CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS

CHAPTER 5 ENVIRONMENTAL AND SOCIAL IMPACTS

5.1 Environmental and Social Impact Analysis

5.1.1 Natural Environment

The study area covers 204 km^2 as a whole catchment area of Garang River, of which most of the part lie in the jurisdiction of Semarang City (Kotamadya), so the area has been already developed in terms of social infrastructure due to the predominant influence of urban environment. In other word, natural forest no longer exists in the study area to provide for wild animals' habitat or refuge. Regenerated woods can be seen instead after natural vegetation covers have been intensively eliminated by cutting trees and fires. Under present environment, there is no endangered species of fauna nor protected flora. This section, therefore, presents general characteristics of river environment as a result of study and analysis.

Water Quality

Water sampling was carried out on October 27, 1997. Sampling locations are the same as those selected in June, 1992 for the Feasibility Study. The total number of samples is 15, out of which 10 are from Garang River/West Floodway and 5 are from Semarang River (refer to Fig.5.1.1). Water quality test was conducted in the laboratory of Diponegoro University for physical, chemical and microbiological analysis. The test results are given in Table 5.1.1. According to the Government regulation No.20 established in 1990, there are four(4) categories on Water Quality Standard as described below;

Standard A: Raw water which can be used for human consumption without treatment
Standard B: Raw water which needs to be properly treated for drinking
Standard C: Water to be used for fishery
Standard D: Water to be used for agriculture or industry

Knowing the fact that Garang River is the major water source for the citizen of Semarang City, Standard B can be applicable to the water of Garang River, since PDAM water intake facility is located upstream of Simongan Weir and nobody uses them as source of domestic water supply. Waters taken from KG7 to KG10, lower part from Simongan Weir, are saline because river water is mixed with tidal sea water.

Test results are considered to represent water quality of the rivers in dry, thereby sampling was carried out in drought-stricken period. According to the results, surface-water in the

upper reaches from Simongan Weir meets requirements of Standard B to some extent. However, it is absolutely necessary to make continuous efforts to improve water quality in line with Clean River Project (Proyek Kali Bersih: PROKASIH). Semarang River is playing double functions as a main urban drainage channel as well as sewerage canal, so that the water is so polluted due to mainly discharge of domestic waste into the river. The water pollution will certainly get worse year by year unless proper measures are taken at an early stage possible.

Further details on water quality are described as follows;

(1) Biodegradable Organics

BOD, an organic pollution indicator, shows 4.4 mg/*l* in the upper reaches from Simongan Weir and 5.1 mg/*l* in the lower reaches. In the meantime COD values are 14.8 mg/*l* and 25.6 mg/*l* respectively, showing a remarkable pollution increase between KG6 and KG7 on Garang River, which may be attributable to the inflow of large volume of domestic wastewater in the lower part from the Weir. With regard to DO, it is over the standard value of 6 mg/*l* in almost all upstream locations, except KG6 where water seems to be less polluted in terms of oxygen demand. It is rather inconsistent with BOD and COD in this regard, but the reason is not explainable. It should be noted that no oxygen is contained in the water of both KG9 and KG10. However, DO value may easily fluctuate in one single day in the tidal area which is stretching from the river mouth to KG7.

BOD, COD and DO at each sampling location are graphically shown in Fig.5.1.2. Based on the study conducted by JICA Study Team in June, 1992, water quality degradation can be observed as compared with new data of 1997 (refer to Fig.5.1.3). It shows remarkable changes in water quality causing Semarang, Asin and Baru rivers to the development of septic conditions. Meanwhile, water in the upstream portion of Garang River is slightly worsened in terms of BOD during the last five years, but it is still on acceptable level to be used for source of water supply.

According to sample analysis data from November 1993 to October 1997 provided by Regional Government Water Supply Enterprise (PDAM), water quality at intake location tends to be somewhat degraded in terms of BOD. On the contrary, DO concentration is gradually improved in recent years (refer to Fig.5.1.4). There is something contradictive because these two parameters have trade-off relations to

each other. The reason remains unknown. Nevertheless, both of them still satisfy PDAM standards describing as 6 mg/*l* for BOD and 3 mg/*l* for DO.

(2) Heavy Metals

Study includes analysis of such parameters as Cd, Zn, Pb, Cr and Cu. Garang River water is characteristically represented by high concentration of Cd in the lower part from Simongan Weir. Pb is, however, detected in both upper and lower reaches. Content of these toxic substances are mainly attributed to the wastewater discharge from industrial area. Pollution source may be identified as dry cell, paint or paint using factories. Generally heavy metal concentration tends to be higher in lower reaches, so that special attention needs to be paid to the fact that Pb concentration is more than five times as high as standard value of 0.1 mg/*l* at KG6 where PDAM water intake is located nearby.

The test results show that there seems to be no significant presence of Zn, Cr and Cu. It is, however, important to keep watch on water quality because heavy metal concentration may vary from time to time and depending on regional economy. According to PDAM weekly-based record for 1996, Cd has been constantly detected as a result of analysis of intake water and its value is frequently over the standard.

(3) Nutrients

Nitrogen and phosphorus are essential nutrients for the growth of undesirable aquatic environment which may result in water quality deterioration and eutrophication. Algal activity can be controlled by such nutrients concentration as dissolved inorganic phosphorus (orthophosphate: PO_4-P) and ammonia nitrogen (NH_4-N) or nitrate nitrogen (NO_3-N). These are mainly contained in domestic wastewater discharge.

Although there is no specific requirements for PO_4-P under Water Quality Standard, it represents high concentration (4.7 mg/*l*) at KG5 where dense residential areas are extended on both sides of Garang River. Nitrogen concentration is slightly high in the form of NO_2-N, at locations of KG7 and KG8 on West Floodway.

(4) Coliform

There is no location to satisfy standards as a result of sample analysis. Total

coliform, expressed in number of cells in 100 ml of water, is fully dominated by fecal coliform in the upper reaches of Garang River which is currently being used for the source of water supply to the city. The test results show obviously high values, if compared to the standards, showing 10,000 cells for total coliform and 2,000 cells for fecal coliform. For example, at KG5 and KG6 near the PDAM water intake, coliform organisms are exceeding $24x10^4$ and $24x10^6$ respectively.

Even at the location KG1 in proposed reservoir area, the situation remains undesirable because bacteriological parameters still represent more than the standard value. The bacteria of total coliform group is, for instance, nearly 5 times higher than the allowable limit. This value is, however, equivalent to 23 times more than the standard in terms of fecal coliform group. Echericia coli, which is common organism found in human feces, has been identified as predominant pathogenic bacteria. It should be noted that there are 12 villages with nearly 30,000 people living around and upstream of the future reservoir site.

Aquatic Biota

For further consideration of river environment, following biological study needs to be carried out to be aware of present aquatic ecosystem.

(1) Plankton

Biological characteristics of the water body can be shown by the abundance and diversity of plankton as shown in Table 5.1.2. Constituents of fitoplankton are identified as Chlorophyta, Chrysophyta, Cyanophyta, Euglenophyta and Bacillariophyta. In general, the water body in low flow period may provide micro-flora or algae with preferable life conditions. Algae are important microorganism with respect to water quality because they will form a symbiotic relationship with bacteria. In this sense the population (total individu/*l*) seems to be high as a result of laboratory analysis. It is probably explained in such a way that sampling was carried out in mid-dry season. Zooplankton, primary consumer of fitoplankton, consists of such genus as Ciliophora, Rhizopoda, Rotatoria and so on.

In judging aquatic environment, diversity index (H') can be applied. This is calculated based upon total individu and species by Shannon-Weaver method. According to Lee et al. criteria, 1978, the significance of diversity index can be divided into following 4 categories;

H'> 2.00 : lightly polluted ~ not polluted
H': 1.51~2.00 : moderately ~ lightly polluted
H': 1.00~1.50 : heavily ~ moderately polluted
H'< 1.00 : heavily polluted

Water in the proposed reservoir area is considered to be desirable quality for aquatic life as it shows high diversity index of 2.58, supported by high evenness index which is nearly 1. Attention should be paid to the appearance of Chrysophyta which may cause water bloom when multiplied in the reservoir water. In the upstream portion of Garang River, water quality is still satisfactory level in terms of presence of algal species. In the downstream portion, however, it is significantly worsened due to the organic pollution. The analysis test shows that total individu is jumped up to tens of thousands and diversity index falls to 0.88~1.31. Representative algal species found in this portion are known as organic pollution indicators such as Oscillatoria, Diatome, Cyclotella, Chlorococcum and Batrydiopsys.

(2) Benthos

Benthos is considered to represent general characteristics of stream-bottom ecosystem. The abundance and diversity of benthos are given in Table 5.1.3 as a result of analysis test. The presence of total number of individu of Tubifex sp, genus Oligochaeta is remarkable in the location KG6. This species is usually predominant in organically polluted bottom deposits. However, it is noted that many other groups and species of aquatic life can also be found in the same location, so that KG6 is supposed to be an unique site providing more desirable ecosystem compared with others in terms of habitat suitability. In the meantime, in the downstream of Simongan Weir, the stream bottom is likely unsuitable for aquatic habitat, though a small number of Bilvalvia and Crustacea are found in KG10.

(3) Nekton

The study was carried out by hearing of local people and some biologists of Diponegoro University in order to identify fish species living in the river. The report in this section is, therefore, not based on the observation, and total individu of each species remain unknow as a result. Habitat suitability varies depending on water quality and river structure. Fish species found in the upstream of Simongan Weir are obviously different from those in the downstream. General characteristics of aquatic

habitat for fishes are summarized as follows;

(a) The river channel is split up into two water areas with different ecosystems by the Weir, freshwater in upstream section and brackishwater in downstream section, which inhibits fishes from anadroming.

(b) Banks are not lined with concrete, and bottom sediment consists of mainly sand and gravel in the upper portion and sand and mud in the lower portion.

(c) There are remarkable changes in river discharge between flood period and drought period. It should be considered that flow rate is extremely low in dry season as water hardly overflows the Weir.

(d) Aquatic plants can be found in some locations upstream which may have a function to provide fishes with spawning places.

(e) River water quality is deteriorated due to the discharge of domestic, commercial and industrial waste.

(f) The river will play a different role as sand quarry site in the upper reaches of Garang River when water level is low. However, this activity definitely leads to a significant impact on aquatic habitat as well as fish-spawning areas.

Under such river environment, following fishes can be listed as identifiable species in both upstream and downstream of the river;

Upstream (Freshwater)		Downstream (Brackishwater)	
(Local Name)	(Scientific Name)	(Local Name)	(Scientific Name)
Kutuk	Ophiocephallus striatus	Lundu	Mystus sp.
Lele	Clanas batrachus	Kutuk	Ophiocephallus striatus
Bader	Puntius sp.	Bloso	-
Wader	Rasbora sp.	Mujaer	Tillapia mossambica
Cethul	Poecilia reticulata		

At KG9 and KG10 located near river mouth where water is more polluted, only two species such as Lundu and Kutuk can be found at high tide. Lundu could be observed in sea water and brackishwater even under undesirable conditions in terms of water quality, whereas Kutuk has its own habitat in both freshwater and brackishwater.

(4) Aquatic Plant

Study was conducted on February 5 and 6, 1998, in mid-wet season, and thereby the rain causes the river to high water. For the growth of plants, an adequate environment is needed to satisfy basic conditions such as light, water and vegetative soil. In addition, it should be stressed that these plants are vulnerable to flooding. As a result of the study, several species of aquatic plants were identified along the river downstream of Simongan Weir. However, some of these plants could be observed in upper basin, too during dry season. Following five(5) species grown at some locations not affected by the flow can be found in the field observation.

Local Name	Scientific Name	Location
Kangkung	Ipomoea aquatica	KG7,8,9 and CS1,2,3,4,5
Krema	Jussieua repens	KG7
Kremah	Alternanthera sessilis	KG7,8,9,10 and CS1,2,3,4,5
Eceng gondok	Eichhornia crassipes	KG7,8,9,10 and CS3
Wlingi	Cyperus sp	KG10

Common characteristics of the above aquatic plants may be described as they grow on rich organic soil and resist brackish water, except Eceng gondok which is known as a floating plant. On the other hand, there are only three species that can be seen on urban river sides.

Sediment Analysis

Sediment samples were taken from five(5) selected locations on Garang River and also from five locations along urban rivers to examine heavy metals concentration. The analysis results are shown in Table 5.1.4. Heavy metals found in bottom sediment are likely to be deposits after soluble metals have been absorbed by soil particles and subsequently settled. They also tend to be more concentrated in the sediment of organic compounds. Therefore, heavy metals concentration will become higher in the lower basin where water quality is degraded by receiving waste discharge. In consequence, it can be understood that metal content values at KG6 are generally much higher as compared with those of other locations, because the flow is once blocked by the Weir and so sediment is accumulated thereby.

In Indonesia, there is no specific standard for heavy metals concentration for sediment, so that Japanese standard for industrial wastes for marine disposal as shown below may be applicable to the environmental assessment in this regard.

Parameter	Allowable Limit (mg/kg)
Cu	70
Cr	25 *
Cd	5
Zn	450
Pb	50

* Value is expressed for hexavalent chromium

According to the above standard, heavy metal content at each sampling location on Garang River is still in allowable limit. However, attention should be paid to the urban rivers as high values of Cu, Zn, Pb are detected at CS1(Asin), CS4(Semarang) and CS5(Baru). High concentration of these hazardous substances are probably found at every location in Asin and Baru rivers and between Gajah Mada street and a railway bridge along Semarang River (refer to Fig.5.1.5).

Small soil particles gradually settle as they absorb dissolved organic and inorganic compounds in the water. This may lead to the increase of heavy metal content in bottom deposit. Comparison of heavy metal concentration between water and sediment can be referred to Fig.5.1.6. It shows extremely high values for the sediment compared to the water. For example, Cu content of Garang River sediment is 2,500~6,300 times much higher than that of water, while Cr content is 330~740 times. The same comparison is made for Cd, Zn and Pb, and these are figured out at 22~380, 12,000~28,000 and 39~320 times respectively.

5.1.2 Social Environment

Basic Consideration

Social environment involves numerous factors not associated with the physical, chemical and biological concerns. It should be more descriptive of human relationships and interactions and, therefore, include in-depth information on social and economic activities in project-affected areas. In discussing these issues, all available information need to be assembled and compiled in an effort to predict significant impacts for the potential changes resulting from project implementation. Considering project components and characteristics, basic approach to social environmental study should be made to take following factors into account, and study output will facilitate subsequent works to analyze social impacts.

(1) Population characteristics in project area, including number of direct and indirect project-affected households.

(2) Employment and unemployment patterns, including occupational distribution and location and manpower availability.

(3) Land use patterns, ownership and covering areas.

(4) Housing characteristics, including types of housing occupancy levels, age and present condition of housing.

(5) Land values based on Tax Object Selling Value (Nilai Jual Objek Pajak : NJOP).

(6) Evaluation of house, agricultural products and other assets values.

(7) Health and social services, including water supply, wastewater discharge system, solid waste collection and disposal, and utilities.

(8) Tourism and recreational opportunities, including monument preservation.

(9) Community's attitudes and public awareness of the project.

Project-affected Area

So far neither house evacuation nor large-scaled land acquisition is required due to Garang River improvement, but it might affect both the land development area on the right bank in the river mouth of West Floodway and a small piece of land on the right bank at Tugu Suharto area. The privet land developers have been undertaking land reclamation in the coastal area on both sides of river mouth. The proposed dike runs along the right river bank, so some area have to be purchased. Regarding the Tugu Suharto area, there is a monument tower at flood-prone area near the confluence of Garang-Kreo rivers, so that it is desirable to transfer this symbolic tower to the safety place if land is available. This question still remains unclear whether the monument can be relocated to some appropriate place.

The river improvement works include demolition of existing Simongan Weir to be replaced by new one. This old structure constructed in Dutch colonial days deserves to be preserved as an historical monument for future generation. It is recommended that a piece of the 100-year aged structure be exhibited at the museum. The museum is believed to be constructed in or around Goa Kreo park.

Tugu Suharto Area for River Improvement

Study was conducted by means of questionnaire to provide basic materials for the prediction of social impacts and its assessment. In this stage it is still difficult to define the border of area in relation to land acquisition, so that samples were carefully chosen from families

representing socio-economic environment of the project-affected locations. Details of the study outcome for each area are described as follows:

(1) General Information

Number of samples is 25 selected from potential project-affected area on the right bank at the confluence with Kreo River. There seems to be no house evacuation due to the river improvement works. Educational background of respondents is relatively high compared to other two areas described in the following sub-sections, as it includes 5 senior high school graduates (SLTA) and 2 university graduates.

An average family consists of 4 or 5 members and large family is hardly seen. Out of the 25 selected families, 17 are content with present living environment.

(2) Home Economy

Many people are engaged in private sector, but various income sources are considered to support their families as they dedicate themselves to the different types of work such as construction worker, clerk, Government employee, industry worker , peddler and so on.

15 people or 60 % of all answerers earn less than Rp.200,000 a month. Among them 8 are supposed to be the most common low income class of between Rp.150,000 and Rp.200,000, whereas 8 others are the common middle class of between Rp.300,000 and Rp.500,000. With respect to monthly expenditure, 15 families spend not more than Rp.200,000, and the most common spending amount is Rp.100,000 to Rp.150,000 represented by 7 families. There are 4 families who can afford to spend more than Rp.300,000. Monthly basis earning and spending are graphically shown in Fig.5.1.7.

