc.) for Stage I Survey form July 6 to July 19, 1992.

Moreover, JICA sent to Indonesia the Stage II Survey team constituted by members of Pacific Consultants International (Inc.) from August 20 to September 19, 1992.

The team held discussions with the officials concerned of the Government of Indonesia, and conducted field studies at the study area. After the Stage II Survey team returned to Japan, further studies were made. Then, a mission was sent to Indonesia in order to discuss a draft report and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the teams.

January, 1993

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency

January, 1993

Mr. Kensuke Yanagiya,
President
Japan International Cooperation Agency
Tokyo, Japan

Letter of Transmittal

We are pleased to submit to you the basic design study report on the Project for the Construction of Yogyakarta Sewage Treatment Plant in the Republic of Indonesia.

This study has been made by Pacific Consultants International (Inc.), based on a contract with JICA, from June 26, 1992 to January 20, 1993. Throughout the study, we have taken into full consideration of the present situation in Indonesia, and have planned the most appropriate project in the scheme of Japan's grant aid.

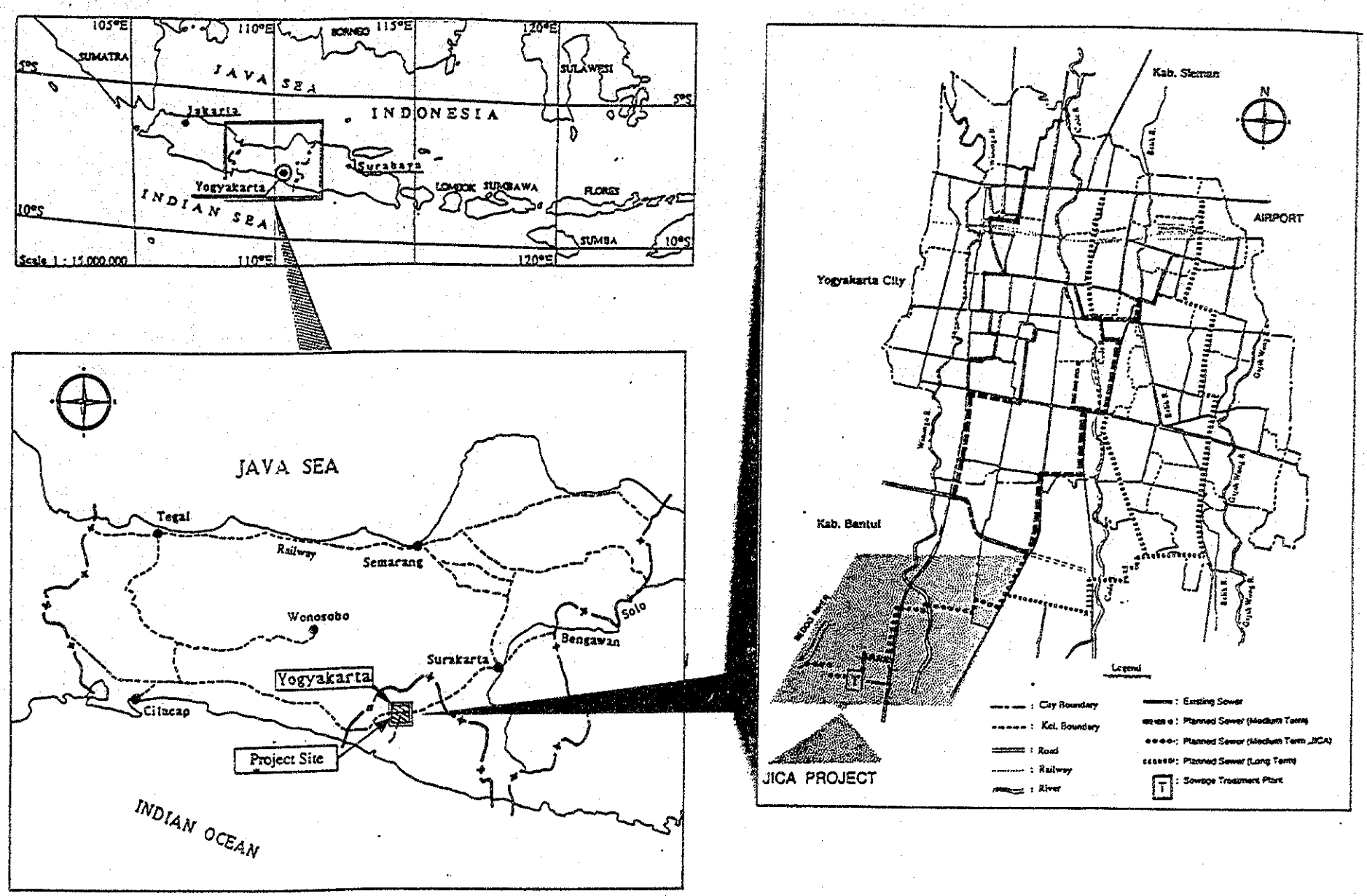
We wish to take this opportunity to express our sincere gratitude to the officials concerned of JICA, the Ministry of Foreign Affairs and the Ministry of Construction. We also wish to express our deep gratitude to the officials concerned of the Ministry of Public Works of the Government of Indonesia, JICA Office in Indonesia, and Embassy of Japan in Indonesia for their close cooperation and assistance during our study.

