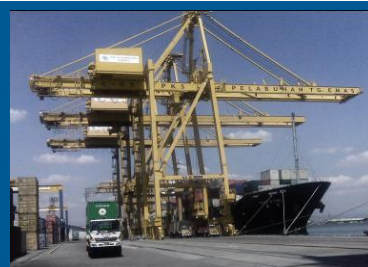




Australia Indonesia Partnership
Kemitraan Australia Indonesia



JATILUHUR - JAKARTA PIPELINE AND WATER TREATMENT PLANT PRE-FEASIBILITY STUDY



**INDONESIA
INFRASTRUCTURE
INITIATIVE**



Australia Indonesia Partnership
Kemitraan Australia Indonesia



JATILUHUR - JAKARTA PIPELINE AND WATER TREATMENT PLANT PRE-FEASIBILITY STUDY

INDONESIA INFRASTRUCTURE INITIATIVE

February 2010

INDONESIA INFRASTRUCTURE INITIATIVE

This document has been published by the Indonesia Infrastructure Initiative (IndII), an Australian Government funded project designed to promote economic growth in Indonesia by enhancing the relevance, quality and quantum of infrastructure investment.

The views expressed in this report do not necessarily reflect the views of the Australian Indonesian Partnership or the Australian Government. Please direct any comments or questions to the IndII Director, tel. +62 (21) 230-6063, fax +62 (21) 3190-2994. Website: www.indii.co.id

ACKNOWLEDGEMENTS

This report has been prepared by GHD which was engaged under the Indonesia Infrastructure Initiative (IndII) as part of the Activity on Jatiluhur-Jakarta Pipeline and Water Treatment Plant, Stage 1, funded by AusAID.

The support provided by Ken Trebilco and his team is gratefully acknowledged. Any errors of fact or interpretation are solely those of the author.

GHD

Jakarta, February 2010

© IndII 2010

All original intellectual property contained within this document is the property of the Indonesia Infrastructure Initiative (IndII). It can be used freely without attribution by consultants and IndII partners in preparing IndII documents, reports designs and plans; it can also be used freely by other agencies or organisations, provided attribution is given.

Every attempt has been made to ensure that referenced documents within this publication have been correctly attributed. However, IndII would value being advised of any corrections required, or advice concerning source documents and/or updated data.

TABLE OF CONTENTS

CHAPTER 1: INTRODUCTION	1
1.1 OBJECTIVES OF PROPOSED JATILUHUR – JAKARTA PIPELINE PROJECT.....	1
1.2 SITE VISITS	1
CHAPTER 2: INITIAL DATA COLLECTION	2
2.1 SUMMARY OF DATA COLLECTION FROM PT JASA TIRTA II	2
2.1.1 Profile of PT Jasa Tirta II (PJT II).....	2
2.1.2 Existing Condition.....	2
2.1.3 Key Issues	5
2.2 SUMMARY OF DATA COLLECTION FROM PDAM KARAWANG	6
2.2.1 Profile of Karawang Regency.....	6
2.2.2 Existing Condition.....	6
2.2.3 Key Issues	10
2.3 SUMMARY OF DATA COLLECTION FROM PDAM BEKASI	10
2.3.1 Profile of Bekasi Regency	10
2.3.2 Existing Condition.....	11
2.3.3 Key Issues	15
2.4 SUMMARY OF DATA COLLECTION FROM PDAM TIRTA PATRIOT – BEKASI CITY	15
2.4.1 Profile of PDAM Tirta Patriot	15
2.4.2 Existing Condition.....	16
2.4.3 Key Issues	18
2.5 SUMMARY OF DATA COLLECTION FROM PALYJA.....	18
2.5.1 Profile of Palyja	18
2.5.2 Existing Condition.....	18
2.6 SUMMARY OF DATA COLLECTION FROM AETRA.....	23
2.6.1 Profile of Aetra	23
2.6.2 Existing Condition.....	23
2.6.3 Key Issues	26
CHAPTER 3: DATA ANALYSIS	28
3.1 INITIAL WATER DEMAND ANALYSIS	28
3.2 SUPPLY ANALYSIS.....	30
3.2.1 Water Quantity	30
3.2.2 Water Quality.....	30
3.2.3 Existing Treatment Plant Capacity	35
3.3 SUPPLY RELIABILITY	36
CHAPTER 4: PROJECT OPTIONS	37
4.1 OPTIONS FOR PROJECT STAGING.....	38
4.2 OPTIONS FOR WTP LOCATIONS.....	38
4.3 OPTIONS FOR TRANSMISSION ROUTES	39
CHAPTER 5: SCOPE OF WORK FOR STAGE II - TECHNICAL ASPECT	41

LIST OF TABLES

Table 1: Site Visit Location	1
Table 2: Citarum River Water Balance	3
Table 3: Effective Volume of Reservoir as per 28 January 2010	4
Table 4: Supply Break Down.....	5
Table 5: PDAM Tirta Tarum Coverage Area	6
Table 6: Service Area, Capacity and Customer of PDAM Tirta Tarum.....	7
Table 7: Production Capacity and Installed Capacity of PDAM Bekasi WTP	13
Table 8: PDAM Bekasi Reservoir Capacity.....	14
Table 9: Projections of Connections and Base Demand.....	15
Table 10: PDAM Tirta Patriot Water Production and Capacity in 2009	16
Table 11: Distribution Components for PDAM Tirta Patriot	17
Table 12: Projections of Connections and Base Demand.....	17
Table 13: PALYJA Water Source and Production Capacity	20
Table 14: Distribution Components for PALYJA	20
Table 15: Base Demand Calculation	22
Table 16: Customer Group Breakdown	22
Table 17: AETRA Water Source and Production Capacity	23
Table 18: Distribution Components for AETRA	25
Table 19: Base Demand Calculation	26
Table 20: Customer Group Breakdown	26
Table 21: Water Demand Prediction	28
Table 22: 2009 Water Balance	30
Table 23: Summary of Water Quality	32
Table 24: Water Quality Standard for Class I (Clean Water Quality Standard).....	34
Table 25: Existing Treatment Plant Capacity.....	35
Table 26: Indicative Options for Project Staging	38
Table 27: Options for WTP Locations	39
Table 28: Options for Transmission Routes	39

LIST OF FIGURES

Figure 1: Schematic of Water Resources (PJT II Presentation – IPA Workshop)	3
Figure 2: Villages Serviced by PDAM Tirta Tarum (Source: Technical Planning of SPAM Development 2010-2014, PDAM Tirta Tarum).....	9
Figure 3: Map of Existing Service Coverage (Source: Business Plan 2009-2013 Presentation)	12
Figure 4: Service Coverage of PDAM Tirta Patriot.....	16
Figure 5: PALYJA Service Area (Source: PALYJA Master Plan, January 2008).....	19
Figure 6: Aetra Service Area (Source: TPJ Master Plan)	24
Figure 7: Projection of Base Demand	29
Figure 8: Water Quality Results in Jatiluhur - Curug	31

CHAPTER 1: INTRODUCTION

A majority of the water supply to Jakarta, Bekasi and Karawang comes mainly from the Jatiluhur reservoir, operated by Perum Jasa Tirta II (PJT II), a state-owned enterprise. The water flows through an open channel - the West Tarum Canal (WTC) until it reaches the water treatment plant in the municipalities. The operators for clean water supply are PT Pam Lyonnaise Jaya (PALYJA) and Aetra in Jakarta, PDAM Bekasi in Bekasi and PDAM Karawang in Karawang. The current raw water supply from Jatiluhur is deteriorating as it has been contaminated by domestic and industrial pollution from the West Tarum canal before reaching the water treatment facility.

PT GHD, together with KPMG and Makarim & Taira's have been appointed by the Indonesia Infrastructure Initiative (IndII) to assist with Stage 1 of the Jatiluhur – Jakarta Pipeline and Water Treatment Plant Project. The scope of work for GHD involves collection and assessment of available technical data in relation with the proposed Jatiluhur – Jakarta Pipeline and Water Treatment Plant, identify information gaps and initial scope of work for Stage 2. KPMG and Makarim & Taira's are responsible for commercial and legal assessments respectively.

1.1 OBJECTIVES OF PROPOSED JATILUHUR – JAKARTA PIPELINE PROJECT

The objective of this activity is to ensure the supply of treated water in the areas of DKI Jakarta, Bekasi City, Bekasi Regency and Karawang Regency, which have increasing demand. The construction of an upstream water treatment plant and the transmission of treated water through a closed-pipe system directly to the operators in Jakarta, Bekasi and Karawang, i.e., Aetra and PALYJA, PDAM Bekasi and PDAM Karawang respectively, is the initial project plan.

1.2 SITE VISITS

While assisting on this project, several site visits have been undertaken to collect the available data from relevant stakeholders. Site visits conducted were:

Table 1: Site Visit Location

Site Visit Location	Date of Visit
PDAM Karawang	13 January 2010
PT Jasa Tirta II Jatiluhur	14 January 2010
<i>Jatiluhur Reservoir, Curug Dam</i>	14 January 2010
<i>Pasir Gombang – alternative WTP location</i>	21 January 2010
PDAM Bekasi	19 January 2010
PALYJA	20 January 2010
AETRA	22 January 2010
PAM Jaya	22 January 2010
PDAM Tirta Patriot	28 January 2010

CHAPTER 2: INITIAL DATA COLLECTION

2.1 SUMMARY OF DATA COLLECTION FROM PT JASA TIRTA II

2.1.1 Profile of PT Jasa Tirta II

PJT II is a state-owned company which manages the water resources for raw water supply in the areas of Citarum river and a part of Ciliwung – the Cisadane river. The company manages the three largest dams in Indonesia - H Djuanda (Jatiluhur), Cirata and Saguling for irrigation, hydropower generation, water utilities and recreational purposes. This source of water is vital for water supply in Jakarta, as 80 percent of water or 14.6 m³/s is supplied from this area (*Source: PALYJA and TPJ Master Plan, 2007*). The channel that supplies water to Jakarta is the WTC with intake at Curug.

2.1.2 Existing Condition

Service Area

PJT II coverage area includes approximately 74 rivers within the West Java Province and DKI Jakarta Province, which comprises of several municipalities/regencies as follows¹:

- East Jakarta City
- Bekasi City
- Bekasi Regency
- Karawang Regency
- Purwakarta Regency
- Subang Regency
- Part of Indramayu Regency
- Part of Sumedang Regency
- Bandung Municipality
- Bandung Regency
- Cimahi Municipality
- Part of Cianjur Regency and
- Part of Bogor Regency

According to the PJT II official website, the total service area is $\pm 12,000 \text{ km}^2$.

