CHAPTER 5 CURRENT SEWERAG CONDITION IN DENPASAR

5.1 General

In Bali Island, commercial and tourism sectors are getting expanded especially in Denpasar, Kuta and Sanur areas. Although large amount of wastewater is discharged from such areas, the both on-site and off-site systems are far from demanded level. Therefore, pollution of natural environment and human health are very much concerned.

In response to the above situation, GOI and JICA entered into loan agreement of Denpasar Sewerage Development Project Phase-I (DSDP-I) in November 1994. The project covers 1,145 ha of urgently required areas of sewerage system identified in the Denpasar Sewerage Development Master Plan (DSDMP) prepared by JICA in 1993.

On the other hand, the Government of Bali province desired to establish a new organization for management and operation of the sewerage system including wastewater treatment plant. And then, governor of Bali province, Mayor of Denpasar and Regent of Badung signed joint agreement regarding the establishment of operation body named Wastewater Management Body (BPAL). However, the operation body was later decided to be established as Public Service Organization of Wastewater Management (BLUPAL) instead of BPAL based on the Government regulation on financial management of public service agency (BLU) promulgated in 2005. And finally, BLUPAL was established in December 2006.

Though DSDP-I completed the construction in August 2008, some urgently required areas of sewerage development in Denpasar and Kuta identified in the Master Plan were not covered by DSDP-I. Some communities in Kuta and Sanur also strongly requested to develop sewerage system immediately. Furthermore, BLUPAL intended to start tariff collection by the end of 2009, since revenue from service areas of the Project would contribute to improve BLUPAL's financial situation. In response to the above conditions, JICA conducted Special Assistance for Project Implementation (SAPI) to start sewerage system expansion works of DSDP-II and to suggest and support the tariff system and financial plan of BLUPAL.

5.2 Sewerage Management Organization

5.2.1 Organizational Policy and Strategy

In order to make Bali as a clean, healthy, and comfortable cultural tourism region then it needs to be concerned not only by Bali people but also the Local Government, one of them by processing the waste water becomes the clean water which today has been done by Denpasar Sewerage System Development Project and managed by the Agency of Public Service for Waste Water Management (BLUPAL) of Bali.

Vision of BLUPAL OF BALI:

To develop the Integrated Wastewater Management System to create clean, healthy, and comfortable cultural tourism region for Bali Dwipa JAYA (Bali Prosperous).

Mission of BLUPAL OF BALI:

- To improve the awareness, willingness, and ability of the people to have clean and healthy attitudes, through the improvement of environment sanitation
- To improve the service access to on-site and off-site wastewater management systems in urban area

- To optimize wastewater management system for the people's benefit, through improvement of technology capability and human resources
- To coordinate the plans of Central Government, Local Government, and stakeholders to prepare integrated implementation programme, according to the application of Finance Management Pattern of Public Service Agency (PPK-BLU)

5.2.2 Organization Structure

Figure 5.2.1 shows organization structure of BLUPAL and ***Figure 5.2.2*** shows organization structure of Wastewater Treatment Plant Section. BLUPAL has 55staff including 12 temporary workers and DSDP has 14 staff for O&M works in December 2009.

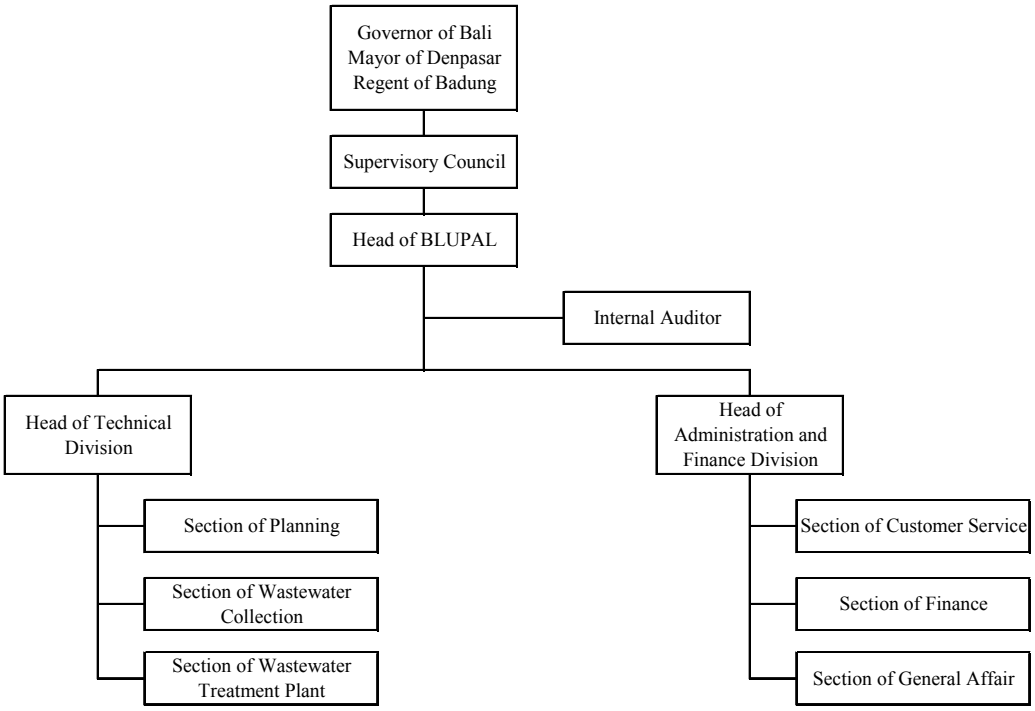

Figure 5.2.1 - Organization Structure of BLUPAL
Source: BLUPAL

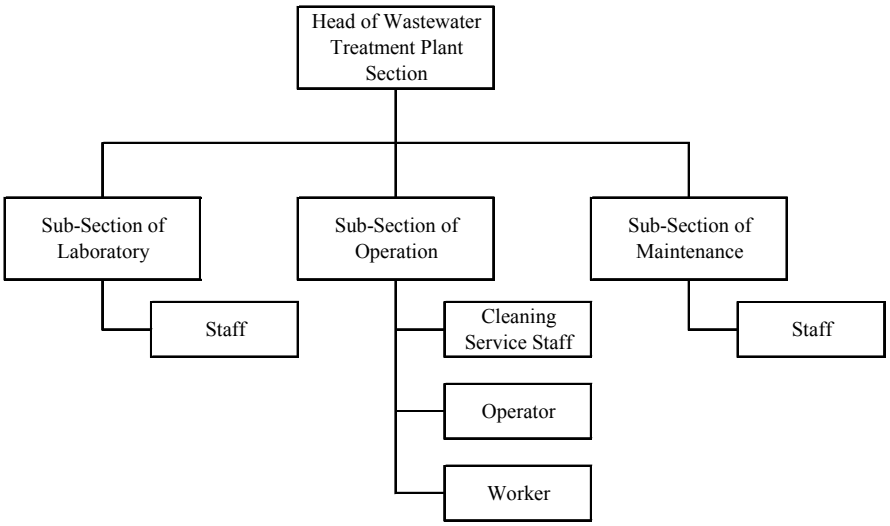

Figure 5.2.2 - Organization Structure of WWTP Section
Source: BLUPAL

5.2.3 Duty and Work

A main duty of BLUPAL is to implement sewerage services smoothly and continuingly, and the functions of BLUPAL are listed as follows:

- To make plan and work programme for short, medium and long periods in order to develop sewerage system and wastewater management
- To make and apply the programme of survey, data collection, analysis, and to make technical guideline for sewerage service and system of wastewater processing
- To operate and maintain the sewerage system including wastewater treatment palnt to meet required effluent standard.
- To serve for application of house connection in its service area
- To supervise and control the quality of wastewater from customer for compliance of wastewater receiving standard.
- To inform sewerage system development plan of the Local Government to the public
- To organize the tariff collection for wastewater management services and other eligible incomes according to the effective regulation
- To organize work relationship with various parties to achieve the objectives as decided.

5.2.4 Law and Regulation

Legal basis which had issued by the Government to support the existence of BLUPAL so that become the basis for BLUPAL in running its duties and functions as the institution of sewerage management body are:

- Acts No.1 year 2004: Regarding the State Treasury
- Regulation of Government No. 23 Year 2005: Regarding the Finance Management of Public Service Agency
- Regulation of Ministry of Home Affairs No.61 Year 2007: Regarding the Technical Guideline for Finance Management of Local Public Service Agency
- Joint Decree of Governor of Bali, Regent of Badung, and Major of Denpasar
  No.10 Year 2002,
  No.640 Year 2002
  No. 276 Year 2002
  : Regarding the Implementation of Joint Management of Sewerage System
- Joint Regulations of Governor of Bali, Regent of Badung, and Major of Denpasar
  No. 37A Year 2006
  No.1 Year 2006
  No.36A Year 2006
  : Regarding the Joint Management of Sewerage System
- Decree of Governor of Bali No. 404/04-F/HK/2007: Regarding the Implementer Decision of agency of Public Service of Sewerage Management (BLUPAL)

5.3 Sewerage System

5.3.1 Covered Area and Sewered Population

The sewerage system of DSDP is divided into three (3) areas of Denpasar, Sanur and Kuta covering catchment areas of 2,760 ha, 699 ha and 960 ha respectively. These three (3) sewerage development areas exist separately; hence, sewerage collection systems were developed independently by area. DSDP-I only covered part of original urgent sewerage development area and due to the request of local community in Kuta, North Legion - Seminyak area was covered by sewerage system instead of South Kuta area by a changing order in 2005. The service areas of Denpasar, Sanur and Kuta by DSDP-I, DSDP-II and the remaining sewerage development area specified in the Master

Plan (refer as DSDP-III) are shown in ***Table 5.3.1***.

Table 5.3.1 - Service Area of DSDP

Location	Denpasar (ha)	Sanur (ha)	Kuta (ha)	Total (ha)
DSDP-I	520	406	295	1,221
DSDP-II (On Going)	290	164	420	874
DSDP-III (Future)	1,950	129	245	2,324
Overall Project	**2,760**	**699**	**960**	**4,419**

Source: BLUPAL

Served population and number of house connection targeted by DSDS-I is shown in ***Table 5.3.2***.

Table 5.3.2 - Targeted Served Population and Service Connection of DSDP-I

Description	Denpasar	Sanur	Kuta	Total
Served Population (person)	73,700	16,500	13,000	103,200
House Connection	5,350	1,890	1,860	9,100

Source: BLUPAL

There is an urgent need to extend the sewerage collection system in Denpasar, Sanur and Kuta to reduce direct discharge of wastewater to the rivers and sea, protect the tourism resources, reduce the public nuisance, and improve the public health.

