PARANA STATE SANITATION COMPANY (SANEPAR)
BRAZIL

PROJECT
FOR
IMPROVEMENT OF OPERATION AND MAINTENANCE OF WATER SUPPLY AND SEWERAGE SYSTEMS
IN
PARANA STATE, BRAZIL

PROJECT COMPLETION REPORT

VOLUME I

-- MAIN REPORT --

September 2015

Japan International Cooperation Agency (JICA)

Nihon Suido Consultants Co., Ltd.

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PROJECT FOR IMPROVEMENT OF OPERATION AND MAINTENANCE OF WATER SUPPLY AND SEWERAGE SYSTEMS IN PARANA STATE, BRAZIL

VOLUME I

-- MAIN REPORT --

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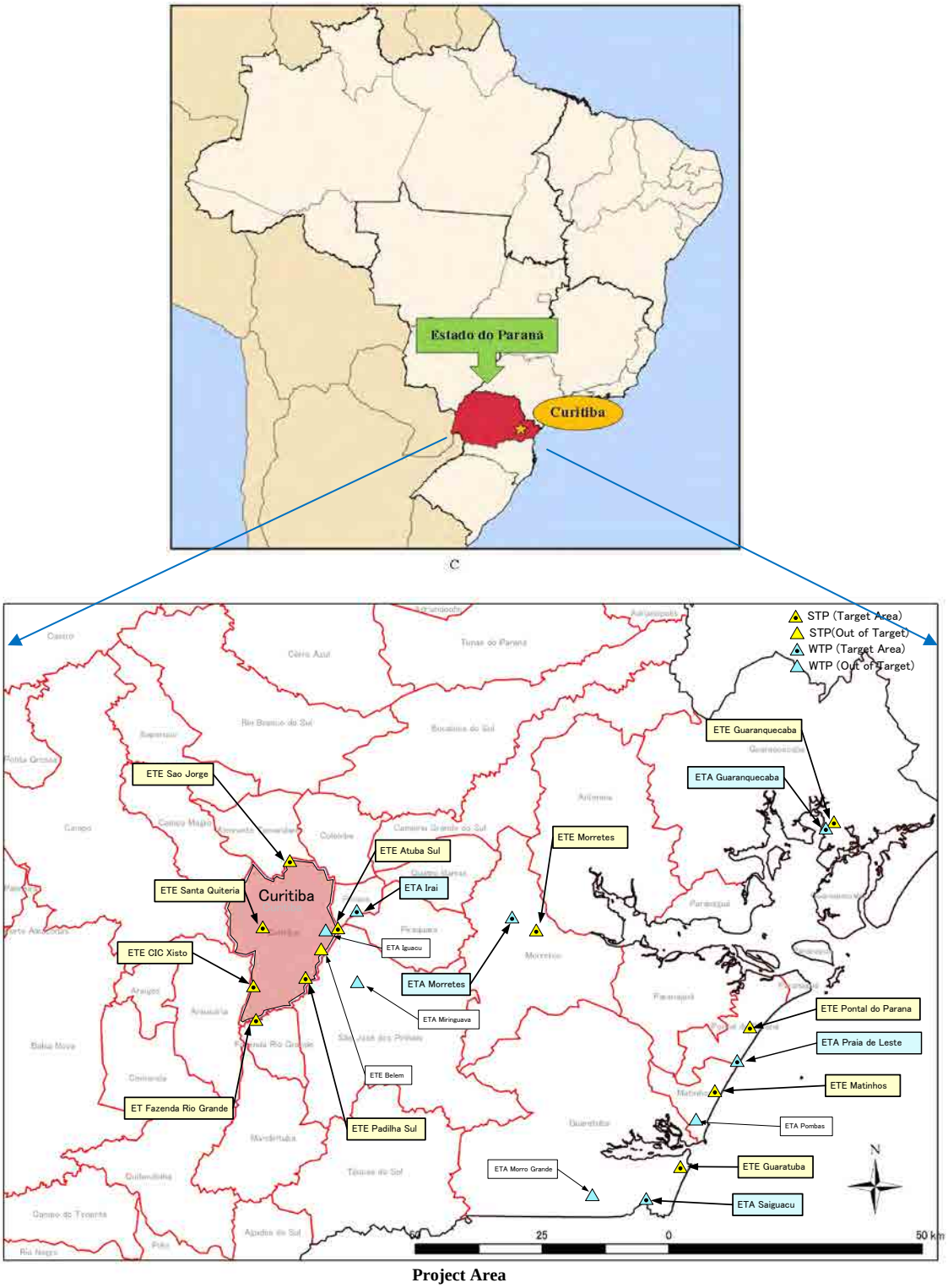
Project Location Map