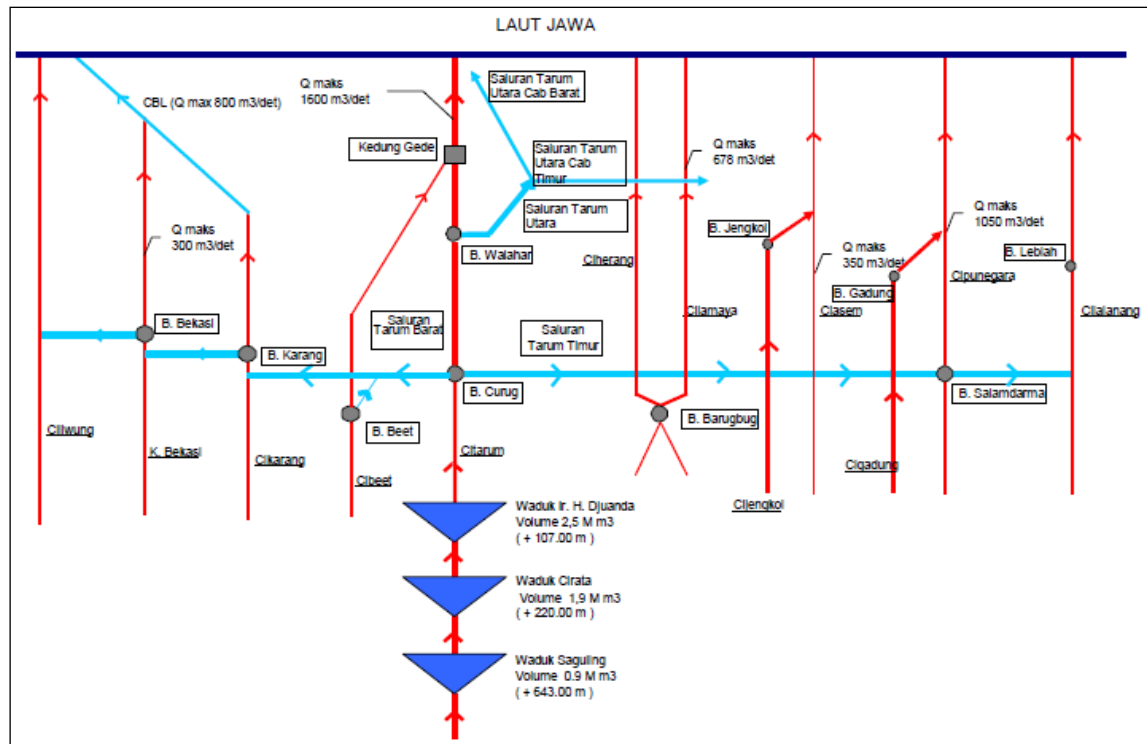
Raw Water Source

The water resources managed by PJT II are derived from the Citarum river (46 percent) and from other rivers (54 percent). The potential water from the above sources amounts to 12.95 billion m³/year. Out of this, only 7.5 billion m³/year (52 percent of the total water source) is currently regulated by PJT II, of which 5.7 billion m³/year comes from Citarum, and the remaining 1.8 billion

¹ Source: <http://www.jasatirta2.co.id/pjtII.php?x=perusahaan&z=c649d1c5a6b6b2a60afb55c859780fcf&y=detail>

m³/year from the other rivers. Thus, there is approximately 5.45 billion m³/year of water (42 percent of the potential water source), unutilised, flowing straight into the Java sea. The water capacity at the dams and the configuration of raw water flow is depicted in **Error! Reference source not found.:**

Figure 1: Schematic of Water Resources (PJT II Presentation – IPA Workshop)



The flow of water from the Citarum river has been recorded for over 40 years and has shown a reliable result to meet water demand for its coverage area. The average annual flow between 1963 – 2007 is 5.6 billion m³/year. The highest annual debit occurred in 1992 with 8.1 billion m³/year, and the lowest was in 1997 with 3.6 billion m³/year. Considering water demand downstream of approximately 4.2 billion m³/year, the current system is likely to be sufficient to meet the demand, provided that no further degradation occurs within the catchment area.

Table 2: Citarum River Water Balance

	Water Debit (billion m³/year)	Percentage (%)
Regulated water	7.5	57.9
Citarum river	5.7	
Other river	1.8	
Unregulated water flowing to sea	5.45	42.1
Total	12.95	100

Source: Presentasi Seminar Tambahan 10 Juta Sambungan Air Bersih 15 Oktober 2008, PJT II

Reservoir Capacity

Reservoir capacity of PJT II is shown in the table below:

Table 3: Effective Volume of Reservoir as per 28 January 2010

Reservoir	Lowest Elevation	Normal Elevation	Normal Effective Volume
H Djuanda (Jatiluhur)	+ 75 m	+ 107 m	530.75 m ³
Cirata	+ 206 m	+ 220 m	668.12 m ³
Saguling	+ 625 m	+ 643 m	1868.94 m ³

Source: *Neraca Air Sungai Citarum 28 Januari 2010, PJT II*

Distribution System

PJT II distributes raw water to its service areas using mainly an open channel. In the distribution system to DKI Jakarta, water is derived from Curug weir and then pumped using 17 hydraulic pumps via WTC to Jakarta's Water Treatment Plants in Buaran, Pulo Gadung and Pejompongan.

Water Quality at Jatiluhur

Based on a presentation by the President Director of PJT II, Mr Djendam Gurusinga in May 2009, titled Integrated Citarum River Basin Management for Jakarta Raw Water Supply, the water quality at Jatiluhur reservoir is provided below:

- Lead (Pb) has been detected:
 - wild fish (*Tilapia nilotica*): 4.1 mg/kg
 - Fisheries (catfish): 13.2 mg/kg
- Plankton:
 - 33 types
 - variety index ranging from 0.730 to 0.888
- Diversity index (H'): 0.837
 - $H < 1$: heavily polluted by organic materials
- No stratification on temperature
 - 1-2 °C difference
- Trophic level
 - In 1996: meso-eutroph
 - In 2006: highly-eutrophic
- Bad odour of H₂S
 - 0.021 ppm at tailrace
 - 0.303 ppm at fisheries area
- Dark colour of water at Jatiluhur outflow

Currently, there are over 16,000 floating-net fish farms which is far in excess of the allowable number of 3,000 according to a study conducted by IPB or 5,000 according to the local government (LG). In addition, water quality monitoring was also conducted in 75 points across the distribution and transmission network.

Raw Water Supply from PJT II

The current water demand comprises approximately 90 percent for irrigation and 10 percent for raw water utilities. The composition is as below:

Table 4: Supply Break Down

User	Current Usage (%)	Current Usage (Million m ³ /year)
Irrigation	86.7 %	6632.55
PDAM DKI Jakarta	6 %	459
Domestic and Industry	2 %	153
Municipal/ Other PDAMs	0.74 %	382.5
Unused	0.3 %	22.95
TOTAL	100 %	7650

Source: PJT II Presentation at IPA Workshop, May 2009

2.1.3 Key Issues

- Jatiluhur reservoir water quality has been degraded due to:
 - Lack of protection of catchment area,
 - waste from upstream polluting Saguling and Cirata reservoir, and
 - fish farming in the reservoir is likely to increase the level of Sulphur Dioxide (SO₂) in the reservoir from excess fish food.
- WTC water quality is poor, due to:
 - Agriculture development and uncontrolled runoff into the canal,
 - rapid population growth around the canal and river, and
 - open channel, so it could be easily polluted with waste.
- No buffer zone along the WTC.
- Degradation of catchment area – which may lead to reduction of water quantity.
- Reservoir is also used for hydropower generation.

2.2 SUMMARY OF DATA COLLECTION FROM PDAM KARAWANG

2.2.1 Profile of Karawang Regency

Karawang Regency is located in North West Java and geographically located at 107°02' - 107°40' Longitude (East) and 5°56'2" - 6°34' Latitude (South). Karawang Regency is considered as lowland and has varied slopes between 0 – 2 percent, 2 – 15 percent and above 40 percent.

Ground surface in the Karawang Regency is relatively flat in majority, with elevation between 0-5 m above sea level. Only a small portion of the area is hilly with elevation between 0-1200 m.

The total area of Karawang Regency is approximately 1753.27 km² or 3.73 percent of the West Java Province area. Administratively, the Karawang Regency comprises of 30 sub districts and is intersected by rivers flowing in the north direction. The Citarum river forms the boundary between the Karawang and Bekasi Regencies, while the Cimalaya River forms the boundary with the Subang Regency. Apart from the two rivers, there are three main irrigation canals which originate in Jatiluhur. These canals are the North Tarum Main Canal, Central Tarum Main Canal and West Tarum Main Canal, which are utilised for field irrigation, fish pond, power generation and raw water source for Karawang Regency PDAM.

2.2.2 Existing Condition

PDAM Tirta Tarum is the main provider of clean water in Karawang Regency. Up to October 2009, the PDAM demonstrated good performance based on BPPSPAM assessment with performance rate of 2.15. According to this result, PDAM Tirta Tarum is classified as a “healthy” PDAM.

Service Area

The PDAM Tirta Tarum served 15 percent of the total population and 31.33 percent of the administrative area for the 2009 period. The service area of PDAM Tirta Tarum comprises of 16 subdistricts out of the total 30 subdistricts in the Karawang Regency. The serviced subdistricts as well as total villages is shown in **Error! Reference source not found..**

Table 5: PDAM Tirta Tarum Coverage Area

No	Sub District	Villages Covered
1	Karawang Barat	6
2	Karawang Timur	5
3	Banyusari	6
4	Telukjambe	3
5	Klari	4
6	Pangkalan	3
7	Cilamaya Wetan	4
8	Rengas Dengklok	4

No	Sub District	Villages Covered
9	Ciampel	2
10	Kutawaluya	3
11	Cibuaya	5
12	Batujaya	9
13	Cikampek	8
14	Pedes	5
15	Jatisari	4
16	Telagasari	3
17	Rawamerta	3
18	Kota Baru	7

Service area of PDAM Tirta Tarum is illustrated in **Error! Reference source not found.**

Raw Water Source

A majority of the PDAM's raw water supply comes from surface water sources, coming from the WTC and a small portion from deep wells (approximately 3.2 percent of total production)

Production Capacity

The total installed production capacity of PDAM Tirta Tarum is 720 l/s in 2009 with 80 percent production efficiency. This total production includes all water treatment plants (WTPs) within PDAM Tirta Tarum authority, including deep wells. Capacity and production of each WTP is provided in **Error! Reference source not found.**

Table 6: Service area, capacity and customers of PDAM Tirta Tarum

No	Water Treatment	Source	Capacity l/s	Production l/s	Status
1	Karawang	Surface Water	300	270	Branch (Cabang)
2	Rengasdengklok	Surface Water	40	27	Branch (Cabang)
3	Klari	Surface Water	40	22	Branch (Cabang)
4	Telukjambe	Surface Water	50	50	Branch (Cabang)
5	Cilamaya	Surface Water	70	20	Branch (Cabang)
6	Rawamerta	Deep Well	5	4	Capital Subdistrict (IKK)

No	Water Treatment	Source	Capacity l/s	Production l/s	Status
7	Telagasari	Deep Well	5	4	Capital Subdistrict (IKK)
8	Lemah Abang	Deep Well	10	8	Capital Subdistrict (IKK)
9	Pedes	Surface Water	20	13	Capital Subdistrict (IKK)
10	Jatisari	Surface Water	30	20	Capital Subdistrict (IKK)
11	Batujaya	Surface Water	20	20	Capital Subdistrict (IKK)
12	Pangkalan	Surface Water	20	14	Capital Subdistrict (IKK)
13	Cibuaya	Surface Water	20	17	Capital Subdistrict (IKK)
14	Cikampek*	Surface Water	40		
15	Ciampel	Surface Water	10	5	Capital Subdistrict (IKK)
16	Tirta Jaya*	Surface Water	50		
	TOTAL		730	494	

*The WTP at Cikampek and Tirta Jaya are not yet operating in full production.