The amount of money spent on food is from Rp.75,000 to Rp.125,000 for the majority of respondents. The situation is further described in such a way that 20 respondents (80 %) are paying between Rp.26,000 and Rp.150,000 for food. On the other hand, education and transportation expenses have also large shares of spending. Although 9 families spend less than Rp.25,000/month for education, 6 others need to pay Rp.26,000 to Rp.50,000. And nearly same expenses are required for transportation, too.

(3) Land and Housing

As a result of survey it was shown that 22 respondents are owners of property and 3 others are renters, one from the third person and two from the relative. Area of land is relatively spacious as it is 125 m^2 or more (52 %). Those who own the land of less than 100 m^2 are only 8 families (32 %). Common floor space of a house is to be between 50 m^2 and 100 m^2 and there are 6 houses (24 %) with more than 100 m^2 of building superficies. Details are given in the following table.

LAND AND HOUSE SIZE

Area (m2)	Land		House	
	No.of Families	%	No.of Families	%
< 25	1	4.0	1	4.0
25 ~ 50	3	12.0	5	20.0
51 ~ 75	2	8.0	11	44.0
76 ~ 100	2	8.0	2	8.0
101 ~ 125	4	16.0	3	12.0
126 ~ 150	6	24.0	2	8.0
> 150	7	28.0	1	4.0
Total	25	100.0	25	100.0

All houses are single floor-typed structure with permanent materials (68 %) or semi-permanent (16 %) and with panel or wood (16 %). Cement plastered floor is the most common way accounting 56 % followed by cement tile (24 %) and ceramics (12 %). Earth floor is for the rest taking a minor share.

Clay tile is most commonly used for roof material. It covers over 80 % of all respondents' houses. Asbestos and zinc are also employed but particularly for low income houses.

Electricity is supplied for all 25 houses. Of those beneficiaries, 18 houses are connected to PLN power line system, and remaining 7 are taking share of electric power supplied to neighboring house.

(4) Water Use and Sanitation

Although PDAM water supply system is available in this area, groundwater is the principal source of water for domestic use. Many families have their own shallow well in the yard to take advantage of groundwater resources . River water is also used some people for only bathing. Water sources currently in use can be referred to the following table.

WATER SOURCE

(Unit: Number of households)

Classification	Cooking		Washing and Bathing	
	Wet Season	Dry Season	Wet Season	Dry Season
Shallow Well	16	16	14	13
Deep Well	1	1	1	1
Spring	0	0	0	0
Public Hydrant	1	1	1	1
Water Supply (PDAM)	7	7	5	6
Water Seller	0	0	0	0
Rain Water	0	0	0	0
River Water	0	0	4	4
Total	25	25	25	25

According to the survey, only 9 households have family-owned latrine with proper septic tank, and 6 are using public toilet without channeling to the river or stream. However, It should be noted that 10 out of 25 sample respondents are utilizing river.

The majority of people collect domestic solid waste by themselves and place it in garbage bin or public disposal site. For people who have no such a facility nearby burn it, but several persons can be judged careless about disposing refuge. They might throw it somewhere around the river.

20 respondents gave same answer to the question about disease which may outbreak most frequently, that is influenza or flu causing respiratory tract infectious disease, then coughing and skin disease follow.

(5) Public Understanding and Perception

15 people answered to have heard something about project from neighbors or other media. Fig.5.1.8 shows reaction or attitude of respondents about the project together with expected method of compensation. It appears to be 14 people (56 %) "for the project", 7 people (28 %) "against" and 4 others (16 %) "undecided". Agreed people express the desire to have alternative land or money compensation.

It is important to pay particular attention to the reaction of 11 respondents who by no means relinquish their property. The main reason for agreement is to reduce flood damage (79 %) and for disagreement is to cause disadvantage for the community or to generate social unrest. Reasons of pro and con are illustrated in Figs.5.1.9 and 5.1.10 respectively.

5.2 Environmental and Social Impact Assessment

Environmental impact study has been conducted in accordance with terms of reference of Environmental Impact Statement, so called KA-ANDAL, which was approved by the Central Committee on Environment (KOMPUS) in October 1997. The study includes data collection, sample analysis, questionnaire and interview survey on present natural and social environment. The output of such a study is to be effectively used for the identification and evaluation of the potential impacts of proposed projects, and then management techniques and mitigation measures are discussed simultaneously as a basic approach to establish Environmental Management Plan (RKL). Likewise, Environmental Monitoring Plan (RPL) should also be required to formulate a comprehensive follow-up plan.

5.2.1 Present Environmental Condition

It is extremely important to consider main causes of present environmental problems prior to assessing the potential impacts of proposed projects. This idea is based on the concept that key factors of current environmental issues are concerned with the project and, therefore, should be considered as subjects of discussion for impact assessment. Under present environment, there is no endangered species of fauna nor protected flora.

Basic Concept for Comprehensive Environmental Management

Economic activities may give significant impacts on water resources environment. In fact, recent urbanization and industrialization have caused river water pollution due to mainly domestic and industrial wastewater discharges. On the other hand, land subsidence is occurring in coastal plain as a result of over pumping of groundwater by commercial and industrial sectors. Ground water exploitation should be restricted strictly and enactment of regulation to change water sources of commercial and industrial water from ground water to river surface water is quite necessary.

Under these circumstances, administrative measures should also be taken to strictly control resources extraction activities in a given river basin. There seems to be relevant regulations, standards and policies in both central and local governments to restrict development activities, but the question is how effectively these can be enforced. Although legal control on water or land use have to be consistent with public interests, it sometimes leads to the clash of interests between institutions or agencies concerned.

If adverse effects are predicted by the project implementation, every possible measure needs to be taken to mitigate impacts on natural and social environment. Furthermore, the following should be taken into account in association with the project and as part of comprehensive approach to the environmental management.

(1) Groundwater level will be restored and stabilized in an effort to reduce the consumption of groundwater reserves and also to develop river surface water resources. Land subsidence will no longer occur as a consequence, and if so, it may ease the situation to improve urban drainage system.

(2) Water quality will be improved if natural purification system of the river is recovered due to the control of wastewater discharge as well as sand quarry operation. This may substantially help reduce water treatment cost and ensure that clean water can be supplied to the residents.

(3) Erosion control is expected by conducting soil conservation practices together with land development control for the purpose of reducing river water turbidity. As a result it can also play an important role in reducing sediment load at the water intake location.

Special Issues and Concerns

As noted above, the present bottle neck problems need to be considered for environmental impact assessment. Resources extraction such as groundwater abstraction, surface-water development and sand quarry activities are main concerns in this regard. Relevant regulations or progress of these activities are described below for reference.

(1) Groundwater Development

The regulation on groundwater development is established under the Ministry of Mining and Energy No.02.P/101/M.PE/1994 and the detailed implementation of the said regulation is described in SK Dirjen No.005.K/10/DDJG/1995. In this regard provincial regulation PERDA No.5/1985 should also be respected in Central Java.

The groundwater exploitation is subject to the permission issued by Dinas Pertambangan (Mining Agency) in the Provincial Government, which is valid for three (3) years. There are two kinds of permission, one for the boring or drilling and the other one for the groundwater abstraction. The owner of the well is requested to

submit monthly-based abstraction report to the Mining Agency. If some discrepancies or doubtful information are found in the report, the Mining Agency may dispatch inspectors to the site to check the consumption record of groundwater resources. Should the report is totally false in its statement of abstraction volume, the Mining Agency will issue a warning letter to the owner. If the owner still disregard the warning, sanction will be imposed by closing the well. But practically imposing sanction is hardly implemented. In fact, it is quite difficult to measure or check the volume of groundwater abstraction as the well is generally privately owned and particularly, deep wells are installed in industrial companies.

Furthermore, following restrictions are imposed on the construction of wells in terms of groundwater development:

- The maximum number of wells is four (4) in an area of 10 ha of land with a distance of not less than 110 m between the wells, and
- If more wells are required, one monitoring well needs to be installed in the area.

(2) Sand Quarry Activities

Quarry activities in the river are controlled under the decree No.458/KPTS/1986 of the Ministry of Public Works for the mining of Category (Golongan) "C" materials, which includes sand, gravel, boulder and sandy gravel. The letter of permit for the quarry operation is issued by the different authorities under the following conditions:

- If daily production is more than 100 m^3 and/or mechanical operation is applied, the permit will be issued by the Governor or Head of provincial level (Tk.I), and
- If the production is less than 100 m^3 and/or its operation is dependent on manual laborers, the permit will be issued by the Mayor or Head of Regency.

The decree No.176/KPTS/A/1987 issued by the Directorate General of Water Resources Development provides guidance for the implementation of the above ministerial decree. It is stipulated that the quarry activities should be avoided in such locations as river degradation area, concave side of flood plain of meandering portion and other restricted areas around river structures. Particularly, it is strictly prohibited to take river bed materials in the area of 500 m upstream and 1,000 m downstream from the river structures.

Companies wishing to deal with quarry business is required to conduct environmental study and then its report should be submitted to the Central Committee for Environmental Impact Assessment (KOMPUS) for approval. The permit for quarry activities is subject to the approval by the KOMPUS. The effective period of the permit is five (5) years.

The provincial decree (Peraturan Daerah: PERDA) is also applicable to the quarry activities in rivers. In Central Java, the regulation No.6/1994 was established on May 16, 1994 and the area of exploitation is defined as follows:

- Maximum exploitable area is 10 ha. in one location for a person.
- Maximum exploitable area is 50 ha. in one location for a company.
- In case of 50 ha of area mentioned above, five (5) companies can be involved if permit is issued to each of them.

The operation permit is valid for 30 years with a possible extension of 10 years, and the extension is allowed twice in this regard.

The guidelines for the above provincial decree is established under the Governor's Decision No.188.3/01/1996 providing detailed descriptions with regard to the procedure for obtaining mining permit.

(3) River Surface Water Resources Development

Besides the proposed Jatibarang Dam which is expected to supply 2.00 m^3/s of water, Kedung Ombo reservoir is another promising surface-water resources to be developed in this region. JRATUNSELUNA Project Office is undertaking the construction of raw water transmission channel from Klambu to Kudu located northeast of Semarang City. The project is envisaged to convey 2.25 m^3/s of water to a new treatment plant at Kudu. The total length of the proposed conduction line is estimated at 40.5 km, of which so far 39.5 km was completed and the rest of 1.0 km is still under construction. It is scheduled to be completed by May 1999. This remaining portion was taken over to SSUDP from the JRATUNSELUNA Project Office in June 1998, and it will be, therefore, financed by the World Bank. The new treatment plant at Kudu will have the capacity of 1.25 m^3/s and is expected to have an additional capacity of 1.00 m^3/s in the future, but so far there is no detailed schedule

for the future plan due to the financial difficulties. In consequence, it remains undecided for the use of 1.00 m^3/s of water. Although this new water resource is to be used for drinking water, it will contribute to the reduction of groundwater consumption and would even be more helpful if many commercial and industrial companies could use it as an alternative source of water.

5.2.2 Predicted Impacts and Impact Sources

The prediction of impacts of project activities can be approached from three stages: (1) pre-construction, (2) construction, and (3) post-construction. For addressing environmental impacts, quantification approach can be considered to measure impact level. It can also be used to determine impact significance and required mitigation measures, so that it is desirable to quantify as many impacts as possible. However, in many cases quantification is impossible and qualitative impact prediction is practiced instead.

Predicted impacts are likely to be the key subjects to discuss environmental management plan. To provide a basis for such a discussion, impact sources should be identified in each stage of the project regardless of whether the effect is beneficial or detrimental. These are the causes of environmental changes resulting from the project implementation and should be, therefore, properly controlled and managed.

Man-induced environmental changes can be anticipated from the experience of similar projects undertaken in the last few decades, so predicted impacts and impact sources are considered as follows.

<u>Pre-construction Stage</u>

Problems to be considered in this preparatory stage are associated with the land. Small area of land will be required for the construction of earth dike and drainage channel in the river mouth area. The land in the area is owed by privet land developers. The design of dike and channel has been carried out with their approval for land acquisition, so that no social problem may arise regarding this issue.

Speculation and illegal use of land are troublesome problems. Significant impacts and impact sources commonly predicted in pre-construction stage are as follows:

Predicted Impacts		Impact Sources
- Social unrest	:	Unsuccessful negotiation or insufficient compensation relative to the land acquisition
- Illegal land use	:	Squatter's entry into the land prepared for the project
- Land ownership	:	Private property transaction by speculators

No impacts are predicted on natural environment.

Construction Stage

It must be noted that the project site is located in the urban area and population-concentrated region. Minimization of nuisance conditions to the private citizens will be pre-requisite for the management of social environment. It involves such items as noise, air pollution, traffic disturbance, road damage and so on. In addition, the project-induced changes in urban environment are another important factor for addressing potential impacts. Water quality, dredged sludge and aquatic biology are main concerns in this connection.

Impact sources for the public nuisance can be identified as the operation and mobilization of heavy equipment or machinery. These may result in disruption in daily living and movement patterns for the people. On the other hand, those affecting urban environment are related to earth-moving works or concrete works undertaken in and along the rivers. During the construction period, the river or the drainage channel improvement works will affect routine functions of public facilities such as water intake for domestic water supply, railway bridge and even ferry boat service. The summary of impacts and impact sources are presented in the following:

Predicted Impacts		Impact Sources
- Noise	:	Operation and mobilization of construction equipment and machinery.
- Air pollution	:	Operation of equipment and transportation of materials.
- Traffic disturbance	:	Mobilization of equipment and materials.
- Sedimentation	:	Dike embankment, soil excavation, dredging and other earth works relating to the project.
- River water quality	:	Earth works, concrete works, discard of construction waste materials and wastewater discharge from the camp.

- Road damage	:	Mobilization of equipment and transportation of materials.
-Aquatic biota	:	Earth works, concrete works, discard of construction waste discharge and wastewater discharge from the camp.
- Dredged material	:	Dredging river bed to increase flow capacity.
- Water intake facilities	:	Dredging works and reconstruction of Simongan Weir and its appurtenant facilities.
- Railway bridge	:	Raising a railway bridge to cope with design high water level.
- Ferry boat service	:	Dredging works and dike embankment works in West Floodway / Garang River.
- Sand quarry operation	:	Dredging works in Garang River

Post-construction Stage

For the river improvement works, impacts are predicted on water intake facilities resulting from the reconstruction of Simongan Weir. Particularly, PDAM water intake, located about one(1) km upstream from the weir, may have potential impact on intake volume, provided that the water level is not properly adjusted and controlled by the weir. Impact prediction is further emphasized on river morphological features which will be changed as a result of dredging work from 1.5 km upstream of Simongan Weir to the river mouth. Roadside trees along the floodway are to be transplanted temporarily during the embankment work and should be replanted to recover slope stability and scenic beauty as soon as the work is completed.

The magnitude of the predicted impact mentioned below are summarized in the succeeding sub-section.

Predicted Impacts		Impact Sources
- Water quality	:	Reconstruction of Simongan Weir
- Flow of Garang River	:	Construction of Simongan Weir and river improvement
- Land use pattern	:	Increase in development potentiality due to the project
- Replanting of roadside trees	:	Trees temporarily transplanted during the embankment works along the west floodway

- Water intake facilities : Reconstruction of Simongan Weir
- River morphology : River dredging work and channel improvement
- Land subsidence : Groundwater abstraction for commercial and industrial use
- River mouth morphology : Change of sediment transport by the use of pump drainage system

5.2.3 Environmental Management Plan

Based on the significant impacts predicted in the previous section, environmental management plan needs to be prepared with a view to prevent, control, mitigate and compensate adverse effects or environmentally undesirable impacts resulting from the project implementation. It can be expected to provide conceptual approach for assessing impact significance and describing managing approach, location and responsible agency or institution.

Assessment of Impact Significance

For determining the significance of anticipated impacts, mitigation level can be systematically categorized according to the characteristics of negative impacts in order to consider appropriate mitigation measures within reasonable environmental and economic constraints. In this concept, mitigation includes (1) avoiding the impact altogether by not taking certain actions; (2) minimizing the impact by limiting the degree or magnitude of the action; (3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations; and (5) compensation for the impact by replacing or providing substitute resources or environment. Based upon the above discussion, impact significance for the Project can be assessed as follows:

(1) Improvement of West Floodway / Garang River

Knowing the fact that sand quarry operation causes the degradation of river bed morphology, it should be strictly controlled in the proposed area. It implies that the impacts can be eliminated on premise that restrictions are imposed under the administrative guidance on any quarry activities. Almost all impacts or adverse effects during the construction stage can be potentially minimized if managing

approaches are properly undertaken. Rectification for the impact includes road damages and railway bridge that can be repaired and raised respectively. The following shows the summary of the above discussion.

Mitigation Category		Negative Impacts
Avoidance	:	Flow of Garang River
Minimization	:	Noise, Air pollution, Traffic disturbance, River water quality, Sedimentation, Aquatic biota, Water intake facilities, Ferry boat service, River morphology
Rectification	:	Road damage, Railway bridge
Reduction or elimination	:	Sand quarry operation
Compensation	:	Social unrest caused by land acquisition, Roadside trees

Mitigation Measures

This section addresses a variety of considerations associated with impact mitigation measures. Relevant measures should be identified and then incorporated in project construction and operational characteristics so as to minimize undesirable effects on natural and social environment. Mitigation measures or impact managing approaches need to be developed for specific projects and should be applied actively to decrease the magnitude of significant impacts. It is also necessary to specify the location for taking mitigation measures, but in fact the determination of project influential area is not so easy. It will be dependent upon the particular project type and location. Mitigation measures can be referred to the following.