Project Area

Abbreviations

APE	Assessora de Planejamento Estratégico
BOD	Biochemical Oxygen Demand
CMA	Curitiba Metropolitan Area
COD	Chemical Oxygen Demand
COPEL	Companhia Paranaese de Energia
C/P	Counterpart
DAF	Dissolved Air Floatation
DAFF	Dissolved Air Floatation Filter
DI	Directoria de Investimentos
DO	Diretoria de Operações
FAD	Fisco/Quimico Flotaçao
ETA	Estação de Tratamento de agua
ETE	Estação de Tratamento de Esgoto
GGML	Gerência Metropolitane de Curitiba e Litoral
GIS	Geographic Information System
GPDO	Gerência de Planejamento e Desenvolvimento Operacional
IBRD	International Bank for Reconstruction and Development
IDB	Inter-American Development Bank
ISO	International Organization for Standardization
JCC	Joint Coordinating Committee
JET	JICA Expert Team
JFY	Japanese Fiscal Year
JICA	Japn International Cooperation Agency
LCC	Life Cycle Cost
L/S	Liter per second
MCN	Microcystin
M/D	Minutes of Discussion
MOU	Memorandum of Understanding
O&M	Operation and Maintenance
OD	Oxidation Ditch
OJT	On the Job Training
PARANASAN	Projeto de Saneamento do Parana
PCM	Project Cycle Management
PDM	Project Design Matrix
pH	potencia Hydrogen
PI	Performance Indicators
PLC	Power Line Communications
PO	Plan of Operations

PVC	Polyvinyl Chloride
R$	Brazilian Real
SABESP	Companhia de Saneamento Basico do Estado de Sao Paulo
SANEPAR	Parana State Sanitation Company
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operation Procedure
SDT	Sewage Pipe Network Diagnosis Team
SS	Suspended Solid
STP	Sewage Treatment Plant
UASB	Up-flow Anaerobic Sludge Blanket
URCT-L	Unidade Regional Curitiba Leste
URCT-N	Unidade Regional Curitiba Norte
URCT-S	Unidade Regional Curitiba Sul
URLI	Unidade Regional Litral
USAG	Unidade de Serviço Processo Água
USDO	Unidade de Serviço de Desenvolvimento Operacional
USEG	Unidade de Serviço Esgoto
USES	Unidade de Serviço Processo Esgoto
USMV	Unidade de Serviço Medidores de Vazão
USPD	Unidade de Serviço Produção
USPL	Unidade de Serviço Planejamento Operacional
VAT	Value Added Tax
WTP	Water Treatment Plant

Exchange rate: R$ 1 = JPY 37.186 US$ 1 = JPY 124.21 (August 2015, JICA official rate)

Chapter 1 Outline of Project (Background, Purpose, Scope of Works)

1.1 Background of Project

In the Curitiba Metropolitan Area (CMA) of Parana State situated on the Atlantic Coast in southern Brazil, rapid urbanization has resulted in a shortage of water and sewage treatment services and this has had serious adverse effects on the sanitary environment of the area's inhabitants. Under these circumstances, the Japan International Cooperation Agency (hereinafter referred to as JICA) had implemented PARANASAN Project in CMA and coastal area in order to improve water supply and sewerage services. The project was completed in 2009 after the construction and repair of reservoirs, water supply system and water treatment plants for the water supply projects and the construction and repair of wastewater treatment plants and appurtenances for the sewerage projects.

However, various problems have been found in the facilities and operation and maintenance (O&M) of sewer pipe systems, sewage treatment plants (STPs) and water treatment plants (WTPs), as treatment capacities and efficiencies expected have not been obtained in some facilities. Furthermore, effluent quality standards in STPs and drinking water quality required in WTPs have become stricter and Parana State Sanitation Company (SANEPAR) worries whether stricter quality standards can be met with the current treatment methods. Under the background mentioned above, the agency concerned of the Federal Republic of Brazil, SANEPAR, requested technical cooperation from JICA aimed at improvement of water and sewage treatment technologies and capacity development of O&M of water and sewerage systems. Accordingly, JICA implemented the detail plan formulation survey. Both parties agreed to the project design for "Incidental Project on Japanese Yen Loan and exchanged the Minutes of Discussion (M/D) in January 2012. Subsequently, both parties made an agreement of Minutes of Understanding (MOU) in May 2012 after several modifications, and the project was launched in September 2012.