At last, we hope that this report will be effectively used for the promotion of the project.

Very truly yours,

村田直人

Team leader, Naohito Murata
Basic design study team on
the Project for the Construction of
Yogyakarta Sewage Treatment Plant
Pacific Consultants International (Inc.)



Location Map

SUMMARY

Summary

Yogyakarta City is the capital of Yogyakarta Province, which is one of the 27 provinces of Indonesia. The total population of the city is 413,000, and has developed as one of the representative tourism cities and center of culture in Indonesia.

The city has a sewage pipeline network which was constructed in the colonial age and later expanded by the Provincial Government. However, this sewerage system covers only 14 % of total population and directly discharges collected wastewater to the adjacent rivers without treatment.

As a result, the pollution of rivers is serious, and early construction of a sewage treatment plant is aspired.

On the other hand, the Government of the Republic of Indonesia has prepared the master plan for sewerage development as a part of "Yogyakarta Urban Development Project" (YUDP), in which they established a medium-term plan setting the target at the year 2002 and long-term plan setting the target at the year 2012. In the medium-term plan, it is planned to repair the existing sewer network and increase the number of households connected to the system within the service area in addition to construct new sewage lateral sewers, trunk sewers and a sewage treatment plant.

The Government of Indonesia requested the Government of Japan to provide a grant aid for the construction of sewage treatment plant and a part of the trunk sewers proposed in the medium-term plan. The Government of Japan decided to conduct a preliminary study, and Japan International Cooperation Agency dispatched the study team from October 29 to November 9, 1991. As a result, the adequacy of this project as a subject of the grant aid was confirmed, and the Government of Japan decided to conduct a basic design study. According to this governmental decision, Japan International Cooperation Agency dispatched the study team.

The sewerage master plan of YUDP was completed in February 1992, and the Yogyakarta Provincial Government has been proceeding with the land acquisition for constructing the sewage treatment plant according to the master plan. In parallel with this, the feasibility study for the sewage treatment plant was being conducted by YUDP consultants and was to be completed by June, 1992, including the site selection. On the other hand, the Indonesian Government was requesting Asian Development Bank (ADB) loan for the rehabilitation of existing sewer networks, reinforcement of lateral sewer and construction of new trunk sewer of 11 km on the upstream side.

The field study for the basic design was divided into two stages, namely the stage I field study for confirming the prerequisites of this plan such as the technical feasibility of the sewage treatment plant, the possibility of land acquisition and the possibility of the approval of the ADB loan and the stage II field study for investigating the matters necessary for the basic design.

The stage I study was conducted for 2 weeks from July 6 to July 19, 1992. During this study, the report of the feasibility study for sewage treatment plant was submitted to the study team by staff member of YUDP.

The survey team scrutinized the report, conducted a site investigation on the location and space of selected land, and confirmed its appropriateness. The planned site of the sewage treatment plant is located in the middle of paddy fields in Kabupaten Bantul adjacent to southern Yogyakarta City. It is suitable for the construction of the treatment plant because there are only a small number of dwelling houses in the neighborhood. At the time of the study, 6.2 hectares of land was on the process to be acquired. Also, the survey team discussed and confirmed the details of revised request made by the Government of Indonesia for submission to the Government of Japan. The request includes the construction of the sewage treatment plant (15,500 m^3/day), and installation of approximately 6 km of the trunk sewer connected to the treatment plant and approximately 1.2 km of discharge line. It was agreed that the Government of Indonesia would report the approval result of ADB loan and the result of environmental assessment concerning the construction of the sewage treatment plant to the Japanese Government by the end of November, 1992.

In the stage II field study which was conducted for 31 days from August 20 to September 19, 1992, the survey team made discussions with related officials of the Government of Indonesia, and conducted survey necessary for the basic design including the topographical survey and soil investigation. In this study, the study team confirmed the results of the YUDP feasibility study, checked the relation with the upstream trunk sewer, and selected the route for the discharge line. The planned location for the treatment plant is the same as that of stage I study, but the space is expanded to 6.7 hectares.

