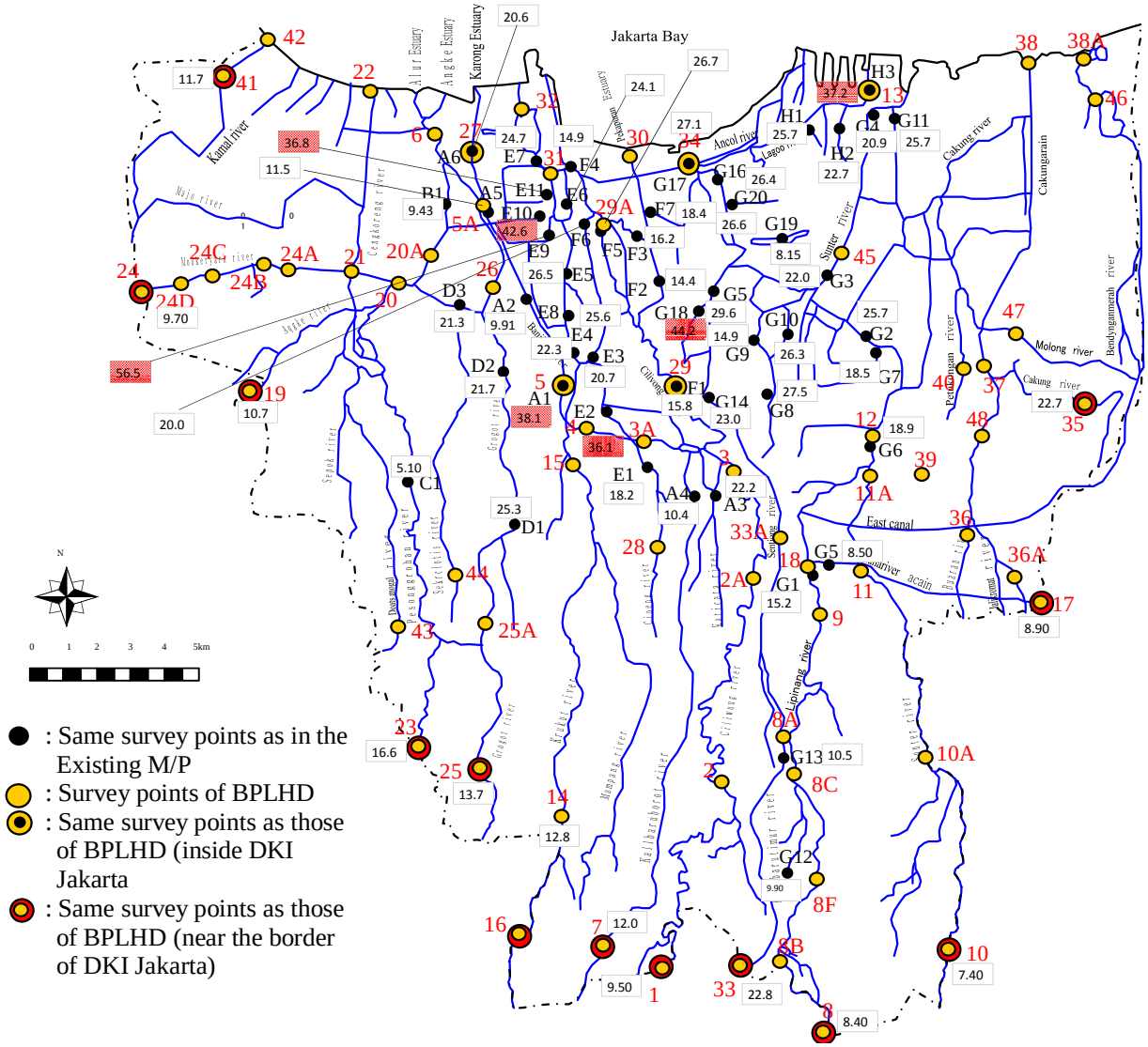


Source: JICA Expert Team

Note: The locatons where T-N is 30 mg/L or more (3 times of water quality standared for drinking water of WHO) are shown with red color.

Figure B3-10 The Results of 1st Round Water Quality Survey (Item Measured : T-N, Date of Measurement : February 2011, Rainy Season)

(4) Phosphorus

1) Current Condition of Phosphorus Pollution

Not only nitrogen but also phosphorus are one of the factor which causes eutriphication of enclosed water body (enclosed coastal seas). It is assumed that phosphorus has strong relation with severe water pollution at the north of DKI Jakarta.

The results of total phosphorus (T-P) on 65 locations along main rivers in DKI Jakarta conducted in February 2011 (dry season) and June 2011 (rainy season) are shown in Figure B3-11 and Figure B3-12, respectively.

The summary of water quality survey for T-P is shown in Table B3-8.

The Summary of Water Quality Survey (Item Mesured: Total Phosphorus)

Table B3-8 The Summary of Water Quality Survey (Item Mesured: Total Phosphorus)

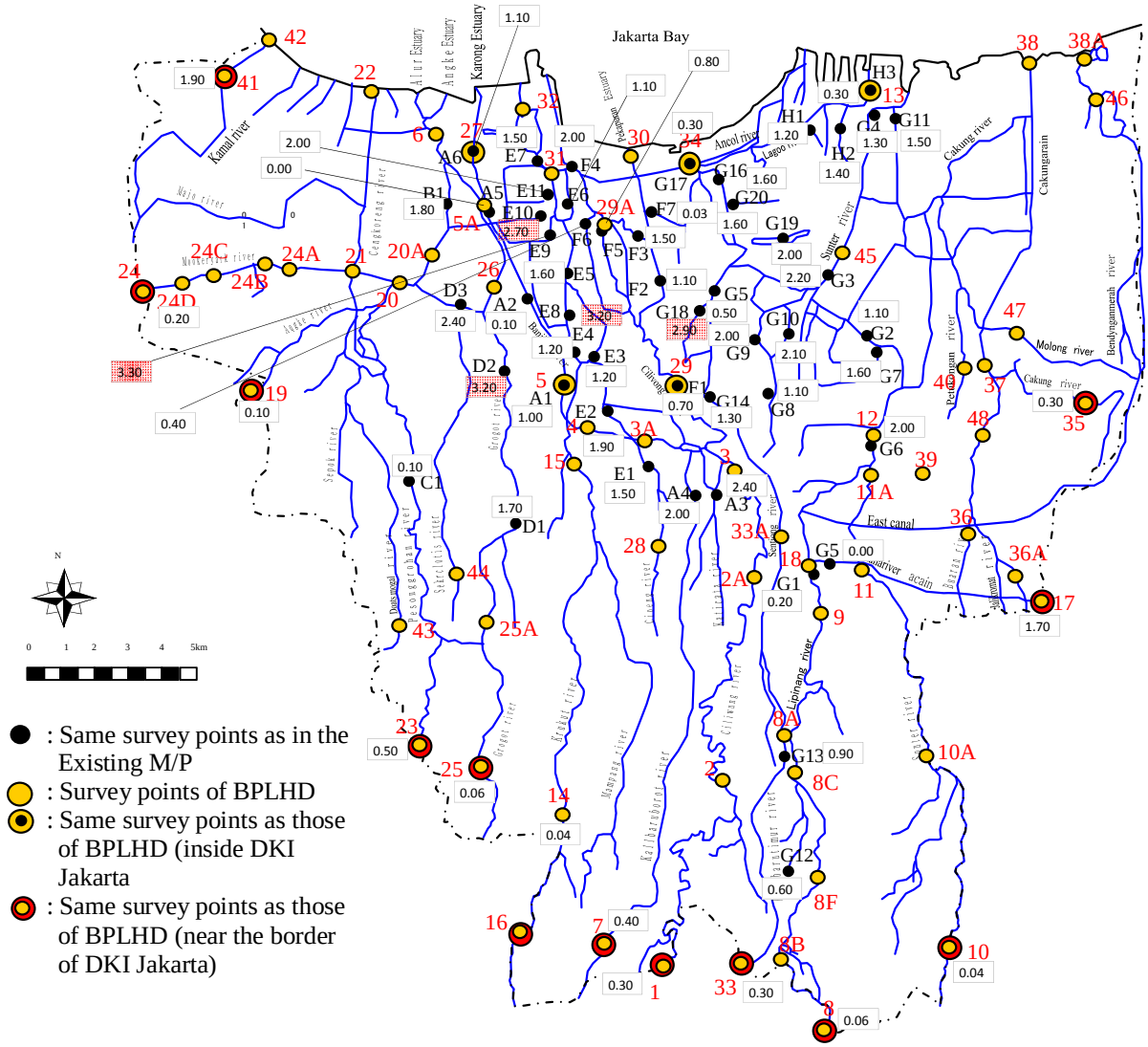
	Ave.	Max.	Min.	Div.	Sample Number	Number >=0.5mg/L	(%)	Number >=2.5mg/L	(%)
2011_2	1.14	4.50	0.00	1.00	65	39	60	8	12
2011_6	1.22	3.30	0.00	0.90	65	46	71	5	8
Total	1.18	4.50	0.00	0.95	130	85	65	13	10

Source: JICA Expert Team

The results of water quality survey are summarized below.

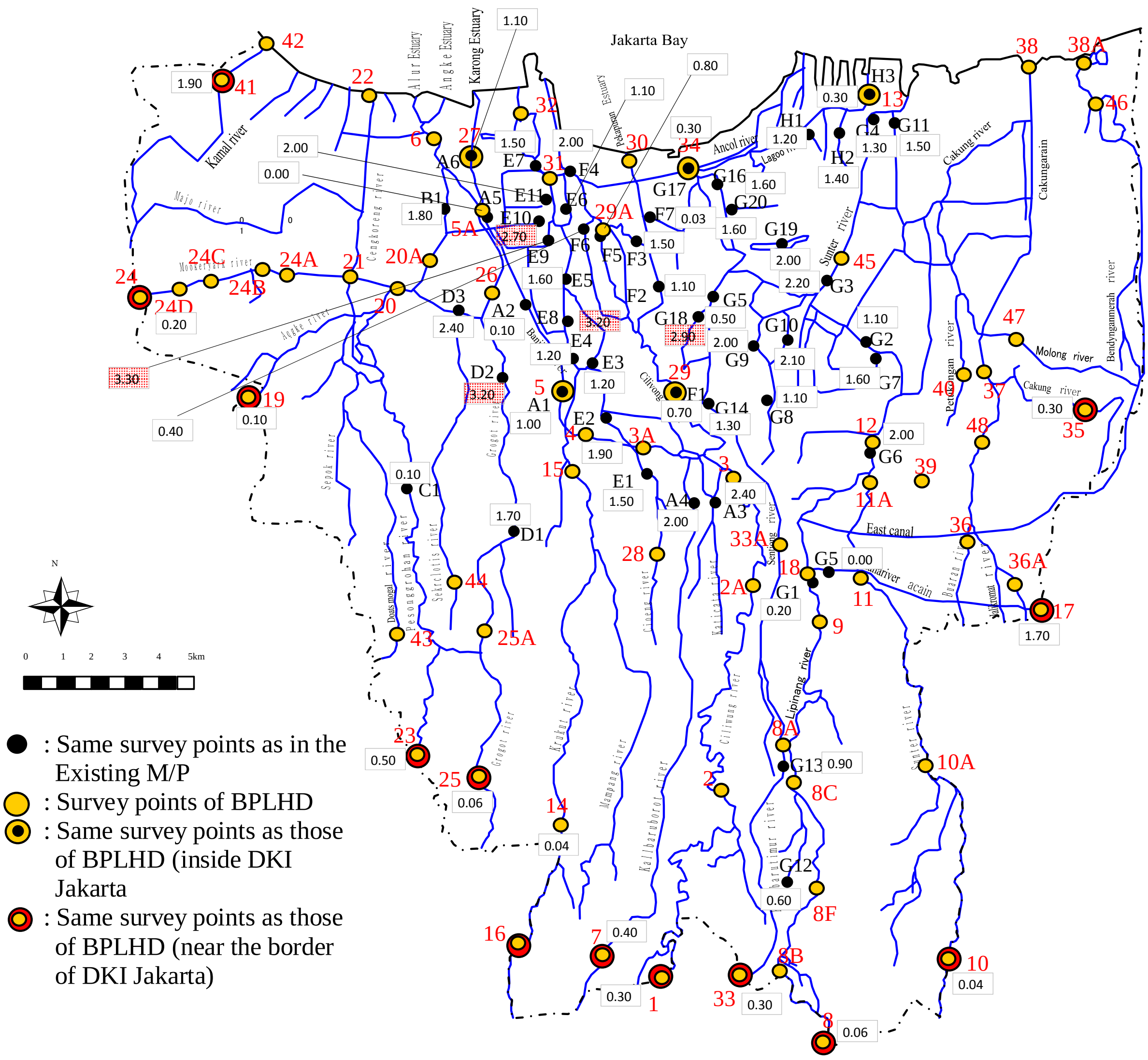
- 65% of total 130 samples (65 locations×2 times) are 0.5mg/L or more, which is water quality standard (Group D) in DKI Jakarta.
- 10% of total 130 samples (65 locations×2 times) are 2.5mg/L or more.
- T-P is relatively high, especially at the north of DKI Jakarta. The locations where both T-P of two analysis are 2.5mg/L or more are shown below;

  Grogol area (E5), Kota area (F6)



Source: JICA Expert Team
Note: The locations where T-P is 2.5mg/L or more (5 times or more of water quality standard in DKI Jakarta) are shown with red color.

Figure B3-11 The Results of 1st Round Water Quality Survey (Item Measured: Total Phosphorus, Date of Measurement: February 2011, Rainy Season)



Source: JICA Expert Team

Note: The locations where T-P is 2.5mg/L or more (5 times or more of water quality standard in DKI Jakarta) are shown with red color.

Figure B3-12 The Results of 2nd Round Water Quality Survey (Item Measured: Total Phosphorus, Date of Measurement: June to July 2011, Dry Season)

B3.2.2 Data for River Water Quality and Flow (by BPLHD)

The Environmental Bureau of DKI Jakarta (hereinafter referred to as “BPLHD”) has been conducting annual monitoring of river water quality and flow for the main rivers in DKI Jakarta since 1979 for 2 to 5 times in a year. JICA Expert Team collected the data from 2006 to 2010.

Table B3-9 shows the outline of river water quality and flow which JICA Expert Team has obtained.

Table B3-9 Outline of Water Quality and Flow for Main Rivers measured by BPLHD

No.	Item	Contents
1	Frequency/Date of Measurement	Frequency: 14 times in total Date: Jun. 2006, Dec. 2006, Jun. 2007, Dec. 2007, Aug. 2008, Oct. 2008, Nov. 2008, Apr. 2009, Jul. 2009, Mar. 2010, May 2010, Aug. 2010, Oct 2010, Nov. 2010
2	Location of measurement	67 locations on the main rivers in DKI Jakarta[*1]
3	Items measured	River flow: 2 times in 2006, 2 times in 2008, 2 times in 2009, 2 times in 2010 Water quality items measured: 36 items [*2] **(1) General item** Electric Conductivity (EC), Total Dissolved Solid (TDS), Total Suspended Solid (TSS), Turbidity, Water Temperature, Color, Dissolved Oxygen (DO), pH, Salinity **(2) Heavy metal, Organic and Inorganic** Mercury (Hg), Iron (Fe), Cadmium (Cd), Chromium (Cr) (Total), Hexavalent Chromium (Cr^{6+}), Nickel (Ni), Zinc (Zn), Copper (Cu), Lead (Pb), Manganese (Mn), Ammonia (NH_3), Fluorine (F), Chloride (Cl), Free Chlorine (Cl_2), Nitrate (NO_3), Nitrite (NO_2), Phosphorus (PO_4), Sulphate (SO_4), Hydrogen Sulfide (H_2S), Phenol, Oil and Grease, Methylene Blue Active Substance, Organic ($KMnO_4$), BOD, CODcr **(3) Bacteria** Coli Bacteria, Fecal Coliform

Note: 1. Refer to Figure 5.2-3 for locations of measuring point.
2. Measuring method for each water quality item shall be explained in the Final Report.

Source: Prepared by JICA Expert Team based on the data from BPLHD

Plase refer to Surroting Report for the detailed result and discutssion of water quality.

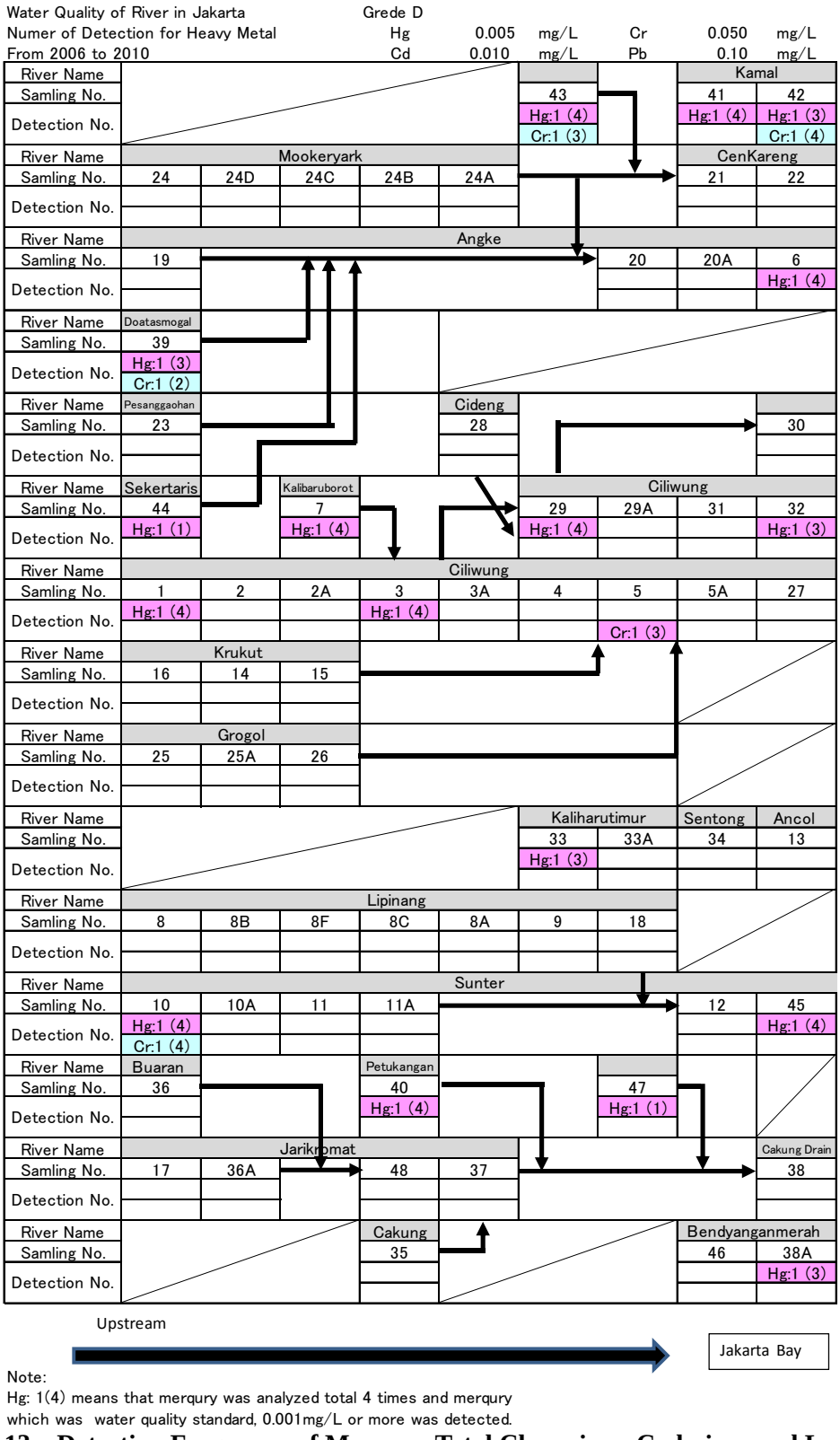
Only heavy metal is reported in this chapter because we was not able to disucss it at B 3.2.1 Data for River Water Quality and Flow due to the lack of number of data.

(1) Heavy Metal

Figure B3-13 shows the frecuency which the concentration of mercury, total chromium, cadmium and lead are detected above 0.001mg/L, 0.05mg/L, 0.010mg/L and 0.10mg/L, respectively at the 67 locations on the mail rivers in DKI Jakarta by total 14 times analysis.

Ref: Water quality standards based on WHO guideline for drinking water are as follows;

Mercury: 0.001mg/L, Total Chromium: 0.05mg/L, Cadmium: 0.003mg/L, Lead: 0.01mg/L



Note:
Hg: 1(4) means that merqury was analyzed total 4 times and merqury which was water quality standard, 0.001mg/L or more was detected.

Figure B3-13 Detection Frequency of Mercury, Total Chromium, Cadmium and Lead on the Main Rivers in DKI Jakarta.

As the result of water analysis of heavy metal conduced periodically, mercury or chromium was detected in the lot of area of DKI Jakarta. These results show that water environmental pollution by heavy metal is generated in the area.

B3.2.3 Summary of River Water Quality Survey

Based on the results of water quality survey conducted in dry sesson and in wet sesason, the concentration of BOD, fecal coliform, nitrogen and phosphorus at the many locations along main river in DKI Jakarata are over the water quality satandard of DKI Jakarta. Especilly at the north of DKI Jakarta, the concentrations of water quality items described previously reaches up to several times of water quality standard.

In addition, it is shown that water environmental pollution by heavy metal is also generated on the main rivers in DKI Jakarta by the water analysis conducted by BPLHD periodically

As the result of water analysis, sewage or on site sanitation faicities which treat domestic water up to appropriate water quality level shall be construted prompty. And waste water treatment facilities which treat industrial waste water up to appropriate water quality level also shall be constructed promptly.

In addition, it is important that strengthing environmental administration encourages private factories to install appropriate facilities and to operate it appropriately.

B3.3 Groundwater Quality and Groundwater Level

B3.3.1 Groundwater Quality

BPLHD has been conducting water quality monitoring of 75 shallow wells (refer to Table B3-10) once or twice annually. JICA Expert Team obtained the monitored data for the past 5 years (2005 to 2009).

The outline of groundwater quality data obtained by JICA Expert Team is shown in Table B3-11.

Table B3-10 Quantity of Monitoring Well by BPLHD

City	Number of Monitoring Well
North Jakarta	15
West Jakarta	15
Central Jakarta	11
South Jakarta	17
East Jakarta	17
Total	75

Source: Prepared by JICA Expert Team based on the data from BPLHD

Table B3-11 Outline of Groundwater Quality Data by BPLHD

No.	Item	Contents
1	Frequency/Date of Measurement	Frequency: 6 times in total Date: April 2005, July 2006, May 2007, October 2008, November 2008, May 2009
2	Location of measurement	75 shallow wells in DKI Jakarta[*1]
3	Items measured	Water quality items measured: 24 items[*2] **(1) General item** Electric Conductivity (EC), Turbidity, Water Temperature, Total Dissolved Solid (TDS), pH **(2) Heavy metal, Organic and Inorganic** Mercury (Hg), Iron (Fe), Fluorine (F), Methylene Blue Active Substance, Cadmium (Cd), Hardness (Mg), Hardness (Ca), Total Hardness, Chloride (Cl), Chromium (Cr) (Total), Manganese (Mn), Nitrate (NO_3), Nitrite (NO_2), Zinc (Zn), Sulphate (SO_4), Lead (Pb), Organic ($KMnO_4$) **(3) Bacteria** Coli Bacteria, Fecal Coliform

Note: 1. Refer to Figure 5.3-1 to 5.3-4 for locations of measuring point.
2. Measuring method for each water quality item shall be explained in the Final Report.

Source: Prepared by JICA Expert Team based on the data from BPLHD

As an example of the measurement results, major water quality items (Fe, Mn, Coli Bacteria, Fecal Coliform) at 75 shallow wells measured periodically by BPLHD are shown in Figure B3-14 to Figure B3-17.

As shown in Table B3-12 for the measurement results, Coli Bacteria does not meet the water quality standard of Ministry of Health by 55% in the whole DKI Jakarta and 93% in North Jakarta. For Fecal Coliform, as shown in Table B3-13, it does not meet the water quality standard of Ministry of Health by 49% in the whole DKI Jakarta and 87% in North Jakarta. This situation is due to the fact that the on-site sanitation area accounts for more than 90% and the untreated domestic wastewater has been discharged and soaked into underground.

There are parameters for nitrogen[2] as water quality to grasp the effect of domestic wastewater such as ammonium nitrogen (NH_4-N), nitrite nitrogen (NO_2-N) and nitrate nitrogen (NO_3-N). However, BPLHD does not have a data for ammonium nitrogen and therefore, total nitrogen (T-N) and proportion of the concentration of nitrite nitrogen plus nitrate nitrogen to the total nitrogen can not be obtained.

Table B3-12 Water Quality of Monitoring Wells by BPLHD (Coli Bacteria)

No.	City	Number of Monitoring Well (No.)	Coli Bacteria	
			Not Meet the Standard	Proportion（%）
1	North Jakarta	15	14	93%
2	West Jakarta	15	7	47%
3	Central Jakarta	11	7	64%
4	South Jakarta	17	8	47%
5	East Jakarta	17	5	29%
	DKI Jakarta	**75**	**41**	**55%**

Source: Prepared by JICA Expert Team based on the data from BPLHD

Table B3-13 Water Quality of Monitoring Wells by BPLHD (Fecal Coliform)

No.	City	Number of Monitoring Well (No.)	Coli Bacteria	
			Not Meet the Standard	Proportion（%）
1	North Jakarta	15	13	87%
2	West Jakarta	15	6	40%
3	Central Jakarta	11	7	64%
4	South Jakarta	17	6	35%
5	East Jakarta	17	5	29%
	DKI Jakarta	**75**	**37**	**49%**

Source: Prepared by JICA Expert Team based on the data from BPLHD

B3.3.2 Data of Groundwater Level (Ministry of Mining and Energy)

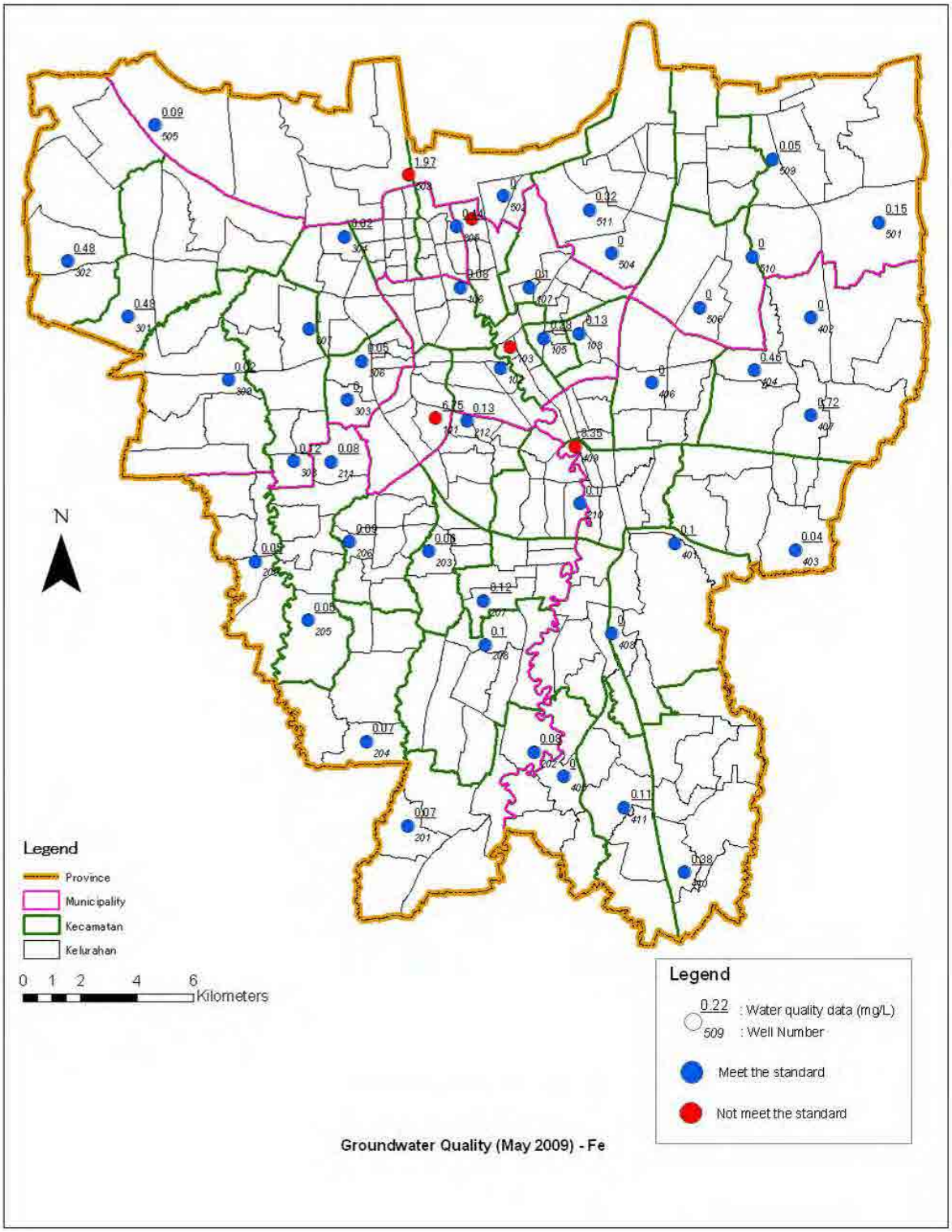
The groundwater level is being monitored by Directorate General of Geology and Mineral, Ministry of Mining and Energy. The wells monitored by the Directorate General are as shown in Table B3-14. JICA Expert Team obtained the groundwater level data in 2010 (refer to Figure B3-18). However, it is found that the groundwater level distribution in 2010 is much different from that of the Old M/P prepared by the same Directorate General. The reasons will be examined in Phase-2 for the Project.

[2] Relation between total nitrogen and these parameters for nitrogen is as follows:
Total Nitrogen (T-N)=Ammonium nitrogen (NH_4-N) + Nitrite nitrogen (NO_2-N) + Nitrate Nitrogen (NO_3-N)
For the water quality data for nitrogen, total nitrogen (T-N) above will be a parameter to know the pollution by the domestic wastewater.

Table B3-14 Number of Wells Monitored by Ministry of Mining & Energy

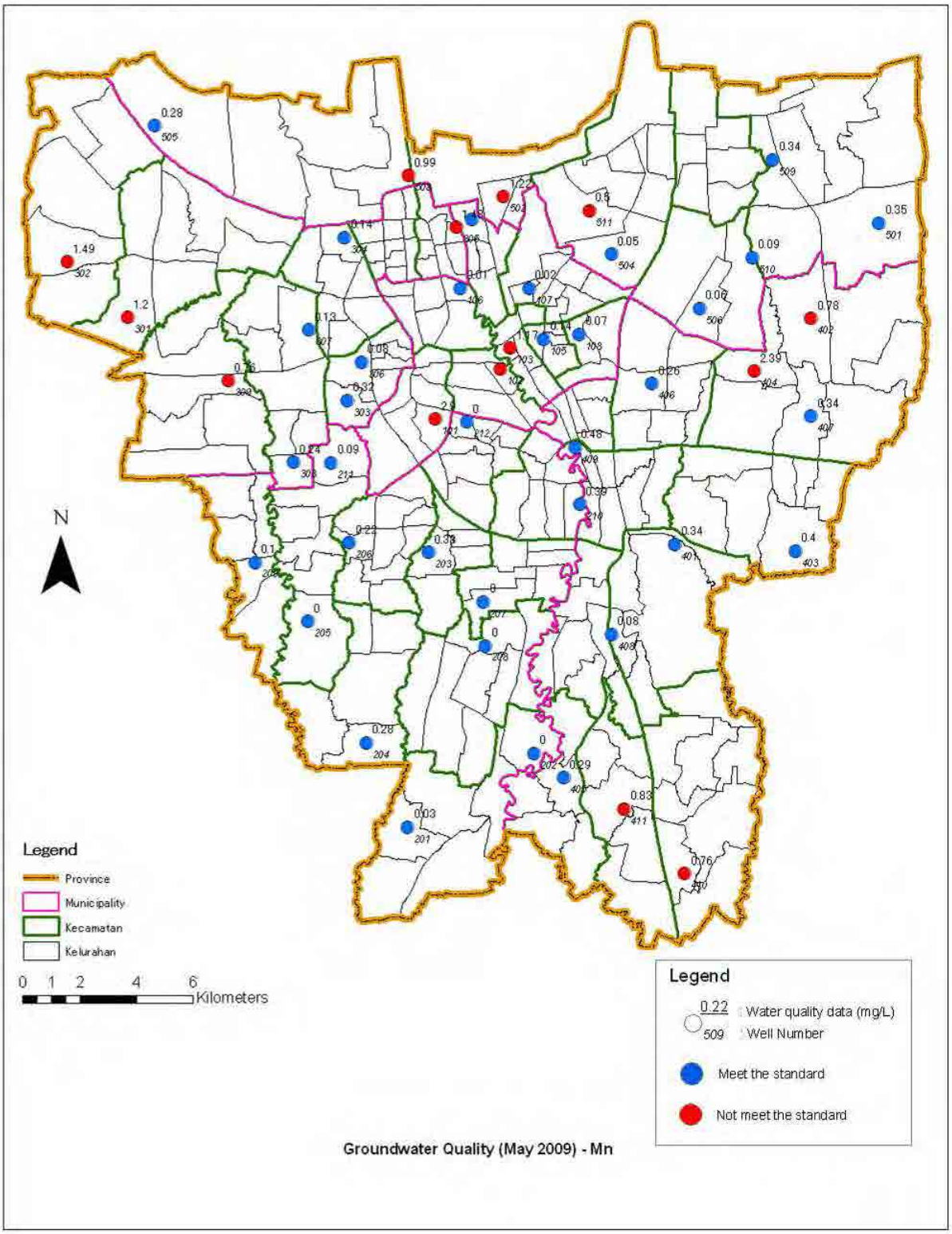
Depth of Well (m)	Number of Monitored Well (No.)
Less than 40m	48
40m to 140m	33
More than 140m	44
Total	125

Source: Directorate General of Geology and Mineral, Ministry of Mining and Energy



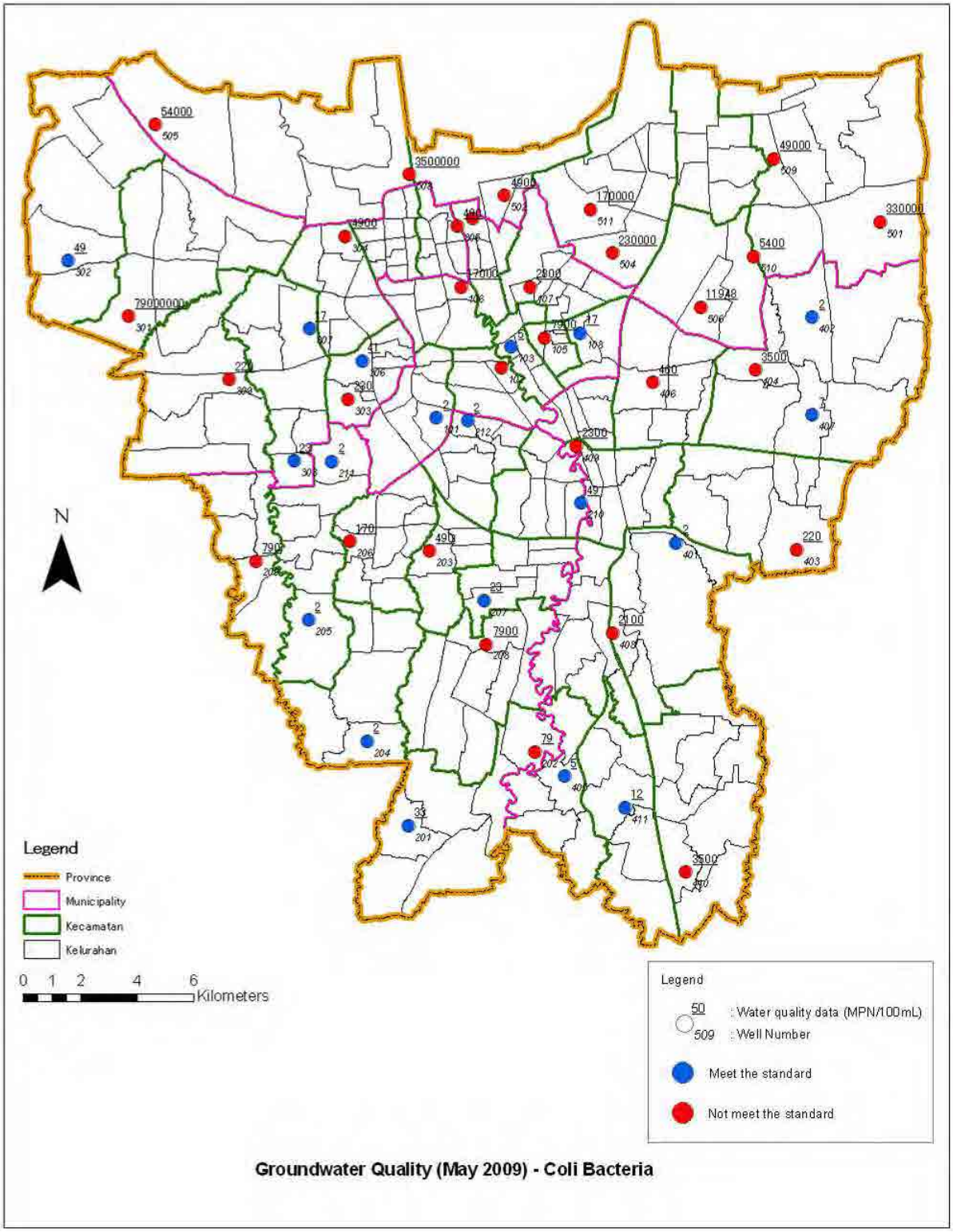
Source: Prepared by JICA Expert Team based on the data from BPLHD

Figure B3-14 Results of Groundwater Quality Survey by BPLHD (Fe – May 2009)



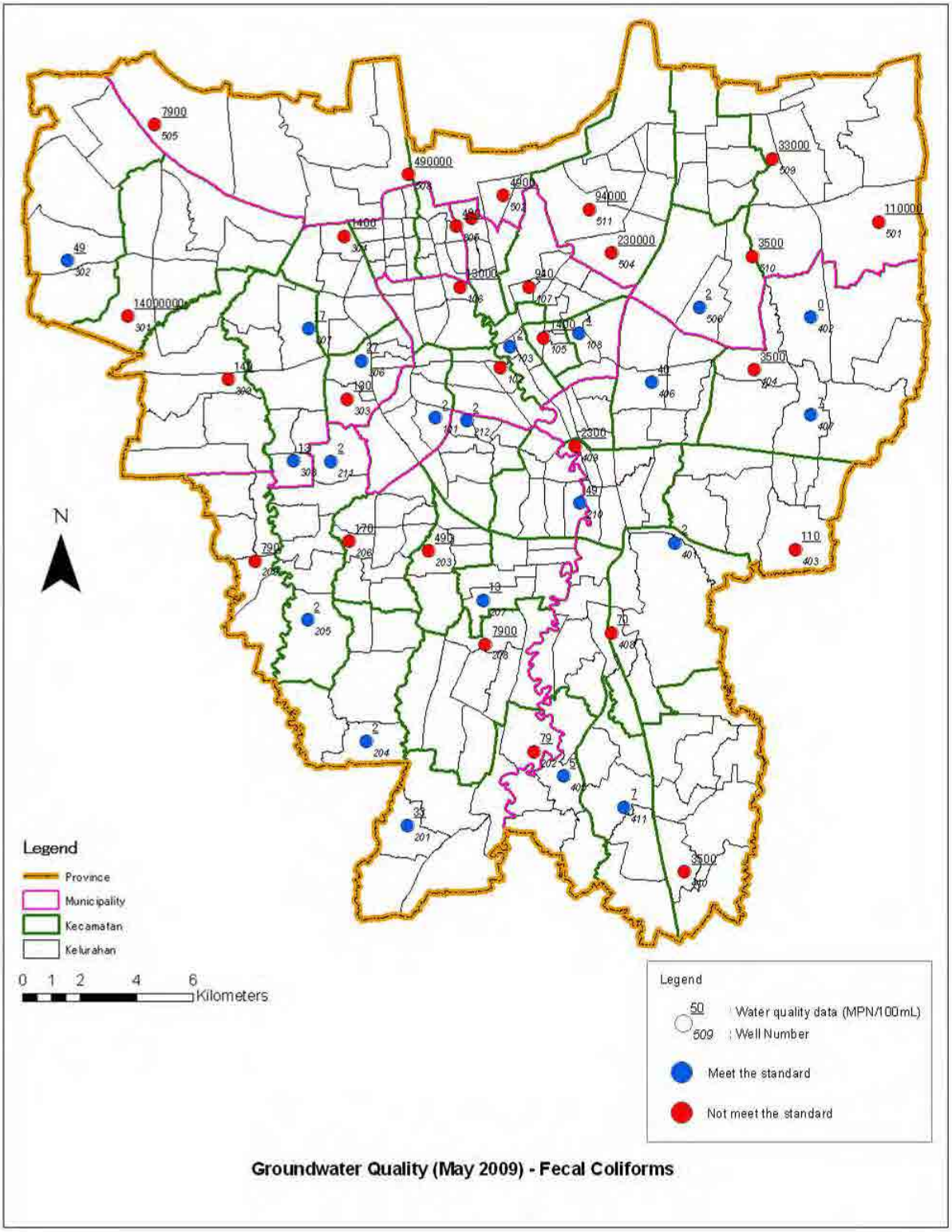
Source: Prepared by JICA Expert Team based on the data from BPLHD

Figure B3-15 Results of Groundwater Quality Survey by BPLHD (Mn – May 2009)



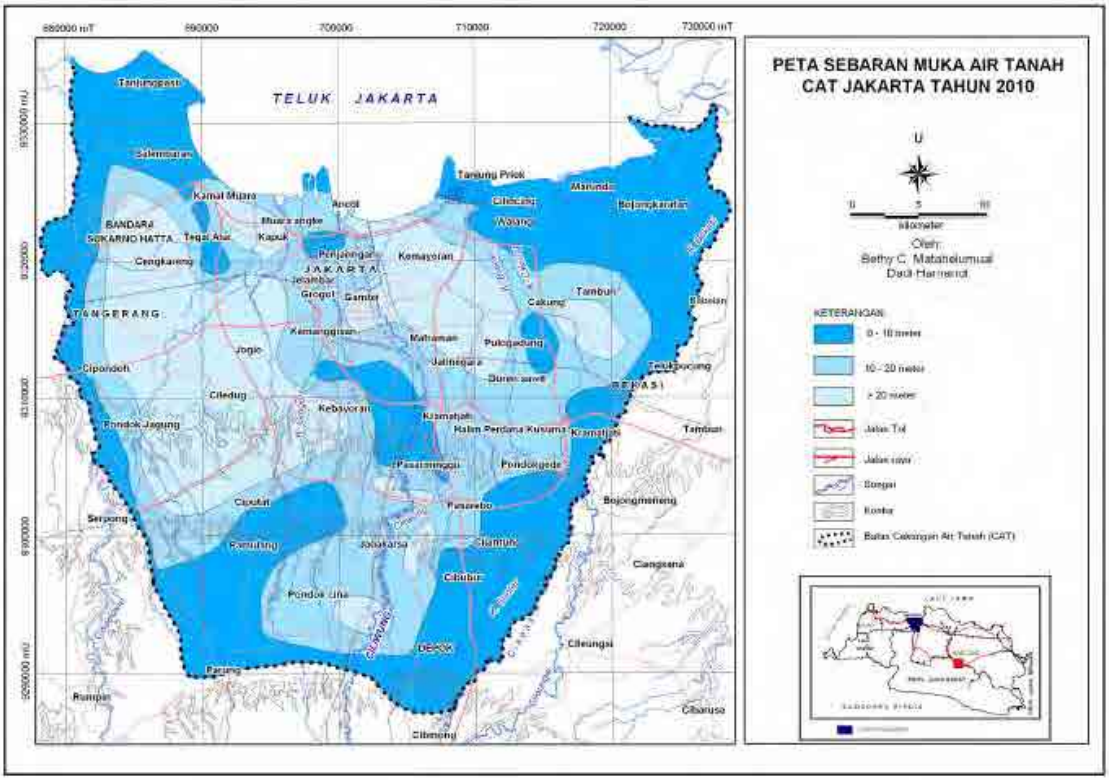
Source: Prepared by JICA Expert Team based on the data from BPLHD

Figure B3-16 Results of Groundwater Quality Survey by BPLHD (Coli Bacteria – May 2009)



Source: Prepared by JICA Expert Team based on the data from BPLHD

Figure B3-17 Results of Groundwater Quality Survey by BPLHD (Fecal Coliform – May 2009)



Source: Directorate General of Geology and Mineral, Ministry of Mining and Energy

Figure B3-18 Groundwater Level Distribution Monitored by Ministry of Mining and Energy

B3.4 Waterborne Disease

In the old M/P 1991 it has been stated that a large number of people in DKI Jakarta suffer every year from various diseases such as Malaria, Gastroenteritis, Cholera, Tuberculosis, DHF, Typhoid, Dysentery, Diphtheria, Measles, Hepatitis A, Hepatitis B and Skin diseases in which majorities of diseases were waterborne diseases such as Malaria, Gastroenteritis, Cholera, Typhoid, Dysentery, Hepatitis A and Skin diseases. Based on the sampling questionnaire survey conducted under the old M/P 1991, the rate for waterborne diseases for the last three years in DKI Jakarta was reported to be 56.5 cases (cumulative cases of three years) per 1000 people in which 45.8% cases were of Gastroenteritis only. The district wise contraction rate reported to be ranged from 14.5 cases per 1000 people in Kebon Jeruk (West Jakarta) to 155.9 cases per 1000 people in Tanah Abang (Central Jakarta). The major causes of infant mortality in DKI Jakarta were fever, small pox, typhoid, cholera, diphtheria, dysentery, tuberculosis, beri-beri, etc. The infant mortality rate for the last three years in DKI Jakarta was 16.3 cases per 1000 infants. Infant mortalities were reported to be most prevalent in low income families.

World Bank in their Draft Final Report "Support to DKI Jakarta for wastewater Management" referring "DKI Jakarta Health Indicator 2004" stated that there were almost 180,000 cases of diarrhea reported in year 2001. The rate in DKI Jakarta was 20 cases per 1000 people, with Central Jakarta having 31 cases per 1000 people and East Jakarta 16 cases per 1000 people.

The spread of diarrheal diseases in DKI Jakarta compared with other diseases can be seen in Table B3-15 and Table B3-16.

As shown in the table below among Filariasis, Dengue Fever and Malaria, Dengue fever is a disease with the highest prevalence in DKI Jakarta. Though very small there is also occurrence of Filariasis in DKI Jakarta.

