CHAPTER 5

ENVIRONMENTAL AND SOCIAL IMPACTS

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5.1 Environmental Impact Analysis

5.1.1 Natural Environment

The study area covers 204 km² 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.6.1.1). Water quality test was conducted in the laboratory of Diponegoro University for physical, chemical and microbiological analysis. The test results are given in Table 6.1.1. 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

Standard C can be employed for Semarang, Asin and Baru rivers since PDAM water intake facility is located upstream of those river basins and nobody uses them as source of domestic water supply. Sample waters of Semarang, Asin and Baru rivers taken near the estuary are brackish as well, except for the location CS3 in the upper reaches of Semarang River, where Gajah Mada street crosses over the river channel.

Test results are considered to represent water quality of the rivers in dry season since the rainy season was unusually delayed in 1997, thereby sampling was carried out in drought-stricken period. 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

Semarang River running through downtown of the city was once playing an important role as a source of domestic water, but now its function has been changed due to the population growth, to a main urban drainage channel and sewerage collecting domestic, commercial and industrial wastes. Consequently, BOD and COD are showing so high. Particularly, Asin and Baru rivers, tributaries of Semarang River, are extremely polluted and thereby generating stench as water is stagnant with full of organic matters. Under such environment, DO is depleted in the surface water. This can result in undesirable aquatic ecosystem not allowing faunal or floral species to survive.

BOD, COD and DO at each sampling location are graphically shown in Fig.6.1.2. 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.6.1.3). It shows remarkable changes in water quality causing Semarang, Asin and Baru rivers to the development of septic conditions.

(2) Heavy Metals

Taking a look at Semarang River and its tributaries, Asin and Baru rivers, Cd and Zn are found at high level in Baru River showing 0.033 mg/*l* and 0.050 mg/*l* respectively, both of which are over the requirement of Standard C. In the meantime, Pb concentration is remarkably high as showing 5 or 6 times more than allowable limit for Asin and Baru rivers and 3 times for Semarang River. For further parameters such as Cr and Cu, content values are negligible, that is to say, there will be no particular indication in the test results.

(3) Nutrients

As general characteristics of the urban river, Semarang, Asin and Baru rivers, running through population-concentrated area in the lowland of the city, are more polluted in terms of nutrient concentration, compared to Garang River. Particularly, Asin and Baru rivers are showing high values in NH_4-N and PO_4-P due to the development of undesirable septic conditions.

(4) Coliform

As the urban river is destined for being polluted in proportion to the population growth, the aquatic environment of Semarang, Asin and Baru rivers is extremely worsened as a result of receiving wastewater. The situation is more or less the same as KG6 in relation to the appearance of coliform organisms. Pathogenic bacteria found in the above three rivers are identified as Eschericia coli, Salmonella sp, Shigella sp and Vibrio sp.

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 6.1.2. 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

Semarang, Asin and Baru rivers are all tidal streams, so that water quality may vary depending on tide period. Water becomes full of microorganism at the ebb tide allowing algae to predominate. This can affect DO balance by causing anaerobic conditions. The situation is, however, recoverable at the high tide. As a result of study on algae presence, water quality of the above rivers is, in general, not so deteriorated as predicted if tidal affect is taken into consideration.

(2) Benthos

According to sample analysis, urban rivers are judged improper to provide or maintain desirable habitat, because no benthic animals are found in the bottom of water due to anaerobic conditions, except CS4 where a single species of Oligochaeta, Tubifex sp, is observed.

(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.

In view of habitat suitability and desirability, there seems to be no fishes in urban rivers because DO is depleted due to the high organic pollution, but anadromous fishes might appear sometimes in Asin and Semarang rivers with tidal sea water.

(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. Following three (3) 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	CS1,2,3,4,5
Kremah	Alternanthera sessilis	CS1,2,3,4,5
Eceng gondok	Eichhornia crassipes	CS3

Sediment Analysis

Sediment samples were taken from five locations along urban rivers to examine heavy metals concentration. The analysis results are shown in Table 6.1.4. 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 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, 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.6.1.5).

Sediment Leaching Test

As described above, high content of heavy metals have been detected from the sediment of Asin, Semarang and Baru rivers. It will be, therefore, necessary to conduct sediment leaching test with the aim of assessing significant impacts on environment when dredged material is disposed at a land reclamation site.

Sampling locations are the same as those indicated in the above sediment analysis, and three(3) sediment samples have been taken in proper manner from the channel bed of respective location. These are from the top layer (about 10 cm deep from the river bed), the middle layer (30 to 40 cm) and the bottom layer (about 70 cm deep) and kept in sealed containers which are clean and free from foreign substances. Leaching test was carried out in the laboratory of Diponegoro University for analyzing concentration of the following ten (10) parameters: Alkyl mercury (O-Hg), Total mercury (T-Hg), Cadmium (Cd), Lead (Pb), Organic phosphorus (O-P), Hexavalent chromium (Cr^{6+}), Arsenic (As), Cyanide (Cn), Copper (Cu), and Zinc (Zn). Table 3.1.5 presents the results of sediment leaching test.

From the three samples taken from each location, an average concentration is to be calculated for determining impact significance, and the test output shows that heavy metal concentration is below the standard value (maximum allowable limit) except for alkyl mercury. According to Japanese standard for sediment disposal at reclaimed land, alkyl mercury should not be detected. If detected, it should be properly treated to comply with the standard. The test results are tabulated as follows:

(Unit: μg/l)

Location	Sampling Layer			Average
	Top	Middle	Bottom	
CS1	0.68	0.86	0.86	0.80
CS2	0.20	0.86	0.68	0.58
CS3	0.25	1.91	1.91	1.35
CS4	1.23	1.23	0.86	1.11
CS5	0.25	0.20	0.86	0.44

In considering the test result, treatment test is required to determine the most appropriate method for the prevention of leach of alkyl mercury. The detectable limit by the gas chromatography is said to be 0.01 μgram/liter.

Treatment Test

Treatment test was conducted by mixing sediment with three(3) types of material such as soil, lime and cement in order to reduce concentration of heavy metals in the leachate. Soil is expected to reduce permeability, and lime will function to immobilize heavy metals by increasing pH which may result in low solubility. Meanwhile, cement can be used as the most common and effective means for the prevention of heavy metal leachate. Heavy metals will be physically confined by cement gel or may be absorbed by solidified matrix. The mixing ratio varies in an attempt to find an optimum quantity of material for the treatment. The ratios of sediment to each material are given as follows:

Soil : 1 : 1, 1 : 2, 1 : 3, 1 : 4 and 1 : 5

Lime : 1 : 0.10, 1 : 0.15, 1 : 0.20, 1 : 0.25 and 1 : 0.30

Cement : 1 : 0.03, 1 : 0.05, 1 : 0.07, 1 : 0.10, 1 : 0.15, 1 : 0.20, 1 : 0.25 and 1 : 0.30

As a result of treatment test, alkyl mercury was still detected from the leachate when the sediment was mixed with soil and lime at any ratio. This can be explained in such a way that the specimen was not hard enough to bear the leaching test and broken to pieces in the water. In consequence, alkyl mercury was dissolved again in the water, and its concentration is likely to remain unchanged without reference to the mixing ratio. When the polluted sediment was treated with cement, alkyl mercury could not be detected from the leachate at the mixing ratio of not less than 1: 0.07. It can be, therefore, considered that seven percent (7 %) is the optimum quantity of cement for the treatment of hazardous substance. Table 3.1.6 shows the results of treatment test.

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

(1) General Information

For the installation of pumping station in Bandarharjo, three houses located at the Semarang-Asin confluence are required to move out to the nearby location. In addition, there are about 30 houses south of Telaga Mas Raya street and between Asin River and Hasanudin street, but these are not likely to be directly affected families to evacuate themselves from their places because stormwater drain system will be designed to demand private property to the minimum scale possible and not to widen existing channel. The project also needs to acquire the area covering about 55,000 m^2 of land on the right bank of Semarang River which is legally owned by the Port Authority. However, it is actually occupied by a numerous small-scaled industries, such as dry fish and smoked fish processing plants and woodworking factories, absorbing around 260 local manpower. All these factories are scheduled to be relocated under Urban Renewal Project in the fiscal year 1998/99.

(2) Impact Survey

Impact survey was carried out in Bandarharjo urban drainage area covering 3 families in the proposed Asin River Pumping Station and 22 households situated in upper Asin along Hasanudin street. Among those the majority is composed of 3 to 4 family members, but the above three in north Asin are relatively large families with 6,8 and 9 members respectively. There are 6 respondents who have been living there for 6 years as the minimum length of stay, whereas 12 neighbors are for over 25 years.

Although Port Authority has land ownership for the proposed pumping station, there will be 3 direct affected families for house evacuation so that proper relocation place should be provided for them under the project. Meanwhile, people in upper Asin who have their own land and house are not required to move out. The survey result shows that 17 answerers do not feel comfortable in terms of habitability.