As for the sewage treatment system, the team compared "trickling filters with ponds" and "facultative aerated lagoon with maturation pond" and arrived at the conclusion that the facultative aerated lagoon system would be the most suitable. This was the same as the conclusion of the YUDP feasibility study, and it was agreed with the Indonesian side to employ this system.

After coming back to Japan, the study team prepared a draft report of the study on the basic design and JICA dispatched the study team to Indonesia from November 22 to December 1, 1992 to explain the details of the draft report. Final report was prepared based on the discussions with the Indonesian side.

The facilities included in this project are as follows.

No.	Facilities	Contents
1.	Trunk sewer	Underground concrete pipe of down stream side connected to the treatment plant. 1,000 mm diameter x 1,363 m and 1,300 mm diameter x 4,265 m
2.	Sewage treatment plant	Sewage treatment plant by "the facultative aerated lagoon with maturation pond" system. Capacity : 15,500 m^3/day
3.	Discharge line	Treated water discharge line Underground concrete pipe: 800 mm diameter x 649 m and open channel: 1.4 m width x 1.0 m high x 528 m

The above facilities are constructed by the Japan's Grant Aid and the implementation of the project is carried out by the Directorate General of Human Settlements, the Ministry of Public Works.

The sewage treatment plant is designed for the sewage volume at the year 2002 which is the target year of YUDP medium-term plan, and the service area is 1,330 hectares including Yogyakarta City and a part of adjacent Kabupaten Sleman and Kabupaten Bantul; the served population is 110,000. In designing the treatment facility, the study team considered past performance of similar facilities, technical level of operators, temperature conditions (tropical climate), environmental standards in Indonesia and running cost as well as the easiness of operation and maintenance. After comparing with other treatment methods, and as a result of discussion with the related officials of the Government of Indonesia, the study team decided to adopt facultative aerated lagoon system. BOD concentration of treated wastewater is 30 - 40 mg/l.

The downstream trunk sewer of about 6 km is designed for the planned wastewater discharge at the year 2012. Gravity flow method is employed for the entire section of trunk sewer

taking an advantage of topographic feature of the site. The diameters of pipes are 1,000 mm and 1,300 mm, and the pipes are buried under the road in principle. This trunk sewer traverses the Winongo River by siphon structure.

The treated water is discharged to the adjacent Bedog River. Discharge line is approximately 1.2 km in total. Part of the discharge line is designed to be a type of open channel to drain the water from near-by paddy fields.

At present, the sewerage facilities in Yogyakarta City are operated and managed by Wastewater Section of Cleaning and Park Department. Fourty-three (43) staff members of the section are engaged in maintenance and management of pipe line, operation of gate for flushing water and collection of tariff. The sewage treatment plant and sewer pipes of the medium-term plan will be managed by a new sewerage management organization under the Provincial Government. In the basic design, the number of personnel necessary for the new organization to be engaged in the operation and management of sewerage facilities is proposed. The number of personnel required is 88 including those necessary for maintenance of pipe line, fee collection, operation and maintenance of treatment plant.

Eight (8) months are necessary for execution of detailed design and tendering, and 24 months for construction.

Beneficial effects of this project are as follows.

(1) Increase of sewerage dissemination rate

In Yogyakarta City, the sewerage dissemination rate will increase from present 14 % to 22 % at the time of medium-term plan and to 53 % at the time of long-term plan.

(2) Purification of rivers and prevention of water born diseases

River water in the project area is much polluted due to untreated wastewater discharge. The water pollution will be alleviated to a great extent. Groundwater is also much contaminated due to human waste disposal into underground by septic tank/leaching pit. People are afflicted with waterborne diseases due to domestic use of the contaminated groundwater (85 % of the residents are now using shallow wells). Contraction of the waterborne diseases will be greatly mitigated.

(3) Influential effect of the installation of full-scaled sewage treatment system to other cities, and improvement of hygiene awareness of residents

(4) Bringing up of sewerage system technicians through the operation of treatment plant

As shown the above, this project will much contribute to the betterment of living environment of local residents. It is considered appropriate to provide a grant aid to this plan.

Also as stated before, the Government of Indoensia is applying for ADB loan for installation of upstream lateral sewers and trunk sewers including the repair of existing sewer lines. The negotication with ADB was already conducted and the loan agreement was scheduled to be signed in early December, 1992.

And for implementation of this project, the following actions by the Government of Indonesia are required to be taken without any delay.