Distribution System

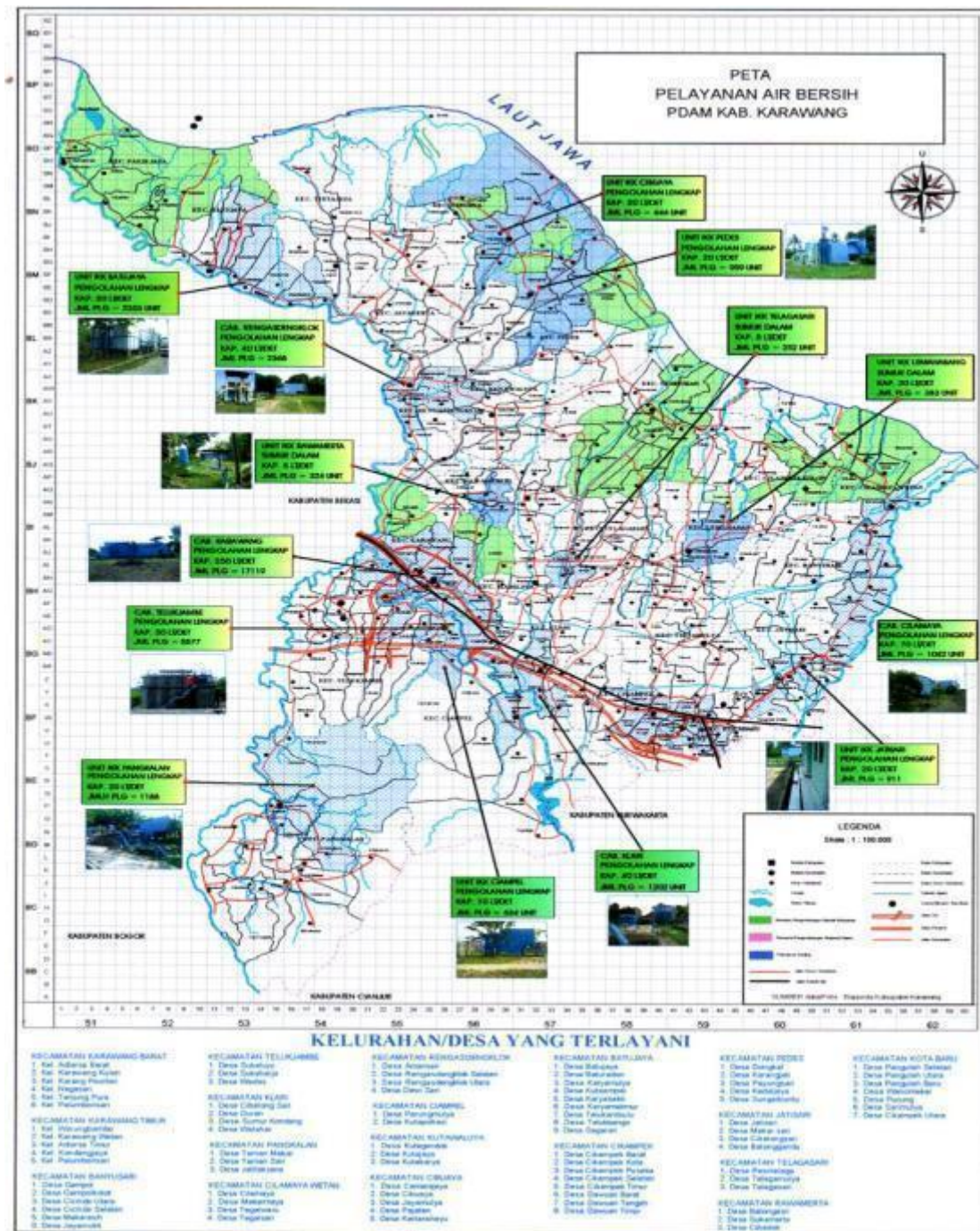
PDAM Tirta Tarum uses a pump system as its distribution system from WTP or deep well.

The serviced areas are not yet interconnected to one and other and are still individually operated, whether it is the raw water source, or its production and distribution.

The NRW level based on 2009 data is 35 percent for the entire coverage area and 40 percent for Karawang area. The NRW is caused by leaks within the distribution pipes, of which many are ageing, especially GIP pipes. NRW target of PDAM Karawang in their business plan is 31 percent.

Schematic of transmission and distribution system is shown in **Error! Reference source not found..**

Figure 2: Villages Served by PDAM Tirta Tarum (Source: Technical Planning of SPAM Development 2010-2014, PDAM Tirta Tarum)



Water Demand/Customer Demand

PDAM Karawang serves only up to 15 percent of the total population and 31 percent of the administrative area.

The water consumption from PDAM Karawang is relatively low. This is identified through:

- Average water consumption < 20 m3 per month
- Approximately 9,938 household connection with water bill < 5 m3 per month (September 2009 data)

The consumer structure of PDAM is currently dominated with households/domestic (approximately 95 percent), while the commercial customer is only 5 percent. Meanwhile, based on the information from local government (PEMDA), there are approximately 650 industries operating in Karawang Regency, where majority are still using deep wells as the source of raw water.

2.2.3 Key Issues

- Quantity and quality of raw water supplied by PJT II is declining and there is no guarantee for raw water quality.
- The system condition, both for production unit as well as distribution unit, generally has been in operation for over 30 years.
- Not all systems in PDAM Karawang have a water meter.
- Meter zoning system by PDAM Tirta Tarum has not been performing optimally due to limited funds.
- Some of the customer meters are in a bad condition (either damaged or unreadable).
- The installed pipes for transmission and distribution are mostly located on the roadside. Leakage improvement will add extra cost. In addition, the pipe leakage could also be caused by repair of other road utilities, etc.
- Production efficiency is below 100 percent at the WTP, caused by the declining condition of the pumps (Q).
- Operational system of clean water supply is still under 24 hours, since the production capacity exceeds the demand. This is because the existing distribution pipes have not yet covered all consumers within the service area.
- PDAM is not involved in the installation of large diameter pipes. Planning and implementation of large-diameter pipe installation is carried out by MPW, whose operation is then transferred to the PDAM.
- There are approximately 650 industries in Karawang Regency, of which a majority disposes their effluent into the Citarum river.

2.3 SUMMARY OF DATA COLLECTION FROM PDAM BEKASI

2.3.1 Profile of Bekasi Regency

In the Bekasi Regency, there are 16 main rivers: Citarum, Bekasi, Cikarang, Ciherang, Belencong, Jambe, Sadang, Cikedokan, Ulu, Cilemahabang, Cibeet, Cipamingkis, Siluman, Serengseng, Sepang and Jaeran. The width of these rivers ranges between 3 to 80 meters.

There are also 13 streams across subdistricts: Situ Tegal Abidin, Situ Bojongmangu, Situ Bungur, Situ Ceper, Situ Cipagadungan, Situ Cipalahar, Situ Ciantra, Situ Taman, Situ Burangkeng, Situ Liang Maung, Siru Cibeureum, Situ Cilengsir and Situ Binong. The groundwater condition in Bekasi regency is mainly shallow groundwater at the depth of 5-25 m from ground level, while deep groundwater was found between the depth of 90 - 200 m.

2.3.2 Existing Condition

Service Area

PDAM Bekasi Tirta Dharma serves customers in the regencies as well as some customers within the city. The total service coverage was 29 percent according to PDAM Bekasi Business Plan Presentation 2009 -2013. During an interview, a PDAM Bekasi representative stated that PDAM Bekasi Coverage Area includes 26.42 percent for Bekasi City and 13 percent for Bekasi Regency. The map of PDAM Bekasi service area is given in **Error! Reference source not found.**

Raw Water Source and Production Capacity

99.25 percent of raw water source for PDAM Bekasi comes from WTC with flow of 2,005 l/s and small portion from groundwater (0.75 percent) with flow of 15 l/s. In addition, PDAM Bekasi also has an agreement to purchase treated water from PDAM Tirta Patriot up to 175 l/s but only utilise 140 l/s.

PDAM Bekasi has 20 units of WTP with current total capacity of 2020 l/s and current production of 1,725 l/s. Details of capacity of each WTP is provided in the following table and also within **Error! Reference source not found..**

Figure 3: Map of Existing Service Coverage (Source: Business Plan 2009-2013 Presentation)