1.2 Project Purpose and Outputs

By strengthening the capacity of SANEPAR regarding (1) maintenance of sewer system, (2) O&M of STPs and (3) O&M of WTPs, by nominating the operation control division as the main target of support, the project will be implemented in order to improve O&M of sewage and water supply facilities in CMA and coastal area, and to contribute to the improvement of sewerage and water supply service of SANEPAR in the target area of the project.

The role of SANEPAR in the project is as follows;

SANEPAR has to play a central role in the project. Project purpose and outputs should be obtained by the implementation of project with strong ownership of SANEPAR. JICA team only support the activities implemented by SANEPAR. What is the most important in the project is ownership of SANEPAR.

Table 1.2-1 shows the purpose, outputs and indicators of the project.

Table 1.2-1 Purpose, Outputs and Indicators of the Project

Narrative Summary	
Overall Goal	Water supply and sewerage service of SANEPAR is improved in the target area of the project.
Project Purpose	O&M of water supply and sewerage system in SANEPAR is improved in the target area of the project
Outputs	1. Capacity of SANEPAR for O&M of sewage pipe networks is strengthened.
	2. Capacity of SANEPAR for O&M of sewage treatment plants is strengthened.
	3. Capacity of SANEPAR for O&M of water treatment plants is strengthened.

1.3 Target Area

As shown in “Location”, Parana State is located in the southern part of Brazil and is bordered by Sao Paulo State in its northern part, Santa Catarina State in its southern part, Mato Grosso do Sul State, Paraguay, and Argentina in its western part, and by the Atlantic Ocean in its eastern part. The total area of the State is 199,314.9 km^2, which is approximately a half of the area of Japan. (Brazilian Institute of Geography and Statistics (IBGE), 2002)

The ground elevation of the eastern coastal area rises sharply to the coastal range and sinks gradually to the inland area through plateaus of 200 to 1,300 meters in elevation. Hence, the main rivers in Parana State do not flow to the coast but to the inland area and join the Parana River.

Northern, western and coastal areas are in the tropical zone, central area is in the subtropical zone and southern area is in the temperate zone.

The population of the state as of July 2012 is 10,577,755 (IBGE census) and the population density is 53.4 persons/km^2.

According to SANEPAR, the water supply service ratio and the connection ratio for sewage system as of 2011 are 100% and 62.1%, respectively.

Curitiba, the capital city of the Parana state is located in the highland (elevation 908 meters) in the eastern area of the state, with variable climate.

According to the census by IBGE, the population of the city was 1,746,896 in 2010. The increase rate from 2000 to 2010 slowed to approximately 10% while it until 2000 showed higher than 20%. According to SANEPAR, the water supply service ratio is 100% from 2004 onward, and the connection ratio to the sewage system inside Curitiba city and in the Metropolitan Area (CMA) in 2012 were 90.52% and 73.06%, respectively.

1.4 Scope of Works of Project

SANEPAR is a government enterprise of which 60% of stocks are held by the Parana state, and the organization of the management level consists of eight (8) departments, as shown in Figure 1.4-1.

The investment department is in charge of planning, design and construction of water and sewage systems. The operation control department is in charge of the operation and maintenance of the water and sewage facilities.