(3) Home Economy

Husband's earning is the major income source, but some housewives and their sons or daughters are also making contribution to the family economy. They are engaged in different types of job such as traders, shop employees, construction workers and so on.

There are 4 families in upper Asin whose income is more than Rp.500,000 a month, but if income level is lowered to less than Rp.300,000, it will correspond to 18 families accounting for 72 % of all respondents, and if further reduced to Rp.200,000 or less, there might be 14 households or 56 %.

Having a look at monthly expenditure, 12 cases or 48 % of interviewed families are spending not more than Rp.200,000 and this goes up to 21 cases (84 %) under the condition of less than Rp.300,000. To know the fact that food is the major item family spends on, further question on food expenditure was posed to the residents, and as a result 17 households answered that the amount of money spent on food is less than Rp.150,000.

(4) Land and Housing

In upper Asin 18 out of 22 households possess their own property and only 2 families

are renting land and house. Table below shows that the living space of less than 50 m^2 can be considered as a representative size for low income habitants in this area as this number is applicable to the 60 % of respondents for the land and 66 % for the house.

LAND AND HOUSE SIZE

Area (m^2)	Land		House	
	No.of Families	%	No.of Families	%
< 25	4	16.0	5	20.0
25 ~ 50	11	44.0	11	44.0
51 ~ 75	5	20.0	5	20.0
76 ~ 100	3	12.0	2	8.0
101 ~ 125	2	8.0	2	8.0
126 ~ 150	-	-	-	-
> 150	-	-	-	-
Total	25	100.0	25	100.0

Almost all houses are permanent or semi-permanent typed structure including 5 units of two stories in upper Asin, and the rest of them are all single floor. With regard to floor type, cement, ceramics and porcelain are predominant and earth floor can be hardly seen except one in the proposed pumping station. Clay tiles are mostly used for roof materials followed by zinc and asbestos. As the location of the subject site is on the northern edge of the urban area, electric power is supplied to the 100 % of houses.

(5) Flood Situation

Inundation occurs frequently in every rainy season mainly because of inadequate urban drainage system for stormwater. The situation becomes even worse if flood occurs by overflowing of river banks. Depth of flood water is less than one meter for most cases but sometimes water reaches more than that level. Only some respondents have experienced in such a critical flood condition. With regard to flood duration, 80% of people answered that it would be not more than one day, and the rest of them would be one to two days. Critical level in terms of flood depth and duration will be usually recovered within one day.

(6) Water Use and Sanitation

River water is so polluted that no body can take it for domestic use. Water sources remain unchanged all the year round. Many people are depending upon PDAM water supply system as shown in the table below. In upper Asin there are two families who

enjoy the benefit of deep groundwater, but those in Asin Pumping Station take water from public water tank installed by PDAM for its water delivery service.

Latrine is commonly used without septic tank so that wastes are directly discharged into the river. It should be noted that there are only two families which own septic tank in upper Asin and two others who have no privy are still utilizing river water. Public toilet is installed for the residents in the proposed site of pumping station.

WATER SOURCE

(Unit: Number of households)

Water Source	Location		Total	%
	Upper Asin	Pump Station		
Shallow Well	0	0	0	0.0
Artesian Well	2	0	2	8.0
Spring	0	0	0	0.0
Public Hydrant	0	2	2	8.0
PDAM	18	1	19	76.0
Water Seller	2	0	2	8.0
Rain	0	0	0	0.0
River	0	0	0	0.0
Total	22	3	25	100.0

Since there is municipal garbage collection service in this area, people collect domestic refuse by themselves and dispose it into the waste bin or container. No people buries or incinerate such solid wastes.

There seems to be the same tendency as other regions in terms of predominant disease. Respiratory tract trouble ranks first in the frequency of outbreak, then skin disease and gastric troubles follow.

(7) Public Understanding and Perception

Residents of the proposed pumping station are more informed of the project compared to those of upper Asin, because north Asin is more concerned with the project. As a result of survey it was understood that 12 people agreed to the project and 7 are not, and 6 respondents remained undecided. In this regard no one disagreed in Asin Pumping Station.

Major reasons for agreement are to reduce flood damage (50 %) and to create employment opportunity (25 %), while those for disagreement are to bring no benefits to respondents and to the society.

Various types of compensation are expected if they are judged to be affected

households. Among those 11 are against the relinquishment of their property. Particular attention needs to be paid to the families in north Asin expressing the desire that there is no way but cash-based compensation (refer to Fig.6.2.2)

Public Awareness of the Project

According to the preliminary socio-economic survey conducted in October 1997, people in Bandarharjo are likely to show positive reaction to the urban drainage project because they have been suffering from chronic inundation. The majority of residents can be classified as low income group as their monthly earnings are not more than Rp.250,000. One out of four is engaged in fish industry that is either fisherman or just simple worker of fish smoking plant. In view of the fact that the land ownership of Bandarharjo area is held by the Port Authority, resettlement seems to be the best choice for the affected people to make up for their house evacuation. However, people express the concern about resettlement location as well as their employment opportunity.

Land acquisition shall be performed in accordance with legal procedure stipulated in the Presidential Decree No.55, 1993. It requires to set up a Land Acquisition Committee under the direction of Governor and Mayor. The Committee comprises various responsible agencies to deal with practical works in their respective field in terms of land acquisition, and then inventory survey is to be conducted to estimate compensation cost on land, house, plants and other assets related to the land. The land price is determined based on real or actual value referring to NJOP. The house price is estimated by the Regional Government Agency responsible for house and building, while the selling price of plant is decided by the Agency specialized in the field of agriculture.

Public Health and Sanitation

Residents living in Bandarharjo are threatened by flooding in every rainy season because of its topographic handicap. Furthermore, existing drain system is inadequate to comply with design stormwater discharge. These circumstances create unfavorable sanitary conditions for the people when the area is stricken by inundation. Most of them enjoy water supply services by PDAM and nobody utilizes river water for either washing or bathing due to high pollution. Private or public toilet is installed in or nearby the house but domestic wastes are discharged into Asin or Semarang River.

The type of disease most frequently occurred in this region is similar to that of Semarang City. For example, respiratory tract infection caused by flu ranks top in both local and city levels. With regard to water-related disease, it is reported that skin disease, diarrhea and gastric trouble are ranked high.

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.

Pre-construction Stage

Problems to be considered in this preparatory stage are associated with the land. Small pieces of land will be required for the improvement of Urban Drainage System, so that no social problem may arise form the land acquisition.

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. 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.

Post-construction Stage

With regard to the urban drainage improvement works, some potential problems which might be encountered include pump operation, sedimentation, land subsidence and river mouth morphology. Solid waste accumulation in retarding pond is detrimental to the pump operation, and it may cause suspension of drainage function in high water conditions. The effects of sediment sludge on human health should be considered when it is dredged in the retarding pond and disposed thereafter. The dredged material is contaminated with industrial hazardous waste. The impacts associated with the land subsidence caused by overpumping of groundwater resources can be hardly controlled by the proposed project itself. However, it should be noted that comprehensive drainage system can not be achieved without taking account of the land subsidence. The potential effects of pump drainage system on estuary is also considered in post-construction stage as the sediment transport system to the river mouth may change. The effects on harbor basin may also help assess impact significance. In considering the above descriptions, potential impacts and impact sources can be summarized as follows.

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

Predicted Impacts		Impact Sources
- River morphology	:	River dredging work and channel improvement
- Pump operation	:	Solid waste accumulation in retarding pond
- Retarding pond	:	Soil brought from upper river basin and settled in retarding pond containing industrial hazardous waste
- 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:

Impacts which can be avoided without taking actions are not found and all predicted impacts therein are supposed to be significant and "mitigable". Illegal land use, negative impact in pre-construction stage, may be foreseen in the proposed location of Asin retarding pond, but can be eliminated if the land is properly managed against squatter's intrusion. Although impacts caused by sediment in retarding pond could be mitigated by means of adequate maintenance, it will turn to "not mitigable" conditions unless restrictions are imposed on industrial waste discharge in terms of heavy metal contents. Likewise, land subsidence is unable to be considered as "mitigable" without control of groundwater abstraction. Anyway, for both cases impact minimization is hardly achieved without resort to the collaboration of the industry. The summary is presented as follows:

Mitigation Category		Negative Impacts
Avoidance	:	Not Identified
Minimization	:	Noise, Air pollution, Traffic disturbance, Sedimentation, Dredged material, Pump operation, Retarding pond, Land subsidence, River mouth morphology
Rectification	:	Road damage
Reduction or elimination	:	Illegal land use (proposed location of Asin retarding pond)
Compensation	:	Social unrest caused by land acquisition

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

- 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.
- 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.

- 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

- River morphology : River mouth morphological survey may be required to figure out environmental changes on estuary due to the pump drainage system.

- Pump operation : Garbage cleaning is frequently required in retarding pond as well as pumping station so as not to suspend pump operation.

- Retarding pond : Periodical dredging will be necessary to maintain design capacity of retarding pond, and dredged material should be well treated before being disposed.