To cope with the above mentioned requirement, the following works were contructed by International Competitive Bidding (ICB) in DSDP-II are to construct:

- Main sewer of 25,500 m in Denpasar, 12,500 m in Sanur and 20,200 m in Kuta
- Main sewer by pipe jacking of 2,300 m in Kuta
- Secondary sewer of 4,500 m in Denpasar, 3,150 m in Sanur and 3,800 m in Kuta
- Manhole of 600 units in Denpasar, 420 units in Sanur and 460 units in Kuta
- Wet pit pumping station of 3 units in Denpasar, 1 unit in Sanur and 5 units in Kuta
- Road restoration of 150,000 m^2 in Denpasar, 80,000 m^2 in Sanur and 151,400 m^2 in Kuta
- Generator for Sanur and Kuta pumping station
- Additional aerator of 10 sets in WWTP
- Drying sludge bed and Garage for maintenance equipment in WWTP
- Procure maintenance equipment

On the other hand, the following constructions are covered by Local Competitive Bidding (LCB):

- Tertiary sewer of 8,100 m in Denpasar, 1,850m in Sanur and 16,800 m in Kuta
- House connection of 1,500 units in Denpasar, 3,000 units in Sanur and 2,620 units in Kuta
- Manhole of 160 units in Denpasar, 40 units in Sanur and 340 units in Kuta
- Road restoration of 32,000 m^2 in Denpasar, 7,400 m^2 in Sanur and 59,000 m^2 in Kuta

5.3.2 Sewerage Generation

The existing master plan conducted in 1993 by JICA estimated the average domestic wastewater as 196 litres per capita per day (lpcd) in 2010.

5.3.3 Facilities and Equipment

(1) Wastewater Collection System

The sewerage system of DSDP-II covers Denpasar area of 290ha, Sanur area of 164ha and Kuta area of 420ha. As the three (3) sewerage development areas exist separately, sewerage collection system is developed independently by area. Each system will be connected to as-built manholes of DSDP-I. ***Figure 5.3.1*** shows general plan of project area.

Main sewers in Denpasar are planned to install in Jl. Ratna, Jl. Suli, Jl. Kartini and Jl. Nusa Kambangan. Diameter of main sewers in Denpasar ranges from 300 mm to 700 mm. Total length of main sewers in Denpasar is about 25,500 m and installed by open cut method. The coverage area and main sewer route are shown in ***Figure 5.3.2***. Secondary sewers in Denpasar are about 4,500 m with a diameter of 250 mm installed by open cut method.

Main sewers in Sanur are planed to install in Jl. Batursari, Jl. Tirtan Nadi II. Diameter of main sewer in Sanur ranges from 300 mm to 500 mm. Total length of main sewers in Sanur is about 12,500 m and installed by open cut method. The coverage area and main sewer route are shown in ***Figure 5.3.3***. Secondary Sewers in Sanur are about 3,150 m with a diameter of 250 mm installed by open cut method.

Main sewers in Kuta are installed in Jl. Raya Legian, Jl. Raya Kuta, Jl. Singo Sari, Jl. Kartika Plaza, Jl. Pantai Kuta and Jl. Raya Pantai Kuta, Jl. Buni Sari, Jl. Wana Segara. Main sewers in Jl. Raya Legion and Jl. Kartika Plaza are installed by pipe jacking method to minimize the adverse effect to traffic. Main sewers in remaining roads are installed by open cut method. Diameters of main sewers installed by pipe jacking method are 300 mm to 800 mm with a total length of 2,300 m. Diameter of main sewers installed by open cut method ranges from 300 mm to 600 mm with the total length of about 20,200 m. The coverage area and main sewer route are shown in ***Figure 5.3.4***.

Secondary sewers in Kuta are about 3,800 m with a diameter of 250 mm installed by open cut method.

The achieved number of connected customers to sewerage service by DSDP-I is 8,647 connections in December 2009, and the details of connection are shown in ***Table 5.3.3***.

BLUPAL has already registered 5,000 customer's information to database.

Table 5.3.3 - Detail of Service Connection of DSDP-I

No	Name of Project Package	Total House Connections
A	PIPING	
1	Social	32
2	Household Type A	4,357
3	Household Type B	3,446
4	Household Type C	628
5	Institution	40
6	Star Hotel per room	-
7	Non star hotel per room	4
8	Inn	-
9	Restaurant-small	28
10	Restaurant -medium	-
11	Restaurant-Large	-
12	Commercial-Small	112
13	Commercial-medium	-
14	Commercial-Large	-
15	Public facility	-
16	Industry	-
B	NON-PIPING	
1	Cleaning Septic tank	-
2	Service Truck for feces	-
TOTAL CONNECTIONS		**8,647**

Note:
Type A: Housing which faces to road with a width of below 7 m including the drainage
Type B: Housing which faces to road with a width of greater than or equal to 7 m to below 10 m including the drainage
Type C: Housing which faces to road with a width of above 10 m including the drainage
Source: BLUPAL

Picture 5.3.1
Main Sewer Root

Road Condition of One of Main Sewer Root

Figure 5.3.1 - General Plan of Project Area
Source: Special Assistance for Project Implementation (SAPI) Report (Final), JICA, October 2007