(1) The land acquisition of the project site and the land clearance for the treatment plant before the start of construction

(2) Acquisition of approvals from the authorities concerned regarding the construction of trunk sewer and discharge line

(3) Electric and water supply to the treatment plant

(4) Installation and supply of incidental out door works such as gardening, fencing, gate and exterior lighting within and around the site

(5) Supply of telephone and general furnitures for the control house in the treatment plant

Furthermore, the following measures are recommended for the new management organization to maintain the sound operation of the sewerage facilities and the financial soundness as a public corporation.

(1) Elimination of illegal connection, and registration of pipe connection

(2) Improvement of tariff collection rate

(3) Preparation of replacement plan for the equipment of treatment plant and acquisition of the budget required

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CHAPTER 1 INTRODUCTION

Chapter 1 INTRODUCTION

The Government of the Republic of Indonesia requested the Government of Japan to provide a grant aid for the construction of sewage treatment plant in Yogyakarta. In response to this request, the Government of Japan decided to conduct a preliminary study, and Japan International Cooperation Agency (JICA) dispatched the preliminary study team headed by Mr. Ikufumi TOMIMOTO, First Basic Design Study Division, Grant Aid Study and Design Department of JICA to the project site from October 29 to November 9, 1991. As a result, the adequacy of this project as the subject of grant aid was confirmed, and the Government of Japan decided to conduct the basic design study, and JICA dispatched the study team.

With the assistance of the Government of Switzerland, on the other hand, the Government of Indonesia made a master plan of sewerage development for Yogyakarta City and its vicinity (final report was completed in February 1992) as a part of "Yogyakarta Urban Development Project" (YUDP), and had been planning to complete the feasibility study for the sewerage facilities including the trunk sewer and sewage treatment plant of this project by June, 1992.

The Yogyakarta Provincial Government had been proceeding with the selection and acquisition of land for the plant construction according to YUDP master plan. Therefore, the field study for the basic design was conducted by dividing it into two stages as described in the following.

The Stage I Study Team headed by Mr. Masashi KONO, Assistant Director, Grant Aid Division, Economic Cooperation Bureau, Ministry of Foreign Affairs, visited Indonesia for 14 days from July 6 to July 19, 1992, discussed with related officials of the Government of Indonesia and conducted a site reconnaissance. As a result, the details of request for trunk sewer and treatment plant have become clear, and the study team was able to confirm the prospective site for the plant construction. Furthermore, it was agreed that the Government of Indonesia would submit to the Government of Japan a report on the approval result of ADB loan (Indonesian Government was applying for ADB loan for the installation of upstream side trunk sewer of 11 km and lateral sewer) and the result of environmental assessment by the end of November, 1992.

The Stage II Study Team headed by Mr. Naohito MURATA, Director of Pacific Consultants International (Inc.), discussed with related officials of the Government of Indonesia and conducted field studies necessary for the basic design including topographical survey and soil investigation.

The results of site survey and basic agreements obtained by the discussion with the officials of the Government of Indonesia were summarized in the minutes of discussions. The minutes of discussions of stage I study were executed and signed on July 17, 1992 by Mr. Masashi KONO, Mr. Rachmadi B. S., Director General of Human Settlement, Ministry of Public Works, the Republic of Indonesia, and Mr. Suprastowo, Provincial Executive Secretary, D.I. Yogyakarta; the minutes of discussions of stage II study were executed and signed on September 16, 1992 by Mr. Naohito MURATA, Mr. Soeratmo Notodipoero, Secretary for Directorate General of Human Settlement, Ministry of Public Works, the Republic of Indonesia and Mr. Bondan Herimanislamet, Head of Planning and Development Agency, D.I. Yogyakarta Province.

After coming back to Japan, the study team analyzed the data obtained by the site survey and prepared draft final report of the basic design on this project.

JICA dispatched the mission to Indonesia for explanation of the Draft Final Report of the basic design, headed by Mr. Hideo MIYAMOTO, staff of First Basic Design Study Division, Grant Aid Study and Design Department, JICA, from November 22 to December 1, 1992.

The mission explained the result of the basic design and discussed with the officials of the Government of Indonesia.

The contents of the Draft Report were accepted by the Government of Indonesia and the mission also confirmed the results of the application of ADB loan, environmental impact assessment and the land acquisition of the project site.

As for ADB loan, the negotiation was already conducted and the loan agreement was scheduled to be signed in early December, 1992.

Environmental impact assessment was evaluated by the EIA Provincial Commission and approved by the Governor of Yogyakarta Province on November 23, 1992.

The land acquisition was in progress and scheduled to be completed in early December, 1992.

The minutes were signed on November 27, 1992 by Mr. Hideo MIYAMOTO, Mr. Sugeng Kartodihardjo, Head of Public Works Office, Province of D. I Yogyakarta and Mr. Rachmadi B.S.

Member of the study team, survey schedule and list of related parties of Indonesia are attached to this report as Appendices.