(1) Pre-Construction Stage

- Land ownership	:	Restrictions of private property transaction is required to control land speculation around the dam and reservoir areas.
- Social unrest	:	Respecting Presidential decree No.55/1993, tough negotiation is expected to reach agreement with project-affected families on land acquisition. Reasonable assets evaluation should be considered for the compensation.
- Roadside trees	:	Trees are to be transplanted temporarily in flood plain during the dike embankment works. Proper care needs to be taken under the guidance of specialist in this field.
- Illegal land use	:	Acquired land should be fenced up to protect the proposed

site of Asin retarding pond from being intruded by squatters.

(2) Construction Stage

- Noise : Control of speed of construction vehicles and equipment is absolutely necessary to keep the noise level below 60 dBA. Working hours should be limited to daytime.

- Air pollution : Particularly dust control is required in this regard. Access road needs to be watered from time to time and materials should be covered with sheet. Air quality standard KEP decree No.02/MENLH/I/1988 is applicable in this regard.

- Traffic disturbance : Schedule adjustment may be necessary for equipment mobilization, and traffic control is required at the project site with construction sign board.

- Sedimentation : Installation of sand settling pond or protection fence may be required in an effort to keep soil suspended level at 100 to 250 mg/l in river water. Dredging work should be carried out from the downstream portion.

- Road damage : Regular check and inspection is required for the maintenance of village road as well as access road, and damaged portion is to be repaired if necessary.

- Water quality : Every effort needs to be made for the protection against spilt soil and concrete into the river. Protection fence may be necessary at the downstream direction. Government regulation No.20/1990 is applicable to the water quality.

- Aquatic biota : Base camp sanitary conditions must be well managed against river water pollution. Sediment control should also be taken into account for aquatic environment.

- Water intake facilities : For Garang river improvement, temporary cofferdam is to be constructed to maintain water level for the intake. During dredging work, protection fence should be set around PDAM intake facility.

- Sand quarry operation : Restrictions need to be imposed on sand quarry activities at the downstream section from Tugu Suharto.

- Railway bridge : Bridges over west floodway and Asin river are to be reconstructed due to the rise of river banks.

- Ferry boat service : Schedule control is required during the dredging work in both Garang river and west floodway.

- Dredged material : Use of water-proof sheet is required for the transportation of dredged material from Asin, Semarang and Baru rivers. It should be treated with cement to protect against

leachate and disposed in designated land reclamation site.

(3) Post-Construction Stage

- Reservoir water quality : Complete land clearance is expected before impounding, and domestic waste discharge into the reservoir should be strictly controlled.

- River water quality : Occasional flush out may be necessary at Simongan weir to improve water quality of floodway. Control of domestic waste discharge should also be considered as a long-term measure.

- Water intake facilities : Water level can be adjusted by the gate operation in order to facilitate existing water intake facilities.

- River morphology : Sand quarry operations should be prohibited in the downstream portion from Tugu Suharto in order to maintain stable river bed. River mouth morphological survey may be required to figure out environmental changes on estuary due to the pump drainage system.

- Land subsidence : Monitoring on land elevation needs to be conducted periodically for the proposed urban area. In this connection, the base station for BM must be carefully selected in the stable site.

In discussing over a wide range of environmental issues, all available data and information have been assembled and compiled to address selected aspects for planning environmental management. Table 5.2.1 summarizes fundamental parameters in matrix with regard to environmental management plan for respective projects.

5.2.4 Environmental Monitoring Plan

Environmental monitoring could be used to determine the effectiveness of each mitigation measure as discussed in the previous section. It provides information to review predicted impacts or effects for proper risk management and uncertainties and also to modify activity or develop mitigation measures in case of unpredictable harmful effects on the environment. Project office should take the initiative in establishing monitoring system including determination of monitoring location, frequency and duration and be engaged in regular site inspection, field measurement, sample analysis and so on. Based on these fundamental activities, the level of project impacts could be assessed in real terms. The matrix of environmental monitoring plan is presented in Table 5.2.2.

Monitoring Items and Locations

Basically, monitoring items remain the same as those selected for management plan. They are associated with predicted impacts in terms of land issues, public nuisance, resource quality deterioration, facilities' functional damage and risk management. These are important factors to keep careful watch on environmental changes. The monitoring location must be selected taking topographic accessibility and geographic desirability into account and should be at the most environmentally vulnerable area. Monitoring items and locations are further described for each proposed project.

(1) Improvement of West Floodway / Garang River

In the pre-construction stage it may be necessary to keep watch on land acquisition progress at Tanah Mas area on the right bank near the river mouth. Interview and field confirmation will be the best way to monitor social impacts. Periodical inspection is expected to watch how the roadside trees along West Floodway are taken care of in the process of transplantation.

In construction stage, monitoring needs to pay particular attention to the public nuisance conditions as every construction site along the river is close to the residential area. Monitoring on river water quality, aquatic biota and sedimentation is to be conducted by means of sample analysis. Sampling locations should remain same as they have been selected in EIA. Monitoring on functional deterioration includes the operation efficiency of water intake facilities and the level of road damages. However, in a sense of risk management, further monitoring items should be considered to assess impacts on railway bridge, ferry boat service as well as sand quarry operation in the river.

Following construction stage, both water quality and water intake facilities need to be watched continuously in post-construction stage, too as no functional disadvantage nor quality deterioration should be expected from the project. Monitoring on flood mitigation effects seems to be significant in evaluating project itself. This can be assessed on the basis of flood frequency and duration in flood-prone area along the river. Another important item to be monitored will be the river morphology from the confluence point with Kreo River to the river mouth because it can be potentially changed due to the flow controlled by the proposed structures.

Monitoring Frequency and Duration

In principle, monitoring should be undertaken by the project office in coordination with other agencies concerned. However, the project office assumes responsibility for the operation and maintenance of facilities for a few years after the completion of construction works, then the facilities are to be handed over to the local government or the municipality. Thus, the local government will take over all responsibilities for the project ever since. Under these circumstances, agencies or institutions responsible for monitoring in post-construction stage are still uncertain. Monitoring frequency and duration are determined according to the project characteristics, monitoring items and impact significance. These are summarized as follows:

(1) Pre-Construction Stage

(a) Land issues and social unrest

Monthly-based monitoring for as long as problems exist.

(b) Roadside trees along the West Floodway

Weekly-based monitoring for transplanted trees until embankment work is completed.

(2) Construction Stage

(a) Noise and air pollution

Monthly basis for the dam project and twice a month for the river improvement project as well as the urban drainage system improvement project.

(b) Water quality, sedimentation, road damage and aquatic biota

Monthly-based monitoring during the construction period.

(c) Traffic disturbance, sand quarry operation and dredged material

Weekly-based monitoring during the construction period.

(d) Water intake facilities, railway bridge and ferry boat service

Daily-based monitoring during the construction period.

(3) Post-Construction Stage

(a) Illegal land use

Bi-monthly (twice a month) basis for minimum two(2) years.

(b) Water quality (reservoir and river), fish farming and sediment disposal site

Monthly-based monitoring without limit of duration unless otherwise specified.

(d) Land use pattern, land subsidence and river morphology

Every six(6) months without limit of duration unless otherwise specified.

(e) Flood mitigation

Every rainy season without limit of duration.

(f) Water intake facilities

Daily-based monitoring without limit of duration.

(g) Pump operation

Bi-monthly-based monitoring without limit of duration

5.3 River Basin Management

5.3.1 Basic Issues and Problems

The Garang river basin comprises part of Semarang City in the north and two other regencies, Kendal and Semarang in the south. As population of the capital city of Central Java Province increases by nearly 2.1 % annually, urban area is expanding toward the south. This trend can be seen in the upper basin of Garang River, particularly in Gunungpati and Mijen sub-districts where the phenomenon is proved by annual population growth rate which indicate 3.7 % and 2.9 % respectively.

Under these circumstances, urban environment has not been discussed to cope with development schemes. In fact it has been always left behind urban development issues. As a result the city is now facing many problems as by-products of development. In dealing with these adverse effects, it is important to realize that urban environmental issues are closely concerned with water-related matters. From this point of view scrupulous attention shall be paid to the whole Garang river basin, and all available information have to be collected in an effort to study existing problems therein in terms of river basin management. In this regard, major problems and issues to be further discussed are abstracted as follows:

(1) Land subsidence is occurring in the northern part of the city due to the over-development of groundwater from the coastal plain aquifer. The number of deep tubewells in Semarang City was 300 in 1989 but this number was increased to 700 in 1997. Such uncontrolled development of groundwater resource has caused quality deterioration resulting from brackish water intrusion. Regulation for Water Pollution Control PP20, 1990 covers only surface-water and is not applicable to the groundwater.

(2) Since there is no sewerage system nor treatment plant for the domestic wastes in Semarang City, discharge of such wastewater may result in a great contribution to the total organic load and microbiological concentration in the river water.

(3) Wastewater discharge from manufacturing plants is uncontrollable, regardless of whether they are equipped with treatment plant or not. Industrial wastes in general contain heavy metals or hazardous substances to the human health. According to the information of Environmental Bureau in the Provincial Government, there are 89 industrial plants in Semarang City. Among those companies 18 are located upstream of PDAM water intake.

(4) Solid waste is currently disposed in city's sole landfill site, located at 8.5 km upstream of PDAM water intake, managed by the Municipal Cleaning Agency (Dinas Kebersihan Kotamadya). The volume of refuse properly collected and disposed of is estimated at 1,130 m^3 a day, including not only domestic wastes but also commercial, industrial and even medical wastes as well, so that it is also being used as a hazardous waste disposal site. Although the location is a little way from Kreo River, no protection measure is taken against leachate and runoff from the landfill site. This situation may result in serious water pollution unless appropriate measure is taken.

(5) Housing complexes are constructed or going to be developed in the upper river basin to cope with rapidly expanding urban population. Housing development is one of the major concerns with impact assessment in terms of river basin management and control. It is, as a matter of course, dependent upon the particular project size and location, but its activity involves topsoil removing which may result in soil erosion and massive flood discharge. A new satellite town is planned to be constructed in sub-district Mijen upstream of the proposed dam site. The project requires 1,220 ha of land, of which about 50 % is to be used for housing area where more than 5,000

families can be accommodated. However, the project is behind the schedule due to the financial difficulties.

(6) As natural vegetation cover has been ripped off by the land development, soil erosion arises over an extensive area of the river basin and as a result the river carries washload downstream. It occurs at intermittent intervals that are related mostly to the rainfall intensity. Soil erosion is the major source of turbidity in surface-water and sedimentation as well. Nevertheless, it is difficult or impossible to determine the exact point of erosion.

(7) The Municipality officially authorizes 17 small local companies to do sand quarry operation business on Garang and Kreo rivers. Quarry area allocated to each of them ranges from 500 m^2 to 2,000 m^2 but its daily production is not clear. According to the Tax Office, the last year's revenue from the quarry company was Rp.400,000, calculated on the basis of Rp.500/ton. The annual production, therefore, amounts to 800 tons, which is rather skeptical and unreliable figure to show the real situation. The production volume may be reported underestimated. Nearly 70 workers are engaged in this job. They simply scoop the sand with bucket in the river bed and store it up on the banks. The broker comes to the site once in a while to buy the materials. Spot delivery price is Rp.20,000/m^3 for sand, whereas Rp.15,000/m^3 for cobble. However, an excessive quarry operation in the river bed will cause adverse effects to both river structures and aquatic environment.

(8) PDAM is currently taking about 1m^3/sec of water from Garang River and pumping it up to its own treatment plant. Sludge deposits, by-products of water treatment, is discharged back to the river at some 50 m downstream from the intake. This system may result in increased sediment load in the lower basin.

(9) Apart from the administrative initiatives for public services, it is absolutely necessary to enhance public awareness and consciousness of the importance of river environment. This can be a basic policy for overall river basin management, but in fact, many people tend to consider the river or open channel as a waste disposal site.

5.3.2 Key Idea and Countermeasures

Problems described above are correlated to each other and may be arisen from the large-scaled human intervention for the last few decades. Basically, countermeasures should be taken in such a way that land management techniques and conservation practices are

undertaken in rural areas, whereas structural and hydrological control are conducted in urban areas.

Long term and short term approaches can be considered for effectively and economically viable measures, and strategically the management practice can be split into two types such as structural and nonstructural measures. Setting target years for 2003 for short term and 2008 for long term, measures and practices for the River Basin Management are described as follows:

Short Term Program

Short term program involves various schemes to support and accomplish on-going study and activities. It is important to consider that structural measures would not be achieved successfully without proper coordination and harmony with nonstructral measures. For example, solid waste collection and disposal system needs to be improved with a new sanitary landfill site and equipment, but at the same time strict control system is required to protect disposal place from entering hazardous wastes. In this sense penalty law should be established.

Soil conservation scheme should be enhanced as part of environmental campaign emphasizing the need to promote reforestation and soil erosion control. These activities have to be performed in the upper basin associated with control of land and housing development. Installation of septic tanks should also be accelerated in line with PROKASIH. Regarding hydrogeological balance between groundwater abstraction and land subsidence, in-depth information is absolutely necessary in order to provide analytical output and key ideas for future action program.

Strategic Approaches and Measures

	Short Term	Long Term
Structural Measures	- Installation of septic tanks - Construction of new sanitary land-fill site - Procurement of garbage collection equipment - Reforestation by rapidly growing vegetation - Soil erosion control by runoff collection basin - Improvement of PDAM sediment discharge system	- Surface-water resources development - Installation of public sewerage system and treatment plant - Installation or improvement of treatment plants for industrial wastes - Reforestation and vegetation coverage in developed land - Construction of check dams (Sabo Dam)
Nonstructural Measures	- Interinstitutional coordination and collaboration - Strengthening of solid waste control and management system - Enforcement of monitoring system for both river water quality and industrial waste discharge - Establishment of penalty law for waste disposal - Monitoring of land subsidence and groundwater level - Study on hydrological balance to determine optimum groundwater abstraction - Revision of regulation for Water Pollution Control PP20/1990 to include groundwater - Strict control and management for groundwater development - Control of land/housing development in the upper basin	- Enhancement of public awareness of environment - Improvement of raw water quality to clear the standards to full satisfaction - Upraising of garbage collection rate to 90 % - Establishment of law or regulation for "polluter's pay principle" - Government subsidy system for private companies or persons - Prohibition of quarry operation in the river

Long Term program

As ultimate structural measures, surface-water resources development and the installation of public sewerage system and industrial wastes treatment plants are highlighted in long term program. The implementation of these projects will require pre-conditions such as huge investment and public consensus. In this respect, new law or regulation should be established to impose tax for beneficiaries of sewerage system so that revenue can be used for the operation and maintenance of facility. It is suggested that the Government provides industries with financial assistance or subsidy for the installation of wastes treatment plant. On the other hand, the regulation must be applicable to those who are identified as polluters. They

are liable to pay for penalty based on "Polluter's Pay Principle". Strategic approaches and measures are summarized in the table above.

5.3.3 On-going Countermeasures and Practice

(1) Groundwater Monitoring and Control

Environmental Impact Assessment Board (BAPEDAL) under the Ministry of Environment is undertaking groundwater monitoring and control project as part of the national environmental program with a technical assistance from the British Government, so called BAPEDAL-ODA Program. Semarang City was selected as a pilot project since it had been ranked in the highest priority. This project started in April, 1996 and is scheduled to be completed in March, 1998. In this connection the Mining Agency of the Central Java Provincial Government is playing a role as project coordinator and Directorate General of Geology in Bandung is also involved in relative investigations for the project.

The project includes technical assistance and suggestive approach to the institutional strengthening for the groundwater management and control, focusing on coastal aquifer and Ungaran aquifer which are considered to be the major groundwater reserves in Semarang City(refer to Fig.5.3.1). In this pilot project, 28 observation wells were installed in mainly coastal area with the view of monitoring groundwater abstraction and quality.

It indicates that the fall of groundwater levels occur in coastal areas as a result of over-development of groundwater reservoir and land is subsiding subsequently. It also mention that the groundwater table has lowered by 10 m in an extensive area and even by 20 m in eastern section of Semarang City. Consequently, it is warning that land subsidence of 5 m may occur resulting from 20 m down in groundwater levels. This may induce quality degradation due to the brackish water intrusion.

Current groundwater abstraction in Semarang City is still not clear enough. According to the study report on Groundwater Conservation in Semarang City and Surrounding Areas conducted in 1993 by the Sub-directorate of Hydrogeology in Bandung, daily abstraction was estimated at 100,800 m^3 in the area covering whole Semarang Municipality and Semarang Regency.

Knowing the actual critical conditions of land subsidence and pollution risk over

coastal areas, it is planned to relocate present industrial zone into Tugu Regency and Genuk Regency in order to reduce groundwater consumption. It is also necessary to enhance surface-water resources development in line with restriction and control of groundwater abstraction. This is rather long-term plan but the basic concept is to determine optimum use of groundwater resources taking account of hydrogeological balance.

(2) Surface-water Resources Development

Apart from proposed Jatibarang dam construction, Kedung Ombo reservoir located about 50 km southeast of Semarang City is nearly completed aiming at supplying domestic water as well as irrigation water. The development of this surface-water resource has been long expected for the benefit of Semarang citizen. PDAM, city water supply enterprise, plans to benefit from the water transfer from Klambu to Kudu located at northeast edge of Semarang City. The development potential for domestic water supply is 2.25 m^3/s.

The above raw water transmission project is undertaken by JRATUNSELUNA Project Office. The first phase will be completed in March 1998 to conduct 1.00 m^3/s of municipal water, and the second phase is due to end by October of the same year for 2.5 m^3/s. PDAM water supply project is designed to take 1.25 m^3/s of water from Kudu for the first phase and 1.00 m^3/s for the second phase. However, the first phase work is behind the schedule due to mainly financial difficulties. It is still on-going process in the hope that all works be achieved by the end of 1999. The first phase is financed by IBRD and the second phase, on the other hand, will be implemented under BOT system.