Table B3-15 Prevalence of Filariasis, Dengue Fever and Malaria in DKI Jakarta

Unit: %

Administrative areas	Filariasis		Dengue Fever		Malaria		
	D	DG	D	DG	D	DG	O
South Jakarta	0.2	0.2	1.0	1.0	0.2	0.4	41.7
East Jakarta	0.1	0.2	0.8	1.4	0.0	0.9	23.1
Central Jakarta	0.1	0.2	1.3	1.6	0.1	0.5	35.7
West Jakarta	0.0	0.0	0.4	0.5	0.0	0.1	0.0
North Jakarta	0.0	0.1	1.2	1.8	0.1	0.7	26.1
DKI Jakarta	**0.1**	**0.1**	**0.8**	**1.2**	**0.5**	**0.1**	**26.8**

Note: D = patients diagnosed with certain diseases, DG = suffering from clinical symptoms of the disease
O = Patient who use program drugs
Source: Riskesdas, 2007

Table B3-16 Prevalence of Typhoid, Hepatitis and Diarrhea in DKI Jakarta

Unit: %

Administrative areas	TBC		Typhoid		Hepatitis		Diarrhea		
	D	DG	D	DG	D	DG	D	DG	O
South Jakarta	0.7	1.1	0.7	0.9	0.6	0.7	5.6	6.2	38.5
East Jakarta	0.6	1.5	1.0	2.1	0.1	0.8	6.0	8.9	35.2
Central Jakarta	1.0	1.6	0.5	1.0	0.3	0.6	7.0	10.3	29.7
West Jakarta	0.4	0.6	0.9	1.2	0.2	0.2	4.5	6.3	41.4
North Jakarta	1.1	1.9	1.3	1.8	0.3	0.8	7.0	10.2	35.3
DKI Jakarta	**0.7**	**1.3**	**0.9**	**1.4**	**0.3**	**0.6**	**5.8**	**8.0**	**36.3**

Note: D = patients diagnosed with certain diseases, DG = suffering from clinical symptoms of the disease
O = Patient who use program drugs
Source: Riskesdas, 2007

As shown in table above, TBC (Tuberculosis) was detected in all of DKI Jakarta region and North Jakarta reached prevalence at 1.1 % compared with other region of Jakarta, with the lowest prevalence in West Jakarta at about 0.4 %. Typhoid was also detected in DKI Jakarta with prevalence at 0.9 % with range about 0.5 - 1.3 %. Based on the patient with clinical symptom of typhoid, prevalence reached at about 1.4 % with the highest prevalence in East Jakarta at 2.1 %. Hepatitis was also detected in all of DKI Jakarta region, but the prevalence was in the range of 0.1 - 0.6 % for diagnosed patient and 0.2 - 0.8 for patient with clinical symptom of the disease. Diarrhea prevalence was at about 8 % on the whole of DKI Jakarta and was distributed consistently in the entire region, the highest in Central Jakarta (10.3 %) and North Jakarta (10.2 %).

Table B3-17 Number of Diarrhea Case, and Diarrhea in Toddlers in DKI Jakarta in Year 2009

	Central Jakarta	North Jakarta	West Jakarta	South Jakarta	East Jakarta
Total cases	21,441	30,726	23,162	30,872	57,452
Cases in toddlers	N.A.	16,654	10,513	12,227	28,222

Source: Puskesmas/Public Health Centers (used from the presentation material of BPLHD for the workshop of February 2nd 2011 under the Project)

As shown in table above, in year 2009 also Diarrhea was consistent in the entire region of DKI Jakarta and toddlers were more prone to diarrhea.

Although above figures which has been obtained from the various sources may have various shortcomings, there is clear indication that poor environmental sanitation including hygiene practices have over the years spread to the entire region of Jakarta which in 1990s were mostly limited in the areas of Central Jakarta. To confirm more precisely prevalence of waterborne diseases in the different regions of DKI Jakarta, the Project Team would obtain additional secondary data from various sources during the Phase II of the Project.

B3.5 Non-Point Pollution Sources

B3.5.1 Wastewater from Slum Areas

(1) Development of Slums

Slum areas appear because of the city urbanization and many people come to Jakarta in the hope to get better life. However, they do not have adequate skill and capital. Because of this, they lose in competition and have low economic condition. They need the place to live in with cheap living expenses and end up living in slums. The slums are mostly located on/besides water bodies, side of railways, empty land owned by private or government.

The following aspects contribute in creating slum areas:

- Low level of education in people leads to lack of awareness towards the importance of health.
- The most of people who live in slum areas do not have steady income.
- Many people who live on slum areas are not living on their own land. They use the open space such as river banks for the settlement.

(2) Characteristics of Slums

Characteristics of slum areas could be described as follows:

- High population density
- The condition of sanitation facilities for the black water and gray water are very minimal
- Clean water facilities are also very minimal
- Poor drainage leads to water stagnation
- Sanitation is very poor as many households defecate in open
- Vulnerability of slums to floods along the rivers
- Mostly ownership of the land is illegal
- Most of the locations are nearby the center of economic activity
- Unorganized layout of the buildings
- Poor accessibility due to narrow winding lanes

(3) Current Situation of Wastewater Disposal in Slums

The following explains the current situation of sanitation and wastewater treatment in low-income settlements developed around the Pluit regulating reservoir and along the Ciliwung and Cakung River.

1) Slum Area around Pluit Regulating Reservoir

Shabby wooden houses cover the area around the floodgate situated near the pumping station at the northern end of the Pluit reservoir, forming a low-income settlement. Half of each house overhangs the reservoir perhaps because the water level is controlled by the drain pump. Although electricity is available, public services such as roads, water and public toilets are not being provided.

The residents purchase water in 20-liter plastic containers and use it as drinking water, etc. The reservoir water is used for washing. Piers extend from the houses which lead to walled spaces that are used as toilets. The excrement drops directly into the reservoir.

Waste which has been dumped in the surrounding area and waste which has drifted from the upper reaches of the river ends up floating in large amounts in the water between the floodgate and the screen. The waste is removed by the screen.

The people in the area have poor living and hygiene conditions due to no public sanitation services being available, perhaps because it is an illegal settlement.

2) Slum Area along the Ciliwung River

The Ciliwung River is a major river which meanders along the railway through the central part of DKI Jakarta. The river water is diverted into a canal around the middle reaches of the river and the quantity

of water decreases around the lower reaches of the river in the area around Menteng. Because the quantity of water decreases in the lower reaches of the river and because of the untreated water discharged into the river, the water is emitting offensive odors in this area. Waste which has drifted from the upper reaches of the river and waste dumped on site is left floating in the water and is also scattered around the banks. The waste will probably be washed away by the large quantities of water which flows down the river when it rains.

There is a low-income settlement extends along the road. Small wooden houses stand close to each other. MCK (mandi, cuci, kakus bathing, washing and toilet) facilities and a waste collection site are installed near the bank every 10-20 meters. They were probably provided by public agencies and various aid organizations. The residents actively use and jointly manage the facilities. The wastewater from the MCK facilities is discharged directly into the river and this suggests that the MCK facilities are contributing to the contamination of the river. There is no running water supply and the residents are using communal wells and purchased tank water.

Toilets in the low-income settlement around the Pluit reservoir are situated outside although they are surrounded by walls. Therefore, the development of basic sanitation facilities is required, while wastewater treatment measures are required for the MCK facilities in the low-income settlement situated along the Ciliwung River. What they have in common is that untreated domestic wastewater is contributing to water pollution and that comprehensive measures are required to tackle the non-point pollution sources. DKI Jakarta is conducting a project to remove low-income settlements from the Jl. Inps. Saluran Tarum Barat area around the upper reaches of the Ciliwung River in the southern part of Jakarta (the BBWSCC Program, implemented by DKI Jakarta). The photograph on the left shows the low-income settlement on the both sides of the river. The photograph on the right shows the river after a low-income settlement has been removed and concrete banks have been built on both sides of the river.

Figure B3-19 Unsanitary Toilets (Pluit Reservoir)

Figure B3-20 Look Directly into the Rivers Flowing from the Drainage of Public Toilets (Ciliwung River)

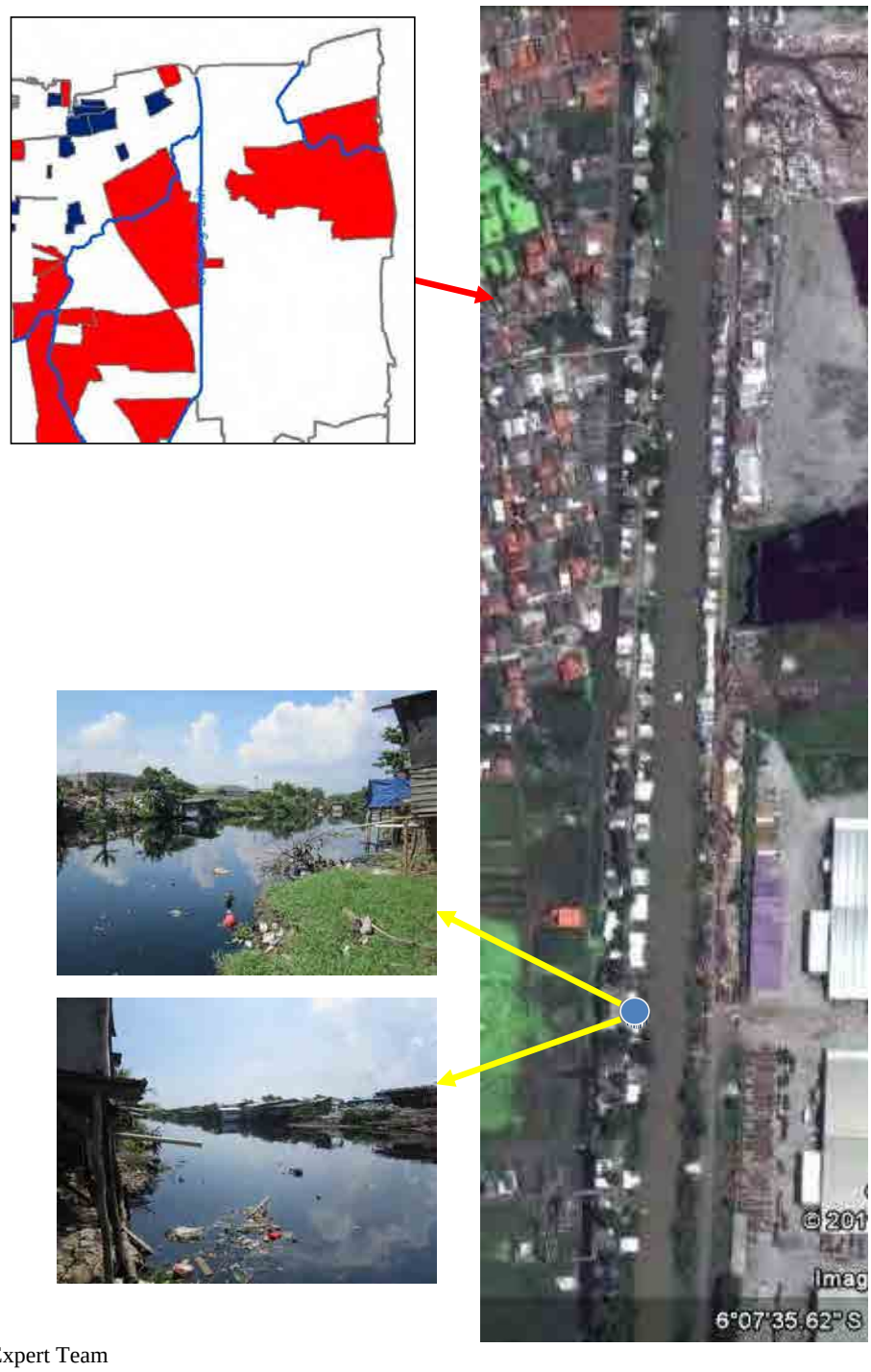
Figure B3-21 Low-income Housing on Both Sides of the Ciliwung River

Figure B3-22 Site of Low-income Housing was Removed Ciliwung River

3) Slum Areas along the Cakung River

The color of Cakung river water is black which means river is highly polluted. This condition perhaps

is because of many residents are living along the river. Many houses discharge their domestic wastewater directly to the river. And also on the upstream part of the river there are several industrial areas, so there is a possibility that the wastewater from industry is also polluting the river. Figure B3-23 shows the slum settlements all along the Cakung river.



Source: JICA Expert Team

Figure B3-23 Slum Settlements All Along the Cakung River

The people live in poor sanitation conditions as can be seen in the photographs below.

Figure B3-24 Black Water Thrown Directly into the River

Figure B3-25 Gray Water Thrown Directly into the River

Figure B3-26 Toilet in Slum Area

Figure B3-27 Houses with Bad Air Circulation

Figure B3-28 Unorganized Layout of the Houses

Figure B3-29 Houses Built so Close to Each Other

Source: JICA Expert Team

(4) Government Initiatives

There are some programs that have been implemented by DKI Jakarta to reduce the slum areas, especially by Housing Agency, Landscaping Agency, Agency of Arrangements and Supervision of Buildings. In general, there are 4 patterns that have been developed to reduce the slum areas which are: restoration, environment improvement by increasing the community economic, rejuvenation of the areas, and developing a new area.

Some programs that the provincial government of DKI Jakarta implemented are as follows:

1) PPMK

For environment improvement, DKI Jakarta implemented PPMK (Community of Kelurahan

Empowerment Program). This program was implemented to increase the living standards of community, so the environment condition around slums to become better. PPMK program was commenced in 2001 to respond with economic crisis in 1998. The budget allocation for PPMK in 2009 was about IDR 72.6 Billion, and in 2010 it was increased to IDR Billion.

2) MHT (Mohammad Husni Thamrin)

Village improvement program to reduce slum areas, the program is called MHT (Mohammad Husni Thamrin). The purpose of this program is to repair or restore the area's infrastructure and facilities so the slum areas will have better facilities and infrastructures. In 2011 there is budget allocation of about IDR 82 billion for this program, which is only a fraction (about 0.3%) of 2011 budget of DKI Jakarta, which is IDR 27,875 billion.

3) Construction of Low-Cost Apartment

Realization and development of low-cost apartments: the purpose of this program is to move the peoples from slum areas to a better place.

4) Community Based Improvement

In the future, improvement program of slum areas will be community based in an integrated manner involving various sectors.

5) Others

Others program by the government to reduce the slum areas, such as: socialization, training, and law enforcement for illegal slum areas that disturb the aesthetics and are socially vulnerable with criminal act.

(5) Lessons Learnt

In several slum areas, government has constructed public toilet (MCK) or have installed some communal septic tank. But one of the problems is that the location of MCK is usually far from slums because the availability of land is very limited near slum areas to construct MCK. Because of that many people do not fully use MCK and communal septic tank and they discharge their black water into the river directly.

Another problem is even though there are some MCK or communal septic tank; the gray water is still discharged directly into the river or drains causing ultimately pollution into the rivers.

Low awareness of the people in slum areas is also the major factor for the source of river pollution and poor sanitation. The sanitation is not their priority for healthier life because of various reasons including economic.

Many people on the slum areas do not have good sanitation facility and infrastructure, which is unsafe for their health.

Slum areas located not on the river banks also contribute the river water pollution. It is because their domestic wastewater is connected to drains causing ultimately pollution into the rivers.

(6) Issues of Slum Areas

There are several issues regarding slum areas, major of which are described as below:

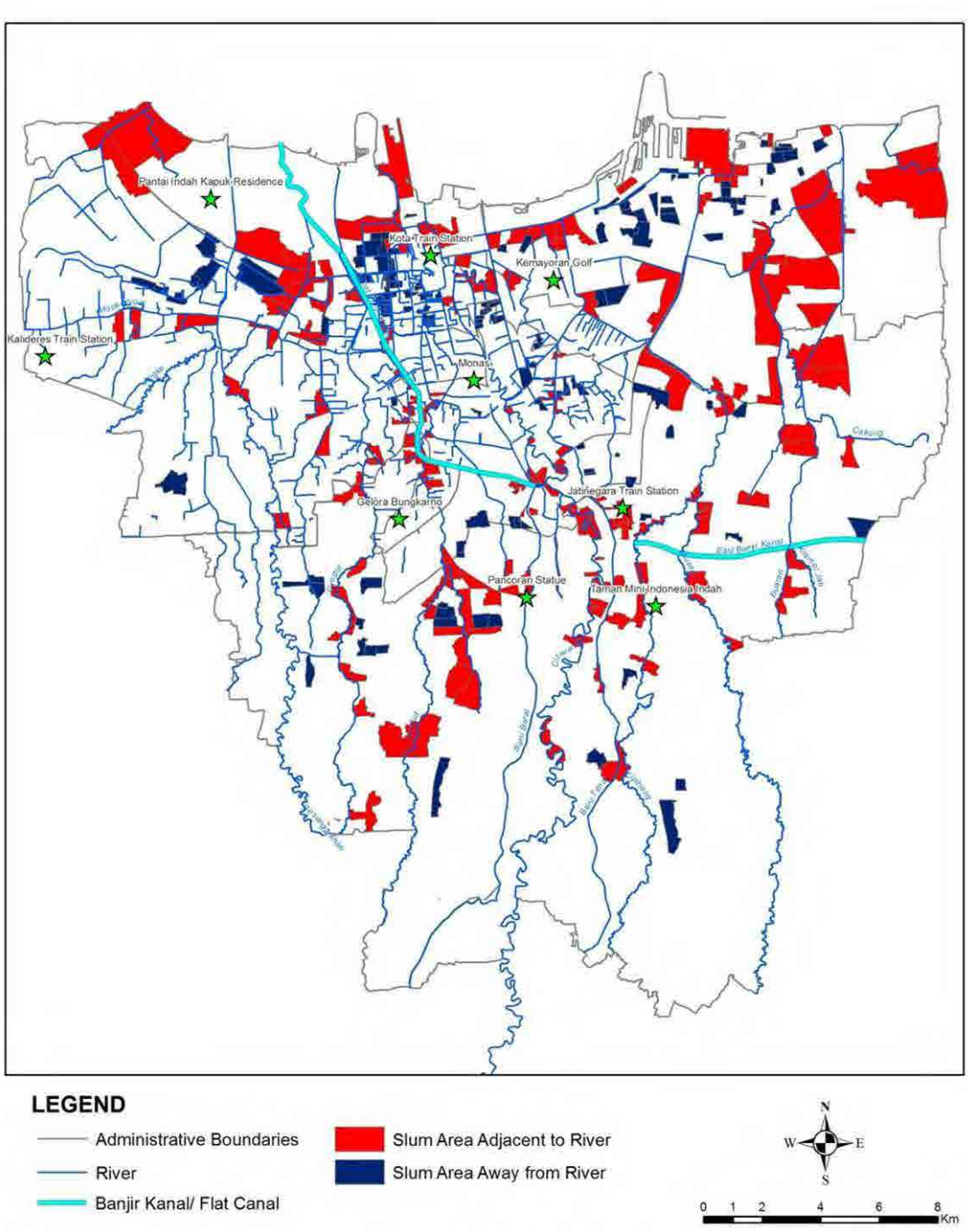
1) Keep Increasing Slum Areas

As urbanization is happening in Jakarta, many people are coming to Jakarta to look for the work. Slum areas are increasing because of unbalance population growth comparing with the increase of housing. On the other hand, the people who live on slum areas have been playing major role, especially in economic growth, because such workers are abundant and usually their wages are not too high.

2) Unregistered Slum Population

Figure B3-30 shows the locations of registered slums across DKI Jakarta. As can be seen, many slums are located along/or on the water bodies. Table B3-18 shows distribution of such registered slum

population in DKI Jakarta.



Source: DKI

Figure B3-30 Slum Areas in DKI Jakarta

Table B3-18 Distribution of Slum Areas in DKI Jakarta

Area	Slum Areas (ha)	Population	Population Density (people/ha)
South Jakarta	417	165,142	396
East Jakarta	449	148,368	330
Central Jakarta	171	86,615	505
West Jakarta	244	73,228	300
North Jakarta	204	91,768	449
DKI Jakarta	1,485	567,413	

Source: Central Bureau of Statistic (BPS), 2008

As shown on table above, total population of slum registered with Central Bureau of Statistics (BPS) in year 2008 in DKI Jakarta was about 567,413 people against the total population of Jakarta which was reported to be more than 9 million people. There are much more people who live in slum areas and are still unregistered.

World Bank in their Draft Final Report "Support to DKI Jakarta for wastewater Management" stated that 5-6 millions of residents in DKI Jakarta live in slums. To the JICA Project team, although this estimate seems to be exacerbated, there is clear indication that a substantial population in DKI Jakarta live in slums.

These are probable factors for the unregistered slum population in DKI Jakarta:

- Seasonal residents: There are many people who come to Jakarta for the work. They do not have permanent house in Jakarta. So they end up living in Slum areas.
- Illegal immigrant: Such people build illegal permanent or semi-permanent houses in open space many along the river banks.

3) Majority of Slum Location

The number of slum areas can be seen in Table B3-19. From the table below about 35.61 % of slum areas were located on the river banks.

Table B3-19 Number of Slum Areas

Area	Number of Slum-RT									
	River Banks	Side of Railways	Swamp land	Around Market	Green open areas	Former lands of eviction	Bus or Train Station	Coast area	Others area	Total
South Jakarta	157	51	10	26	8	11	0	8	261	532
East Jakarta	135	33	0	31	9	4	2	0	319	533
Central Jakarta	114	41	0	57	0	3	3	0	228	446
West Jakarta	197	4	3	21	0	4	0	0	96	325
North Jakarta	179	7	16	7	9	2	0	0	119	339
DKI Jakarta	782	136	29	142	26	24	5	29	1,023	2,196

Source: BPS, 2008

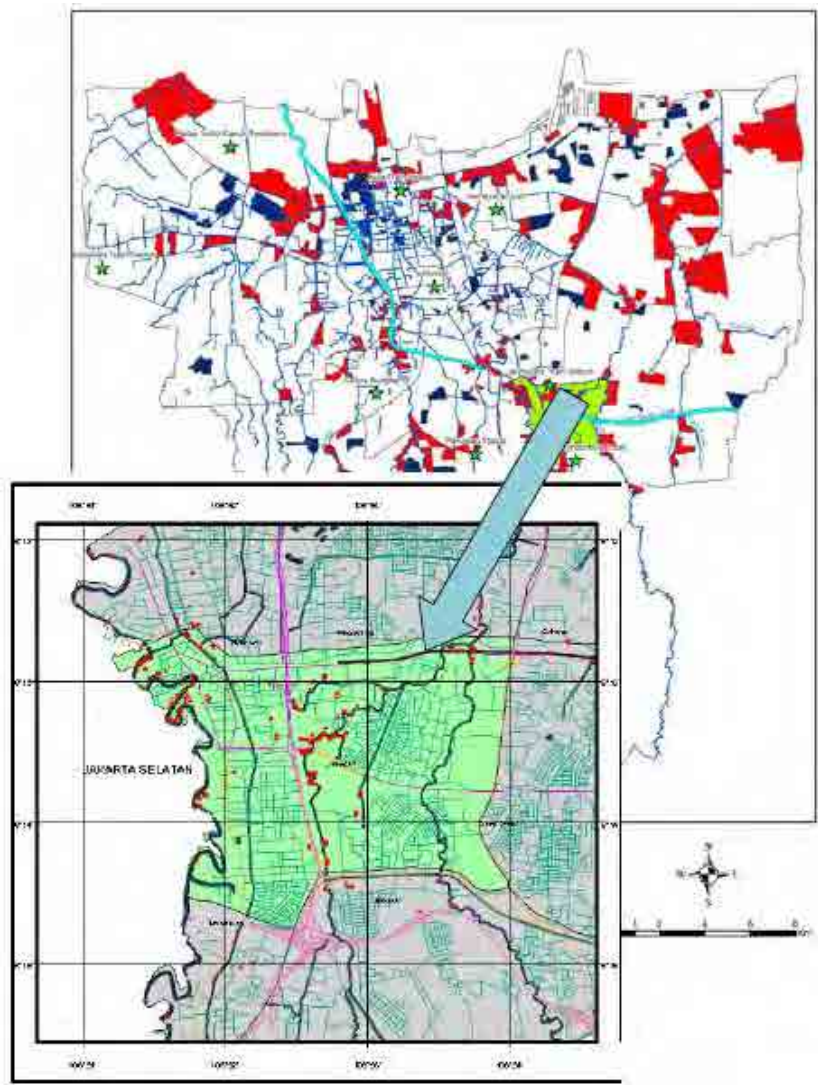
(7) Case Study to Understand the Characteristics of Slums

The Bogor Agricultural Institute in 2010 conducted a case study to understand the characteristics of slums in Kecamatan Jatinegara of DKI Jakarta. The research was done by surveying the site and 72 households which had population of 312. Figure B3-31 shows the area of the case study and slum locations within it.

The findings under the case study are as follows:

- The house area of slums varied from 3 m^2 to 165 m^2 with an average about 20.4 m^2
- The average size of road is about 1 m, so it is very difficult to pass the vehicles through it.

- About 49 % of respondent live in rented house and 51 % have their own house. In general, people who live in the rented house are immigrant people that come to Jakarta to search for work.
- Most of the people in slum area do not have high educational background. Mostly have elementary school and high school. People who finished the college are just 1 %. And there are people who still do not get any education or schooling. As a result, most of them are working in sectors that do not required special skills, such as informal business and labor.



Source: Identification of the Characteristics of Slum Area, Gusmaini 2010

Figure B3-31 Area of the Case Study

(8) Estimation of Slum Population

The population of slums based on BPS data is not realistic as it accounts for registered slum population only. In the absence of realistic data, the JICA Project Team has made the following assumptions to estimate the slum population:

- The majority of slums (35.61% as stated above) live along the river bank
- About 60% of river banks are occupied by the slums
- River length of 13 major rivers in DKI Jakarta is 310 km (approximately determined using Google map)
- One household in average occupy 3-4 meter river length

- One household has 5 members in average

Based on the above assumptions, slum population which lives along both the banks of the rivers passing DKI Jakarta can be estimated as 535,000. The total slum population living across DKI Jakarta can be estimated as 1,500,000. These peoples are non-point source of pollution, because almost all of people's untreated domestic wastewater directly to the rivers or indirectly through the drains goes to the rivers.

(9) Estimation of Slum Pollution Load

In Old M/P, existing domestic unit pollution load in DKI Jakarta was estimated at 27.9 g as BOD per person per day. Using the existing domestic unit pollution load of the old M/P 1991 since slum people are mostly low income people, the BOD load as non-point source of pollution arising out of slum population in DKI Jakarta is estimated at 42.0 ton BOD per day which is a very significant amount. Therefore, DKI Jakarta should consider the issue of wastewater management arising out of the slums as the direct benefit of it would be a significant reduction of daily pollution load on the rivers.

(10) Approach for Developing Strategy

The water quality problems in the rivers arising from the slum settlements can be addressed through resettlement. This can be achieved by the removal and relocation of the settlements to alternative locations, or through the in-situ upgradation of the slums, by way of which better health and sanitation systems could be put in place. In either case, it is important to address the rehabilitation of the affected population. Rehabilitation has a wider goal, in terms of not only relocating displaced families in a physical sense, but also redeveloping their old habitat and environment and merging them in to their surroundings as a single entity. It steps beyond the physical settlement and also includes the reconstruction of the livelihood of displaced persons.

To evaluate the feasibility and efficacy of the resettlement strategy, a pilot project could be the preferred approach to provide the inputs for developing the strategy for the city as a whole.

(11) Institutional Issues

In DKI Jakarta, there is serious problem of multiplicity of agencies. Therefore, institutional restructuring and strict coordination among different agencies involved in developing and executing projects would be required.

(12) Need of a Comprehensive Study

There is no actual count of slum settlements and population in DKI Jakarta. The profile of slums and spatial data to understand the physical, social and economic character of slums are required to identify their resources, demand, priorities, deficiencies of infrastructure, housing conditions, etc. Therefore, there is need to conduct an extensive study on slums settlements to develop an effective strategy to reduce the pollution load on the rivers, as well as exhaustively and holistically address the issue of improvement, rehabilitation and resettlement.

B3.5.2 Current Situation of Wastewater Treatment in Slum

The following explains the current situation of sanitation and wastewater treatment in low-income settlements developed around the Pluit regulating reservoir and along the Ciliwung River.

(1) Slum Area around the Pluit Regulating Reservoir

Shabby wooden houses cover the area around the floodgate situated near the pumping station at the northern end of the Pluit reservoir, forming a low-income settlement. Half of each house overhangs the reservoir perhaps because the water level is controlled by the drain pump. Although electricity is available, public services such as roads, water and public toilets are not being provided.

The residents purchase water in 20-liter plastic containers and use it as drinking water, etc. The reservoir water is used for washing. Piers extend from the houses which lead to walled spaces that are used as toilets. The excrement drops directly into the reservoir. Although rainwater and gray water are discharged directly into the reservoir, the reservoir water is not contaminated to the extent that it emits

offensive odors.

Waste which has been dumped in the surrounding area and waste which has drifted from the upper reaches of the river ends up floating in large amounts in the water between the floodgate and the screen. The waste is removed by the screen.

The people in the area have poor living and hygiene conditions due to no public sanitation services being available, perhaps because it is an illegal settlement.

(2) The Low-Income Settlement along the Ciliwung River

The Ciliwung River is a major river which meanders along the railway through the central part of DKI Jakarta. The river water is diverted into a canal around the middle reaches of the river and the quantity of water decreases around the lower reaches of the river in the area around Menteng. Because the quantity of water decreases in the lower reaches of the river and because of the untreated water discharged into the river, the water is emitting offensive odors in this area. Waste which has drifted from the upper reaches of the river and waste dumped on site is left floating in the water and is also scattered around the banks. The waste will probably be washed away by the large quantities of water which flows down the river when it rains.

There is an about four-meter wide road running along the bank and a 40-meter wide low-income settlement extends along the road. Small wooden houses stand close to each other. MCK (mandi, cuci, kakus˜ bathing, washing and toilet) facilities and a waste collection site are installed near the bank every 10-20 meters. They were probably provided by public agencies and various aid organizations. The residents actively use and jointly manage the facilities. The wastewater from the MCK facilities is discharged directly into the river and this suggests that the MCK facilities are contributing to the contamination of the river. There is no running water supply and the residents are using communal wells and purchased tank water.

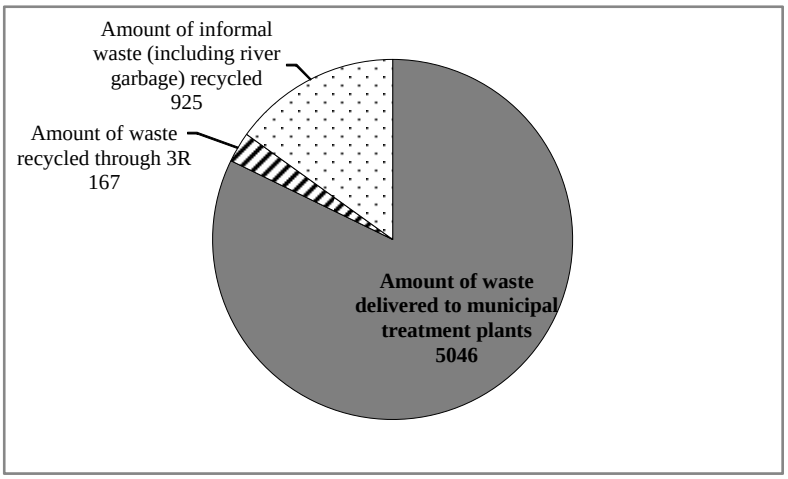
Toilets in the low-income settlement around the Pluit reservoir are situated outside although they are surrounded by walls. Therefore, the development of basic sanitation facilities is required, while wastewater treatment measures are required for the MCK facilities in the low-income settlement situated along the Ciliwung River. What they have in common is that untreated domestic wastewater is contributing to water pollution and that comprehensive measures are required to tackle the non-point pollution sources. DKI Jakarta is conducting a project to remove low-income settlements from the Jl. Inps. Saluran Tarum Barat area around the upper reaches of the Ciliwung River in the southern part of Jakarta (the BBWSCC Program, implemented by DKI Jakarta). The photograph on the left shows the low-income settlement on the both sides of the river. The photograph on the right shows the river after a low-income settlement has been removed and concrete banks have been built on both sides of the river.

B3.5.3 Solid Waste Disposal

In the city of DKI Jakarta, the DK is responsible for the collection of garbage from residential areas (except illegal slums). Meanwhile, the DPU, the Park Agency, and KRL Jabotabek (public railway corporation) are in charge of water areas, including rivers and their banks; of roads and parks; and of areas along railways, respectively. In the illegal slums, the last two organizations are responsible for the collection of waste from riverbanks and from areas along railways. The DK does not collect waste from the illegal residential areas, but delivers it to treatment plants once a week(DPU and Railway coporation will collect the waste from illegal residential house).

Waste thrown into rivers, etc. instead of being collected properly is one of the non-point pollution sources. Unless properly educated, many residents consider waste merely as a nuisance and dump it in gutters, rivers and vacant land. As a result, breeding places for pathogens increase, but the residents are not aware of this fact. It goes without saying that they hardly consider the environmental impact of the waste. Even the municipal authorities responsible for waste collection do not pay attention to the situation in some cases. According to the data (2010) provided by the DK of DKI Jakarta, the daily solid waste generated is 6,139 ton, of which 5,046 ton is brought to the Bantar Gebang final disposal site and of which 167 ton is recycled by 3R program. The remaining 925 ton is the amount of

non-collected waste including waste illegally dumped in vacant land, rivers, etc.



Source: JICA Expert Team

Figure B3-32 Amount of Waste in the City of DKI Jakarta (2010) (tons/day)

Having a strong interest in the matter, DKI Jakarta has been conducting the "campaign to ban illegal dumping of waste" since March 22, 2010, targeting the low-income settlement area along the Ciliwung River. This area is situated in the central part of Jakarta. Low-income settlements along the Ciliwung River in the area have high population densities and large amounts of waste were dumped into the river. It is thought that this resulted in a deterioration of river water quality, as well as hampering the river flow and worsening floods. Therefore, it is strategic to target this area and improvement in the waste collection for the area is expected to have a large impact on improving the control of non-point pollution sources. The following section explains the "campaign to ban illegal dumping of waste."

(1) Pejaten Timur Waste Treatment (Recycling) Plant

BPLHD have been improving four illegal dumping sites in the city through the "campaign to prevent illegal dumping" jointly implemented with DGHS. A site situated along the Ciliwung River in the Pejanten Timur area was used as a dumping site (illegal dumping) for waste emitted by the residents of the area (community RW-09) in the past. The dumped waste flowed into the river in the rainy season and became a source of water pollution. The campaign aimed to stop the dumping of waste into the river by residents, the construction of a recycling plant on the site, the promotion of waste recycling and the introduction of appropriate waste disposal. It is a joint campaign between BPLHD and DGHS. BPLHD conducts awareness-raising activities and environmental education for the residents in target areas and DGHS installs waste collection containers and constructs waste sorting yards.

Communication with residents and awareness-raising for residents was conducted through the household welfare program. In addition, the representative of the area (RW-09) distributed the aims and details of the campaign to all residents via the leader of each RT (neighborhood association, there are 16 in total). About 40 m^3 of waste is brought in from the area (RW-09) annually, of which 8-10 m^3 is sorted and recycled and the rest is taken to the municipal disposal site (Bantar Gebang disposal site).

In the Pejanten Timur plant, dry waste is separated into bottles, cans, plastics, cardboard boxes, etc., which are then sold to scavengers. The proceeds are used to maintain the plant. Wet waste is screened in order to sort it into raw materials for compost and other recyclable waste. One-quarter of 1 m^3 of waste is used to produce compost. In RT5 (one of the 16 neighborhood associations), two waste containers are distributed to each household and sorted collection of dry waste and wet waste is being conducted on a trial basis.

(2) Lenteng Agung Composting Facility

The Lenteng Agung composting facility was constructed through the campaign. At this facility, compost is produced from the waste discharged by 2,000 households in the Lenteng Agung (RW 8) area in the southern part of Jakarta. About half of the waste generated from the area is used to produce

compost. Compost is packed and sold for Rp. 5,000 per bag. It was reported that there is no fluctuation in demand in different seasons. In this facility, the process takes a week from the reception of sorted organic waste to the screening and packing of the compost. The activities conducted at the facility enable environmental education for residents as well as reducing the amount of organic waste disposal through compost production at the same time.

B3.5.4 Measures to Cope with Non-point Source Pollution Load in the Future

Since the slum problem contains in the background a variety of aspects such as regional disparity, education, employment etc., each of which needs its own solution, DKI Jakarta has been tackling with this with a comprehensive approach. Thus, it is expected for DKI Jakarta to improve environmental hygiene of the slums while maintaining consistency with the basic policy of the Authority.

In order to solve the hygienic problem of the slums, it is desirable to implement a medium or long-term redevelopment program, in which the slums should be cleared out. Jakarta is considered to have, besides slums, quite a few urban quarters, which should require a redevelopment in order to rehabilitate sound functions of city. Some of such quarters can be revived to have city functions once they are redeveloped into new residential area. In such a housing redevelopment project, sewage treatment facilities, which have higher-performance than septic tanks, should be integrated in the houses and the construction cost should be included in the land price or the value of a lease before the houses are provided to the residents. It would enable the government to promote sewage treatment plants as well as the housing development. For this purpose, governmental guidance is effective; for example, planning the redevelopment of a residential area whose scale exceeds a certain level requires the installation of a common wastewater treatment plant. The following describes activities required for reducing the pollution load of wastewater (including solid waste) generated in the slums as a temporary measure against sanitation problems until the redevelopment is complete.

Regarding the black and gray water, according to the Millennium Development Goal, the number of the people who cannot use hygienic toilet should be reduced to half. To achieve this goal, it is essential to improve hygiene of toilet facilities in the slums. More specifically, it is recommended to build and improve public toilets and on-site treatment facilities such as SANIMAS. Besides, it is important to launch a campaign in order to enhance awareness for environmental hygiene targeted to the residents of the slums so that they become capable of maintaining voluntary and sustainable hygienic environment.

In the area of solid waste, BPLHD and DK are currently implementing 3R Promoting Program in an effort to reduce solid waste to be dumped into garbage bins. However in the slums area, where no regular garbage collection is carried out, priority should be place on a project where garbage collection is systematically practiced and waste is properly dumped into garbage bins. While the aforementioned “campaign to ban illegal dumping of waste” is evaluated to have certain positive outcome, it is still necessary to further reduce illegal dumping and non-point source pollution load contributed by solid waste. The following shows possible concrete measures.

(1) Extending Collection Routes and Installing Containers

Most slums are in illegal residential areas, but some are in legal areas. The latter require the improvement of waste collection. The slums along Ciliwung River have no roads constructed systematically, which makes it difficult to run collection trucks and hand-carts. Accordingly, roads for hand-carts shall be constructed. In addition, a necessary amount of plastic containers should be arranged at the end of each road, in consideration of the population.

(2) Motivating the Residents

The installation of trash containers cannot in itself change residents’ action the illegal disposal of waste. The city government shall not only give a description of its approaches and purposes but also show its seriousness. In general, residents have a tendency not to evaluate governmental activities rightfully, which is remarkable in Indonesia. Therefore, the city government is required to display its seriousness through definite action.

For example, collection is conducted at a given time on a specified day. Furthermore, the city government announces the results through a graph (picture) of the amount of waste collected. There is a means of letting communities (RT-RW) compete with each other for the results. If there is no garbage (non-point pollution sources) in the living environment, scraps laying scattered over inaccessible space are put in the given trash container and delivered regularly, and the residents can have talks with each other about what is changed. As a result, the city government will be able to achieve a goal the improvement of the collection of waste from the slums.

(3) Motivating the Workers in Charge of Collection

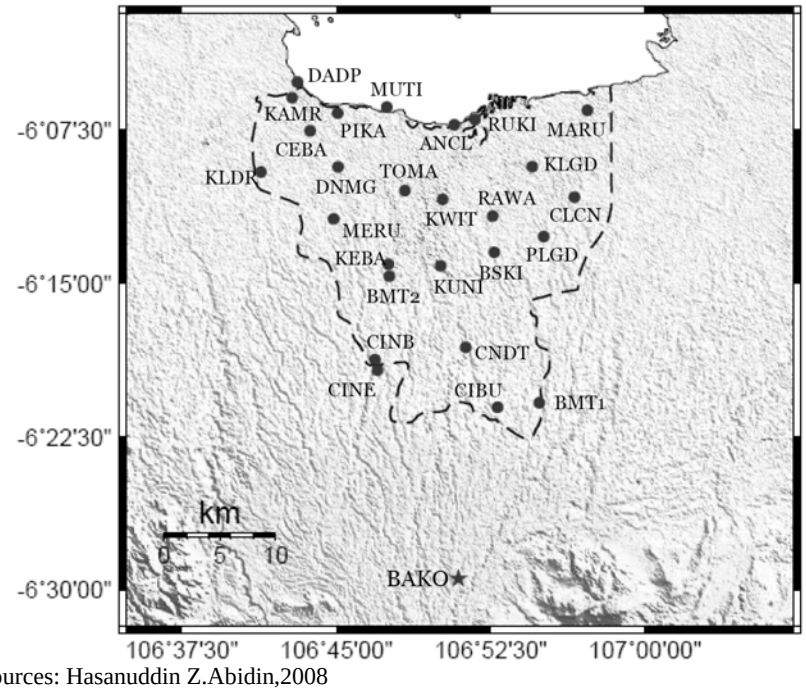
It is important to motivate every worker. In addition to the residents, the workers become proud of their duties by receiving an in-depth description of the project purpose and clean work clothes. Giving them responsibility and authority is essential. For example, the city government needs to show the workers their responsible garbage collection routes and to let them take action against complaints from residents in the given section. It may build up a system in which workers who receive no complaints, cause no accidents, or do not have any other trouble can be awarded commendations.

B3.6 Land Subsidence

In DKI Jakarta, land subsidence occurs widely as the urban development. The main reasons for this land subsidence includes excessive groundwater pump-up in the central city area and decrease of groundwater cultivation by the housing development.

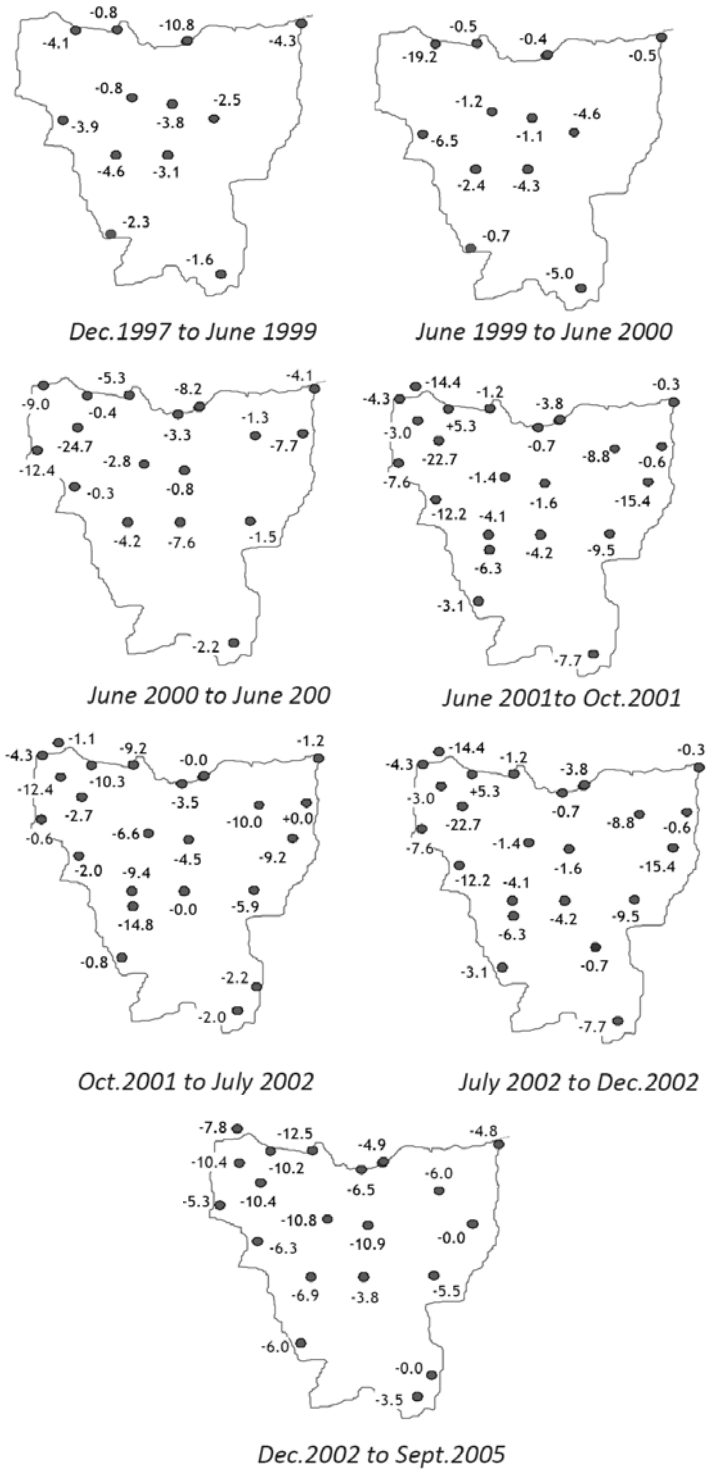
The leveling survey revealed around 2m subsidence from the benchmark for 15 years (from 1982 to 1997) , and its subdidence area reached around 20km from the coarstline. Time sequential change of the subsidence does not show the tendency of bottoming-out.

The topographical survey by GPS from 1997 to 2008 shows the tendency of the further advance of land subsidence. The following figures show the survey points and the survey results of land subsidence.