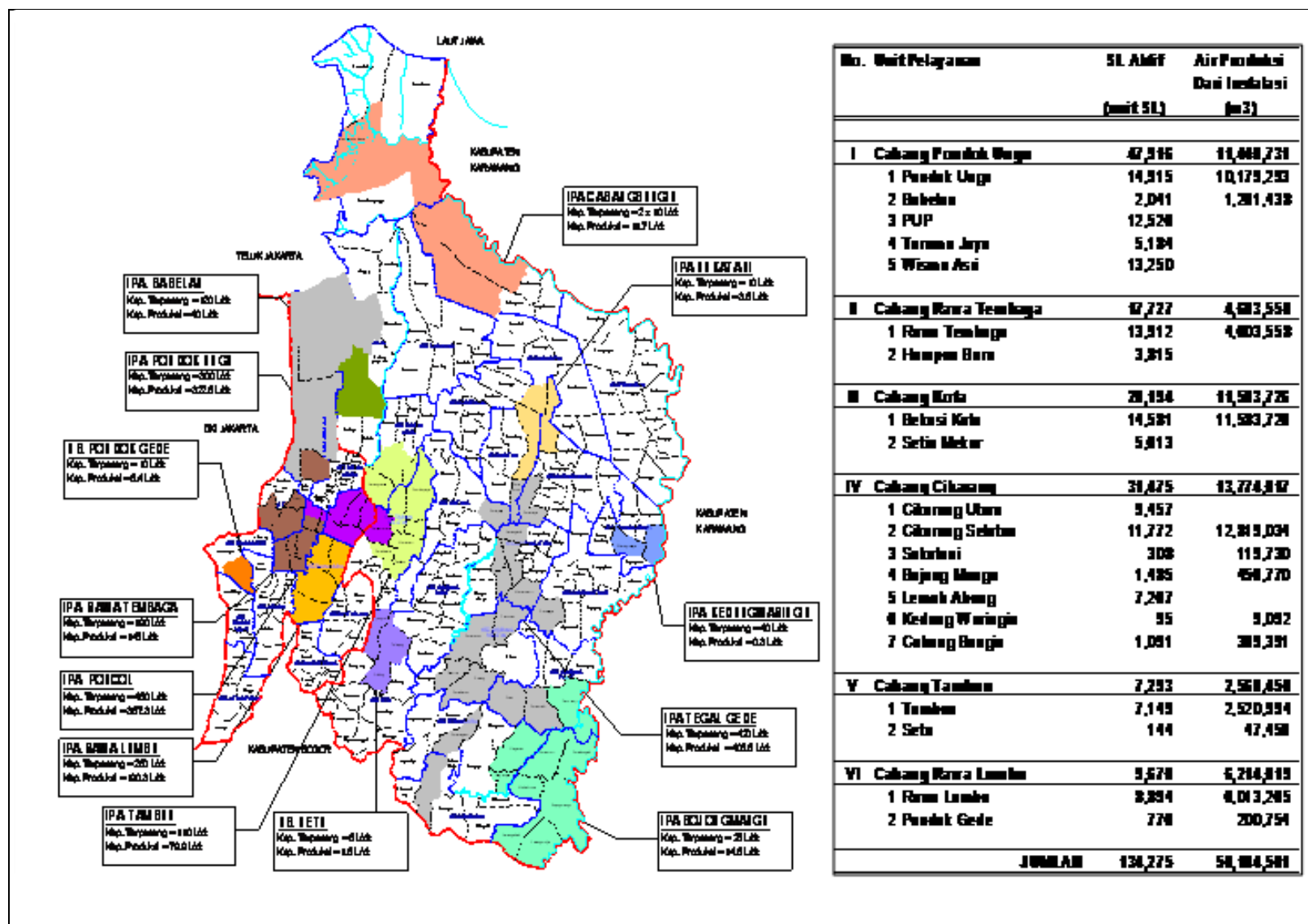


Table 7: Production Capacity and Installed Capacity of PDAM Bekasi WTP

No	Branch / WTP	Production Capacity (l/s)	Installed Capacity (l/s)
Pondok Ungu Branch		491.4	420
1	Pondok Ungu	322.8	300
2	Babelan	40	120
3	PUP	38	-
4	Taruma Jaya	-	-
5	Wisma Asri	90.7	-
Rawa Tembaga Branch		150.9	190
6	Rawa Tembaga	146	190
7	Harapan Baru	5	0
City Branch		367.3	480
8	Bekasi City	367.3	480
9	Setia Mekar	-	-
Cikarang Branch		463.8	545
10	Cikarang Utara	-	-
11	Cikarang Selatan	406.5	420
12	Sukatani	3.8	20
13	Bojong Mangu	14.5	25
14	Lemah Abang	-	-
15	Kedung Waringin	0.3	40
16	Cabang Bungin	11.7	40
Tambun Branch		81.4	115
17	Tambun	79.9	110
18	Setu	1.5	5
Rawa Lumbu Branch		197	270
19	Rawa Lumbu	190.7	260
20	Pondok Gede (Deep Well)	6.4	10

Source: PDAM Bekasi Business Plan Presentation, 2009-2013

Distribution System

Up to 2008, total length of distribution system was approximately 1,886 km, mainly comprising of PVC pipes. Current NRW from distribution is 36.98 percent. Total reservoir capacity is 12,900 m³, capacity at each branch is given below:

Table 8: PDAM Bekasi Reservoir Capacity

Branch	Capacity (m ³)
Pondok Ungu	2000
Rawa Tembaga	2 x 500
City	250 500 4000
Rawa Lumbu	2 x 500
Tambun	250 1000
South Cikarang	1200
Babelan	500
Cabang Bungin	250 50
Sukatani	50
Bojong Mangu	250
Kedung Waringin	500
Pondok Gede	100
Total	12900

Source: PDAM Bekasi Business Plan Presentation, 2009-2013

Water Demand/Customer Demand

It was informed during the interview that PDAM Bekasi has a high demand for new connections, which averaged at three demands everyday. Currently, the PDAM has a waiting list of approximately 60,000 household connections with a total demand of approximately 400 l/s comprising of 20 percent for Bekasi City and 80 percent for Bekasi Regency². The household connections in 2008 were 134,275 according to Business Plan Presentation and 140,495 connections at the end of 2009, based on data from PDAM Bekasi³.

² MoM with PDAM Bekasi Dated 19 Jan 2010

³ Data from PDAM Bekasi – Production and Distribution.pdf: Laporan Sambungan Langganan Cabang / Wilayah

Based on the representative's comment, future water demand in the area could increase between 500 – 1000 m³. Base demand for PDAM Bekasi is calculated using number of connections and its projection for new connections up to 2015⁴ and using an assumption of six persons per connection and general water usage assumption of 150 l/person/day. The base demand up to 2015 was calculated as below:

Table 9: Projections of Connections and Base Demand

Year	2008	2009	2010	2011	2012	2013	2014	2015
Proposed New Connections		4,734	5,097	5,890	10,237	13,373	21,072	26,809
Projected Connections	134,275	139,009	144,106	149,996	160,233	173,606	194,678	221,487
Person/ connection	6	6	6	6	6	6	6	6
Water usage	0.15 m ³ /person/day							
Base demand (m³/day)*	120,848	125,108	129,695	134,996	144,210	156,245	175,210	199,337

* Base demand = (projected connections) x (person/connection) x (water usage)

Current customer structure of PDAM Bekasi comprises of 97 percent domestic households, 2.5 percent commercial and the rest are social, non commercial and very few industry consumption⁵.

2.3.3 Key Issues

- PDAM Bekasi Regency has limited capacity to supply potential industrial customers.
- Poor raw water quality from WTC due to pollution from other rivers upstream of the canal.
- The distribution network should be reviewed particularly for the large diameter pipe to anticipate the increasing water demand.
- As for distribution pipes, they need to be replaced by wider pipes because they are not carrying enough water to meet with the demand.
- Limited budget to reduce current NRW (36.1 percent).

2.4 SUMMARY OF DATA COLLECTION FROM PDAM TIRTA PATRIOT – BEKASI CITY

2.4.1 Profile of PDAM Tirta Patriot

PDAM Tirta Patriot is relatively new in operation. It was established in 2004, currently servicing a small part of Bekasi city and has two WTPs.

⁴ PDAM Bekasi Business Plan Presentation 2009-2013, slide no 48

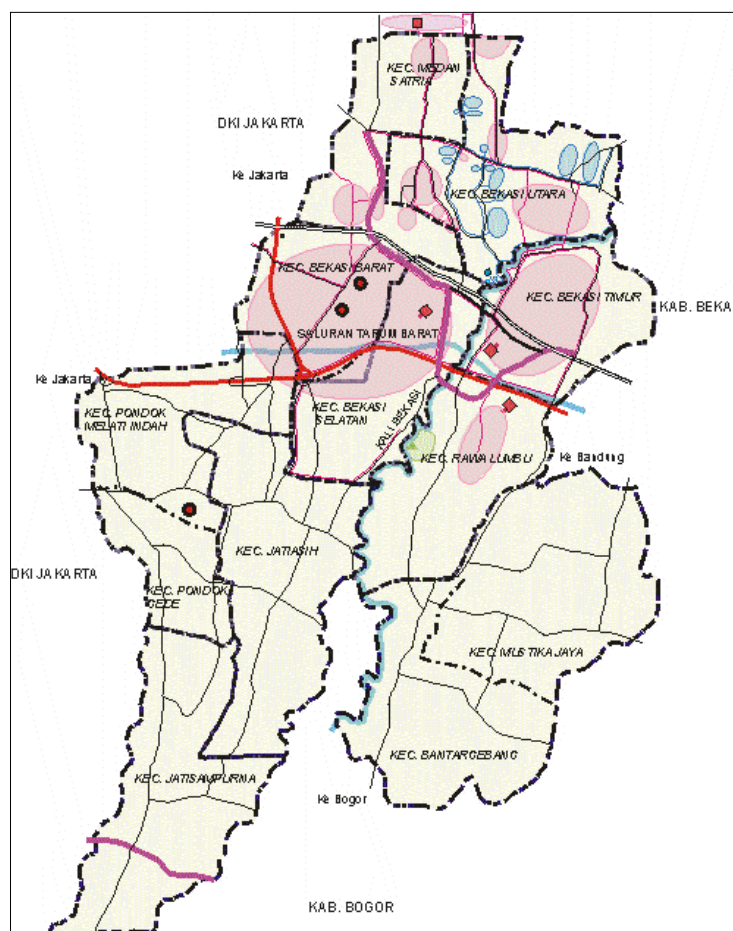
⁵ Data from PDAM Bekasi – Production and Distribution.pdf Laporan Sambungan Langganan Cabang/Wilayah

2.4.2 Existing Condition

Service Area

PDAM Tirta Patriot serves mainly the northern part of Bekasi city, approximately 560 ha. The current coverage area is 11.7 percent of the population or 2.7 percent of Bekasi city area. Illustration of coverage area of PDAM Tirta Patriot is provided in the figure below.