(3) Soil Conservation

Soil conservation in the upper basin of Garang River is undertaken by two different institutions, National Development Planning Board (BAPPEDA) and Forestry Office of each Regency concerned. Practical works and activities are described as follows;

(a) BAPPEDA

The study on agro-climatology and land characteristics in the Garang river basin is now being conducted as part of watershed management under BAPPEDA in collaboration with Soil Research Center of Bogor, Food Plant

Protection Agency (BPTP) and Center for International Cooperation in Agricultural Research for Development (CIRAD) in France. The study began with the collection of basic information on soil and hydrology in the upper basin. Apart from the installation of four(4) automatic rainfall recorders, three(3) water level gauging stations were newly established in March 1997 on Garang, Sikopek and Kripik rivers.

The study includes establishment of farming system and cropping pattern to be introduced in the deforested areas in terms of erosion control and soil conservation, and bench terrace is enhanced to the local farmers with the aim of selecting suitable cover crops under the technical guidance of the above assisting agencies. Such soil conservation by crop management is currently carried out in three pilot farms such as Pagrsari (3 ha), Gunungpati (4 ha) and Gonoharjo (3 ha), where the land is used for intensive cultivation of such crops as water melon, corn, onion, groundnuts, ginger, green pepper and so on.

Knowing the fact that the climate and soil conditions are key elements for farming, crops are carefully selected taking account of productivity as well as effectiveness for soil protection. Small storage reservoir is also seen for a pilot farm where cash crop trees are planted with some intercrops.

So far study results are practically not obtainable as the recording time is too short to analyze the data. Consequently, it can be hardly explained in quantitative way on how much effect the crops may give on soil protection and erosion control.

(b) Semarang Regency

The area of about 80 km^2 in the uppermost basin of Garang River is fallen in the jurisdiction of Semarang Regency and managed by the Forestry Office of Ungaran since its establishment of 1994. This Office is engaged in the practical field work management in relation to soil conservation and water recharging, and its strategic operation consists of two major activities such as reforestation enhancement and structural approach.

According to the last 3 years record, reforestation has been achieved for about 170 ha of sloped land in mainly sub-district of Ungaran. Although the Office is desirous of planting 400,000 trees a year, this number is far beyond the reality

because in real case it reaches only 10 % of the above at the maximum efforts due to the budget constraint.

There are 4 nursery gardens totaling to 4.25 ha, in which seedlings are grown for free distribution to the local farmers and even to other sub-districts lying in the same river basin. The Office currently sends 6 personnel to Mijen, Gunungpati and Ngaliyan sub-districts under Municipality to provide extension services as there is no specific agency in Municipal administration to deal with soil conservation. Plants to be distributed are fast growing species such as sengon (Albizzia falcata), mlinjo (Gnetum gnemon), banana, grass and so on.

Structural measures are also taken as part of operation program. This includes construction of check dams (sabo dam), recharge wells and storage reservoirs and rehabilitation of terrace-shaped land. Well construction seems to be the most frequent case with the aim of obtaining significant effects such as protection of surface runoff and groundwater recharging.

(c) Kendal Regency

Uppermost basin of Kreo River is under the administration of Kendal Regency. It covers about 26 km^2 consisting of two sub-districts, Limbangan and Boja. Forestry Office in Kendal owns 4 ha of nursery garden in 7 different sites in the Regency and is in charge of forest management. There are 18 forest extensionist, of which 2 are assigned for Limbangan and 3 are for Boja.

Operation work started in 1994/95 with reforestation of 25 ha of land in Limbangan in collaboration of local farmers. Since then the operation has continued to cover 25 ha every year, except fiscal year 1997/98 due to the budget cut. So far 75 ha of reforestation and 25 ha of terrace rehabilitation were achieved in the said two sub-districts.

With regard to structural measures, the Office has undertaken the construction of 45 recharge wells together with 42 small storage reservoirs. The unit cost of construction is reported to be Rp.750,000 for the well and Rp.1,500,000 for the reservoir.

(4) Solid Waste Management

Study is being conducted under SSUDP to select a new sanitary landfill site, and the report will be completed in July 1998 . So far six (6) alternative cases are proposed to the Municipality. Final decision will be made after due consideration between local authorities concerned and an early implementation is expected to set up final disposal area because existing site will be no longer used in 2003. This project shall include management system to control both quality and quantity of refuse so that any industrial and medical wastes are not allowed to be brought in.

TABLES

CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS

Table 5.1.1 (1/2) RESULTS OF WATER QUALITY TEST (WET SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter	Water Quality Standard (B)	Sampling Location									
		KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
Temperature	Normal (°C)	27.8	29.6	29.6	29.6	30	29.4	29.6	30.2	29.6	30.6
pH	5 ~ 9	7.6	7.6	7.2	7.7	7.9	7.8	7.6	7.6	7.5	7.5
EC	-μS/cm	20.8	31.2	30.8	26.4	26.9	28.5	33.3	30.9	30.7	107.5
TDS	1,000 mg/l	188	235	208	210	231	250	232	260	292	576
TSS	- mg/l	12	36	38	50	51	59	75	49	85	106
DO	6 mg/l	7.1	6.7	6.7	6.7	6.9	6.9	7	6.6	6.3	6.9
BOD	- mg/l	5.4	1.3	0.8	1.8	0.6	1.3	3.9	5.1	5.2	6.3
COD	- mg/l	8.35	3	1.33	3.34	1.67	4.67	6.01	12.69	9.68	10.35
NH_4-N	- mg/l	0.05	0.09	0.04	0.15	0.02	0.03	0.09	0.1	<0.02	0.17
NO_3-N	10 mg/l	0.01	0.03	0.07	0.04	0.05	0.05	0.06	0.05	0.05	0.07
NO_2-N	1.0 mg/l	0.04	0.09	0.05	0.07	0.08	0.11	0.13	0.13	0.2	0.09
PO_4-P	- mg/l	2.3	4.9	4.7	11.1	2.6	5.6	3.6	11.4	2.9	9.1
Sulfide	0.1 mg/l	<0.02	<0.02	<0.02	<0.02	<0.04	<0.02	<0.06	<0.02	<0.02	<0.02
Cl	600 mg/l	7.47	14.94	16.81	14.94	14.94	15.88	26.15	19.05	18.3	205.45
Ca	- mg/l	15.15	24.62	27.69	23.08	23.85	26.16	28.46	26.15	27.69	34.62
Mg	- mg/l	6.14	6.92	6.92	6.92	6.92	8.77	7.85	8.31	6.92	22.15
Fe	5 mg/l	0.86	1.6	0.62	0.74	0.78	0.7	0.53	0.41	0.45	0.35
Mn	0.5 mg/l	<0.05	0.07	0.05	<0.05	0.06	<0.05	<0.05	<0.05	<0.05	<0.05
Na	- mg/l	3.82	1.2	0.5	15.25	8.94	12.18	13.58	11.89	7.12	165.26
Hardness ($CaCo_3$)	- mg/l	63.46	90.39	98.08	86.54	88.46	101.92	103.85	100	98.08	178.85
Cd	0.01 mg/l	0.002	0.002	0.003	0.002	0.003	0.002	0.004	0.002	<0.002	0.003
Zn	5 mg/l	0.014	0.008	0.029	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	<0.005
Pb	0.1 mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06
Cr	- mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	1 mg/l	0.03	0.05	0.05	0.05	0.06	0.04	0.03	<0.01	<0.01	0.03
T. Coliform	10,000 /100m	$93x10^3$	$20x10^2$	$43x10^3$	$43x10^3$	$93x10^2$	$15x10^4$	$43x10^4$	$24x10^4$	$23x10^4$	$43x10^4$
Fecal Coliform	2,000 /100m	$93x10^3$	$20x10^2$	$43x10^3$	$43x10^3$	$93x10^2$	$73x10^3$	$91x10^3$	$91x10^3$	$23x10^4$	$23x10^4$

Table 5.1.1 (2/2) RESULTS OF WATER QUALITY TEST (WET SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter	Water Quality Standard (B)	Sampling Location									
		KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
Temperature	Normal (°C)	27.2	35.0	32.0	31.0	31.0	30.0	30.8	31.8	35.4	36.6
pH	5 ~ 9	7.9	8.5	8.6	8.4	8.1	7.8	8.1	8.1	9.0	9.1
EC	-μS/cm	28.6	46.8	31.8	32.5	33.7	37.4	103.8	539	1444	1593
TDS	1,000 mg/l	263	149	256	307	276	323	722	3692	9015	5144
TSS	- mg/l	30	34	74	21	76	29	82	74	71	85
DO	6 mg/l	7.77	7.73	7.74	7.25	7.26	5.37	7.12	6.93	0	0
BOD	- mg/l	4.11	5.52	3.88	4.96	5.9	2.17	6.02	4.22	4.99	5.21
COD	- mg/l	15.48	16.46	13.58	15.47	17.48	10.31	26.32	25.31	26.5	24.4
NH_4-N	- mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.19	<0.02	0.42
NO_3-N	10 mg/l	0.09	0.03	0.07	0.16	0.16	0.08	0.07	0.06	0.03	0.02
NO_2-N	1.0 mg/l	0.09	0.09	0.11	0.09	0.16	0.36	1.59	1.37	0.11	0.11
PO_4-P	- mg/l	<1	<1	<1	1.7	4.7	1.3	2.3	2.0	1.3	2.3
Sulfide	0.1 mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cl	600 mg/l	23.32	33.42	21.76	21.37	27.98	23.32	225.4	1821.68	6315.17	6569.91
Ca	- mg/l	24.4	39.1	33.9	33.98	33.9	39.1	47.5	75.6	173.9	247.8
Mg	- mg/l	4.7	6.8	5.7	5.7	5.7	8.9	100	132	302.6	347.8
Fe	5 mg/l	0.82	0.55	0.42	0.94	0.78	0.62	0.62	0.33	1.15	0.72
Mn	0.5 mg/l	<0.05	0.11	0.06	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.14
Na	- mg/l	33.25	46.61	20.25	15.25	12.7	32.11	109.45	1234.2	5610.52	5856.35
Hardness ($CaCo_3$)	- mg/l	73.9	126.1	108.7	108.7	108.7	134.8	208.7	739.2	1695.7	1902.3
Cd	0.01 mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.013	0.03	0.03	0.03
Zn	5 mg/l	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.08	<0.005	0.01	<0.005
Pb	0.1 mg/l	<0.05	<0.05	0.189	0.213	0.237	0.545	<0.05	0.49	0.49	0.065
Cr	- mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	1 mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
T. Coliform	10,000 /100m	$46x10^3$	$>24x10^4$	$46x10^3$	$46x10^4$	$>24x10^4$	$>24x10^6$	$46x10^5$	$93x10^4$	$46x10^5$	$43x10^4$
Fecal Coliform	2,000 /100m	$46x10^3$	$>24x10^4$	$46x10^3$	$46x10^4$	$>24x10^4$	$>24x10^6$	$46x10^5$	$43x10^4$	$75x10^4$	$43x10^4$

Table 5.1.2 (1/2) ABUNDANCE AND DIVERSITY OF PLANKTON (DRY SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter		Total Individual/lt at Each Sampling Location									
		KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
Fitoplankton											
- Chlorophyta (Green)	Individual	34	262	52	52	122	1416	6663	23383	28845	21197
	Species	2	2	2	2	4	4	3	3	3	5
- Chrysophyta (Golden-brown)	Individual	242	365	2552	2898	1204	1975	5192	20321	16631	19169
	Species	10	8	10	15	10	8	6	9	6	4
- Cyanophyta (Blue-green)	Individual	-	507	104	104	69	647	419	698	560	1819
	Species	-	2	2	2	2	2	3	4	2	3
- Euglenophyta (Green)	Individual	-	-	-	-	17	70	17	-	157	-
	Species	-	-	-	-	1	1	1	-	1	-
Zooplankton	Individual	34	17	-	34	69	1154	-	52	68	734
	Species	2	1	-	2	3	2	-	1	4	4
Population (Individual/lt)		310	1151	2708	3071	1481	5256	12291	44454	46261	42919
Total Species		14	13	14	20	20	17	13	18	16	16
Diversity Index (H')		2.58	1.97	1.83	1.83	1.96	2.13	1.31	1.31	0.88	1.10
Evenness Index		0.97	0.76	0.69	0.61	0.65	0.75	0.52	0.46	0.32	0.39

Table 5.1.2 (2/2) ABUNDANCE AND DIVERSITY OF PLANKTON (WET SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter		Total Individual/lt at Each Sampling Location									
		KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
Fitoplankton											
- Chlorophyta (Green)	Individual	34	69	34	87	17	69	51	68	34	86
	Species	2	3	2	2	1	3	3	4	2	3
- Chrysophyta (Golden-brown)	Individual	86	207	278	226	260	121	278	469	17	86
	Species	4	6	6	5	7	5	5	8	1	4
- Cyanophyta (Blue-green)	Individual	17	17	17	17	34	17	52	87	34	104
	Species	1	1	1	1	2	1	2	1	2	3
- Euglenophyta (Green)	Individual	-	-	-	-	17	17	35	17	17	-
	Species	-	-	-	-	1	1	1	1	1	-
Zooplankton	Individual	34	17	34	-	-	-	-	51	34	17
	Species	2	1	2	-	-	-	-	3	2	1
Population (Individual/lt)		171	310	363	330	328	224	416	692	136	293
Total Species		9	11	11	8	11	10	11	17	8	11
Diversity Index (H')		2.16	2.05	2.17	1.87	2.13	2.24	2.03	2.49	1.00	2.39
Evenness Index		0.98	0.85	0.90	0.90	0.89	0.97	0.85	0.88	0.48	0.99

Table 5.1.3 (1/2) ABUNDANCE AND DIVERSITY OF BENTHOS (DRY SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter	Total Individual / lt at Each Sampling Location									
	KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
1. Bivalvia										
- Pisidium	105	-	-	-	-	-	-	-	-	15
2. Crustacea										
- Shrimps	-	-	-	-	-	-	-	-	-	30
3 Gastropoda										
- Brotia spadicea	525	90	-	525	345	225	15	-	-	-
- Indoplanorbia Exustus	-	-	-	-	-	60	-	-	-	-
- Lymnaea sp	-	585	-	-	15	-	-	-	-	-
- Melanoides tuberculata	-	30	75	-	-	30	-	-	-	-
- Melanoides Torulosa	-	-	45	75	-	-	-	-	-	-
- Syncera sp	-	-	-	-	-	15	-	-	-	-
- Tiara scrabra	210	-	-	60	-	225	-	-	-	-
4 Insecta										
- Chironomus thumii	-	-	-	45	60	-	-	-	-	-
- Gomphus sp	-	-	30	-	15	15	-	-	-	-
5 Oligochaeta										
- Pheretima sp	-	-	-	-	-	-	-	-	-	-
- Prionospio sp	-	-	-	-	-	-	-	-	330	-
- Tubifex sp	-	-	-	-	-	1365	-	-	-	-
6 Polychaeta										
- Nereis sp	-	-	-	-	-	15	-	-	-	-
Total Individual	840	705	150	705	435	1950	15	-	330	165
Total Species	3	3	3	4	4	8	1	-	1	3
Diversity Index (H')	0.90	0.50	1.00	0.84	0.69	1.03	0.00	0.00	0.00	0.76
Evenness Index	0.82	0.50	0.94	0.61	0.50	0.49	0.00	0.00	0.00	0.69

Table 5.1.3 (2/2) ABUNDANCE AND DIVERSITY OF BENTHOS (WET SEASON)
(WEST FLOODWAY / GARANG RIVER)

Parameter	Total Individual / lt at Each Sampling Location									
	KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
1. Crustacea										
- Gammarus pulex	-	-	-	-	-	-	-	15	-	-
- Macrobrachium sp	-	-	15	-	-	-	-	-	-	-
- Ketam	-	-	15	-	-	-	-	-	-	-
2. Gastropoda										
- Brotia spadicea	75	420	1,140	150	360	-	-	-	-	-
- Brotia testudinaria	-	195	-	-	-	-	-	-	-	-
- Dreissensiidae	-	-	-	-	-	-	-	-	-	15
- Melanoides tuberculata	-	-	-	-	15	-	-	-	-	-
- Tiara scrabra	-	-	-	-	15	-	-	-	-	-
3. Insecta										
- Chironomus thumii	15	30	15	-	-	-	-	-	-	-
- Hydropsyche instabilis	30	-	-	-	-	-	-	-	-	-
4. Oligochaeta										
- Pheretima sp	-	-	30	-	-	-	-	-	-	-
- Tubifex sp	-	-	120	-	-	-	-	45	-	-
Total Individu	120	645	1,335	150	390	-	-	60	-	15
Total Species	3	3	6	1	3	-	-	2	-	1
Diversity Index (H')	0.38	0.83	0.44	0.00	0.32	-	-	0.56	-	0.00
Evenness Index	0.35	0.75	0.26	0.00	0.29	-	-	0.81	-	0.00

Table 5.1.4 RESULT OF SEDIMENT ANALYSIS (WEST FLOODWAY / GARANG RIVER)

DRY SEASON (Unit: mg/kg)

Parameter	Sampling Location				
	KG1	KG3	KG6	KG7	KG10
Cu	31.73	51.78	62.76	25.16	38.26
Cr	6.67	14.91	12.14	10.77	10.14
Cd	0.19	0.70	0.76	0.80	0.65
Zn	91.51	104.44	118.46	96.94	140.25
Pb	15.18	26.19	21.22	16.03	19.22

WET SEASON

Parameter	Sampling Location				
	KG1	KG3	KG6	KG7	KG10
Cu	21.75	29.50	31.50	31.75	31.30
Cr	15.00	17.50	12.50	12.50	21.25
Cd	0.58	1.09	1.10	1.10	1.12
Zn	60.68	91.70	96.55	101.13	90.78
Pb	32.34	44.32	46.45	47.56	45.67

KG1: Proposed reservoir area on Kreo River, KG3: Tugu Suharto (Garang River), KG6: Simongan weir (Upstream), KG7: Simongan weir (Downstream), KG10: Ring road bridge.