- 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 2.4.1 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 2.4.2.

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.

In pre-construction stage, the land issues will be focused on the proposed site for Asin retarding pond, so that monitoring is required to keep watch on how the situation is going to be.

As the project site is located at the downtown of Semarang City, noise, air pollution and traffic congestion should be frequently monitored to review and feed back the effectiveness of mitigation measures during the construction stage. In general, sedimentation may cause resource quality deterioration, however, in case of Asin, Semarang and Baru rivers, it will be considered as tools for assessing risk management because it reduces flow capacity making the river channel in flood-induced conditions. Dredged material is also considered as a risk management. It should be noted that the river bed deposit contains toxic substances to the human health, so that monitoring is required from the dredging site to the disposal site.

In post-construction stage, the pump operation will be given the first priority in the monitoring items because it plays a key role in urban drainage system. Monitoring includes retarding pond as well as pumping station. Flood mitigation effects ranks second important item associated with land subsidence. The former is related to the evaluation of project output, whereas the latter is limited to the measurement of ground elevations. Sediment of retarding pond and its disposal site need to be monitored as part of risk management. In addition, river morphology should also be included in monitoring item for assessing pump drainage effects on river mouth as well as harbor basin.

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.

(2) Construction Stage

(a) Noise and air pollution

Twice a month during the construction period.

(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.

(3) Post-Construction Stage

(a) Illegal land use

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

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

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

(c) Flood mitigation

Every rainy season without limit of duration.

(d) Pump operation

Bi-monthly-based monitoring without limit of duration

TABLES

CHAPTER 5
ENVIRONMENTAL AND SOCIAL IMPACTS

Table 5.1.1 Results of Water Quality Test (1/2)

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	249	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	5.90	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	26.50	24.40
NH4-N	- mg/l	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.19	<0.02	0.42
NO3-N	10 mg/l	0.09	0.03	0.07	0.16	0.16	0.08	0.07	0.06	0.03	0.02
NO2-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
PO4-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	225.40	1821.68	6315.17	6569.91
Ca	- mg/l	24.4	39.1	33.9	33.9	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	100.0	132.0	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	12.70	32.11	109.45	1234.20	5610.52	5856.35
Hardness(CaCo3)	- 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	0.030	0.030	0.030
Zn	5 mg/l	<0.005	0.006	<0.005	<0.005	<0.005	<0.005	0.008	<0.005	0.010	<0.005
Pb	0.1 mg/l	<0.05	<0.05	0.189	0.213	0.237	0.545	<0.050	0.490	0.490	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	10,000/100ml	$46x10^3$	$>24x10^4$	$46x10^3$	$46x10^4$	$>24x10^4$	$>24x10^6$	$46x10^5$	$93x10^4$	$46x10^5$	$43x10^4$
Fecal Coliform	2,000/100ml	$46x10^3$	$>24x10^4$	$46x10^3$	$46x10^4$	$>24x10^4$	$>24x10^6$	$46x10^5$	$43x10^4$	$75x10^4$	$43x10^4$

Table 5.1.1 Results of Water Quality Test (2/2)

Parameter	Water Quality Standard (C)	Sampling Location				
		CS1	CS2	CS3	CS4	CS5
Temperature	Normal (°C)	31.6	31.2	32.0	31.0	33.6
pH	6~9	7.3	7.6	7.3	7.6	7.6
EC	- μS/cm	675	884	56.5	142	1792
TDS	1,000 mg/l	4137	6130	353	864	13507
TSS	- mg/l	93	79	40	23	77
DO	3 mg/l	0	0	0.35	0	0
BOD	- mg/l	174.00	55.36	53.64	46.74	241.61
COD	- mg/l	410.22	165.64	91.33	78.95	626.94
NH4-N	- mg/l	3.84	2.64	0.46	0.78	3.15
NO3-N	- mg/l	<0.01	<0.01	0.02	<0.01	<0.01
NO2-N	0.06 mg/l	0.04	0.03	0.05	<0.02	0.51
PO4-P	- mg/l	6.69	2.68	1.67	2.68	3.35
Sulfide	0.002 mg/l	<0.02	<0.02	<0.02	<0.02	0.02
Cl	- mg/l	2234.59	3371.33	41.19	76.56	7481.05
Ca	- mg/l	100.0	102.6	43.5	53.1	282.6
Mg	- mg/l	150.8	228.5	10.4	43.8	365.2
Fe	- mg/l	0.66	0.41	0.48	0.68	0.55
Mn	- mg/l	<0.05	<0.05	<0.05	<0.05	<0.05
Na	- mg/l	1178.15	1584.27	54.25	56.74	5947.58
Hardness(CaCo3)	- mg/l	878.3	1208.7	152.3	315.2	2228.3
Cd	0.01 mg/l	0.009	0.009	<0.002	<0.002	0.033
Zn	0.02 mg/l	0.020	0.005	0.010	0.020	0.050
Pb	0.03 mg/l	0.180	0.090	0.080	0.080	0.154
Cr	- mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
Cu	0.02 mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
T. Coliform	- /100ml	$11x10^6$	$>24x10^6$	$>24x10^6$	$46x10^5$	$>24x10^6$
Fecal Coliform	- /100ml	$21x10^5$	$>24x10^6$	$>24x10^6$	$46x10^5$	$>24x10^6$

Table 5.1.2 Abundance and Diversity of Plankton (1/2)

Group		Total Individu/lt at Each Sampling Location									
		KG1	KG2	KG3	KG4	KG5	KG6	KG7	KG8	KG9	KG10
Fitoplankton											
- Chlorophyta (Green)	Individu	34	262	52	52	122	1416	6663	23383	28845	21197
	Species	2	2	2	2	4	4	3	4	3	5
- Chrysophyta (Golden-brown)	Individu	242	365	2552	2898	1204	1975	5192	20321	16631	19169
	Species	10	8	10	15	10	8	6	9	6	4
- Cyanophyta (Blue-green)	Individu	-	507	104	87	69	647	419	698	560	1819
	Species	-	2	2	1	2	2	3	4	2	3
- Euglenophyta (Green)	Individu	-	-	-	-	17	70	17	-	157	-
	Species	-	-	-	-	1	1	1	-	1	-
Zooplankton	Individu	34	17	-	34	69	1154	-	52	68	734
	Species	2	1	-	2	3	2	-	1	4	4
Population (Individu/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 Abundance and Diversity of Plankton (2/2)

Group		Total Individu/lt at Each Sampling Location				
		CS1	CS2	CS3	CS4	CS5
Fitoplankton						
- Bacillariophyta	Individu	890	384	296	1048	2238
	Species	8	3	5	8	9
- Chlorophyta (Green)	Individu	86	17	85	278	715
	Species	4	1	5	5	8
- Cyanophyta (Blue-green)	Individu	2378	1067	1451	4529	2081
	Species	3	2	3	4	2
- Euglenophyta (Green)	Individu	699	191	140	157	87
	Species	4	4	2	2	1
Zooplankton	Individu	121	34	121	68	17
	Species	4	2	4	4	1
Population (Individu/lt)		4174	1693	2093	6080	5138
Total Species		23	12	19	23	21
Diversity Index (H')		2.04	1.66	1.52	1.28	1.72
Evenness Index		0.65	0.67	0.52	0.41	0.57

Table 5.1.3 RESULT OF SEDIMENT ANALYSIS

(Unit: mg/kg)

Parameter	Sampling Location				
	CS1	CS2	CS3	CS4	CS5
Cu	123.67	0.86	55.09	143.46	122.50
Cr	20.06	0.38	12.76	21.32	16.63
Cd	1.35	0.91	0.57	1.62	1.40
Zn	728.90	327.38	279.04	786.64	645.66
Pb	162.61	3.14	53.96	172.63	124.86

Sampling Date: October 27,1997

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 5.1.4 (1/3) RESULTS OF SEDIMENT LEACHING TEST (URBAN DRAINAGE CHANNELS)

Unit : mg/l

Parameter	Standard	Location	Sample Layer	Concentration	Average
Alkyl Mercury (O-Hg)	Not Detected	CS1	Top	0.680	0.000800
			Middle	0.860	
			Bottom	0.860	
		CS2	Top	0.200	0.000580
			Middle	0.860	
			Bottom	0.680	
		CS3	Top	0.250	0.001350
			Middle	1.910	
			Bottom	1.910	
		CS4	Top	1.230	0.001110
			Middle	1.230	
			Bottom	0.860	
		CS5	Top	0.250	0.000440
			Middle	0.200	
			Bottom	0.860	
Total Mercury (T-Hg)	< 0.005 mg/l	CS1	Top	0.775	0.001144
			Middle	1.640	
			Bottom	1.017	
		CS2	Top	0.497	0.000882
			Middle	1.548	
			Bottom	1.098	
		CS3	Top	1.557	0.002312
			Middle	2.926	
			Bottom	2.454	
		CS4	Top	3.920	0.002222
			Middle	1.554	
			Bottom	1.191	
		CS5	Top	0.551	0.000661
			Middle	0.534	
			Bottom	0.897	
Cadmium (Cd)	0.1 mg/l	CS1	Top	0.001	0.0003
			Middle	0.000	
			Bottom	0.000	
		CS2	Top	0.002	0.0010
			Middle	0.001	
			Bottom	0.000	
		CS3	Top	0.001	0.0013
			Middle	0.001	
			Bottom	0.002	
		CS4	Top	0.001	0.0020
			Middle	0.002	
			Bottom	0.003	
		CS5	Top	0.002	0.0027
			Middle	0.004	
			Bottom	0.002	
Lead (Pb)	0.1 mg/l	CS1	Top	0.07	0.030
			Middle	0.02	
			Bottom	0.00	
		CS2	Top	0.05	0.043
			Middle	0.06	
			Bottom	0.02	
		CS3	Top	0.06	0.033
			Middle	0.00	
			Bottom	0.04	
		CS4	Top	0.05	0.060
			Middle	0.07	
			Bottom	0.06	
		CS5	Top	0.05	0.033
			Middle	0.02	
			Bottom	0.03	