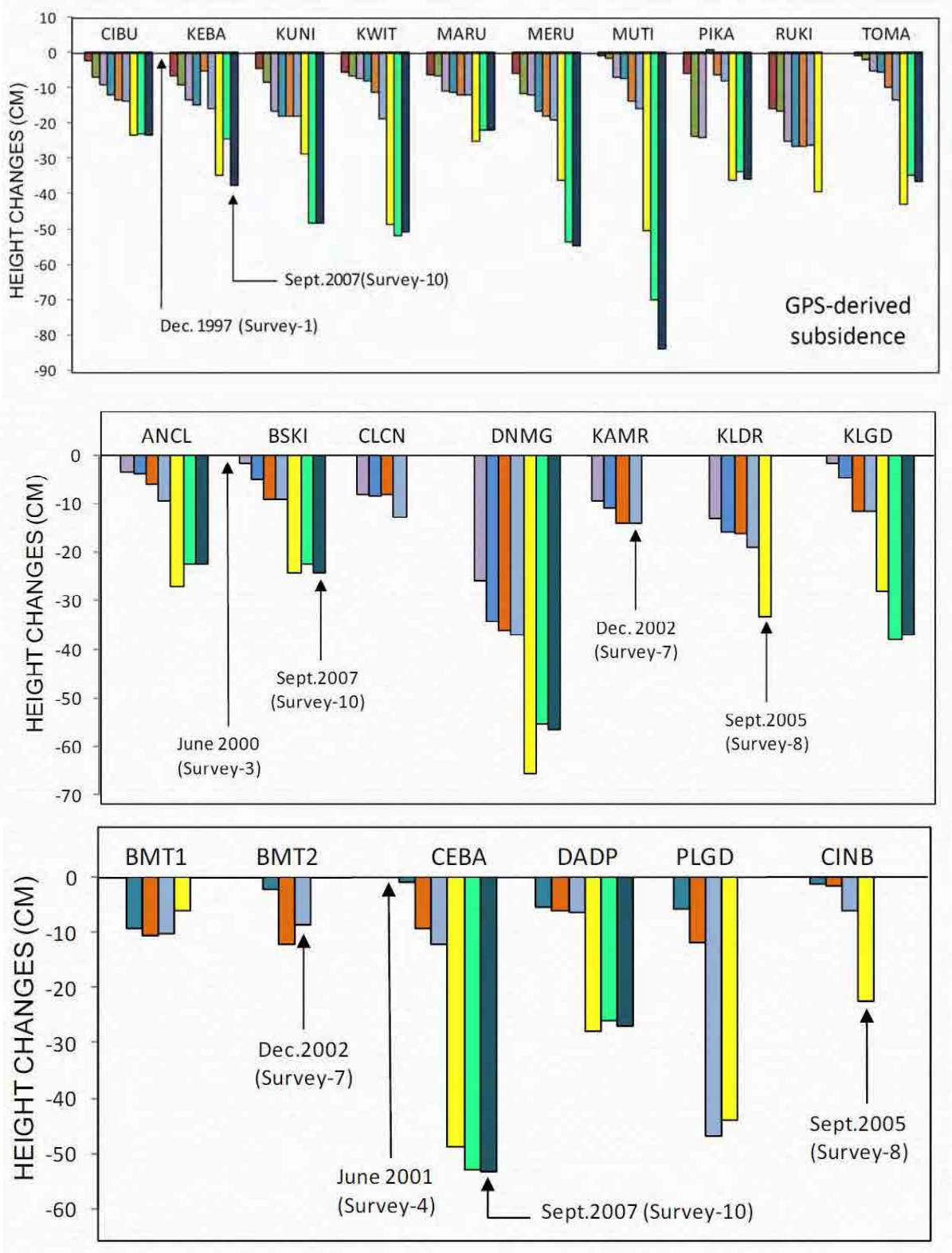
Sources: Hasanuddin Z.Abidin,2008

Figure B3-33 Topographic Survey Points by GPS



Sources : Hasanuddin Z.Abidin,2006

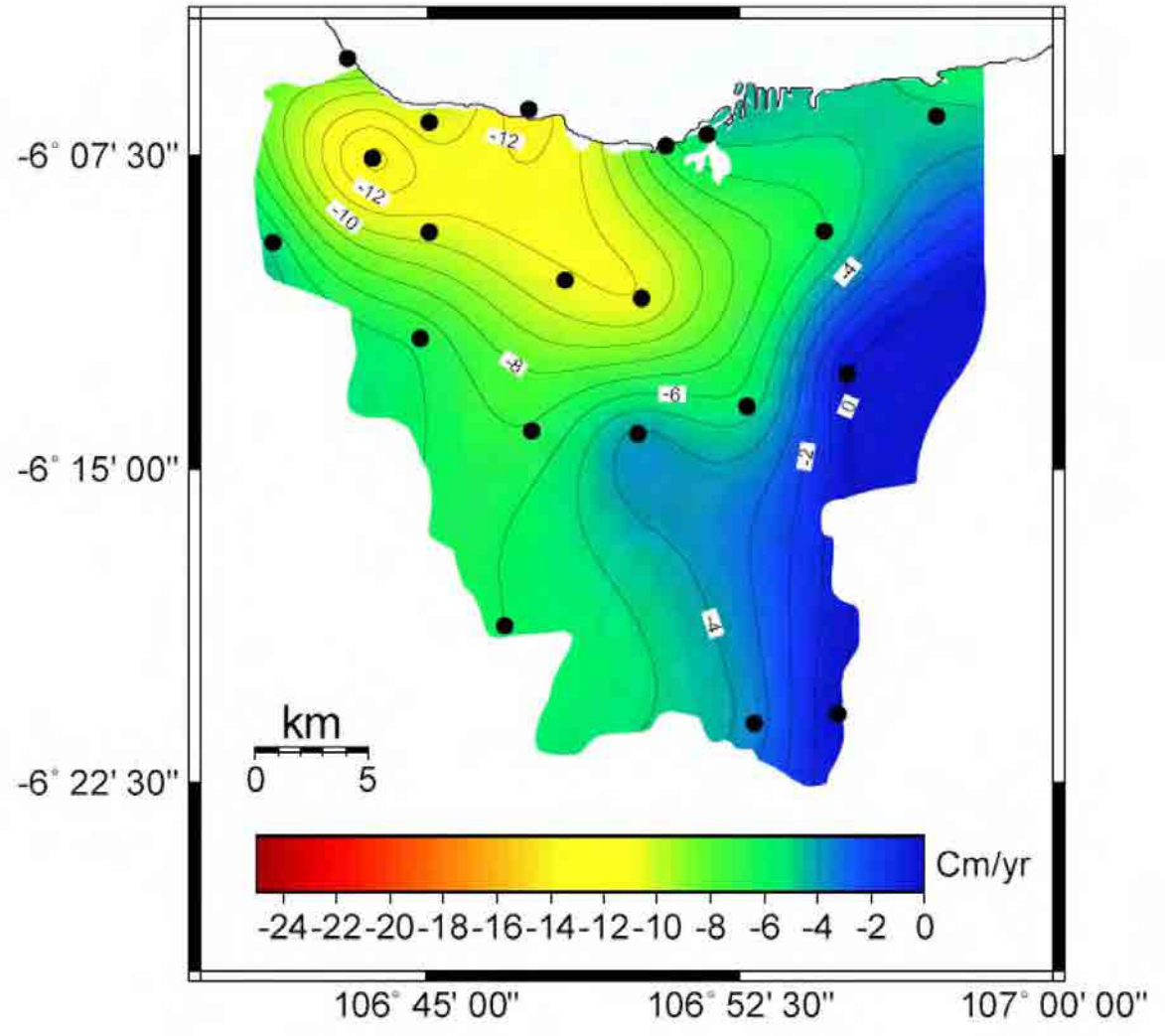
Figure B3-34 Topographic Survey Results of Land Subsidence



Sources : Hasanuddin Z.Abidin,2008

Figure B3-35 Time Sequential Change of Land Subsidence

The following figure shows the regional characteristic of land subsindece in DKI Jakarta. The land subsindence in the south-east area is small, on the other hand, the subsidence in the north-west is large as 12cm per year.



Sources : Hasanuddin Z.Abidin,2006

Figure B3-36 Regional Characteristic of Land Subsindece in DKI Jakarta.

B4 Present Conditions and Issues of Off-Site Sanitation

B4.1 Existing Off-Site Sanitation Facilities Constructed Under JSSP

The existing off-site facilities were constructed in the Jakarta Sewerage and Sanitation Project (JSSP) and are currently controlled by PD PAL JAYA.

B4.1.1 Wastewater Treatment Plant

Surface aerators were installed in Setiabudi Pond, which was a flood-control reservoir, in 1991 to aerate wastewater. Therefore, the Setiabudi wastewater plant is also used as a flood-control reservoir.

The Setiabudi wastewater treatment plant is divided into the two sections, West pond and East pond. The total area is 43,500 m^2, the effective capacity is 133,980 m^3, and the effective depth is 3 m in the West pond and 3.2 m in the East pond. However, the actual effective depth is thought to be less than those values because the sediment and sludge are accumulated on the bottom.

The designed treatment capability is 28,000m^3/day. The average treatment volume of year 2009 is 18,031.68 m^3/day according to PD PAL JAYA, and the West pond receives about 75% of wastewater and the East pond receives about 25% of it.

Four surface aerators are installed in the West pond and three surface aerators in the East pond. The treated wastewater aerated in the respective ponds is discharged into the Banjir Canal near the ponds

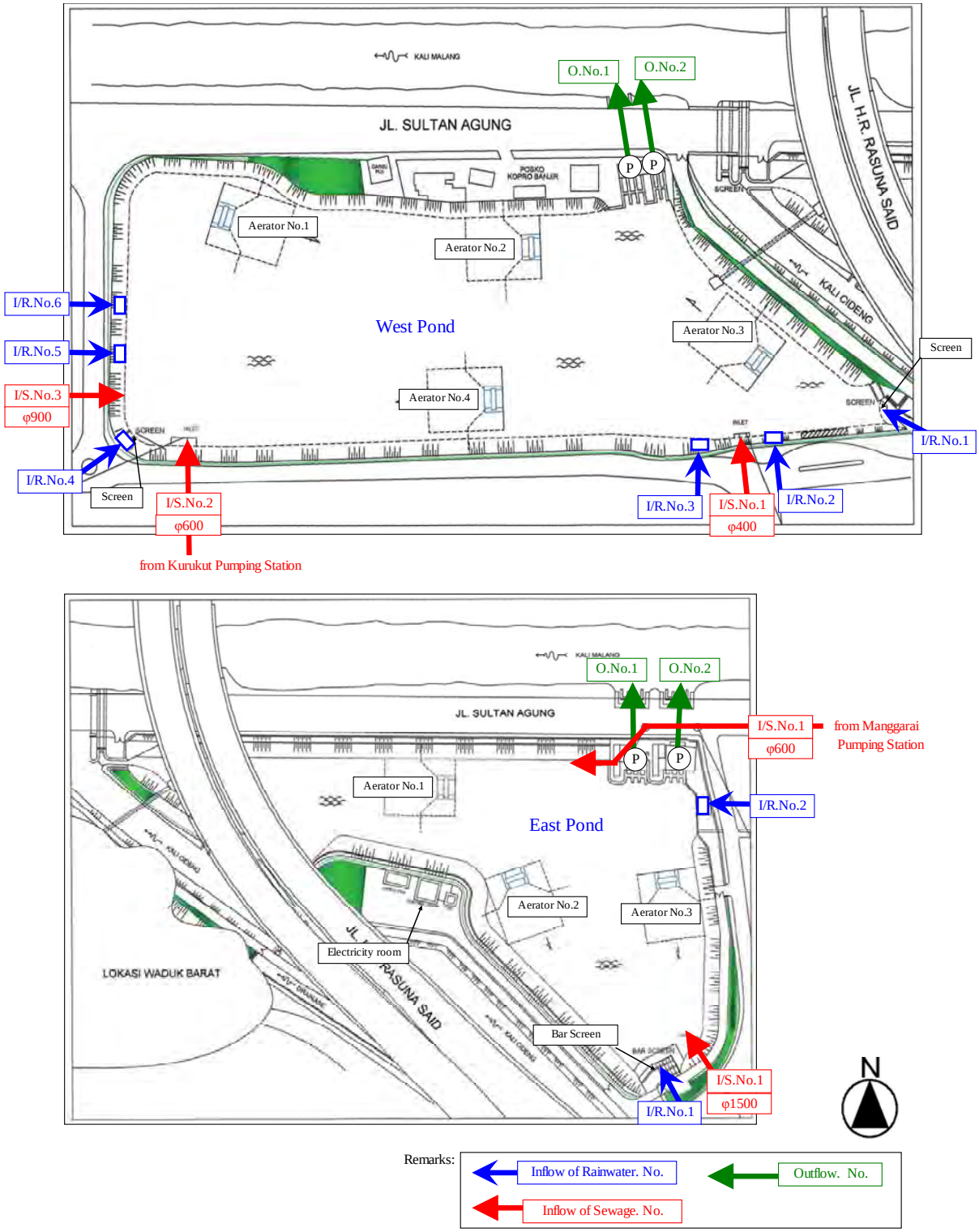
by the effluent pumps when the water level in the ponds becomes high. Table B4-1 shows the outline of the Setiabudi wastewater treatment plant and Figure B4-1 shows the top view of it.

Table B4-1 Outline of Setiabudi WWTP

Physical Condition		West Pond	East Pond	Total
Surface area		26,100 m^2	17,400 m^2	43,500 m^2
Water level	in high condition	4.5 m	4.7 m	-
	in low condition	1.5 m	1.5 m	-
Pond depth (effective)		3.00 m	3.20 m	-
Elevation at the bottom of pond		-0.5 m	-0.5 m	-
Pond capacity(effective volume)		78,300 m^3	55,680 m^3	133,980 m^3
Treatment process		Aerated Lagoon	Aerated Lagoon	-
Treatment capacity *1		13,523.76 m^3/day	4,507.92 m^3/day	18,031.68 m^3/day
Present quantity of influent *2		9,720 m^3/day	3,240 m^3/day	12,960 m^3/day
Retention time *3	Based on treatment capacity	4.3 day	5.5 day	4.7 day
	Based on present quantity	8.1 day	17 day	10.3 day
Inlet	Wastewater	3	2	5
	Drainage	6	2	8
Screen (Mechanical Screen)		2 (0)	2 (2)	4 (2)
Aerator unit		4	3	7
Effluent Pump		5 x 1.10 m^3/s	3 x 1.10 m^3/s	-

Note: 1. Based on JSSP
2. Hearing from PD PAL JAYA
3. Calculated by pond capacity, 1 and 2.

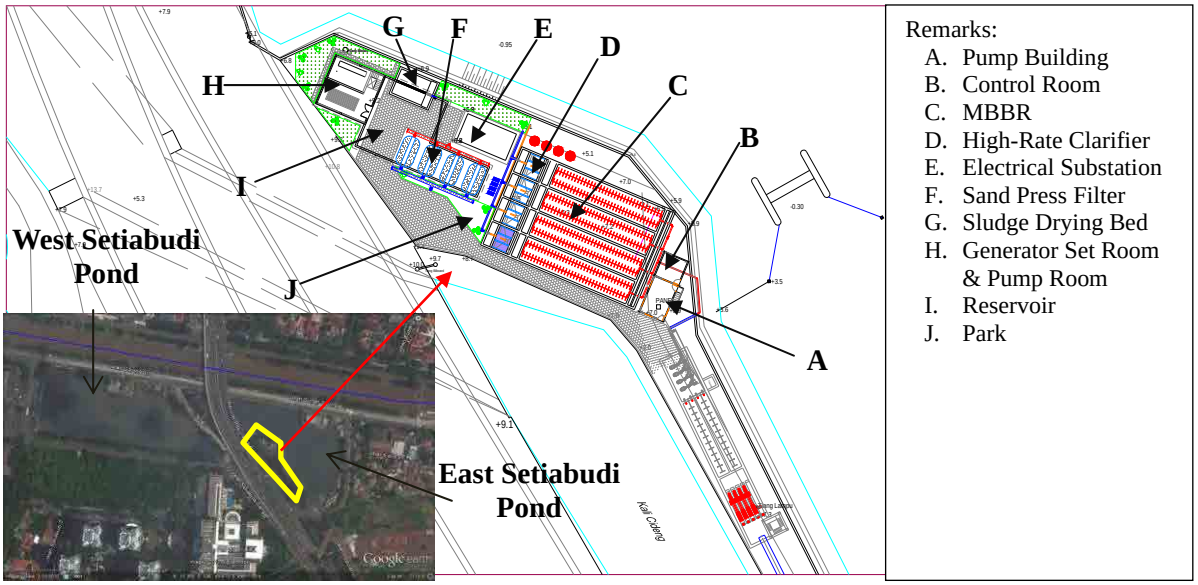
Source: Draft Final Report, Detail Engineering Design STP Waduk Timur, PD PAL JAYA, PT. Kanta Karya Utama



Source: PD PAL JAYA

Figure B4-1 Top view of Setiabudi Wastewater Treatment Plant

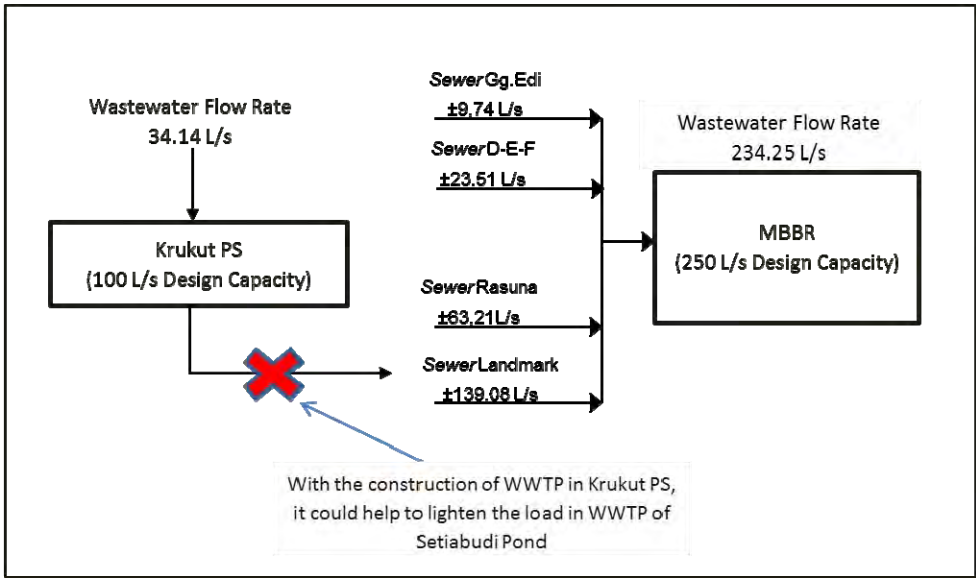
The existing coverage of "Zone 0" is 1.67%. There is plan to develop Setaibudi-Tebet, Casablanca system in the year 2010-2020 to increase the service coverage to 4%. As a result about 350-400 L/s of wastewater flow would be generated by 2020. A WWTP of capacity 250 L/s based on MBBR (Moving-Bed Biofilm Reactor) based technology is under construction at the East Setiabudi pond. A Layout of East Setiabudi WWTP is as in Figure B4-2.



Source: PD PAL JAYA

Figure B4-2 Layout of East Setiabudi WWTP

There is another plan to construct WWTP of capacity 100 L/s at Krukut pumping station which will be then demolished. Currently, wastewater of flow around 50 L/s is pumped from the Krukut pumping station to sewer Landmark which flow under gravity to East Setiabudi pond. The schematic line diagram of plan flow in the year 2010-2020 to East Setiabudi ongoing WWTP and Krukut planning WWTP is shown in Figure B4-3.



Source: PD PAL JAYA

Figure B4-3 Plan Flow in the year 2010-2020 to East Setiabudi Ongoing WWTP and Krukut Planning WWTP

The flood-control reservoir is under the jurisdiction of the DPU in DKI Jakarta and so priority is given to the flood control in a rainy season. In addition, mutual coordination is not made between DPU and PD PAL JAYA for the control of the Setiabudi pond including the dredging process of deposited sand. (See Section B1.3.4 for details.)

PD PAL JAYA controls only the surface aerators and part of screens and does not have a measurement device for influent wastewater flow. It is difficult for this plant to understand the basic mass balance in wastewater treatment.

In addition, judging from the exterior appearance of the ponds, there is no suspended activated sludge, which is usually found in an aerobic lagoon, and anaerobic gas is generated from part of accumulated anaerobic sludge. The surface aerators stir the surface water and supplies oxygen only partly. Furthermore, the effluent water in the Setiabudi pond seems to be diluted by the influent rainwater especially in a rainy season and so it seems this plant does not have a normal wastewater treatment and control function. In addition, a large amount of solid waste is flowed into the ponds and additional labor is required to remove it before performing the usual wastewater treatment.

B4.1.2 Pumping Station

Currently there are two wastewater pumping stations, the Krukut pumping station and the Manggarai pumping station.

Figure B4-5 shows the outline of the respective pumping stations. The Manggarai pumping station has small manhole pumps. The Krukut pumping station is a large-scale pumping station, but has not performed screening from the very beginning. One of the three main pumps installed there is out of order and not used.

Table B4-2 Outline of Wastewater Pumping Stations

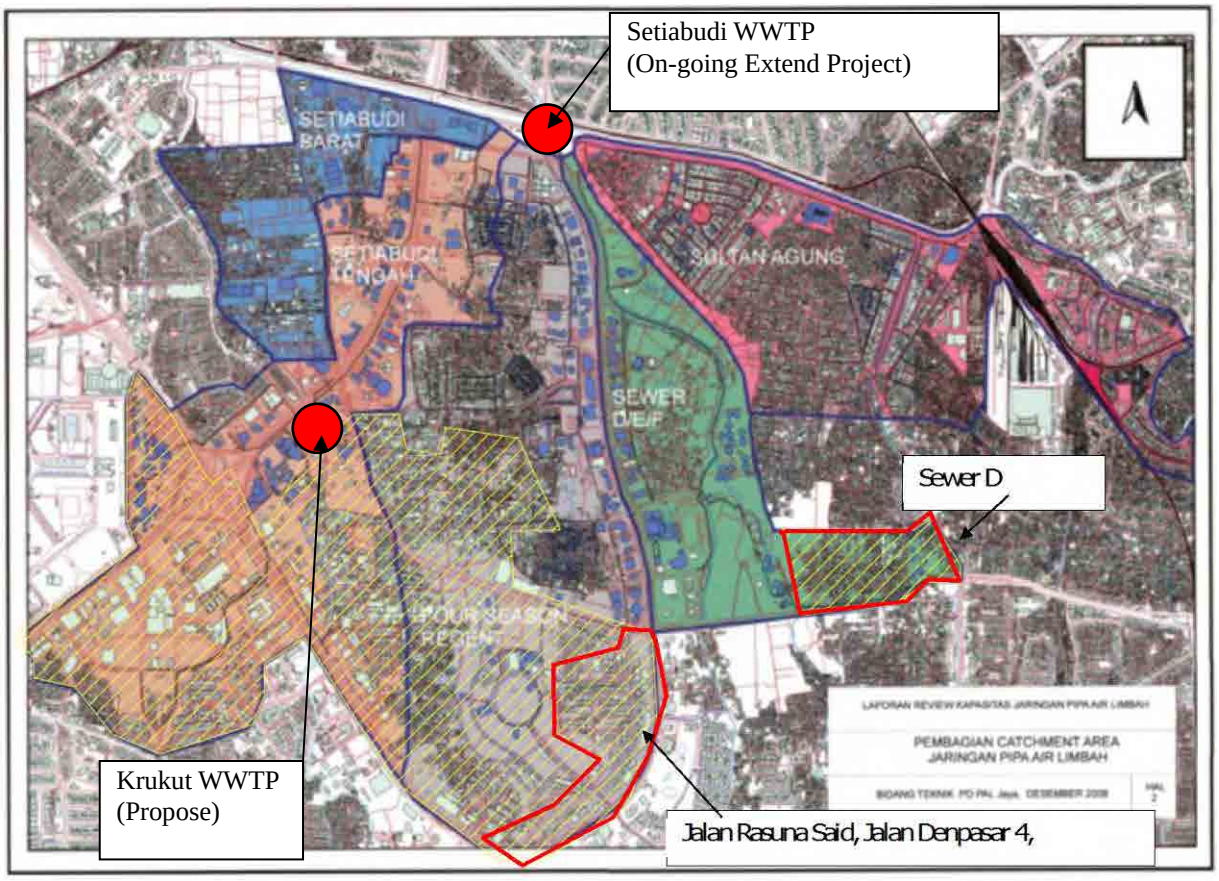
Items	Krukut Pumping Station	Manggarai Pumping Station
Final destination	West Setiabudi Pond	East Setiabudi Pond
performance of pump	365 L/s×16.7m×90kW×3unit (=21.9 m^3/min= 31,536 m^3/day)	38.9L/s×11.7m×7.5kW×2units (2.33 m^3/min=3,361m^3/day)
type of pump	Vertical spiral pump	Aquatic pump
technique of operate	Manually-operated	Automatically-operated (by water level)
Structure of facility	- Manhole (Inflow) - Sand Settling Tank - Screen (no operation) - Pump (3 units) - Generator/ Fuel Tank (2 units) - Electricity	- Manhole - Aquatic pump (2 unit) - Measuring (water level) - Electricity

Source: PD PAL JAYA

B4.1.3 Sewer Network

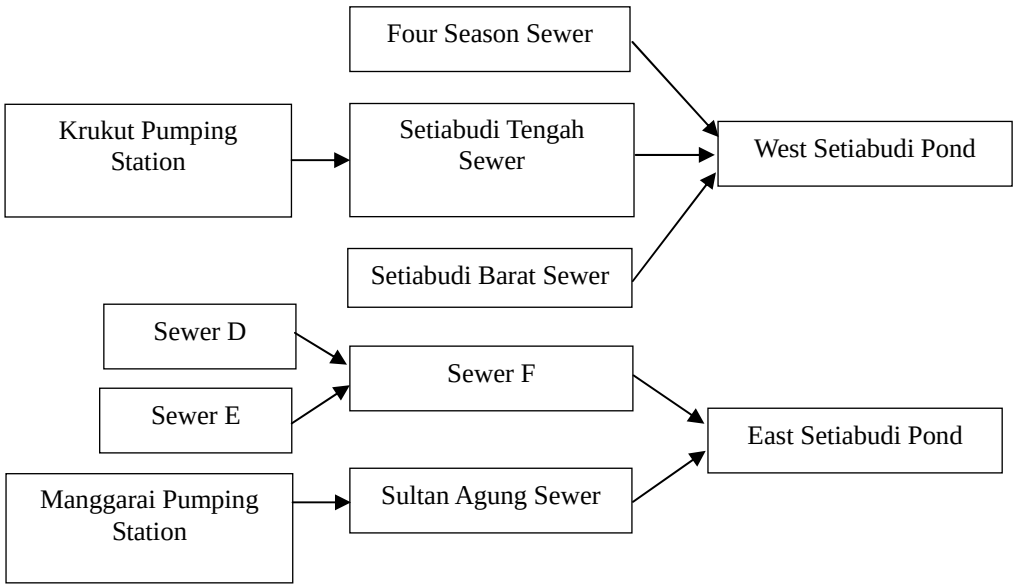
In the existing sewer network, the treatment district is divided into two districts for the West Setiabudi pond and the East Setiabudi pond. Figure B4-4 shows the outline of the sewer network. ”Sewer D” and “Jalan Rasuna Said, Jalan Denpasar 4” (red circled parts) shown in this figure are under construction at present.

The total length of the sewer line is about 76 km, the number of manholes is 1,300 and that of the inspection chambers is about 3,500. Table B4-3 shows the sewer length and other data. Washing is mainly performed for control of the sewer to prevent clogging of it and foul odor. S/R PART-B : B4 shows the existing sewerage pipe system for each catchment area.



Source: PD PAL JAYA

Figure B4-4 Existing Sewerage Cover Area



Source: Detail Engineering Design STP Waduk Timur, PD PAL JAYA, PT. Kanta Karya Utama

Figure B4-5 Outline of Sewer Network

Table B4-3 Sewer Length and Numbers of Manholes and Inspection Chambers

Pond	No	Catchment Area	Pipe (m)	MH (unit)	Service Pipe (m)	IC (unit)
East Setiabudi Pond	1	Sultan Agung	19,830	480	9,022	1,432
	2	Sewer D,E & F	4,648	77	882	40
West Setiabudi Pond	3	Four Season Regent	16,319	487	8,843	1,713
	4	Setiabudi Tengah	10,995	245	3,078	292
	5	Setiabudi Barat	2,184	48	668	10
total			53,977	1,337	22,493	3,487

Note: MH=Manhole, IC=Inspection chamber

Source : PD PAL JAYA, Annual Report of Technical Section 2010

B4.2 ITP for Commercial and Institutional Entities

The on-site sanitation facilities, which were constructed by other than JSSP, can be divided into three categories indicated below.

- Individual treatment plants (ITPs) managed by PD PAL JAYA
- ITPs constructed by Public Works Agency of DKI Jakarta
- ITPs constructed by business operators

The present situation of each individual ITP is described below.

B4.2.1 ITP Operated by PD PAL JAYA

(1) Outline

PD PAL JAYA is entrusted by seven private enterprises to provide operation and maintenance (O&M) service for ITPs in their possession.

An overview of O&M service of ITPs entrusted to PD PAL JAYA is shown in Table B4-4. The majority of these ITPs are commercial facilities and the scale of its treatment capacity is 29 to 400 m^3/day, which is the range of small scale to medium scale.

Table B4-4 ITP operated by PD PAL JAYA

Name of ITP	Process	Capacity (m^3/day)
Aston	Bio activator	400
Tifa Arum	Bio activator	100
Agro	Extended Aeration process	275
Cengkareng	Extended Aeration process	150
Menara Danamon	Bio activator	261
Manara Dea	Rotating Biological Contactor(RBC)	120
Pasific Paint	Extended Aeration process	29

Source ; PD PAL JAYA

(2) Situation of O&M Contract with Private Enterprises

The form of O&M contract for ITPs between PD PAL JAYA and private enterprises is shown in Table B4-5. Of seven (7) cases which PD PAL JAYA is entrusted to provide O&M service, three (3) cases (43%) are operated by PD PAL JAYA itself, and remaining four (4) cases (57%) are outsourced from PD PAL JAYA to private companies.

As the method for setup of O&M commission fee, the commission fee is set based on the building area (m^2) like the fee structure for sewerage systems on five (5) cases (71%) out of seven (7) cases, and for remaining two (2) cases (29%), a monthly fee is set by individual contract regardless of the building area.

Table B4-5 Implementation & Fix of Commission Fee by PD PAL JAYA

Item	Contents	Numbers (%)
Implementer of O&M	PD PAL	3 (43%)
	Outsourcing by PD PAL	4 (57%)
How to Fix of Commission Fee for O&M	Fixed based on Floor area (m^2)	5 (71%)
	Fixed with talks of customer	2 (29%)
	Total	7 (100%)

Source: Hearing from PD PAL JAYA

(3) Condition of Operation and Maintenance (O&M)

The contents of service are inspection of facilities (maintenance of water tanks and equipment) and water quality control.

1) Inspection of Facilities

Inspection of facilities is conducted daily, weekly and monthly. For maintenance of machines, servicing such as oil change and belt replacement is performed during weekly inspection and monthly inspection.

Typical items of inspection of facilities are shown in Table B4-6.

Visual inspection is mainly conducted for inspection of facilities, and maintenance of machines is limited to breakdown maintenance.

Table B4-6 Inspection Items for Private ITPs (Example)

Inspection	Daily	Weekly	Monthly
Main Inspection	Watch	Check for utility and supply	Check for parts and exchange of parts Desludging
Cases	・Cleaning of Screen	・supply of Oil	・Exchange for belt and oil of blower and pump etc.
	・Check of Pump	・Supply of grease	
	・Watch of Electric panel		・Desludging
	・Watch of Return sludge		
	・Check of amount of oil & grease		
	・Check of settling sludge in the settling tank		

Source: Hearing from PD PAL JAYA

2) Inspection and Analysis of Effluent Quality

For water quality control, effluent only is sampled and analysis is conducted in PD PAL JAYA's own laboratory once every two weeks. The items and methods for analysis are shown in Table B4-7.

In the O&M using the activated sludge process, it is important to keep the sludge in appropriate conditions by checking properties such as concentration, activity and sedimentation property of activated sludge in the aeration tank and by making adjustments such in aeration airflow, change in return sludge rate and setup of desludging rate. As O&M of activated sludge, however, the only work done is to visually check the color of the activated sludge in the aeration tank, and the criteria for judgment of color and measures taken based on the judgment are not clear. Measurement for on-site activated sludge control (SV30: activated sludge sedimentation efficiency, etc.) and simplified judgment of water quality (such as transparency) are not implemented.

On the other hand, no clear reply was given against the question, however results of periodic water quality inspection is reflected to operation. It appears that feedback related to O&M of ITPs is not made except for judgment of conformity/nonconformity to water quality reference items.

Table B4-7 Items and Method of Effluent Quality Analysis

Items	Effluent quality standards by DKI Jakarta Governor's Decree *	Method of water quality analysis
pH	6 - 9	
BOD (20 (°C, 5days)	50 mg/L	Manometric method
COD (Dichromate)	80 mg/L	Titration method
NH_4-N	-	Spectrophotometric method
Detergent(Surfactant)	2 mg/L	Spectrophotometric method
SS	50 mg/L	
$KMnO_4$ consumption	85 mg/L	Titration method
Oils	10 mg/L	

Source: DKI Jakarta Governor's Decree No.122, 2005

The results of water quality analysis in each ITP are shown in Table B4-8. Details are shown in S/R PART-B : B4 of ITP operated by PD PAL JAYA. The effluent quality in ITPs that are controlled by PD PAL JAYA is in excess of reference values in 5 plants (83%) out of currently operating 6 plants, and the situation is such that it cannot be said that appropriate water quality control is executed as described in 2) above.

Table B4-8 Result of Water Quality Analysis on Private ITPs

ITP Name	Capacity	BOD		COD_{Cr}		SS	
		Influent	Effluent	Influent	Effluent	Influent	Effluent
	(m^3/day)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
ITP Aston *[1]	400	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
ITP Tifa Arum	100	92	43	157	79	63	30
ITP Agro	275	88	30	209	69	200	**50**
ITP Cengkareng *[2]	150	150	**75**	Unknown	Unknown	150	**100**
ITP Menara Danamon	261	158	**66**	230	**80**	94	42
ITP Manara Dea	120	116	**71**	149	**92**	250	**50**
ITP Pasific Paint	29	176	**60**	243	**84**	80	30
		203	**53**	221	**93**	67	14
Effluent Water Quality Standards *[3]		50		80		50	

Notes:
1. ITP Agro still not be operated yet (new ITP)
2. ITP Cengkareng is broken, so that PD PAL doesn't do water quality check.
   As for result of BOD and SS are based on hearing from PD PAL JAYA.
3. Governor Regulation NO 122 / 2005, Domestic Wastewater Quality Standards for communal

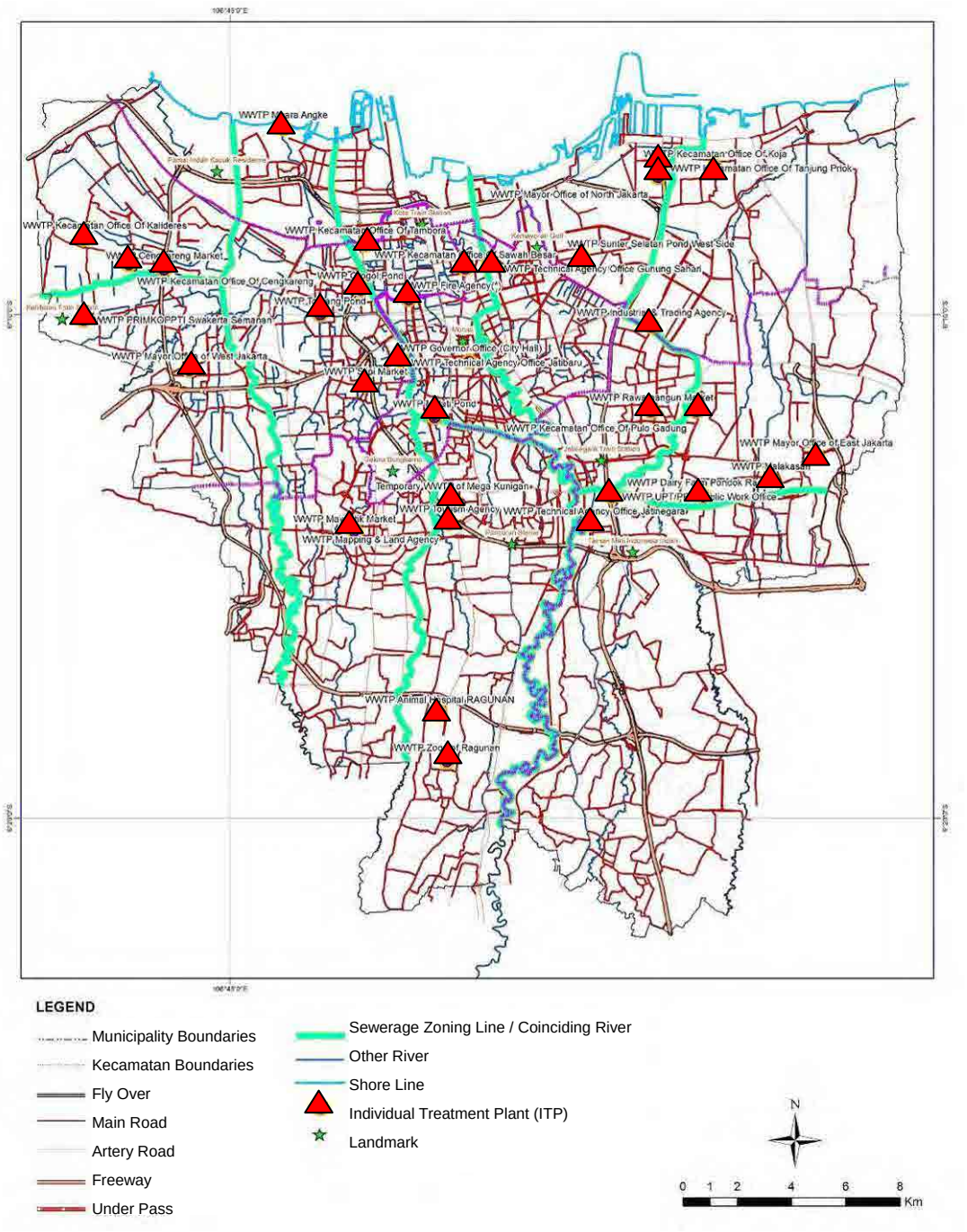
Source :Water quality analysis report, PD PAL JAYA, 2010

PD PAL JAYA does not measure influent flow or effluent, which are fundamentals of wastewater treatment O&M and are needed for obtaining material balance. The only thing that has done is that the flow is assumed as what is equivalent to the tap water consumption on the ITP owner side. It is naturally required to confirm that the effluent flow does not exceed the capacity of the treatment plant, and in addition, fluctuation of influent flow exerts direct influence over the effluent quality. Such a basic attitude that present operating conditions are controlled in correspondence to the plant design particulars is not observed.

B4.2.2 ITP built by DPU of DKI Jakarta

(1) General Information on 35 ITP

The DPU of DKI Jakarta has ITP since 1990 in about 35 local government offices (kecamatan and kelurahan), as well as 12 others in industries, markets and special facilities, such as the Zoo. The JICA Project Team surveyed the sites of all 35 ITP of capacities ranging from 10-800 m^3/day, which are located in the Central, Western and Eastern part of DKI Jakarta.



Source: DPU

Figure B4-6 DPU of DKI Jakarta of 35 ITP

Generally, based on the source of influent, ITP can be divided into four (4) categories as follow:

a) To treat office wastewater, such as Kecamatan office building and Mayor office building

b) To treat market wastewater

c) To treat residential/commercial/mix area wastewater and

d) To treat special wastewater such as liquid tofu industries, liquid fishery industries

Out of 35 ITP, 19 ITP treat the office wastewater, 4 ITP treat the market wastewater, 7 ITP treat the residential/commercial/mix area wastewater and 5 ITP treat the special wastewater. There is a ITP at Waduk Sunter, which treats about 200 m^3/day and one at Waduk Grogol which treats about 100 m^3/day.

Other facilities include a sewer system at a fisherman's estate in Kali Angke, treating 400 m^3/day and treatment of domestic wastewater at Pulau Untung Jawa in Kabupaten Pulau Seribu. The Governor's office complex has a sewer system and ITP, as do a government office complex in Jatibaru (200m^3/day) and the Mayor's office complex in East Jakarta (100m^3/day). In addition, there are ITP facilities at 7 kecataman offices, each treating about 10m^3/day, and at a number of larger markets in the city, ranging from 100-130m^3/day.

1) Existing Condition of 35 ITP

Table B4-9 shows the existing condition of 35 ITP which is according to survey conducted by the JICA Project Team. The main purpose of the survey was to confirm the operating condition of ITP and to identify the possibility to extend the capacity of ITP or the coverage.

Table B4-9 Existing Condition of ITP

No.	Category of Wastewater Source	STP Location	Technology of Treatment	Capacity (m^3/day)	Year of Construction	O&M agency	Operation condition
A	Office Wastewater	1. Kecamatan Office of Tambora West Jakarta	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		2. Kecamatan Office of Cengkareng West Jakarta	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		3. Kecamatan Office of Kalideres West Jakarta	a. Anaerobic - Aerobic Process (SATS) b. Anaerobic Process	a. 15 b. 18	a. 2005 b. 2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		4. Mayor Office of West Jakarta	a. Activated sludge b. MBR (VRM)	50 160	2006 2007	Public Work Agency	Operated 24 hours
		5. STP Industrial & Trading Agency	Anaerobic - Aerobic Process (Bioreactor)	60	2006	Not clear	Not operated
		6. STP Technical Agency Office Gunung Sahari	Activated sludge + Membrane Clear Box	25	2006	Public Work Agency	Not operated
		7. STP Mayor Office of East Jakarta	a. RBC (Bioactivator) b. RBC c. MBR (VRM)	25 25 8	2006 2006 2010	Mayor Office	Operated Operated Implementation just finish
		8. STP Mayor Office of North Jakarta	Activated sludge + Recycling (Sand Filter-Carbon active)	50	2006	Mayor Office	Not operated
		9. STP Kecamatan Office Of Pulo Gadung, East Jakarta	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		10. STP Kecamatan Office Of Koja North Jakarta	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		11. STP Kecamatan Office Of Tanjung Priok, North Jakarta	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated, aerobic process is not operated
		12. STP Kecamatan Office Of Sawah	Anaerobic - Aerobic Process (SATS)	15	2005	Kecamatan Office	Anaerobic process operated,

Table B4-9 Existing Condition of ITP

No.	Category of Wastewater Source	STP Location	Technology of Treatment	Capacity (m^3/day)	Year of Construction	O&M agency	Operation condition
		Besar, Central Jakarta					aerobic process is not operated
		13. STP Technical Agency Office Jatibaru	Anaerobic - Aerobic Biomedia	140-300	2003	Public Work Agency	Operated 24 hour (dispose every 6 hour)
		14. STP Technical Agency Office Jatinegara	Activated sludge (Bioreactor with FRP Tank)	30	2006	Public Work Agency	Operated twice a week
		15. STP Mapping & Land Agency	Activated sludge (Bioreactor with FRP Tank)	30	2006	Not Clear	Not operated
		16. STP Tourism Agency	Activated sludge (Bioreactor with FRP Tank)	30	2006	Not Clear	Not operated
		17. STP UPT/PPP Public Work Office	Activated sludge (Bioreactor with FRP Tank)	30	2006	Public Work Agency	Not operated
		18. STP Governor Office (City Hall)	Activated sludge + VRM	200	2006	Mayor Office	Operated 24 hour
		19. STP Fire Agency(*)	Activated sludge + Membrane Clear Box	30	2006	Not Clear	Not Operated
B	Market Wastewater	1. Slipi Market	RBC	70	2005	PD Pasar Jaya	Not operated
		2. Cengkareng Market	Activated sludge (Bioreactor with FRP Tank)	160	2003	PD Pasar Jaya	Not operated
		3. STP Rawamangun Market	Extended Aeration	50	2005	PD Pasar Jaya	Operated 24 hour
		4. STP Mayestik Market	Activated sludge (Bioreactor with FRP Tank)	160	2003	PD Pasar Jaya	Not operated (demolished)
C	Residential/Mix Area Wastewater	1. Grogol Pond	a. RBC b. RBC (Bioactivator) & Recycling (clarifier, sand filter, carbon active)	400 800	2005 2006	Public Work Agency	a. Not operated b. RBC operated, Recycling not operated
		2. Tomang Pond	Aerated lagoon (Solar Cell Surface Aerator 3 unit)		2006	Public Work Agency	1 unit operated, 2 units not operated
		3. Sunter Selatan Pond, West Side	RBC (Bioactivator)	400	2004	Public Work Agency	Operated 12 hour
		4. STP Melati Pond	RBC (Bioactivator)	800	2006	Public Work Agency	Operated 24 hour
		5. Temporary STP of Mega Kuningan	RBC (Blivet)	3 × 70	2006	Public Work Agency	Not operated
		6. STP Malakasari	a. Aerobic Anaerobic Biomedia b. RBC (Bioactivator)	200 200	1996 2006		a. Operated b. Operated not properly
		7. STP Untung Jawa Island	a. BC(Bioactivator)+recycling Sand filter+carbon active b. RBC (Blivet)	200 2 × 70	2007 2006	Public Work Agency	a. Operated 24 jam b. Not operated
D	Special Wastewater	1. PRIMKOPPTI Swakerta Semanan	Anaerobic - Aerobic with Biomedia + Recycling (coagulation-flocculation, sedimenta-tion, sand filter, carbon active)	200	1990	PRIMKOPPTI Swakerta	Anaerobic process operated, aerobic process & recycling process is not operated
		2. Muara Angke	Trickling Filter and Recycling (coagulation-flocculation, sedimenta-tion, sand filter,	140	1993	UPT PKPP & PPI Fishery	- Not operated for 2 days (Raw water pump

Table B4-9 Existing Condition of ITP

No.	Category of Wastewater Source	STP Location	Technology of Treatment	Capacity (m^3/day)	Year of Construction	O&M agency	Operation condition
			Carbon active)			Agency	broken) - Recycling not operated
		3. STP Dairy Farm Pondok Rangon	Facultative Pond + Maturation Pond	51	2006	Not Clear	Not operated
		4. STP Animal Hospital Ragunan	Aerobic - Anaerobic Biomedia	30	2004	Not Clear	Not operated
		5. STP Zoos of Ragunan	a. RBC (Blivet) b. RBC (Blivet)	70 25	2005 2005	Not Clear	a. Not operated b. Not operated

Source: JICA Expert Team by DPU

2) Lessons Learnt

The lesson that we can learn from the survey are as follow:

1) The operation of ITP needs clear O&M agency to guarantee the sustainable operation & maintenance including clear task & responsibility, trained operator, technical support and sufficient O&M budget.

2) It would be better to treat small capacity of office building by simple technology and low cost maintenance such as anaerobic-aerobic process. For bigger capacity, it would be more benefit if the treatment can also produce recycling water to cover the part of its water need. The other alternative is to combine with the sewerage system.

3) We realize that it is very hard to handle the pre-treatment operation in treating market wastewater, so we are not surprise to find the market ITP not in operation condition. Also, it is very hard to operate the ITP which is constructed under the ground in the crowded market. It needs more effective design for easier operation & maintenance under such condition. Because of limited area for ITP, it would be better if the market agency only handle pre-treatment and discharge the liquid wastewater to the sewerage system.

4) There are household industries such as fishery and tofu which discharge high load pollutant in the environment. Moreover, these household industries have low affordability to pay for the O&M cost to treat their wastewater. To sustain these household industries and to protect the environment, the government may consider providing them some sort of incentives to treat their wastewaters.

5) The handling of sludge is a heavy work and need great effort of energy and cost. So, it must be supported by sufficient equipment, capable operator & cost.

3) Expansion of 7 ITPs out of 35 existing ITPs for the Community Wastewater Treatment

Out of 35 ITP, 7 ITP can be used to construct ITP for the community wastewater treatment. However, there is need for a further study for available area, coverage, receiving water body, etc. Table B4-10 shows name, location and area of 7 ITP.

Table B4-10 Names, Location and Area of 7 ITP

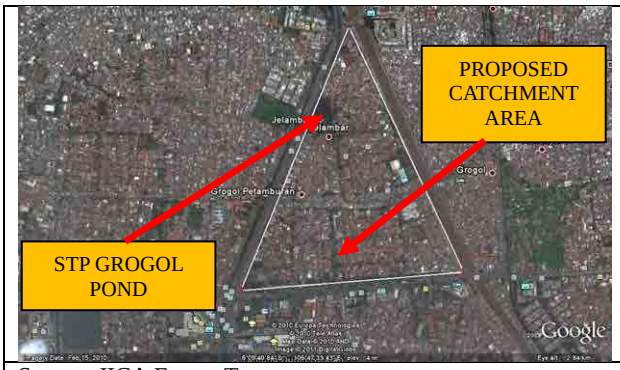
No.	Name of ITP	Location (sub-district, district, Municipality)	GPS	Approx. Area which can be allocated for ITP
1	Melati Pond	Kelurahan Kebon Melati, Kecamatan Gambir, Central Jakarta	S 06° 12.039' E 106° 49.064'	1 ha
2	Grogol pond	Kelurahan Grogol, Kecamatan Grogol Petamburan, West Jakarta	S 06o 09.5' E 106° 47.6'	1-0.5 ha
3	Muara Angke	Kelurahan Pluit, Kecamatan Penjaringan, North Jakarta	S 06° 06.3' E 106° 46,06'	1-0.5 ha
4	PRIMKOPPTI	Kelurahan Semanan, Kecamatan Kalideres, West Jakarta	S 06° 10,1' E 106° 42.1'	1-0.5 ha
5	Malakasari	Kelurahan Malakasari, Kecamatan Duren Sawit, East Jakarta	S 06° 13.293' E 106° 55.748'	1 ha
6	Zoos of Ragunan	Kelurahan Ragunan, Kecamatan Pasar Minggu, South Jakarta	S 0.6° 18.968' E 106° 49.312'	3-4 ha (there is two land parcels available little away from ITP)
7	Dairy Farm	Kelurahan Pondok Rangon, Kecamatan Cipayung, East Jakarta	S 06° 021.402' E 106° 54.382'	2-3 ha

Source: JICA Expert Team

Figure B4-7 to Figure B4-13 shows locale of 7 ITP.