Table 5.2.1 ENVIRONMENTAL MANAGEMENT PLAN

Managing Item	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency
(Pre-Construction Stage)					
- Social Unrest	- Land acquisition - Assets evaluation	- Compensation - Public protest and demonstration	- Negotiations - Presidential decree No.55/1993	- Right bank near river mouth (Tanah Mas area)	- Project office
- Roadside trees	- Dike embankment	- Number of affected trees	- Temporary transplantation - Proper care taking	- Downstream from Simongan weir	- Project office
(Construction Stage)					
- Noise	- Operation of heavy equipment	- Noise level : 60 dBA	- Control of speed of vehicles/equipment - Working hours/schedule	- Villages along the river and floodway	- Project office
- Air pollution	- Mobilization of equipment and materials - Earth works	- Air quality standard KEP decree No.02/ MENLH/I/1988	- Covering materials with sheet - Watering the road - Materials stock yard	- Villages along the river and floodway	- Project office
- Traffic congestio	- Mobilization of equipment and materials	- Public complaint - Traffic congestion frequency/duration	- Schedule adjustment for equipment mobilization - Traffic control	- Villages along the river and floodway	- Project office
- Water quality of the river	- Dike embankment - Dredging work - Reconstruction of Simongan Weir	- Water quality standard according to Gov. regulation No.20/1990	- Effort to minimize split soil into the river - Protection fence at downstream direction	- Garang river and floodway	- Project office - Environmental bureau of Provincial Gov.
- Sedimentation	- Dike embankment - Dredging work - Reconstruction of Simongan Weir	- Soil suspended level 100 to 250 mg/l	- Protection fence at downstream direction - Temporary cofferdam - Dredging from downstream	- Garang river and floodway	- Project office
- Road damages	- Mobilization of equipment and materials	- Public complaint - Damage level	- Regular check system for road maintenance and repair	- City roads along the river and floodway - Access road	- Project office
- Aquatic biota	- Dike embankment Dredging work - Reconstruction of Simongan Weir	- Diversity index of plankton and benthos	- Sediment control - Effort to preserve natural ecology	- Garang river and floodway	- Project office
- Existing water intake facilities	- Dredging work - Reconstruction of Simongan Weir	- Water quality and quantity	- Temporary cofferdam to - maintain water level Protection fence around PDAM intake facility	- Intake facilities	- Project office - PDAM
- Sand quarry oper in the river	- Dredging work - River improvement	- Intensity of sand quarry activities	- Restrictions imposed on sand quarry in the river	- Downstream portion from Tugu Suharto	- Project office
- Railway bridge	- Raising river banks - River improvement	- Disturbance for train operation service	- Reconstruction of bridge over west floodway	- Existing railway bridge	- Project office - PJKA
- Ferry boat servic	- Dike embankment - Dredging work	- Number of services suspended	- Schedule control for ferry services	- Ferry service location and route	- Project office -
(Post-Construction Stage)					
- Replanting of Roadside trees	- Temporary trans-plantation due to emabankment	- Number of trees replanted	- Transportation of trees and translating techniques	- Roads along floodway downstream from	- Project office
- Water quality	- Reconstruction of Simongan Weir	- Water quality standard according to Gov. regulation No.20/1990 - Diversity index of plankton and benthos	- Occasional flush out by gate operation - Control of domestic waste discharge	- Garang river and floodway - Simongan weir	- Project office
- Flow of Garang r	- Reconstruction of Simongan Weir - River improvement	- Minimum (2.69 m³/s) for drought period - Maximum (790 m³/s) for flood period	- Adjusting flow discharge by dam operation - Gate operation	- Garang river and floodway - Simongan weir	- Project office
- Water intake facilities	- Reconstruction of Simongan Weir	- Water quality and quantity	- Adjusting water level to facilitate water intake - Gate operation	- PDAM water intake facility - Leftbank canal	- Project office - PDAM
- Water intake facilities	- Reconstruction of Simongan Weir	- Water quality and quantity	- Adjusting water level to facilitate water intake - Gate operation	- PDAM water intake facility - Leftbank canal	- Project office - PDAM
- River morpholog	- Dredging work - River improvement	- Flow discharge - Riverbed profile	- Restrictions imposed on sand quarry in the river	- Downstream protion from Tugu Suharto - River mouth	- Project office

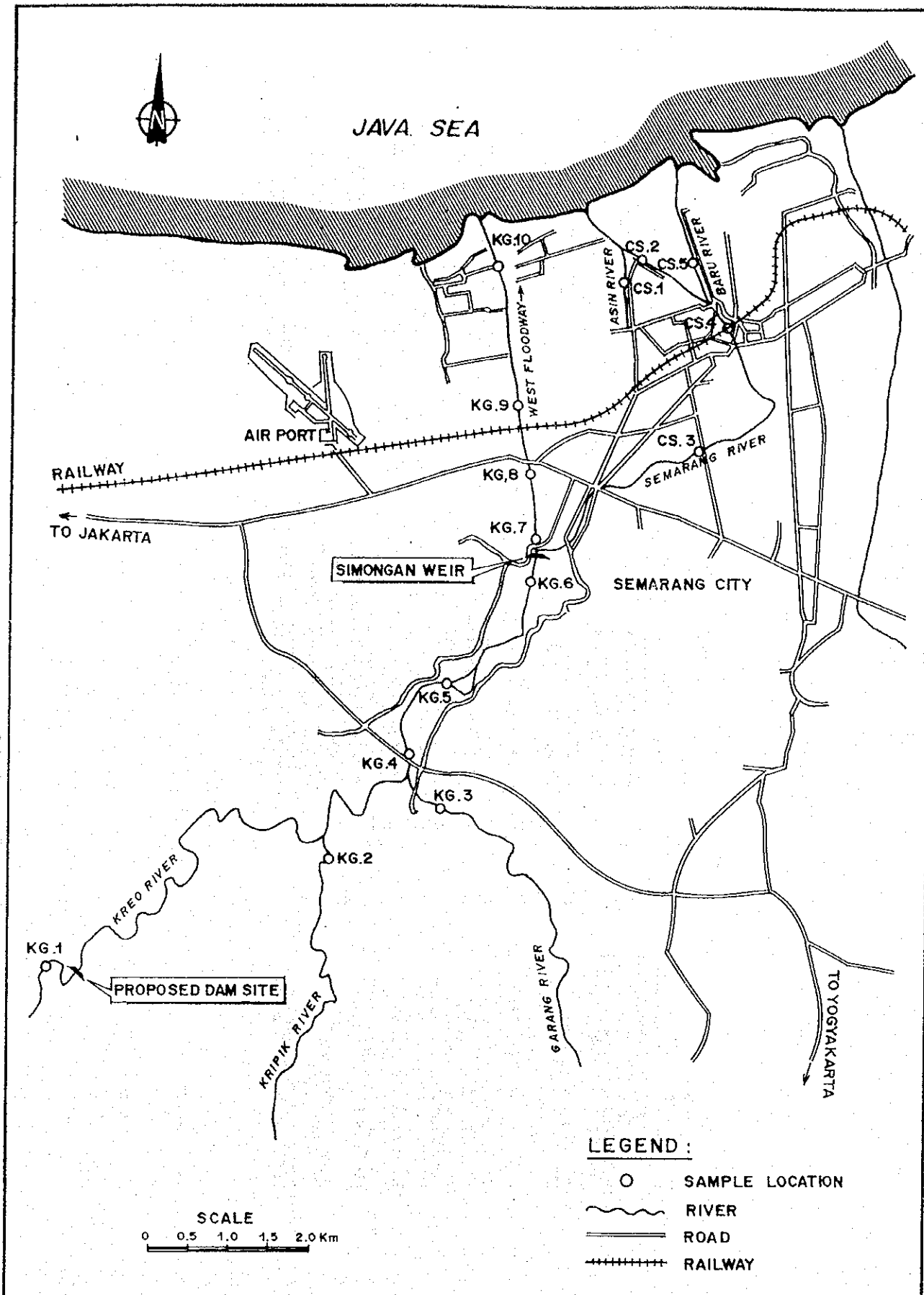
Table 5.2.2 ENVIRONMENTAL MONITORING PLAN

Managing Item	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency
(Pre-Construction Stage)					
- Land issues and social unrest	- Interview and field confirmation	- Tanah Mas area on the right bank near river mouth	- Monthly	- As long as problems exist	- Land acquisition committee - Project office
- Roadside trees along the floodway	- Field Inspection	- Downstream from Simongan Weir	- Weekly	- Until embankment work is over	- Project office
(Construction Stage)					
- Noise	- Measured by noise level meter	- villages along the river and floodway	- Bi-monthly	- Construction period	- Project office
- Air pollution	- High volume sampling method	- villages along the river and floodway	- Bi-monthly	- Construction period	- Project office
- Traffic congestion	- Traffic congestion frequency/duration	- villages along the river and floodway	- Weekly	- Construction period	- Project office
- Water quality of the river	- Test and analysis of sample water in laboratory	- sampling locations selected in EIA	- Monthly	- Construction period	- Project office - Environment bureau of Provincial Gov.
- Sedimentation	- Field Inspection and measurement	- Downstream from Tugu Suharto	- Monthly	- Construction period	- Project office
- Road Damage	- Field Inspection and measurement	- City roads along the river/floodway	- Monthly	- Construction period	- Project office
- Aquatic biota	- Test and analysis of sample water in laboratory	- sampling locations selected in EIA	- Monthly	- Construction period	- Project office
- Existing water intake facilities	- Water flow - Water level	- PDAM Water Intake Intake to the left bank canal	- Daily	- Construction period	- Project office - PDAM
- Sand quarry operatio	- Field Inspection of sand quarry activity	- Downstream portion from Tugu Suharto canal	- Weekly	- Construction period	- Project office
- Railway Bridge	- Field Inspection on risk management	- Railway bridge over west floodway	- Daily	- Construction period	- Project office - PJKA
- Ferry Boat service	- Inspection on service frequency	- Ferry service location and route	- Daily	- Construction period	- Project office
(Post-Construction Stage)					
- Illegal land use	- Field Inspection	- Tanah Mas area (right bank near river mouth)	- Bi-monthly	- Min. 2 years	- Project office - Chief of Sub-district
- Water quality	- Test and analysis of sample water in laboratory	- sampling locations selected in EIA	- Monthly	- No-limit	- Project office
- Flood mitigation	- Inspection flood frequency/duration	- Flood-prone area along Garang river/floodway	- Every rainy season	- No-limit	- Project office
- Water intake facilities	- Field Inspection	- PDAM Water Intake - Intake to the left bank	- Daily	- No-limit	- Project office - PDAM
- River morphology	- Field Inspection and measurement	- Downstream portion from Tugu Suharto	- Every 6 months	- No-limit	- Project office

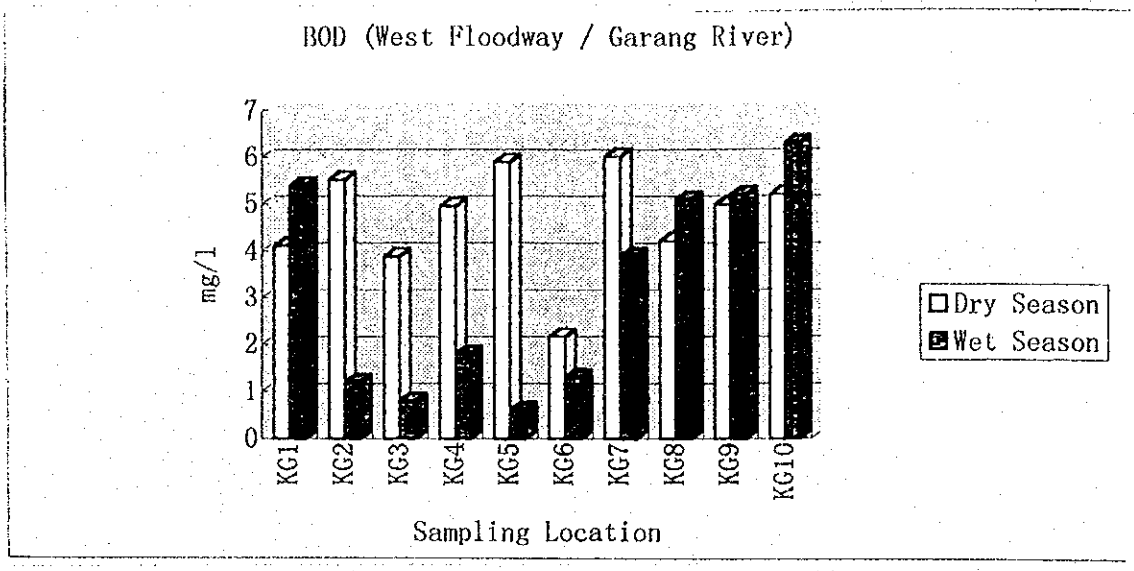
FIGURES

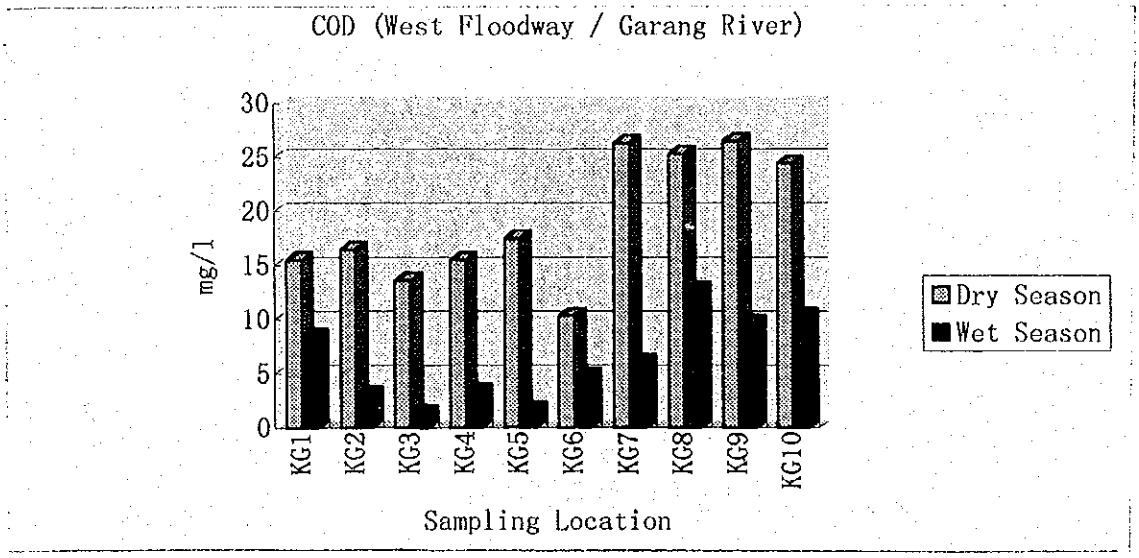
CHAPTER 5

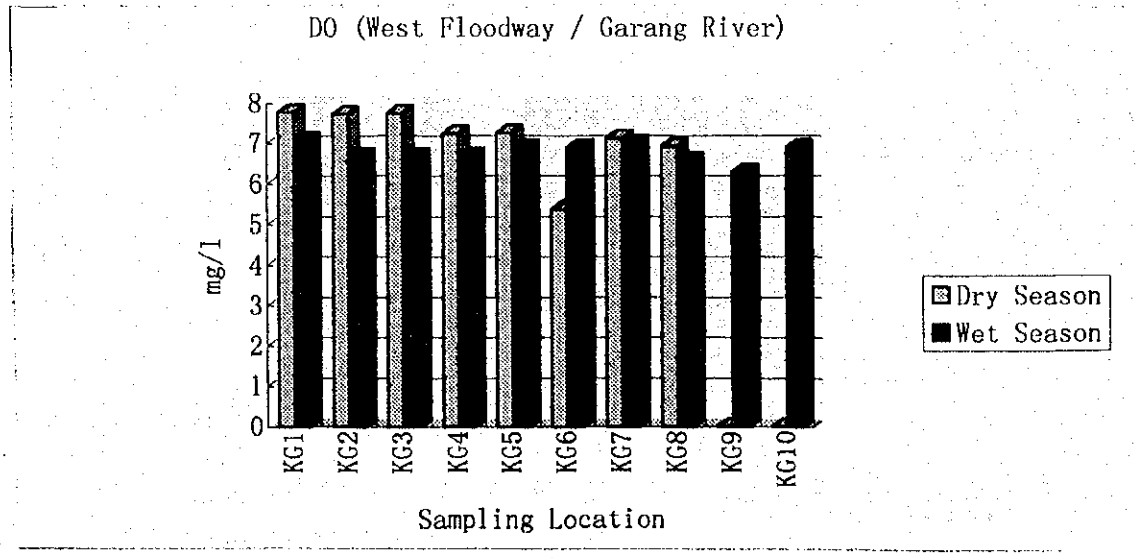
ENVIRONMENTAL AND SOCIAL IMPACTS



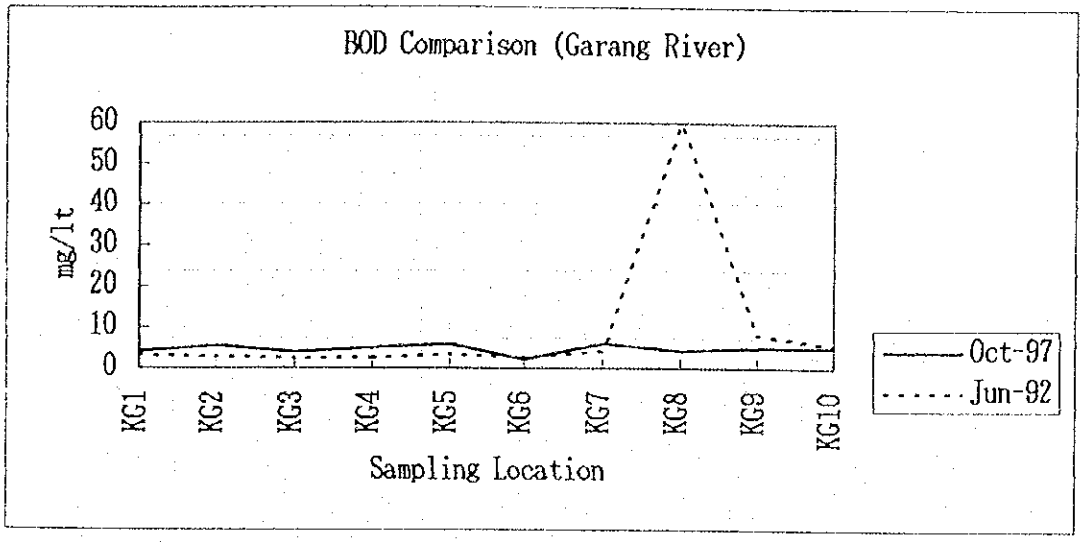
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.1 WATER SAMPLING LOCATION
JAPAN INTERNATIONAL COOPERATION AGENCY	