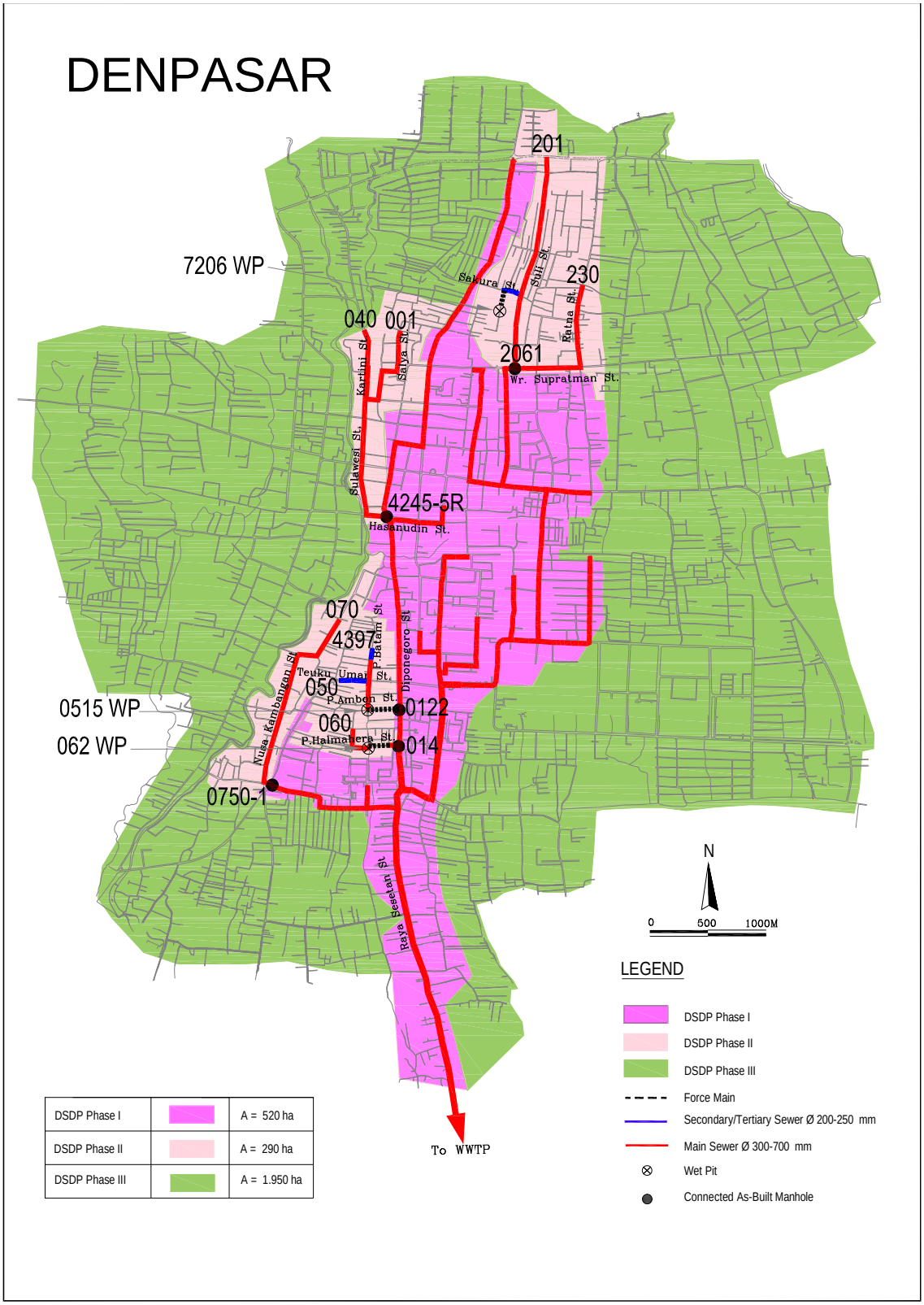

Figure 5.3.2 - Coverage Area and Sewer Route in Denpasar
Source: BLUPAL

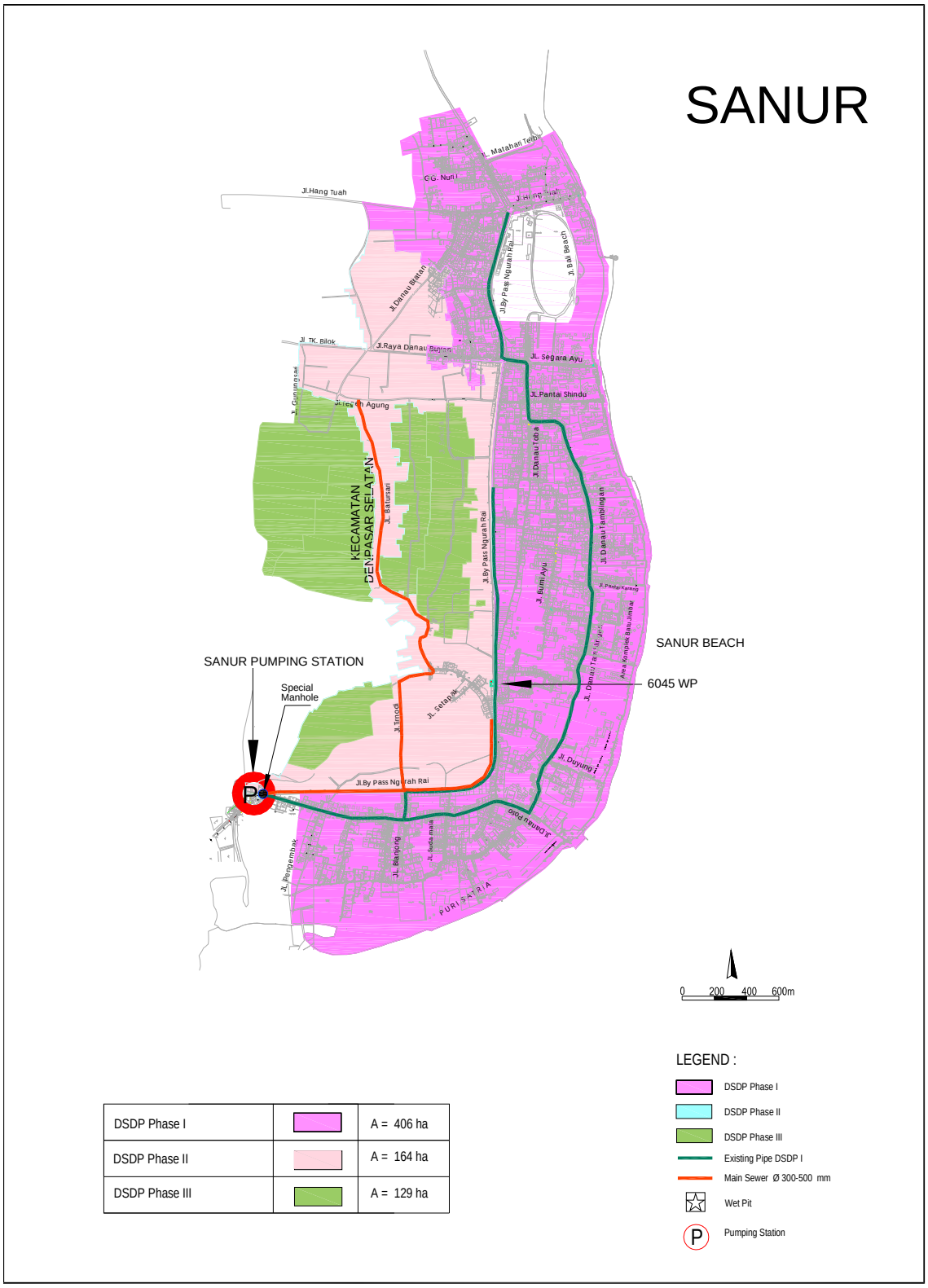

Figure 5.3.3 - Coverage Area and Sewer Route in Sanur
Source: BLUPAL

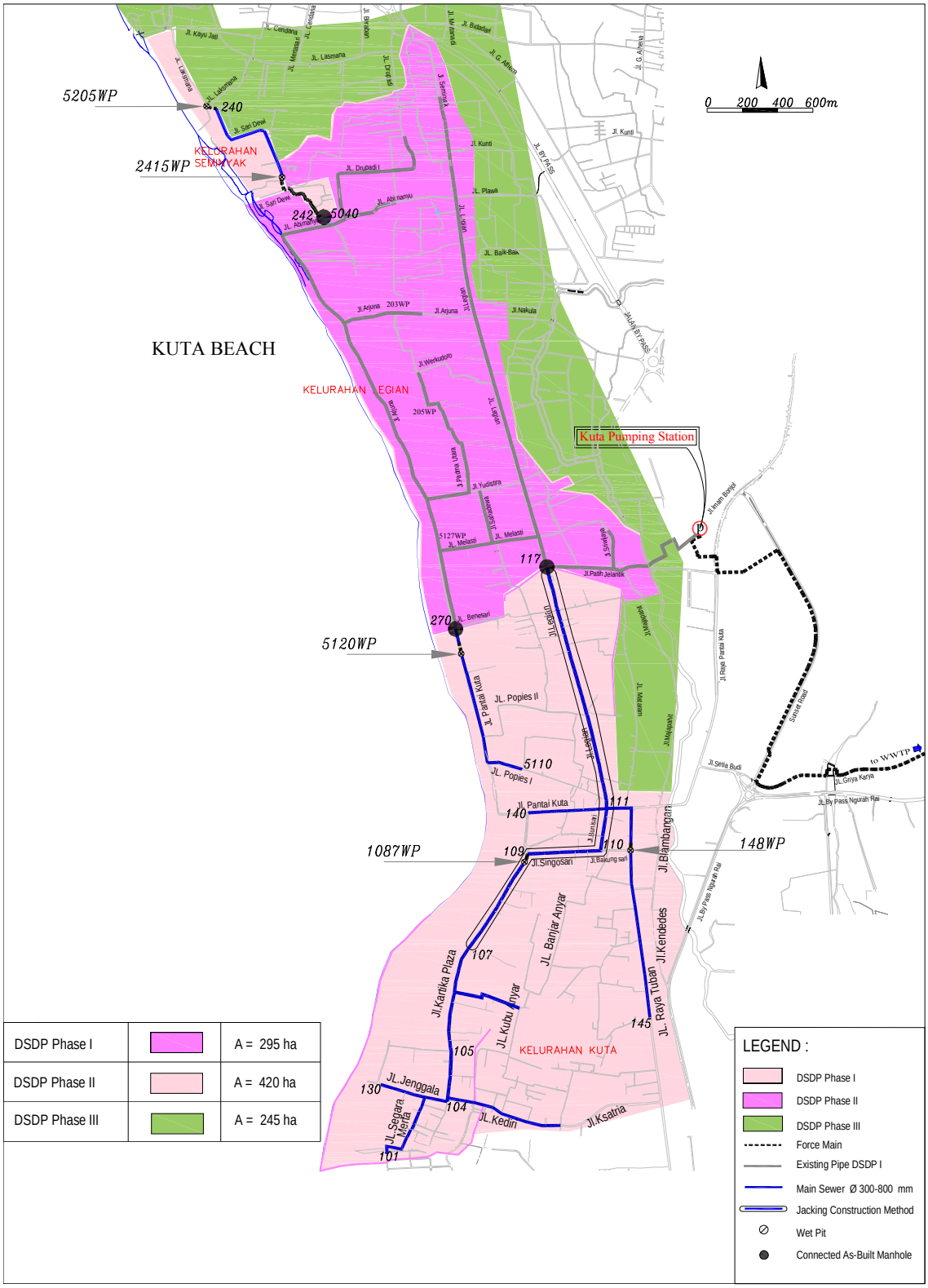

Figure 5.3.4 - Coverage Area and Sewer Route in Kuta
Source: BLUPAL

(2) Wastewater Treatment System

The Pengolahan Wastewater Treatment Plant is located at Suwung Village in Pamogan area of Denpasar city with an acquired area of 10 ha, and the designed capacity is 51,000 m^3/day. Howerver, number of connection and influent quantity are still low as 8,647 connections and approximately 8,000 m^3/day by DSDP-I.

The layout plan of Pengolahan WWTP is depicted in ***Figure 5.3.5***, and summary of treatment process is illustrated in ***Figure 5.3.6***.

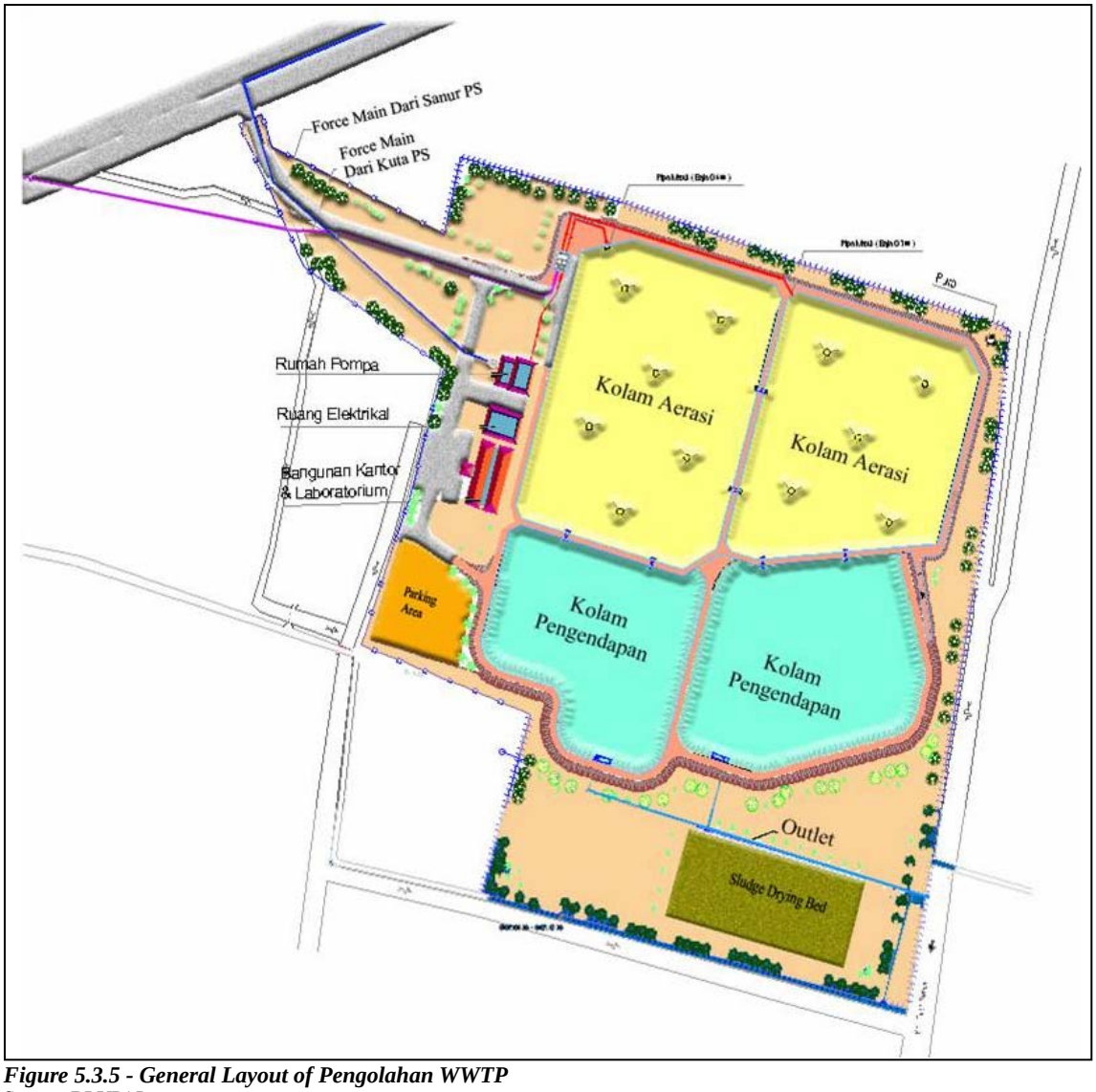

Figure 5.3.5 - General Layout of Pengolahan WWTP
Source: BLUPAL

The Summary of WWTP is shown as follows:

- Location : Suwung, Village of Pemogan, Denpasar
- Area : 10 ha and the used/built is 5.5 ha
- Design Capacity : 51,000 m^3/day
- Quality of effluent : BOD < 30 mg/1it, SS < 40 mg/lit
- Treatment Process : Aerated Lagoon