Figure 4: Service Coverage of PDAM Tirta Patriot



Raw Water Source and Production Capacity

PDAM Tirta Patriot receives its entire supply of raw water from the WTC and has two WTPs with the following capacity:

Table 10: PDAM Tirta Patriot Water Production and Capacity in 2009

	Installed Capacity (l/s)	Current Use (l/s)	Idle Capacity
	WTP 1 = 200	Distributed to service area = 150	125 l/s
	WTP 2 = 250	Treated water to PDAM Bekasi = 175	

	Installed Capacity (l/s)	Current Use (l/s)	Idle Capacity
Total	450 l/s	325 l/s	

Distribution System

Summary of PDAM Tirta Patriot's distribution system is given in table below:

Table 11: Distribution Components for PDAM Tirta Patriot

Components	Description
Current NRW	Less than 20 percent ⁶ or 16 percent average NRW ⁷
Distribution network length, diameter and material	The overall length of distribution pipe is approx 212 km, of which almost 100 percent are PVC and the rest is Galvanised Iron (GI). The diameter of PVC pipe ranges between 50 – 450 mm. Diameter of GI ranges between 100 – 500 mm.
Pumps	PDAM Tirta Patriot has three intake pumps with a capacity of 100 l/s each, and one stand-by pump with a capacity of 250 l/s. The distribution system also consists of three pumps with a capacity of 100 l/s each and one stand-by pump with a capacity of 250 l/s PDAM Tirta Patriot proposes to have two additional distribution pumps with a capacity of 200 l/s each.
Storage Reservoirs	Reservoir capacity is 4000 m ³ . PDAM Tirta Patriot proposes to have additional storage of 4000 m ³

Source: PDAM Tirta Patriot Company Profile

Water Demand/Customer Demand

According to data provided by PDAM Tirta Patriot⁸, it had approximately 11,002 connections in 2009, with a target to increase 1,500 connections per year, up to 2020. This data was utilised to predict the water demand, using assumptions of 7 persons per house connection and water usage of 150 l/person/day. Accordingly, the projection of water demand is given in table below:

Table 12: Projections of Connections and Base Demand

Year	2009	2010	2011	2012	2013	2014
Proposed New Connections		1,500	1,500	1,500	1,500	1,500

⁶ From Interview with PDAM Tirta Patriot Representative

⁷ PDAM Tirta Patriot Company Profile Presentation

⁸ Spreadsheet Data provided by Tirta Patriot – Jumlah pelanggan.xls

Projected Connections	11,002	12,502	14,002	15,502	17,002	18,502
Person/ connection	7	7	7	7	7	7
Water Usage	0.15 m ³ /person/day					
Base demand (m³/day)*	11,552	13,127	14,702	16,277	17,852	19,427
Year	2015	2016	2017	2018	2019	2020
Proposed New Connections	1,500	1,500	1,500	1,500	1,500	
Projected Connections	20,002	21,502	23,002	24,502	26,002	27,502
Person/ connection	7	7	7	7	7	7
Water Usage	0.15 m ³ /person/day					
Base demand (m³/day)*	21,002	22,577	24,152	25,727	27,302	28,877

* Base demand = (projected connections) x (person/connection) x (water usage)

Up to October 2009, the PDAM's customer structure consisted of 99 percent domestic households, with the remaining being small commercial, social and non-commercial users.

2.4.3 Key Issues

- Poor raw water quality from the WTC.

2.5 SUMMARY OF DATA COLLECTION FROM PALYJA

2.5.1 Profile of Palyja

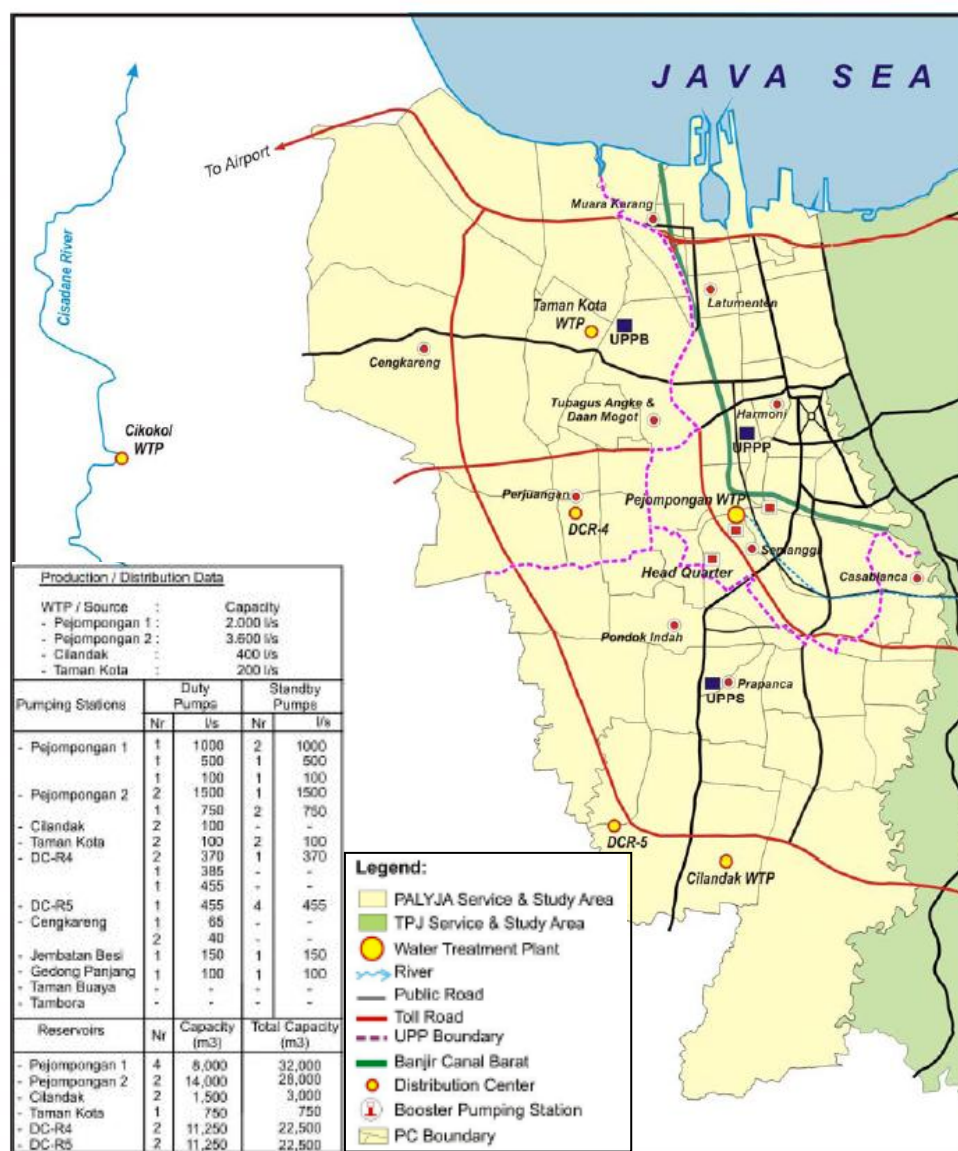
PT Pam Lyonnaise Jaya (PALYJA) is a part of Suez-Environment, PT Astratel Nusantara and Citigroup Financial and has been operating drinking water services in the Western Part of DKI Jakarta since 1998. PALYJA owns four water plants, with two high capacity plants in Pejompongan (up to 6,200 l/s). The main raw water source for PALYJA comes from the WTC and some from Cisadane River, through purchased treated (bulk) water agreement with Tangerang.

2.5.2 Existing Condition

Service Area

PALYJA service area coverage is the western region of DKI Jakarta as shown in figure below. Service coverage in 2006 was 55.5 percent⁹.

Figure 5: PALYJA Service Area (Source: PALYJA Master Plan, January 2008)



Raw Water Source and Production Capacity

PALYJA receives raw water supply from the WTC, Cengkareng Drain, Krukut River, and Banjir Kanal and it also purchases treated water from Serpong WTP, Cikokol WTP and from Aetra, as shown in the table below.

⁹ PALYJA Master Plan, Volume 1, pg. 2-3

Table 13: PALYJA Water Source and Production Capacity

Description	Raw Water Source (l/s)		Design Capacity (l/s)	Actual Production (l/s)
PALYJA Production				
Pejompongan 1	WTC	2,100	2,200	2,000
Pejompongan 2	WTC	3,780	3,800	3,600
Cilandak	Krukut River	n/a	400	400
Taman Kota (to be closed)	Cengkareng Drain	n/a	200	160
Total WTP Production Capacity				6,160 l/s
Purchased Treated Water				
DCR5+DCR4	Cisadane Serpong	n/a	2,800	2,600
Cikokol	Cikokol WTP	n/a	78	84
TPJ		n/a	199	50
Total	5,880 l/s from West Tarum Canal		9,677 l/s	8,894 l/s

Source: PALYJA Master Plan Volume 4, 2007

Distribution System

Summary of PALYJA's distribution system is given in **Error! Reference source not found..**

Table 14: Distribution Components for PALYJA

Components	Description
Customer Services Unit (CSU)	Central CSU (Zone 1) West CSU (Zone 4) South CSU (Zone 5) Main CSU for large volume customers
Water into distribution network	Pejompongan 1 and 2 WTP (mainly CSU Central) Cilandak WTP (mainly CSU South) Taman Kota WTP (CSU West) Distribution Centre DC-R4 (from Cisadane into CSU West) Distribution Centre DC-R5 (from Cisadane into CSU South) Cikokol pipeline into CSU West Cengkareng Booster pump station

Components	Description
	Transfer from TPJ
Pressures within network	Ranges between 0 and 1.4 bar Average: 0.4 – 0.6 bar, inadequate pressure in the north and northwest
Current NRW	43 percent ¹⁰
Primary and Distribution network	The overall length is 5106 km, of which 379 km – or 7 percent – forms the primary network. Distribution network makes up 93 percent of overall network which amounts to 4,727 km.
Pipe Diameter	Diameter of primary network pipeline ranges from 300 – 1200 mm. Diameter of distribution network is approximately 250 mm or less.
Pipe Materials¹¹	Primary network: 49 percent DCI, 23 percent PVC, 23 percent STL, the rest are HDPE, GIP, FGP, AC Distribution network extension: 84 percent PVC, 8 percent GIP, 8 percent DCI
Pumping Stations <i>Distribution pumping stations</i> <i>Booster Pump Stations</i>	At all WTPs and DCs. Highest capacity and number of pumps in Pejompongan 1 and 2, as follows: Pejompongan 1: 3 x 1000 l/s x 42m 2 x 500 l/s x 42m 2 x 100 l/s x 42m Pejompongan 2: 3 x 1500 l/s x 48m 3 x 750 l/s x 48m BP Jembatan Besi, BP Gedong Panjang, BP Cengkareng, BP Daan Mogot
Storage Reservoirs <i>At Treatment Plants</i> <i>At Distribution Centres</i> <i>Booster Pump Stations</i>	111,220 m³ 63,750 m ³ 45,000 m ³ 2,470 m ³

Source: PALYJA Master Plan Volume 5, 2007

¹⁰ From MoM with PALYJA dated 20 January 2010

¹¹ PALYJA Master Plan Vol 5 p.2-7/2.8

Water Demand/Customer Demand

Based on PALYJA master plan, water demand was predicted to increase from 354,368 m³/day in 2005 to 515,775 m³/day by 2022. The prediction of base demand is summarised below.

Table 15: Base Demand Calculation

Year	2005	2007	2012	2017	2022
Base Demand	354,368	360,356	443,842	486,355	515,775

Source: PALYJA Master Plan, Vol 3, 2007

According to its official website, PALYJA had approximately 412,456 connections in 2009¹². Structure of the customer group is provided below:

Table 16: Customer Group Breakdown

Group	Description	Customer Percentage
K1	Social Customer	48 percent
K2	Low Income Costumer	
K3A	Middle Class	
K3B	Upper Class	22 percent
K4A	Small Business	30 percent
K4B	Non Domestic	
KSP	Special	

Source: PALYJA Master Plan Volume 2, 2007

Water Quality

According to PALYJA Master Plan, 97.25 percent of water samples taken from distributed water to customers in 2006 were in compliance with 'Clean Water Standards'. The highest proportion of failed samples was mostly due to total coli and organics.