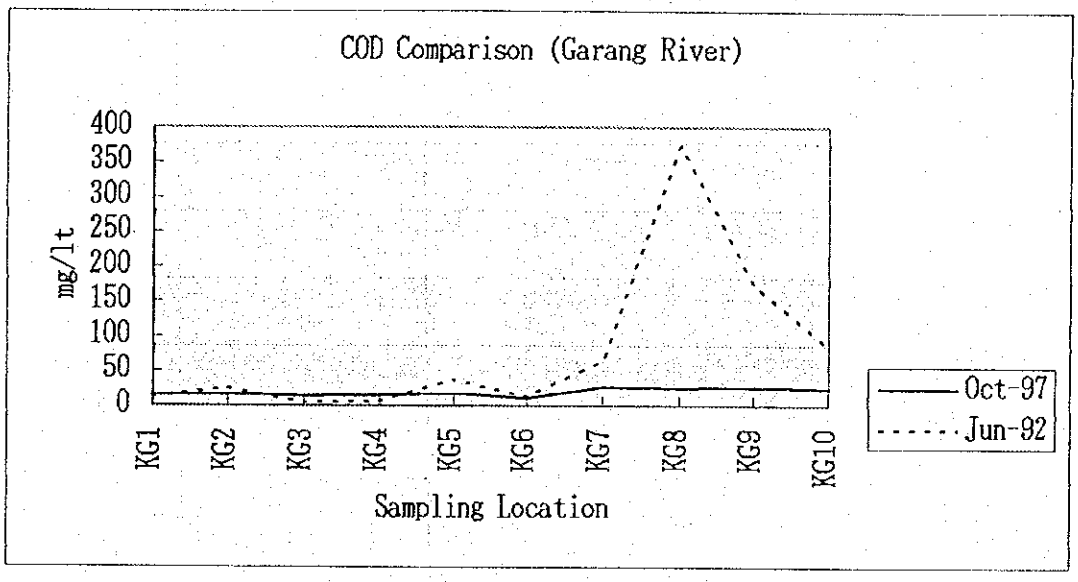


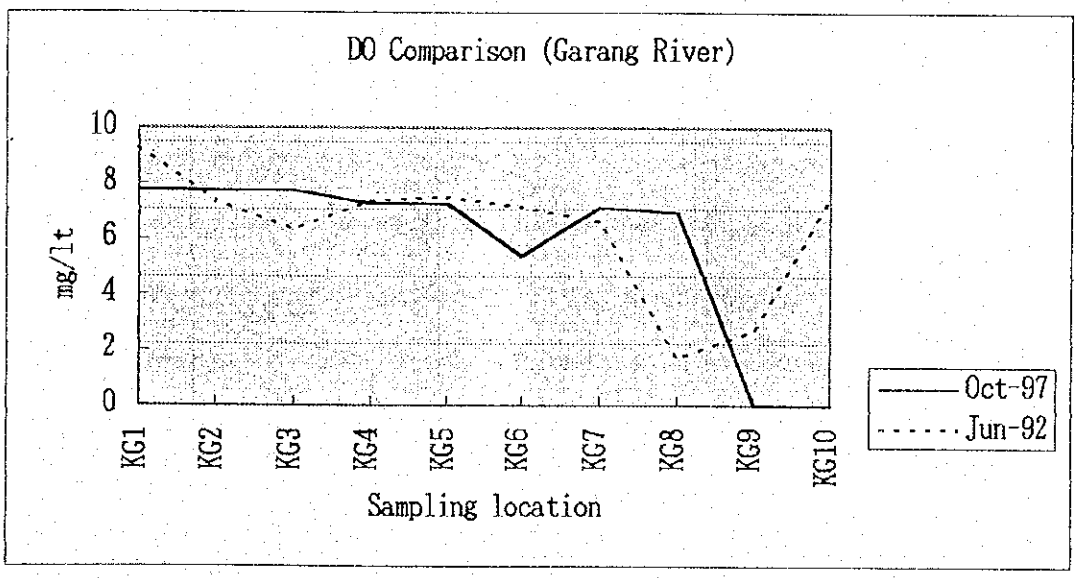




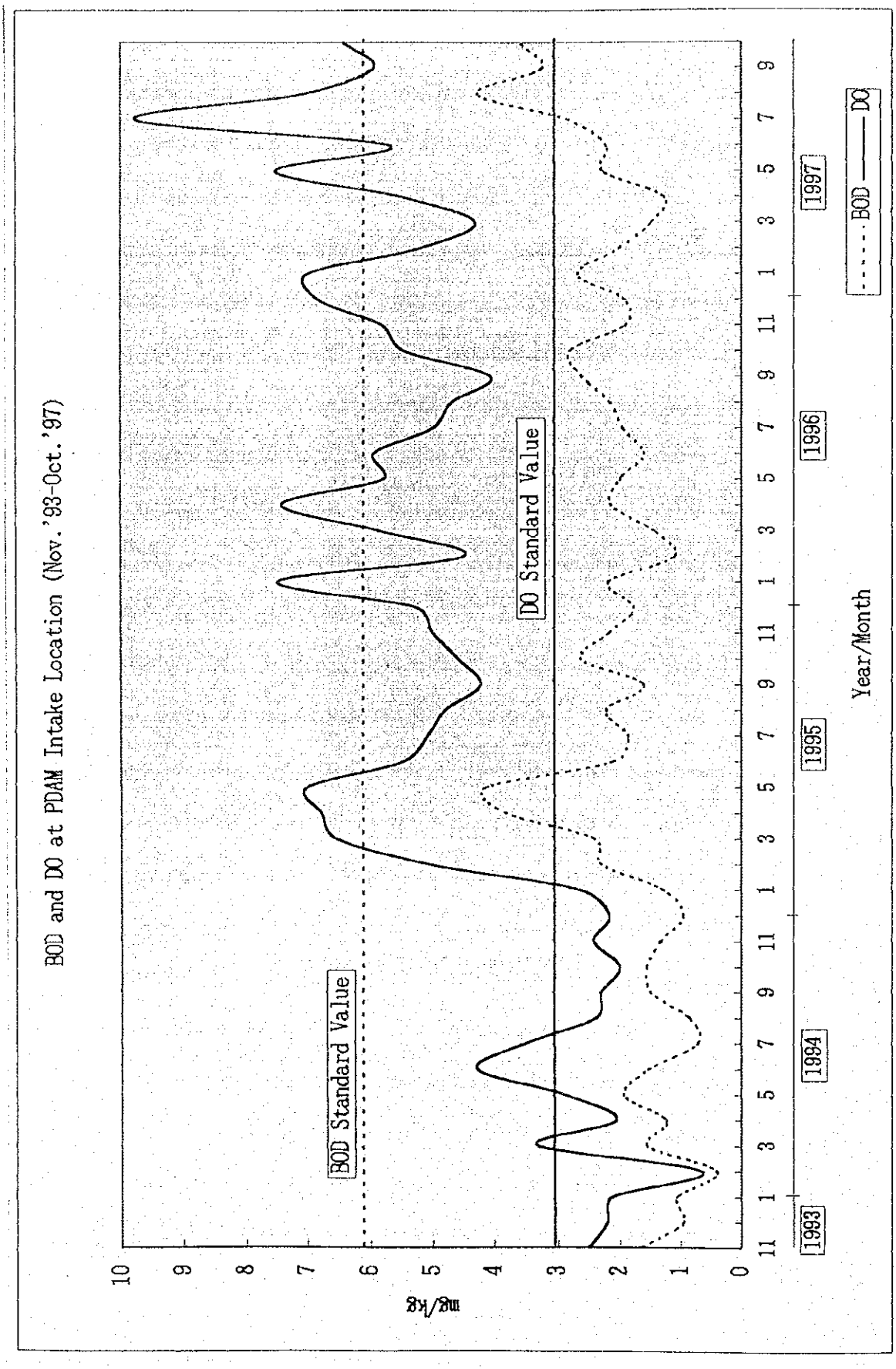
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.2 CONCENTRATIONS OF BOD, COD AND DO
JAPAN INTERNATIONAL COOPERATION AGENCY	



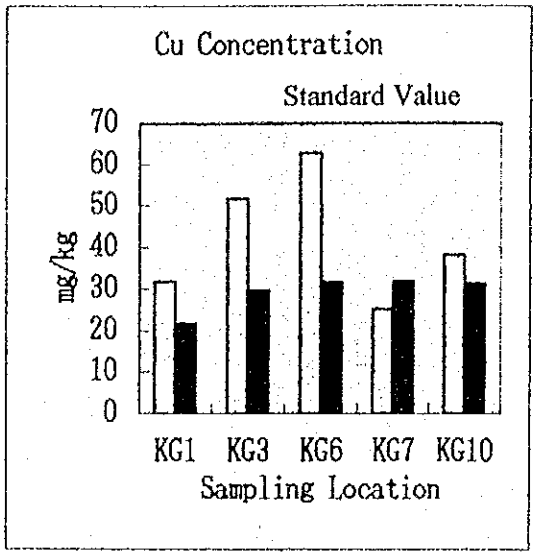


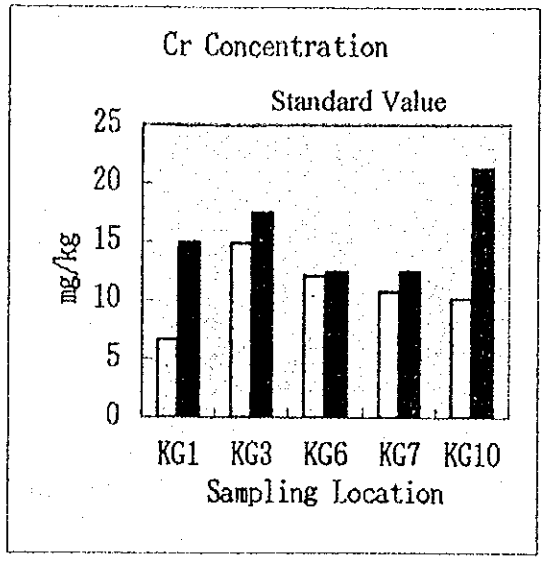


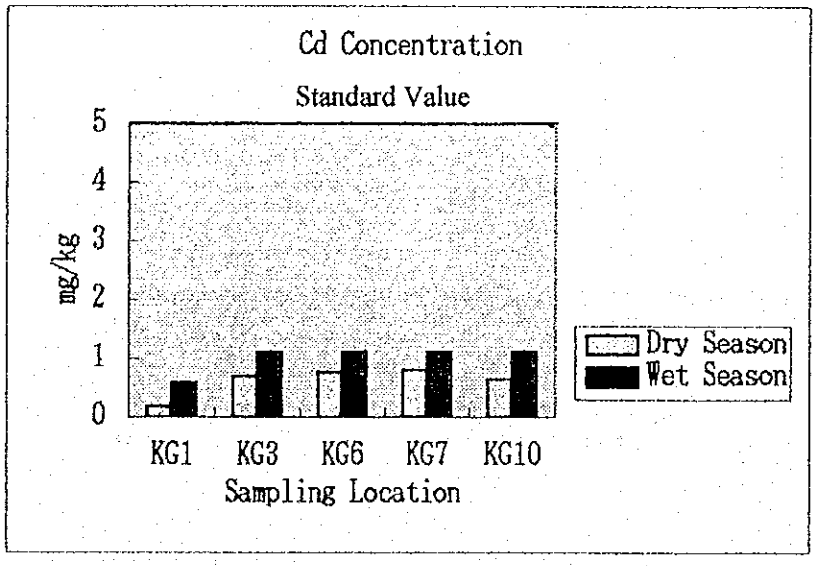
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.3 BOD, COD AND DO COMPARED WITH RESULTS OF 1992
JAPAN INTERNATIONAL COOPERATION AGENCY	

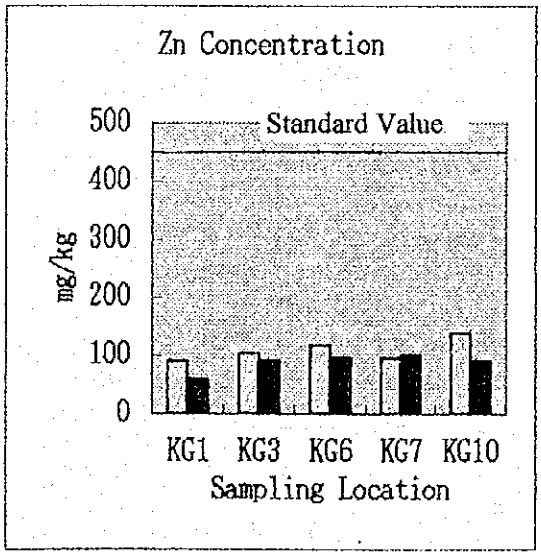


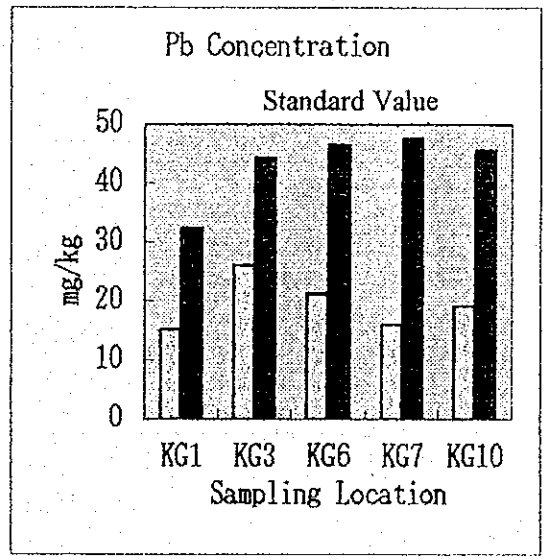
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.4 BOD AND DO AT PDAM WATER INTAKE LOCATION
JAPAN INTERNATIONAL COOPERATION AGENCY	