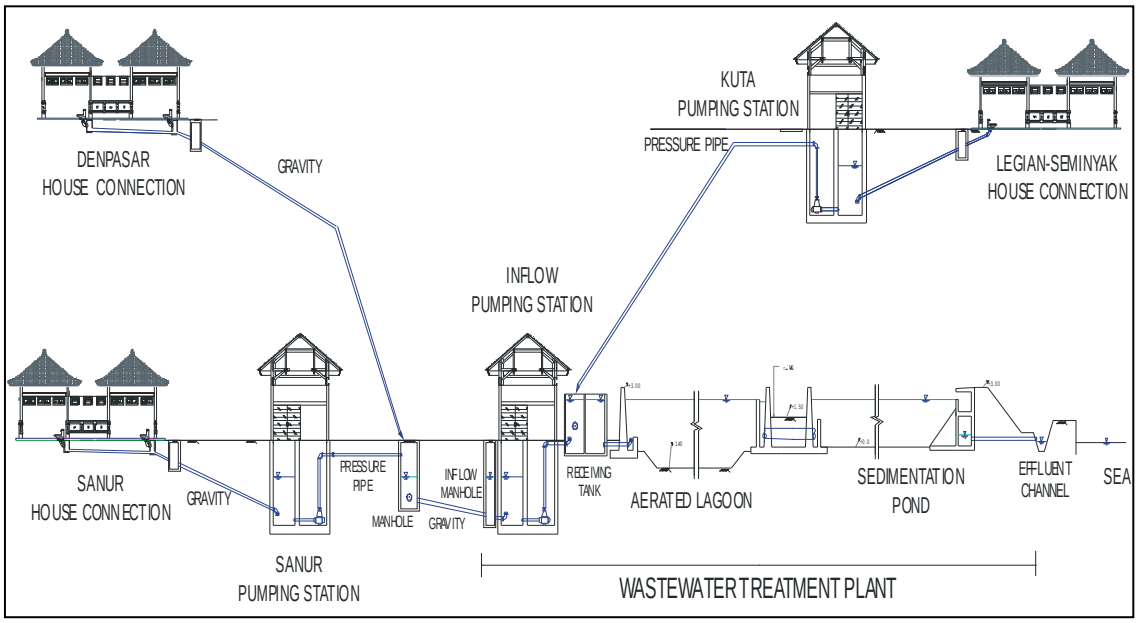

Figure 5.3.6 - General Diagram of Treatment Process
Source: DSDP

Picture 5.3.2
Pengolahan WWTP

Inlet Facilities

5.3.4 Water Quality Control

BLUPAL monitors and controls of effluent quality. ***Table 5.3.4*** shows record of flow rate and influent quality (COD & BOD_5) of WWTP in September 2009.

Table 5.3.4 - Record of Flow Rate and Influent Quality (COD & BOD) of WWTP in September 2009

No	Date	Day	Inflow from Denpasar & Sanur (m^3/day)	Inflow from Kuta PS (m^3/day)	Total Inflow (m^3/day)	COD (mg/l)		BOD (mg/l)	
						influent	effluent	influent	effluent
1	1-Sep-09	Tue	4,491.9	714.0	5,205.9	193.6	158.4	98.7	16.5
2	2-Sep-09	Wed	6,231.0	2,142.0	8,373.0	202.4	96.8	27.5	11.5
3	3-Sep-09	Thu	9,904.5	1,428.0	11,332.5	246.4	98.6	28.5	18.0
4	4-Sep-09	Fry	3,831.6	1,428.0	5,259.6	325.6	75.4	137.8	17.4
5	5-Sep-09	Sat	7,393.5	1,428.0	8,821.5	195.0	128.8	24.5	12.3
6	6-Sep-09	Sun	5,859.0	1,428.0	7,287.0	93.3	95.0	13.8	3.6
7	7-Sep-09	Mon	5,561.4	714.0	6,275.4	263.1	99.4	86.4	8.8
8	8-Sep-09	Tue	8,323.5	714.0	9,037.5	75.4	112.2	9.6	31.2
9	9-Sep-09	Wed	7,867.8	714.0	8,581.8	51.5	58.8	12.6	19.5
10	10-Sep-09	Thu	18,488.4	1,428.0	19,916.4	158.4	167.2	79.5	19.8
11	11-Sep-09	Fry	5,431.2	714.0	6,145.2	52.8	193.6	20.4	18.9
12	12-Sep-09	Sat	5,961.3	2,142.0	8,103.3	91.5	63.4	8.4	6.8
13	13-Sep-09	Sun	6,054.3	1,428.0	7,482.3	223.5	75.7	20.8	12.8
14	14-Sep-09	Mon	6,705.3	2,142.0	8,847.3	149.6	61.6	15.0	5.6
15	15-Sep-09	Tue	9,374.4	2,856.0	12,230.4	73.9	100.3	20.7	19.5
16	16-Sep-09	Wed	3,152.7	2,142.0	5,294.7	76.2	98.6	70.3	70.3
17	17-Sep-09	Thu	9,858.0	714.0	10,572.0	134.4	96.3	50.4	19.2
18	18-Sep-09	Fry	5,580.0	714.0	6,294.0	425.6	150.0	55.2	20.4
19	19-Sep-09	Sat	5,645.1	2,142.0	7,787.1	109.7	78.4	26.6	12.4
20	20-Sep-09	Sun	5,635.8	1,428.0	7,063.8	127.7	67.2	69.6	22.4
21	21-Sep-09	Mon	5,580.0	1,428.0	7,008.0	56.0	78.4	7.6	10.4
22	22-Sep-09	Tue	5,180.1	1,428.0	6,608.1	123.2	179.2	3.0	39.0
23	23-Sep-09	Wed	4,808.1	1,428.0	6,236.1	136.6	89.6	55.2	24.8
24	24-Sep-09	Thu	6,184.5	714.0	6,898.5	82.0	72.0	48.0	20.8
25	25-Sep-09	Fry	5,598.6	714.0	6,312.6	68.0	74.0	69.6	43.2
26	26-Sep-09	Sat	5,542.8	1,428.0	6,970.8	98.0	60.0	67.2	22.4
27	27-Sep-09	Sun	4,873.2	1,428.0	6,301.2	80.0	66.0	52.8	28.0
28	28-Sep-09	Mon	6,379.8	1,428.0	7,807.8	172.0	140.0	81.4	12.8
29	29-Sep-09	Tue	-	1,428.0	-	160.0	92.0	67.2	38.0
30	30-Sep-09	Wed	-	1,428.0	-	170.0	98.0	100.8	72.2
		Total	**185,497.8**	**41,412.0**	**224,053.8**				
		Average	**6,624.9**	**1,380.4**	**8,001.9**	**145.9**	**101.2**	**45.0**	**20.3**

Note:
1 to 15 September : aerator was operated within 17 hours
16 to 30 September : aerator was operated within 11 hours

Average COD effluent for 17 hours operated aerator is 106 mg/l
Average COD effluent for 11 hours operated aerator is 97 mg/l

Average BOD effluent for 17 hours operated aerator is 15 mg/l
Average BOD effluent for 11 hours operated aerator is 33 mg/l

Source: BLUPAL

The regulation of Governor of Bali Number 8 Year 2007 is stated the quality standard of environment and criteria standard of environmental damage as shown in ***Appendix 5.3.1***. BLUPAL tries to keep effluent quality to hold this regulation.

5.3.5 Laboratory

The laboratory for basic water quality analysis is in the WWTP. Two biologists and one sanitary engineer are assigned in the laboratory and analyze basic water quality parameters everyday. ***Table 5.3.5*** shows the laboratory works in the Pengolahan WWTP of BLUPAL Denpasar.

Table 5.3.5 - Laboratory Works in the Pengolahan WastewaterTreatment Plant

Staff	Biologist 2, Sanitary Engineer 1
Analyzing Parameters	Water Temperature, pH, COD_{Cr} (Titration Method), DO (Winklar Method), BOD (Dilution Method)
Samples	Influent, Inflow to Sedimentation (Maturation) Pond, Effluent
Frequency of Analysis	Everyday including holidays

The high frequency of analysis was fixed at the beginning of operation of WWTP in order to learn the analyzing method and soon the frequency will be reduced. Currently analyzing parameters are only five and the WWTP is requesting to introduce analyzing equipments in DSDP Phase II. Until the introduction of the equipments, water quality parameters like heavy metals are analyzed in the laboratory of City Health Department once a month.

Table 5.3.6 shows Laboratory equipment which DSDP shall procure in DSDP-II.

Picture 5.3.3
Pengolahan WWTP

Receiving Chamber

Table 5.3.6 - List of Laboratory Equipment

NO	ITEM	UNIT	QUANTITY
1	**Analysis Equipment**		
1.1	Analytical Balance, capacity 240 g, readability 0.1 mg	unit	1
1.2	Microscope Binocular	unit	1
1.3	High Temperature Oven, temperature 600 OC, Cap. 20 lit	unit	1
1.4	Incubator, temperature 15 ~ 80 OC, Cap. 11 lit	unit	1
1.5	Water Bath, Control range 10 ~ 95 OC, Cap. 30 lit	unit	1
1.6	Water Distilling, Cap. 4 lit/h, Storage tank 8 lit	unit	1
1.7	Deionizer, Cap. 19 ~ 38 l/h	unit	1
1.8	Centrifuge, Max. 4000 rpm, Cap. 6 × 50 ml	unit	1
1.9	Vacuum Filtering	unit	1
1.10	Refrigerator, Cap : 479 lit	unit	1
1.11	DO meter	unit	1
1.12	pH meter	unit	2
1.13	Glassware such as Erlenmeyer, Beaker glass, Mattglass, Desicator, Buret, Thermometer, BOD, bottles, etc	unit	1
1.14	Glassware Dryer	unit	1
2	**Ancillary Equipment**		
	Supply and installation of equipment, including all material necessary to complete the work.		
2.1	Sink porcelain, 90 (L) × 75 (W) × 80 (H)	unit	1
2.2	Stainless sink, 180 (L) × 75 (W) × 20 (H)	unit	1
2.3	Central experiment table, 250 (L) × 180 (W) × 80 (H)	unit	1
2.4	Side wall experiment table, 200 (L) × 75 (W) × 80 (H)	unit	1
2.5	Table for microscope, 120 (L) × 75 (W) × 75 (H)	unit	1
2.6	Table for balance, 140 (L) × 75 (W) × 75 (H)	unit	1
2.7	Chemical shelf, 180 (L) × 40 (W) × 180 (H)	unit	2
2.8	Equipment shelf, 180 (L) × 40 (W) × 180 (H)	unit	2
3	**Chemical Agent**	L.S.	1
4	**Others**		
	Computer (including printer)	unit	1

Source: DSDP

5.3.6 Operation and Maintenance

Periodic O&M works of sewers have not been implemented; only accident response works have been implemented by both BLUPAL and DSDP. Also O&M works of facilities and equipment have responded when the facilities is damaged or equipment is broken-down.