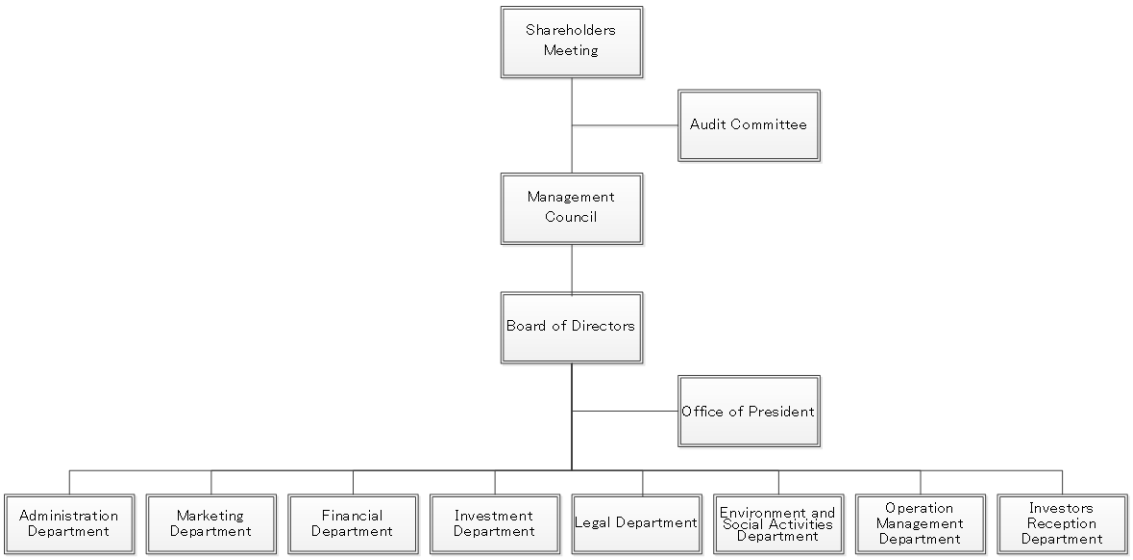


Figure 1.4-1 Organization of Management Level of SANEPAR

The operation control department consists of six (6) divisions, as shown in Figure 1.4-2.

Planning/Operation/Development division controls O&M of water and sewage treatment plants

and sewage pipe system. The metropolitan and coastal area division implements the O&M of water and sewage facilities in the Curitiba metropolitan and coastal area. The north-east, south-east, north-west and south-west regional division controls water and sewage facilities in the relevant regions, which are not the target area of the project.

The target of the project is eleven (11) STPs and five (5) WTPs in CMA and the coastal area, as shown in Figure 1.4-3. The target of Output-1, O&M of sewer system, is the service area of those 11 STPs. SANEPAR indicated Pombas WTP is actually Praia de Leste WTP. Also, SANEPAR indicated Belem STP is out of scope of the target of the project.