Table 5.1.4 (2/3) RESULTS OF SEDIMENT LEACHING TEST (URBAN DRAINAGE CHANNELS)

Parameter	Standard	Location	Sample Layer	Concentration	Average
Organic Phosphorus (O-P)	1.0 mg/l	CS1	Top	0.002	0.002
			Middle	0.002	
			Bottom	0.003	
		CS2	Top	0.001	0.001
			Middle	0.001	
			Bottom	0.001	
		CS3	Top	0.003	0.003
			Middle	0.002	
			Bottom	0.003	
		CS4	Top	0.005	0.004
			Middle	0.004	
			Bottom	0.004	
		CS5	Top	0.009	0.007
			Middle	0.006	
			Bottom	0.007	
Hexavalent Chromium (Cr^{6+})	0.5 mg/l	CS1	Top	0.005	0.005
			Middle	0.005	
			Bottom	0.004	
		CS2	Top	0.005	0.007
			Middle	0.005	
			Bottom	0.010	
		CS3	Top	0.005	0.006
			Middle	0.005	
			Bottom	0.008	
		CS4	Top	0.005	0.005
			Middle	0.004	
			Bottom	0.005	
		CS5	Top	0.008	0.003
			Middle	0.000	
			Bottom	0.000	
Arsenic (As)	0.1 mg/l	CS1	Top	0.006	0.005
			Middle	0.000	
			Bottom	0.010	
		CS2	Top	0.000	0.000
			Middle	0.000	
			Bottom	0.000	
		CS3	Top	0.000	0.000
			Middle	0.000	
			Bottom	0.000	
		CS4	Top	0.000	0.000
			Middle	0.000	
			Bottom	0.000	
		CS5	Top	0.000	0.000
			Middle	0.000	
			Bottom	0.000	
Cyanide (Cn)	1.0 mg/l	CS1	Top	0.003	0.003
			Middle	0.003	
			Bottom	0.002	
		CS2	Top	0.003	0.003
			Middle	0.003	
			Bottom	0.002	
		CS3	Top	0.002	0.002
			Middle	0.003	
			Bottom	0.002	
		CS4	Top	0.002	0.002
			Middle	0.003	
			Bottom	0.002	
		CS5	Top	0.003	0.003
			Middle	0.003	
			Bottom	0.003	

Table 5.1.4 (3/3) RESULTS OF SEDIMENT LEACHING TEST (URBAN DRAINAGE CHANNELS)

Parameter	Standard	Location	Sample Layer	Concentration	Average
Copper (Cu)	3.0 mg/l	CS1	Top	0.006	0.007
			Middle	0.008	
			Bottom	0.008	
		CS2	Top	0.010	0.010
			Middle	0.012	
			Bottom	0.008	
		CS3	Top	0.006	0.007
			Middle	0.006	
			Bottom	0.008	
		CS4	Top	0.008	0.009
			Middle	0.008	
			Bottom	0.010	
		CS5	Top	0.012	0.013
			Middle	0.014	
			Bottom	0.012	
Zinc (Zn)	5.0 mg/l	CS1	Top	0.004	0.120
			Middle	0.138	
			Bottom	0.217	
		CS2	Top	0.200	0.195
			Middle	0.193	
			Bottom	0.191	
		CS3	Top	0.127	0.176
			Middle	0.218	
			Bottom	0.184	
		CS4	Top	0.271	0.230
			Middle	0.168	
			Bottom	0.251	
		CS5	Top	0.189	0.265
			Middle	0.338	
			Bottom	0.267	

Table 5.1.5 (1/3) RESULTS OF SEDIMENT TREATMENT TEST (MIXED WITH SOIL)

(Unit: µg/l)

Location	Sediment : Soil (Dry Basis)				
	1 : 1	1 : 2	1 : 3	1 : 4	1 : 5
CS-1	0.66	0.66	0.66	0.66	0.66
CS-2	0.55	0.55	0.55	0.55	0.55
CS-3	0.84	0.84	0.84	0.84	0.84
CS-4	0.68	0.68	0.68	0.68	0.68
CS-5	0.32	0.32	0.32	0.32	0.32

Table 5.1.5 (2/3) RESULTS OF SEDIMENT TREATMENT TEST (MIXED WITH LIME)

(Unit: µg/l)

Location	Sediment : Lime (Dry Basis)				
	1 : 0.10	1 : 0.15	1 : 0.20	1 : 0.25	1 : 0.30
CS-1	0.43	0.43	0.43	0.43	0.43
CS-2	0.36	0.36	0.36	0.36	0.36
CS-3	0.59	0.59	0.59	0.59	0.84
CS-4	0.45	0.45	0.45	0.45	0.45
CS-5	0.20	0.20	0.20	ND	ND

Note: ND stands for not detected

Table 5.1.5 (3/3) RESULTS OF SEDIMENT TREATMENT TEST (MIXED WITH CEMENT)

(Unit: µg/l)

Location	Sediment : Cement (Dry Basis)							
	1 : 0.03	1 : 0.05	1 : 0.07	1 : 0.10	1 : 0.15	1 : 0.20	1 : 0.25	1 : 0.30
CS-1	0.30	0.15	ND	ND	ND	ND	ND	ND
CS-2	0.20	0.11	ND	ND	ND	ND	ND	ND
CS-3	0.14	0.09	ND	ND	ND	ND	ND	ND
CS-4	0.15	0.17	ND	ND	ND	ND	ND	ND
CS-5	0.13	0.05	ND	ND	ND	ND	ND	ND

Note: ND stands for not detected

Table 5.1.6 ENVIRONMENTAL MANAGEMENT PLAN (IMPROVEMENT OF URBAN DRAINAGE SYSTEM)