5.3.7 Operation and Maintenance Equipment

Table 5.3.7 shows O&M equipment which DSDP shall procure in DSDP-II.

Table 5.3.7 - List of O&M Equipment

NO	ITEM	UNIT	QUANTITY
1	Water jet cleaner 4 t (2.5 m^3, 19.6 MPa, 220 lit/min)	unit	1
2	Vacuum cleaner 4 t (3 m^3)	unit	1
3	Water tanker 4t	unit	1
4	Vacuum car for sewage 3 m^3	unit	3
5	Sludge hauling dump truck 4 t	unit	2
6	Truck with crane 4 t	unit	1
7	Fork Lift 1.5 t	unit	1
8	Engine Pump 100 mm 4 kw vacuum type, h = 20 m, Q = 1.4 m^3/min	unit	4
9	Portable generator on trailer		
9.1	50 kVA AC 220 V, 50 Hz, 3phase, 4wire	unit	1
9.2	Portable generator on trailer 20 kVA, AC 220 V, 50 HzZ, 3 phase, 4 wire	unit	2
10	Portable gas detector (combustible gas, CH^4, O^2, H^2S)	unit	2
11	Car four-wheel two-drive, displacement 2000 cc carrying 7 person	unit	2
12	Car pick up 1 t	unit	2
13	Motorbike displacement 125cc	unit	10
14	Sewer pipe cleanner (mechnical) with rotating rod		
14.1	Sewer pipe cleanner (mechnical) for pipe diameter 75 ~ 100 mm	set	2
14.2	Sewer pipe cleanner (mechnical) for pipe diameter 75 ~ 350 mm	set	2
15	Blower fan 50 m^3/min	set	2
16	Tripod φ 60 mm × 3 post h = 3 m	set	2
17	Chain hoist 2 t	set	2
18	Chain hoist 1 t	set	2
19	FRP Rowboat capabble of carrying 4 person	set	1

Source: DSDP

5.3.8 Disposal of Waste, Sludge and Garbage

The sludge collected from septic tank is transported to night soil treatment plant (Inhof Tank plus Oxidation Ditch) located in Tabanan regency. Garbage and solid wastes collected in sewerage system are translated to Suwung disposal site located in Denpasar.

The sludge generated in WWTP has not been collected currently. It is expected to treat by drying bed which will be constructed in 2014 by DSDP-II.

5.3.9 Ledger

BLUPAL is currently preparing a customer database which includes basic customer information and water consumption, and amount of charges for water supply and electricity. The sample application form for customer information survey is shown in ***Appendix 5.3.2***.

	***Picture 5.3.4*** ***Pengolahan WWTP*** Aerated Lagoon
	***Picture 5.3.5*** ***Pengolahan WWTP*** Effluent from Pengolahan WWTP
	***Picture 5.3.6*** ***Discharge of Effluent from WWTP*** Discharge Point of Effluent from WWTP

	***Picture 5.3.7*** ***Pengolahan WWTP*** Laboratory in Pengolahan WWTP
	***Picture 5.3.8*** ***O&M Equipment*** Dump Track with Crane and Mobile Power Generator Units
	***Picture 5.3.9*** ***Suwung Disposal Site*** Suwung Disposal Site for Garbage and Solid Wastes

5.4 Current Water Supply Condition

(1) Management Condition

The current water supply conditions of Denpasar and Badung administrative divisions are summarized in ***Table 5.4.1***.

Table 5.4.1 - Water Supply Conditions of Denpasar and Badung Administrative Divisions

City/Regency	Population in 2005	Service Ration in 2005		Supply Capacity (lit/sec)	Demand (lit/sec)
		Urban	Rural		
Denpasar City	574,610	64 %	36 %	1,085	1,085
Badung Regency	388,548	85 %	15 %	609	557

Source: Preparatory Survey for Southern Bali Water Supply Development Project in the Republic of Indonesia (Final Report), NSC under JICA, October 2009

(2) Financial Condition

The financial status of PDAM Denpasar and PDAM Badung is shown in ***Table 5.4.2***. PDAM Denpasar recorded negative profit for 3 (three) years from 2004 to 2006. In addition, the ratio of short-term liability for both PDAMs is relatively high. Based on 2007 statistics, the ministry of Public Works (DEPPU) evaluated the financial conditions of PDAM Denpasar and PDAM Badung as being unhealthy.

Table 5.4.2 - Financial Status of PDAM Denpasar and PDAM Badung

PDAM	Total Profit before Tax (IDR/m^3)			Ration of Short-Term Liability in 2006	Evaluation by DEPPU in 2008
	2004	2005	2006		
PDAM Denpasar	-45	-362	-529	83 %	Less Healthy
PDAM Badung	-349	34	43	60 %	Less Healthy

Source: Preparatory Survey for Southern Bali Water Supply Development Project in the Republic of Indonesia (Final Report), NSC under JICA, October 2009

By the Ministry of Finance Decree established in July 2008, PDAMs qualified with certain conditions can obtain reduction or exemption of debt. PDAM Denpasar and PDAM Badung were evaluated as financially unhealthy.

(3) Relationship with Sewer Management

The BLUPAL will merge PDAM after becoming stable management in future, and sewerage is always close relationship with water supply.

5.5 Socio-Economic Survey

The socio-economic conditions of Bali province are shown in the report on Special Assistance for Project Implementation (SAPI) for Denpasar Sewerage Development Project (DSDP) implemented by JICA in 2007. On the other hand, a "Willingness to Pay" survey was carried out by BLUPAL in 1998; however, the result of survey could not get in these surveys.

5.6 Tariff Structure

Proposed tariff structure is currently under processing for approval. The proposed tariff structure is shown in ***Table 5.6.1***.

Table 5.6.1 - Proposed Tariff Structure in 2009

NO	CUSTOMER CLASSIFICATION		IDR/month
A.	**PIPING**		
I.	**Social**		
		Social Foundation, Orphanage, School	10,000.-
II.	**Household**		
1.	Type A	Housing which faces to road with a width of below 7 m including the drainage	15,000.-
2	Type B	Housing which faces to road with a width of greater than or equal to 7 m to below 10 m including the drainage	20,000.-
3.	Type C	Housing which faces to road with a width of above 10 m including the drainage	25,000.-
III.	**Institution/Office**		70,000.-
IV.	**Hotel**		
1.	Star Hotel		
		Tariff is counted for each room	100,000.-
2.	Non star/Rest House		
		Tariff is counted for each room	50,000.-
3.	Inn		150,000.-
V.	**Restaurant**		
1.	Restaurant-small	has seats below 50	400,000.-
2.	Restaurant-medium	has seats between 50 till 100	500,000.-
3.	Restaurant-Large	has seats more than 100	700,000.-
VI.	**Commercial**		
1.	Commercial-Small	small business license	45,000.-
2.	Commercial-medium	medium business license	100,000.-
3.	Commercial-Large	large business license	150,000.-
VII.	**Public Facility**		40,000.-
B.	**NON-PIPING**		
1.	Cleaning of septic tank for feces with truck per m^3		150,000.-
2.	Service truck to dispose the domestic waste to Suwung disposal site per m^3		25,000.-

Source: BLUPAL

5.7 Financial Condition

The existing financial conditions of BLUPAL in 2008 and 2009 and financial projections in 2010 - 2014 are shown in ***Table 5.7.1***. And ***Table 5.7.2*** shows record of power consumption and costs of Pumping Stations (PS) & WWTP in September 2009 as a sample.

Table 5.7.1 - Existing Financial Conditions in 2008 & 2009 and Financial Projection in 2010 - 2014

DESCRIPTION	EXISTING FINANCIAL CONDITION		FINANCIAL PROJECTION				
	2008	2009	2010	2011	2012	2013	2014
INITIAL CAPITAL	**0**	**0**	**0**	**0**	**841**	**3,515**	**7,125**
INCOME	**1,424**	**5,400**	**7,755**	**8,596**	**10,429**	**13,692**	**18,699**
- TARIFF SERVICE	0	0	0	841	3,515	7,125	14,764
- OTHER SERVICES	0	0	0	0	0	0	0
- SUBSIDY	1,424	5,400	7,755	7,755	6,914	6,567	3,935
EXPENSES O & M	**1,424**	**5,400**	**7,755**	**7,755**	**7,755**	**10,082**	**11,060**
- EMPLOYEE EXPENSES	629	959	3,094	3,094	3,094	4,022	3,406
- EXPENSES OF GOODS/SERVICE	795	3,003	4,661	4,661	4,661	6,059	7,654
- CAPITAL EXPENSES	0	1,437	0	0	0	0	0
DEFICIT/SURPLUS	**0**	**0**	**0**	**841**	**3,515**	**7,125**	**14,764**

Source: BLUPAL

Picture 5.3.10 Sewerage Transmission Pumping Station

Transmission Pumps

Table 5.7.2 - Record of Power Consumption and Cost of PS and WWTP in September 2009

No	Day	Date	Power Demand (kWh/day)		
			Aerator	Pump	
				STP	Kuta PS
1	Tue	1-Sep-09	-	217.35	90.00
2	Wed	2-Sep-09	-	301.50	270.00
3	Thu	3-Sep-09	-	479.25	180.00
4	Fry	4-Sep-09	1.00	185.40	180.00
5	Sat	5-Sep-09	1.00	357.75	180.00
6	Sun	6-Sep-09	1.00	283.50	180.00
7	Mon	7-Sep-09	2.00	269.10	90.00
8	Tue	8-Sep-09	2.00	402.75	90.00
9	Wed	9-Sep-09	2.00	380.70	90.00
10	Thu	10-Sep-09	3.00	894.60	180.00
11	Fry	11-Sep-09	-	262.80	90.00
12	Sat	12-Sep-09	-	288.45	270.00
13	Sun	13-Sep-09	-	292.95	180.00
14	Mon	14-Sep-09	-	324.45	270.00
15	Tue	15-Sep-09	-	453.60	360.00
16	Wed	16-Sep-09	-	152.55	270.00
17	Thu	17-Sep-09	-	477.00	90.00
18	Fry	18-Sep-09	-	270.00	90.00
19	Sat	19-Sep-09	1.00	273.15	270.00
20	Sun	20-Sep-09	-	272.70	180.00
21	Mon	21-Sep-09	1.00	270.00	180.00
22	Tue	22-Sep-09	1.00	250.65	180.00
23	Wed	23-Sep-09	1.00	232.65	90.00
24	Thu	24-Sep-09	-	299.25	90.00
25	Fry	25-Sep-09	-	270.90	90.00
26	Sat	26-Sep-09	-	268.20	180.00
27	Sun	27-Sep-09	-	235.80	180.00
28	Mon	28-Sep-09	-	308.70	180.00
29	Tue	29-Sep-09	-	-	180.00
30	Wed	30-Sep-09	1.00	-	180.00
		Total	**17.00**	**8,975.70**	**5,130.00**

Cost per kWh = IDR 1,380

Operational Cost (pumps + aerators) at STP in September 2009 =

IDR **19,465,866**

Source: BLUPAL

5.8 Current Problem

The sewerage system currently has much reserved capacity, because of small number of connections (customers).