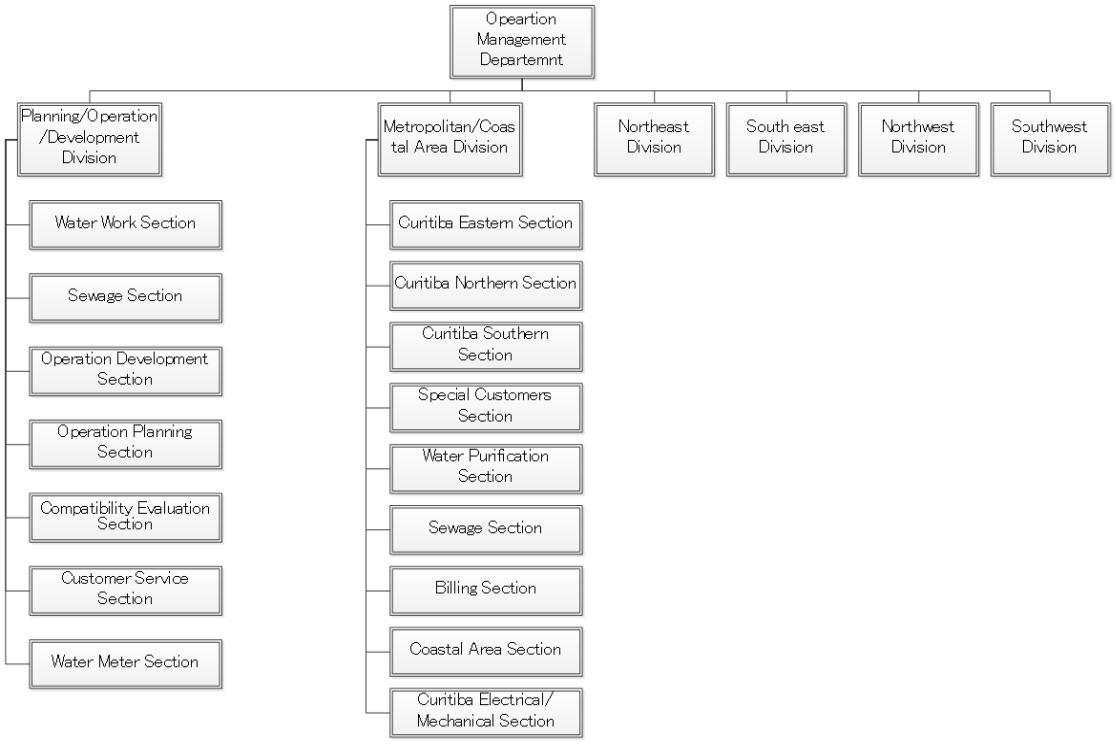
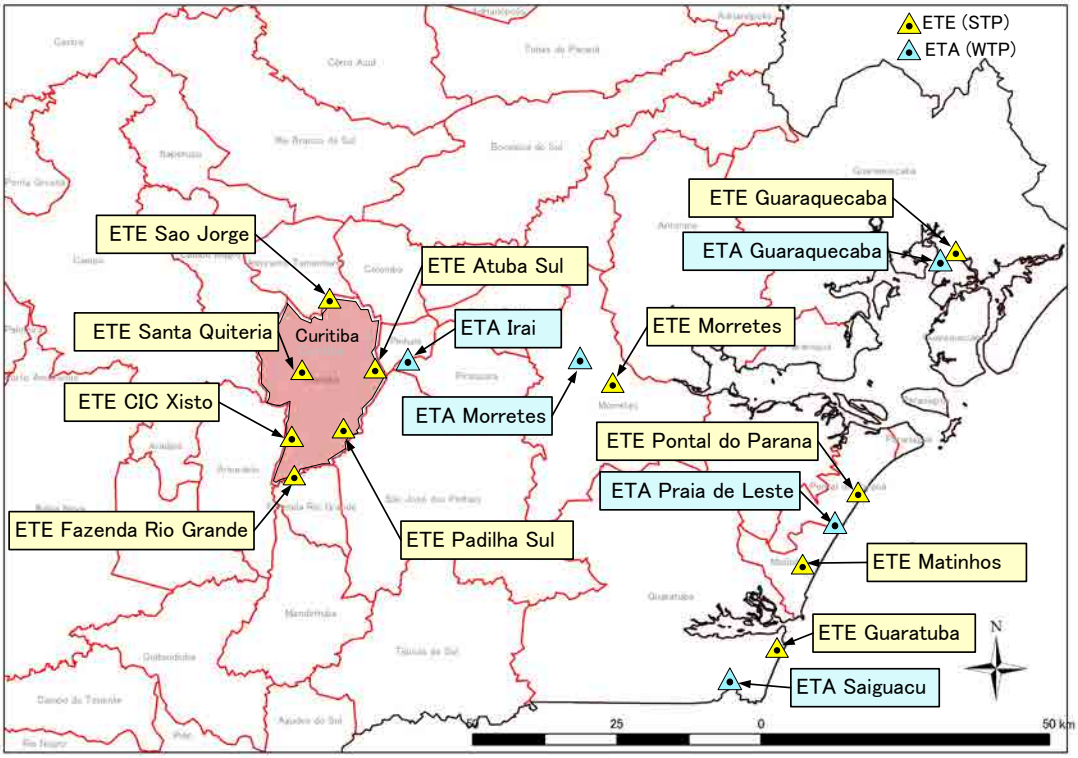


Figure 1.4-2 Organization of Operation Control Department



Project Area

Figure 1.4-3 Target STP and WTP in the Project

Chapter 2 Input to Project

2.1 Result of Dispatch of JICA Expert

The project was carried out over a period of three (3) years from September 2012 to August 2015. These three (3) years of the project were divided into four (4) terms according to the Japanese fiscal years as shown below;

- The 1st FY: September 2012 to March 2013
- The 2nd FY: May 2013 to March 2014
- The 3rd FY: May 2014 to March 2015
- The 4th FY: May 2015 to August 2015

Members of the JICA Expert Team (JET) are listed in the following Table 2.1-1.