CHAPTER 2 BACKGROUND OF THE PROJECT

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2-1 Outline of the Sewerage Development and Management in Yogyakarta City

(1) Sewerage Development by the Government of Indonesia

1) Five Year Development Plan

The Government of Indonesia has been implementing Five-Year Development Plans (Rencana Pembangunan Lima Tahun) since 1969. In implementing each 5-year plan, the Government established general guidelines. In the 5th 5-year plan which started in 1989, the Government established the following general guidelines for the urban development sector aiming at the nation's "take-off" from 1994.

(i) The urban infrastructures shall be planned, constructed, and maintained under the responsibility of local government.

(ii) Centralization shall be avoided and each sector shall be well coordinated in establishing policies for urban development and determining the priority of investment.

(iii) The capacity of local government shall be improved to attain the optimum use of man-power and financial resources in the development of urban infrastructures.

(iv) Training shall be conducted and necessary technical guidelines shall be established to improve the technical level of staff members engaged in the urban development plans.

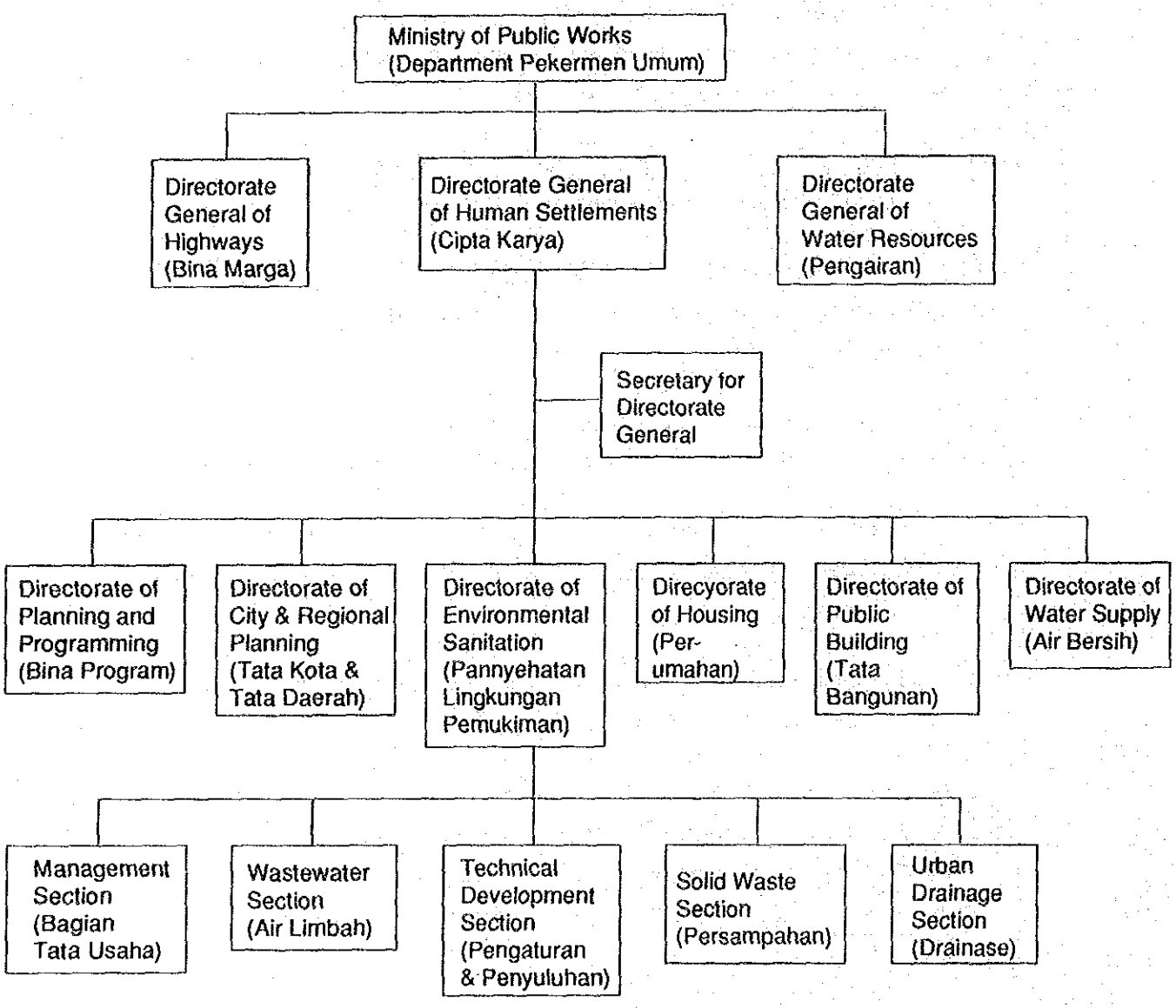
(v) Well coordination shall be maintained among the sectors in order to implement urban development efficiently and effectively.