5.9 Master Plan / Long-Term Plan

There is master plan on wastewater disposal for Denpasar conducted by JICA in 1993, and executive summary of the study report is attached in ***Appendix 5.9.1***.

5.10 Middle-Term Plan

BLUPAL has next Middle-Term Sewerage Development Plan for 2010 - 2014 prepared in June 2009 as shown in ***Appendix 5.11.1***.

5.11 Action Plan

DSDP-II will commence construction from 2010, and the details are shown in ***Appendix 5.11.1***.

5.12 Current Programme or Project

DSDP-II is currently on going, and a detail of activity plan in 2010 is shown in ***Appendix 5.11.1***.

5.13 Relevant Organization

Many organizations are related with BLUPAL to make BLUPAL's stable management.
Figure 5.13.1 shows major relevant organizations with BLUPAL and their relationships.

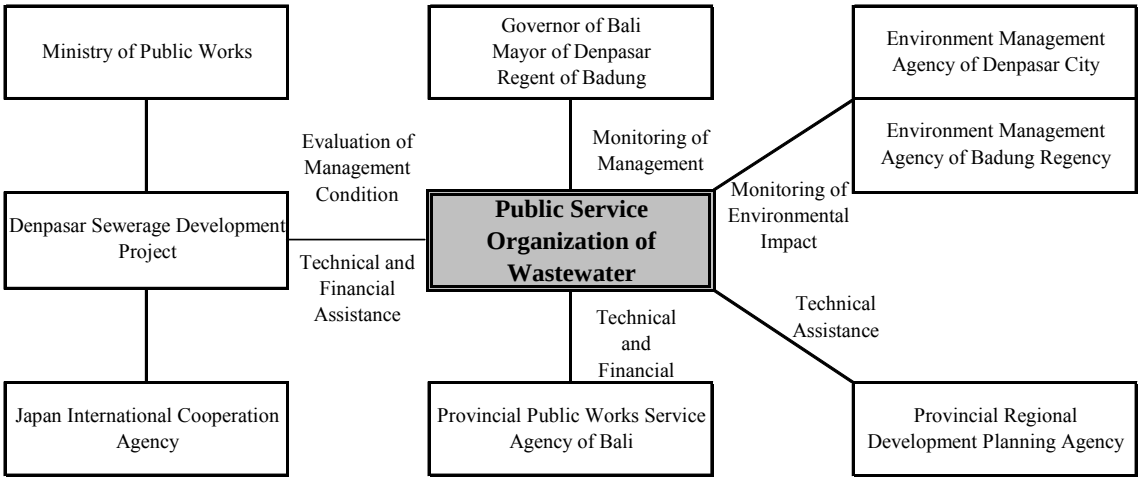

Figure 5.13.1 - Relevant Organization with BLUPAL

(1) Provincial Development Planning Agency of Bali

The Provincial Development Planning Agency (BAPPEDA - Prop) of Bali coordinates all provincial development strategies, plans, programmes and projects. The organization structure of BAPPEDA -Prop Bali is shown in ***Figure 5.13.2***.

Existing night soil treatment plan managed by BAPPEDA - Prop Bali will be closed, because of complaints on odour from residents caused by overload by population incensement.

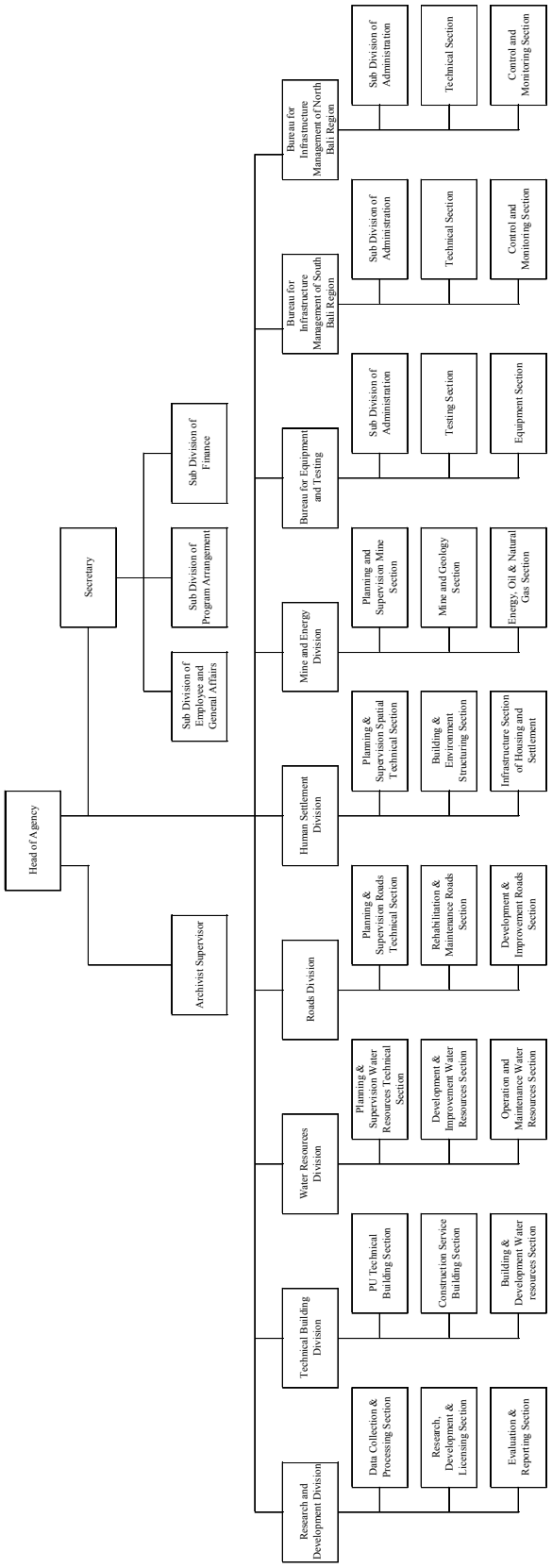

Figure 5.13.2 - Organization Structure of Provincial Development Planning Agency of Bali
Source: BAPPEDA - Prop Bali

(2) City Regional Development Planning Agency of Denpasar

The Regional Development Planning Agency of Denpasar (BAPPEDA - Kota Denpasar) has initiative of sewerage development on city development policy, plan and strategy.

BAPPEDA - Kota Denpasar has city regional long-term development plan in 2005 - 2025 as shown in ***Appendix 5.13.1***. Moreover, Denpasar City has Sanitation Strategy in 2008 - 2033, and parts of sanitation sector of strategy are shown in ***Appendix 5.13.2***.

There are 4 (four) existing Community-Based Sanitation (SANIMAS) system sites, and one of them is currently under construction.

There is 1 (one) pilot project site of Integrated Community Sanitation Program (SANTIMADU) which targets is improvement of water supply, sewerage, solid waste, and drainage.

(3) Regency Regional Development Planning Agency of Badung

The Regional Development Planning Agency of Badung (BAPPEDA - Kab Badung) will share the O&M cost of sewerage system of BLUPAL with Denpasar city. The sharing ratio will be determined with considering of connection numbers, type and number of connected, financial conditions etc.

BAPPEDA - Kab Badung is planning to expand their service area and treatment capacity of existing lagoon for treatment of wastewater located in Nusadua in Sratan Area, and is investigating planned WWTP site in Ginbaran area. BAPPEDA - Kab Badung is planning to conduct detailed design study of new WWTP and wastewater collection system in 2010, and will request the budget for the project to Central Government.

(4) Provincial Public Works Service Agency of Bali

The cleaning department of Denpasar City and Badung Regency cleans the same roads four (4) times in a day by 1,800 staffs with 4-shift system. The cleaning department of Denpasar has 34 dump tracks, though it is not enough. The garbage with volumes of 2,000 m^3/day and 1,100 m^3/day are generated in Denpasar City and Badung Regency.

(5) Provincial Environment Management Agency of Bali

Provincial Environment Management Agency of Bali (BLH - Propinsi Bali) is supposed to manage the water quality of Pengolahan WWTP, because the sewerage system of BLUPAL covers Denpasar City and Bandung Regency; however BLH - Propinsi Bali only sometimes carries out the checking of water quality of WWTP. Pengolahan WWTP reports the effluent quality to Government of Bali Province; however Government of Bali Province does not give these data to BLH - Propinsi Bali.

(6) Provincial Environmental Impact Management and Control Agency

The provincial Environmental Impact Management and Control Agency (BAPEDAL) of Bali suggested the methodology of water quality analysis for Environmental Impact Assessment (EIA) as shown in ***Appendix 5.13.3***.

5.14 Related Project

Central Government, Provincial government and DPU - Kota Denpasar with support of NGOs are processing to provide Community-Based Sanitation (SANIMAS), and DPU of Denpasar is also conducting Integrated Community Sanitation (SANTIMADU). As mentioned in **Section 2.8.1**, Indonesian Sanitation Sector Development Programme (ISSDP) has implemented in 2005 ~ 2009.

	***Picture 5.14.1*** ***SANIMAS*** One of SANIMASU Site
	***Picture 5.14.2*** ***SANIMAS*** Effluent of SANIMAS
	***Picture 5.14.3*** ***SANIMASU*** Cooking by Bio-Gas from SANIMAS

CHAPTER 6

RESULTS OF ANALYSIS

CHAPTER 6 RESULTS OF ANALYSIS

6.1 General

Sewerage works situation in 3 (three) cities, i.e. Jakarta, Bandung and Denpasar were surveyed and differences on structure, service charge and wastewater treatment process etc were found. Municipalities which will implement sewerage works should recognize and refer to the advantages and disadvantages of those differences.

6.2 Identified Differences of sewerage Works in service providers

6.2.1 Differences in Structure

Table 6.2.1 shows the structures of sewerage works in the 3(three) providers

Table 6.2.1 - Structure of Sewerage Works in 3 Areas

	Jakarta	Bandung	Denpasar
Structure	PD PAL	PDAM	BLU PAL
	Public Enterprise in sewerage Works	Public Enterprise in Water Works	Public Agency in sewerage Works

In Jakarta, PD PAL which is public enterprise in sewerage works is adopted. In Bandung, sewerage works is implemented under PDAM which is public enterprise in water works. In Denpasar, sewerage works is carried out under BUL PAL which belongs to public organization. Advantages, disadvantages and particularities of those structures are mentioned in ***Table 6.2.2***, ***Table 6.2.3*** and ***Table 6.2.4***.