Table 2.1-1 Member of JET

Title	Name
Team Leader/O&M of STP	Kiyohiko HAYASHI
O&M of sewer system	Takashi DAIRAKU
Diagnosis of sewer pipe（1st to 2nd FY） Diagnosis of sewer pipe/Improvement of sewer pipe (3rd FY)	Kenji UCHIDA
O&M of WTP	Harutoshi UCHIDA (1st FY) Tetsuji KAWAMURA (2nd to 4th FY)
Water treatment technology	Ryunan MATSUE
Sewage treatment technology (1st to 2nd FY) Sewage treatment technology/ Investigation of RO treatment (3rd FY)	Tadashi TAKESHIMA
Electrical/mechanical technology	Kozo OBARA

The planned and actual assignment of the each member of the JET is as shown in Table 2.1-2.

Table 2.1-2 Assignment Schedule of JET (Planned & Actual)

Speciality	Name	The first year (2012 Sep.–2013 Mar)	Days	M/M	The second year (2013 Apr.–2014 Mar)	Days	M/M	The third year (2014 Apr.–2015 Mar)	Days	M/M	The forth year (2015 Apr.–Aug)	Days	M/M	Total Days	Total M/M
Team Leader/O&M of STP	Kiyohiko HAYASHI	(60) 10/1–11/30; (60) 1/9–3/8	120	4.0	(67) 5/28–8/2; (60) 9/24–11/20; (43) 1/15–2/26	170	5.7	(45) 7/22–9/4; (30) 11/4–12/3; (30) 1/23–2/21	105	3.5	(30) 6/26–7/25	30	1.0	425	14.2
O&M of sewer system	Takashi DAIRAKU	(60) 10/1–11/30; (60) 1/9–3/8	120	4.0	(53) 5/28–7/19; (60) 9/24–11/22; (43) 1/15–2/26	156	5.2	(45) 7/22–9/4; (30) 11/4–12/3; (30) 1/30–2/28	105	3.5	(30) 6/26–7/25	30	1.0	411	13.7
Diagnosis of sewer pipe	Kinji UCHIDA	(60) 10/1–11/30; (60) 1/9–3/8	120	4.0	(53) 5/28–7/19; (60) 9/24–11/22; (37) 1/21–2/26	150	5.0	(30) 8/6–9/4	30	1.0				300	10.0
O&M of WTP	Harutoshi UCHIDA	Plan (39) / Results (36) 10/26–11/30; Plan (36) / Results (39) 1/9–2/16	75	2.5										75	2.5
	Kenji KAWAMURA				(38) 6/26–8/2; (52) 10/2–11/22; (36) 1/29–3/5	126	4.2	(30) 7/29–8/27; (38) 11/5–12/11; (37) 1/28–3/6	105	3.5	(30) 6/26–7/25	30	1.0	261	8.7
Sewage treatment technology /Experiment of RO treatment	Tadashi TAKESHIMA	(45) 10/1–11/14; (30) 2/1–3/2	75	2.5	(53) 5/28–7/19; (52) 10/2–11/22; (43) 1/15–2/26	148	4.9	(30) 8/6–9/4; (30) 1/23–2/21	60	2.0				283	9.4
Water treatment technology	Ryunan MATSUE	(30) 2/1–3/2	30	1.0	(45) 6/19–8/2; (45) 10/9–11/22	90	3.0	(30) 8/6–9/4; (30) 11/4–12/3; (30) 1/30–2/28	90	3.0	(30) 6/26–7/25	30	1.0	240	8.0
Electrical/mechanical technology	Kozo OBARA	(45) 10/1–11/14; (45) 1/23–3/8	90	3.0	(45) 6/5–7/19; (45) 10/9–11/22	90	3.0	(45) 7/22–9/4; (30) 11/4–12/3; (30) 1/23–2/21	105	3.5				285	9.5

Plan (black bar)
Results (orange bar)

2.2 Training in Japan

2.2.1 Output 1

SANEPAR nominated six (6) candidates for the training tour in Japan, as listed in Table 2.2-1. This training was intended to help improve day-to-day operation and maintenance works of the technicians in the target area. It provided various types of trainings, including lectures, and site visits of sewer pipe facilities, testing agencies of sewer pipes, training facilities for the staff of host organization and actual work sites. This training in Japan was conducted from September 28th, 2014 to October 9th, 2014, as described in Table 2.2-2

By combining lectures with facility visits, as well as blending training in hands-on-type facilities, trainees seemed become interested and were able to learn advanced technologies of sewer pipe management effectively, as well as sewer pipe rehabilitation methods used in Japan. Above all, sewer pipe rehabilitation methods were learned effectively by being present at demonstrations and actual construction sites, as well as by given lectures such as principle of construction and points to be noted. Furthermore, videos recorded during these training sessions (demonstration construction and actual construction) can be used to share the contents of this program to colleagues who could not join the training in Japan.