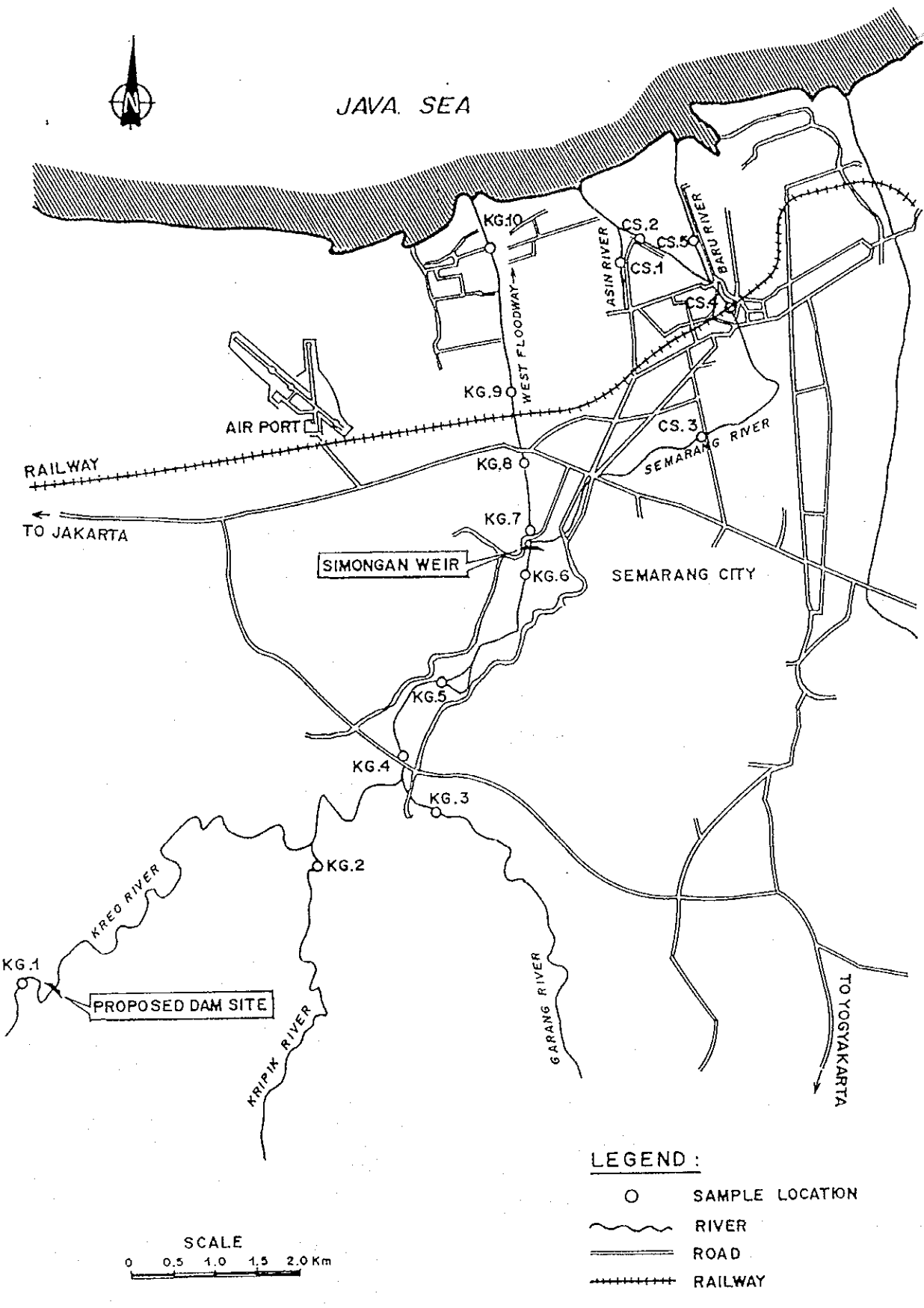
Managing Item	Source of Impact	Measuring Standard of Impact	Managing Approach	Management Location	Managing Agency Concerned
(Pre-Construction Stage)					
- Illegal land use	- Open space remains unutilized	- Squatter's intrusion	- Fencing around acquired land - Strict control	- Proposed location of Asin retarding pond	- Project office - Municipality
- Social unrest	- Land acquisition - Assets evaluation	- Compensation - Public protest and demonstration	- Negotiations - Land resettlement - Presidential decree No.55/1993	- Proposed location of Asin pumping station	- Project office - Land acquisition committee
(Construction Stage)					
- Noise	- Operation of heavy equipment	- Noise level : 60 dBA	- Control of speed of vehicles/equipment - Working hours/schedule - Equipment operators	- Proposed urban drainage areas	- Project office
- Air pollution	- Mobilization of equipment and materiales - Earth works	- Air quality standard KEP decree No. 02/ MENLH/I/1988	- Covering materials with sheet - Watering the road - Materials stock yard	- Proposed urban drainage areas	- Project office
- Traffic congestion	- Mobilization of equipment and materiales - Street blockage	- Public complaint - Frequency/duration for blockage and traffic congestion	- Schedule adjustment for equipment mobilization - Traffic control	- Proposed urban drainage areas	- Project office
- Sedimentation	- Dredging work - Raising dikes - Soil excavation	- Soil suspended level 100 to 250 mg/l	- Dredging from downstream - Effort to minimize spilt soil into the river	- Asin, Semarang and Baru rivers	- Project office
- Road damages	- Mobilization of equipment/materials	- Public complaint - Damage level	- Regular check system for road maintenance, and repair if necessary	- City roads along the rivers - Access road	- Project office
- Dredged material	- Dredging work	- Concentration of heavy metals - Public complaint - Generation of stench	- Use of water-proof sheet for transportation - Treated with cement - Disposed in designated land raclamation site	- From working site to disposal area - Land reclamation site	- Project office
- Railway bridge	- Raising river banks - River improvement	- Disturbance for train operation service	- Reconstruction of railway bridge over Asin river	- Existing railway bridge and its surrounding areas	- Project office - PJKA
(Post-Construction Stage)					
- Pump operation	- Solid waste accumulation	- Suspension of operation due to solid waste	- Frequent cleaning of retarding pond and pumping station	- Pumping station - Retarding pond	- Project office
- Retarding pond	- Industrial waste discharge - Soil brought from upper basin	- Heavy metal contents - Volume of sediment accumulated in retarding pond	- Periodical dredging - Control of industrial waste discharge	- Asin retarding pond - Baru retarding pond	- Project office
- Land subsidence	- Groundwater abstraction mainly for industrial use	- Area and intensity of subsidence	- Monitoring on land elevation	- Proposed urban drainage area	- Project office
- River mouth morphology	- Change of sediment transport - Pump drainage system	- Volume of sediment at river mouth	- River mouth morphological survey - Pump operation	- River mouth - Harbor basin	- Port authority

Table 5.1.7 ENVIRONMENTAL MONITORING PLAN (IMPROVEMENT OF URBAN DRAINAGE SYSTEM)

Monitoring Item	Monitoring Method	Location	Monitoring Frequency	Duration	Monitoring Agency Concerned
(Pre-Construction Stage)					
- Land issues and social unrest	- Interview and field inspection	- Proposed location of Asin retarding pond - Proposed Asin pumping station	- Monthly	- As long as problems exist	- Land acquisition committee - Project office - Municipality
(Construction Stage)					
- Noise	- Measured by noise level meter	- Proposed urban drainage areas	- Bi-monthly	- Construction period	- Project office
- Air pollution	- High volume sampling method	- Proposed urban drainage areas	- Bi-monthly	- Construction period	- Project office
- Traffic congestion	- Traffic congestion frequency/duration	- Proposed urban drainage areas	- Weekly	- Construction period	- Project office
- Sedimentation	- Field inspection and measurement	- Asin, Semarang and Banr rivers	- Monthly	- Construction period	- Project office
- Road damage	- Field inspection and measurement	- City roads along the rivers - Access roads	- Monthly	- Construction period	- Project office
- Dredged material	- Field inspection and supervision	- From dredging site to disposal area - Land reclamation site	- Weekly	- Until dredging work is over	- Project office
- Railway bridge	- Field inspection on risk management	- Railway bridge and its affected area	- Daily	- Construction period	- Project office - PJKA
(Post-Construction Stage)					
- Pump operation	- Field inspection	- Pumping station - Retarding pond	- Bi-monthly	- No limit	- Project office
- Flood mitigation	- Field inspection and interview on flood frequency/duration	- Proposed urban drainage area	- Every rainy season	- No limit	- Project office
- Sedimentation and its disposal site	- Field inspection	- Retarding pond - Disposal site	- Monthly	- No limit	- Project office
- Land subsidence	- Inspection and measurement	- Proposed urban drainage area	- Every 6 months	- No limit	- Project office - Mining agency
- River morphology	- Field inspection and measurement	- River mouth - Harbor basin	- Every 6 months	- No limit	- Port authority

FIGURES

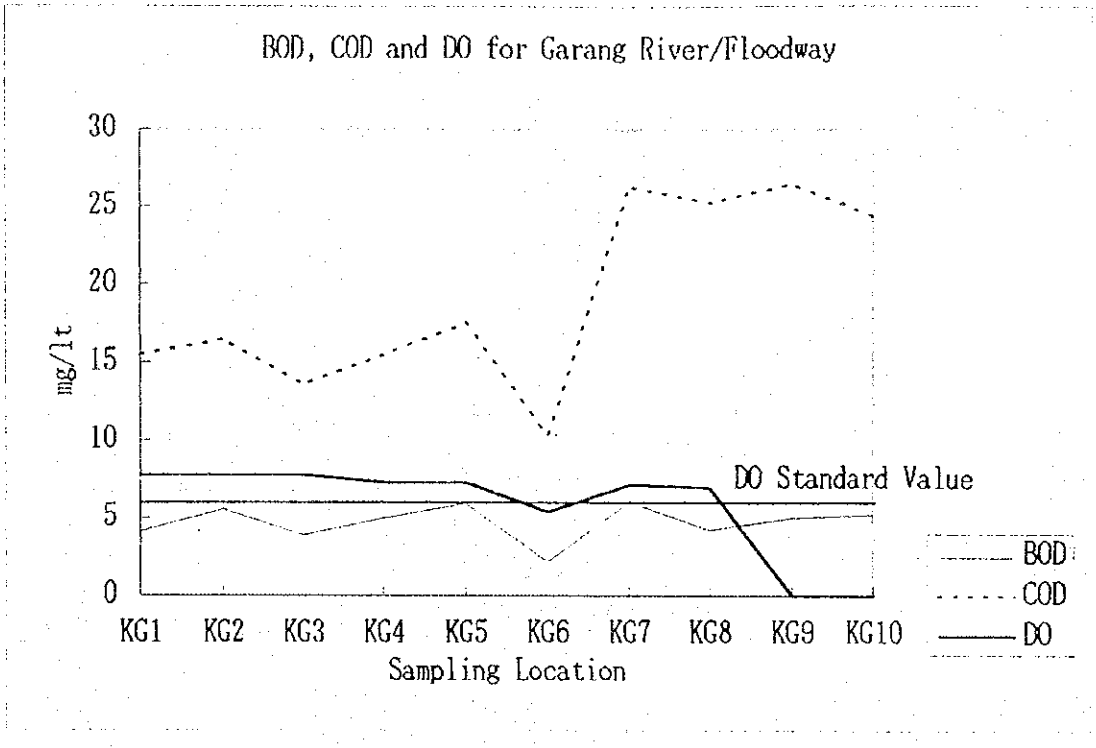
CHAPTER 5
ENVIRONMENTAL AND SOCIAL IMPACTS