Table 6.2.2 - Characteristics of PD PAL, PDAM and BLUPAL

	PD PAL Jakarta	PDAM Bandung	BLUPAL Denpasar
Advantages	Sewerage works can be developed independently.	Experienced water works engineers can be dispatched to sewerage works easily. Existing service charge collection system and customer database can be applied.	Not only for designing and construction but also for O&M, BLUPAL can receive national and provincial subsidies.
Disadvantages	Sewerage works can not use service charge collection system of water works.	Sewerage works can not be implemented independently. Accomplishment of sewerage works is affected by that of water works.	Still not clear.
Particularities	PD PAL is the public enterprise only in sewerage works. PD PAL Jakarta has been managed well; however it is because most of the customers are large commercial buildings. Therefore when other municipalities adopt this structure, financial issues have to be considered.	PDAM is public enterprise of water works and sewerage works is managed together with water works. Not only Bandung but also other municipalities like Banjarmasin and Cirebon use this structure.	Because BLUPAL has only a few years history, it is premature to evaluate the structure.

6.2.2 O&M Cost

Table 6.2.3 shows the O&M cost and influent wastewater quantity of the 3 (three) service providers.

Table 6.2.3 - O&M Cost and Influent Wastewater Quantity

	PD PAL Jakarta	PDAM Bandung	BLUPAL Denpasar
O&M Cost (mill. IDR/year)	17,700	8,623	2,494
Influent Quantity (m^3/day)	13,815	~ 40,000	8,000
Ratio of O&M Cost to Annual Influent Quantity (IDR/m^3)	3,510	~ 590	854

Source: PDPAL Jakarta, PDAM Bandung and BLUPAL Denpasar

Ratio of O&M cost to annual influent quantity in PD PAL Jakarta is the highest in the three providers, because it is managed independently and can use revenue of service charge without any restriction. In case of PDAM Bandung, the ratio is the minimal in the three providers, because oxidation pond process which is much economical than aerated lagoon process was adopted, and also total amount of sewerage service charge which is 30 % of water charge can not be used for O&M of sewerage system. In case of BLUPAL, the facilities and equipment are very new and don't have many problems, therefore O&M works is not frequently and O&M cost is not much. However, in case of BLUPAL, the ratio should not be evaluated yet because the idling rate of the treatment plant is still 84 % as shown in ***Table 6.3.1***.

6.2.3 Tariff Revenue and Ratio of Revenue to O&M Cost

Table 6.2.4 shows the tariff revenue, O&M cost and ratio of the revenue to O&M cost. Data of BLUPAL Denpasar is not shown because service charge is not fixed yet.

Table 6.2.4 - Tariff Revenue and Ratio Revenue to O&M Cost

	PD PAL Jakarta	PDAM Bandung
Tariff Revenue (mill. IDR/year)	24,961	21,507
O&M Cost (mill. IDR/year)	17,700	8,623
Ratio of the revenue to O&M Cost	1.41	2.49

Source: PDPAL Jakarta and PDAM Bandung

This table shows that both service providers have balanced management based on appropriate tariff.

6.2.4 Wastewater Treatment Processes, Influent Quantities and Effluent Quality

Table 6.2.5 indicates wastewater treatment processes, influent quantities and effluent qualities in the treatment plants of the 3 (three) service providers. It is considerd that why values of BOD of influent in 3 cities are low is because of spread of septic tanks.

Table 6.2.5 - Treatment Processes, Influent Quantities and Influent and Effluent BOD

	PD PAL Jakarta*	PDAM Bandung**	BLUPAL Denpasar***
Treatment Process	Aerated Lagoon	Oxidation Pond	Aerated Lagoon
Influent Quantity (m^3/day)	13,815	~ 40,000	8,000
Influent BOD (mg/lit)	74	91	45
Effluent BOD (mg/lit)	45	31	23
Removal Rate (%)	39	66	51

* Source: Comparative Study - Centralized Wastewater Treatment Plants in Indonesia, USAID, September 2008
** Source: PDAM, Jan. to Nov. 2009
*** Source: BLUPAL, Sep. 2009

According to the decree of the ministry of living environment No.112 in 2003 on the standard quality of domestic waste, effluent quality standard of WWTP for BOD is 100 mg/lit, therefore the effluent quality of WWTP in the three service providers is under the standard.

6.3 Extraction of Issues

6.3.1 Structural Issues

There are specific advantages and disadvantages in PD PAL and PDAM, and predicted advantage in BLUPAL as shown in **Section 6.2.1**. A disadvantage in PD PAL i.e. the sewerage works can not use the service charge collection system of water works and 2 (two) disadvantages in PDAM i.e. the sewerage works can not be implemented independently and the accomplishment of the works is affected by that of the water works. However such disadvantages might cause financial difficulty in other small scale municipalities.

6.3.2 Management Issues

(1) Idling Rate

As shown in ***Table 6.3.1***, idling rate i.e. actual influent quantity/design influent quantity is low in Bandung and Denpasar because of low household connection rate. When idling rate is low, O&M cost per influent wastewater quantity becomes high therefore it should be improved by promoting household connection. In Bandung idling rate will soon be improved when west side of the city is connected to the treatment plant. In Denpasar, low idling rate is caused by low connection rate of stared hotels. Because many hotels installed on-site treatment facilities already, they have refused to connect to the sewerage system. However connection of stared hotels is indispensable for stable management of sewerage works.

During low influent quantity it is recommended to stop operation of a part of treatment facilities.

Table 6.3.1 - Idling Rate in Wastewater Treatment Plants

	PD PAL Jakarta	PDAM Bandung	BLUPAL Denpasar
Design Influent Quantity (m^3/day)	42,768*	80,000	51,000
Actual Influent Quantity (m^3/day)	13,815	~ 40,000	8,000
Idling Rate (%)	68	~ 50	84

*Source: Comparative Study - Centralized Wastewater Treatment Plants in Indonesia, USAID, September 2008

(2) Numbers of Staff

Table 6.3.2 shows the number of staff, household connections and number of connections per staff in the three providers. 12 connections per staff in PD PAL Jakarta are around 1/30 comparing to that in PDAM Bandung. In case of PD PAL Jakarta, most of the customers are large scale buildings; therefore even though number of connection is 1444, influent quantity is as much as 13,815 m^3/day. On the other hand, in case of BLUPAL Denpasar, only a year has passed after the completion of construction of treatment plant and the number of connection is still small; therefore the ratio of connection per staff becomes low. In case of Bandung, most of the customers are domestic household and sewerage works are already in stable condition, therefore the number of connection per staff seems be the most proper in these three service providers.

According to the Management Evaluation of Water and sewerage works of Kyoto City (2009) as an example in Japan, the number of water meter per staff is 622. In Kyoto city, number of staff in water works and sewerage works is not much different; therefore the ratio i.e. 622 seems to represent the number of connection per staff in sewerage works. Consequently the ratio in Bandung i.e. 713 is not remote from Japanese example.

On the other hand, World Bank recommends the 5 staffs per 1,000 connections (means 200 staffs / connection) as indicator.

Appropriate number of staff differs to financial condition and employment policy of municipality, however it is effective to compare to other providers in same scale.

Table 6.3.2 - Number of Staff and Household Connection

	PD PAL Jakarta	PDAM Bandung	BLUPAL Denpasar
Staff	121	138	69
Household Connection	1,444	98,350	8,647
Connection / Staff	12	713	125
Staff / 1,000 Connections	83.80	1.40	7.98

Source: PDPAL Jakarta, PDAM Bandung and BLUPAL Denpasar

6.3.3 Financial Issues

(1) Initial Investment Cost

Table 6.3.3 shows initial investment cost for sewerage works, and ratio to unit design influent and actual influent quantity in 15 years. In case of PD PAL Jakarta, because the existing storm water reservoirs are utilized for aerated lagoon ponds, initial investment cost is quite low and the ratio also is low. In case of PDAM Bandung, treatment plant was freshly constructed therefore the ratio is much higher i.e. 259.2 IDR/m^3. On the other hand, the ratio against actual influent quantity is higher by twice i.e. 518.5 IDR/m^3. When no large increase of influent quantity is expected, step-by-step construction in proportion to increase of household connection has to be considered. Calculation is not carried out in BLUPAL Denpasar because no connection to stared hotel is progressed yet.

Table 6.3.3 - Initial Investment Cost and Ratio to Unit Design Influent and Actual Influent Quantity

	PD PAL Jakarta	PDAM Bandung
Initial Investment Cost (bill. IDR)	11.86*	113.55*
Cost/Design Influent in 15 years (IDR/m^3)	50.6	259.2
Cost/Actual Influent in 15 years (IDR/m^3)	107.6	518.5

Source: Comparative Study - Centralized Wastewater Treatment Plants in Indonesia, USAID, September 2008

(2) Tariff

The 3 (three) service providers surveyed adopt their own tariff systems. In case of PD PAL Jakarta, flat rate for household based on house type and proportional rate for commercial based on commercial size and floor area is adopted. In PDAM Bandung sewerage service charge is fixed to 30% of water charge. In BLUPAL Denpasar service charge is not collected yet. According to proposed tariff flat rate for household and commercial by size will be used.

Table 6.3.4 shows the advantages and disadvantages of each tariff system. Generally raise of sewerage service charge is much difficult comparing to raise of water charge, therefore fixed percentage of water charge might be advantageous in order to promote stable management. In this case sewerage service is affected by water service.

Table 6.3.4 - Advantages and Disadvantages of Tariff System

Tariff System	Advantage	Disadvantage
Fixed Price Tariff	➢ Easy to calculate based on house type ➢ Easy to calculate for non-water works user	➢ Tariff usually low ➢ For hotels and other commercial organizations tariff much too low and not adequate to load discharged ➢ Tariff difficult to raise ➢ Difficult for bill collection
Tariff Based on Floor Area	➢ Easy to calculate for non-water works user	➢ Tariff difficult to raise ➢ Not easy to calculate if area of house not known ➢ Relation between area and water usage not always clear ➢ Difficult for bill collection
Tariff Based on Water Charge	➢ Logic, because water used becomes wastewater ➢ Easy to bill through PDAM	➢ Not easy to raise tariff ➢ Other tariff is necessary for non-PDAM user
Percentage of Water Bill Paid for sewerage Users	➢ Logic, because water used becomes wastewater ➢ Easy to bill through PDAM ➢ Raise of tariff follows raise of water tariff	➢ Other tariff is necessary for non-PDAM user
Percentage of Water Bill to All Water Service Users	➢ Easy to bill through PDAM ➢ Raise of tariff follows raise of water tariff ➢ Very high income to operator which can cover investment	➢ Difficult to argue against non-sewerage user which have to pay because connected to PDAM

Source: Comparative Study - Centralized Wastewater Treatment Plants in Indonesia, USAID, September 2008

(3) Bill Collection

Table 6.3.5 shows bill collection systems in PD PAL Jakarta and PDAM Bandung. In PD PAL sewerage service charge is collected independently because water service is completely privatized. On the other hand in PDAM Bandung sewerage service charge is collected together with water charge because sewerage works and water works is implemented under same organization. Bill collection efficiency shown in the table indicates that efficiency by independent collection is lower than that by together. Therefore accompanied collection with water charge is better for a sound sewerage works management.