Development plans for environmental sanitation are prepared according to the above general guidelines. The environmental sanitation sector covers wastewater disposal, urban drainage and solid waste disposal. It aims at the improvement and enhancement of public hygiene not only in the urban area but also in the rural area.

In the wastewater disposal sector, it is planned to construct on-site facilities (facilities to treat human wastes such as septic tank) at 200 cities and 5,000 villages, and to construct off-site facilities (sewerage facilities) only at the large cities considering the recovery of expenses.

2) Division of central government in charge of sewerage

The division of Central Government in charge of sewerage is Wastewater Section (Air Limbah), Directorate of Environmental Sanitation, Directorate General of Human Settlements (Cipta Karya), Ministry of Public Works. Besides this, the Directorate of Environmental Sanitation has Management, Technical Development, Solid Waste, and Urban Drainage Sections. The mission of the Wastewater Section is to provide technical advice to the sewerage projects and human waste treatment in all the cities (Kotamadya) and prefectures (Kabupaten) throughout the nation.



(2) Sewage Facilities in Indonesia

The dissemination rate of toilet in Indonesia is around 90 % (to the population) at urban areas including both on-site and off-site sanitation facilities and others are directly disposed to rivers, etc.

The sewage treatment plants are limited to those such as aerated lagoon in Jakarta City, oxidation ditch in Kab. Tangelan, and pilot plant of trickling filters in Yogyakarta City and household package treatment plants of some large scaled hotels, etc.

In a part of cities such as Yogyakarta, Semarang, Bandung, and Surakarta, the sewers of flushing system which were constructed in the colonial age are still used at present, but they were constructed only for the purpose to discharge the waste water, and therefore, the wastewater is directly discharged to rivers without being treated.

(3) Sewerage Development and Management in Yogyakarta City

1) The existing sewer system in Yogyakarta City is operated and managed by Wastewater Section of Cleaning and Park Department (DKP). The management includes the maintenance of sewer networks and collection of tariff, and 43 staff members are engaged in this section. The revenue from tariff collection shares only 19 % of total expenditure and the operation of this section is largely dependent on the financial assistance of Provincial Government.

2) The sewerage project in YUDP medium-term plan is implemented under the administration of Central Government (Directorate General of Human Settlements, Ministry of Public Works), but the Planning and Development Agency (BAPPEDA) of Provincial Government and related organizations have been participating in this project from the stage of planning. The new sewerage facilities will be managed by a new organization under the administration of the Provincial government, because the facilities cover not only Yogyakarta City but also a part of Kabupaten Bantul and Kabupaten Sleman.

(4) Sewerage Facilities in Yogyakarta City

In Yogyakarta City and its adjacent urban areas, 88 % of total population are using toilets, of which 81 % are using toilet with septic tank/leaching pit, and remaining 7 % are using the toilet connected to sewers.

Septic tanks/leaching pits treat only the waste water from toilets and gray water from kitchen, washing and bathing is discharged to the drains and rivers without any treatment.

In the existing sewer system, both the toilet waste and gray water are collected into the sewer lines. It is separated from the rainwater drainage system. However, the collected sewage is discharged to rivers and irrigation channels without being treated.

Therefore, contamination is progressing in the river water and underground water which are used for drinking. It is necessary to urgently construct the sewer networks and sewage treatment plant from the viewpoint of environmental sanitation.

2-2 Outline of the Request

(1) Outline of Original Request and Result of Preliminary Study

1) The original request from the Government of Indonesia is as follows:

(i) Project area

As shown in Fig. 2-1, the project area is 1,050 ha located between Winongo River and Code River, and the sewerage service area is to be expanded from present 540 ha to 750 ha by the year 2005.

(ii) Outline of the request

The included works are construction of sewage treatment plant, pumping station and pressured pipeline.

(a) Sewage treatment plant
Capacity: 11,200 m^3/day

(b) Pumping station
Capacity: 2,080 m^3/day

(c) Pressured pipeline
1,500 mm dia pipe: 2,000 m

2) Results of preliminary study

The followings are the results of study made by the preliminary study team during the period from October 29 to November 9, 1991.

(i) Sewerage facilities are indispensable for urban life. The requested project is given high priority in Indonesia to improve the existing unsanitary conditions and polluted environments of the project area. It is judged to be worthy to study the grant aid for this project.

(ii) F/S for sewage treatment plant is now being implemented based on the YUDP sewerage master plan. It is necessary to further discuss the project request including the location of treatment plant.