Visit construction site of sewer pipe by using shield method

Training at the Sewage Technology Training Center of Tokyo Metropolitan Sewerage Works Bureau

Table 2.2-1 Member List of Training in Japan

No.	Name	Organization	Position/Specialty	Remarks
1	Mr. Cláudio Luiz **Piccolotto** Simon	Board of operations	Advisor to the board of operations/Chemist	
2	Mr. **Eraldo** Vitorino	URLI/GGML	Coordinator of water and sewage pipe network maintenance	
3	Ms. **Flávia** Marcela Lago	USPE/DI	Engineer/Civil	
4	Mr. **Murilo** Bertolino	USEG/GGML	Engineer/Civil	
5	Mr. **Nelson** Mori	URCTL/GGML	Assistant of sewer pipe network maintenance	
6	Mr. **Robson** de Paula Waltrick	USEMCT/GGML	Engineer/Mechanical	

Table 2.2-2 Outline of Training

	Site of Training	Taining Item	Contents/Purpuse of Training
26/Sep (Fri)			
		Leaving from Curitiba	
27/Sep (Sat)		Leaving from Sao Paulo	
28/Sep (Sun)			
		Arriving at Japan (Kansai air port)	
29/Sep (Mon)	JICA Kansai	Briefing & Orientation	
	Akashi-Kaikyo Bridge	Technical tour to Akashi-Kaikyo Bridge	To tour a facility constructed using an advanced technology of cuvil engineering and to laearn planning, design, contruction and O/M of a public facility with advanced technology.
30/Sep (Tue)	Higashi-Water Environment Center in Kobe city	Technical tour to demonstration and actual construction sites of sewer rehabilitation method	To learn on the sewer rehabilitation method through site technical tour to demonstration and actual construction of it and to consider the applicability to the works of SANEPAR
	Higashi STP in Kobe city	Lecture on the sewage works in Kobe city and the measures for infiltration to sewer pipe	To learn on the measures for infiltration to sewer pipe and to consider the applicability to the works of SANEPAR
	Higashi STP in Kobe city	Lecture and technical tour on efforts of resource use in Kobe city	To learn on the works of the use of bio-gas and phosphorous ecycled from sewage sludge and to consider the applicability to the works of SANEPAR
1/Oct (Wed)	Osaka city sewerage science musium	Lecture on the sewer rehabilitation method and micro-tunneling	To learn on the theory, design and construction of the sewer rehabilitation methods and the micro-tunneling methods, and to consider the applicability to the works of SANEPAR
	Osaka city sewerage science musium	Lecture and technical tour on the use of thermal resource of sewage using a pipe rehabilitation method	To learn the facility of the use of thermal resource of sewage using a pipe rehabilitation method, and to consider the applicability to the works of SANEPAR
	Osaka city sewerage science musium	Technical tour to the civic enlightenment facility (Osaka city sewerage science musium)	To learn on the method of civic enlightenment by technical tour to the sewerage science musium, and to consider the applicability to the works of SANEPAR
2/Oct (Thu)	Pump facility office in Kyoto city	Lecture and technical tour on the remote moitoring and control system of pump facility	To learn on the remote monitoring and control system of pump facility, and to consider the applicability to the works of SANEPAR
	Ishida STP in Kyoto city	Lecture and demonstration of sewer pipe inspection and maintenance instruments	To learn on the technology of sewer pipe maintenance by watching the demonstration works of sewer pipe inspection and maintenance instruments, and to consider the applicability to the works of SANEPAR
3/Oct (Fri)	Construction site of shield method in Kyoto city	Lecture and technical tour on the trunk sewer construction by shield method	To learnon non-digging sewer construction technology in Japan using pipe rehabilitation, shield and micro-tunneling, and to consider the applicability to the works of SANEPAR
	Horikawa babbling Square in Kyoto city	Lecture and technical tour on the urban river re-vitalization work	To visit the site of urban river re-vitalization work by both sewerage works and river works, to learn its method and to consider the applicability to the works of SANEPAR
4/Oct (Sat)		Kyoto culture visit	
		To create outcome presentation material	
5/Oct (Sun)		To create outcome presentation material	
		Moving - Kyoto to Tokyo	
6/Oct (Mon)		Moving - Tokyo to Saitama	
	G&U technical research center	Lecture and technical tour on the hidraulic research facility	To visit the hidraulic research facility for technology develpoment of sewer system and to learn the characteristics of water flow in sewer pipe
7/Oct (Tue)	Shibaura STP in Tokyo	Lecture and technocal tour on the sewage treatment facility	To learn on environmntal measure, top use and reclaimed water use technology of STP in downtawn city
	Sewage technology training center in Tokyo	Technical tour and experience laerning in the sewage technology training centef	To learnon O/M of sewer pipe network by visitting to the sewage technology training center, to learn on contents and management of a training facility and to consider the applicability to the works of SANEPAR
8/Oct (Wed)	Head office of Nihon Suido Consultant	Lecture on a sewage facility ledger system and a simulation method of flow volume calculation	To learn on a sewage facility ledger system and a simulation medel of flow volume calculation, and to consider the applicability to the works of SANEPAR
	Head office of Nihon Suido Consultant	Lecture on the sewage works in Japan	To learn on the history of sewage works, contribution to the improvement of water environment, and agenda of the current situation
9/Oct (thu)	JICA Tokyo	Presentation of outcome of the training cource, evaluation meeting and celemony	
		Leaving from Japan (Narita air port)	
10/Oct (Fri)			
		Arriving at Curitiba	