Table 6.3.5 - Bill Collection Systems

	PD PAL Jakarta	PDAM Bandung
Collection System	Independent	Together with water charge
Collection Efficiency	60 to 80 %	80 %

Source: Comparative Study - Centralized Wastewater Treatment Plants in Indonesia, USAID, September 2008

(4) O&M Cost

O&M cost depends on aging of sewer pipes, treatment process and effluent quality etc. ***Table 6.3.6*** shows total O&M cost and O&M cost per actual influent quantity in PD PAL Jakarta and PDAM Bandung. O&M cost in BLUPAL Denpasar also is shown however because O&M of sewerage facilities has just been commenced, it is not appropriate for reference. O&M cost will increase with aging of facilities and affect financial condition, therefore it should be considered deliberately from the first time. The cost for wastewater treatment plant depends on the treatment process.

Table 6.3.6 - Total O&M Cost and O&M Cost per Actual Influent Quantity

	PD PAL Jakarta	PDAM Bandung	BLUPAL Denpasar
Total O&M Cost (mill. IDR/year)	17,700	8,623	2,493
O&M Cost per Actual Influent Quantity (IDR/m^3)	3,510	590	854

Source: PDPAL Jakarta (2008), PDAM Bandung (2008) and BLUPAL Denpasar (2009)

6.3.4 Technical Issues

(1) Extreme Propagation of Algae

Effluent of PDAM Bandung with oxidation pond process and BLUPAL Denpasar with aerated lagoon process contains high concentration of algae. Propagation of algae is unavoidable in both treatment processes however if it is necessary to control algae for preserving environment of discharging river or sea, provisions like shading has to be implemented.

(2) Effluent Standard

Various types of wastewater treatment process from simple oxidation pond to complicated conventional activated sludge process have been adopted in Indonesia. However effluent standard which is determined by Local Government is not fixed on process by process but on uniformly. Therefore some effluent standard parameters can not be abided in oxidation pond process. Generally the standard should be fixed on by process.

(3) Water Quality Analysis

In the 3 (three) service providers, common water quality parameters like BOD and COD are analyzed in their own laboratory and heavy metals and toxic substances of which analysis require expensive equipments are analyzed in laboratories of provincial environment division etc. This analyzing system requires less expensive equipments and laboratory staff, therefore it should be continued.

(4) Maintenance of Sewer Pipes

According to the USAID report, periodically maintenance of sewer pipes is not adopted in PD PAL Jakarta and PDAM Bandung but collective maintenance is used. In proportion to the increase of household connection, number of pipe clogging will increase; therefore preparation of organization and machines is required for those situations.

6.4 Comparison with Japanese Situation

6.4.1 Organization Structure

As shown in ***Table 6.4.1***, all of the sewerage works in Japan are managed by municipalities or prefectures even if they adopt corporate accounting system. In Indonesia, PD PAL Jakarta and PDAM Bandung are managed as public enterprises and BLUPAL Denpasar belongs to municipality. Indonesian government has promoted Public-Private Partnership (PPP) and also privatization of public services including sewerage works.

In Japan, sewerage Works Agency, Sewerage works Association and Institute of Sewerage have assisted the implementation of sewerage works in municipalities. Especially at the incunabula of sewerage works, those assistances were quite effective. In Indonesia there is no such organization.

Table 6.4.1 - Comparison of Organization Structure for Sewerage Works

Japan	Indonesia
➢ Municipality or Prefecture	➢ Public Enterprise ➢ Municipality or Province

6.4.2 Law and Regulation

As shown in ***Table 6.4.2***, municipal sewerage works is implemented based on the sewerage Law which is established by Central Government in Japan. And also it has to abide other laws like Water pollution Control Law, Air Pollution Control law, Soil Contamination Control Law, Offensive Odor Control Law and Noise Control Law established by national government and other regulations established by provincial government. On the other hand in Indonesia, provincial regulations are already established however there is no basic law for sewerage works by Central Government.

Table 6.4.2 - Comparison of Law and Regulation regarding Sewerage Works

	Japan	Indonesia
Central Government	Sewerage Law	No
Provincial Government	Provincial Regulations	Provincial Regulations

6.4.3 Finance

In Japan sewerage works has been implemented by using Central Government subsidy (usually 50 to 55 % depends on facilities, and main sewers is can be subsidized, however branch sewers and house connections are the loan) and municipal bond issue from the planning of sewerage system to construction of facilities (Repayments of loan are assumed as Local Allocation Tax). And basically O&M of wastewater is managed by service charge and that of storm water is managed by transferred budget from other municipal finance. For small scale municipalities, other special subsidies are prepared.

On the other hand in Indonesia, planning and designing are carried out by provincial subsidy and construction of wastewater treatment plant is carried out by subsidy of Central Government. O&M cost is covered by service charge in PD PAL Jakarta and PDAM Bandung as shown in ***Table 6.2.6***, however according to Ministry of Public Works, subsidy of Central Government for covering O&M cost is indispensable in most cases. Basically storm water management is not carried out by the sewerage service providers but by public works division on municipalities because separate sewer system is mainly adopted.
Table 6.4.3 shows comparison of finance condition for sewerage works.

Table 6.4.3 - Comparison of Financial Condition for Sewerage Works

		Japan	Indonesia
Planning and designing		* Subsidy of Central Government * Bond Issue	* Provincial Subsidy
Construction			* Central Government Subsidy
O&M	Wastewater	* Service Charge	* Service Charge * Central Government Subsidy
	Storm Water	* Municipal Budget	* Mainly managed by public works division of municipalities

6.4.4 Tariff Structure and Bill Collection

As shown in ***Table 6.4.4***, tariff of sewerage service is fixed by estimating O&M cost and compensating the cost by service charge in Japan. Specific tariff system of which the unit service charge (yen/m^3) increase in proportion to water supply consumption is adopted for domestic and commercial wastewater. For highly polluted industrial wastewater like food processing factories, tariff based on water quality is also adopted. On the other hand in Indonesia, percentage of water bill and type of house (e.g. widths of house in front of road and floor area of commercial building) are used for basis of tariff.

Bill is collected together with water charge in Japan because water works also are managed by municipalities. In Indonesia bill is collected with water charge in case of PDAM, however it is collected independently in the other types of organization like PD PAL.

Table 6.4.4 - Comparison of Tariff and Bill Collection System

	Japan	Indonesia
Tariff	* Based on O&M Cost	* Percentage of Water Charge * Type of House * Floor Dimension in Commercial Area
Bill Collection	* With Water Charge	* With Water Charge in PDAM * Independently in PD PAL

6.4.5 Wastewater Treatment Process

In Japan secondary treatment or advanced treatment is adopted for wastewater treatment process. However in Indonesia not only such secondary treatment processes but also primary treatment processes like oxidation pond is adopted. Such primary processes are advantageous in construction and O&M cost, and simplicity of O&M while they have disadvantage in effluent quality. As mentioned in **Section 6.3.4 (2)**, there is no specific effluent water quality standard for those primary treatment processes. ***Table 6.4.5*** shows comparison of wastewater treatment processes in both countries.

Table 6.4.5 - Comparison of Wastewater Treatment Processes

Japan	Indonesia
Secondary Treatment Advanced Treatment ***Advantage:*** ➢ High effluent quality ***Disadvantages:*** ➢ High construction and O&M cost ➢ High O&M technology	Primary Treatment Secondary Treatment **Advantages:** ➢ Low construction and O&M cost ➢ Low energy consumption ➢ Low O&M technology **Disadvantage:** ➢ Low effluent quality

6.5 Evaluation and Deliberation of the Results

6.5.1 Organization Structure

3 (three) types of organization structure were surveyed and advantages and disadvantages of each structure were emerged as shown in **Section 6.2.1**. Desirable structure might depend strongly on the municipal situation but sewerage service in PDAM might be recommended for newly sewerage works promoting municipalities. Especially small or middle size municipalities of which financial condition is weak should adopt this type of structure.

6.5.2 Law and Regulation

As mentioned above there is no Sewerage Law in Indonesia yet while provincial regulations regarding sewerage works were established already. It is the basic law and should be established soon. As for effluent standard, the standard for every treatment processes have to be fixed in order to make all treatment plants comply with the law.

6.5.3 Finance

Except a few big cities, most of municipalities can not commence sewerage works without subsidy from Central Government. Currently planning and designing are subsidized by provincial government and construction of main sewer and treatment plant are subsidized by Central Government. This subsidy system has invigorated municipalities to implement the works therefore it should be continued. Besides such subsidies bond issue by municipalities also should be considered in order to inspire individual implementation of the works. In case of issuing bond, it must be indemnified by Central Government.

In case of Bandung, PDAM collect the 30 % of of the water charge as sewerage service charge, and part of tariff revenue of sewerage service is assumed for water supply services. And, 30 % of tariff revenue of sewerage service is allocated for O&M works, however according to Sewerage Department; it is not enough for sufficient O&M works of sewerage system.

In case of PD PAL Jakarta, most of bill revenue is from high-rised buldings, and is large amount; however O&M cost is not much. Therefore, the tariff revenue consequently can be covered O&M costs.

6.5.4 Tariff System and Bill Collection

Principle of tariff system is the fairness for all users. Percentage of water consumption like 30% which is adopted in PDAM Bandung seems to be fair because consumed water becomes wastewater. Moreover service charge can be increased together with water charge easily. On the other hand, tariff based on floor dimension seems to be unfair because wastewater quantity and floor dimension has no relation in some cases. During the service charge is low enough no complaint might be made, however when the charge increases complain also might increase. Bill collection together with water charge is easy for collectors and convenient for customers.

6.5.5 Wastewater Treatment Process

Wastewater treatment processes adopted in Indonesia like oxidation pond system are the optimum choice for rapid development of sewerage system in the country. When such treatment process is operated and maintained well effluent quality would be sufficient for preventing water pollution in discharging water bodies. In the future when it becomes necessary to improve environmental condition treatment plant can be modified to the superior process easily because superior process requires less treatment site area.