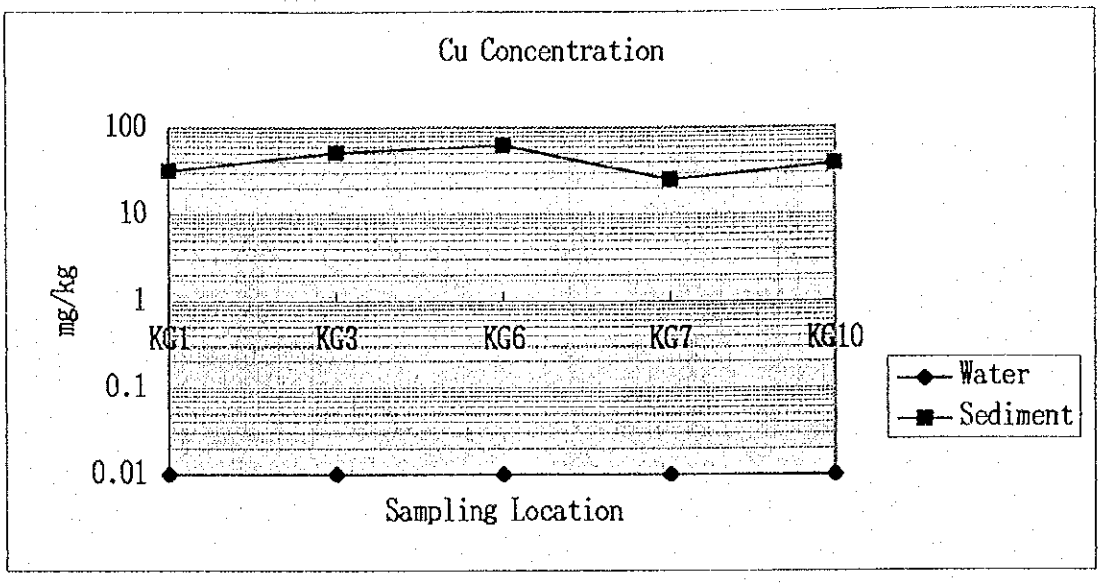


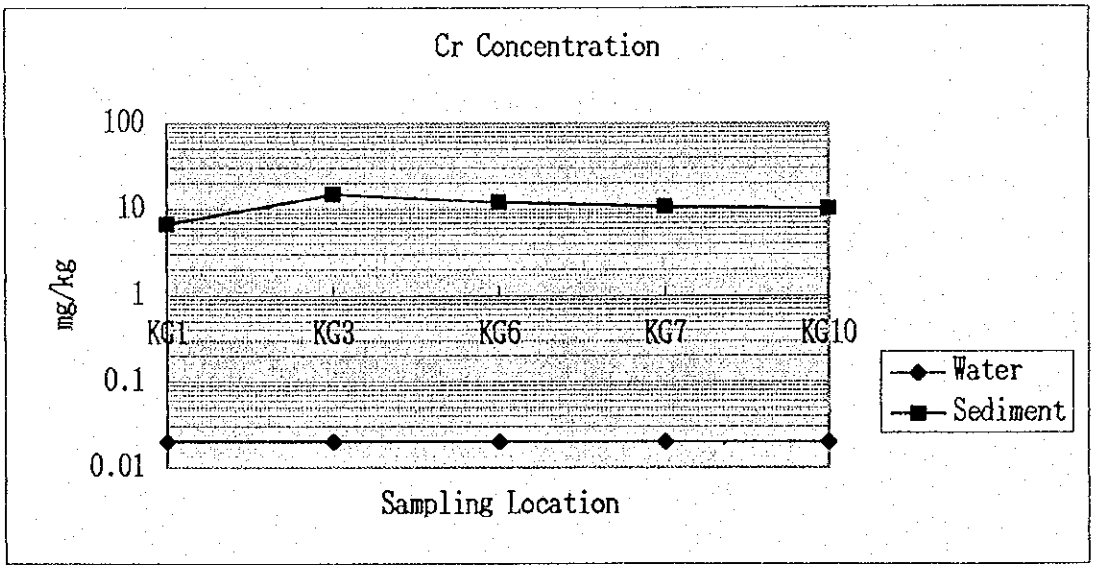


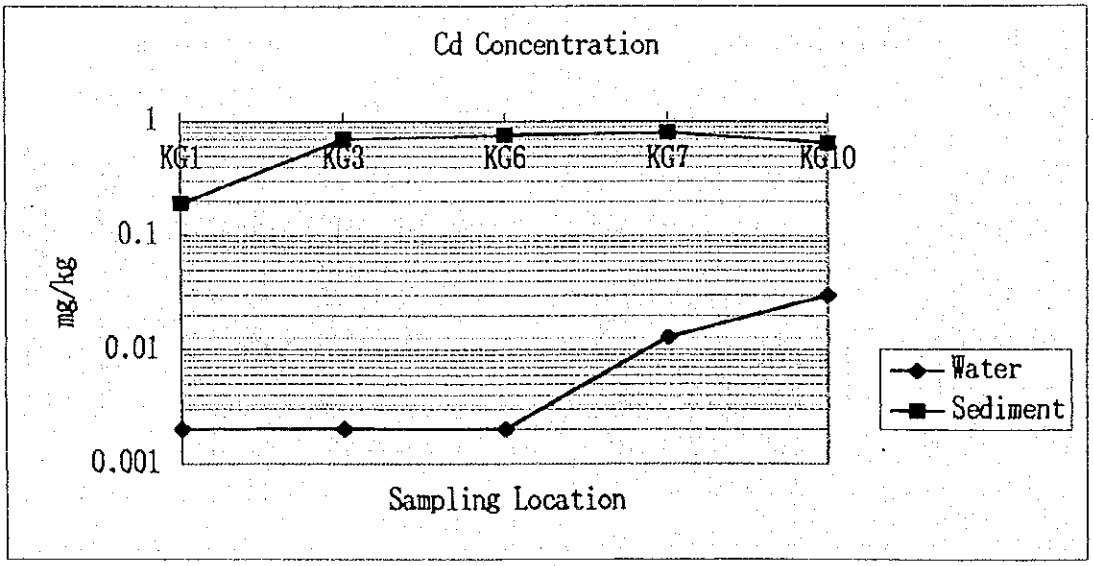
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

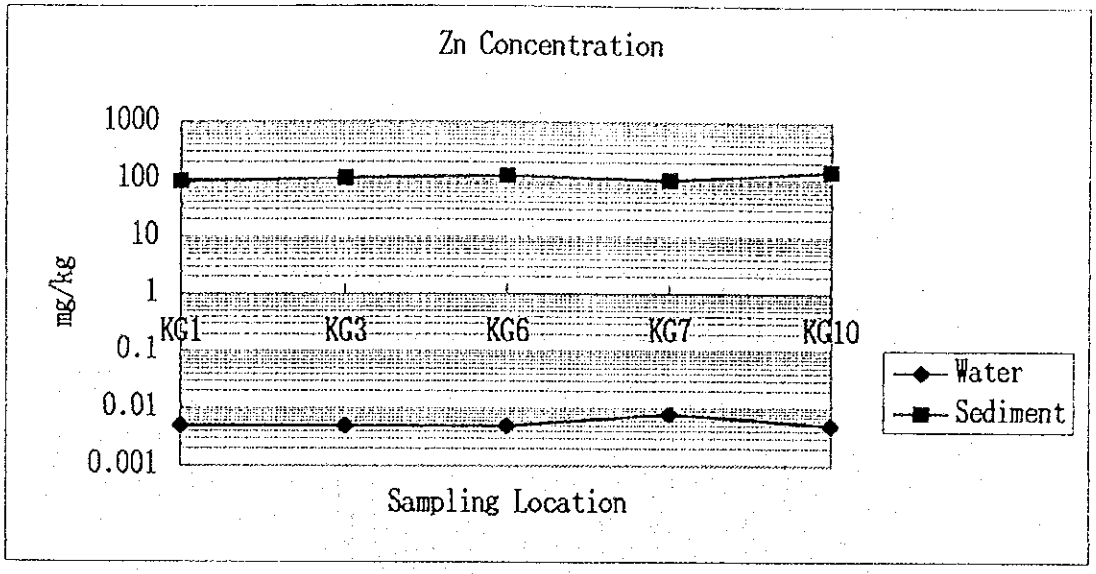
Fig. 5.1.5
CONCENTRATION OF HEAVY METAL IN SEDIMENT

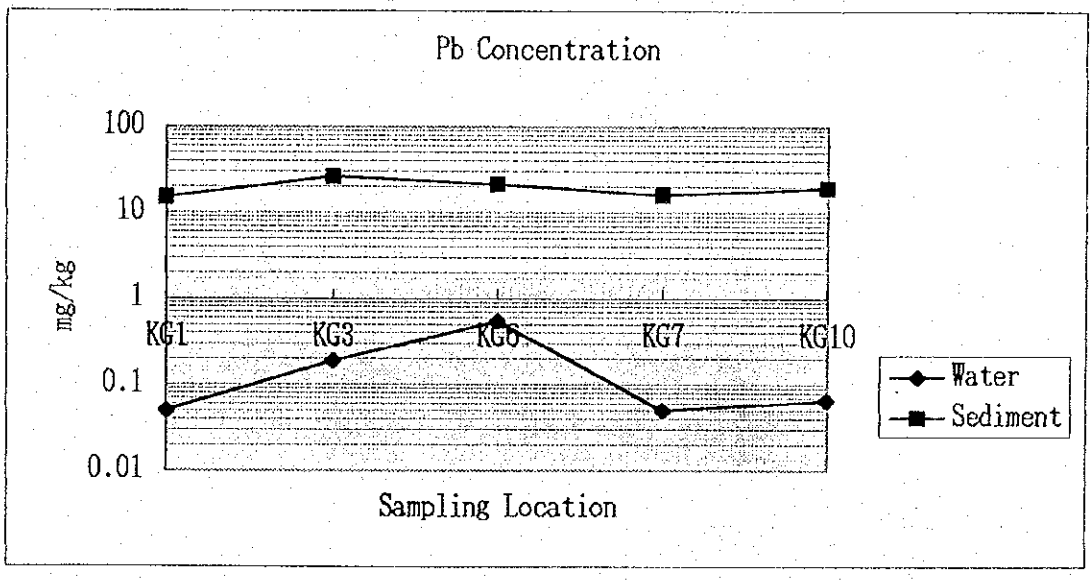




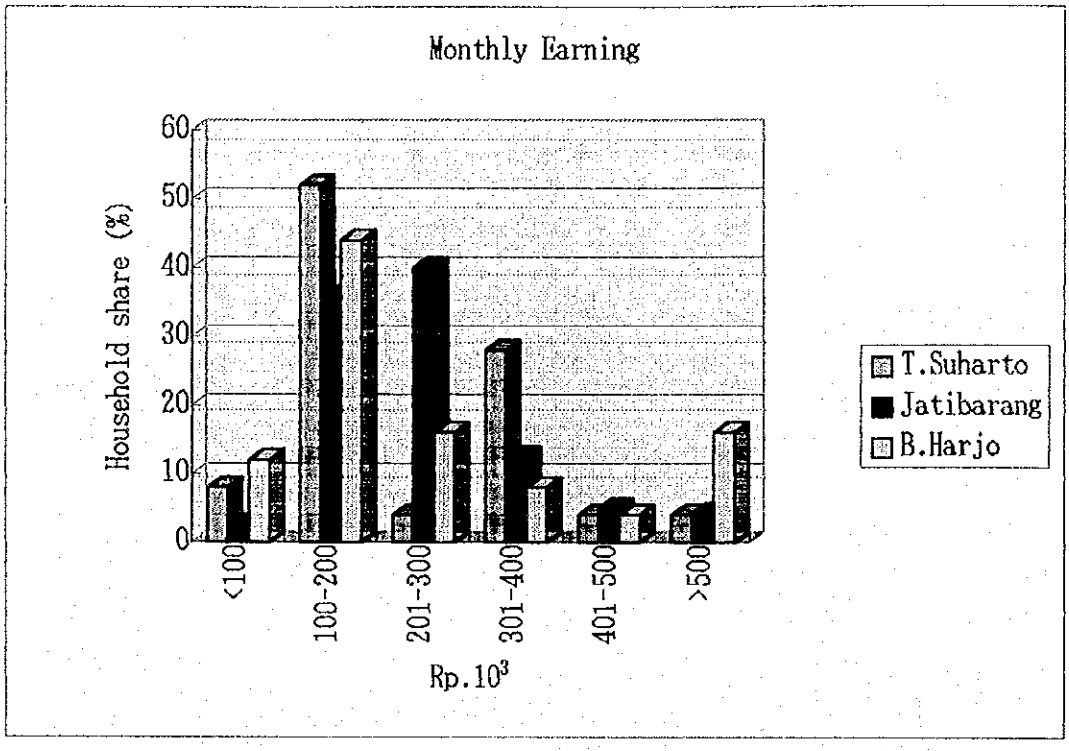


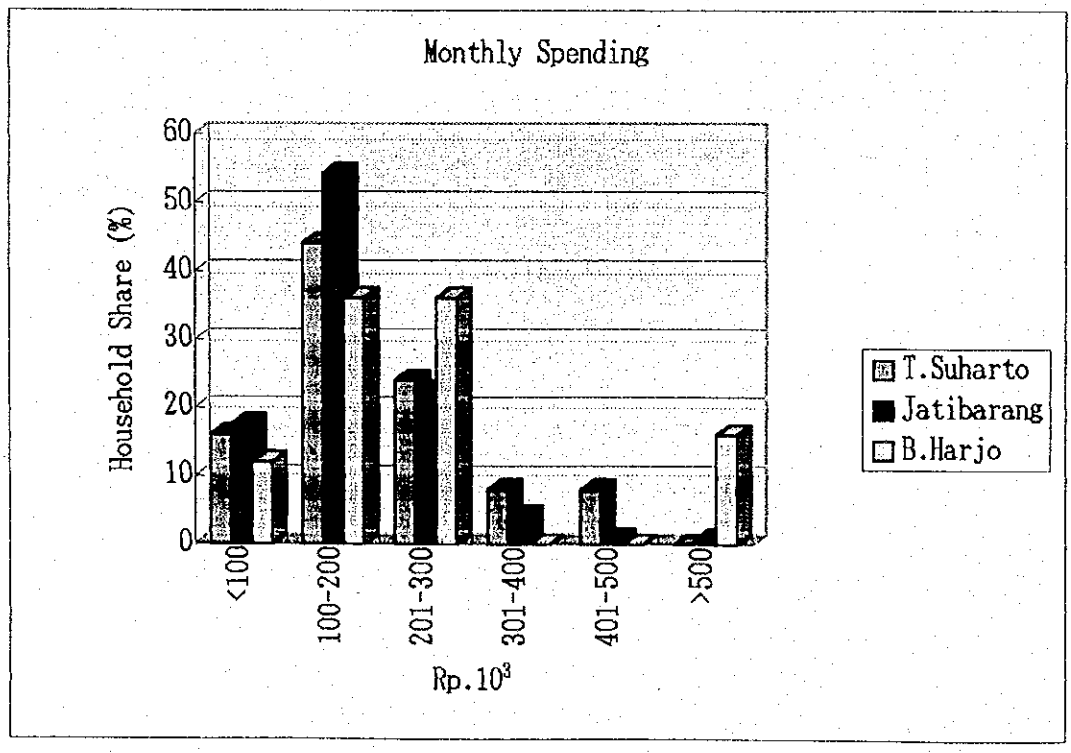
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.6 (1/2) COMPARISON OF HEAVY METAL CONCENTRATION BETWEEN WATER AND SEDIMENT
JAPAN INTERNATIONAL COOPERATION AGENCY	



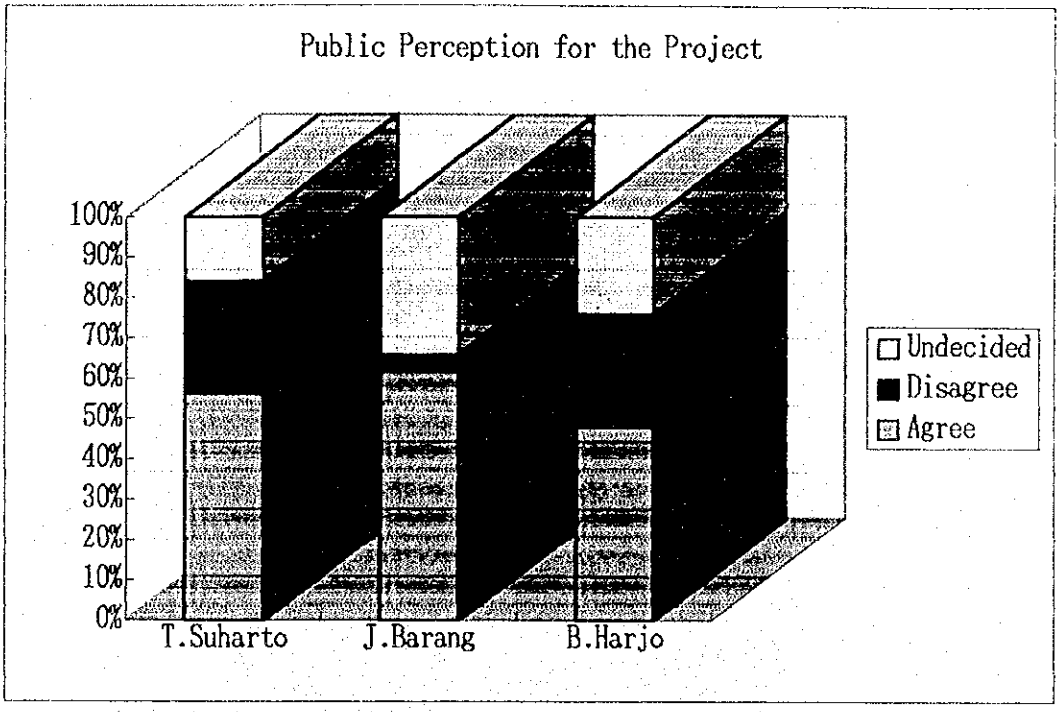


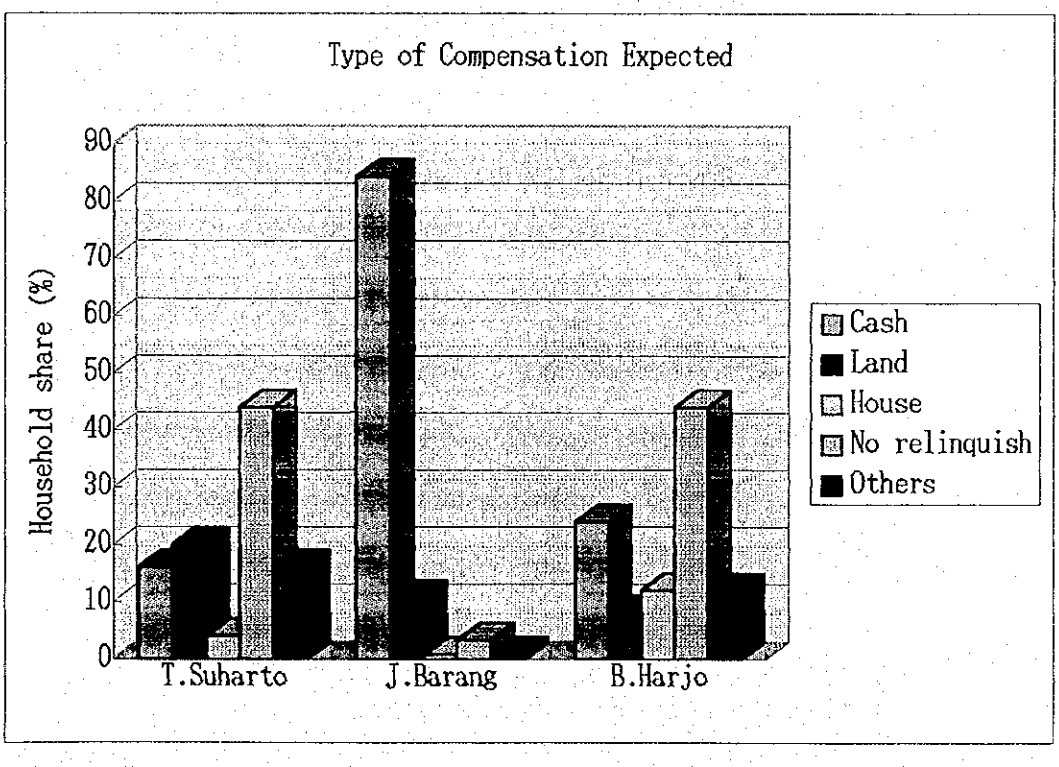
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.6 (2/2) COMPARISON OF HEAVY METAL CONCENTRATION BETWEEN WATER AND SEDIMENT
JAPAN INTERNATIONAL COOPERATION AGENCY	