Source: JICA Expert Team

Figure B4-7 Melati Pond ITP

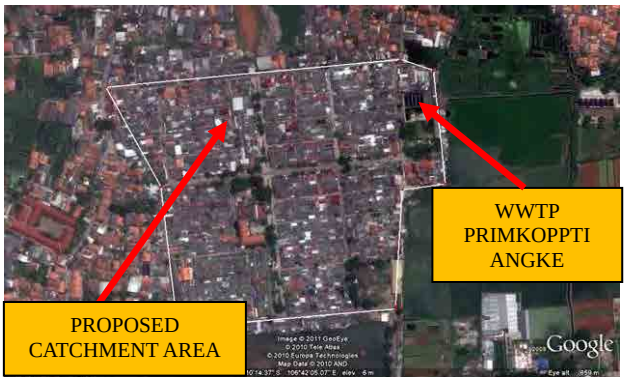


Source: JICA Expert Team

Figure B4-8 Grogol Pond ITP

Source: JICA Expert Team

Figure B4-9 Muara Angke ITP



Source: JICA Expert Team

Figure B4-10 Primkoppti Angke ITP

Source: JICA Expert Team

Figure B4-11 Malakasari ITP

Source: JICA Expert Team

Figure B4-12 Ragunan Zoo ITP

Source: JICA Expert Team

Figure B4-13 Dairy Farm ITP

B4.2.3 ITP Built by Others

(1) Outline of Survey

On ITPs owned by business operators of shopping centers, hotels, offices, factories, restaurants, hospitals and schools, 29 business operators were extracted out of 51 business operators, which were targets of social and economic survey, with the scale and other factors taken into account, and a survey was conducted on the items shown in Table B4-11. Regarding the willingness to make connection with sewerage system, to clarify the reason for it in the replies from 29 business operators was set as the purpose of the survey.

Table B4-11 Survey Items for ITPs

No.	Items	Contents
1	Wastewater treatment Method	・Septic tank ・ITP(Extended Aeration / Others)
2	Target wastewater	・Black water and /or GraRp.y water
3	Effluent quality	・Satisfied / Unsatisfied based on BPLHD Inspection Data
4	Conditions of O&M	・Effluent water quality ・Maintenance conditions of process and equipments ・Understanding of O&M
5	Wastewater recycle system	・Operating / Planning / Not required
6	Willingness to connect with sewer pipe	・Yes / No ・Reason

Source: JICA Expert Team

The survey target 29 business operators are shown in Table B4-12 as classified by category of business. For draw-up of the master plan in 1991, survey of treatment method, effluent water quality and so forth was conducted on ITPs owned by 18 business operators (6 hotels, 6 offices, 6 shopping centers). Therefore, 29 sampling survey target ITPs included 17 ITPs, which are existing out of 18 IPTs surveyed for draw-up of the master plan, for comparison of the sequence between 1991 and present (2011).

Table B4-12 Numbers of ITPs for Survey

Type of Business	Target	M/P (1991)	Remarks
Shopping mall	7	6	5 (1991) included
Hotel	7	6	6 (1991) included
Office	8	6	6 (1991) included
Factory	2	—	
Restaurant	1	—	
Hospital	2	—	
School	1	—	
Total	29	18	17 (1991) included

Source: JICA Expert Team

(2) Survey Results

1) Treatment Method and Process

The number and ratio of individual treatment plants classified by wastewater treatment method are shown in Table B4-13.

Septic tank method had a 50% ratio in 1991, but its ratio dropped to 10% as of 2011. On the other hand, the ratio of ITP increased to 72%, of which the ratio of plants adopting extended aeration treatment method is 62% and is the largest. Among the surveyed business operators, plants of all of 5 business operators located in sewerage system area are connected to sewerage system, and this ratio was increased to 17%.

The main current of the treatment method of individual treatment plants owned by business operators is extended aeration.

Table B4-13 Numbers of ITP's on Wastewater Treatment Methods and Process (Master plan Survey in 1991 and Current Survey in 2011)

Wastewater treatment method	1991 (M/P)		2011 (Current)	
	Number	ratio	Number	ratio
Septic Tank	9	50%	3	11%
Conventional	9	50%	2	7%
Modified	0	0%	1	4%
ITP	9	50%	20	72%
Extended aeration	8	44%	18	62%
Others	1	6%	3	10%
Connected to sewer pipe	0	0%	5	17%
Total	18	100%	29	100%

*In case an individual treatment plant is installed or owned but septic tanks are remaining at some toilets, such a case is not counted in the category of septic tank.
Source: JICA Expert Team

2) Treatment Target Wastewater

The number and ratio of individual treatment plants classified by treatment target wastewater are shown in Table B4-14.

In 1991, 56% individual treatment plants adopted treatment of black water and gray water as combined (so-called combined treatment), and 44% plants were treating black water only (so-called independent treatment). In 2011, combined treatment is adopted by the majority (86%) of plants and independent treatment is almost none in individual treatment plants owned by business operators.

Table B4-14 Numbers of ITPs on Treatment Target Wastewater (Master plan Survey in 1991 and Current Survey in 2011)

Treatment target wastewater	1991 (M/P)		2011 (Current)	
	Number	Ratio	Number	ratio
Combined wastewater from toilet and others	10	56%	26	90%
Wastewater from toilet only	8	44%	3	10%
Total	18	100%	29	100%

Source: JICA Expert Team

3) Effluent Quality

The effluent quality of individual treatment plants classified by treatment method is shown in Table B4-15.

In 1991, all concentration of COD_{Cr}, BOD and SS were of high levels with all the treatment methods, and inferiority of septic tank effluent quality was noteworthy in particular. (Mean COD_{Cr}=973m/L, mean BOD=686 m/L, mean SS=106 m/L) The effluent quality with extended aeration treatment method was inferior next to the septic tank method. As the reason for it, it can be considered that, besides lack of control, the load was excessive or control of maintenance of the plant was insufficient.

In 2011, mean values of COD_{Cr}, BOD and SS are less than reference values with all treatment methods, and improvement of effluent quality is apparently observed. It is considered that it represents an effect of wastewater control of 2005 by an ordinance of Governor of DKI Jakarta. On ammonia, however, the mean value is higher than the reference value and there are many individual treatment plants that are not observing the reference value.

Table B4-15 Effluent Quality Sorted by Wastewater Treatment Methods and Processes (Master plan Survey in 1991 and Current Survey in 2011)

Wastewater treatment methods			1991 (Old M/P)			2011 (Current : BPLHD Inspection)			
			CODcr (mg/L)	BOD (mg/L)	SS (mg/L)	CODcr (mg/L)	BOD (mg/L)	SS (mg/L)	NH_4-N (mg/L)
Septic Tank	Conventional	AVE	973	686	106	unknown	unknown	unknown	unknown
		MIN	419	243	15	unknown	unknown	unknown	unknown
		MAX	2143	1251	460	unknown	unknown	unknown	unknown
	Modified	AVE	-	-	-	70	27	15	unknown
		MIN	-	-	-	-	-	-	-
		MAX	-	-	-	-	-	-	-
ITP	Extended aeration process	AVE	527	363	69	48	16	16	**14**
		MIN	96	53	10	15	5	2	0
		MAX	1516	1164	180	**90**	36	**60**	**75**
	Others	AVE	122	78	40	17	22	10	**25**
		MIN	122	78	40	11	8	5	**13**
		MAX	122	78	40	14	47	19	**39**
Effluent standard			-	-	-	80	50	50	10

Source: The Old M/P 1991

The number of treatment plants where effluent quality does not satisfy the water quality standard is shown in Table B4-16 as classified by water quality. Organic matters such as COD_{Cf} and BOD are treated to less than control values in almost all ITPs. On the other hand, however, effluent ammonia exceeds 10 mg/L at ten ITPs. 34% ITPs are not removing ammonia to the control value or less.

Table B4-16 Number of ITP which dose not Satisfy Effluent Standard

CODcr	BOD	SS	NH_4-N
2 (7%)	0	1 (3%)	10 (34%)

(Counting overlapped)
Source: JICA Expert Team

With the extended aeration method in Japan, ASRT is 13 to 50 days under the conditions of BOD-SS load 0.05 to 0.10 kg-BOD/kg-SS, MLSS concentration 3000 to 4000 mg/L, HRT 24h. In Indonesia, since it is considered that the water temperature is kept at 15℃ or higher in general throughout the year, it is possible to fully secure and maintain ASRT, as long satisfactory control is executed. Therefore, the conditions are such that effluent BOD can be kept at 10 mg/L or less and ammoniac nitrogen can be fully nitrified. The results shown in Table B4-16 indicate that although good points (minimum values) are satisfied, effluent BOD and ammoniac nitrogen are high at ITPs in a considerable number, and it is estimated that MLSS control of reaction tanks is not good enough.

4) Condition of Operation and Maintenance (O&M)

An overview of items of operation evaluation of individual treatment plants is shown in Table B4-17. Evaluation is made in three categories, i.e., effluent quality, O&M conditions of treatment process and equipment and understanding of O&M. On the water quality, the on-site situation was studied using the BPLHD inspection result as an index, and others were qualitatively judged upon on-site study and hearing.

Table B4-17 Estimation Items for Operation & Maintenance of ITPs

No.	Item	Contents
1	Effluent quality	・ Satisfied / Unsatisfied BPLHD Inspection Data ・ Current Effluent Condition (Scum, Transparency, Micro-froc, etc)
2	O&M conditions of treatment process and equipments	・ Activated Sludge Conditions (SV, MLSS, etc.) ・ Electric &Mechanic Conditions
3	Understanding of O&M	・ Understanding of ASM ・ Understanding of Analysis Items ・ Attitude to Environmental Issue

Source: JICA Expert Team

Regarding O&M of individual treatment plants, appropriate control is executed at 42% plants and the effluent quality is having no problem. In the remaining 58% plants, however, excess of standard in the effluent quality was observed due to reasons such as insufficient activated sludge and insufficient maintenance of main equipment such as blower, and it was judged that tackling with O&M was not good enough.

Table B4-18 Conditions on O&M (2011)

WWT Methods		Estimation		Remarks
		Sufficient	Insufficient	
Septic Tank	Conventional	1 (50%)	1 (50%)	No desludging is judged as "insufficient".
	Modified	1 (100%)	0 (0%)	
ITP	Extended aeration	8 (44%)	10 (56%)	
	Others	0 (0%)	3 (100%)	
Total		10 (42%)	14 (58%)	

Source: JICA Expert Team

The frequency of desludging from settling tank and so forth in individual treatment plants as classified

by treatment method is shown in Table B4-19.

As sludge control (desludging from sedimentation basin and so forth in particular) in individual treatment plants, 70% plants are performing desludging by the quantity that can be loaded on a sludge carrier once every year or oftener. The remaining 30% plants replied that no desludging was executed in the past due probably to short history of plant operation or small treatment rate against the plant capacity. Although efforts in the sludge volume reduction such as promotion of aerobic digestion are observed in some ITPs, the situation does not permit proper judgment from the material balance that is calculated from influent and effluent.

Table B4-19 Frequency of Desludging (2011)

Wastewater treatment methods		never	once a year	twice a year
Septic tank	Conventional	0	1	1
		0%	50%	50%
	Modified	0	1	0
		0%	100%	0%
ITP	Extended aeration process	5	8	4
		29%	47%	24%
	Others	2	1	0
		67%	33%	0%
Total		7	11	5
		30%	48%	20%

Source: JICA Expert Team

Typical trial calculation made on generated sludge volume is shown in Table B4-20. At an ITP of 100 m^3/day, desludging at a rate of once every two weeks is required using a 4-ton honey truck (desludging truck). Furthermore, in case sludge is stored anomalously in a reaction tank, once every two and a half months will do as the frequency of desludging. But the desludging volume at a time is equivalent to the load on about four 4-ton vacuum cars.

As is apparent from this simple calculation, the reported desludging frequency and de-sludged sludge volume are extremely small compared to assumed sludge generation volume.

As judged from the fact that BPLHD inspection is conducted once every three months based on sampling performed by the business operator, apart from the judgment of whether it is intentional or not, it can be estimated that the possibility where carry-over of effluent SS caused by large inflow of rainwater at an occasion of a storm, for instance, is continuing on a routine basis is high. We experienced flooding with squall a number of times during the study, and the possibility of major inflow of rainwater to septic tanks can be easily estimated in addition to ITPs.

Furthermore, also regarding the balance between generated sludge volume and de-sludged sludge volume and the place of sludge disposal, almost no information that can help as evidence could be confirmed because of lack manifest scheme or similar, and the present situation is such that clear balance cannot be grasped. In addition, a number of hearing repliers clearly stated that there is such a fact that de-sludged sludge is discharged to rivers and rainwater drainage channels.

Table B4-20 Estimation of Generated Sludge Volume

Item	Contents	Remarks
Conditions	Influent SS 160mg/L Effluent SS 50mg/L Process Extended aeration HRT 24 h MLSS concentration 5,000 mg/L Yield rate of Removed SS amount (YR) 75% Quantity(Q) 100 m^3/day	・Influent SS is based on average quality of discharged wastewater to sewer pipe analyzed by PDPAL in 2010. ・Yield rate of Removed SS amount is based on Extended aeration process of Japanese design standards.

Table B4-20 Estimation of Generated Sludge Volume

Item	Contents	Remarks
Calculation	Excess Sludge amount (kg/day) Excess Sludge amount ＝ (influent SS－effluent SS)mg/L×Q m^3/day×YR% ＝ (160－50) kg/L×100 L/day×75%×10^{-6}×10^3 ＝ 8.25 kg/day	
Excess Sludge volume	Premising that Sludge concentration is 1%, Excess sludge volume is 8.25kg/day÷0.01＝825L/day=0.825m^3/day Premising that Sludge concentration is 2%, Excess sludge volume is 8.25kg/day÷0.02＝412.5L/day=0.413m^3/day Premising that Sludge concentration is 3%, Excess sludge volume is 8.25kg/day÷0.03＝275L/day=0.275m^3/day	
Frequency of Desludging	1. Periodic desludging Premising that Sludge concentration is 3% and desludging is conducted by 4t honey truck, Periodic dates are, 4 m^3÷0.275 m^3/d＝14.5days 2. Periodic desludging by using storage in aeration tank, Premising that sludge is stored in aeration tank which sludge concentration increase from 1，000 mg/L at beginning to 5000mg/L, Periodic dates are, (5000－1000)×10^{-3}×100m^3÷8.25＝48.5days Premising that Sludge concentration is 3% and desludging is conducted by 4t honey truck, Required numbers of honey truck are, (5,000－1,000)t/m^3×10^{-9}×10^3×100m^3÷0.03÷4 t/unit＝3.3 units ＝4 units	

Source: JICA Expert Team

5) Wastewater Recycle System

The number of plants that introduced wastewater recycle systems and that are planning to introduce wastewater recycle systems as classified by category of business is shown in Table B4-21.

Of sampling survey target 29 plants, 5 plants (17%) are in possession of wastewater recycle systems in addition to individual treatment plants, and another 17% plants are planning and/or considering to introduce wastewater recycle systems. All of these plants belong to the categories of large-scale shopping mall, hotels and offices of large tap water consumption and wastewater treatment rate, and wastewater recycled water is mainly used for building cooling towers and for watering of gardens. There is no plant where wastewater recycled water is used for drinking.

At five plants having wastewater recycle systems at the present time, the wastewater recycled water consumption and usage rate to total water consumption are 48 to 310 m^3/day and 10 to 44% respectively. Furthermore, sand filtration and activated charcoal treatment or organic membrane treatment is used for advanced treatment plants for reuse.

Table B4-21 Numbers of ITPs with Advanced Treatment Process for Recycle System (2011)

Category	Operating	Now planning	Now considering	Not Required	Not used	Total
Shops	2 (1990,2007)	0	1	2	2	7
Hotel	2 (1997,2006)	1	0	5	0	8
Office	1 (Unknown)	2	1	4	0	8
Factory	0	0	0	2	0	2
Restaurant	0	0	0	1	0	1
Hospital	0	0	0	2	0	2
School	0	0	0	1	0	1
Total	5	3	2	17	2	29
	17%	10%	7%	59%	7%	100%

Source: JICA Expert Team

The situation of eight hotels as classified by scale is shown in Table B4-22. Three hotels out of four large-scale hotels have introduced or are planning to introduce wastewater recycle systems. One of them is have recycle rate about 40%. On the other hand, one of large-scale hotels achieved connection to the sewerage system in 1997 and it was replied that recycling of wastewater is not needed. As judged from these results, it is estimated that recycling of wastewater is either implemented or planned in a large number of large-scale hotels.

Table B4-22 Trend of Hotel ITP toward Re-use System

Category	Operating	Now Planning	Now Considering	Not Required
Total	2	1	0	5
Capacity of ITP (m^3/d)	925 (Installed in1997)	600		40
	1500 (Installed in 2006)			40
				80
				80
				1200 (Connected to sewer pipe in 1997)

Source: JICA Expert Team

Thus, large-scale commercial facilities have the consciousness to use recycled wastewater as one of water sources. The reasons indicated below are located as the background of this consciousness.

- The water supply cost is high.
- The water charge is high. (It is IDR 12,500/ m^3 in general, although it varies by area and consumption.)
- The ground water usage tax is higher. (It varies by area and pumping rate, and is IDR 6,500 to 85,000/ m^3.)
- Intake of ground water is limited.
- The water supply volume and water quality are unstable.
- The water supply volume is unstable (in the dry season in particular).
- The ground water is have high iron content and high salt concentration, and is not good for use.

On the other hand, two shopping malls replied that although they used wastewater recycle systems in the past, they are not using systems at the present time. The reason why these shopping malls discontinued use of wastewater recycle systems is that the wastewater recycle rate did not reached the goal and expected wastewater recycle water volume could not be obtained. They are cases where recycling of wastewater is not necessarily successful. As the main reasons for such unsuccessful, it can be considered that due to the fact that since ITP effluent control values are BOD 50 mg/L and SS 50 mg/L, the load applied to the advanced treatment plant was large, increase of running operation and cost such as increase of backwash frequency occurred and the recovery rate did not increase to the anticipated level. The business establishments where wastewater recycling is successful are devising operation of ITPs to facilitate running of advanced treatment plant by adding biological treatment and by largely improving the ITP effluent quality to a level that is better than the control value.

6) Willingness to Connect with The Sewerage System

The willingness to make connection with sewerage system as classified by category of business is shown in Table B4-23.

The percentage of facilities that indicated the willingness to make connection with sewerage system was 28% of all facilities. The percentage of such an opinion that connection with sewerage system will be made if it costs less compared to existing individual treatment plant management expenses was 21%.

The number of facilities which clearly stated that connection to sewerage system will not be made is two (7%), and both of them are large-scale hotels. The reason is that they are already in possession of wastewater recycle systems and were successful in the reduction of total cost by reducing consumption of tap water and ground water. For these hotels, wastewater is one of water resources, and it is apparent that to discharge the entire wastewater to the sewerage system without reuse is not an economical choice from the viewpoints of securing of water volume (during the dry season in particular) and reduction of ground water consumption. In the project of Denpasar, there was a case that large scale hotels could not wait for the development of sewerage and did not connect the sewerage because the construction was delayed so much. This should be considered as a lesson learnt.

28%, who replied as "Cannot determine", represents the case where the replier is not the responsible person, and it is considered that decision is made on economy in this case. It means that about one half of business operators have economy in mind as the criteria for judgment of connection to sewerage system.

In view of these matters, two subjects indicated below can be introduced in the planning of the sewage system.

- It is necessary that the sewage charge is less than the ITP cost.
- It is necessary to consider handling of business operators having wastewater recycle systems at the occasion of expansion of the sewerage system area.
- There is a risk that the treatment volume might be smaller than the estimated treatment capacity because the large scale customers, such as hotels, might not connect to the sewerage system.

Table B4-23 Willingness to Connect with Sewer Pipe (2011)

Type of Business	Yes	Depend on cost	Cannot determine	Already connected	No	Total
Shops	1	4	2	0	0	7
Hotel	1	1	3	1	2	8
Office	1	1	2	4	0	8
Factory	2	0	0	0	0	2
Restaurant	0	0	1	0	0	1
Hospital	2	0	0	0	0	2
School	1	0	0	0	0	1
Total*	8	6	8	5	2	29
	28%	21%	28%	17%	7%	100%

Note: The total of ratio values does not reach 100%, as individual values have been rounded off.
Source: JICA Expert Team

7) Treated Water Quality of Johkaso-like ITP's

In Japan, structural specifications and O&M procedures of Individual Treatment Plant (ITP) is regulated by the Building Standards Act and Purification Tank Act under the name of "Johkaso". In Indonesia, Japan-based manufacturers have produced and delivered "Johkaso" for ITPs of private sector.

In order to confirm the treatment performance of the "Johkaso", we investigated treated water qualities of three "Johkaso" which employs anaerobic filter and contact aeration process, anaerobic filter and biofilter filtration process as typical treatment method (hereinafter called the "Johkaso-like ITP"), in addition to the 29 sites of sampling survey. The treated water quality results are based on inspection by BPLHD.

Table B4-24 shows the analysis results of treated water quality on the three Johkaso-like ITPs. The results of the 29 sites of the sampling survey are reproduced in the table to compare with Johkaso-like ITPs.

Detail results of the investigation are attached as S/R PART-B: B4.

The results on "Johkaso-like ITP"s satisfy the Effluent Quality Standards and are less than half of each

criterion of COD_{Cr}, BOD, SS and Ammonia nitrogen. In addition, "Johkaso-like ITP" performed better than both modified septic tank and extended aeration process in every water quality item.

Regarding desludging, the ITPs are regularly de-sludged once or twice a year in case O&M is outsourced to private company.

These results suggest that, in Indonesia, the system of "Johkaso-like ITP" is working well and is expected to have treatment performance equal to or higher than the other treatment methods as long as both appropriate O&M and regular desludging are provided.

Table B4-24 Comparison of Treated Water Qualities between Johkaso-like ITP and Other Treatment Methods

Wastewater treatment methods			Treated water qualities (BPLHD Inspection)			
			CODcr (mg/L)	BOD (mg/L)	SS (mg/L)	NH_4-N (mg/L)
Johkaso	anaerobic treatment and contact aeration process	AVE	24	11	14	3
		MIN	6	5	8	3
		MAX	40	17	24	4
Septic Tank	Modified	AVE	70	27	15	Unknown
		MIN	-	-	-	-
		MAX	-	-	-	-
ITP	Extended aeration process	AVE	48	16	16	**14**
		MIN	15	5	2	0
		MAX	**90**	36	**60**	**75**
	Others	AVE	17	22	10	**25**
		MIN	11	8	5	**13**
		MAX	14	47	19	**39**
Effluent standards			80	50	50	10

Source: JICA Expert Team

8) Summary

(a) Treatment Method

- Over 90% business establishments are in possession of ITPs or are connected to sewerage systems.

(b) Target Wastewater

- ITP's target wastewater is living (domestic) wastewater, and is not limited to human waste (black water).

a) Effluent Quality

- Organic substances (BOD, SS, etc.) are treated with ITP to control values or less. About 30% ITPs are not able to treat ammonia to the control value or less.

(c) Situation of O&M

- About 60% ITPs require improvement of some kind. The actual sludge generation volume is extremely small compared to result of trial calculation, and in addition, there is no information that clarifies the balance regarding treatment and disposal of de-sludged sludge.

(d) Wastewater Recycle System

- 30% ITPs have introduced or are planning to introduce wastewater recycle systems with high water charge and instability of water volume and water quality as reasons.

(e) Willingness of Connection to Sewerage System

- 28% ITPs are willing to make connection to the sewerage system, if the sewerage system area reaches their locations. About one half is thinking that economy is the criteria for judgment of connection.

(f) Treated Water Quality of "Johkaso-like ITP's"

- In Indonesia, compared with both of modified septic tank and extended aeration process, "Johkaso-like ITP"s produced and delivered by Japan-based manufacturers produce treated water with good quality, and they are evaluated as a method with sufficient treatment performance.

B4.3 Community On-Site Treatment Systems

In Indonesia, wastewater collected from multiple households is normally treated at a common facility called SANIMAS (Sanitasi Masyarakat), but Jakarta has a different system where domestic wastewater collected from a community apartment house is delivered to an individual wastewater treatment plant, and PD PAL JAYA makes a contract to maintain the facility. The following summarizes the results of a survey of the case.

B4.3.1 Outline of the Wastewater Generation Source

The study was conducted on medium-rise apartment buildings for low-income people that were built in 1991 using the funds of the National Housing Commission. They include 16 four-story reinforced concrete buildings with 3,072 rooms in total. 75% of the rooms are occupied and the average number of family members is four. The designed quantity of household wastewater per unit is 40-50 L/person/day. Based on these figures, household wastewater emissions are calculated as: 3,072 × 0.75 × 50 ÷ 1,000 = 461 m^3/day.

(1) Wastewater Treatment Facilities

1) Outline of the Facilities

- Designed treatment capacity: 200 m^3/day × 3 systems
- Treatment method: activated sludge method
- Designed water quality: water inflow: 160 m^3/day, treated water: BOD 20 mg/L (standard values: BOD 50 mg/L, NH_4-N 10 mg/L)
- Designation for discharge: the gutter
- Sludge treatment: Sludge is suctioned from the sludge storage tank of each system and moved to two sludge pits once every four months. The sludge is then transported outside of the compound and disposed of once a year.

2) Operation and Maintenance

- Three staff members of PD PAL JAYA are in charge of the operation and maintenance, of which two of them reside on site and manage the facilities.
- PD PAL JAYA conducts water quality inspections every two weeks. Water quality checks include pH, CODCr, BOD, NH_4-N and detergents.
- They add one bottle of biological substances as a decomposition accelerator every day. Each bottle costs IDR 50,000-60,000
- The income of PD PAL JAYA is an annual payment of IDR 15,000,000 from the National Housing Commission.

3) Problems

Although the designed quantity of household wastewater per unit is 40-50 L/person/day, the actual wastewater emissions are higher. It is surmised that they are adding the decomposition accelerator as a measure to overcome the overload.

The top of the aeration tank is open, from which foam formations were observed. This is probably caused by detergents. The foam (wastewater) may be dispersed by the wind.

The regulatory value for NH_4-N in treated water is 10 mg/L.

(a) Structure

A package form of wastewater treatment facility has mainly 2 types: precast type and cast-in-place type. Regarding to the precast type, the plastic wastewater treatment facility is transferred by a truck to the site and installed. It has an advantage to shorten the construction period. On the other hand, the treatment capacity has a limitation and a market of mass production is necessary. Regarding to the cast-in-place type, mainly steel sheet units of facility is assembled at the site in general. From now on, aerobic treatment system would be the mainstream, and a package form of wastewater treatment facility would be increased. Therefore, it is necessary to establish a legal system, such as structure standards to secure the stable function.

(b) Operation and Maintenance

As same as design and structure, it is necessary to establish a legal system of the facility operation and maintenance, such as standards and manuals, in order to secure the stable function. Also it would be expected to establish a system that excellent private companies could tap into the market freely.

(c) Application

To make a package form of wastewater treatment facility popular, institutional support is expected, such as an obligation to install a small-scale concentrated treatment system mainly in a new housing development area where the sewerage system will not be developed immediately.

B4.4 Existing Conditions for Operation and Maintenance (O&M)

B4.4.1 O&M for Off-Site Sanitation

(1) Sewerage Service

1) Service Area

PD PAL JAYA provides the sewerage service to part of Tebet and Setiabudi out of total 42 districts and 261 towns in DKI Jakarta. It serves nine towns including Kelurahan and the total service area is 854ha. The East Setiabudi wastewater treatment plant serves about 487ha and the West Setiabudi wastewater treatment plant serves about 367ha. The service area of PD PAL JAYA is 1.3% of the total area of DKI Jakarta. Table B4-25 shows a list of sewerage service areas.

Table B4-25 PD PAL JAYA's Sewerage Service Area

Pond	No	Chatchment area	Area (ha)	
East Setiabudi Pond	1	Manggarai Selatan	232	387
	2	Bukit Duri	155	
West Setiabudi Pond	3	Four Season Regent	337	745
	4	Setiabudi Tengah	313	
	5	Setiabudi Barat	95	
Sewerage Service Area (total)			**1,132**	
			1.7%	
DKI Jakarta Total Area			**65,575**	

Source: JICA Expert Team

2) Number of Customers by Category

The total number of customers for PD PAL JAYA is 1366 as of 2009. The ordinary households account for 86% (1,179) of it and the large commercial facilities account for 11% (143) of it.

The sewerage charge is decided by building floor area. The large commercial facilities account for 91% of the total floor area and the ordinary households account for only 3% of it.

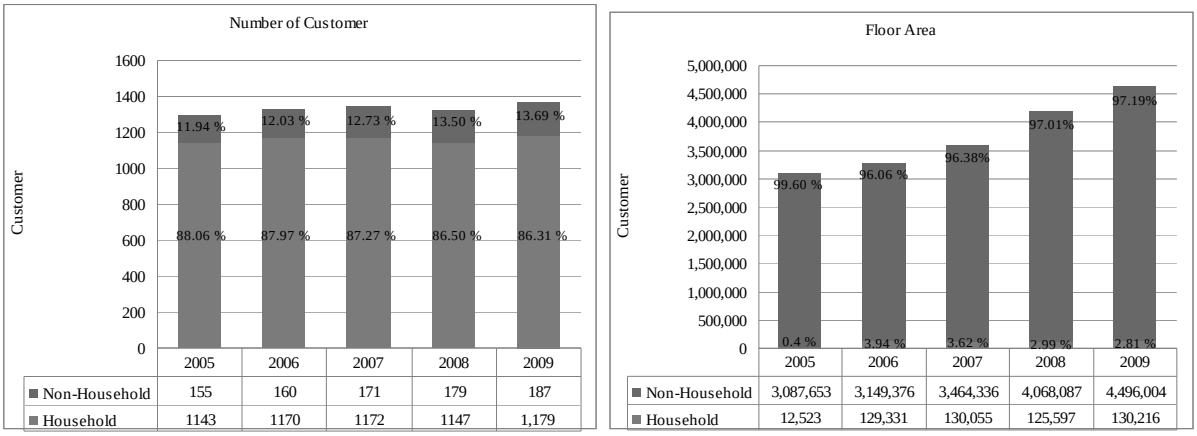
The number of customers in 2008 decreased from 2007. In 2007, the customer list was computerized and the number of customers was checked. As a result, the abandoned houses with no residents were

found and the number of customers slightly decreased in 2008. Table B4-26 and Figure B4-14 show the number of customers and the building floor area for each category. S/R PART-B: B4 shows the details of the number of customers and the building floor area.

Table B4-26 PD PAL JAYA's Number of Customers and Building Floor Area (2009)

category of customer	Customer		Floor area	
	Number	Rate(%)	Area(m^2)	Rate(%)
Household	1,179	86.3%	130,216	2.8%
Small commercial	12	0.9%	62,328	1.3%
Large commercial	143	10.5%	4,201,569	90.8%
Social	31	2.3%	231,707	5.0%
Industry	1	0.1%	400	0.0%
total	1,366	100.0%	4,626,220	100.0%

Source: Annual Report PD PAL JAYA, 2009



Source: Annual Report PD PAL JAYA, 2005 - 2009

Figure B4-14 PD PAL JAYA's Number of Customers and Building Floor Area

(2) Sewerage Charge

1) Tariff System

The local government has the right to decide the sewerage charge, which is the main revenue source for PD PAL JAYA to perform the business. The sewerage charge system is specified by the Decree of the Governor of DKI Jakarta No.1470/2006.

In this system, there are two charges. One is the connection fee that must be paid only once when a customer applies for connection to the sewerage system, and the other is the specific fee that must be paid according to building floor area. For large commercial facilities, the connection fee differs depending on whether or not facilities are equipped with a sewage treatment system. If not equipped, the higher connection fee is applied.

The sewerage charge is divided into four (4) divisions of A – D for household, into seven (7) divisions for small commercial facilities, into ten (10) divisions for large commercial facilities, nine (9) divisions for social (public) facilities and into three (3) divisions for factory, namely a total of 33 divisions. The different connection fee and the specific fee are set for each division.

The specific fee for household type A (contract electricity up to 900W) is 90 IDR/m^2/month, the lowest among the fees. The specific fee for five-star hotel and large industry (factory) is 720 IDR/m^2/month, the highest among the fees and eight times as high as that of household type A. The sewerage charge list is shown in Table B4-27 and Table B4-28.

Table B4-27 Sewerage Charge (Specific Fee and Connection Fee) (per m^2 and month)

No	Customer Category	Tariff	Connection Fee	
		IDR/m^2	Unit	IDR
I	**Household**			
1	Household Type A (Electricity up to 900Watt)	90	Unit	10,000
2	Household Type B (Electricity up to 1300Watt)	113	Unit	10,000
3	Household Type C (Electricity up to 2200Watt)	135	Unit	10,000
4	Household Type D (Electricity over 2200Watt)	158	Unit	110,000
II	**Small Commercial**			
1	Shop	135	per m^2	1,000
2	Office (Building up to 3 Floors)	135	per m^2	1,000
3	Salon	158	per m^2	1,000
4	Catering	180	per m^2	1,400
5	Small Restaurants/ Restaurants	225	per m^2	1,500
6	Inn	225	per m^2	1,500
7	Other Small Commerce	225	per m^2	1,500
III	**Large Commercial**			
1	Office of high rise buildings	450	per m^2	1,750
2	Office of high rise buildings includes a restaurant and or Fitness	495	per m^2	1,925
3	Shopping Center/Mall/Supermarket/Show Room	495	per m^2	1,925
4	I, II, III, Star Hotel	495	per m^2	1,925
5	Apartment/Condominium	675	per m^2	2,625
6	IV Star Hotel	675	per m^2	2,625
7	Place of Entertainment/Large Restaurant /Café	720	per m^2	2,800
8	Private Hospital	720	per m^2	2,800
9	V-star Hotel	720	per m^2	2,800
10	Other Large Commerce	720	per m^2	2,800
IV	**Social**			
1	Place of Worship	50	per m^2	550
2	School	135	per m^2	850
3	Health Center	180	per m^2	1,100
4	Government Institutions	180	per m^2	1,100
5	Other Institutions/Agencies	180	per m^2	1,100
6	Schools include dormitory	180	per m^2	1,100
7	Swimming Pool	225	per m^2	1,100
8	Private Hospital	270	per m^2	1,500
9	Clinic/Medical Clinic	270	per m^2	1,500
V	**Industry**			
1	Small Industry	475	per m^2	1,000
2	Medium Industry	675	per m^2	4,200
3	Large Industry	720	per m^2	4,300

Source: DKI Governor's Decree No.1470 / 2006

Table B4-28 Sewerage Connection Fee (per m^2/place) for Large Commercial Facilities without Sewage Treatment Plant (STP)

No	Customer Category	Unit	Connection Fee
III	**Large Commercial**		
1	Office of high rise buildings	Area of building per m^2	3,500
2	Office of high rise buildings includes a restaurant and or Fitness	Area of building per m^2	3,850
3	Shopping Center/Mall/Supermarket/Show Room	Area of building per m^2	3,850
4	Hotel Star I, II, III	Area of building per m^2	3,850
5	Apartment/Condominium	Area of building per m^2	5,250
6	Hotel Star IV	Area of building per m^2	5,250
7	Place of Entertainment/Large Restaurant /Café	Area of building per m^2	5,600
8	Private Hospital	Area of building per m^2	5,600
9	V-star Hotel	Area of building per m^2	5,600
10	Other Large Commerce	Area of building per m^2	5,600

Source: DKI Governor's Decree No.1470 / 2006

2) Sewerage Charge Collection

(a) Methods of Sewerage Charge Collection

a) Sewerage Charge Collection from Household

The following three methods are used to collect the charge.

[1] Bill collection by visiting individual households/facilities

[2] Payment at counter: Residents pay the bills directly at PD PAL JAYA's counter

[3] Bill collection and payment by representative of community: The representative of each community collects money and makes payment collectively to PD PAL JAYA.

The ratio of the above methods is roughly 70% for [1], 10% for [2] and 20% for [3]. Approval by the governor of DKI Jakarta is necessary for above Method [3] "Bill Collection and Payment by Representative of Community".

b) Sewerage Charge Collection from Non-Household

Bank transfer is used basically for payment by business operators.

c) Actions Taken when Charge is not Paid

When the charge is not paid, the following four steps are taken.

[1] Step 1: Re-visit by collector

[2] Step 2: Dispatch of information letter (reminder notice)

[3] Step 3: Connection to the sewerage system is stopped (The connecting pipe is blocked).

[4] Step 4: If payment is not made within one month after the Step 3 is taken, a reminder notice is sent in the name of governor.

(b) Sewerage Fee Collection Ratio

a) Sewerage Fee Collection Ratio from Entire Customers

The sewerage fee collection ratio from entire customers was 99% on sewerage fee basis in 2010. This ratio was very high because most of the fees were paid by business operators basically through bank transfer.

Table B4-29 Fee Collection Ratio from Entire Customers (Actual Record in 2010)

Items	IDR / %
Actual income for sewerage fee	32,063,081,413
Estimated income for sewerage fee	32,472,427,891
Sewerage fee collection ratio	**99%**

Source: PD PAL JAYA

b) Sewerage Fee Collection Ratio from Household

The actual collection ratio from households was 63% on customer basis in March 2011. Each of two employees of PD PAL JAYA visits 350 to 450 households separately in a month and collects the charges, but the collection ratio is low. In one district only, the representative of community collects the fees, and the collection ratio is 75%, the highest. For collection of fees from households, collective collection by representative of community is the most effective method.

Table B4-30 Fee Collection Ratio from Household (Actual record in March 2011)

Person in charge	Number of customer		Collection rate (%)
	Target	Performance	
Employee 1 (PD PAL JAYA)	446	206	46%
Employee 2(PD PAL JAYA)	343	240	70%
Citizen 1(Head of community)	392	295	75%
total	1181	741	**63%**

Note: Citizen 1 is Head of community (only one area: Kel. Karet Kuningan).
Source: Hearing from PD PAL JAYA (March 2011)

c) Types of Customer Complaint

The contents of customer complaint are as follows.

i) Complaint from Households

- The most of complaints are about defects of sewerage pipes (clogged pipe, overflow, etc.).

ii) Complaint from Business Operators

- Error in payment (Business operators transfer money to a wrong bank account and PD PAL JAYA cannot confirm their payment. Then a reminder letter is sent to the business operator and they make complaint.)

Report on customer complaints is compiled every quarter (three months) and is contained in the annual customer service report.

(3) Operation and Maintenance Situation

1) Wastewater Treatment Plant

(a) Operation

For operation and control of the Setiabudi wastewater treatment plant (Setiabudi West and East ponds), only manual on-off operation of seven surface aerators is required. Four workers of PD PAL JAYA perform this operation on two shifts (two daytime workers and two nighttime workers). The surface aerators are operated mainly midnight for eleven hours a day. They are operated midnight because if they are operated daytime, the neighboring hotels complain of foul odor. The operation of the effluent pumps and the dredging of accumulated sludge are performed by the Public Works Agency in DKI Jakarta and PD PAL JAYA has no right to perform these works. Table B4-31 shows the operational control status of the Setiabudi wastewater treatment plant.

Table B4-31 Operational Control Status in Setiabudi Wastewater Treatment Plant (East and West)

Items		Implementation
Operator		4 persons (total) - Daytime : 2 persons - Nighttime : 2 Persons
Operating	Aerator	Operating time (Manually-operated) - from 00:00 to 08:00 (8 Hr) - from 11:00 to 12:00 (1 Hr) - from 15:00 to 17:00 (2 Hr) total 11 hr
	Pump	- In charge of Public Works Agency - Automatically-operated (by water level) - HWL=3.0m, LWL=2.5m
	Dredging sludge	- In charge of Public Works Agency

Source: Hearing from PD PAL JAYA

(b) Maintenance

Maintenance work is required mainly only for the surface aerators. The O&M department of PD PAL JAYA performs repair work, periodic replacement of oil, overhaul and coating of the surface aerators.

(c) Water Quality Management

For water quality management of the Setiabudi wastewater treatment plant, water is sampled from the seven positions of the Setiabudi pond once a week and analyzed at its own laboratory. The sampling points are two influent (inlet) positions and one effluent position in the West Setiabudi pond, and three influent positions and one effluent position in the East Setiabudi pond.

Table B4-32 shows the analysis items and water quality standards. Table B4-33 shows a list of the analysis instruments in the laboratory.

Table B4-32 PD PAL JAYA's Analysis Items and Standards for Water Quality in Setiabudi Wastewater Treatment Plant

Items	Unit	Water quality standards		Method of water quality analysis
		Inlet*1	Effluent *2	
pH	-	5 - 9	6 - 9	
BOD (20°C, 5days)	mg/L	400	50	Manometric method
COD(Dichromate)	mg/L	600	80	Titration method
NH_4-N	mg/L	65	10	Spectrophotometric method
Detergent	mg/L	30	2	Spectrophotometric method
SS	mg/L	850	50	
$KMnO_4$ consumption	mg/L	550	85	Titration method
Oils	mg/L	20	10	

Notes:
1 : DKI Jakarta Governor Decree No.1040, 1997
2 : DKI Jakarta Governor Decree No.122, 2005
Source: PD PAL JAYA

Table B4-33 Water Quality Analysis Instruments Prepared in PD PAL JAYA Laboratory

No.	Insturuments name	Number of unit	Application (item analysis)
1	Ultoraviolet-Visible(UV/VIS)	1 unit	Ammonia, Detergent etc
2	Spectrophotometer	1 unit	Ammonia, Detergent etc
3	Oil content analyzer	1 unit	Oil
4	COD_{Cr} reactor	1 unit	COD_{Cr}
5	BOD reactor	3 unit	BOD
6	instrument for measuring SS	1 set	SS
7	pH meter	2 unit	pH

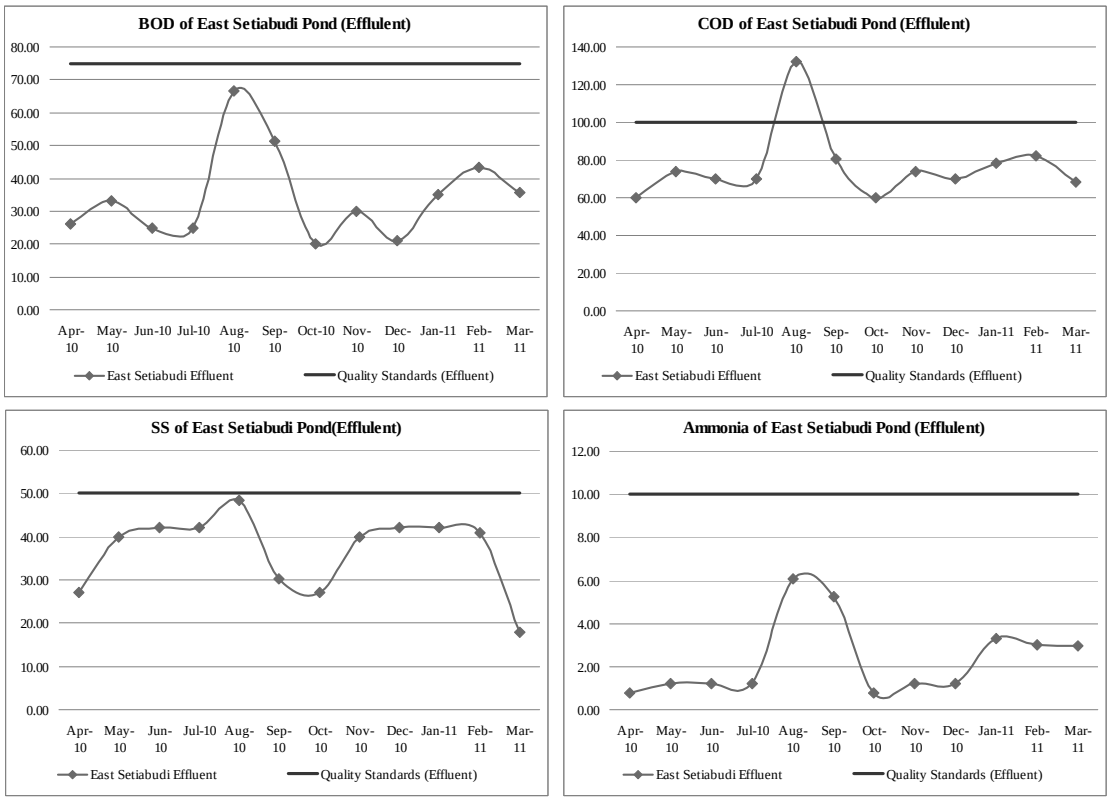
Source: Hearing from PD PAL JAYA

Figure B4-15 and Figure B4-16 show the water quality analysis results of the Setiabudi pond. The quantity of BOD, COD_{Cr}, SS and ammonia increased suddenly in August. The COD_{Cr} of the East pond and the COD_{Cr} and ammonia of the West pond exceeded the standard values. This fact indicates that August is in the midst of dry season, precipitation is low and the water quality of the pond deteriorates. The Public Works Agency operates the effluent pumps and dredges the sludge, and PD PAL JAYA has no right to control these operations. Therefore, PD PAL JAYA cannot control the effluent volume and cannot decide dredging time to improve the water quality of the pond. S/R PART-B: B4 shows the results of water quality analysis of the Setiabudi ponds by PD PAL JAYA.

(d) Water Quantity Control

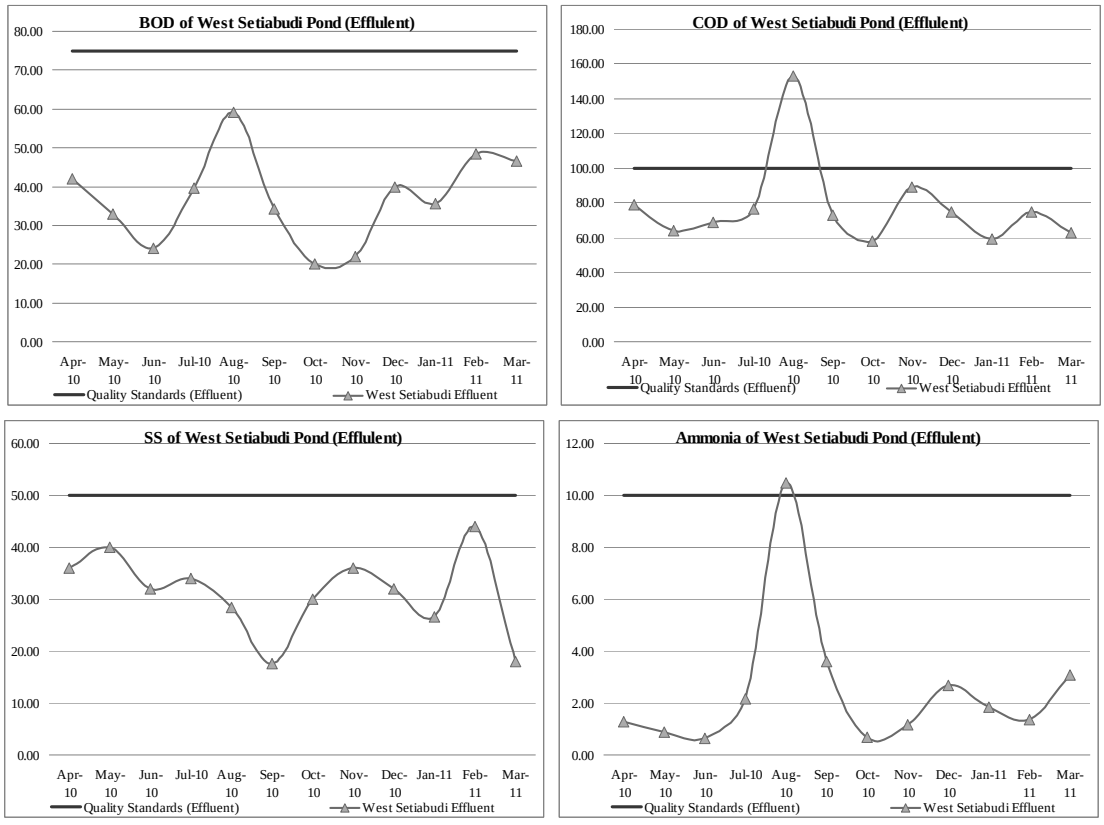
Five sewerage pipes and eight storm water pipes are connected to the Setiabudi ponds (East and West), but influent quantity is not known. The effluent quantity can be estimated from the operating time of the effluent pumps, but the Public Works Agency has the right to operate the pumps and PD PAL JAYA, who is responsible for wastewater treatment, has no right to control the effluent quantity.