(2) Stage I Site Survey and Revised Request

1) During the stage I site survey carried out from July 6 to 19, 1992, F/S report for sewage treatment plant prepared by the YUDP was submitted to the study team, and revised request was presented from the Govenment of Indonesia to the Government of Japan. After discussing with related officials of the Govenment of Indonesia about the revised request, it was agreed to conduct basic design study on the following conditions.

(i) Project area

The service area of sewerage facilities will be 1,330 ha for the medium-term plan targeting at 2002, and 2,413 ha for the long-term plan targeting at 2012. (Refer to Fig. 2-2).
This project area includes Yogyakarta City (Kotamadya) and a part of adjacent Kabupaten Sleman and Kabupaten Bantul.

(ii) Outline of the request

The included works are construction of sewage treatment plant, trunk sewer and discharge line

(a) Sewage treatment plant
Capacity: 15,500 m^3/day

(b) Trunk sewer:
6 km length connected to the treatment plant (gravity flow system)

(c) Treated wastewater discharge line
1.2 km from the sewage treatment plant to Bedog River

2) At the time of stage I site survey, additional study of F/S was still in progress, and the capacity of sewage treatment plant was scheduled to be finalized at the stage II site survey. Thereafter in the discussion made in the stage II site survey, it was confirmed that the capacity should be 15,500 m^3/day.

3) The study team surveyed the proposed site of sewage treatment plant, and confirmed that both the location conditions and space were appropriate.