Key Issues

- Poor raw water quality standard.
- High NRW (51-43 percent).
- Frequency of interruptions affecting water supply, in particular for Pejompongan (unreliable electricity).

¹² <http://www.palyja.co.id/?page=ourcompany&postid=20>

2.6 SUMMARY OF DATA COLLECTION FROM AETRA

2.6.1 Profile of Aetra

PT Aetra Air Jakarta (AETRA) is a private company operating clean water systems in the eastern side of Jakarta since 2007. This service was formerly operated under PT Thames Pam Jaya.

AETRA has three water treatment plants; two of which are located in Buaran and the third in Pulo Gadung. The total production capacity of AETRA is approximately 9,000 l/s, where almost 100 percent of water supply is from the WTC.

2.6.2 Existing Condition

Service Area

AETRA service area covers the eastern region of DKI Jakarta as shown in the figure below. Service coverage was 67 percent¹³ in 2006 and 62 percent in 2009, based on an interview with the AETRA representative¹⁴.

Raw Water Source and Production Capacity

AETRA receives raw water from WTC to supply all of its WTPs. The raw water source and production capacity is shown in table below.

Table 17: AETRA Water Source and Production Capacity

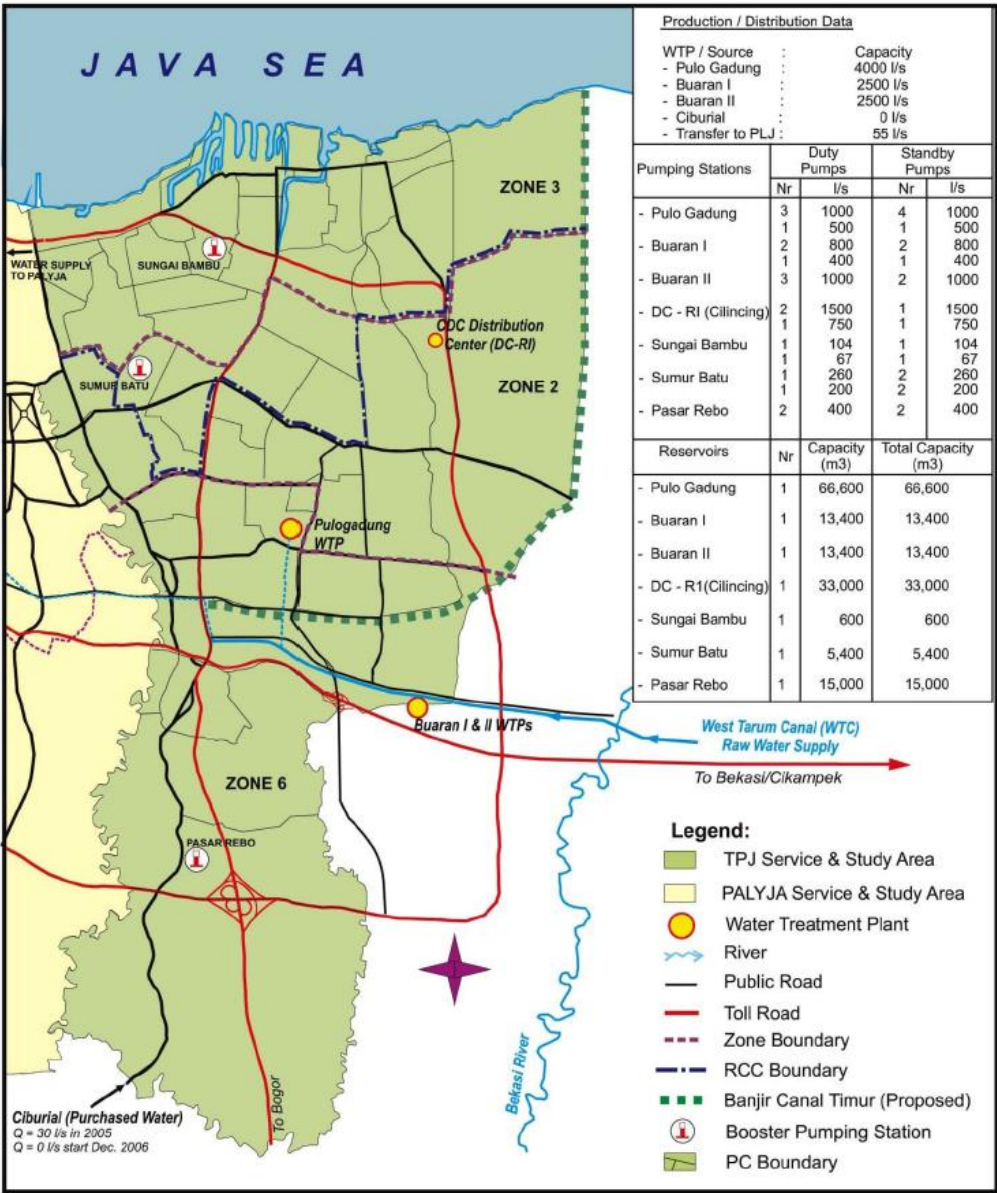
Description	Raw Water Source (l/s)		Design Capacity (l/s)	Actual Production (l/s)
Aetra Production				
Buaran 1	WTC	5,250	2,500	2,500
Buaran 2	WTC		2,500	2,500
Pulo Gadung	WTC	4,200	4,000	4,000
Total	9450 l/s from West Tarum Canal		9,000 l/s	9,000 l/s

Source: TPJ Master Plan Volume 4, page 3-2, 2007

¹³ TPJ Master Plan, Volume 1, Page 2-2 (January 2008)

¹⁴ MoM with Aetra dated 22 January 2010

Figure 6: Aetra Service Area (Source: TPJ Master Plan)



Distribution System

Summary of AETRA’s distribution system is given in **Error! Reference source not found.**

Table 18: Distribution Components for AETRA

Components	Description
Customer Services Unit (CSU)	<p>Zone 2: comprises part of North Jakarta, Central Jakarta and East Jakarta, densely populated, high concentration of industry</p> <p>Zone 3: North Jakarta, most densely populated, the sea port is an important customer, large development areas at Kemayoran and Cakung</p> <p>Zone 6: East Jakarta, least densely populated</p>
Water into distribution network	<p>Pulo Gadung WTP (mainly Zone 2 and Zone 3)</p> <p>Buaran 1 WTP (mainly Zone 6)</p> <p>Buaran 2 WTP (mainly Zone 3)</p>
Pressures within network	Ranges between 0 – 1.4bar; Average: 0.4 – 0.6 bar
Current NRW	48.6 percent ¹⁵
Primary and Distribution network	<p>The overall length is 5,421 km, of which 7 percent (354 km) forms the primary network</p> <p>Distribution network makes up 93 percent of overall network which amounts to 5,067 km</p>
Pipe Diameter	<p>Diameter of primary network pipeline ranges from 200 – 1800 mm.</p> <p>Diameter of distribution network are approximately 50 – 300 mm</p>
Pipe Materials¹⁶	<p>Primary network:</p> <p>76 percent DIP, 17 percent PVC, 5 percent Steel, 2 percent HDPE</p> <p>Distribution network:</p> <p>81.5 percent PVC ,11 percent GIP, 7 percent DIP, the rest are steel, PVC and AC</p>
Pumping Stations <i>Distribution pumping stations</i> <i>Booster Pump Stations</i>	<p>At all WTPs and Distribution Centre R-1 (Cilincing), see details in Error! Reference source not found. above</p> <p>BP Pasar rebo, BP Sumur Batu, BP Sungai Bambu and Tugu¹⁷</p>
Storage Reservoirs <i>At Treatment Plants</i> <i>At Distribution Centres</i> <i>Booster Pump Stations</i>	<p>147,400 m³</p> <p>93,400 m³</p> <p>33,000 m³</p> <p>21,000 m³</p>

Source: TPJ Master Plan Volume 5, 2007

¹⁵ From Data Supplied by Aetra (Master Cetak), received January 2010

¹⁶ TPJ Master Plan Vol 5

¹⁷ <http://www.aetra.co.id/>

Water Demand/Customer Demand

Based on TPJ master plan, water demand was predicted to increase from 377,276 m³/day in 2005 to 562,823 m³/day by 2022. The prediction of base demand is summarised below.

Table 19: Base Demand Calculation

Year	2005	2007	2012	2017	2022
Base Demand	377,276	345,690	452,203	514,206	562,823

Source: TPJ Master Plan, Vol 3, 2007

The latest data from AETRA¹⁸ shows that it had a total of 382,693 connections in 2009. Structure of customer group is provided below:

Table 20: Customer Group Breakdown

Group	Description	Total Customer	Percentage
K1	Social Customer	4140	1 percent
K2	Low Income Costumer	37590	10 percent
K3A	Middle Class	200853	52 percent
K3B	Upper Class	82653	22 percent
K4A	Small Business	45200	12 percent
K4B	Non Domestic	12254	3 percent
KSP	Special	3	0 percent
TOTAL		382,693	

Source: AETRA Customer Structure Data, excerpt from PPSES Report

Water Quality

According to TPJ Master Plan, 97.6 percent of water samples taken from water supplied to customers in 2006 were in compliance with 'Clean Water Standards'.

2.6.3 Key Issues

- High number of connections with zero consumption.

¹⁸ Data from AETRA, Number of Customer 2009 (Master Cetak)

- Poor raw water quality
- High NRW (48.6 percent)

CHAPTER 3: DATA ANALYSIS

3.1 INITIAL WATER DEMAND ANALYSIS

Based on the existing data, the current base water demand is estimated at 937,500 m³/day and is projected to increase to 1,606,000 m³/day or approximately to 18 m³/s in 2025, excluding NRW. However, this figure has to be confirmed in the next stage as there are missing data and targets required in making accurate projections. The water demand projection is shown in the table and figure below.