For the Setiabudi wastewater treatment plant of aerated lagoon system, it is important to understand the influent and effluent quantity and the retention period. However, no method is available to measure the flow rate, and the control right of the plant is shared by the two organizations because the Setiabudi wastewater treatment plant is also used as a flood-control reservoir. Therefore, water quantity is not controlled in this plant.



Source : Water quality Analysis Report, PD PAL JAYA 2010

Figure B4-15 Water Quality Analysis Results of East Setiabudi Pond



Source: Water quality Analysis Report, PD PAL JAYA 2010

Figure B4-16 Water Quality Analysis Results of West Setiabudi Pond

2) Wastewater Pumping Station

Table B4-34 shows the operational control and maintenance status in the Krukut Pumping Station and the Manggarai Pumping Station. In the Krukut Pumping Station, the manual operation is performed by two operators every morning and evening for about one hour each time, a total of two hours a day. Since the pumps are not operated except for these two daytime hours, the wastewater may overflow into the nearby river at night. Although an auto screen is provided, it has not been operated since it was installed and one of the three main pumps is out of order and no maintenance work is performed for it. The Krukut pumping station is equipped with a private power generator in case of blackout and it is test run twice a week to check operation. However, this generator has never been operated even during power blackout probably due to the following reasons. In this pumping station, the pumps are manually operated during daytime and the operators are not always monitoring the station. Therefore, they cannot see the influent status and the power blackout status in the pumping station and so cannot operate the private power generator during blackout.

In the Manggarai pumping station, small manhole pumps are used. They are operated automatically according to the water level within the manhole. One operator patrols and inspects the station everyday and checks the operation of the pumps only with the indicated value of electric current. When the water level of the manhole is low and the pump is not operating in his inspection, the operation of it cannot be checked. In addition, the operating time of the pump is not checked and the flow rate is not known. Accordingly, when the influent quantity is more than the capacity of the two pumps, the wastewater overflows into the nearby river. The sealing and bearings are replaced in overhaul conducted once a year and maintenance is performed properly.

Table B4-34 Operation Control and Maintenance Status in Krukut and Manggarai Pumping Stations

Items		Krukut Pumping Station	Manggarai Pumping Station
Operator		2 persons (total) - In the office : 1 person - In the P/S : 1 person	1 person
Technique of operate		Manually-operated	Automatically-operated (by water level
Operating	Auto Screen	Never been operated	None
	Pump	Operating time - from 07:00 to 08:00 (1 Hr) - from 15:00 to 16:00 (1 Hr) total 2 Hr	Operating time - Unknown (No control of operating condition)
	Generator	Never been operated	None
Maintenance	Auto Screen	Cleaning once a week	None
	Pump	Checking once a week - Checking mechanical sea, oil and grease - Checking operating condition	Checking patrol every day - Checking the electricity current - Manhole cleaning - Checking operating condition Overhaul once a year - Replace seal and bearing
	Generator	Test operation twice a week	None

Source : Hearing from PD PAL JAYA

3) Sewer Pipeline

The total length of sewer pipes is about 76 km, and there are about 1,300 manholes and about 3500 inspection chambers. Management of sewerage network is performed by five workers of the Sub-Division for O&M of Pipe & Pumping Station.

For cleaning of the pipes, schedule is made for every month and one group cleans the pipes five days a week. In addition, if a customer complains of clogging of pipe or inspection chamber, the workers remove such clogging.

Regarding equipment for maintenance of the pipelines, they have a jetting truck equipped with a pipe washer, honey truck to remove sludge from manholes, and bucket machine to carry sludge.

They have utilized simple inventory to maintain their facilities. Although, the pipelines are cleaned

and corrective actions for accidents such as clogging are taken, they do not monitor the status of pipelines for aging, etc. and do not collect information for such status. Twenty (20) years have already passed since the pipelines were installed, and so the aging of them will progress. If no corrective action is taken to solve the aging problem, an accident such as a sagging road may result. Therefore, it is important to check the status of pipelines in daily cleaning and make a database of such information to effectively repair and renovate the pipelines. In this project, GIS is planned to utilize as management tools for drawings, data management and visualization tools for inspection data. Such information will be also very useful and important when they extend the pipelines in the future.

B4.4.2 Present Conditions of GIS Database

(1) Objective of Survey

As part of Capacity Development (hereafter CD), this project shall provide environment to perform sewerage network implementation planning. Counterpart team shall learn how to use GIS software for their implementation plan in the future. In Indonesia, map and Survey agency (BAKOSURTANAL) have been implementing National geo-Spatial Data Infrastructure (hereafter NSDI). But mapping industries have not yet raised to the level to provide reasonable priced spatial data. Therefore in CD, it is required for counterpart team to earn not only ability to utilize GIS. But also it has to have ability to update and add spatial data to the provided data by themselves.

Considering about above mentioned requirement, the JICA expert team have evaluated present condition of GIS Database in each institute. Survey items are as follows;

- Geo-spatial data (Conditions of data)
- Existing application of GIS software
- O&M body for GIS Database on mid & long term

(2) Methodology

Surveys were mainly done through interview of the counterpart team and collection of the existing sewerage network related data. Target institutes were selected from counterpart team.

Table B4-35 Target Institutes

	PD PAL JAYA	Spatial Agency	BAPPEDA
Respondent / Position	Mr. Erwin Marphy Au Technical Division Manger	Mr. Izhar Chaidir Head of Division for Urban Spatial Planning	Ms. Vera Revina Sari Head of Division for Infrastructure and Environment
Survey Date	2nd March 2011	14th March 2011	31st March 2011
Respondent / Position	Dr. Ilham Lecturer of University of Indonesia (Support for GIS System in PD PAL JAYA)	Mr. Heri Purwanto Head of Section for Geo-information and Spatial Data Network	
Survey Date	29th March 2011	21st March 2011	

Source: JICA Expert team

(3) Existing Data from Counterpart Team

Major data owned by each counterpart team were mostly CAD data. Because of very few GIS user bases, each of the institute set its target user environment as CAD software. For short term, every time when data is updated, it requires conversion to GIS data from CAD data. As long as data O&M is done by CAD software, work load for up-dating the data shall become huge and it will increase difficulty to maintain GIS database which will be provided by JICA Expert.

- To utilize data, it will require conversion from CAD data
- As long as O&M is done by CAD software, it will increase difficulty to maintain GIS Database

Table B4-36 Data Belongs to each Counterpart Agency

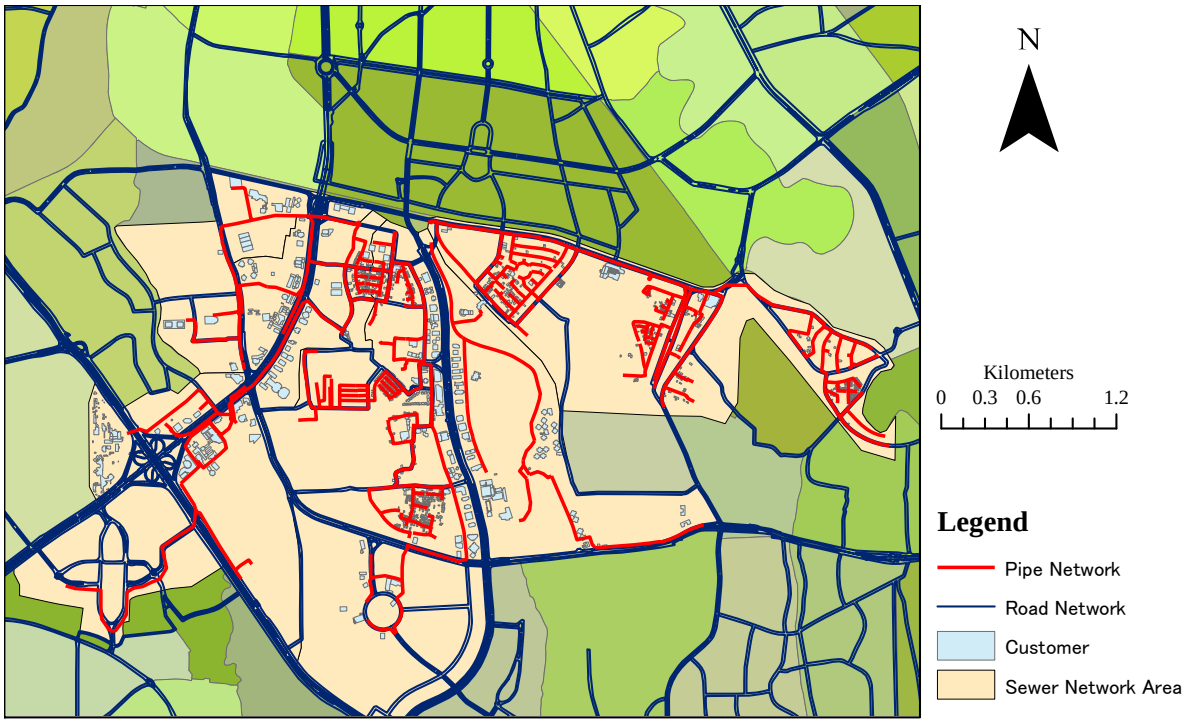
No	Counterpart Agency	Theme	Data Format	Remark
1	DKI Spatial Agency	1/1000 Base map	CAD Data	DKI Area (600km^2+)
2	DKI Spatial Agency	1/5000 Base map	CAD Data	DKI Area (600km^2+)
3	DKI Spatial Agency	Land use 1990	GIS Data	DKI Area (600km^2+)
4	DKI Spatial Agency	Land use 1996	GIS Data	DKI Area (600km^2+)
5	DKI Spatial Agency	Land use 2003	GIS Data	DKI Area (600km^2+)
6	DKI Spatial Agency	Land use 2007	Raster Data	DKI Area (600km^2+)
6	DKI Spatial Agency	Topography	CAD Data	DKI Area (600km^2+)
7	DKI Spatial Agency	Road Network	CAD Data	DKI Area (600km^2+)
8	DKI Spatial Agency	Water line Network	CAD Data	DKI Area (600km^2+)
9	DKI Spatial Agency	GAS line Network	CAD Data	DKI Area (600km^2+)
10	BAPPEDA	Land use 2030	Raster Data	DKI Area (600km^2+)
11	PD PAL JAYA	Minor River	GIS Data	Sewage Service Area (11.3km^2)
12	PD PAL JAYA	River	GIS Data	Sewage Service Area (11.3km^2)
13	PD PAL JAYA	Channel	GIS Data	Sewage Service Area (11.3km^2)
14	PD PAL JAYA	Railway	GIS Data	Sewage Service Area (11.3km^2)
15	PD PAL JAYA	Customer	GIS Data	Sewage Service Area (11.3km^2)
16	PD PAL JAYA	Non-Customer	GIS Data	Sewage Service Area (11.3km^2)
17	PD PAL JAYA	Name of Road	GIS Data	Sewage Service Area (11.3km^2)
18	PD PAL JAYA	Main Hole	GIS Data	Sewage Service Area (11.3km^2)
19	PD PAL JAYA	Pipe Network	GIS Data	Sewage Service Area (11.3km^2)
20	PD PAL JAYA	Road	GIS Data	Sewage Service Area (11.3km^2)
21	PD PAL JAYA	Ic Survey	GIS Data	Sewage Service Area (11.3km^2)
22	PD PAL JAYA	Ic Pipe	GIS Data	Sewage Service Area (11.3km^2)
23	PD PAL JAYA	Ic Corridor	GIS Data	Sewage Service Area (11.3km^2)
24	PD PAL JAYA	Ic Not Yet Surveyed	GIS Data	Sewage Service Area (11.3km^2)
25	PD PAL JAYA	Ic	GIS Data	Sewage Service Area (11.3km^2)
26	Housing and Regional Government Building Agency	Slum Area	CAD covers	DKI Area (600km^2+)

Source: JICA Expert Team

Currently, counterpart agency which utilized GIS software and maintained GIS Database was only PD PAL JAYA. Other counterpart agencies were outsourcing data generation process. Every agency is hiring full-time operator for data maintenance except BAPPEDA.

GIS database owned by PD PAL JAYA is mainly sewerage service area (11.3km^2). They were used for following application.

- Customer Information (to simulate usage fee)
- Sewer Network and Related Facilities (for O&M)



Source: PD PAL JAYA

Figure B4-17 Sewer Network GIS Database Cover Area

Table B4-37 GIS Database and Records

No	Table	In Indonesian Language	Record	Coordinate System
1	Minor River	(sungai_kecil)	6229	TM3 Zone 48.2
2	River	(sungai)	249	TM3 Zone 48.2
3	Channel	(saluran)	5	TM3 Zone 48.2
4	Railway	(rel_ka)	2640	TM3 Zone 48.2
5	Customer	(pelanggan)	1446	TM3 Zone 48.2
6	Non-Customer	(non_pelanggan)	69823	TM3 Zone 48.2
7	Name of Road	(nama_jalan)	80688	TM3 Zone 48.2
8	Main Hole	(main_hole)	1055	TM3 Zone 48.2
9	Pipe Network	(jarigan_pipa)	314	TM3 Zone 48.2
10	Road	(jalan)	10862	TM3 Zone 48.2
11	Ic Survey	(ic_survey)	2401	TM3 Zone 48.2
12	Ic Pipe	(ic_pipa)	2159	TM3 Zone 48.2

Source: PD PAL JAYA

GIS software which owned by PD PAL JAYA is ArcView3.3 (out of vender support since May 2002). Crash was occurred in the existing GIS Database, it is stopped updating since 2008. Currently GIS database is substituted by CAD drawings.

(4) Result of Survey and Conclusion

To select adequate counterpart agency for running GIS database survey were performed. From result of survey, it is considered that PD PAL JAYA is the most adequate counterpart agency. Reasons were as follows.

- GIS database exists with PD PAL JAYA and PD PAL JAYA has inevitability to maintain GIS Database
- PD PAL JAYA is hiring full-time operators and through training technology transfer is possible

Table B4-38 Summary of Survey Result

Items	PD PAL JAYA	DKI Spatial Agency	BAPPEDA
Full-time operator	Exist	Exist	-
Data Maintenance	In-house	Out source	Out source
Major Platform	GIS (CAD)	CAD	CAD
Data Asset	- Sewer network database - Customer database	- Base map 1/1,000 - Base map 1/5,000 - Current land use	- Future land use
Remark	There were operating GIS database system. But since 2008, it is stopped updating due to data crash System was substituted by CAD drawing.	Operations based on CAD drawing. Disseminating base map data including hardcopy is priority issue.	Holding many classified data, problem with the data exchange.
Recommendation	First candidate for the GIS system provision. It shall earn direct profit from O/M for GIS Database provided by the Project. More advanced position to glow full-time operator and application.	The data provided by DKI Spatial Agency were used by PD PAL JAYA as base map. If it is converted to GIS data, it will provide more benefit to other GIS users. However, their original coordinated jurisdiction for data preparation is wide. So it is difficult to concentrate on sewerage network data maintenance.	They are in position to effectively utilize result of sewerage network development plan. But there are not enough human resource to develop and maintain these database. If developed GIS database is operated with classified data, it will be difficult to share among other institutes.

Source: JICA Expert Team

However, PD PAL JAYA has lack of human resources and technical resources. It is difficult to maintain and develop GIS database by PD PAL JAYA alone. Reasons were as follows;

- Whole area of DKI Jakarta is sixty (60) times larger than current sewerage service area and human resources required for development of these data is lacking
- Existing GIS Database maintenance scheme is already crashed since long, without no support for it.

For PD PAL JAYA to keep maintaining GIS database, it is required to reduce total workload and to have mid & long term technical support. Especially, cooperation between other counterpart agencies is also important. Such as provisions of basemap and other basic data and burden share for database development, building relationship to receive the full benefit from database development is required.

(5) Roadmap for Database Development and Overview of GIS Database

It has to be agreed by PD PAL JAYA and other participating institutes, GIS Database development's implementation strategies were as follows;

- Establish data updating and sharing cycle (Sharing data structure and data itself)
- Through periodical workshops (hereafter referred to as WS) and lectures develop GIS user and GIS application engineer base
- Acquiring continuous technical support (Relation between software vender and Universities)

Especially, to reduce workload for PD PAL JAYA has to burden, set base on GIS Database that provides by the Project and carry forward the database development. On the other hand, with WS and lectures, technology transfer is planned. By sharing common information bases, foster the sense of same GIS community. With sharing data and burden, establishing close relationship between participating institutes. Roadmap for Database Development is shown below.

Table B4-39 Roadmap for Database Development (Draft)

Items	Project period	Short Term (First Year)	Mid Term(Post First Year)
Database Development	Data prepared for M/P planning	Base Data (such as base map)	Individual Data
Goal and Objectives for GIS technology Transfer	Basic operation, Data entry Designing data structure	Data structure modification	Application Development
Main body of database development	JICA Expert	PD PAL JAYA	PD PAL JAYA + Institutes which participate in WS
Main body of Technical Support	JICA Expert Vender support	Vender Support University of Indonesia	Vender Support University of Indonesia
WS Host	JICA Expert	PD PAL JAYA Vender	PD PAL JAYA Vender
Other	Coordination for burden sharing between each participating institutes		

Source: JICA Expert team

Following table shows GIS Database that is developed by JICA Expert team.

Table B4-40 Overview of GIS Database

No	Item	Data type	Attribute	Remark
1	Treatment Plant	Polygon / Point	Name, Capacity, Treatment Method, Existing or Plan	
2	Sewerage Coverage Area	Polygon	Area Name, Treatment Plant, Area	
3	Sewer Pipe Network	Line	network id, Diameter, length, gradient, Type	
4	Observing Station	Point	Observing Station id, Position, Address	Incl. groundwater
5	Sewer Pump Station	Polygon / Point	Name, Capacity, Lift height	
6	On-site Treatment Plant Coverage Area	Polygon	Area Name, Treatment Plant, Area	
7	On-site Treatment Plant	Polygon / Point	Name, Capacity, Treatment Method, Existing or Plan	
8	Ground Water Contour	Line	Ground water level	
9	Settling Area	Polygon / Coverage	Settlement Level	
10	Slum Area	Polygon	Kecamatan, Kelurahan, Slum Level	
11	Water Supply Area	Polygon	Company, network id	
12	Administrative Boundary	Polygon	Municipality, District, Sub-District, Area	
13	Administrative Boundary	Line	Municipality, District, Sub-District, RT, RW	
14	Future Plan	Line	Canal, MRT	
15	Socio Economical Survey Result	Point	Address, Name, Class	
16	Drainage Facility	Point	Name, Capacity,	Pump, Gate
17	Drainage Channel Network	Line	Name, Class, Length	
18	Land Use (Existing)	Polygon	Class, Area	
19	Land Use (Future)	Polygon	Class, Area	
20	Public Facility	Point	Class, Name	
21	Government Owned Land	Polygon	Name, Address, Area	Candidate Site
22	Road Network	Line	Class, Name	
23	Elevation Point	Point	Elevation	
24	Contour Line	Line	Elevation	
25	Building	Polygon / Point	Name, Area, Address	
26	Water Supply Pipe Network	Line	Diameter, Type	
27	Gas Supply Pipe Network	Line	Diameter, Type	
28	Electricity Supply Network	Line	Diameter, Type	

Source: JICA Expert team

B5 Current Situation of On-site Sanitation

B5.1 Current Situation of the On-Site Sanitation Facilities Constructed by the JSSP

B5.1.1 Current Status

The Jakarta Sewerage and Sanitation Project (JSSP) was approved by the World Bank on February 8, 1983. The project was launched after the loan became effective in June 1983, four months after the signing. The loan amount was 22.4 million USD. The main purpose of the project was to improve the means for protecting public health through improving the urban environment.

The long-term goal of the project was to develop an appropriate organization responsible for sewerage and sanitation services. The goal of establishing a financially independent organization in Jakarta was achieved.

However, the main purpose was not achieved due to several problems and restrictions.

In the sanitation project, 80 MCK facilities (256 toilet seats) were installed while the installation of 30 MCK facilities (240 toilet seats) was approved. However, only 778 leaching pits were constructed while the installation of 3,000 leaching pits was approved.

B5.1.2 Lessons Learned

Nearly 30 years have passed since the JSSP was implemented. Since then, people from other cities and provinces have continued to migrate to Jakarta City. In particular, this led to an increase in the number of low-income people, the expansion of low-income settlements and increased population density. Their living spaces are getting smaller and it is becoming difficult to secure spaces for installing sanitation facilities, spaces for constructing pipes and drains and spaces for building roads wide enough for sludge collecting trucks to pass.

Ground subsidence caused by pumping up groundwater resulted in 40% of the total area of Jakarta City being at sea level or below. This led to the increased occurrence of floods. Drainage for gray water and water contaminants from sanitation facilities overflow when flooding occurs and this causes insanitary conditions.

It is also expected that the ground subsidence results in higher groundwater levels relative to the ground and increases the possibility of groundwater contamination from septic tanks which work through the infiltration of waste into the ground and from heavily contaminated rivers.

When considering the lessons learned from the JSSP and the recent situation in DKI Jakarta, future Jakarta sewerage and sanitation projects need to consider the following points.

(1) Building an Off-Site System with Effectively Deployed On-Site Systems

In an area where it is difficult to clearly divide the on-site zones and off-site zones, it is necessary to develop a plan to combine a supplemental off-site system while mainly using on-site systems.

(2) Switching from Infiltration Septic Tanks to Non-Infiltration Septic Tanks

Infiltration septic tanks are not suitable for areas with a high population density (called Kampung areas), areas with high groundwater levels where waste does not easily infiltrate into the soil, and flood-susceptible areas.

(3) Appropriate Construction of Drainage Systems

In the JSSP, undersized drains were constructed in most cases. The drainage systems did not function properly due to the violation of regulations by real estate developers. Appropriate rules and implementation of the rules will be necessary to maintain the function of the drainage systems.

(4) The Need for Sanitation Improvement and the Selection of Sites

In the JSSP, land for constructing sanitation facilities was not available in areas where sanitation improvement needs were high. The securing of land will be an important issue for sanitation improvement projects.

(5) High Public Awareness

In the JSSP, public awareness was high although it targeted low-income communities. The communities welcomed the sanitation program and actively participated in the program.

B5.2 Present Conditions of On-Site Sanitation Facilities by Other than JSSP

B5.2.1 Toilets in Individual Houses

(1) Types of Toilets

The typical type of toilet in individual houses is situated in a room which contains a water storage tank, a toilet bowl and a bathing space. A pail is typically used to flush the toilet bowl, but flush toilets are installed in high-end housing. The toilet bowls are Turkish toilets or stool toilets, and the latter are more often found in houses. Water is traditionally used to clean oneself after passing stools, using a manually-operated nozzle or a pail. Toilet paper is not provided in many cases, but when it is used, it is disposed of separately. Therefore, black water does not contain toilet paper.

(2) Properties of Effluents

1) Properties of Black Water

Black water contains excrement and water used to flush the toilet bowls. According to the Old M/P 1991 report, the amount of black water was 23 L/person/day. The custom of flushing a toilet bowl using a pail has not changed since the report was published, therefore it is assumed that this figure is close to the current situation. If flush toilets are introduced in the future, an increase in the amount of water used is expected when compared to using pails. The Old M/P 1991 reports that the BOD (biochemical oxygen demand) emission per unit was 10.5 g/person/day. It is assumed that this figure is also close to the current situation.

- The quantity of black water 23 L/person/day (Old M/P 1991)
- BOD load in black water 10.5 g/person/day (Old M/P 1991)
- BOD concentration in black water 457 mg/L

2) Properties of Domestic Wastewater

The properties of domestic wastewater (including black water and gray water from kitchens and bathrooms) emitted from general housing are summarized as follows, based on existing literature, etc.

- Quantity of domestic wastewater 120 L/person/day (No. 122/2005)
- BOD load in domestic wastewater 23.2 g/person/day (Old M/P 1991)
- BOD concentration in domestic wastewater 193 mg/L

(3) On-Site Wastewater Treatment Systems

On-site wastewater treatment systems for black water emitted from a house include pit latrines and septic tanks. Modified septic tanks are also used to treat both black water and gray water from kitchens and bathrooms (combined-type).

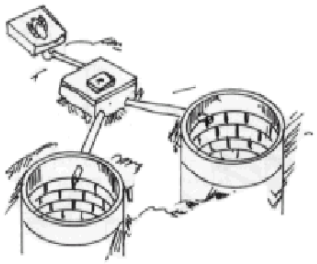
1) Outline of Septic Tanks

Septic tanks are largely divided into two types: the conventional type which treats only black water and the modified type which treats both black water and gray water from kitchens and bathrooms. Conventional septic tanks include the direct infiltration type where content infiltrates into the soil from the bottom and the sides of a septic tank, and the sealed type which combines a sealed tank with an infiltration tank or with a system to discharge the content into surface water.

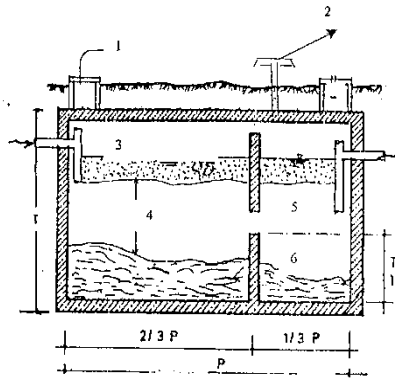
It is surmised that the main type of septic tank installed in recent years is the sealed type because the structural regulations for the sealed type were established in 2002. The septic tank system is a system

to treat wastewater in the soil through the infiltration of wastewater into the ground, which relies on the purification capacity of the soil layer. The treatment capacity depends on the properties of the soil (such as the permeability). It is expected that the sealed type has less impact on the soil when compared to the direct infiltration type because the sealed type does not release black water directly into the soil.

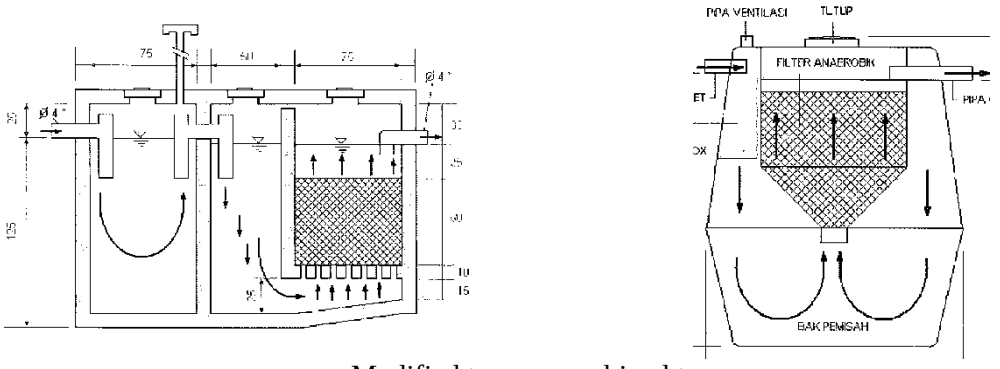
The modified type is a combined septic tank which means that it treats both black water and gray water from kitchens and bathrooms. The structural regulations for the modified type were established in 2005. However, the number of modified septic tanks installed in private housing is relatively small perhaps due to the absence of a rigorous installation requirement for housing and the high price (40,000 JPY per unit for a factory product designed for five users). Figure B5-1 shows schematic diagrams of the structures of the conventional type and the modified type.



Conventional type: a direct infiltration type with two tanks for switching



Conventional type: a sealed type



Modified type: a combined type

Source: JICA Expert Team

Figure B5-1 Schematic Diagrams of the Structures of Septic Tanks

2) Structures of Septic Tanks

(a) Conventional Septic Tanks

The structural standards for conventional sealed septic tanks are stipulated in the SNI 03-2398-2002 Standard National Indonesia. It stipulates that a septic tank designed for five users shall have an effective capacity of 3.5 m^3. However, it is unknown to what extent the standards are followed when they are installed.

(b) Modified Septic Tanks

The design standards and structural standards for combined-type modified septic tanks for housing are stipulated in the ordinance of DKI Jakarta, Domestic Wastewater Quality Standards NO.122/2005. The tank capacity is stipulated as shown in Table B5-1. Similarly to conventional septic tanks, it is unknown to what extent the standards are implemented in reality.

Modified septic tanks include those constructed on-site and those manufactured in factories. Factory products are easy to install and are compact. They are made of FRP (fiber reinforced plastic) and have a vertical cylindrical shape. The household wastewater which flows into the outer tank then flows down to the bottom. It then flows upwards from the bottom and is treated by upflow filtration through the anaerobic filter placed in the center. The capacity of the anaerobic filter is 9-15% of the total tank capacity. The outer cylinder tank has a separation function using a sedimentation process and a sludge storage function. The inner cylinder tank (the anaerobic filter) has an anaerobic treatment function.

Table B5-1 Standards for the Tank Capacity for Modified Septic Tanks (Combined-Type)

Number of users (people)	Dimensions of the tank (m)		Effective capacity (m^3)	Retention period (h)
	Diameter	H		
3-5	0.47	1.43	0.985	19 - 31
6-10	1.11	1.67	1.62	16 - 26
11-15	0.68	1.90	2.77	18 - 24
16-25	0.93	2.40	6.55	25 - 36
26-35	0.92	2.80	9.27	25 - 34
Treatment performance: BOD 50 mg/L for treated water				

Note: The retention period was calculated assuming that the inflow of water is 250 L/person/day.

Source: Domestic Wastewater Quality Standards NO. 122/2005

3) Standards for the Quality of Septic Tank Treated Water

There are no standards for the quality of the water treated by conventional septic tanks. On the other hand, the water quality standards for modified septic tanks (combined-type) are stipulated in the DKI Jakarta ordinance, Domestic Wastewater Quality Standards NO.122/2005. The standard is BOD 75 mg/L for treated water.

(4) Challenges and Measures for the Treatment of Black Water in Houses

Although direct infiltration septic tanks have hygiene problems, since they are installed in old houses, it is expected that they will be replaced by a sewerage system and modified septic tanks when the houses are reconstructed in the future.

The BOD of the water treated by conventional sealed septic tanks (infiltrated water) was high (BOD 200 mg/L) according to the study results from two sites. Therefore, it is possible that conventional sealed septic tanks are a contamination source for groundwater and river water. The principal improvement measure should be to switch from septic tanks with limited capacity to combined-type treatment systems such as the modified septic tanks. However, due to the limited size of housing plots, another option would be to connect individual wastewater outlets with pipes and install a small-scale concentrated treatment system.

In order to maintain the stable functioning of septic tanks, it is necessary to conduct desludging appropriately. However, the regular desludging has not been institutionalized. The amount of sludge generated and decomposed depends on conditions of installation and usage of the septic tanks. Therefore, there is not enough data to clearly determine how frequently desludging needs to be conducted. It is surmised that desludging should be conducted every 3-5 years under normal use conditions, therefore desludging at this frequency needs to be institutionalized.

It was difficult to study the actual treatment performance of modified septic tanks in the survey, because they were being used in overloaded conditions. We are planning to continue studying them.

It was difficult to study the actual treatment performance of modified septic tanks in the survey, because they were being used in overloaded conditions. Under the conditions of such overloading and less space of the tank comparing to those of conventional septic tanks, desludging from modified septic tanks should be conducted every 1-2 years.

B5.2.2 Public Toilets

According to the list of public toilets provided by the DK there are currently 1,263 public toilets in

DKI Jakarta. These are toilets for residents who do not have toilets in their home rather than toilets for the general public. They have been constructed by the DK, other departments, private capital and individuals since the 1970s. These public toilets include types which directly discharge effluent into public water such as rivers, toilets which discharge effluent into public water via attached septic tanks, and toilets which allow effluent to infiltrate into the ground. The data on the number of public toilets in each city is shown in the attached material. The following outlines the 1,263 public toilets installed in DKI Jakarta.

(1) Types of Public Toilets

The types of public toilets include: 581 MCK (toilet, washing and shower) facilities; 534 KU (toilet only) facilities; and 148 MC (shower only) facilities.

(2) The Year of Installation

Many public toilets were installed a long time ago. In West Jakarta and South Jakarta, very few toilets have been installed since 2000.

(3) Sources of Funds

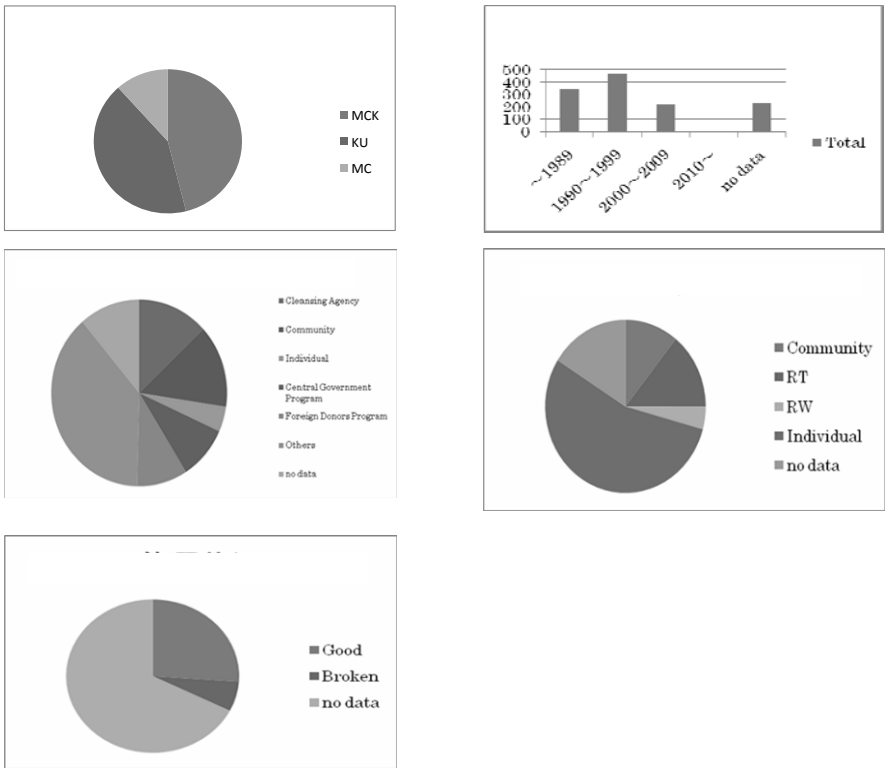
A variety of sources provide funds for the installation of public toilets including the DK, communities, individuals, NGOs, central government programs and foreign donors programs.

(4) Maintenance

Those who conduct maintenance of public toilets include communities, individuals, RTs and RWs. The highest number of public toilets is maintained by specific individuals (about 50%).

(5) Current Use Situation

Regarding the current use situation, about 20% of public toilets are broken.



Source: Prepared by JICA Expert Team based on the data from DK

Figure B5-2 Situation of Use and Management of Public Toilets

B5.2.3 Sludge Treatment Plants

Sludge accumulated in household septic tanks in DKI Jakarta is collected by each municipality and

private businesses. It is then transported and treated at two sludge treatment plants situated in the east and west of DKI Jakarta. The following shows the results of an outline survey on the sludge treatment plants. The sludge treatment plants do not treat surplus sludge from commercial facilities.

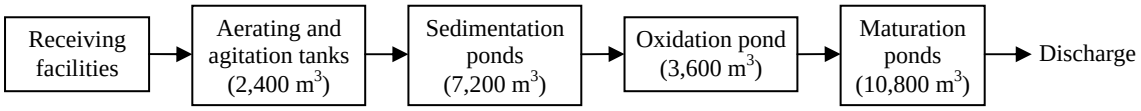
(1) Sludge Treatment Plants

1) Outline of the Facilities

The following outlines the sludge treatment plant (east) and the sludge treatment plant (west).

(a) Sludge Treatment Plant (East): Pulogebang IPAL

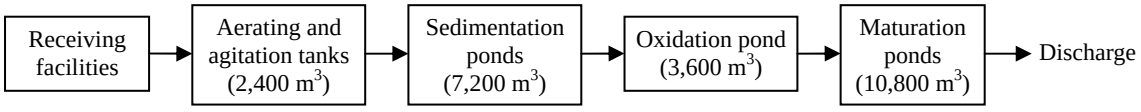
- Treatment capacity: 300 m^3/day
- Collection areas: the whole of East Jakarta, 50% each of West Jakarta, South Jakarta, North Jakarta and Central Jakarta
- Destination for discharge: East Flood Canal
- Operating and managing body: the DK of DKI Jakarta
- Treatment method: lagoon system
- Flow sheet:



- Quality of treated water: pH 6-9, BOD 75 mg/L, COD_{Cr} 100 mg/L, SS 100mg/L
- Year of completion: 1984
- Design: PT. WASECO TIRTA

(b) Sludge Treatment Plant (West): IPAL Durikosambi

- Treatment capacity: 300 m^3/day
- Collection areas: the whole of West Jakarta, 50% each of East Jakarta, South Jakarta, North Jakarta and Central Jakarta
- Destination for discharge: Angke River
- Operating and managing body: the DK of DKI Jakarta
- Treatment method: lagoon system
- Flow sheet:



- Quality of treated water: pH 6-9, BOD 75 mg/L, COD_{Cr} 100 mg/L, SS 100mg/L
- Year of completion: 1994
- Design: PT. WASECO TIRTA

2) Outlines of Components

(a) Sludge Receiving Facilities

At Pulogebang, the collected sludge is put into the receiving tank. Sediment impurities (foreign matter) such as sand are removed manually every time the sludge is poured. On the other hand, at

Durikosambi, the collected sludge is put directly into the aerating and agitation tanks. Part of the aerated and mixed fluid is fed into the foreign matter removal device using a submerged pump. Each aerating and agitation tank is cleaned once a week. The method employed at Pulogebang is unhygienic for the workers, but they are able to remove most foreign matter and therefore they only need to use the foreign matter removal device as a supplementary measure. The DK considers that the method employed at Pulogebang is more desirable because cleaning the water tanks is extremely heavy labor.

(b) Aerating and Agitation Tanks

The sludge is treated aerobically in the aerating and agitation tanks using an air supply. The retention period is eight days. The aerating and agitation tanks are made up of two lines of four tanks. The amount of air supplied is not controlled for individual tanks.

(c) Air Supply Blowers

There are eight blowers to supply air to the aerating and agitation tanks and the oxidation pond. 2-3 blowers work continuously. Air is sent to the aerating and agitation tanks 24 hours a day and to the oxidation pond intermittently. We were told that problems occur with the blowers frequently (almost every week).

(d) Sedimentation Ponds

The sedimentation ponds are designed to separate solids from liquids using gravitational settlement. There are two sedimentation ponds. One is used at a time and they are used alternately (by switching them once a month). The retention period is 12 days (in one pond). The sludge is suctioned by submerging a temporary pump regularly.

(e) Oxidation Pond

The oxidation pond is designed to conduct biological treatment mainly using oxygen which dissolves through the surface of the water. The retention period is 12 days. The pond is aerated intermittently at Durikosambi.

(f) Maturation Ponds

The maturation ponds have the same function as the oxidation pond. In addition, they are designed to conduct biological treatment through the photosynthesis of algae. They are composed of three tanks. The retention period is 36 days.

(g) Sludge Drying Bed

Sludge removed from the sedimentation pond is transported to the sludge drying bed and dried. The dried sludge is disposed of at a landfill site.

3) Reasons for Not Treating Surplus Sludge from Commercial Facilities

The sludge treatment plants only treat sludge removed from household septic tanks. They do not treat sludge from wastewater treatment systems at commercial facilities, etc. In fact, we did not find any evidence for sludge from commercial facilities being brought to the sludge treatment plants. It is thought that this is due to the following reasons.

(a) Ordinance of the DKI Jakarta Government

The 2010 ordinance of the DKI Jakarta government No. 133 stipulates in Chapter 3 that the role of the sludge treatment division of the DK is to “treat sludge emitted from household septic tanks.”

(b) Problems Concerning the Existing Treatment Plants

a) The Difference in Properties between Sludge from Household Septic Tanks and Sludge from Commercial Facilities

Sludge removed from household septic tanks has gone through a long digestion period. Therefore, the dissolved organic matter has already decomposed to a certain extent and the sludge has relatively stable properties. At Pulogebang and Durikosambi, this relatively stable sludge is being treated using

the lagoon system with a long retention period.

On the other hand, surplus sludge generated at wastewater treatment systems at commercial facilities has similar properties as the sludge generated at Japanese combined household wastewater treatment facilities. The surplus sludge is generated through aerobic treatment and it has fundamentally different properties from sludge generated in septic tanks where the wastewater is treated anaerobically. Although the surplus sludge has stable properties in aerobic conditions, if it is kept in anaerobic conditions for a certain period of time, the sludge will become rotten and this will cause an increase in dissolved organic matter and the development of odors. In addition, surplus sludge is inferior to the sludge resulting from anaerobic treatment in terms of the sedimentation speed and the dewatering speed.

b) Problems Expected to Occur When Treating Sludge from Commercial Facilities in the Existing Treatment Plants

At Pulogebang and Durikosambi, the whole treatment process requires 68 days. Therefore, they are suitable for treating relatively stable digested sludge over a long period of time. Supposing that surplus sludge is treated at these facilities, it is expected that various problems will occur including the rotting of the sludge accompanied by odor development as well as difficulties in separating solids from liquids. This will be the case particularly when anaerobic conditions develop in part or all of the sludge exceeding a certain period of time in the sedimentation pond. In order to prevent these problems, it will be necessary to remove the solid matter which is the cause of the rotting before conducting biological treatments. This means that an additional treatment process will become necessary.

(2) Desludging by DKI Jakarta and Private Businesses

In Jakarta City, there are no laws and regulations which stipulate desludging of septic tanks. Desludging is being conducted on an on-call basis from users. Although the DK is responsible for desludging, it often takes 2-3 days from receiving a call to conducting desludging. Therefore, private businesses are often used in urgent cases. Desludging fees are IDR 60,000 for the DK and IDR 250,000-300,000 for private businesses. Although private businesses charge more, there is high demand due to their prompt service. The numbers of vacuum trucks possessed by the Cleansing Agency and private businesses are 75 trucks and 70 trucks, respectively.

The quantity of sludge brought into the two sludge treatment plants (Pulo Gegang IPAL (east) and Duri Kosambi (west) was 93,769 m^3 in 2010. This figure is significantly lower than would be expected considering the estimated number of septic tanks installed in DKI Jakarta (1.9 million units). The small quantity of sludge collected indicates that desludging is not being conducted frequently. When it is supposed that regular desludging is conducted every five years for all septic tanks, the annual quantity of sludge collected can be estimated as 1,344,000 m^3. This means that the daily quantity of sludge collected will be 3,682 m^3. This figure is considerably larger than the current capacity of the sludge treatment plants (300 m^3/day × 2 plants). Since the sludge collected from septic tanks has already gone through a long digestion period and has stable properties, it is expected that directly dewatering the sludge will reduce loads significantly. It is thought that increasing the treatment capacity will be possible by effectively utilizing the existing facilities, but the difference is still large between the capacity of the existing sludge treatment plants and the estimated quantity of sludge to be collected when regular collection of sludge is conducted.

The following describes the situation of desludging for six septic tanks in the two areas visited for the survey. The results suggest that the situation of desludging varies depending on how individual septic tanks are used, how they have been installed and the content of the wastewater treated in the tanks. For example, when comparing No. 5 and No. 7, they desludge from No. 7 three times a year while desludging was not conducted at all for No. 5, although the capacity and the content of the wastewater being treated are the same. The difference between the two is the load factor. No. 5 (where desludging is not conducted) is used at four times its capacity, but No. 7 (where desludging is frequently conducted) is used at around the same level as the design load.

This indicates that the septic tank used at an appropriate load is functioning properly and this leads to

the generation of sludge.

Table B5-2 Situation of Desludging for Six Septic Tanks

No	Address	Installation year	Number of users	Capacity (planned number of users)	Treatment method	Content of wastewater	Desludging frequency
1	Jl. Menteng Wadas	Unknown	15	3 m^3 × 2 tanks	Digestion tank, infiltration tank	Black water only	Once a year
2	Jl. Menteng Wadas	2000	4	2.2 m^3	Digestion tanks (2 tanks)	Black water only	Twice a year
3	Jl. Menteng Wadas	Unknown	4	2.9 m^3	Digestion tank (1 tank)	Black water only	None
4	Jl. Casablanca	2007	4	-	BiokleenSS1 Aerobic tank	Black water only	None
5	Jl. Menteng Granit	2008	40	10 users	BiokleenSS2 Anaerobic tank	Black water gray water	None
6	Jl. Menteng Granit	2008	18	10 users	BiokleenSS2 Anaerobic tank	Black water gray water	None
7	Jl. G. Kavling Kebon Baru,	Unknown	13	10 users	BiokleenSS2 Anaerobic tank	Black water gray water	3 times a year
8	Jl. G. Kavling Kebon Baru,	December 2007	15	10 users	BiokleenSS2 Anaerobic tank	Black water only	None

Source: Prepared by JICA Expert Team with the received data

The table below shows a comparison between the desludging situation in Jakarta and other countries.

In Malaysia, desludging is regulated by law. In other countries, it is conducted on an on-call basis from users. In many countries, it is surmised that desludging is conducted when there are problems such as toilet bowl blockages, in the case of infiltration-type septic tanks. In the case of septic tanks which discharge content into the surface water, sludge flows out from the septic tank and problems of use should not arise. Therefore, desludging may not be conducted for this type of septic tank.

The desludging frequency is once every 2-3 years in many countries, although it cannot be simply compared because desludging is a pay service in many countries and the desludging frequency depends on tank capacity.

Table B5-3 Desludging Situation in Jakarta City and Other Countries

Item	Jakarta	China	Laos	Cambodia	Thailand	Vietnam	Malaysia	India
Fees	Municipality: USD6/tank Private: USD20-30 /tank	Unknown	Unknown	Unknown	USD15 /tank	USD0.8-0.9/ ton	USD14-50 /tank	Free of charge
Frequency	Depending on the situation	Once a year	Unknown	Once every 3-10 years	Unknown	Once every 2-3 years	Once every 3 years	Once every 2-3 years
Legal control	None	None	None	None	None	None	Controlled	None

Source: Prepared by JICA Expert Team with the received data

(3) O&M of Sludge Treatment Plants

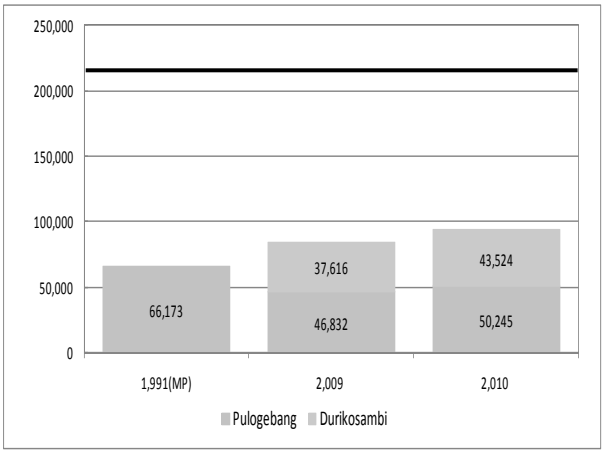
The following explains the results of a survey conducted on the maintenance situation for two sludge treatment plants in east and west DKI Jakarta.