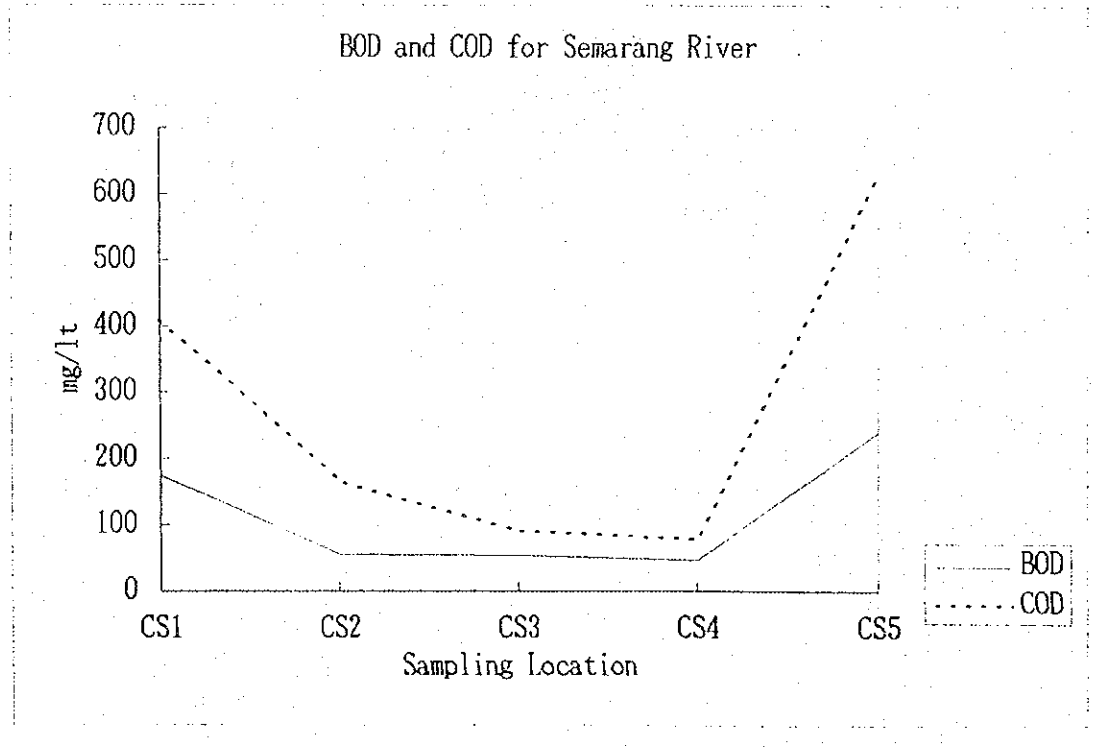


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA

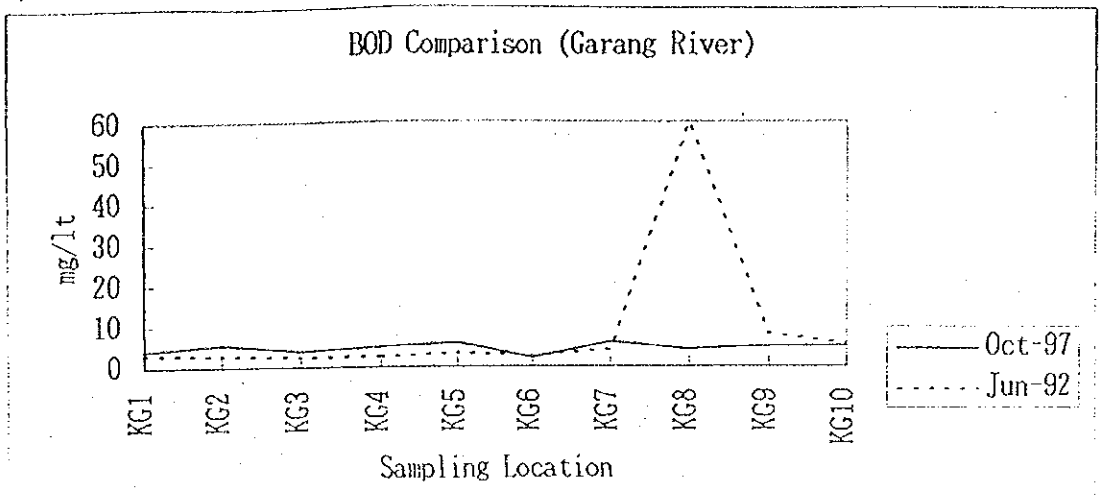
JAPAN INTERNATIONAL COOPERATION AGENCY

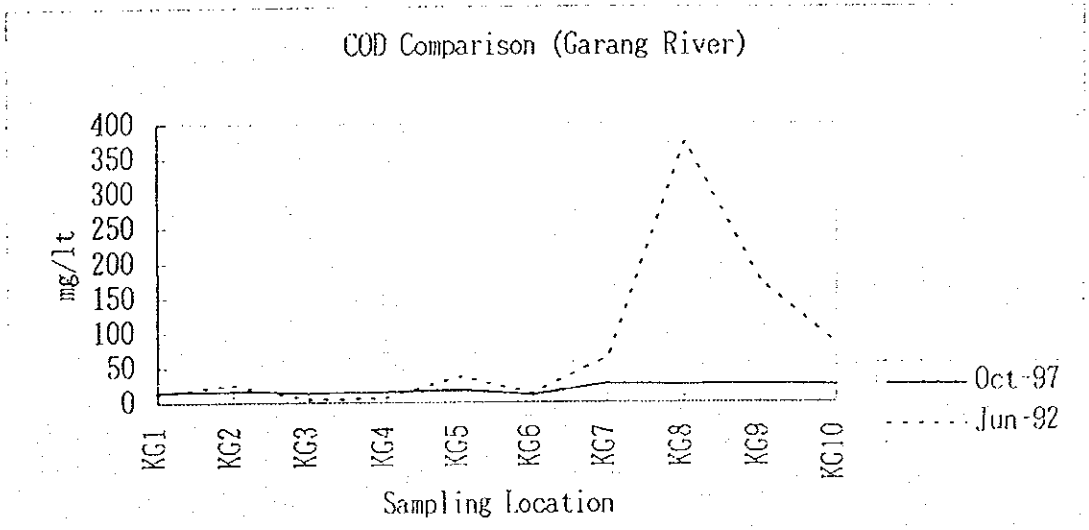
Fig. 5.1.1
WATER SAMPLING LOCATION

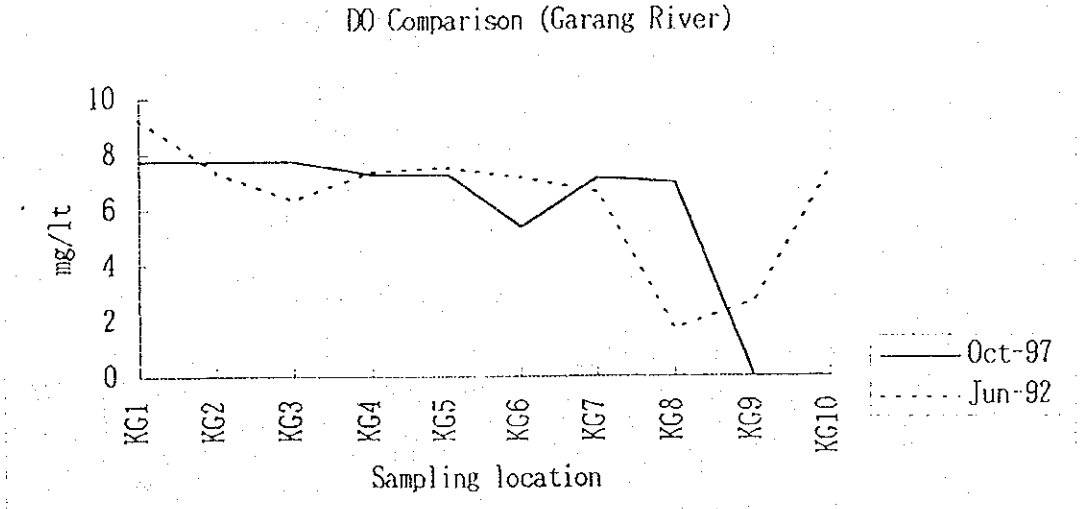




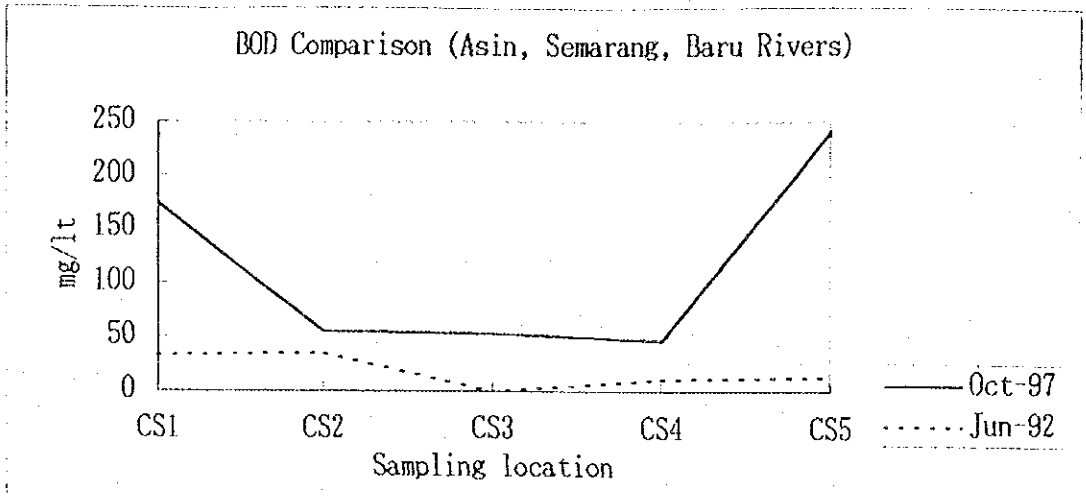