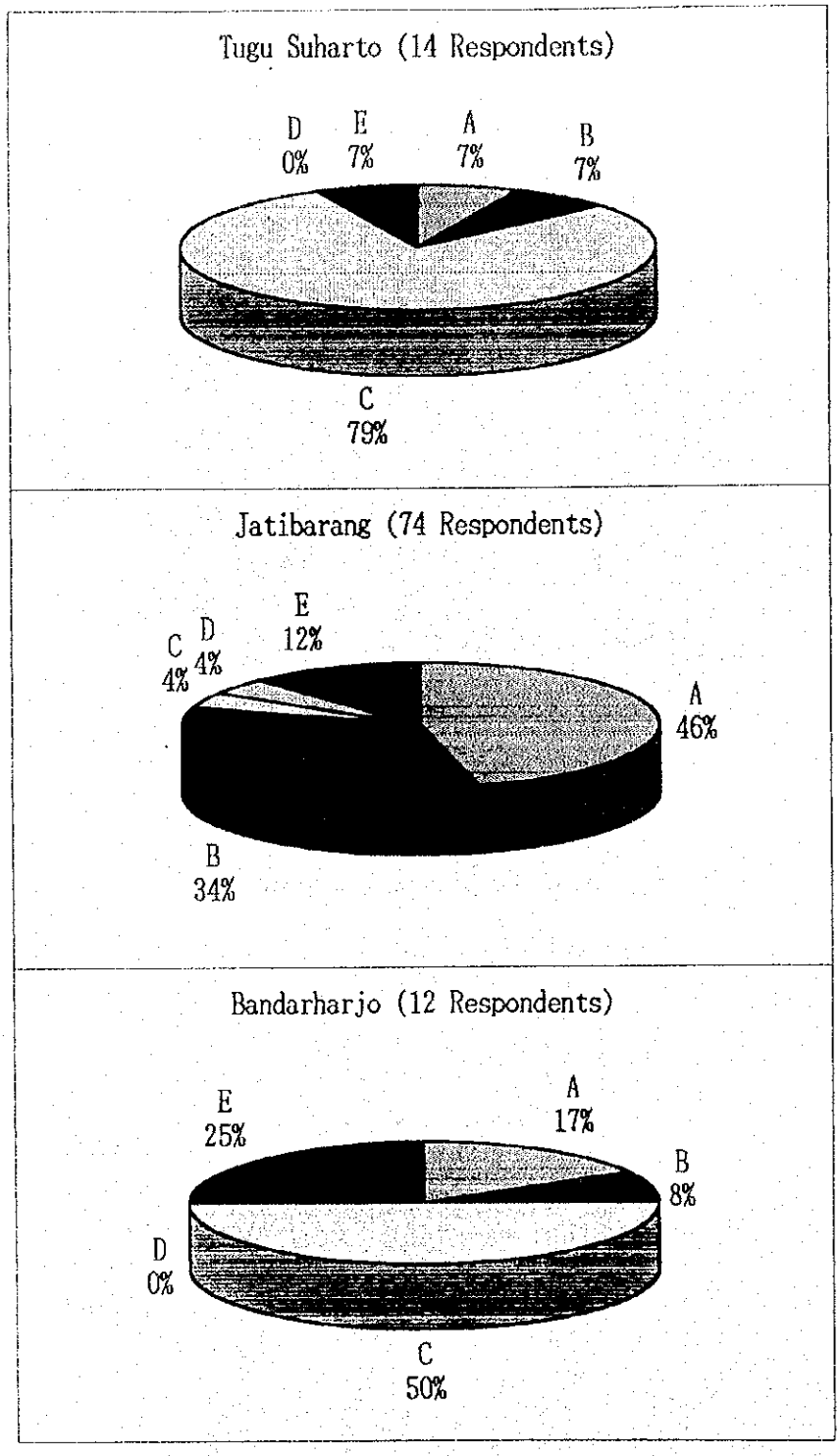


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.7 ECONOMY OF PROJECT-AFFECTED FAMILIES
JAPAN INTERNATIONAL COOPERATION AGENCY	



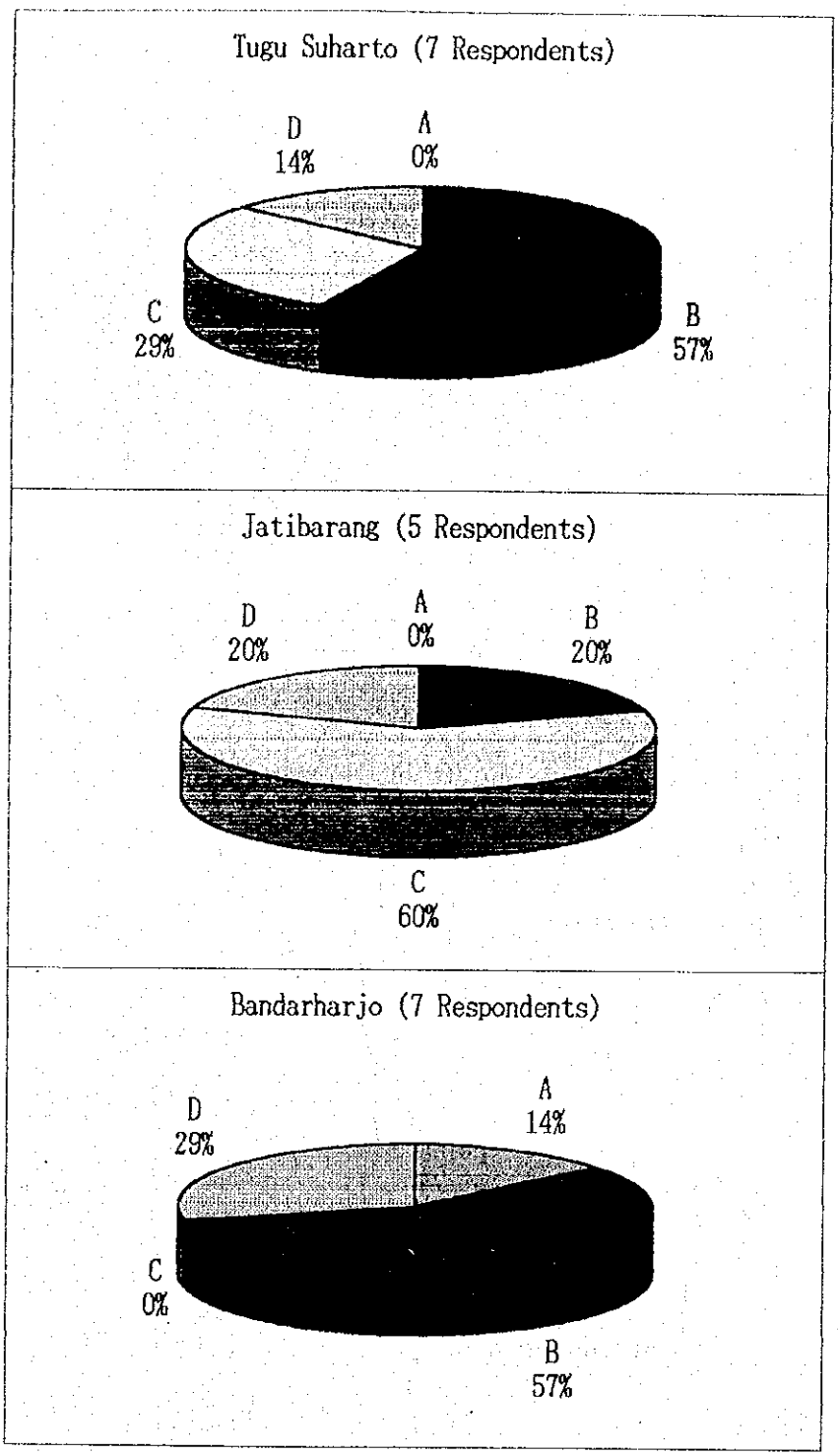


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.8 PUBLIC PERCEPTION FOR THE PROJECT AND EXPECTED METHOD OF COMPENSATION
JAPAN INTERNATIONAL COOPERATION AGENCY	



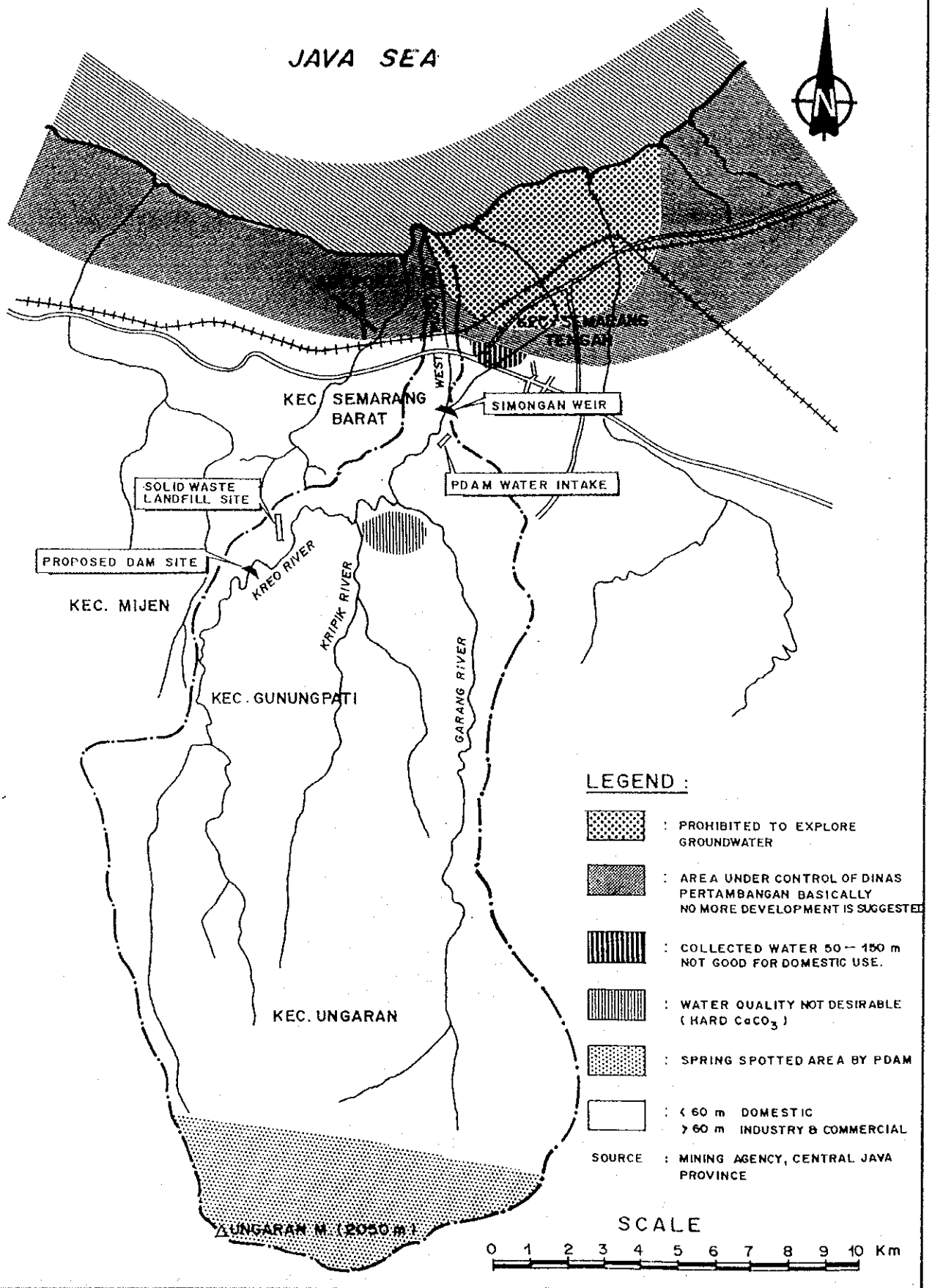
A: Willingness to participate in the Project
B: Obligation because of Govt's program
C: Desire of flood damage mitigation
D: Enhancement of water supply availability
E: Others

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.9 REASONS FOR AGREEMENT ABOUT PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY	



A: No benefit expected for respondents
B: No benefit expected for community
C: Concern about social unrest
D: Others

THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.10 REASONS FOR DISAGREEMENT ABOUT PROJECT
JAPAN INTERNATIONAL COOPERATION AGENCY	

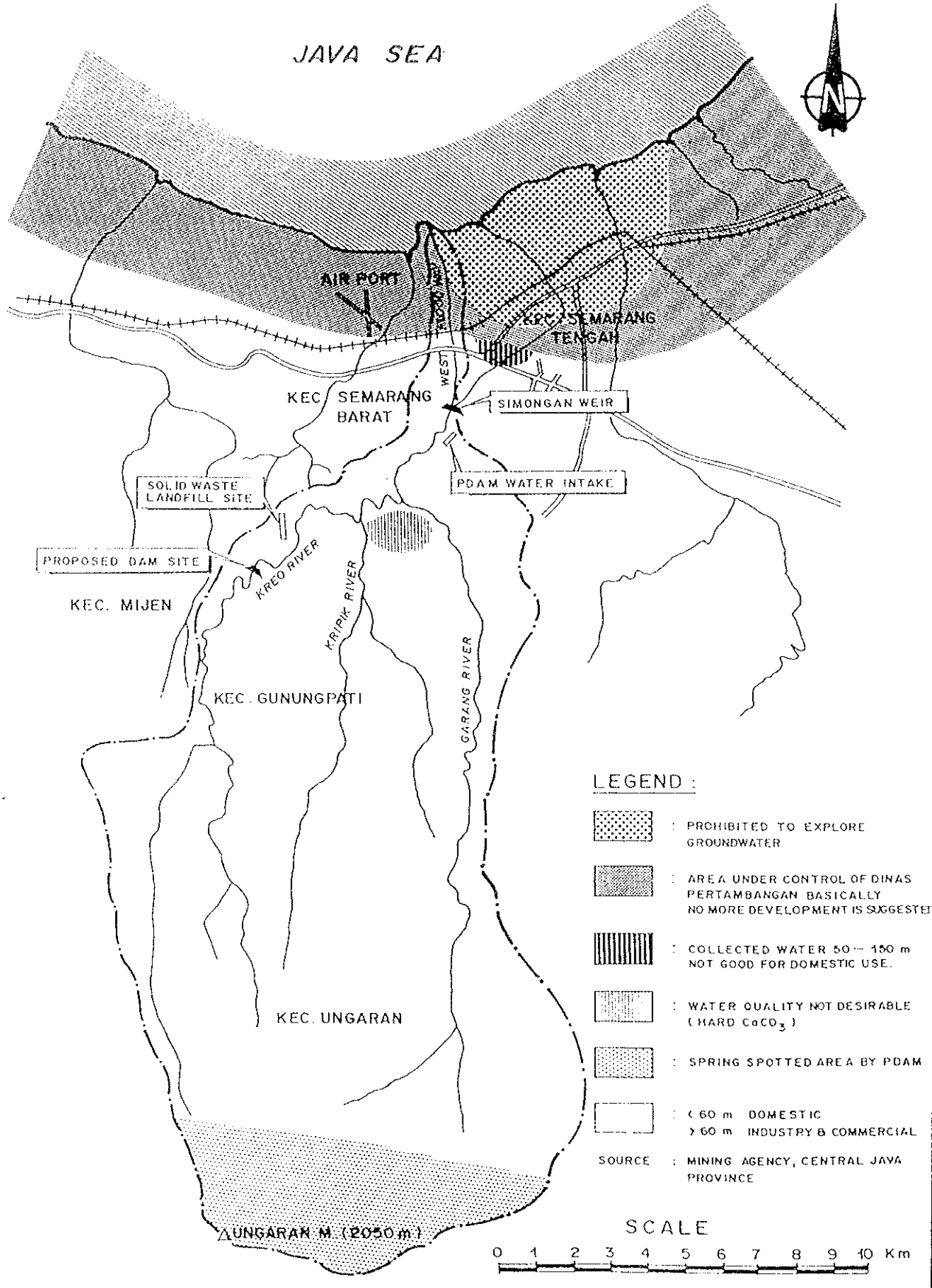


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.3.1

GROUNDWATER RESERVOIR AND CONDITIONS OF AQUIFIER ZONE



THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

JAPAN INTERNATIONAL COOPERATION AGENCY

Fig. 5.3.1

GROUNDWATER RESERVOIR AND CONDITIONS OF AQUIFIER ZONE