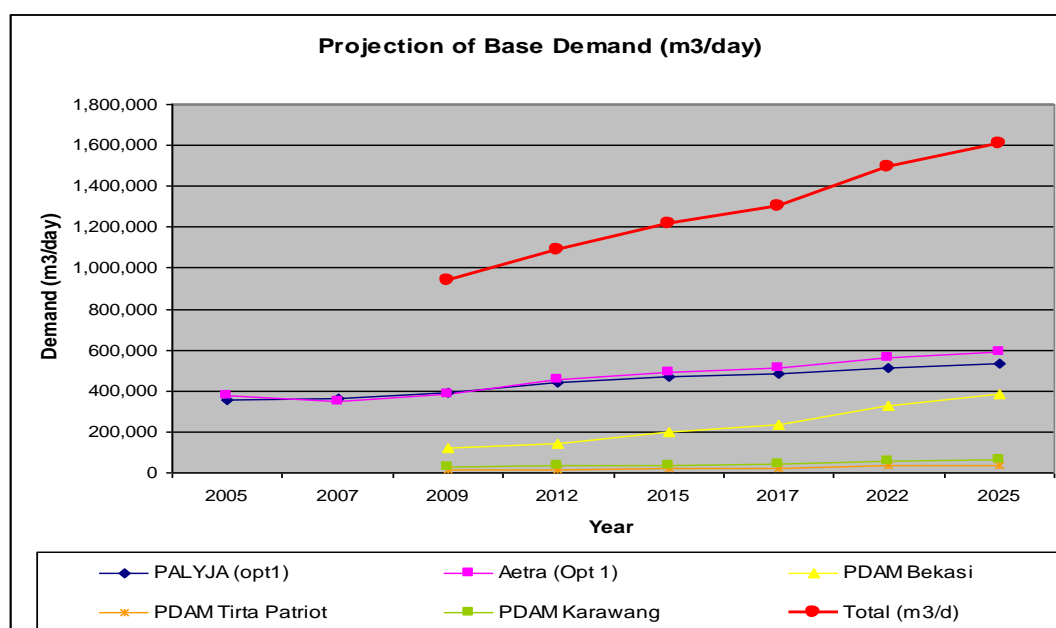
Table 21: Water Demand Prediction

	2005	2007	2009	2012	2015	2017	2022	2025
PALYJA (opt1)	354,368	360,356	393,750	443,842	469,350	486,355	515,775	533,427
Aetra (Opt 1)	377,276	345,690	382,693	452,203	489,405	514,206	562,823	591,993
PDAM Bekasi			120,848	144,209	199,337	236,090	327,971	383,099
PDAM Tirta Patriot			11,552	16,277	21,002	24,152	32,027	36,752
PDAM Karawang			28,620	33,131	38,354	42,285	53,967	60,977
Total (m3/d)			937,463	1,089,662	1,217,448	1,303,088	1,492,563	1,606,248
Total (m3/s)			10.85	12.61	14.09	15.08	17.28	18.59

Legend:

5% growth rate assumption	from master plan	from calculations / projections	from PALYJA - master cetak	data not available
---------------------------	------------------	---------------------------------	----------------------------	--------------------

Figure 7: Projection of Base Demand



From the table and figure above, water demand from both PALYJA and AETRA makes up 70 percent of the overall demand, followed by Bekasi Regency, Bekasi City and Karawang. Assumptions used for calculating water demand for each operator is described below:

- **PDAM Karawang**

The demand for Karawang is estimated based on current house connections¹⁹, water demand assumption of 120 litre/person/day and ratio of six people per connection (verbal confirmation from PDAM Karawang) and assumption of 5 percent increase in growth rate.

- **PDAM Bekasi Regency**

The demand for PDAM Bekasi is estimated based on current house connections and its target for expansion up to 2015, as given in their Business Plan²⁰, using ratio of six people per connection. Since no data is available, water demand in 2017-2025 is projected from demand in previous year, using linear equation.

- **PDAM Tirta Patriot, Bekasi City**

The water demand for PDAM Tirta Patriot is calculated based on their actual existing connection, rate of 1,500 connection increase per year²¹ and ratio of seven people per connection.

- **PALYJA**

All data used for PALYJA is taken from Master Plan 2007, except for the years 2009, 2015 and 2025, where it uses projection method.

¹⁹ PDAM Karawang presentation – Perencanaan Teknis Pengembangan SPAM Tahun Anggaran 2008 - 2014

²⁰ PDAM Bekasi presentation – Business Plan 2009 – 2013

²¹ PDAM Tirta Tarum PROYEKSI KEBUTUHAN AIR BERSIH PENDUDUK WILAYAH UTARA KOTA BEKASI s.d Th. 2020 – excel spreadsheet

- **AETRA**

The current data (2009) used for AETRA is based on actual data provided by the operator. The past and future projections are taken from TPJ Master Plan 2007, except for 2015 and 2025 where it uses projection method.

3.2 SUPPLY ANALYSIS

The supply analysis is performed for both, quantity and quality of water in relevant location.

3.2.1 Water Quantity

Based on the Citarum Water Balance provided by PJT II (dated 28 January 2010), the combined effective annual volume of Saguling, Cirata and Djuanda (Jatiluhur) dam is 1,708.28 million m³. Quantity of water from Citarum river is 4,764.63 million m³ per annum, with an assumption of normal flow. With addition of water from other local sources, the volume of water available is 8,126 million m³ per annum before extracted with current use. The detail is provided below:

Table 22: 2009 Water Balance

Water Supply (million m ³ /year)		Existing Use (million m ³ /year)	
Effective Volume from 3 dams	1,708.28	Irrigation	4,651.8
Flow from Citarum	4,764.63	Industrial	813.57
Other Local sources	1,653.29	Gadu II (Others)	286.5
Total Potential Water Supply	8,126.2	Total existing usage	5,751.87
Water Balance Available for Other Use		2,374.33	million m³/year
		75.29	m³/s

Source: PJT II Neraca Air Sungai Citarum as per 28 January 2010

3.2.2 Water Quality

GHD has obtained water quality results within Jatiluhur Reservoir and along Citarum River from January - December 2009, provided by PJT II. The water quality results appear not to have been carried out by an accredited testing agency. The sampling and analysis methods have not been indicated.

This section provides evaluation of the results as presented.

The locations of interest are the possible locations for proposed WTP, except for Cikao which is the only waterway between Jatiluhur and Curug. From all the sampling points, the locations of interest are described below:

1. Pasir Gombong – *possible location for WTP*. There was no sampling taken in the location during 2009. The nearest water quality sampling taken was in Kerenceng, approximately 7 km from Pasir Gombong on the Jatiluhur Dam.
2. Citarum river before the confluence with Cikao river – *possible location for WTP*. Represented by the sampling taken at Jatiluhur outlet.
3. Cikao river – the only major waterway between Jatiluhur – Curug. Sampling taken upstream or before confluence with Citarum river.
4. Curug dam – *possible location for WTP*.

All the above locations of interest are shown in **Error! Reference source not found.****Error! Reference source not found..**

Figure 8: Water Quality Results in Jatiluhur - Curug



The water quality data for the above locations are summarised in **Error! Reference source not found.****Error! Reference source not found..**

Table 23: Summary of Water Quality

	Water Quality Standard ²²	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Turbidity (NTU)													
1.Kerenceng		4.06	1.54	2.86	2.86	-	-	2.86	1.93	4.06	-	-	-
2.Jatiluhur outlet		6.29	1.32	1.28	-	-	-	2.30	2.28	6.29	2.02	2.50	2.50
3.Cikao		69.50	39.10	84.50	-	-	-	21.90	12.50	69.50	11.70	2.70	2.70
4.Curug		28.6	44.0	5.4	60.1	27.6	-		28.6	28.6	-	-	-
TDS (mg/l)	1000												
1.Kerenceng		180.00	100.00	280.00	280.00	-	-	280.00	320.00	180.00	-	-	-
2.Jatiluhur outlet		190.00	100.00	100.00	-	-	-	270.00	30.00	190.00	110.00	60.00	60.00
3.Cikao		130.00	110.00	80.00	-	-	-	260.00	670.00	130.00	130.00	110.00	110.00
4.Curug		70	210	150	160	140	-	-	70	70	-	-	-
BOD (mg/l)	6												
1.Kerenceng		7.34	1.08	3.04	3.04	-	-	3.04	4.36	7.34	-	-	-
2.Jatiluhur outlet		8.33	5.56	3.04	-	-	-	4.02	2.18	8.33	1.11	3.34	3.34
3.Cikao		2.55	5.51	1.37	-	-	-	9.43	2.98	2.55	1.22	2.13	2.13
4.Curug			4.08	5.88	5.56	5.12	-	-	-	-	-	-	-

²² Surat Keputusan Gubernur Jawa Barat No 39 Tahun 2000

	Water Quality Standard ²²	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
COD (mg/l)	10												
1.Kerenceng		19.12	5.00	7.23	7.23	-	-	7.23	10.71	19.12	-	-	-
2.Jatiluhur outlet		21.51	13.54	7.14	-	-	-	10.16	5.26	21.51	5.00	8.06	8.06
3.Cikao		6.37	13.54	5.00	-	-	-	25.20	6.88	6.37	5.00	5.24	5.24
4.Curug		7.14	10.20	15.26	13.54	12.85	-	-	7.14	7.14	-	-	-
H₂S (mg/l)	0.002												
1.Kerenceng		0.03	0.03	0.03	0.03	-	-	0.03	0.03	0.03	-	-	-
2.Jatiluhur outlet		0.03	0.05	0.03	-	-	-	0.08	0.04	0.03	0.35	0.03	0.03
3.Cikao		0.08	0.11	0.03	-	-	-	0.03	0.04	0.08	0.04	1.03	1.03
4.Curug		< 0.025	0.04	0.07	0.04	0.09	-	-	< 0.025	< 0.025	-	-	-

Source: Consolidated Water Quality Data Provided by PJT II

Based on the above results, the water quality in proposed locations is within the permitted limit for raw water, except for H₂S in all locations and for turbidity and COD at Curug (high turbidity from Cikao River is causing high turbidity at Curug).

However, there are significant gaps in provided data i.e. missing data in May - June and October – December, no WQ sampling for lead, identical results repeated for several months, etc. These results also contradict with the water quality results presented by PJT II in the IPA Workshop presentation²³, dated May 2009. PJT II - IPA Workshop presentation results indicate:

- lead detected in some fish species
- heavily polluted by organic materials
- highly eutrophic level in 2006
- bad odour of H₂S at tailrace and fisheries area
- high sediment in at least half of the dam area
- dark colour water at Jatiluhur outflow

The source of the data presented has not been confirmed. A sampling and testing program by accredited laboratory is required for more reliable assessment of the water quality.

In addition, the reference standard currently used is the *Surat Keputusan Gubernur Jawa Barat No 39 Tahun 2000 tentang Peruntukan Air pada sungai Citarum dan anak-anak sungainya di Jawa Barat*, with water quality for class BCD (suitable for fish cultivation, farming, irrigation, etc). If the raw water from Jatiluhur will be used as raw water for drinking water, it has to comply with water quality standard for Class I of Government Regulation - Peraturan Pemerintah No. 82 Tahun 2001. The key water quality parameters for Class I are as follows:

Table 24: Water Quality Standard for Class I (Clean Water Quality Standard)

PARAMETER	Unit	Class	PARAMETER	Unit	Class
		I			I
Physical			Chemical – cont.		
Temperature	°C	± 3	Chrome (VI)	mg/L	0.05
TDS	mg/L	1000	Copper	mg/L	0.02
TSS	mg/L	50	Iron (Fe)	mg/L	0.3
Chemical			Lead (Pb)	mg/L	0.03
pH		6 - 9	Manganese	mg/L	0.1
BOD	mg/L	2	Mercury (Hg)	mg/L	0.001
COD	mg/L	10	Zinc	mg/L	0.05

²³ PJT II Presentation – Integrated Citarum River Basin Management for Jakarta Raw Water Supply

PARAMETER	Unit	Class
		I
DO	mg/L	Minimum 6
Phosphate - P	mg/L	0.2
NO ₃ - N	mg/L	10
NH ₃ -N	mg/L	0.5
Arsenic	mg/L	0.05
Cobalt	mg/L	0.2
Barium	mg/L	1
Boron	mg/L	1
Selenium	mg/L	0.01
Cadmium	mg/L	0.01

PARAMETER	Unit	Class
		I
Chloride	mg/L	600
Cyanide	mg/L	0.02
Fluoride	mg/L	0.5
Nitrite - N	mg/L	0.06
Sulphate	mg/L	400
Free Chlorine	mg/L	0.03
Sulphur as H ₂ S	mg/L	0.002
Microbiology		
Fecal Coliform	/100 ml	100
Total coliform	/100 ml	1000

3.2.3 Existing Treatment Plant Capacity

Existing treatment plant capacity of PDAMs and Operators are summarised in the following table. No assessment of the residual economic life of these plants has been conducted.