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.2 CONCENTRATIONS OF BOD, COD AND DO
JAPAN INTERNATIONAL COOPERATION AGENCY	

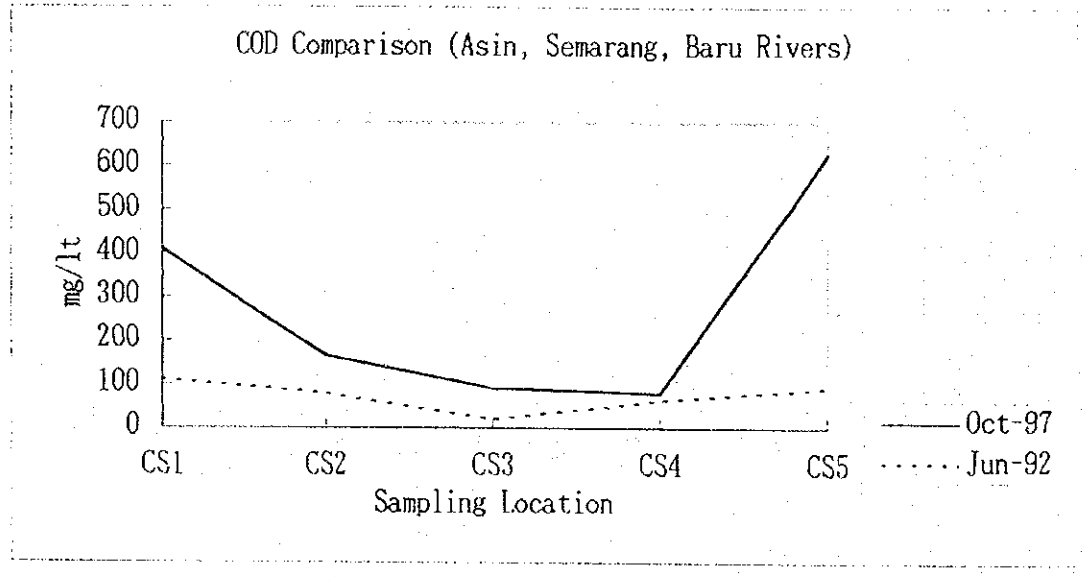


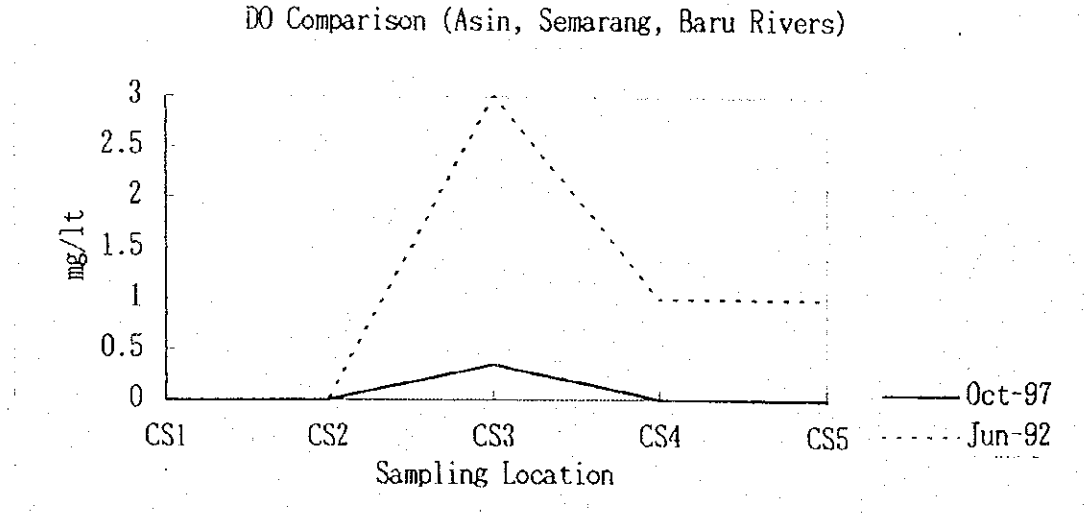




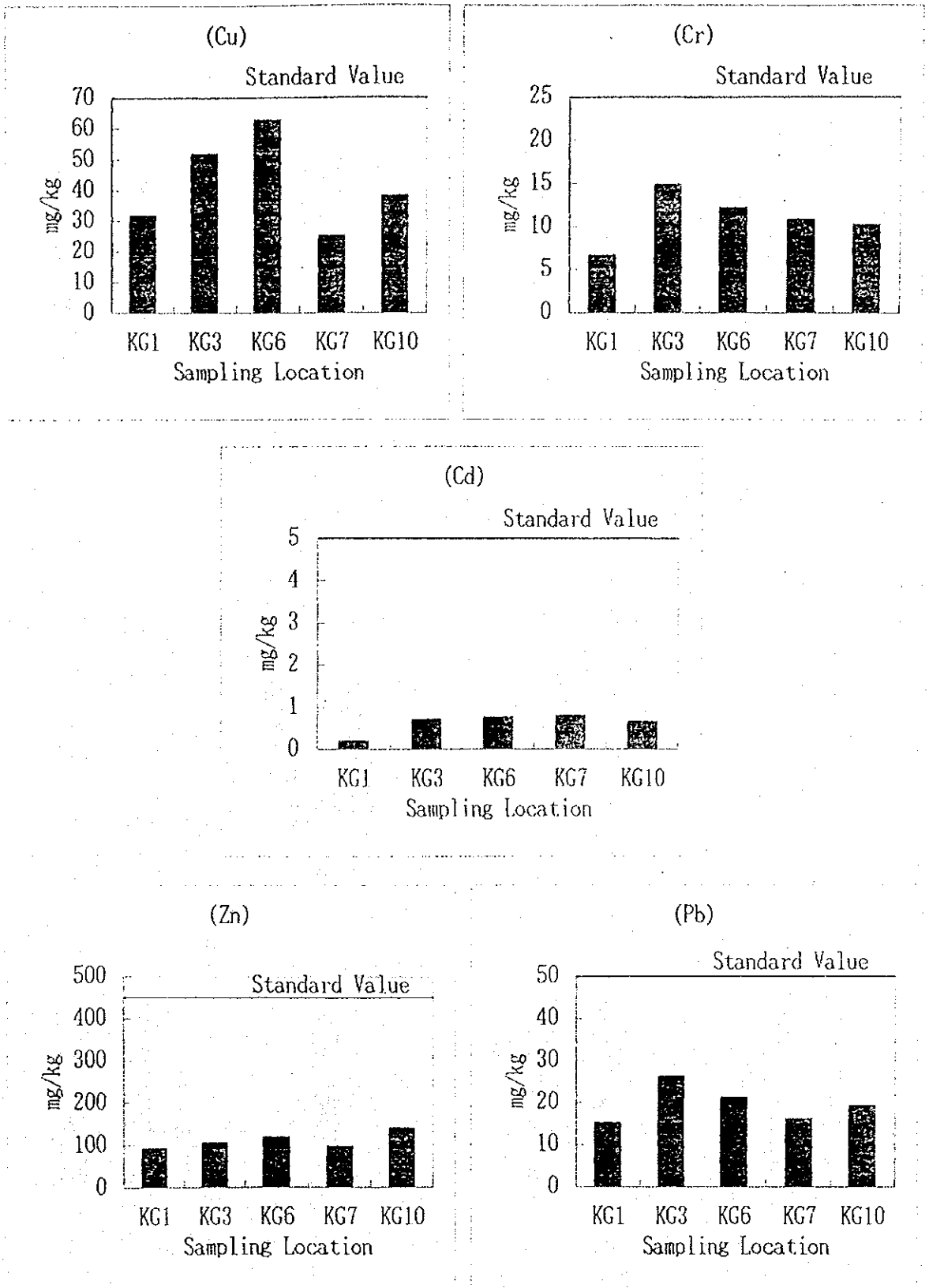
THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 5.1.3(1/2) BOD, COD AND DO COMPARED WITH RESULTS OF 1992