1) Operation of Plants

(a) Quantities of Sludge Brought into Plants

Figure B5-3 shows the quantities of sludge brought into the plants in 2009 and 2010. The total annual quantity brought in was 93,570 m^3 in 2010. The quantity brought in was about 40-50% of the planned treatment capacity (300 m^3/day) for both plants.

According to the sludge management master plan for 1991, it was reported that an average of 66,173 m^3/year of sludge was brought into the plants between 1985 and 1989. When converting these figures, the quantity in 1991 was 0.0085 m^3/person (with the population of 7,745,000) and the quantity in 2010 was 0.0098 m^3/person (with a population of 9,590,000). Therefore, the quantity per person only increased slightly.



Source: Prepared by JICA Expert Team with the received data

Figure B5-3 Quantities of Sludge Brought into the Plants Each Year

(b) Power Consumption

The power required to treat 1 m^3 of sludge is calculated as 4-8 kWh/ m^3 based on the power consumption of the plants. The equipment which requires power includes the foreign matter removal devices, the blowers and the pumps. From the operation hours, the rated current of the motors and other data, most power is thought to be used for the operation of the blowers. Pulogebang consumes slightly less power than Durikosambi. This is probably because Pulogebang relies on man power to remove the foreign matter at the sludge receiving stage and uses the foreign matter removal device only as a supplementary measure.

(c) Operational and Maintenance Costs

a) Operational and Maintenance Expenditures

The running costs include the electricity costs, the costs for purchasing consumable goods and the costs for inspection and maintenance. The running costs for 2010 were approx. IDR 2,800,000,000 /year. The treatment cost per cubic meter of sludge was approx. IDR 30,000 /year, of which 85% were the costs for consumable goods and 15% were the electricity costs. The budget for repairing equipment was IDR 100,000,000. This is only about 3% of the total treatment expenditures. Therefore, they are unable to conduct sufficient repairs due to a lack of budget.

b) Business Income (Treatment Fees)

The fee for bringing in sludge is IDR 5,000 /m^3, which is collected from private sludge collecting businesses. When it is supposed that 4-ton trucks are used by private businesses to bring in the sludge and the number of trucks coming in is 2,373 trucks per year, the annual income from treatment fees for the two plants is estimated at IDR 47,480,000 in total. This is equivalent to 1.7% of the running costs.

2) Operational and Maintenance System

(a) Operational and Maintenance Personnel

16 in Pulogebang, 12 in Durikosambi, 28 in total

(b) Operation Hours (the Same at Both Plants)

24 hours (three shifts)

3) Results of Water Quality Analysis

Table B5-4 shows the water quality analysis data from the Durikosambi plant submitted by the Cleansing Department of DKI (sampled in July, 2010). A water quality survey was conducted using prompt and on-the-site analysis method named a Pack Test. COD_{Mn} value using Pack Test analysis is determined as COD_{Mn}, not as COD_{Cr}. Based on the Pack Test data, the treatment performance of both plants were studied as follows.

(a) Collected Sludge

The analysis results for sludge collected at Pulogebang were as follows: water temperature 29˚C; pH 7.6; COD_{Mn} 600 mg/L; and chloride ions 50 mg/L. The COD_{Mn} concentration of an anaerobic digestive supernatant fluid is around 2,000-1,500 mg/L in black water treatment facilities in Japan which use anaerobic digestion treatment methods. When comparing the levels of COD_{Mn} concentration, it is thought that sludge from septic tanks is brought into the plants after its digestion (decomposition) has progressed to a considerable extent.

(b) Mixed Fluid in the Aerating and Agitation Tanks

SVs (sludge volume) of the content in the aerating and agitation tanks are in the range of 36-41% at both plants. The sludge settles well at both plants and this indicates that the sludge has been digested to a considerable extent.

(c) Water Treated in the Oxidation Ponds

The properties of the water treated in the oxidation ponds at both plants were: pH 7.5-8.0; COD_{Mn} 35-120 mg/L; and NOx-N (NO_2 + NO_3) 0-45 mg/L. Nitrification of nitrogen was observed at Durikosambi. This indicates that biological treatment is successfully progressing in the oxidation ponds. Although nitrification of nitrogen was not observed in Pulogebang, the COD_{Mn} removal rate of around 80% indicates the successful treatment performance of the plant.

(d) Discharged Water

The discharged water was pH 7.0-8.0, COD_{Mn} 30-75 mg/L at both plants and no total coliform bacteria were detected at both plants. The designed BOD value for the plants is 75 mg/L. The COD_{Mn} concentration in the survey results suggests that the designed BOD value has been achieved (because the BOD value is normally lower than the COD_{Mn} value in biologically treated water).

Table B5-4 Groundwater Contamination by Septic Tanks

Parameter		Water Quality (Process in Duriko sambi)					River water quality (Angke river)	
		Aeration Basin (0 day)	Aeration Basin (0 day)	Oxidation Basin	Sludge Basin	Neutralization Basin	Before outlet	After outlet
TDS	(mg/L)	893.000	850.000	282.000	2230.000	171.000		
TSS	(mg/L)	1888.000	3028.000	53.000	290.000	32.000	85.000	65.000
NH_3-N	(mg/L)	169.480	115.630	8.010	126.000	0.130		
NO_3-N	(mg/L)	2.420	3.850	3.730	1.380	0.090		
NO_2-N	(mg/L)	0.030	0.130	0.980	0.030	0.010		
Sulfide	(mg/L)	0.740	0.410	0.080	0.640	0.090		
Fluoride	(mg/L)	0.060		0.250	1.490			
pH		7.800	7.800	7.800	7.900	7.400	7.900	7.400
Hs	(mg/L)	0.001	0.006	0.002	0.001	0.002	0.001	0.001
T-Fe	(mg/L)	20.070	52.800	0.420	1.230	0.550		
Phenol	(mg/L)	0.050	0.220	0.040	0.050	0.040		
Oil & fat	(mg/L)	3.060	1.120	0.790				
BOD	(mg/L)	737.700	1203.400	44.100	191.000	36.700	4.800	10.650
COD_{Cr}	(mg/L)	2062.020	8914.730	77.520	73.640	66.670	21.360	13.590
$KMnO_4$ consumption value	(mg/L)	1040.830	4821.510	52.920	272.740	52.950	16.070	11.260
PO_4-P	(mg/L)						0.450	0.480
Mn	(mg/L)						0.270	0.290

Source: DKI Cleansing Department

(4) Problems

1) Required Treatment Capacity

The quantity of sludge brought into the sludge treatment plants was 93,769 m^3 in 2010. This figure is significantly lower than would be expected considering the estimated number of septic tanks installed in DKI Jakarta. The small quantity of sludge collected indicates that desludging is not being conducted frequently. If the frequency of desludging is estimated from the quantity of sludge collected and the estimated number of septic tanks installed using a simple calculation, the frequency is calculated as once every 72 years. When it is supposed that regular desludging is conducted every five years for all septic tanks, the annual quantity of sludge collected can be estimated as 1,344,000 m^3. This means that the daily quantity of sludge collected will be 3,682 m^3. This figure is considerably larger than the current capacity of the sludge treatment plants (300 m^3/day × two plants). Therefore, the improvement of facilities is needed.

Since the sludge collected from septic tanks has already gone through a long digestion period and has stable properties, it is expected that directly dewatering the sludge will reduce loads significantly. It is thought that increasing the treatment capacity will be possible by effectively utilizing the existing facilities, but the difference is still large between the capacity of the existing sludge treatment plants and the estimated quantity of sludge to be collected when regular collection of sludge is conducted. Therefore, detailed examination is needed together with the examination of desludging policies.

2) Operation and Maintenance

Regarding the sanitary conditions for workers, the operation has not been automated by introducing machinery. Man power is used for the removal of sand at the sludge receiving facilities, cleaning

aerating and agitation tanks and desludging of the sedimentation ponds. Therefore, improvements such as automation are needed.

Regarding safety, fall prevention measures such as railings are not in place for water tanks apart from the aerating and agitation tanks at both plants.

With regard to the operation, although water quality is analyzed regularly, the results do not seem to be used to improve the operational management.

Concerning the maintenance, they are having difficulties in maintaining the blowers, etc. due to a lack of budget for repairs. Problems frequently occur with the blowers such as malfunctions. Currently, 2-3 out of the eight blowers are working and the plants are performing properly. However, this is thought to be largely due to the smaller quantity of sludge treated than the designed treatment capacity as well as the stable properties of the sludge. The plants may have difficulties if they start treating sludge at their full capacity (300 m^3/day/plant).

3) Treatment Function

Currently, both plants treat sludge at 40-50% of the planned treatment capacity. Possible reasons for the smaller quantity of sludge being treated are: (1) there are a small number of requests for desludging (regular desludging is not conducted); or (2) suctioned sludge is dumped illegally. However, the details are unknown.

The collected sludge is dark brown, has low viscosity and has relatively low levels of offensive excrement odor. From these properties, it is thought that the digestion of sludge progressed to a considerable extent while it was in the septic tanks. The results of the Pack Test show that the concentration of contaminants is low. This is probably reducing the load on the treatment facilities, although the designed water quality of the sludge to be brought into the plants is unknown.

B5.2.4 The Current Situation of the Industry Manufacturing On-Site Wastewater Treatment Facilities in Indonesia

There are 20-30 manufacturers of factory-made wastewater treatment systems in Indonesia. They design, manufacture and sell household septic tanks as well as medium-scale wastewater treatment systems for commercial facilities and high-rise apartments. In particular, since the installation of combined individual wastewater treatment systems in business establishments and housing was made mandatory in 2005 (No. 122/2005), the production of combined wastewater treatment systems has accelerated.

(1) Results of Visits to Manufacturers in Indonesia

The following explains the results of a survey conducted by visiting the factories of two private companies which manufacture combined wastewater treatment systems.

1) PT. PAL JAYA BUMI UTAMA (Example of a Local Company)

This is a subsidiary of PT. PAL JAYA. They manufacture a range of products from small residential modified septic tanks to medium-sized wastewater treatment systems for business establishments. They have introduced a technology for manufacturing modified septic tanks from a Malaysian private company (PT. DC. BUMI BERHARD).

(a) Residential Modified Septic Tanks

a) Outline of the Systems

They produce four types of septic tanks: tanks for 1-3 users, 4-6 users, 7-9 users and 10-12 users. We observed septic tanks for 4-6 users on the visit. The specifications of the tank for 4-6 users are: it is a cylindrical shape, has a capacity of 0.75 m^3, and its body is made of FRP (Fiber Reinforced Plastic) and the biological filter media is made of plastic.

The treatment method used is an anaerobic treatment combined with treatment through biological contact (bio-carriers). The designed removal rate is 40% through anaerobic treatment and 60% through

biological contact. The designed retention period is 24 hours.

The price is 3,500,000-9,000,000 IDR (including materials and construction). The price changes depending on the currency exchange rate because the raw materials for FRP (e.g., glass fiber, plastic coating, etc.) are all imported. The biological filter media is replaced because it wears out about 10 years after installation.

(b) Other Information

According to PT. PAL JAYA BUMI UTAMA, there are 20-30 companies which manufacture similar modified septic tanks in Indonesia including their company. The other factories also have similar manufacturing capacities. Assuming that there are 25 private companies, the supply of modified septic tanks can be estimated as 3,750 units/year (150 units/year/company × 25 companies).

(c) Wastewater Treatment Systems for Commercial Facilities

a) Outline of the Systems

The company manufactures three types of systems, namely systems with a treatment capacity of 3.4 m^3/day, 6.8 m^3/day and 15.8 m^3/day. We observed systems with a treatment capacity of 3.4 m^3/day. The specifications of the system with a 3.4 m^3/day treatment capacity are: it is vertical, has a capacity of 3.15 m^3 and is made of FRP. The treatment methods used are separation through sedimentation combined with intermittent aeration (anaerobic and aerobic treatment). The quality of the treated water is 45 mg/L.

The price is 20,000,000 Rp (including materials and construction).

b) Manufacturing Capacity of the Factory

For households: maximum 5 units/day

(units manufactured annually: about 150 units/year)

For high-rise buildings: maximum 1 unit/week

(the number of units manufactured per year is unknown)

They make them on order basis, in accordance with demand.

c) Problems

There is a need to set the designed quantity of the wastewater for small treatment tanks by considering the coefficient of variation for the designed average quantity of wastewater. However, the company adopted a designed quantity of 120 L/person/day, although the structural standards (No. 122/2005) stipulate a designed quantity of 250 L/person/day. Therefore, there is the possibility that the tank capacity is inadequate.

The company also adopted the designed quantity of 120 L/person/day when designing wastewater treatment systems for business establishments. Therefore, the tank capacity of these systems may also be inadequate. The structural standards do not stipulate conditions for attaching a wastewater flow control tank. Therefore, measures to control the fluctuations in wastewater quantities are not known and this presents problems.

As explained above, since clear design methods are not stipulated, it is possible that the structures might not have met conditions which ensure the stable performance of the products. It will be necessary to make improvements including establishing design manuals.

2) PT BESTINDO AQUATEK SEJAHTERA (Example of a Foreign Company)

The company was established by a Japanese company Best Plant Kogyo in 2002. The company mainly manufactures combined wastewater treatment systems for business establishments. They employ separation through sedimentation combined with the anaerobic filter bed method for small-scale systems, and separation through sedimentation combined with the activated sludge (biological contact aeration) method for medium-sized systems. The products are made of FRP by hand lay-up molding. They produce one unit per 1-2 weeks. According to PT BESTINDO AQUATEK SEJAHTERA, their

share in the Indonesian market is probably around 40%. They export products to markets in the Middle East including Saudi Arabia and Algeria, in addition to selling products in the domestic market.

(a) Customers

Their customers are Japanese companies. They deliver products for condominium buildings, office buildings, shopping malls and other commercial buildings in the central part and the suburbs of Jakarta. They are currently considering entering the market of household wastewater treatment facilities (modified or combined household wastewater treatment facilities).

(b) The Situation for the Maintenance of Commercial On-Site Wastewater Treatment Facilities in Jakarta

According to PT BESTINDO AQUATEK SEJAHTERA, about 10% of commercial facilities which purchased the company's combined wastewater treatment systems have signed a maintenance contract with the company. They said that it is essential that professionals conduct maintenance in order for the combined wastewater treatment systems to work properly and that there are cases where inadequate maintenance is suspected at commercial facilities which did not sign the maintenance contract with the company. There are three maintenance workers at the company and they provide the maintenance services.

(c) Effluent Standards

According to the company, achieving NH_4-N 10 mg/L when the standard for discharged water is BOD 50 mg/L would be difficult, because the nitrification of ammonia does not progress when the treated water contains BOD 50 mg/L. In the case of combined wastewater treatment systems manufactured by PT BESTINDO AQUATEK SEJAHTERA, NH_4-N 10 mg/L can be achieved because they can reduce the BOD concentration down to 20 mg/L. The company considers that it would not be possible to achieve the standards with wastewater treatment methods other than combined wastewater treatment systems.

(d) Problems Regarding the Methods to Install On-Site Wastewater Treatment Systems

PT BESTINDO AQUATEK SEJAHTERA provided us with a competitor's pamphlet about on-site wastewater treatment systems. According to an example of system installation illustrated in the pamphlet, some of the treated water is infiltrated into the ground, relatively clean household effluents bypass the treatment system and join the treated water before it reaches the drain. The company pointed out that, if the treatment system is installed as the pamphlet illustrates and the effluent is sampled at the drain in order to check compliance with effluent standards, the samples may not reflect the performance of the treatment system properly and could lead to the evasion of the effluent standards.

(2) Problems Faced by the Wastewater Treatment System Manufacturing Industry in Indonesia

It is difficult to reach conclusions because we could not arrange visits to manufacturers in Indonesia other than the above two companies. However, the following problems can be considered even though it is based on the limited information.

a) Design standards for modified septic tanks and on-site wastewater treatment systems for commercial facilities have not been established.

b) In particular, maintenance businesses for on-site wastewater treatment systems at commercial facilities are underdeveloped.

c) It is necessary to establish standards and supervising systems for installing on-site wastewater treatment systems (construction methods including piping).

d) There is a need to develop a framework for discussions between industry and government authorities including the points mentioned in a), b) and c) above.

B5.2.5 SANIMAS

(1) What is SANIMAS?

SANIMAS (Sanitasi Berbasis Mayarakat) is a community sanitation program developed by Indonesia. In SANIMAS, household wastewater management in urban low-income settlement areas is conducted using a community based approach. The Indonesian government, particularly BAPPENAS is committing themselves to implementing the program. In Indonesia, household wastewater is mainly treated using septic tanks, but regular sludge collection is hardly conducted. Some low-income settlement areas do not have septic tanks or any other wastewater treatment facilities. The low level of residents' awareness about sanitation is also a problem in Indonesia and it is necessary to provide practical education about sanitation at the community level and to facilitate changes in behavior. SANIMAS was introduced as a measure suitable for these current conditions concerning sanitation in Indonesia[3]. There are three cases of target wastes including balack water only, gray water only, black water and gray water. The SANIMAS program started in 2003. 420 projects have been implemented in Indonesia by 2009. The SANIMAS project has two concepts, two objectives and six principles. Its two concepts are as follows: (1) to facilitate and assist poor urban communities to plan, implement and maintain sanitation systems of their choice; and (2) sanitation systems built will become demonstration projects to promote community based sanitation within poor urban areas of Indonesia. Its two objectives are: (1) to improve sanitation conditions of the poor in densely populated urban areas using the community based sanitation (CBS) approach; and (2) to ensure that the community based sanitation (CBS) becomes one of the options for the local government's wastewater management system. SANIMAS also follows the six principles shown below.

- Demand responsive approach
- Self-selection
- Multi-source financing
- Participation of beneficiaries
- Technology informed choices
- Capacity building

(2) Achievements

SANIMAS (Community Based On-site System) started as a pilot project in 2003. The project was then implemented at five sites in East Java Province and at one site in Bali Province in the same year. Six sites in East Java Province and two sites in Bali Province were further added in 2004. The projects in 2003 and 2004 were implemented using the funds of AusAID and grants managed by the WSP-World Bank. Community empowerment was carried out by BORDA and its partners. The Water and Sanitation Working Group conducted coordination and provided advice for the program implementation. The Ministry of Public Works took over the funding and increased the scope areas in 2005. SANIMAS 2005 was implemented in East Java Province (six locations), Central Java Province (four Locations) and Bali Province (one location). Based on the SANIMAS success in 2005, the Ministry of Public Works replicated the SANIMAS approach on a national scale using different funding schemes. The project was implemented at 68 sites in 2006, 125 sites in 2007, 108 sites in 2008 and 97 sites in 2009. In total, 423 projects had been implemented nationwide by 2009. The units installed had increased to about 1,000 in 2010. The number is expected to reach 1,500 units in 2011. This is because domestic funding and overseas funding increased. Regarding financial sources for SANIMAS, a direct subsidy from the Ministry of Finance for local governments' sanitation sector (APBN) was established in 2010. Overseas funding included, funding from Australia in 2010, funding from the ADB (Asian Development Bank) in 2011 and funding from the World Bank and the IDB

[3] In order for SANIMAS to work, it is necessary for the community residents themselves to show a strong willingness to solve sanitation problems and to pay the maintenance costs for sanitation facilities in order to solve the problems. It is also necessary for the local government to pay for the construction of SANIMAS facilities. The latter depends on whether the local government has the political will or not. Therefore, the SANIMAS program provides opportunities to raise the awareness of people at the community level and at the political and administrative level.

(Islamic Development Bank) in 2012. Each overseas donor funds its own allocated regions. The ADB funds projects in Central Java, Bali and part of Sulawesi. The Word Bank funds projects in East Java and Papua. The IDB funds Sumatra and Kalimantan.

(3) Technologies Used by SANIMAS

Aerobic biological treatment and anaerobic biological treatment are typically used in wastewater treatment which aims to achieve the sanitary treatment of wastewater and environmental conservation. However, in developing countries, it is often necessary to meet the following conditions: inexpensive construction costs, inexpensive maintenance costs, systems which can cope with a lack of power supply or unstable power supply, as well as simple and inexpensive operation and maintenance. In developing countries, it is necessary to solve sanitation problems, but the completion of sewerage system construction takes a long time. For these reasons, BORDA developed systems to treat wastewater using anaerobic biological treatment for groups of dozens to hundreds of households and for small-scale and micro enterprises. These are called DEWATS (Decentralized Wastewater Treatment Systems). In Indonesia, the national government and local governments are striving to widely disseminate these systems with the cooperation of BORDA, as systems to realize SANIMAS. The basic components of DEWATS are wastewater collection pipes and drains, the initial settler, the anaerobic baffled reactor and the final settler. The concrete water tank is separated into 5-7 chambers by baffles. The first chamber is a settler, the following 3-5 chambers work as an anaerobic baffled reactor, and the last chamber is the final settler. The initial settler also works as a digestion tank. A filler is used in the anaerobic baffled reactor in some cases in order to increase the digestion efficiency and the filtration effect. Biogas (gas mainly composed of methane gas and CO_2) obtained from the digestion tank is used for cooking, etc. without controlling the pressure or desulfurizing the gas. If nitrogen and phosphorus need to be removed, the water discharged from the final settler is channeled into a wetland planted with aquatic plants which absorb the nitrogen and phosphorus. The construction costs and maintenance costs for the systems are inexpensive and the quality of the treated water is believed to be good, but it can be judged that the BOD concentration in the treated water is 50-100 mg/L, based on the appearance of the treated water. Therefore, they may not be sufficient as environmental measures. It will be necessary to conduct detailed water quality monitoring as well as studying and investigating maintenance methods including the desludging and the long-term durability of the systems.

(4) Types of Systems Used by SANIMAS

There are three types of systems used by SANIMAS.

1) Simplified Sewerage System

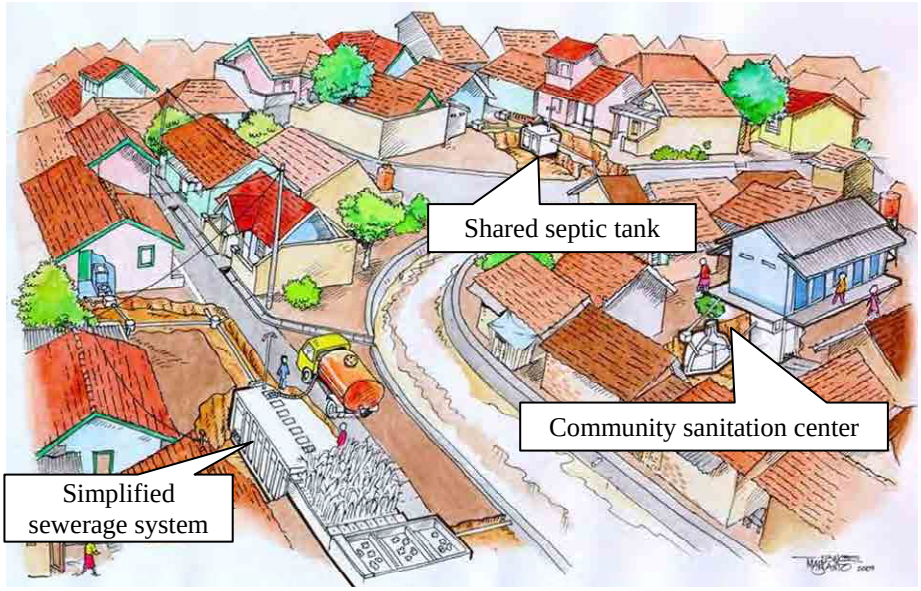
It is a system connected to a simplified wastewater treatment plant. It is employed in poor areas where the majority of households are privately owned and space is available for sanitary hardware.

2) Community Sanitation Center

It is a system which comprises of a water supply point, toilets, shower rooms and a laundry area. It is employed in poor areas where the majority of residents live in rented rooms/households and no space is available for sanitary hardware.

3) Shared Septic Tank

It is a shared system which connects a group of households.



Source: JICA Expert Team

Figure B5-4 Types of Systems Used by SANIMAS

(5) Examples of Systems Installed by SANIMAS

We visited two SANIMAS project sites in Tangerang. Both are community sanitation centers equipped with toilets and showers. They are managed by the residents of the areas. The number of users is 80 to 100 person in Kota Tangerang and 40 to 75 in Kab.Tangerang respectively. The actual number of users reported is smaller than the planned number (230 person in Kota Tangerang, 300 person in Kab.Tangerang). The maintenance costs are covered by user fees which are IDR 1,000 for toilets and IDR 2,000 for showers.

Item	RT 02/01 Kel. Jatake	Masyarakat Kampung Pisangan
Address	Kota Tangerang	Kab. Tangerang
Year of completion	September 2004	December 2007
Type of SANIMAS	Community sanitation center	Community sanitation center
The number of units	6 toilets, 6 showers	7 toilets, 4 showers
Construction costs (source of funds)	IDR 240,568,915 (BORDA)	IDR 249,882,347 (Cipta Karya, PU)
The number of users	80-100 users (230 users)	45-70 users (300 users)
Exterior view		

Source: JICA Expert Team

Figure B5-5 Examples of SANIMAS

(6) Future Trends

The missions of SANIMAS are to establish safe and healthy living conditions through the establishment of environmental sanitation, the strengthening of organizations, legal control and community participation. The level of sanitary improvement increases proportionally to the costs of

the sanitary improvements. Systems provided by SANIMAS are intermediate options between the current poor sanitary conditions and expensive sewerage systems and they provide opportunities to narrow this gap. It is expected that SANIMAS projects will increase nationwide in Indonesia in the future, using domestic subsidy schemes and overseas multi-funds. However, in Jakarta, SANIMAS options have not been installed because the construction of sewerage systems is given priority. The reasons given for this are, SANIMAS is for poor areas and that Jakarta is a financially rich area with a high population density where it is difficult to secure installation spaces.

B5.3 On-site Treatment in Seribu Islands

B5.3.1 Features of Seribu Islands

Seribu Islands, which are Seribu Regency (Kepulauan Seribu), are located on the Northern Jakarta in the form of small archipelago with total around 300 small islands. And from these 300 islands Untung Jawa Island is one of the largest inhabitant islands in Seribu Islands located in the South Seribu Island district (Kecamatan). Area of Untung Jawa Island is around 38ha and it has inhabitant population of around 1,782 in the year 2007 and in year 2009 the population has increased to 2,029 people. It has become one of the tourist destinations, especially in the weekend for the Jakarta's city dweller and overseas visitors. Exotic mangrove forest and rich of flora and fauna are the major tourist attractions in the Untung Jawa Island.

B5.3.2 Existing On-Site Treatment in Untung Jawa Island

JICA expert team together with the officials from the DKI Jakarta had visited the Untung Jawa Island for the site survey of ITP. At the same time, JICA expert team had implemented the hearing survey to the operators of ITP and residents.

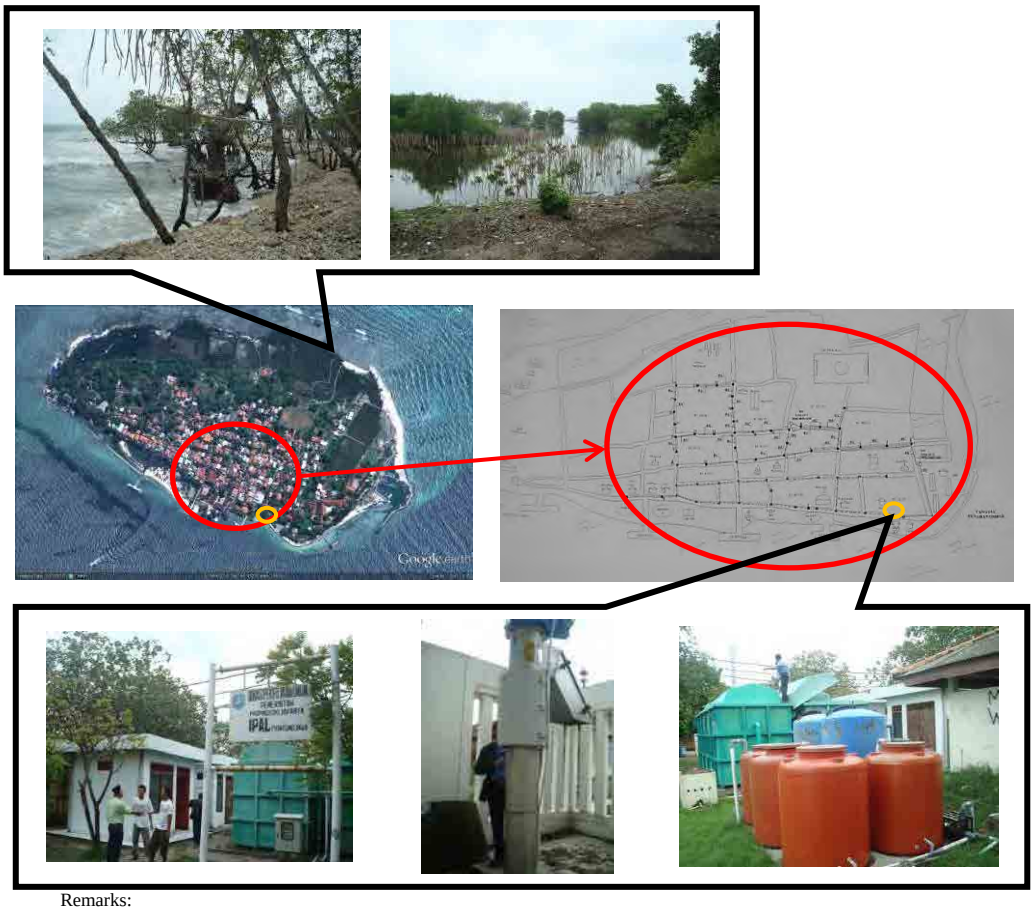
Existing ITPs were built by Public Works Agency of DKI, which are shown as No. 7 under No. C (Residential/Mix Area Wastewater) in Table B4-9. There are 2 ITPs. On of existing ITPs is not operated. The treatment process has two units of RBC (Rotating Biological Contactor) with capacity of 70m^3/day per unit. Another ITP is under operation. The treatment process is using BC (Bioactivator) plus recycling sand filter plus activated carbon with capacity of 200m^3/day.

Wastewater is collected through sewer system with pumps (kind of shallow sewer system). In the year 2006, the coverage of the ITP was only 50 Households out of total of 475 Households. The current total of service coverage should be around 120 households.

B5.3.3 Suggestions for Wastewater Treatment in Seribu Islands

The suggestions for wastewater treatment in Untung Jawa Island in order to improve the water environment and sanitation are as follows;

- It is needed to expand the coverage of the collection system in order to cover the all population. From the hearing to the residents of the Untung Jawa Island and ITP operators, it appears that some pumps are broken and some parts of the sewers are damaged. Thus the rehabilitation of the existing collection system will be needed.
- With the expansion of the service coverage, ITP should have enough capacity to treat all of the wastewater. Hence, the expansion of ITP will be required. To cover around 2,000 people who live in Untung Jawa Island and tourists coming to the Island, ITP will require the capacity of around 500m^3/day. One of the existing ITPs is not under operation due to broken equipments, it is necessary to rehabilitate the existing ITPs.



Remarks:
: ITP Location
: ITP Service Coverage

Figure B5-6 Existing ITP and Coverage Area in Untung Jawa Island

B5.4 Main Issues On-site System

B5.4.1 Groundwater Pollution Caused by the Septic Tank

Septic tanks which treat black water are normally installed in a hole dug to a depth of around 1.5 to 2 meters under the ground. When the septic tank is designed to allow treated water to infiltrate into the ground, the quality of the treated water is not good. There is a high possibility that the released treated water will contaminate nearby shallow wells with organic matter and nitrogen compounds such as BOD as well as causing epidemiologically dangerous contamination which could lead to waterborne diseases.

Therefore, the installation of septic tanks is often regulated to make sure that there is a specific distance between the septic tank and any wells[4]. The same caution is needed when a non-watertight tank for black water other than a septic tank is to be installed. The following shows a summary of results of past studies on groundwater contamination by septic tanks, etc.

(1) In Jakarta City, 75-77% of shallow wells, the depth of which is generally less than 20m, were contaminated with coliform bacteria in 2007-2009 due to the inappropriate management of household wastewater. Shallow wells with good water quality only accounted for 23-25% of the total number. The standards for the appropriate management of sanitation facilities stipulate that feces and animals which carry pathogenic bacteria should be isolated from people and that contamination by feces, etc. should be prevented. From this standpoint, it is recommended that low quality treated water from septic tanks should be discharged into surface water instead of

[4] SNI03-2398-2002 TATA CARA PERENCANAAN TANGKI SEPTIC DENGAN SISTEM RESAPAN (Planning Procedure for Septic Tank Infiltration System)

letting it infiltrate into the ground. (Literature 1[5])

(2) Out of the 100 sites where BPLHD conducted a groundwater survey in 2002, 90 sites met the chemical standards and metal salt standards (except for Mn). However, high concentrations of fecal coliform bacteria exceeding the standards were detected at 50 sites. The results of a survey conducted by UNESCO in February 2004 for well water used by 452 households in East Jakarta showed that the total coliform counts exceeded the standards (0/100 mL) at 92% of the households and over 2,400/100 mL was detected at 64% of the households. Only two households met the standards for fecal coliform bacteria out of the 25 households studied (8%). (Literature 2[6])

As shown above, densely-populated Jakarta City has a high percentage of wells contaminated from an epidemiologic standpoint. Therefore, it will be necessary to ban the use of infiltration-type septic tanks which lead to groundwater contamination and switch them to septic tanks which discharge the treated water into surface water.

B5.4.2 Improvement of Septic Tanks (Comparison between Conventional Septic Tanks and Modified Septic Tanks)

The differences in structures between conventional septic tanks and modified septic tanks were explained in B5.2. In order to confirm the performances of these two types of septic tanks as wastewater treatment systems, the JICA team conducted a water quality survey for effluent discharged from each type of septic tank, jointly with PD PAL JAYA, DK and BPLHD.

(1) Outline of the Survey

1) Objectives

Three operating systems in Jakarta City have been visited and studied with the cooperation of PD PAL JAYA, in order to study the performances of conventional septic tanks and modified septic tanks as on-site treatment systems.

2) Dates for the Survey

Conventional septic tanks: Monday, February 7 2011

Modified septic tanks: Monday, February 14 2011

3) Survey Methods

Spot sampling was conducted due to the limited time available for measuring the quality of the wastewater.

Water quality analysis for pH, BOD, CODcr and NH_4-N was conducted at PD PAL JAYA. Water quality analysis for E. coli was conducted at the P. T. Nusantara Water Centre which was recommended by PD PAL JAYA. Details are shown in attached tables and figures.

(1) Survey Results

(a) Results of Water Quality Measurement

1) Conventional Septic Tanks (Three Sites: CST-1, CST-2 and CST-3)

Treated water from conventional septic tanks which treat only black water at individual households had the following quality: pH 6.8-7.0 (average 6.9), BOD 150-230 mg/L (average about 200 mg/L), CODcr 420-620 mg/L (average about 530 mg/L), NH_4-N 4-7 mg/L (average about 5.6 mg/L). CODcr/BOD was 2.5-2.9 (average about 2.7). Results of the surveys are shown in S/R Part-B : B5.

The treated water from septic tanks had a similar composition as gray water, as can be seen from the fact that the pH and NH_4-N values were similar and that the CODcr/BOD values were similar although

[5] Mr. Joni Tagor, Environment Board (BPLHD), DKI Jakarta, Groundwater Quality and the Impact of Septic Tank on the Groundwater Quality, Open Workshop for JICA Technical Cooperation Project on Wastewater Management in DKI Jakarta, At Kartika Chandra Hotel, 2nd February 2011

[6] John M. Miller, Support to DKI Jakarta for Wastewater Management, Draft Final Report, October 2006

the BOD and CODcr values were higher than the values of gray water.

Standard values for the "individual/household" category stipulated in Domestic Wastewater Quality Standards NO.122/2005 are BOD 75 mg/L and COD_{Cr} 100 mg/L. Therefore, the treated water from conventional septic tanks did not meet these standard values (although it met the standards for pH and NH_4-N). Details are shown in attached tables and figures.

2) Modified Septic Tanks (Three Sites: MST-1, MST-2 and MST-3)

MST-1 treats (partly aerobically) black water from the toilet used by security guards and drivers at BPLHD. MST-2 and MST-3 anaerobically treat black water and gray water (combined-type) emitted by 3-6 households (18-40 residents). Therefore, they are categorized as communal wastewater treatment systems.

The quality of the treated water from MST-2 and MST-3 (which anaerobically treat black water and gray water) was: pH 6.4-7.0 (average 6.7), BOD 160-210 mg/L (average about 190 mg/L), CODcr 360-400 mg/L (average about 380 mg/L) and NH_4-N 5.5-8.5 mg/L (average 7.0 mg/L). CODcr/BOD was 1.9-2.3 (average about 2.1).

The standard values for the "communal" category stipulated in Domestic Wastewater Quality Standards NO.122/2005 are BOD 50 mg/L and COD_{Cr} 80 mg/L. The quality of water treated by the modified septic tanks MST-2 and MST-3 does not satisfy the standards.

One reason for this is thought to be because the septic tanks are overloaded. MST-2 treats influent from six households (40 people) and MST-3 treats influent from three households (18 people) although the designed number of users is 10 people for each septic tank.

Concerning wells, the water quality of a well at only one site (MST-3) was measured. Although the well water appeared clear and E. coli was not detected in the water quality analysis, the results of measurement were BOD 124 mg/L, CODcr 221 mg/L and NH_4-N 6.2 mg/L, which indicates that the water is significantly contaminated. Details are shown in attached tables and figures.

(b) Examination of the Performance of Septic Tanks Based on the Results of Water Quality Test

Attached tables and figures show details of the factors which influence the quality of treated wastewater including the addresses and members (which affect the quantity and quality of wastewater) of families which use each septic tank, as well as the year of installation, dimensions, internal structure, capacity and desludging frequency for each septic tank.

When looking at CST-2 and CST-3 which are conventional septic tanks that only treat black water, their common characteristics are that they both treat black water for a family of four (it is expected that the daily quantity of wastewater to be treated is similar although there are differences in the day-time and night-time populations) and that only black water is treated by the septic tank before it is discharged into the drainage. The differences between the two sites are: (1) desludging is conducted twice a year from CST-2 while desludging has never been conducted for CST-3; (2) the capacity of the septic tank CST-3 (2.9 m^3) is 30% larger than CST-2 (2.2 m^3); and (3) CST-2 has two chambers in the septic tank while CST-3 has one chamber.

The BOD concentrations in the water treated by CST-2 and CST-3 were similar (231 mg/L and 217 mg/L, respectively).

This means that, with conventional septic tanks which only treat black water, the quality of treated water can only achieve around the BOD 200 mg/L level, For CST-3, the water quqlity will worsen when overflowing sludge is found as regular desludging is not conducted. Therefore, it will be necessary to revise the structures, treatment functions and maintenance systems for conventional septic tanks in order to satisfy the standard values for treated water.

When looking at MST-2 and MST-3 which are modified septic tanks that treat both black water and gray water, the expected water quality improvement effects were not observed, with the BOD concentration in the treated water being about 190 mg/L on average.

It is thought the high level of BOD concentration is caused by the septic tanks being overloaded, because as explained in (a) 2) above, MST-2 and MST-3 were treating influent from six households (40 people) and three households (18 people) respectively, although the designed number of users is 10 people. The reason why modified septic tanks designed for appropriate numbers of users were not installed in spite of the expected overload is thought to be because the system to check the installation of appropriate-sized septic tanks is not in place. The establishment of such a checking system is important. It will be necessary to consider checking whether modified septic tanks have been manufactured correctly in compliance with regulations for functions and standards (a checking system equivalent to performance assessments for Japanese Johkasou). In addition, it will be necessary to consider checking treatment functions by conducting monitoring surveys to assess the initial treatment performance of modified septic tanks, which is possible at this stage where modified septic tanks have not been widely disseminated. Details are shown in attached tables and figures.

(c) Remarkable Points in the Survey

The old M/P took an assumption that only gray water becomes a source of pollution load in public water areas such as rivers because the water treated by conventional septic tanks (which treat only black water) infiltrates into the ground.

However, at many sites in the survey, the treated water from modified septic tanks and conventional septic tanks was discharged into surface water.

Therefore, it is necessary to take into consideration the pollution load discharged by septic tanks into public water bodies such as rivers.

B5.4.3 Introduction of Regular Desludging

(1) The Need for a Desludging System

A septic tank is a device which treats wastewater by combining the separation of organic pollutants in black water through sedimentation with anaerobic treatment. Normally, wastewater is treated for about 30 days in the tank. The BOD concentration in the supernatant fluid after digestion is around 200 mg/L. It then goes through soil infiltration treatment or it is discharged directly into surface water such as a ditch. After using a septic tank for a long period of time, sludge resulting from digestion accumulates and the effective capacity of the tank decreases. This leads to deterioration of the treatment function and the leaking of sludge out of the system, which then causes environmental pollution. It is surmised that the BOD concentration in the sludge brought to a sludge treatment plant is around 1,000 mg/L, which is a few times higher than the BOD in treated water. Therefore, it is extremely important to properly manage digestion sludge in septic tanks.

1) Accumulation of Sludge in Septic Tanks

As mentioned above, the physical sedimentation process and digestion by anaerobic bacteria occurs in septic tanks. As a result, organic matter is converted into digestion gas and digestion sludge accumulates as residue. According to DK personnel, desludging is conducted once every five years for a typical five-user septic tank.

Based on this information, the quantity of the accumulated sludge is estimated as follows.

Conditions: a 5-user tank, a tank capacity is 3.5 m^3, the desludging frequency is once every five years.

Generation of sludge: 3.5 m^3/5 years $\rightarrow$ 1.9 L/day

Generation of sludge per person: 0.38 L/day

We studied the sludge value (SV) for the sludge collected from septic tanks brought into the sludge treatment plants. The result was about 40%. This suggests that sludge accounts for 40% of the total capacity of septic tanks on average when desludging is conducted. Therefore, it is surmised that the need to desludge a tank arises and desludging is conducted when about 40% of the tank capacity is filled with scum and accumulated sludge.

2) Relation betwwen Desludging and Treated Water Quality

A rise in the level of the sludge in a septic tank impedes the separation of solids through sedimentation and causes a deterioration in the tank's digestion function, as well as blocking pipes and deterioration in the treated water quality. In order to prevent this, it is necessary to control the maximum quantity of accumulated sludge and this requires regular desludging.

Currently, desludging is conducted upon requests when problems occur due to the blocking of pipes, etc. It is expected that the introduction of a regular desludging system will stabilize the treatment function of septic tanks.

3) The Structures of Septic Tanks and Desludging

Septic tanks are installed under the floors of buildings in some cases. Some residents do not know where they are installed. In order to implement regular desludging, it will be necessary to take appropriate measures such as making it compulsory to attach an opening to septic tanks for cleaning.

(2) Measures Needed to Introduce Regular Sludge Collection

1) The Structure of On-Site Sanitation Facilities

In order to make the regular collection of sludge effective, it is of primary importance to ensure that the sludge accumulated at on-site sanitation facilities does not flow into surface water or underground before it is collected. This is because, when sludge flows out into nature before being treated, it becomes one of the worst pollutants. Therefore, in Japan, the Building Standard Law stipulates that vault toilets and the Johkasou (a type of household wastewater treatment facility) shall have a sealed structure. The minimum size of vault toilets and the Johkasou is also stipulated in accordance with the number of users.

In order to enable efficient sludge collection work, an outlet for desludging should be attached in an accessible place for desludging service operators. In Japan, vault toilets and the Johkasou must have an outlet outside a building.

2) Legal Controls Needed to Implement Regular Sludge Collection

In order for the regular collection and treatment of sludge to work, legal controls are essential. It is necessary to stipulate that residents are required to accept regular sludge collection services and that local governments are required to develop facilities and systems which enable regular sludge collection. In Japan, the Johkasou Law provides that a Johkasou manager (a resident if he/she has a Johkasou installed) must conduct or have a maintenance service provider conduct a maintenance checkup and cleaning (desludging) once a year. In the case of a Johkasou, maintenance is difficult without the involvement of experts. Therefore, the law practically requires residents to sign maintenance contracts with maintenance service providers. In Japan, the installation of a Johkasou is required when a house is newly built in an area with no sewerage system. When applying for permission to build a house, the owner needs to report the installation of a Johkasou. He/she must then submit a maintenance contract within 30 days from the completion of the house and the start of the use of the Johkasou. Under the Waste Management and Public Cleansing Law, local governments are required to develop facilities and systems for black water treatment.

3) Financial Measures to Enable Regular Sludge Collection

In order to enable regular sludge collection, a system for desludging businesses to collect desludging fees should be put in place. It is also necessary to have financial incentives in order to ensure that desludging businesses will bring the collected sludge to sludge treatment plants without dumping it in rivers, etc. In addition, collection fees to be paid by residents to desludging businesses should be set at levels which meet the residents' willingness to pay.

In Japan, desludging costs are recovered through collecting fees paid by the residents in principle. In the Japan's case, black water and sludge collection businesses are protected by a licensing system which controls newcomers in order to prevent the collection fees from falling below the collection costs through excessive competition, because it is not a job that many people are willing to engage in. Local governments set the collection fees by balancing the costs of black water/sludge collection and

residents' willingness to pay. Each country can find different ways because circumstances vary depending on the country.

Regarding residents' willingness to pay, there is a case in Tokyo where collection fees were free for the first three years after the introduction of black water collection services and fees were charged from the fourth year.

Regarding the collection fees for Johkasou sludge in Japan, desludging has been a pay service from its start and fees are collected without fail.

In Japan, local governments pay all the operational costs for black water and sludge treatment plants. Residents and collection businesses do not pay the costs. This prevents collection businesses from dumping collected sludge in rivers, etc. Collection businesses that conduct illegal dumping of black water and sludge into rivers, have their business licenses revoked.

4) Development of Organizational Structures and Human Resource Development for the Regular Collection and Treatment of Sludge

In order to implement the regular collection and treatment of sludge, it is necessary to develop organizational structures. Since most of the regular sludge collection services are conducted by the private sector, the main roles of the national and local governments are the regulation and supervision of the private operations. The regular collection of sludge requires specialized training because it affects people's sanitation environment and health.

In Japan, in order to ensure that private businesses conduct maintenance of Johkasous and regular desludging of Johkasous without causing any sanitation problems, a qualification system has been put in place, where only those who have received training and passed tests can provide services to install, maintain or desludge Johkasous. The Japan Education Center of Environmental Sanitation was established as an organization to give training and qualifications. Currently, there are 40,000 qualified Johkasou-related service vendors in Japan. These Johkasou-related services provide a good business opportunity for medium- and small-sized businesses.

In the governmental administration of Japan, the Ministry of the Environment is responsible for the collection and treatment of black water and sludge although the Ministry of Land, Infrastructure and Transport is responsible for sewerage systems. At the local government level, the collection and treatment of black water and sludge is managed by a separate bureau from the sewerage bureau, such as the sanitation bureau. It is not the best arrangement to have sewerage systems and sludge collection and treatment being administered by separate bureaus. It is possible to manage both sewerage systems and the collection and treatment of black water and sludge where one organization is in charge of sanitation.