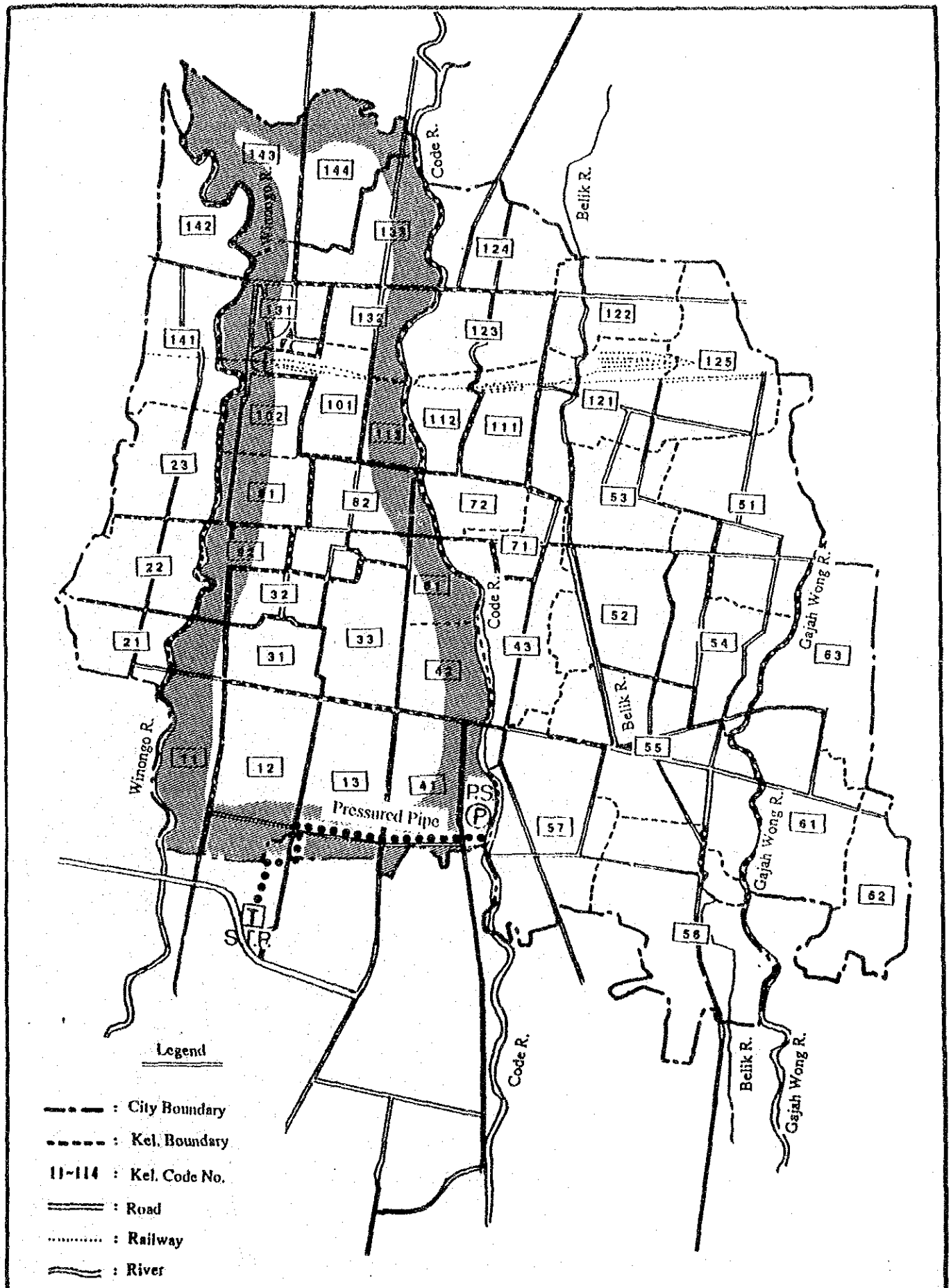


Fig. 2-1 Service Area of Original Request

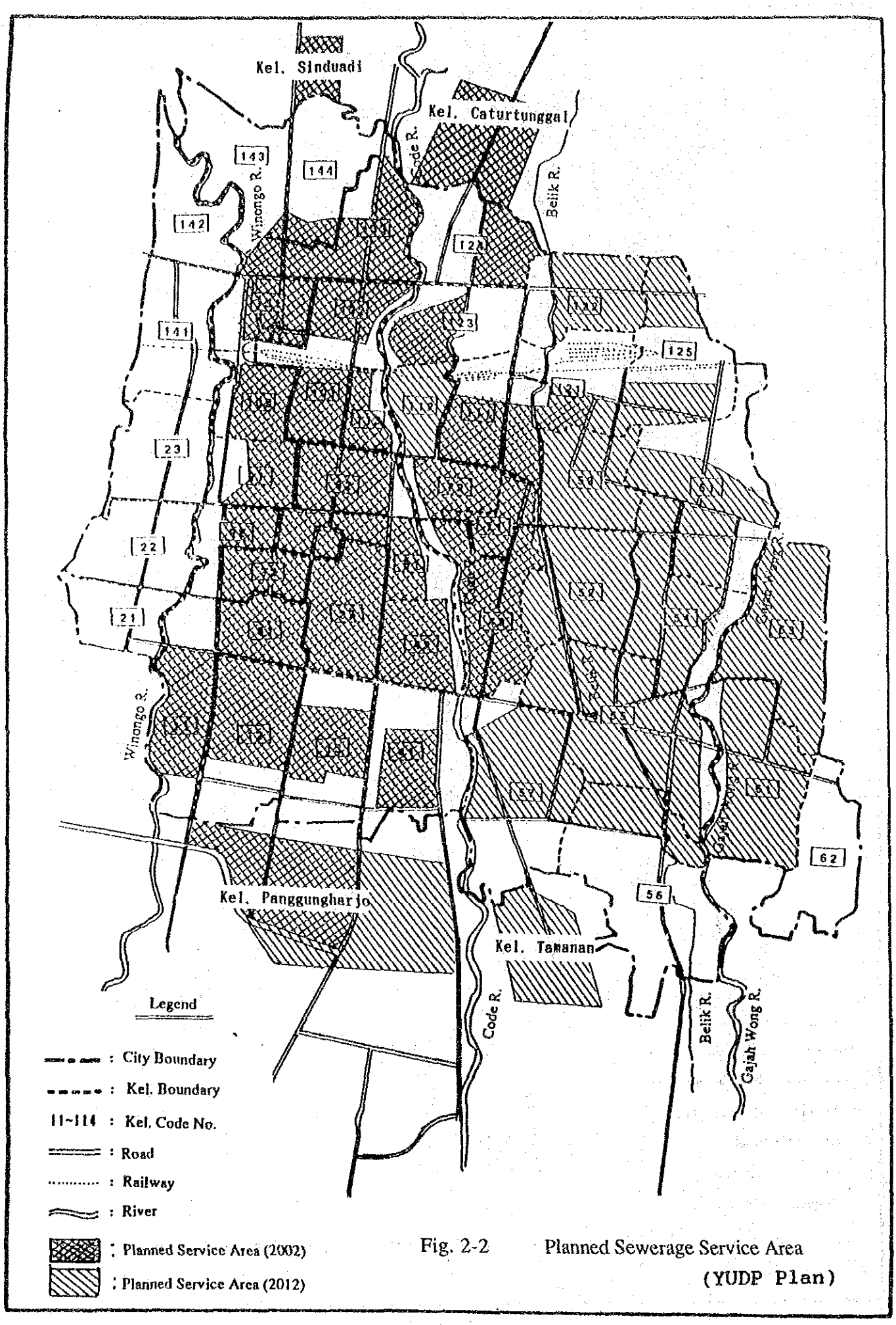


Fig. 2-2 Planned Sewerage Service Area (YUDP Plan)