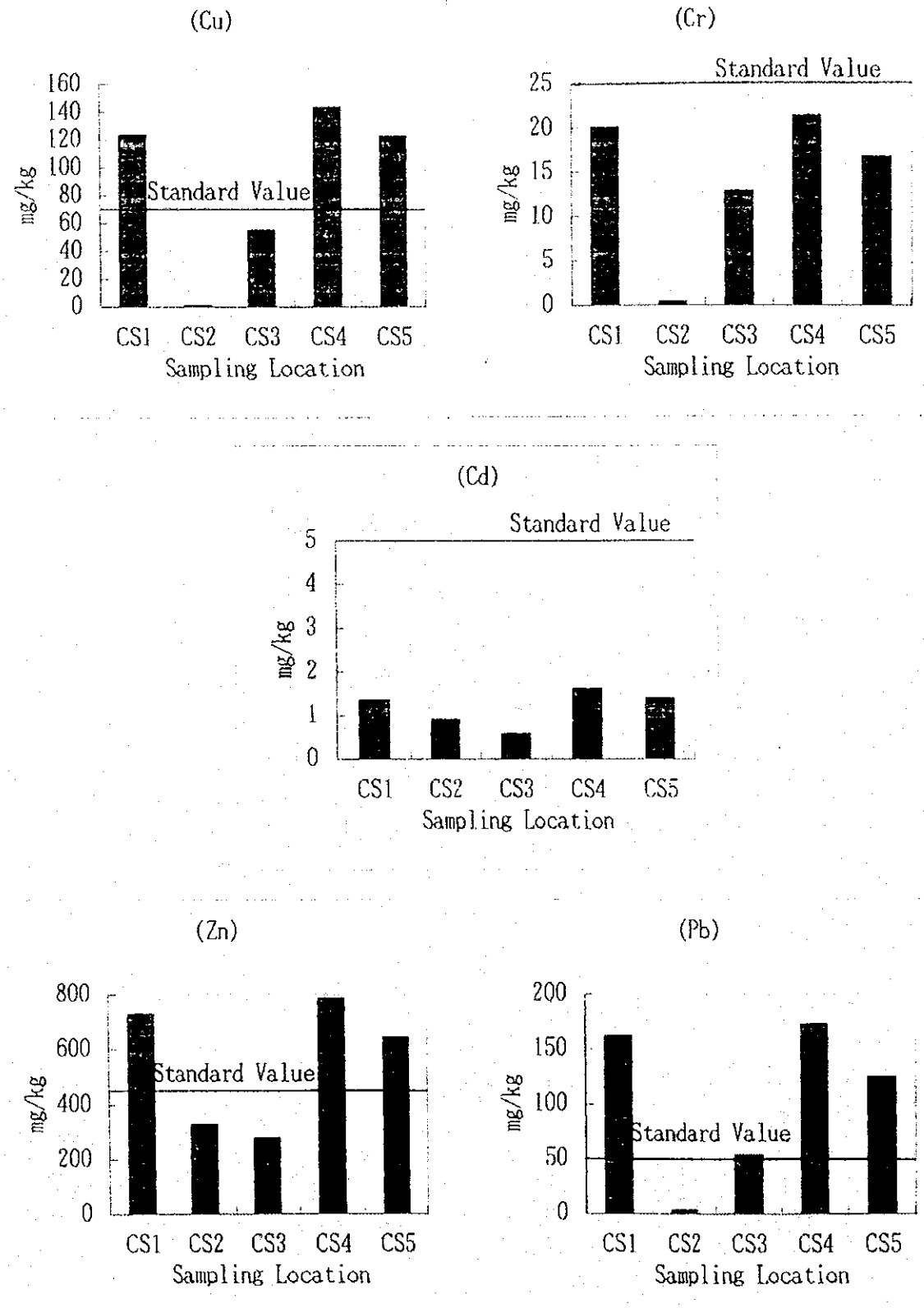




THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.3 (2/2) BOD, COD AND DO COMPARED WITH RESULTS OF 1992
JAPAN INTERNATIONAL COOPERATION AGENCY	

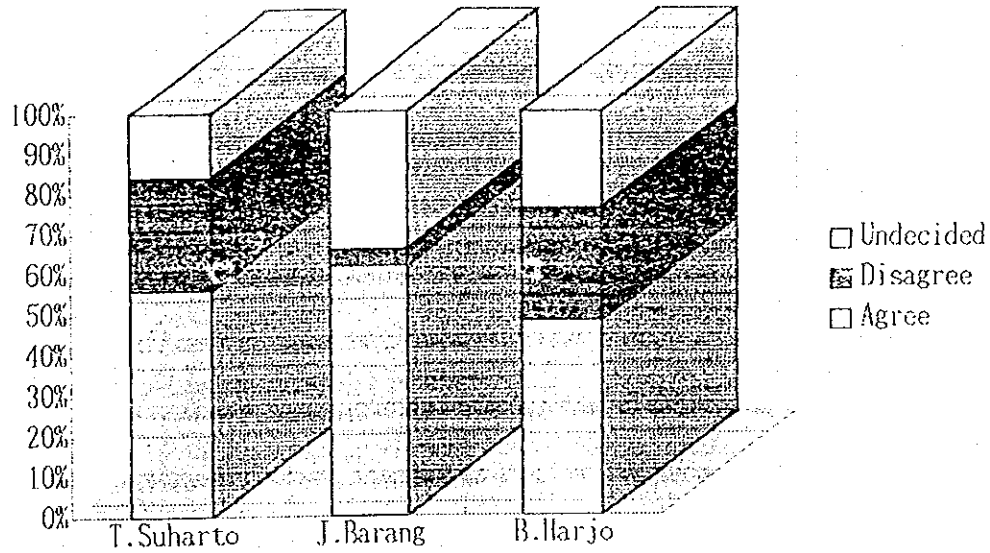


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA	Fig. 5.1.4(1/2) CONCENTRATION OF HEAVY METAL IN SEDIMENT
JAPAN INTERNATIONAL COOPERATION AGENCY	

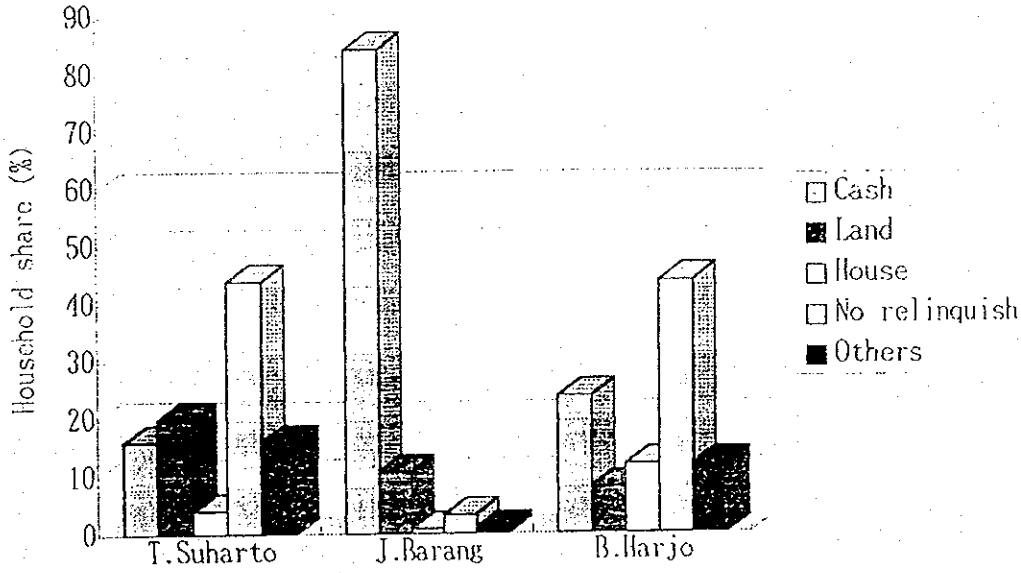


THE DETAILED DESIGN OF FLOOD CONTROL, URBAN DRAINAGE AND WATER RESOURCES DEVELOPMENT IN SEMARANG IN THE REPUBLIC OF INDONESIA JAPAN INTERNATIONAL COOPERATION AGENCY	Fig. 5.1.4 (2/2) CONCENTRATION OF HEAVY METAL IN SEDIMENT

Public Perception for the Project



Type of Compensation Expected



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 PUBLIC PERCEPTION FOR THE PROJECT AND EXPECTED METHOD OF COMPENSATION