5) Development of Facilities for the Regular Collection and Treatment of Sludge

In order to collect black water and sludge regularly, it is necessary to have a sludge treatment plant within a certain distance from each household.

In Japan, it is said that black water and sludge collection businesses can make a profit if they make four round trips a day between the collection points and black water (sludge) treatment plants. In Japan, a total of 1,100 black water treatment plants were constructed nationwide by local governments in the 1950s and 1960s. They are still in operation, treating black water and Johkasou sludge. There is a central government subsidy system for local governments who construct black water treatment plants (30% of the construction costs).

6) Measures to Utilize the Private Sector for Regular Sludge Collection Services

The private sector conducts sludge collection services in many cases. In such cases, measures to train and supervise the private sector will be needed.

As mentioned above, in Japan, the private sector conducts black water and sludge collection services in many cases. Excessive competition has been prevented by adopting a licensing system and the quality of operations was ensured by introducing a qualification system. A low-interest loan system is provided for the purchase of collection trucks.

In Japan, local governments own the sludge treatment plants, but private companies are employed to conduct the operation and maintenance of the plants in many cases. The central government has a qualification system for the operators in such cases, in order to ensure the quality of operations.

B5.5 Acitivities of Percepatan Pembangunan Sanitasi Permukiman (PPSP)

Modifying the wastewater management master plan in DKI Jakarta makes it possible to promote the construction of sewerage works, to improve on-site facilities for household use and maintenance work (regular sludge extraction), and to improve on-site facilities for corporate use and maintenance work. As a result, the budget increases and the citizens and companies are obliged to pay higher treatment costs. However, the persons concerned neither recognize nor justify the increased burden toward environmental improvement. Given the importance of their understanding such circumstances and cooperating with each other, campaigns and environmental education shall be conducted.

DKI Jakarta participates in the Accelerated Development of Residential Sanitation Program (PPSP) and is establishing a working group in accordance with a city governor's order in 2011. Currently, BPLHD is holding a meeting (see S/R PART-H). The working group plans to develop a white paper on sanitation in the autumn of 2011 to show basic strategies for making the city hygienic. For the white paper, the working group conducts an environment and health risk assessment (EHRA) to collect data on the current state of sanitation and to identify and evaluate hygienic problems. The PPSP will continue in the next year and later, this project carries on environmental education and campaigns while supporting the program and considering its fruits. Note that the S/R Pert-H shows inormation of environmental education and campaigns for waste and sanitation conducted in Indonesia in 2008 and later.

B5.6 The Situation in Other Developing Countries

This section explains the current situation for the population covered by sewerage systems, sewerage fees and on-site sanitation in developing countries in Asia.

Table B5-5 shows the population, the percentage of the population who use toilets, the percentage of the population who use septic tanks and the septic tank sludge (septage) treatment situation in countries for which reliable sets of data are available.

Table B5-5 Toilets, Septic Tanks and Their Management

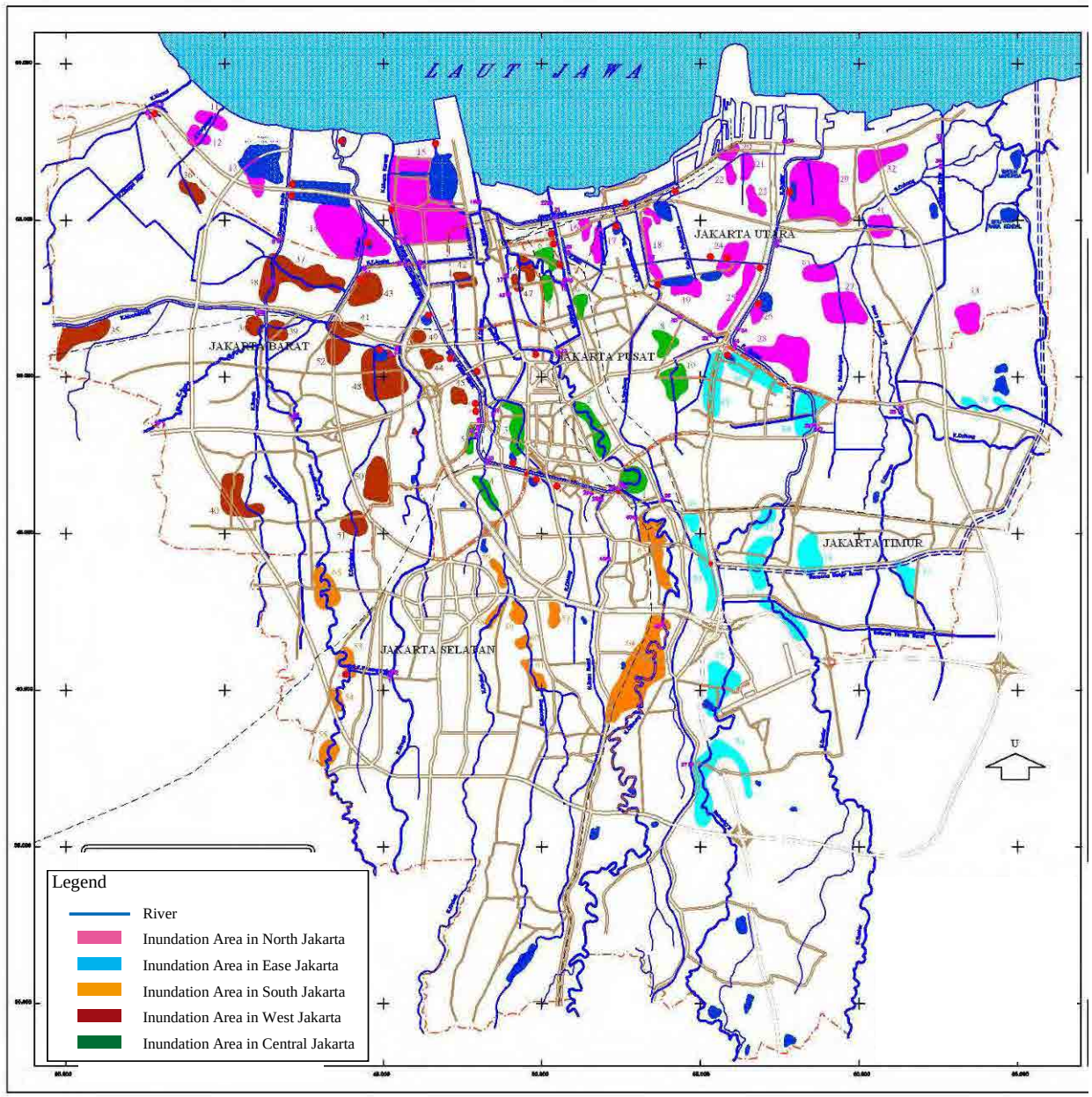
Country	Population		Use of sanitation facilities			Use of septic tank		Septage management	
	Total (thousand)	% urban population	% population			% population		% septage treated	
			Total	Urban	Rural				
INDIA	1181412	29	31	54	21	29	urban	0	
INDONESIA	227345	52	52	67	36	62	urban	4	urban
MALAYSIA	27014	70	96	96	95	27	IWK areas	100	IWK areas
PHILIPPINES	90348	65	76	80	69	85	Metro M	5	Metro M
THAILAND	67386	33	96	95	96	21	urban	30	
VIETNAM	87096	28	75	94	67	77	urban	4	

Source: United sates agency for international development 2010

B6 Present Conditions of Drainage System

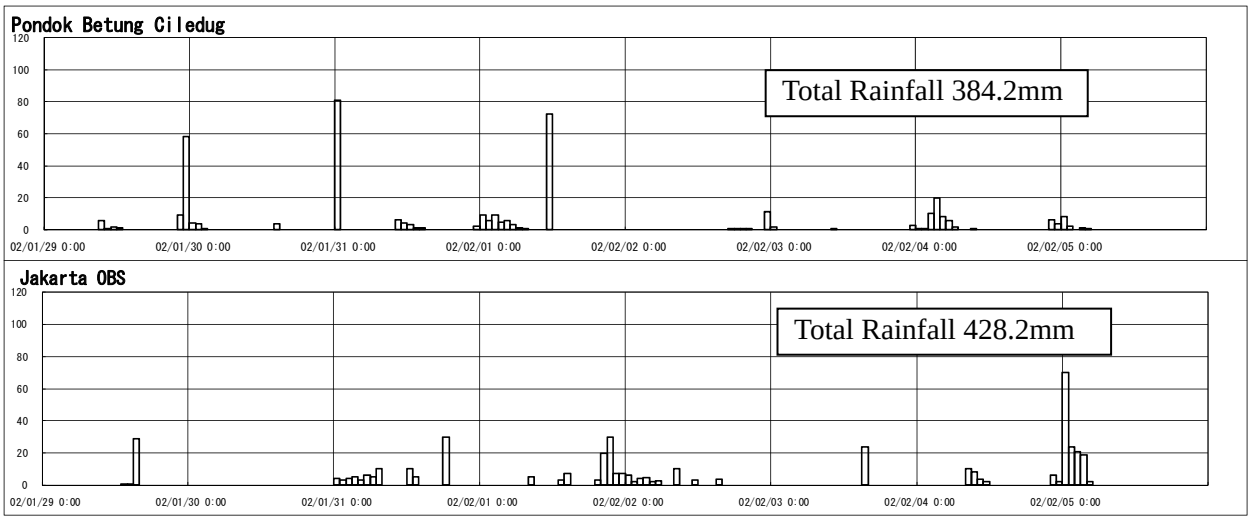
B6.1 Flood Experience in DKI Jakarta

In DKI Jakarta, rivers have flooded frequently because of the rapid urban development. In recent years, huge floods happened in 2002 and 2007. Figure B6-2 and Figure B6-3 show the records of precipitation at the main observatories in DKI Jakarta in 2002 and 2007 respectively. And the overflowing situation during the food in 2007 is shown in Figure B6-4.



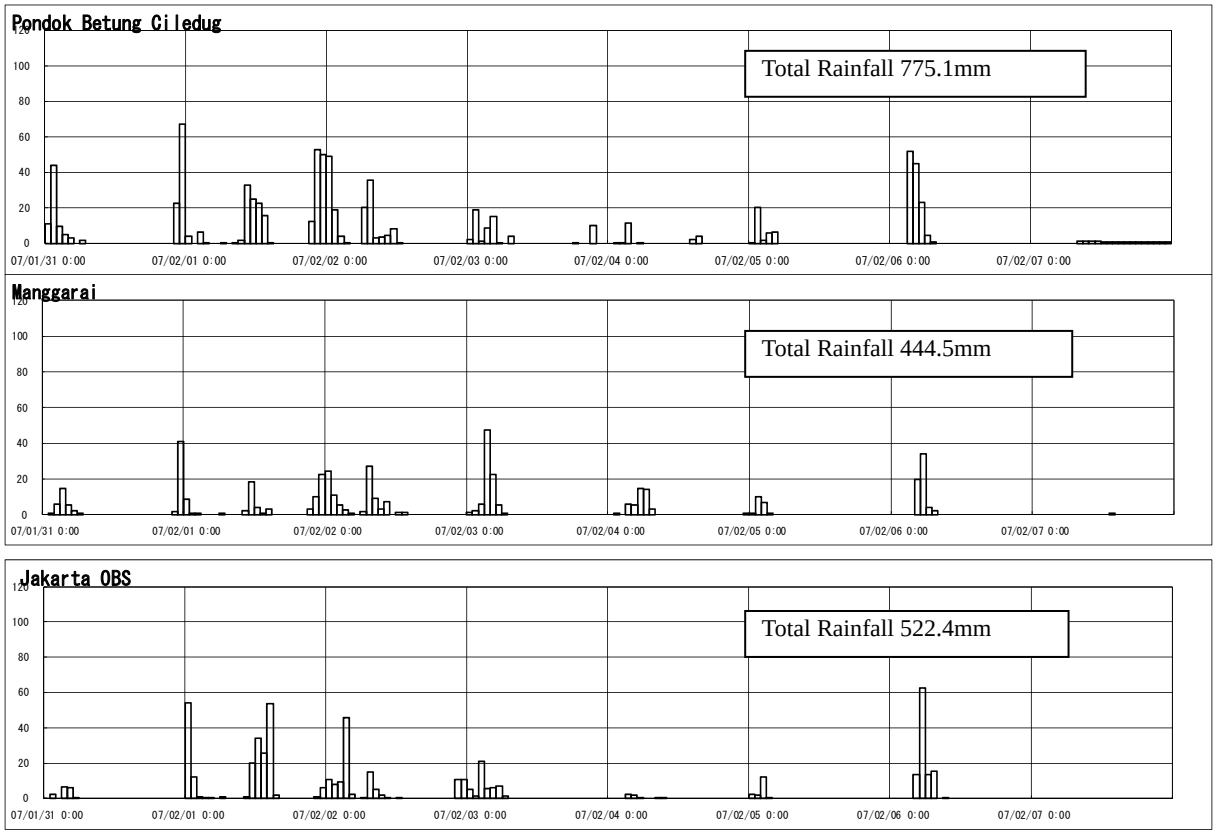
Sources : Balai Besar Wilayah Sungai Ciliwung-Cisadane: Ciliwung-Cisadane River Basin Main Office：BBWS CC

Figure B6-1 Flood Situation 2002 of DKI Jakarta



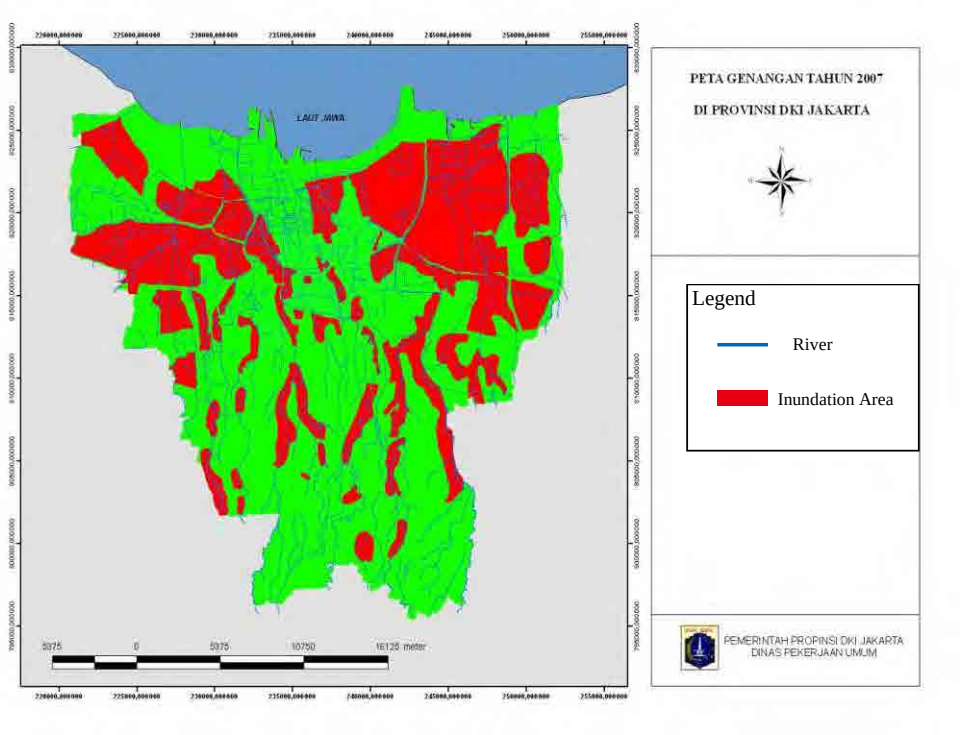
Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management"

Figure B6-2 Record of Precipitation and Flood in DKI Jakarta in 2002



Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management"

Figure B6-3 Record of Precipitation and Flood in DKI Jakarta in 2007



Source: BBWS CilCis

Figure B6-4 Overflowing Situation during the Food in DKI Jakarta in 2007

B6.2 Existing Flood Management Plans

Table B6-1 shows the outline of the flood management Plan concerning DKI Jakarta at the present time.

Table B6-1 Existing Flood Management Plans

Study	Flood Management Plan and Progress
Urban Drainage and Flood Management Plan in Jakarta, PU, 1973	■ Expansion of West Banjir Canal (WBC) (constructed in 1924) intercepting Ciliwung and Krukut rivers and East Banjir Canal (EBC) intercepting rivers in eastern Jakarta area with 100-year return period ■ Construction of Cengkareng Banjir Canal in downstream of WBC with 100-year return period, and expansion of WBC based on M/P was completed. Construction of EBC is almost completed in January 2010 and started to be operated. ■ Plan of drainage areas between WBC and EBC was formulated. In accordance with this plan, existing river was improved to be used for main drainage with 25-year return period, and pump stations and drainages were constructed in the areas divided into 6 areas. ■ In the plan, improvement of existing river and construction of pump stations have been achieved. Currently, since these facilities are suffered from the sea level, the water discharge has been conducted at 18 of pump stations and 23 flood gates.
The Study on Comprehensive River Water Management Plan in JABOTABEK, JICA, 1995-1997	■ To formulate the M/P on flood management in JABOTABEK area and to conduct F/S study on the proposed priority projects ■ M/P aims to improve the return period from 25-year to 100-year through the river improvement, canal reconstruction and new dredging in the main eight river basins

Source: JICA Expert Team

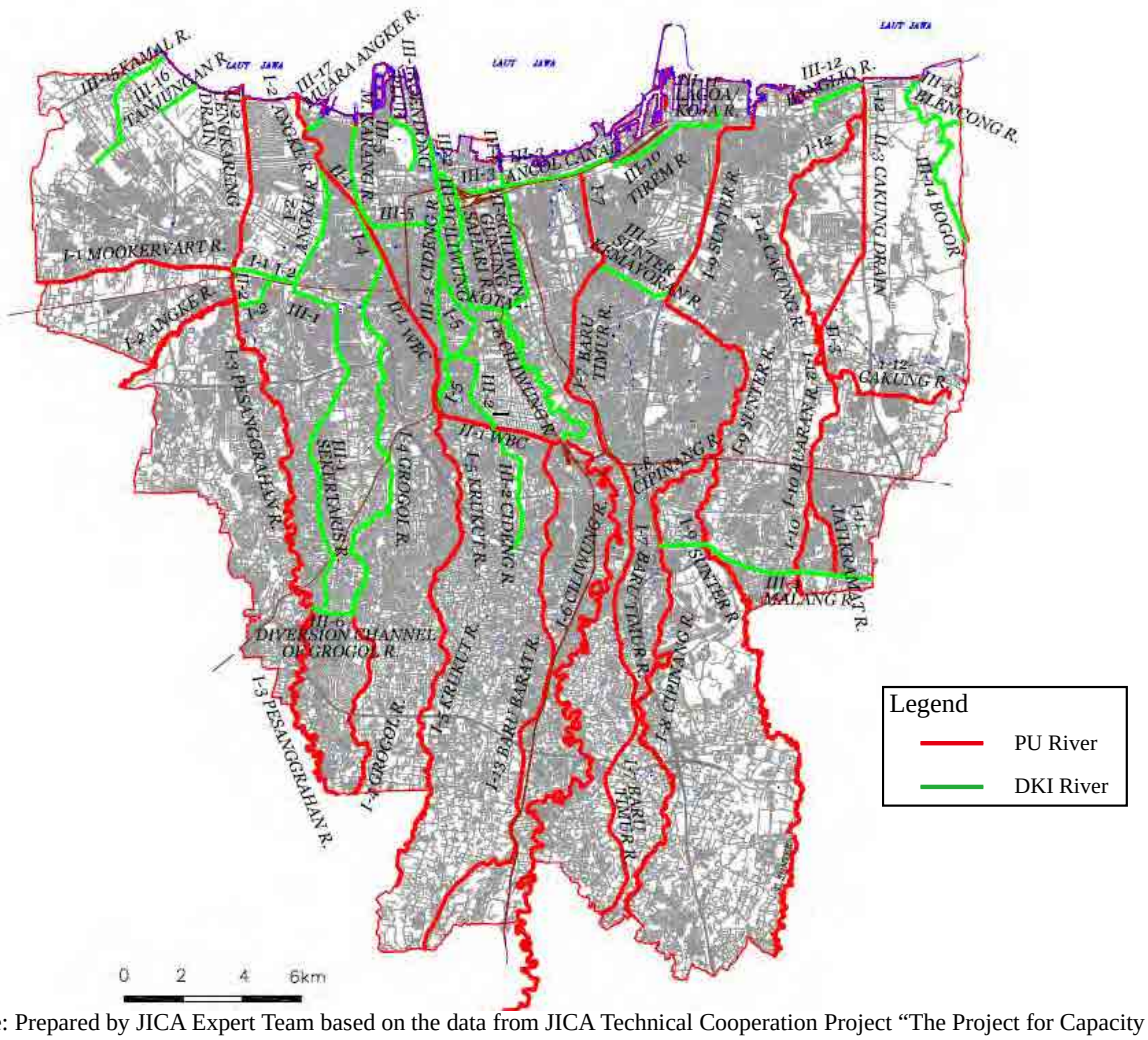
B6.3 Present Conditions of Drainage System

The major drainage channels in the DKI Jakarta are shown in Table B6-2 and Figure B6-5.

Table B6-2 Major Drainage Channels

No.	River Name	No.	River Name
1	Mookervart R.	18	Ancol Canal
2	Angke R.	19	Malang R.
3	Pesanggrahan R.	20	M.Karang R.
4	Grogol R.	21	Diversion Channel Of Grogol R.
5	Krukut R.	22	Sunter Kemayoran R.
6	Ciliwung R.	23	Ciliwung Gunung Sahari R.
7	Baru Timur R.	24	Ciliwung Kota
8	Cipinang R.	25	Tirem R.
9	Sunter R.	26	Lagoa/Koja R.
10	Buaran R.	27	Banglio R.
11	Jatikramat R.	28	Blencong R.
12	Cakung R.	29	Bogor
13	WBC	30	Kamal R.
14	Cengkareng Drain	31	Tanjungan R.
15	Cakung Drain	32	Muaraangke R.
16	Sekertaris R.	33	Gendong Pluit
17	Cideng R.		

Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management"



Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management"

Figure B6-5 Major Drainage Channels

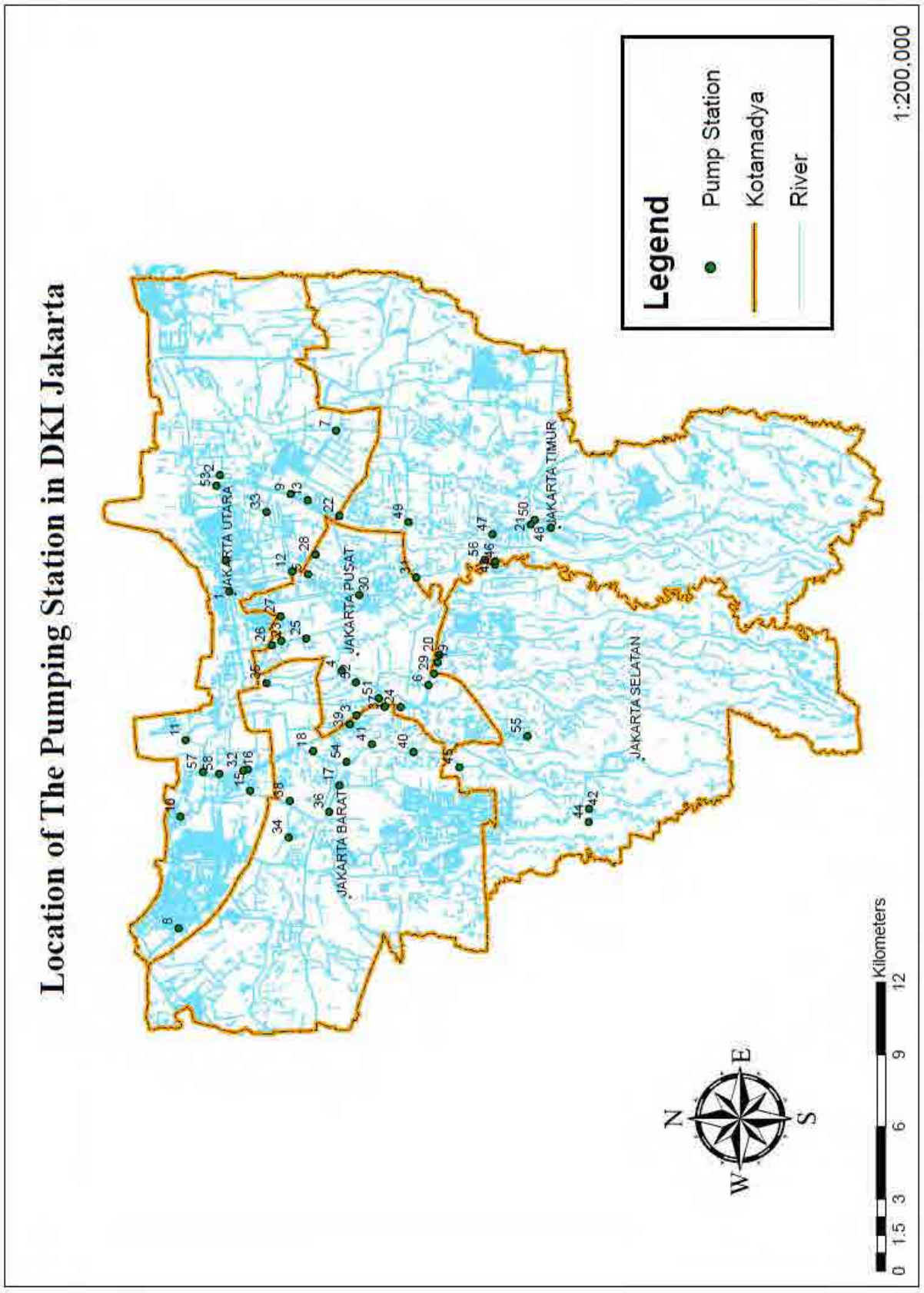
B6.4 Present Conditions of Drainage Facilities

The major drainage facilities in the DKI Jakarta are shown in Table B6-3 and Figure B6-6.

Table B6-3 Major Drainage Facility

No.	Name	Pump Capacity	No. of Units	Reservoir Area (ha)	Drainage Area (ha)	River Drained	Management
1	Ancol	15.00	3	4.00	635.00	Ancol Canal - Java Sea	BBWS-CC
2	Sunter III	15.00	3	8.00	570.00	Sunter R.	BBWS-CC
3	Cideng	40.20	7	0.00	750.00	WBC	DPU
4	Istana Merdeka	1.00	4	0.00	50.00	Ciliwung-Gajah Mada R.	DPU
5	Kali Item	8.00	4	0.00	278.00	Kali Item R.	DPU
6	Melati	12.80	9	8.50	185.00	WBC	DPU
7	Kelapa Gading	4.00	2	0.50	130.00	Cakung R.	DPU
8	Tanjungan	12.00	3	0.00	385.00	Tanjungan R.	DPU
9	Yos Sudarso	0.25	1	0.00	1.50	Sunter R.	DPU
10	Muara Angke	2.00	3	0.50	50.00	WBC	DPU
11	Pluit	48.40	11	80.00	2,663.00	Java Sea	DPU
12	Sunter Selatan	15.00	6	25.90	586.00	Sunter Channel - Java Sea	DPU
13	Sunter Timur I	4.00	3	8.00	200.00	Sunter R.	DPU
14	Sunter Utara	20.00	5	32.00	1,250.00	Japat R. - Java Sea	DPU
15	Teluk Gong	5.40	9	2.10	90.00	Angke .R-WBC	DPU
16	Penjaringan	4.50	3	6.00	150.00	Muara Angke R.	DPU
17	Tomang Barat	10.96	8	6.00	200.00	Sekretaris R.	DPU
18	Grogol	2.70	3	3.00	100.00	Grogol R.	DPU
19	Setiabudi Barat	8.98	7	2.85	170.00	WBC	DPU
20	Setiabudi Timur	8.52	6	1.70	140.00	WBC	DPU
21	UPP	0.25	1	0.00	1.50	Cipinang R.	DPU
22	Pulo Mas	7.50	3	6.80	460.00	Sunter R.	DPU
23	Industri	1.60	4	0.00	32.00	Pademangan R.	DPU
24	Jati Pinggir	1.00	2	0.00	50.00	WBC	DPU
25	Kartini	0.50	1	0.00	22.00	Pademangan R.	DPU
26	Mangga Dua Abdad	2.60	2	0.00	30.00	Ciliwung-Gunung Sahari River	DPU
27	Rajawali	0.25	1	0.00	2.00	Pademangan R.	SDPU-Center
28	Sumur Batu	0.50	2	0.00	25.00	Sunter R.	BBWS-CC
29	Terowongan Dukuh Atas	0.36	6	0.00	1.00	WBC	SDPU-Center
30	Under Pass Pasar Senen	0.80	4	0.04	1.50	Kalibaru Timur- Sentiong R.	SDPU-Center
31	Under Pass Pramuka	0.80	4	0.00	50.00	Sentiong R.	SDPU-Center
32	Bimoli	1.00	2	0.00	3.00	Muara Angke R.	SDPU-Center
33	Gaya Motor	0.25	2	0.50	1.50	Sunter Barat R.	SDPU-North
34	Kapuk Muara	0.25	1	0.00	60.00	Angke R.	SDPU-North
35	Pinangsia	2.00	2	0.00	5.00	Anak Ciliwung R.	SDPU-West
36	Gang Macan	3.00	2	0.00	60.00	Sekretaris R.	SDPU-West
37	Pondok Bandung	1.95	4	0.06	90.00	WBC	SDPU-West
38	Jelambar Wijaya	8.00	4	1.20	50.00	Angke R.	SDPU-West
39	Rawa Kepa	1.50	4	0.50	223.00	WBC	SDPU-West
40	Sipil Hankam	0.24	6	1.00	50.00	Grogol R.	SDPU-West
41	Under Pass Tomang	0.50	4	0.00	1.50	Grogol R.	SDPU-West
42	IKPN Bintaro	1.10	3	0.00	8.00	Pesanggrahan R.	SDPU-South
43	Kebon Baru	0.80	4	0.00	32.00	Ciliwung R.	SDPU-South
44	Terowongan Bintaro	1.60	6	0.00	1.00	Pesanggrahan R.	SDPU-South
45	TVRI	0.36	2	0.00	5.00	Sekretaris R.	SDPU-South
46	Bidara Cina	1.65	5	0.00	40.00	Ciliwung R.	SDPU-East
47	Terowongan DI Panjaitan	1.36	5	0.00	40.00	Cipinang R.	SDPU-East
48	Under Pass Cawang	0.80	1	0.00	1.50	Cipinang R.	SDPU-East
49	IKIP	1.00	2	0.00	10.00	Sunter R.	SDPU-East

Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project “The Project for Capacity Development of Jakarta Comprehensive Flood Management”



Source: Prepared by JICA Expert Team based on the data from JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management"

Figure B6-6 Major Drainage Facility

B6.5 Existing and Future Projects

The Flood Management Master Plan in DKI Jakarta will be developed in "The Project for Jakarta Comprehensive Flood Management (from 2011 to 2013)".

The drainage pump station is planned at three locations. This plan was proposed in "The Institutional Revitalization Project for Flood Management in JABODETABEK ".

From now on, the progress and data of these plans are planned to be collected.

The plan for the inner water drainage should be consistent with the above Flood Management Master Plan. JICA Expert Team will share the data and information with the team of the Project for Jakarta Comprehensive Flood Management, and prepare the facility and management plan for the inner water drainage.

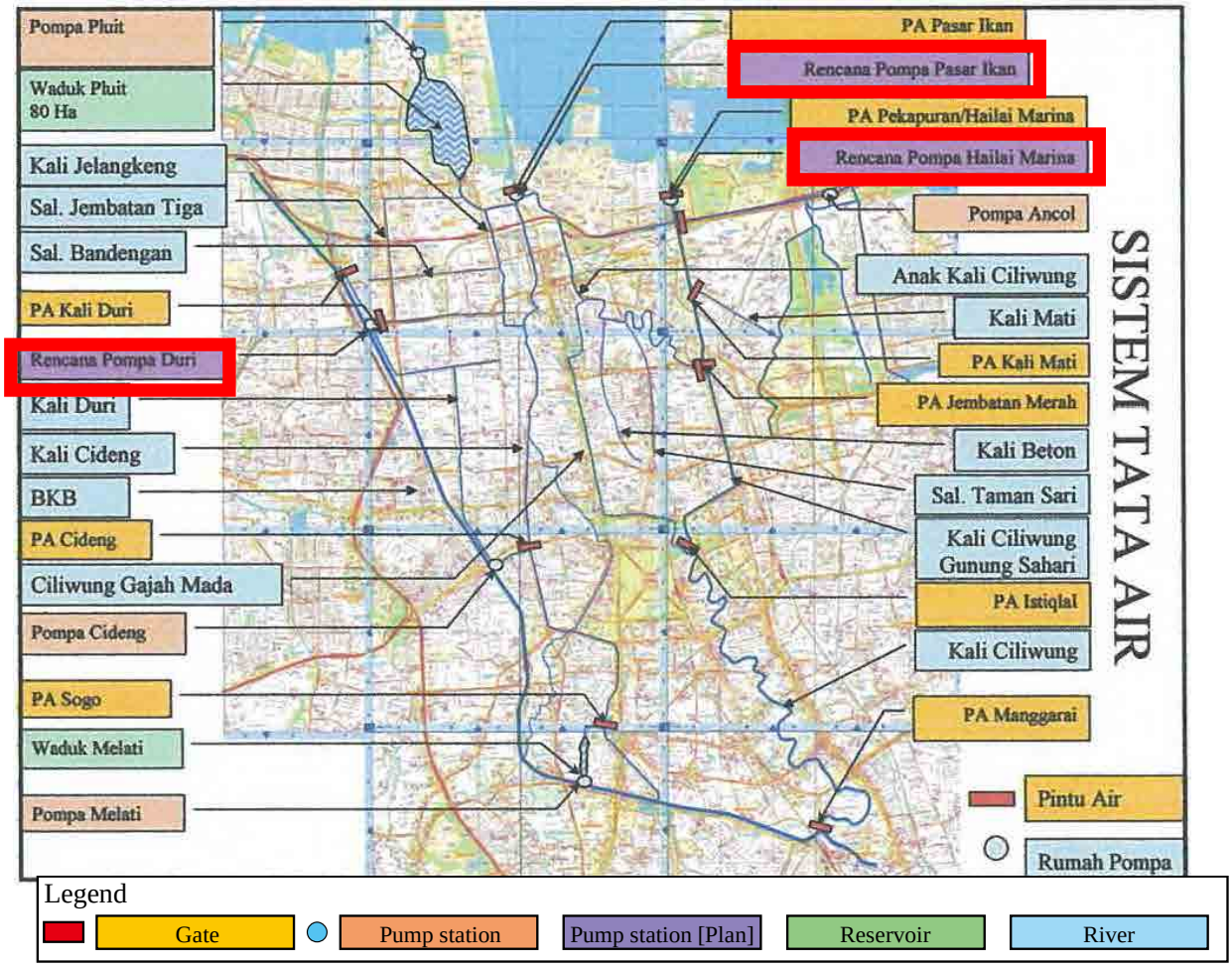


Figure B6-7 Primary Stormwater Drainage Facilities Location Map (Drainage Pumping Station Plan) in DKI Jakarta

The maximum capacities of three planned stations are as follows;

Duri Pump Pump Station: 12m^3/s, Pasar Ikan Pump Station: 30m^3/s, Marina Pump Station: 60m^3/s

Considering the existing capacity of Pluit Pump Station as 45m^3/s, the total capacity will be more than 150m^3/s. If these stations are constructed, the drainage capacity in the downstream area from Manggarai Gate would be increased, and the flood control safety will be improved.

The above plans are for the downstream areas, however, DGHS has another plan for the comprehensive drainage improvement (refer to as “Drainage M/P”) (small drainage (micro): 1/5 return year, small rivers (sub-macro): 1/25 return year) after implementing the topographic survey for drainages in DKI Jakarta and setting the drainage areas for each drainage. This plan will be

commencement in August 2011 and completed in the end of March 2012. At the stage of the feasibility study (F/S) for the sewerage development, when it is found that rainwater in the project area for F/S can not be discharged by the surface dainage only after the examination of the Drainage M/P, study for development of drainage pipelines will be considered.

Flood control plan being prepared by JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management" should be considered for the New M/P, such as the facility plan for internal water drainage and its impact.

If the comprehensive drainage improvement plan for whole DKI Jakarta is prepared and improvement works are impremented following this plan, the return year will be 1/5 in DKI Jakarta. However, the schedule of such improvement works is not decided and takes a long period of time. Draft report of this comprehensive plan was planned to be finalized in January 2012, but it is delayed. So JICA expter team cannot collect the results of topographic survey, improvement plans and so on. On the other hand, there is another project related to drainages, "Jakarta Emergency Dredging Initiative (JEDI)" by WB. In this project, dredging at the main drainages and canals was implemented. Conditions of dredging by JEDI are as follows;

Table B6-4 Conditions of Dredging by JEDI

Location	Condition of Dredging Drain		
	Length (m)	Width (m)	Depth (m)
Sentiong Sunter Drain	5,950	16.10 – 35.20	0.50 – 2.10
Ciliwung Gunung Sahari Drain	5,100	21.50 – 45.90	1.90 – 2.70
Cengkareng Floodway	7,840	38.00 – 87.00	1.50 – 3.50
Lower Sunter Floodway	9,980	20.20 – 47.40	1.60 – 2.30
Cideng Thamrin Drain	3,840	10.00 – 19.00	0.60 – 2.30
Tanjungan Drain	600	9.20 – 26.00	1.10 – 1.90
Lower Angke Drain	4,050	31.00 - 51.00	2.00 – 3.60
West Banjir Canal	3,060	33.00 – 141.00	1.70 – 2.50
Upper Sunter Floodway	5,150	15.00 – 36.00	1.80 – 3.40
Grogol Sekretaris Drain	2,970	21.00 – 51.00	0.70 – 2.30
Pakin Kali Besar Jelakeng Drain	4,910	13.00 – 31.00	0.60 – 1.60
Krukut Cideng Drain	3,250	15.00 – 29.00	0.70 – 0.80
Krukut Lama Drain	3,490	7.00 – 29.00	0.50 – 0.80
Kamal Drain	5,070	8.00 – 28.00	1.10 – 1.90
Cakung Floodway	9,870	30.00 – 60.00	1.20 – 3.90

Source: Jakarta Emergency Dredging Initiative (JEDI) by World Bank

Flood control plan being prepared by JICA Technical Cooperation Project "The Project for Capacity Development of Jakarta Comprehensive Flood Management" should be considered for the New M/P, such as the facility plan for internal water drainage and its impact. At the same time, the dredging results by JEDI are also examined for the New M/P.

B7 Current Situation of Water Supply System

B7.1 Current Situation of Water Supply Services

As shown in Table B7-1, the current situation for water supply service in DKI Jakarta is about 5.61million of served population and service ratio is still as small as 62.3% to the administrative population.

Table B7-1 Served Population for Water Supply in Jakarta

Item	Unit	Figures
Administrative Population	Person	8,998,755
Served population	Person	5,607,338
Service Ratio	%	62.3

Source: PAM JAYA

Water supply service operation for DKI Jakarta has been conducted by Jakarta Water Supply Agency (PAM JAYA) as one of DKI Jakarta agencies until 1997. However, in 1998, DKI Jakarta made a concession contract of 25 years with two private water service providers (PT. AETRA for eastern area and PT.PAM LYONNAISE JAYA for western area).

- Main contents of the contract between DKI Jakarta and service providers are as follows:
  (1) Improvement of house connection ratio by the customers
  (2) Expansion & rehabilitation of water treatment plant
  (3) Construction of water distribution pipelines
- Water tariff and bulk water charge shall be reviewed every 5 years.

For PAM JAYA, through the privatization in 1998, 2,800 out of 3,000 staff were shifted to the private water supply service providers. At present, it is supervising the observance of the contract contents and regulations on water production and water quality.

In 2001, Jakarta Water Supply Regulatory Body was established as a regulatory body which is monitoring water supply and water quality based on the regulations.

Service areas, number of customer and non-revenue water (NRW) are listed in Table B7-2 below.

Table B7-2 Service Areas Operated by Private Water Supply Company and the Number of Customer

District	Service Area	Service Provider	No. of Customer	Service Ratio	NRW
West	Wilayah I			62.3%	46.4%
	Wilayah IV	PT.PAM LYONNAISE JAYA	419,776		
	Wilayah V				
East	Wilayah II				
	Wilayah III	PT.AETRA	385,377		
	Wilayah VI				
		Total	805,153		

Source: PAM JAYA

B7.2 Capacity of Water Supply Facilities

(1) Capacity of the Existing WaterTreatment Plant (WTP)

There are 6 existing WTPs in DKI Jakarta. The total capacity is 17,875L/s (or 1,544,400m^3/day). Table B7-3 shows names of WTP and its capacity.

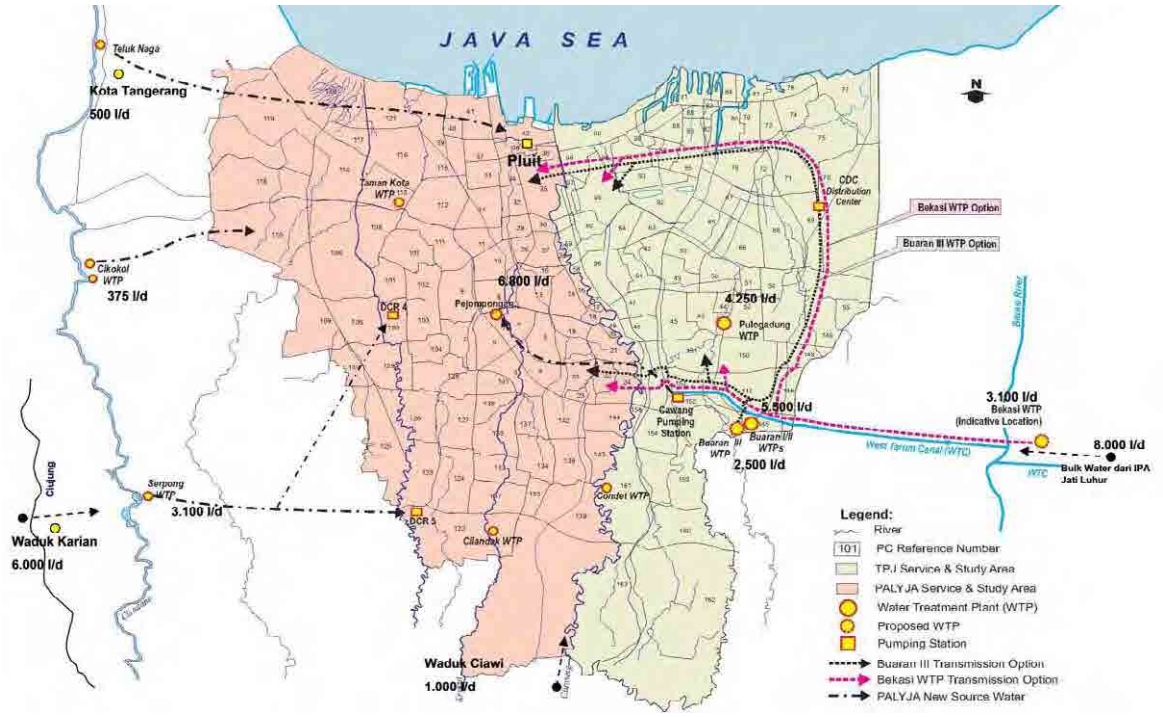
Table B7-3 Water Treatment Plants in DKI Jakarta and their Capacities

Item	Unit	Capacity	Remark
All WTPs	L/s	17,875	
	m^3/day	1,544,400	
Each WTP			
1. Pejompongan I & II	L/s	5,600	Central
2. Cilandak	L/s	400	South
3. Pulo Gadung	L/s	4,000	East
4. Buaran I & II	L/s	5,000	East
5. Cisadane	L/s	2,800	
6. Cengkareng	L/s	75	
Total		17,875	

Source: PAM JAYA

(2) Future Plan for Expansion & Rehabilitation of Water Supply Facilities

PAM JAYA is planning to develop 7 new water sources in total, 2 in the east side and 5 in the west side as shown in Figure B7-1.



Source: PAM JAYA

Figure B7-1 Development of New Water Resources in DKI Jakarta

The capacity of new water resources is as shown in Table B7-4.

Table B7-4 Development Plan for New Water Sources in DKI Jakarta

	Name of Facility/District	Capacity of WTP	
		(L/s)	(m^3/day)
East	Bulk Water dari IPA Jati Luhur	8,000	691,200
	Bekasi WTP	3,100	267,840
	East - Total	**11,100**	**959,040**
West	Kota Tangeran	500	43,200
	Cikolol Karian	375	32,400
	Waduk Karian	6,000	518,400
	Serpong WTP	3,100	267,840
	Waduk Ciawi	1,000	86,400
	West - Total	**10,975**	**948,240**
Total – DKI Jakarta		**22,075**	**1,907,280**

Source: PAM JAYA

B7.3 Water Distribution

Daily and annual treated water volume (Table B7-3) and the water distributed in DKI Jakarta are as shown in Table B7-5.

Table B7-5 Treated and Distributed Water in DKI Jakarta

Item	Unit	Figure
Treated Water	m^3/day	1,544,400
	m^3/year	563,706,000
Distributed Water	m^3/day	1,450,385
	m^3/year	529,390,502

Source: PAM JAYA

B7.4 Per Capita Water Consumption

Per Capita Water Consumption shall be determined by the distributed water from PAM system and that

from wells obtained from PAM JAYA.

Table B7-6 shows water consumption of ordinary household customers and water consumption of non-household customers (commercial, industrial, etc.). As seen in the table, it was found that daily per capita water consumption (Liter Capita per Day: LCD) is almost the same amount of 200LCD in either case of PAM system or wells as water sources.

Table B7-6 Unit Water Consumption for PAM System Users and Well Users

No.	Item	Served Population (person)	Supplied Water (m^3)	Unit Water Consumption (LCD)
1	Water consumption by domestic users of wells	5,204,387	338,611,212	179
2	Water consumption by domestic users of PAM system	3,298,470	156,220,000	130
3	Water consumption by non-domestic users of wells		22,205,353	12
4	Water consumption by non-domestic users of PAM system		99,687,224	83
5	Water consumption for wells			191
6	Water consumption for PAM			213
	Total／Average	8,502,857	616,723,789	199
	Averaged domestic consumption			154
	Averaged non-domestic consumption			45

Source: Prepared by JICA Expert Team through the data from PAM JAYA

B7.5 Water Tariff Structure

Water tariff system is categorized into 7 groups for each customer and set by the water consumption. Comparing between commercial/industrial as the highest (group IV and V) and domestic users (group II), water tariff of group IV&V is set as high as 12 to 14 times.