Table 25: Existing Treatment Plant Capacity

WTP	Operator	Production Capacity (l/s)	Design Production Capacity (l/s)	Raw Water Source	Raw water from WTC (l/s)	Year Built/ Upgrade
Pejompongan I WTP	PALYJA	2,000	2,200	West Tarum Canal	2,100	1957/1996
Pejompongan II WTP	PALYJA	3,600	3,800	West Tarum Canal	3,780	1970/1986
Taman Kota WTP (proposed closure)	PALYJA	160	200	Cengkareng Drain	-	1982/1989
Cilandak WTP	PALYJA	200	400	Krukut River	-	1977/1999
Buaran WTP	AETRA	5,000	5,000	West Tarum Canal	5,250	1995
Pulo Gadung WTP	AETRA	4,000	4,000	West Tarum Canal	4,200	1982
Bekasi WTP	PDAM Bekasi	1,725	2,020	West Tarum Canal	2,010	n/a

WTP	Operator	Production Capacity (l/s)	Design Production Capacity (l/s)	Raw Water Source	Raw water from WTC (l/s)	Year Built/ Upgrade
Tirta Patriot WTP	PDAM Tirta Patriot	325	450	West Tarum Canal	n/a	2003
Karawang WTP	PDAM Karawang	494	720	West Tarum Canal	n/a	1968/ 2007/ 2008

3.3 SUPPLY RELIABILITY

The water supply in terms of quantity appears to be adequate for the estimated demand projection up to 2025. From the limited water quality data provided, it appears all sources may not meet the clean raw water for drinking water quality standard.

The reliability of both, water quantity and water quality depends on protection of catchment area, which is still very poor. This is evident by the extensive fish farming in the Jatiluhur Reservoir, limited control of untreated wastewater discharge to the waterways as well as forest degradation.

The supply reliability is also influenced by the PLN power generation storage and demand requirements.

The next stage will need to include comprehensive plan of water balance for the Jatiluhur reservoir to substantiate supply reliability.

CHAPTER 4: PROJECT OPTIONS

The Jakarta-Jatiluhur Pipeline Project to provide drinking water quality supply to DKI Jakarta and selected PDAM's should include:

Staging Options

There are two options for project development.

One is to start treating to drinking water standard immediately. This would require existing PDAM's assets to be shut down or convert to distribution centres. The sub-options are to stage or not to stage process unit and the pipelines (see **Error! Reference source not found.** – Indicative Staging options).

Second option is to treat clean water using the existing PDAM system and stage the development of the new treatment plant until eventually it will deliver drinking water quality.

Intake and WTP Location

Currently three possible intakes and water treatment locations have been considered. These locations and primary reason for consideration are as follows. The detailed pros and cons are considered in **Error! Reference source not found.**

- Curug, adjacent to the existing WTC headworks. This location has associated infrastructure, such as power and access are already established.
- Citarum river upstream of the confluence with Cikao river. Better quality of water and close to the discharge of Jatiluhur Reservoir.
- Pasir Gombong. Better quality of water as new intake will be directly from Jatiluhur Reservoir and pumping costs would be considerably reduced as advantage can be taken of the dam elevation.

For scenario utilising current PDAM's WTP, a treatment plant in the upstream is still required since it has to meet the standard of clean raw water for drinking water quality standard (Government Regulation no. 82 year 2001: Water Quality Standard Class I Water), the capacity of existing WTP should also be considered to meet with drinking water quality standard.

Piping route (trunk main route options)

The main consideration for piping routes are the land acquisition and head availability related with pumping system consideration.

From all three options, the route along toll road and route along kalimalang would have relatively minimal land acquisition, but has other considerations, in particular the possibility of inadequate space.

The alternative route via Jonggol presumably requires more land acquisition and has longer trunk main as it has to be connected to Bekasi and Karawang, but has possible future development for south Jakarta.

4.1 OPTIONS FOR PROJECT STAGING

Project options identified are summarised below.

Table 26: Indicative Options for Project Staging

Staging Option (Indicative)				
Expected Water Quality	WTP	Pipelines	Advantages	Disadvantages
Drinking Water	Staging of process unit	2 pipelines	Provide standby capacity during maintenance Staging pipeline construction	Relatively high investment cost for drinking water WTP May have gaps between demand and supply before upgrading the capacity (demand > supply)
	WTP without staging	1 pipeline	Sufficient capacity to meet all demand	High investment cost in WTPs Maintenance needs careful planning otherwise could cause significant service disruption Large diameter of pipelines
		2 pipelines	Sufficient capacity to meet all demand No service disruption during maintenance	Highest investment cost in WTP and pipes Lost of existing investment in WTPs
Clean Water	Staging of process units	2 pipelines	Lowest cost in the initial stage May utilise existing facilities at each PDAM Water supply can be provided in stages, in line with PDAMs performance improvement	High additional cost in the future to upgrade to drinking water quality Pipelines have to meet drinking water standard from the beginning Need additional treatment/upgrading the WTP to meet drinking water standard Before upgrading to drinking water, the entire pipeline need to be disinfected

Further assessment on each of the above option is required in Stage II, including its financial and legal implications, to determine the most feasible scenario.

4.2 OPTIONS FOR WTP LOCATIONS

Three possible locations for the new water treatment plant have been identified. The options and initial analysis is provided below.

Table 27: Options for WTP Locations

WTP Location			
	Pros	Cons	Consideration Factors
At Curug	Requires less pipeline length, closer to other PDAMs population	Poor water quality, pumping requirement is higher, land availability is unknown	Water quality, protection of waterway from Jatiluhur and Curug, staging development
At Pasir Gombong	Better water quality, high head difference with Jakarta, higher head and thus pumping costs will be reduced	High investment in pipelines and equipment to control head loss	Water quality, protection of catchment area up to Bandung, restriction of fish farming, less water available for existing power plant, staging development
Jatiluhur - Upstream of Cikao River	Better water quality	High pumping requirement, land availability	Water quality, protection of waterways, staging development
Utilise current PDAM's WTP	Less investment cost, better water quality	Still require WTP upstream for preliminary treatment	Future capacity at PDAM's WTP, staging development

Further assessment on each of the above options is required in Stage II, including its financial and legal implications, to determine the most feasible location.

4.3 OPTIONS FOR TRANSMISSION ROUTES

Three possible routes for the transmission system from Jatiluhur to Jakarta have been identified. The options and initial analysis is provided below.

Table 28: Options for Transmission Routes

Piping Routes			
	Pros	Cons	Consideration Factors
Along Kalimalang (From Curug or upstream of Cikao River)	Relatively minimum land acquisition, along existing road to Jakarta	Insufficient width of RoW for pipeline construction, insufficient access on land for embankment for use of heavy machinery during canal maintenance, cross sections are not uniform	Depth of pipe due to heavy maintenance equipments on embankment, pipeline construction. Pipeline length approximately 68.5 km from Curug. Additional pipeline from upstream of Cikao River to Curug is approximately 6.5 km – 8 km.
Along Toll Road (From Curug or upstream of Cikao River)	Relatively minimum land acquisition	Lack of space for pipeline placement since there are electricity, telecommunication and also gas utilities alongside the toll road, may face difficulties in obtaining MoU with Jasa Marga and Bina Marga. Constructed within toll RoW	Agreement (MoU) with Bina Marga / Jasa Marga to use RoW, coordination with PLN, Telkom and PN Gas, pipeline construction consideration. Pipeline length approx 67 km. Additional pipeline from upstream of Cikao River to Curug is approximately 6.5 km – 8 km.

Piping Routes			
	Pros	Cons	Consideration Factors
From Pasir Gombong via Jonggol - Cibubur	Less pumping required (higher elevation), construction is relatively easy as mostly is rural land, possible future development for south Jakarta	Long connection of pipeline to supply Karawang and Bekasi (longer trunk mains)	Land acquisition, longer trunk mains. Pipeline length approximately 64 – 70 km (excluding trunk mains to Karawang and Bekasi)

Further assessment on each of the above options is required in Stage II, including its financial and legal implications, to determine the most feasible route.

CHAPTER 5: SCOPE OF WORK FOR STAGE II - TECHNICAL ASPECT

The Scope of Work for Stage II – Technical Aspect includes the following:

- **Water quality**
 - Review and verification of existing water quality data
 - Water quality sampling and laboratory analysis program at relevant locations
 - Analyse water quality result and compare with Water Quality Standard requirements
- **Detailed demand analysis**
 - Review and verification of existing demand data
 - Future demand projection
- **Detailed supply analysis**
 - Review and verification of existing supply data
 - Water balance analysis of Jatiluhur Reservoir
 - Risk analysis of supply sustainability
- **Identification of possible alternatives for Jakarta water supply**
 - Identify other possible sources for drinking water supply for Jakarta, e.g. desalination, Jati Gede reservoir in West Java, etc.
 - Develop ballpark costing for comparison with Jatiluhur project
 - Identify risks of alternative project implementation in the future to Jatiluhur project
- **Assessment of Water Treatment Plant**
 - Review and verification of WTP locations and treatment capacity
 - Preliminary topographic and geotechnical survey
 - Identify options for WTP process
 - Assessment of staging requirements for each option
 - Preliminary design and budget estimation for each option, including capex and opex
 - Identify preferred option
- **Assessment of Pipeline Route and Pump Stations Options**
 - Review and verification of route options
 - Establish termination points for pipeline options
 - Preliminary topographic and geotechnical survey
 - Preliminary design and budget estimation for each option including capex and opex
 - Identify preferred option for pipeline route and pumping
- **Concept Design**
 - Detailed topographic and geotechnical survey
 - Develop concept design for WTP
 - Develop concept design for transmission pipeline and pumping
 - Develop technical specification
 - Cost estimation

GHD

Jl. HR Rasuna Said Kav C5

Jakarta 12940 Indonesia

T: 62 21 2557 8000 F: 62 21 522 9095 E: jktmail@ghd.com.au

© GHD 2010

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.