Table B7-7 Water Tariff System of PAM JAYA

Tariff Code	Customer Group	Tariff per water consumption (m^3) (IDR)		
		0 - 10	**11 - 20**	**>20**
[Group I]		**1,050**	**1,050**	**1,050**
1A	Dormitory of Social organization (charity)			
1B	House of orphaned			
1C	Place of worship			
5A	Hydrant, water tap, etc.			
[Group II]		**1,050**	**1,050**	**1,575**
1D	Governmental Hospital			
2A1	Very simple/very low class household			
5F1	Very simple flats (high rest building) and as same with this types			
[Group III-A]		**3,550**	**4,700**	**5,500**
2A2	Simple/low class household			
5B	Water station and tank vehicle			
5F2	Simple flats and similar types			
[Group III-B]		**4,900**	**6,000**	**7,450**
2A3	Medium household			
2E1	Non-commercial private institution			
3A	Small shop			
3B1	Small service shop (such as motorcycle service station)			
3C1	Small business/small enterprise			
3D1	Small enterprise in Household/dormitory and similar type			
5F3	Medium flats and similar types			
[Group IV-A]		**6,825**	**8,150**	**9,800**
2A4	High class/rich household			

Table B7-7 Water Tariff System of PAM JAYA

Tariff Code	Customer Group	Tariff per water consumption (m^3) (IDR)		
		0 - 10	**11 - 20**	**>20**
2B	Embassy/consulate			
2C	Govt. Institution office			
2D	Foreign Representative Office			
2E	Commercial private institution			
2F	Institution/University/course			
2G	Military Institution			
3B	Medium service/repair shop			
3C	Medium enterprise			
3D	Medium enterprise in Household/dormitory			
3E	Barbershop			
3F	Tailor			
3G	Small restaurant			
3H	Private hospital/clinic/Laboratory			
3I	Doctor's place (private clinic)			
3J	Lawyer office			
3K	Non-star hotel			
4A	Small industry			
5F4	High class/rich Flats and similar types			
[Group IV-B]		**12,550**	**12,550**	**12,550**
3L	1,2,and 3 star hotel/non-star hotel			
3M	Steam bath/beauty saloon			
3N	Night club			
3O	Bank			
3P	Service station, large service shop			
3Q	Trading company/commercial/house-shop/office-shop			
3R	4,5 star hotel			
3C	High rise Building/condominium			
4B	Ice factory			
4C	Food/beverage Factory			
4D	Chemical/ drug/cosmetic factory			
4E	Industrial warehouse			
4F	Textile factory			
4G	Warehouse/other industry			
5C	Water barges			
5E	BPP Ancol and similar type			
[Group V/Special]		**14,650**	**14,650**	**14,650**
5D	BPP Tanjung Priok and similar type			

Source：PAM JAYA

B8 Activities of Foreign Donors in Sewerage and Sanitation Field in DKI Jakarta

B8.1 Main Donors in Sewerage and Sanitation Field in Indonesia

There are five (5) active donors in Indonesia's sewerage/sanitation sector, namely, World Bank, Asian Development Bank (ADB), Japan International Cooperation Agency (JICA), USAID and AusAid. Regular meetings of the agencies discuss sector issues and coordinate effective engagement with the government on sector related policy and future project work.

B8.2 Activities of Main Donors

B8.2.1 Water and Sanitation Program (WSP) of World Bank

World Bank extended a loan amounting USD22.4 million for Jakarta Sewerage and Sanitation Project (JSSP) on Feb.8, 1983. The final disbursement was made on August 14, 1991. Some parts of the original scope of the project were not completed under the loan and were carried over by the Second

JABOTABEK Urban Development Project amounting USD190.0 million which was extended on June 5, 1990. By both loans, the sewerage portion was completed as originally planned but only the part of the sanitation portion originally planned was completed.

These were the only investment support of the World Bank for the sewerage in the major urban center in the past. After that, the World Bank sifted their emphasis towards the hygienic sanitation in the low income areas by incorporating the sanitation components in three (3) project loans for the low income communities, namely, Water Supply and Sanitation for Low Income Communities Project (1993), Second Village Infrastructure Project (1996) and Third Water Supply and Sanitation for Low Income Communities Project (2006).

The Water and Sanitation program (WSP) is one of the World Bank's longest standing external partnership programs which is administered by the World Bank and follows the World Bank's management and administrative processes.

As for the urban sewerage/sanitation, since 2006, the World Bank has adopted the innovative approach, instead of funding investments directly, by launching a partnership program between the Government of Indonesia and WSP, namely, Indonesia Sanitation Sector Development Program (ISSDP), funded by the Netherlands Embassy and Swedish Agency for International Development (Sida) and administered by WSP, the purpose of which is to foster an enabling environment for progress, with special attention to city-level planning, strengthening sector strategy and institutional arrangements, and advocacy and awareness-raising at all levels.

ISSDP effectively paved the way for the Government of Indonesia to launch PPSP (the Accelerated Urban Sanitation Development Program) 2010-2014. ISSDP ended in January 2010 and was succeeded by the Urban Sanitation Development program (USDP), which is funded by the Netherlands Embassy. USDP is five (5) year program which run parallel with PPSP and provide the comprehensive technical assistance to enable 330 cities to implement 'the Roadmap for PPSP'.

(1) Economic Impacts of Sanitation in Indonesia (WSP's research)

In August 2008, WSP published a report titled 'Economic Impacts of Sanitation in Indonesia', which concludes that, in 2006, Indonesia lost IDR 56 trillion (USD 6.3 billion) due to the poor sanitation and hygiene, equivalent to approximately 2.3% of gross domestic product (GDP). This report is being used as the important input for the advocacy campaign by ISSDP/USDP.

(2) Activities of USDP (formerly ISSDP)

The primary role of ISSDP was to raise the awareness at both national and local level, and to support cities to develop their City Sanitation Strategy (CSS) under PPSP. At the national level, National Sanitation Technical Team (TTPS) was created by 8 ministries. The PMU is located at BAPPENAS as the lead agency of TTPS and the three PMUs are located at the Ministry of Health, the Ministry of Home Affairs and the Ministry of Public Works. At the local level, the Sanitation Working Group is created in order to formulate CCS. ISSDP supports them at all levels by creating manuals, e.g., Program Management Manual PPSP, training, etc. Under the Phase I (-Sept. 2008) of ISSDP, six (6) cities successfully created CCS, they were Payakumbuh, Jambi, Banjarmasin, Denpasar, Blitar and Surakarta. The work of ISSDP was succeeded by USDP.

B8.2.2 Asian Development Bank (ADB)

ADB's support to the 'Water and Sanitation' sector in Indonesia was limited to a few technical cooperation (T/A) projects since the loans were extended to Bandung Water Supply Project, Rural Water Supply and Sanitation Project, IKK Water Supply Sector Project, Water Pollution Control Project, Semarang Water Supply Project, Small Towns Water Supply Sector Project in 1995, and to Capacity Building of Water Supply Enterprises for Water Loss Reduction Sector Project in 1997. ADB resumed their lending to the sector by extending a loan to Community Water Services and Health Project and West Jakarta Water Supply Development Project (a private sector loan) in 2010, and to Metropolitan Sanitation Management and Health Project in 2011.

The reason why ADB was not active in lending to the sector during the period was that, under the

De-Centralization Policy, the 'Water and Sanitation' sector had become the responsibility of local governments and the local governments lacked the implementing capacity, and, therefore, ADB was unable to extend the loan to them.

The Metropolitan Sanitation Management and Health Project, one of the three projects in the sector to which ADB extended their loans in 2010 and 2011, includes the development and expansion of the sewerage systems and the on-site sanitation systems in two (2) cities, namely Yogyakarta and Medan. ADB had considered to include the sewerage and sanitation in Makassar, in addition to Yogyakarta and Medan. But since there was a issue of the land acquisition for the sewerage treatment plant in Makassar, the loan making was limited to only for two cities. ADB wishes to conduct F/S for eight (8) cities, namely, Bogor, Surabaya, Palembang, Pekanbaru, Batam, Cimahi, Makassar, Bandung, one by one, and materialize the ADB lending for these cities.

Although ADB is not conducting any particular preparatory work for the sewerage and sanitation project in DKI Jakarta, ADB is very much interested in the progress of the JICA's revision of the Master Plan for the wastewater management in DKI Jakarta and mentioned the possibility of co-financing with JICA in the future.

B8.2.3 USAID

Although the USAID Indonesia Office's current Country Assistance Program for Indonesia does not include the assistance activities in the sewerage and sanitation in Jakarta DKI, there are related activities in the USAID's past activities and in the Water Operator's Partnership (WOPs) program which is being conducted through ECO Asia（Environmental Cooperation-Asia）which is administered by the USAID Thailand Office.

(1) Petojo Utara Project (Community Sanitation)

This project is an integrated community development project targeted to a low income community in the North Petojo area of DKI Jakarta, which was implemented by the USAID with Mercy Corp, an international NGO as the contractor, in 2008. One component of the project was the communal toilet (MCK) which is to be operated and maintained by the community themselves. Although SANIMAS has not been introduced in DKI Jakarta, the concept of the Petojo Utara Project, communal toilet maintained by the community themselves resembles to the SANIMAS concept. Her Honorable Clinton, Secretary of State, USA, visited the Petojo Utara Project in March 2009.

(2) ECO-Asia WOPs (Septage Management)

USAID Thailand Office is promoting the intercourse among water utilities in Asia region through Eco-Asia (Environmental Cooperation-Asia), as a part of the Water Operators Partnerships (WOPs) initiative which UNHABITAT is playing the leading role in accordance with 'Hashimoto Action Plan' of the United Nation Secretary General Advisory Board on Water and Sanitation (UNSGAB). ADB is also active in this initiative. One of the WOPs program, which ECO-Asia is promoting in Indonesia, is the partnership between the IWK (Indah Water Konsortium), the Malaysian company which is delegated the operation and maintenance of the sewerage facilities and the septage management operations nationwide by the Malaysian government, and Indonesian counterparts (Bandung PDAM and PD PAL JAYA). Through this partnership, the know-how of IWK which has succeeded to introduce the regular desludging for 50% of total septic tanks nationwide in Malaysia, will be utilized in the technical exchange between IWK and Indonesian counterparts (Bandung PDAM and PD PAL JAYA).

B8.2.4 USDP (Urban Sanitation Development Program)

USDP, funded by the Netherlands Embassy, succeeded the ISSDP administered by WSP which was completed on January 2010. The same consultant who implemented the ISSDP was awarded the contract. The role of USDP is to continue providing supports for the awareness raising in the central as well as the local level, and providing supports for the formulation of the City Sanitation Strategy (CSS) by municipalities. USDP will support it at all levels by preparing manuals such as the Program

Management Manual, conducting the training, etc. Under the PPSP (2010-2014), all 330 municipalities are expected to prepare their own CSS.

From the beginning of 2010, USDP and DKI Jakarta have initiated the contact. In order for the New M/P to be formulated through this Project to be actually implemented, the awareness raising at the all levels of DKI Jakarta would be vitally important. The JICA Team considers that the role of USDP in this area would be enormous.

B9 Review of the Old Master Plans on Wastewater Management in DKI Jakarta

B9.1 Review of the Study on Urban Drainage and Wastewater Disposal Project in the City of Jakarta (1991 by JICA)

B9.1.1 Purpose of Review

In the Project, the Old M/P which was formulated under JICA's development study in 1991 have been reviewed and the New M/P have been formulated through examining the sewerage and sanitation system based on the latest data and information.

B9.1.2 Policy for Reviewing the Old M/P

The policy for reviewing the Old M/P in the Project is as shown in Table B9-1.

Table B9-1 Policy for Reviewing the Old M/P in the Project

No.	Item	Policy
1	Basic design conditions	
	(1) Target year	Since new spatial planning explains that the population of DKI Jakarta will be saturated by the year of 2030, it is reasonable to set the target year for facility development plan for the Project as the same year. The facility development plan will be formulated in the following three (3) stages. ・ Year 2012 to 2020: Short-term plan ・ Year 2021 to 2030: Medium-term plan ・ Year 2030 to 2050: Long-term plan
	(2) Design population	The design population will be set in accordance with the population projection results which were applied in the new spatial planning 2030 (RTRW 2030) for the target year of 2030 by Urban Spatial Planning Department of DKI Jakarta
	(3) Design wastewater flow	Design wastewater flow will be calculated based on the method applied in the Old M/P. However, the water consumption for calculating the wastewater flow will be reviewed based on the latest data.
	(4) Pollution load	Pollution load will be set based on the related latest data, past data and the related documents.
2	Demarcation between off-site sanitation areas and on-site sanitation areas	In DKI Jakarta, low income class areas (or slum areas) with high-dense population and houses are found almost all over DKI Jakarta. In these areas, there is no space for installation of sewerage facilities and it is considered difficult to develop sewerage system for the time being. Therefore, the demarcation of off-site and on-site sanitation in terms of population density is not practicable. In the Project, the candidate sites for new WWTP have been identified as the first step and the off-site area where the treatment is conducted by the WWTP is set. The areas other than the off-site areas shall be defined as the on-site sanitation area.
3	Development plan for off-site (sewerage) facilities	1. As the sewage collecting system, separate system in which wastewater and rainwater are collected separately shall be applied in principle in accordance with the policy of Ministry of Public Works and DKI Jakarta. However, for the areas where storm water can not be discharged sufficiently into rivers and drains, applying combined system shall also be examined. 2. In order to formulate a workable M/P, the first priority shall be put on securing the sites for new WWTPs and incorporating these sites in the new Spatial Planning of DKI Jakarta. 3. Sewerage zoning shall be conducted taking into account the location of WWTPs, the natural conditions of DKI Jakarta (especially rivers and canals), easiness of O&M and locations of main urban facilities (highways, subways, etc.). 4. Sewage treatment process shall be determined through comparison among several methods, taking into account the constraints of the available lands, O&M cost, construction cost, etc.

Table B9-1 Policy for Reviewing the Old M/P in the Project

No.	Item	Policy
4	Development plan for on-site sanitation	At present, water pollution in public water bodies in and around DKI Jakarta is getting serious due to inappropriate wastewater treatment by the on-site sanitation system which is applied for more than 90% of the whole DKI Jakarta. Since the entire development of sewerage system in DKI Jakarta needs another several decades, improvement of on-site treatment facilities, among for all, the improvement of septic tank and regular desludging will become more important. Therefore, examination on on-site treatment plan and the required organization/institution to implement the plan will be conducted, taking into account these matters.
5	Operation and maintenance (O&M)	Organization, staff and financial conditions for sewerage related organization such as DESD/DGHS, DKI Jakarta and PD PAL JAYA are surveyed and the optimum O&M system plan for wastewater management will be formulated.
6	Project implementation plan	In order to develop sewerage system efficiently for the limit period, huge investment of money is required. Therefore, for formulation of workable New M/P, available resources in the national level and DKI Jakarta will be surveyed and at the same time, introduction of public-private partnership (hereinafter referred to as "PPP") scheme to utilize finance, technology and human resources of private company will be examined.

Source: JICA Expert Team

B9.1.3 Outline of the Old M/P

(1) Demarkation between Off-site and On-site Development in the Old M/P

In the Old M/P, development of off-site and on-site systems is divided into 3 areas as shown in Figure B9-1 based on the population density.

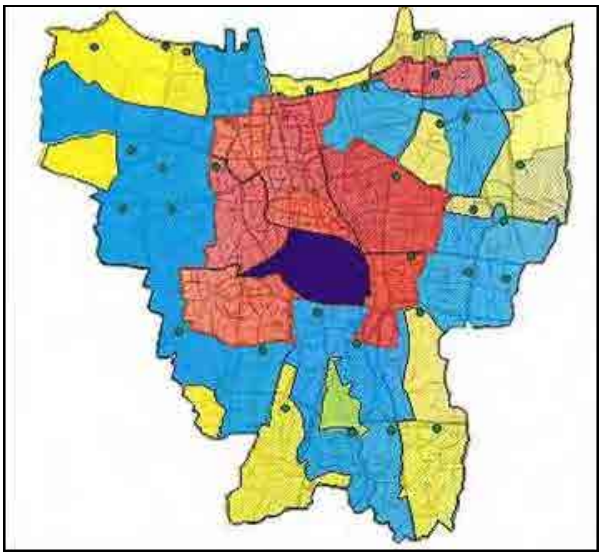
Area-A: Simple on-site treatment system development area (pop. density < 100PE/ha)

Area-B: High level on-site treatment system development area (pop. Density 100 to 300PE/ ha)

Area-C: Sewerage development area (pop. density 300PE ha or more)

The existing sewerage zone

(Area-C is divided into 6 sewerage zones: Central, North-east, North-west, South-east, South-west and Tanjung Prioku)



Source: The Old M/P (1991, JICA)

Figure B9-1 Off-site and On-site Development Areas in the Old M/P

(2) The Old M/P 1991

In 1991, DGHS and DKI Jakarta formulated the "Master Plan on Urban Drainage and Wastewater

Disposal Project in the City of Jakarta" for the Target Year of 2010 (the Old M/P) assisted by the Japan International Cooperation Agency (JICA).

In this Old M/P 1991, wastewater development was proposed in the core part of the Study Area covering 16,604 ha. Further, this core part of the Study Area was divided into 6 wastewater development zones.

The location of WWTP for each of the sewerage zone is shown in Figure B9-2. WWTP sites were proposed to be located on the wet area of the reservoirs which had primary function of flood control.

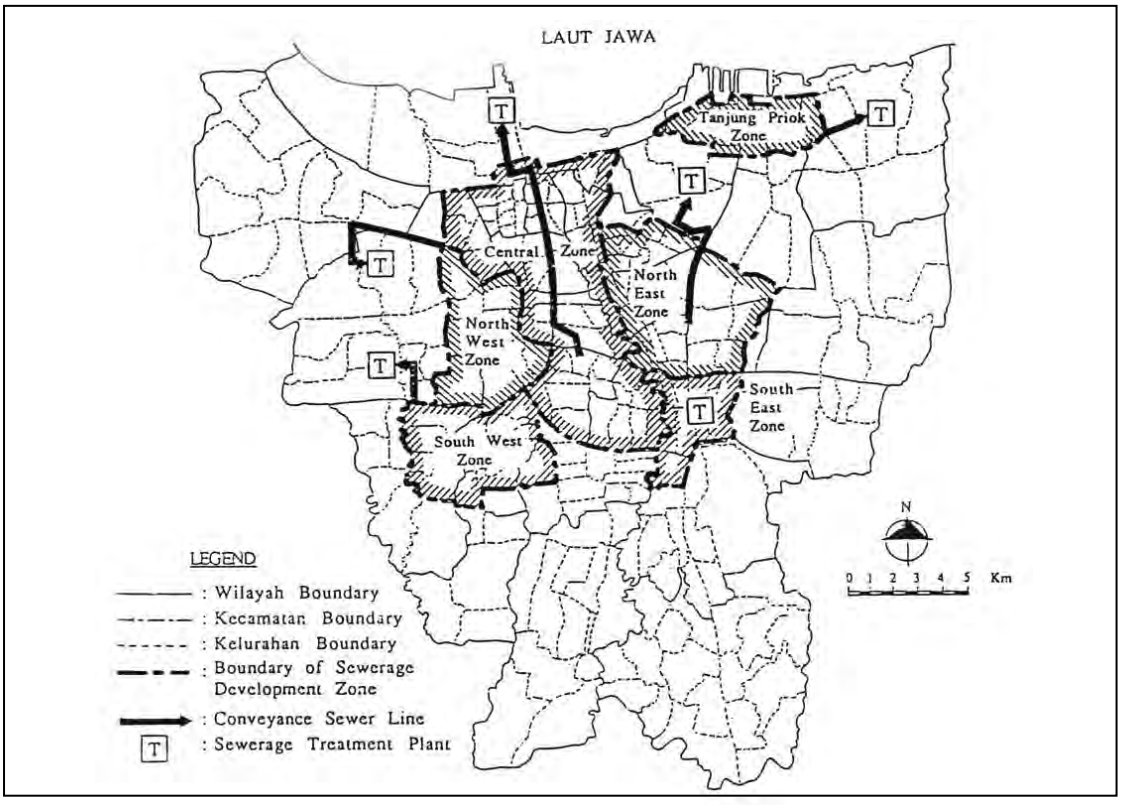
(3) Main Facilities in Each Sewerage Zone

The outline of main facilities in each sewerage zone is as shown below:

Table B9-2 Main Facilities of Each Sewerage Zone in the Old M/P (Targer Year of 2010)

Sewerage Zone	Central	North	South-west	North-east	South	Tanjung Priok	Total
Area of Zone (ha)	6,107	2,016	2,170	3,566	1,243	1,502	16,604
Served Population	2,466,000	642,000	674,000	1,383,000	523,000	663,000	6,351,000
Pop. Density (PE/ha)	410	345	311	396	421	441	382
Relay Pumping Station	1	3	5	0	0	1	10
WWTP							
Area (ha)	88	18	16	14	13	37	186
Process	AL & FP	AL	AL	AS	AL	AL & FP	---
Capacity (m^3/day)	529,000	124,000	117,000	261,000	101,000	120,000	1,252,000

Remark: AL=Aerated Lagoon、AL&FP＝Aerated Lagoon & Facultative pond、AS: Conventional Actibated Sludge
Source; Old M/P



Source: Old M/P 1991

Figure B9-2 Six Zones for Sewerage Development in Old M/P 1991

(4) Lessons Learnt

The reason of unsatisfactory development of the sewerage system in DKI Jakarta is also attributed to as following besides budgetary constraints:

i) No land use change for Wastewater Management in Urban Spatial Planning

ii) The M/P itself was not approved through issuance of regulation by the provincial government

iii) PD PAL JAYA can not conduct O&M of the ponds at WWTP because the ponds also have a flood control function and DPU is responsible for the O&M

iv) Inappropriate land selection

v) Treatment technology selection was inappropriate considering that land is scarce

vi) Low priority to the wastewater management issue

Taking into account the lessons leart from the New M/P, the following issues should be dealt with as the most important items.

- To get DKI Jakarta Governor's pproval for the facility site of the prioritized project during the project
- To select the land where sewerage and sanitary system agency can conduct O&M by itself
- To take necessary action to get DKI Jakarta Governor's approval for the New M/P
- To get understanding from the Indonesian side for the treatment process suitable for small space of land
- To enhance awareness for importance of wastewater management and sanitation

B9.2 Jakarta Wastewater Development Project (JWDP2001)

B9.2.1 Background

In 1991, DGHS and DKI Jakarta formulated the "Master Plan on Urban Drainage and Wastewater Disposal Project in the City of Jakarta" for the Target Year of 2010 (Old M/P) assisted by the Japan International Cooperation Agency (JICA). In this old M/P 1991, wastewater development was proposed in the core part of the Study Area (DKI Jakarta) covering 16,604 ha. Further, this core part of the Study Area was divided into 6 wastewater development zones.

These 6 wastewater development zones were:

1) Central Zone (6,107 ha), which included the system on Casablanca, Thamrin, Gajahmada, Pantai Mutiara, Siantar, Waduk Grogol, kali Grogol and kali Ancol.

2) Other Zones (1,0497 ha), which covered northwest, southwest, northeast, southeast and Tanjung Priok zones.

The above respective zones were evaluated in the M/P and the highest priority was given to the Central Zone, followed by South East Zone, North East Zone, Tanjug Priok Zone, North West Zone and South West Zone. In the Central Zone for Stage I (Target year 2000), wastewater discharge was estimated at 440,997 m^3/day (including 124,800 m^3/day for the JSSP area) and for Stage II (Target year 2010), wastewater discharge was estimated at and 529,000 (including 136,000 m^3/day for the JSSP area). The Feasibility Study for the sewerage development was conducted for Stage I works.

B9.2.2 JWDP 2001

In order to implement the M/P, the Government of Indonesia and the Japan Bank for International Cooperation (now, JICA) concluded Loan Agreement IP-399. JAKARTA WASTEWATER DEVELOPMENT PROJECT 2001 (JWDP 2001) was a continued step to design for Stage I works. The Study Area in JWDP 2001 covered 40 Kelurahans, 8 districts and 3 municipalities. JWDP 2001 would serve 6,550 ha, about 9.9% of the city. However, the implementation of the project was not realized. The JICA Project Team could not find any documented evidence for the reasons of not implementing the project. It is believed to be mainly because of no resolution between DGHS and DKI Jakarta for sharing of the project cost.

(1) Phasing

JWDP 2001 planning was phased into two (2) stages:

A. Stage I

1. Phase 1

a. Setiabudi system (existing)
b. Casablanca/Sudirman system

2. Phase 2

a. Setiabudi system (existing)
b. Casablanca/Sudirman system
c. Thamrin sub-system (Gambir, Senen, Menteng, Tanah Abang)
d. Gajah Mada sub-system (Grogol, Taman Sari, Tambora, Sawah Besar, Pademangan)
e. Pantai Mutiara sub-system
f. Local Collector System
   - Siantar (Kampung Bali and Petamburan)
   - Grogol Reservoir
   - Kali Grogol (Jelambar)
   - Kali Ancol (Taman Sari and Sawah Besar)

B. Stage II

a. Gajah Mada System
b. Thamrin System
c. Pantai Mutiara System

(2) Wastewater Service System

Wastewater service system was divided in 7 sub-systems namely: Gajah Mada, Pantai Mutiara, Thamrin, Kali Ancol, Kali Grogol, Waduk Grogol and Siantar. For these 7 sub-systems for the wastewater treatment, 3 locations were proposed, namely WWTP Muara Baru to serve the sub-systems of Gajah Mada, Thamrin and Pantai Mutiara. Kali Ancol was planned to have self WWTP and while Kali Grogol and Grogol Reservoir are treated in their self WWTP in Grogol Reservoir.

JWDP 2001 proposed developing the sewerage system in the Central zone, as follows:

- Casablanca System (S1C and S2C)
- Thamrin System (S2T)
- Gajah Mada System (S2GM)
- Pantai Mutiara System (S2PM)
- Siantar System (S2SI)
- Grogol Reservoir System (S2WG)
- Grogol River System (S2KG)
- Ancol River System (S2KA)

The entire Stage I of the sewerage system including existing Setiabudi network, would cover 1,537 ha, or about 2.3% of the city. The Detailed Engineering Design was completed for this area under JWDP 2001.

(3) Capacity of the Wastewater Service Systems

Figure B9-3 shows the sewerage service area in the Central zone (JWDP 2001 Stage I Phase I & II).

The capacity of the wastewater service sub-system was as follows:

i) Gajah Mada sub-system: The wastewater capacity was estimated at 43,200 m³/day and this wastewater was proposed to be treated at Muara Baru WWTP.

ii) Pantai Mutiara sub-system: The wastewater capacity was estimated at 13,200 m³/day and this wastewater was proposed to be treated at Muara Baru

iii) Thamrin sub-system: The wastewater capacity was estimated at 15,900 m³/day and this wastewater was proposed to be treated at waduk Setiabudi

iv) Kali Ancol sub system: The wastewater capacity was estimated at 13,790 m³/day and this wastewater was proposed to be treated at Ancol

v) Kali Grogol sub-system: The wastewater capacity was estimated at 11,300 m³/day and this wastewater was proposed to be treated beside Mal Taman Anggrek

vi) Waduk Grogol sub-system: The wastewater capacity was estimated at 10,700 m³/day and this wastewater was proposed to be treated beside Mal Taman Anggrek

vii) Siantar sub-system: The wastewater capacity was estimated at 2,768 m³/day and this wastewater was proposed to be treated at Muara Baru

(4) Sewerage Pipe Alignment

In JWDP 2001, the main trunk for Thamrin sub system was flowed to WWTP at Setiabudi. As for the Gajah Mada sub system, the pipe line was flowed northern to WWTP at Muara Baru. While initially flows from the main thoroughfare (JL. Thamrin) would be conveyed to Setiabudi, ultimately these flows would be directed to Munara Baru. The planned main pipeline was to use single main pipe, which has diameter of around 600 mm - 2,400 mm.

(5) WWTP

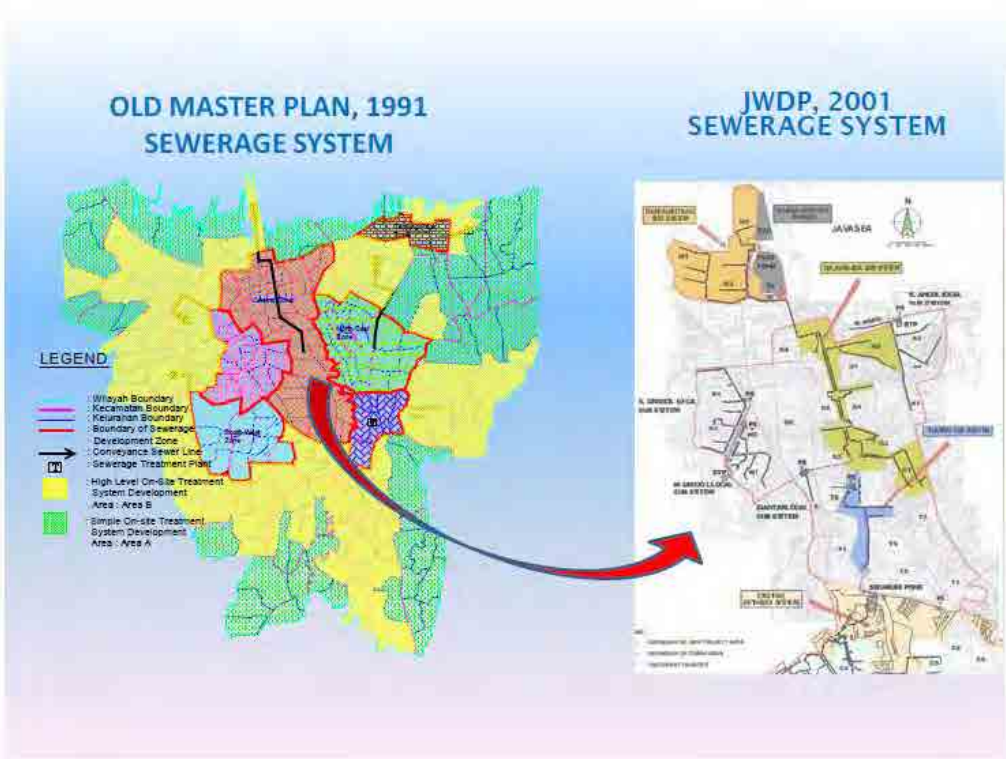
1) WWTP at Setiabudi Ponds

The proposed WWTP was based on Activated Sludge process with planning capacity of 66,000 m^3/day, which consists of 16,000 m^3/day from Phase 1 (East pond) and 50,000 m^3/day from Phase 2 (West pond). It was proposed to construct WWTP on the wet area of the Setiabudi ponds.

2) WWTP at Muara Baru

WWTP was proposed to handle wastewater from the Northern part of the Central zone (from Menteng) with planning capacity of 62, 000 m^3/day from Phase 2 based on Aerated Lagoon Process and with planning capacity of 78, 000 m^3/day from Stage II based on Activated Sludge Process. However, land was proposed from Sea Reclamation, moreover, access road to WWTP required sea reclamation and resettlements.

The design water quality of influent and effluent was 210 mg/L as BOD and 30 mg/L as BOD, respectively.



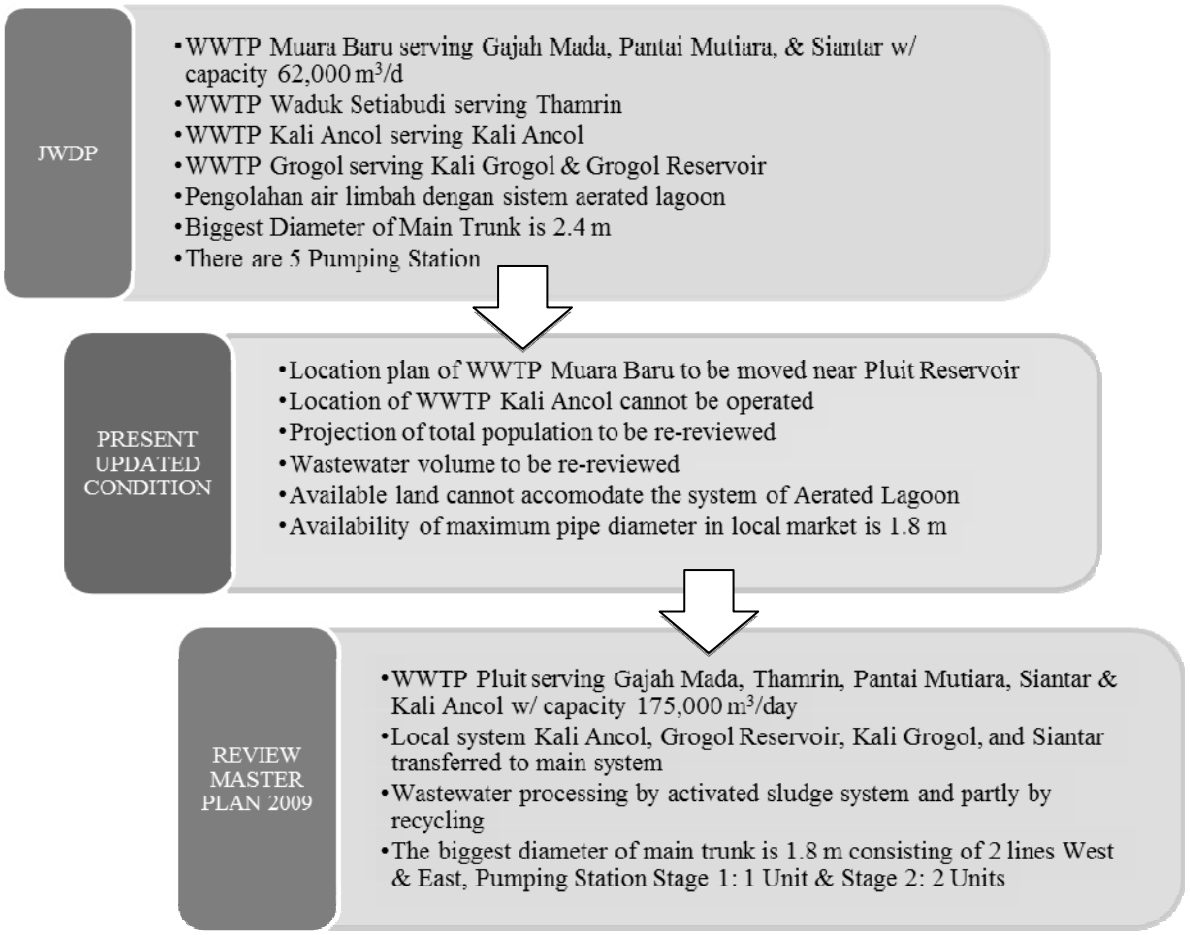
Source: Prepared by JICA Expert Team with Old M/P 2001 and JWDP 2001

Figure B9-3 Sewerage Development Area (old M/P 1991) and Service Area in the Central Zone (JWDP 2001 Stage I Phase I & II)

B9.3 Review of Master Plan and Detail Design for Jakarta Wastewater Development Project (Review Master Plan 2009)

B9.3.1 Background

The Review Master Plan 2009 is based on the review of old M/P 1991 and Detail Engineering Design documents of JWDP 2001 Phase 2 (Kuningan, Gatot Subroto, SCBD, Krukut, Menteng Pulo, Thamrin, Gajah Mada and Pantai Mutiara) to adapt to the present updated condition as outlined in Figure B9-4. The implementing agencies for the Review Master Plan 2009 preparation were DGHS and DKI Jakarta and the budgetary support was provided by DGHS.



Source: Prepared by JICA Expert Team with Review Master Plan 2009

Figure B9-4 Outline of the Review Master Plan 2009

B9.3.2 General Features of the Study Area

Figure B9-5 shows the Study Area of the Review Master Plan 2009.

The general features of the Study Area are as follows:

a) Study Area is the Central zone (Phase 2) consisting of 50 Kelurahan, 10 districts in 3 municipalities (Central Jakarta, West Jakarta and North Jakarta)

b) Size of the Study area is 6,532 hectares with a total population of 1,092,235 people (in 2009)

c) Topographic conditions

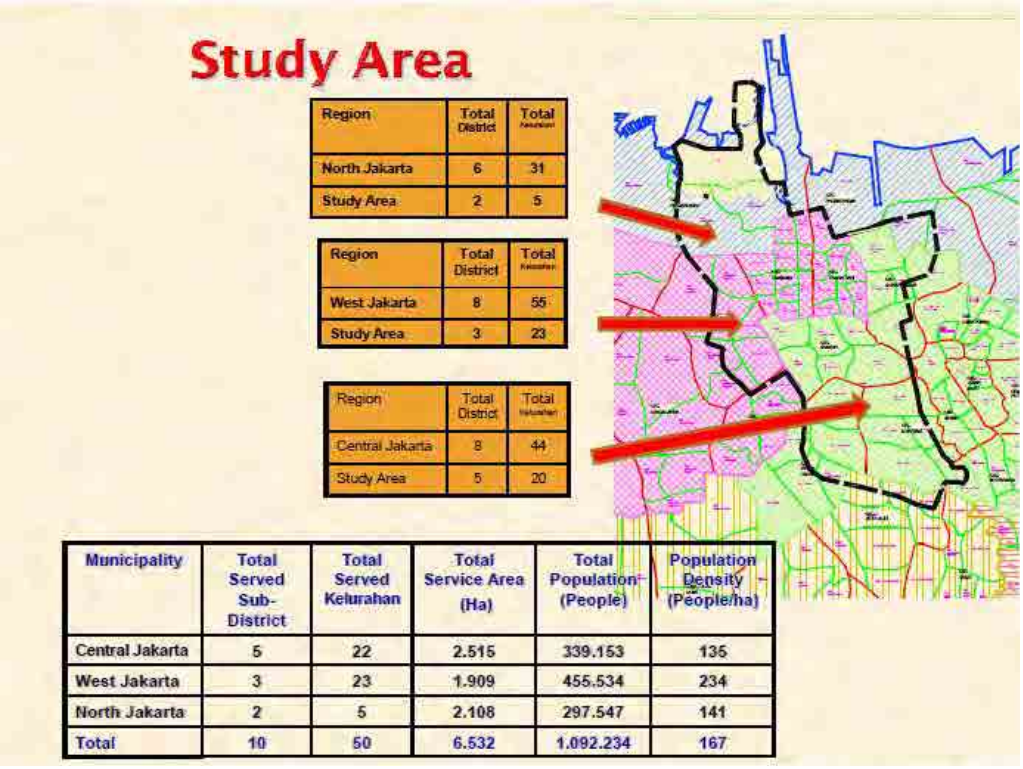
i) 40% of Jakarta area is under sea tide and crossed by 13 major rivers.

ii) The height of land from the coast up to the flood channel is 0-10 m above the sea level.

d) Geo-hydrological condition

i) Ground Water: Ground Water conditions in the service area is located in Region I in a form of low sediment 0-3 m (Saline) and the Land Region II is high sediment at 7-12 m

ii) Surface Water: DKI Jakarta crossed by 13 large rivers and some small rivers and 40 ponds spread across in 5 areas of the city.



Municipality	Total Served Sub-District	Total Served Kelurahan	Total Service Area (Ha)	Total Population (People)	Population Density (People/ha)
Central Jakarta	5	22	2.515	339.153	135
West Jakarta	3	23	1.909	455.534	234
North Jakarta	2	5	2.108	297.547	141
Total	10	50	6.532	1.092.234	167

Source: Prepared by JICA Expert Team with Review Master Plan 2009

Figure B9-5 Study Area of the Review Master Plan 2009

B9.3.3 Population Analysis of Review M/P 2009

i) Population Projections of the Study Area was based on data sources from the "District in Figures - Central Bureau of Statistics in 2006, 2007 and 2008".

ii) Population growth rate in Central Jakarta was generally negative, i.e. -0.8% to 0.2%, in West Jakarta positive at 0.1% to 3% while in North Jakarta 0.9%.

iii) Average growth rate estimated at + 1%, so the population in Study Area in 2020 was projected at 1,206,327 people.

iv) Population distribution leads to the outer regions while in the center the total population increasingly empty.

v) Density in the Central Jakarta showed a declining trend due to decline in population related with the changes in designated residential to commerce & institutors

B9.3.4 Service Levels

Table B9-3 shows the service level in the Review Master Plan 2009

Salient features of the service level are as follow:

a) Wastewater service area for the Central zone covered residential area, high building (Multistoried Building) and commercial& institution area. Along the piping line from Thamrin, Gajah Mada up to WWTP location at the South of Pluit reservoir, mostly are multi storied building and commercial area.

b) Based on the Regional Regulation of Governor of DKI Jakarta No. 122 in year 2005, the region which is passed by the wastewater piping system is obliged to connect with the piping system.

c) It was planned that the service level for multistoried building is 90% in Stage I (Target year 2020). It is expected that all the building that included in the multistoried building category shall connect

to the piping system.

d) Besides the multistoried building, commercial & institution area also mostly passed by piping system. It is planned than 60% of commercial & institution area will connect to piping system. In the meantime, for residential area the service target is only 23%.

e) Average wastewater service level in the Central zone up to the year of 2020 was proposed to be 45%, which was 7.4 % of the average service level of DKI Jakarta.

f) In 2030, the service level was to be increased to 70% in the Central zone or 14% against the population of DKI Jakarta.

g) The total service area in the Central zone would be increased to 69% or 6.6% against the total area of DKI Jakarta

Table B9-3 Service Level in the Review Master Plan 2009

DESCRIPTION	2020			2030		
	Area (ha)	Population (people)/(PE)	Wastewater (m^3/day)	Area (ha)	Population (people)/(PE)	Wastewater (m^3/day)
SERVICE AREA						
Residential	4,336	978,543	123,555	4,336	1,337,232	168,839
Multistoried Building	855	285,000	35,984	855	285,000	35,984
Commerce & Institution	947	346,400	43,781	947	347,667	43,781
Total	6,138	1,609,943	203,319	6,138	1,969,899	248,603
WASTEWATER SERVICE						
Residential	997	254,421	32,124	2,558	788,967	99,615
Multi-storied Building	769	256,500	32,386	855	285,000	35,984
Commerce & Institution	568	207,840	26,268	852	312,900	39,402
Total	2,335	718,761	90,778	4,266	1,386,867	175,001
SERVICE LEVEL						
Residential	23%	26%	26%	59%	59%	59%
Multistoried Building	90%	90%	90%	100%	100%	100%
Commerce & Institution	60%	60%	60%	90%	90%	90%
Average Service Level	38%	45%	45%	69%	70%	70%
DKI Jakarta	65,000	9,758,500		65,000	9,915,600	
DKI Jakarta (%)	3.60%	7.40%		6.60%	14.00%	

Source: Prepared by JICA Expert Team with Review Master Plan 2009

B9.3.5 Sewerage Pipe Alignment

In Review Master Plan, the Service area was divided into 2 Sub System of Main pipe routes, namely East Sub System Main piping route and West Sub System Main piping route, which has diameter of around 600 mm - 1,800 mm.

Figure B9-6 shows the wastewater collection system in the Review Master Plan 2009 comparing with JWDP 2001.

B9.3.6 WWTP

(1) WWTP at the South Side of Pluit Reservoir

The Stage I WWTP of capacity 86,400 m^3/day (or 1000 L/second) was planned to be constructed at the South side of Pluit reservoir. The planned treatment process type proposed was Activated Sludge by using Membrane Biological Reactor (MBR) 25%. The total necessary land required was around 3-4 ha, however, this land is occupied with the settlements.

(2) WWTP at the North Side of Pluit Reservoir

The Stage II WWTP of capacity of 86,400 m^3/day (or 1000 L/second) was planned to be constructed at the North side of Pluit reservoir. The planned treatment process type proposed was the same as in the Stage I, namely Activated Sludge by application of MBR 25%. The total necessary land required was around 3-4 ha, however, this land is occupied with the settlements.

The design water quality of influent and effluent was 213.31 mg/L as BOD, 124.52 mg/L as SS and 20 mg/L as BOD for the Extended Aeration (<5 mg/L as BOD for the Extended Aeration Plus Membrane), respectively.

The land condition at the two locations is still the people's land and is very difficult to acquire as it involves relocation of the people and compensation.

B9.3.7 Planning Stage

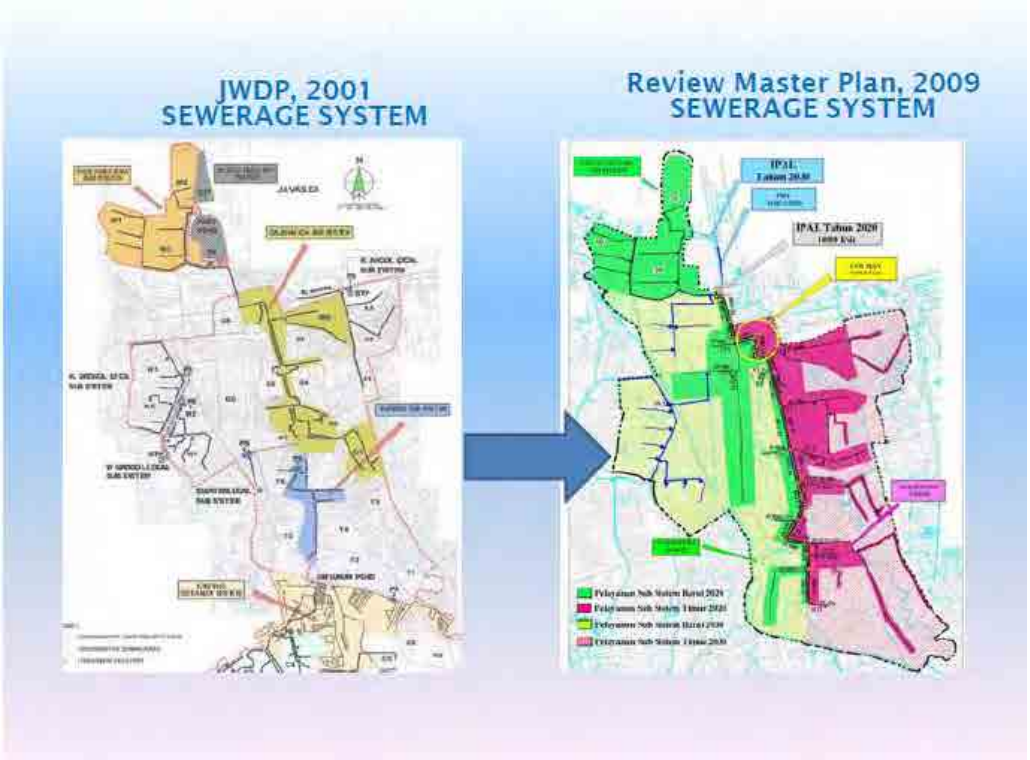
The construction of WWTP and piping system was planned in 2 stages:

(1) Stage I: 2010 – 2020

In the stage I, the construction of WWTP of capacity 86,400 m^3/day (or 1000 L/second) was planned in 2 phases which is respectively 43,200 m^3/day (or 500 L/second) for the West sub-system and 43,200 m^3/day (or 500 L/second) for the East sub-system.

(2) Stage II: 2020 – 2030

This stage was planned up to the year 2030. It is expected that up to 2030 the total volume of wastewater would increase to 175,001 m^3/day (or 2,000 L/second).



Source: Prepared by JICA Expert Team with JWDP 2001 Review Master Plan 2009

Figure B9-6 Wastewater Collection System (Lft Side-JWDP 2001; Right Side-Review Master Plan, 2009)

B10 Experiences in Similar Project

For Denpasar Sewergae Development Project (L/A for Japanese yen loan project was signed in November 1994) as the first large-scale sewerage development project in Indonesia, the project period was delayed for 7 years by the reasons of Asian monetary crisis, decentralization, delay of land acquisition, taking much time in coordination of investment sharing between the central government and local government, etc.

Through this experience, following lessons have been learnt for implementing sewerage project in Indonesia.

1) In case that sanitation project including sewerage is implemented not only in Indonesia, but also in many other countries, financial assistance by the central government is indispensable. It is necessary that some rule should be arranged for the financial sharing between the central and local governments. In Japan, establishment of subsidy system for sewerage project by the central government in 1970s contributed much to the acceleration of sewerage service ratio. In Indonesia, it has been confirmed that the central government will assist the sanitation project of the local government through a matching grant system which assists by the grant of the same amount as the local government share as a financial source of Acceleration of Urban Sanitation Development Program (PPSP) 2010-2014.
2) Since securing lands for wastewater treatment facilities is the most important issue in the sewerage devolopment, it is needed that required lands should be kept at the stage of M/P formulation.