2.2.2 Output 2

In order to obtain knowledge of operation and maintenance work by visiting actual sewage treatment plants and by receiving on-site lectures, five (5) trainees as listed on Table 2.2-3 were nominated by counterpart (C/P) organization as the trainees. Training in Japan was practiced from August 19th, 2013 to August 28th, 2013, as described in Table 2.2-4.

Table 2.2-3 Member List of Training in Japan

No.	Nama	Organization	Position/Speciality	Photo
1	Ms. Jacqueline Shirado	USEG/GGML	Chief of Santa Quitéria STP (Environmental technology)	
2	Mr. Marino Kumegawa	USEG/GGML	Responsible person in technology (Chemistry)	
3	Mr. Arilson Mendes	URLI/GGML	Coordinator of technology (Electronic technology)	
4	Mr. Laercio Mateus Squiba	USEG/GGML	Operator of STP (Agriculture/Environment)	
5	Mr. Alceu Pedrazzi Junior	USEMCT/GGML	Electric technician (Electricity)	

Table 2.2-4 Outline of Training

Date	Training Site	Training Items	Purpose of Training
8/16 (Fri)			
	Left Curitiba		
8/17 (Sat)	Left Sao Paulo		
8/18 (Sun)			
	Arrival at Osaka		
8/19 (Mon)	JICA Kansai	Briefing and orientation	
	Kyoto City Toba STP	Observation and lecture of O&M of sewage and sludge treatment and laboratory works in the large scale STP	Studying the saving-energy process, the way to produce the optimum effluent quality by observing treatment and laboratory works in a large scale STP and considering the way to apply them into STP of SANEPAR.
8/20 (Tue)	Kyoto City Keihoku STP	Observation and lecture of O&M of small scale STP	Studying O/M of small scale STP by patrol system
	Kyoto City Kami-Yuge Rural sewage treatment facility	Observation and lecture of O&M of minimum scale STP Observation of small scale WTP adopted membrane filter system	Studying treatment technology and O/M procedure of rural treatment facilities and considering application into STPs of SANEPAR.
8/21 (Wed)	(Kyoto to Takamatsu)		
	Kagawa Prefecture Katougawa STP DHA pilot plant	Observation and lecture of pilot plant experiment of DHA process	Studying a pilot plant experiment for DHA process, one of the post treatment processes of UASB invented in Japan and considering application of the technology into SANEPAR
	Kagawa Prefecture Katougawa STP Effluent reclamation plant	Observation and lecture of reclaimed sewage production facility	Observing a reclaimed sewage plant by sand filtration process in a middle scale STP and studying O/M procedure,
8/22 (Thu)	Kagawa Prefecture Tadotsu-cho Effluent reclamation project	Observation and lecture of high quality reclaimed sewage facility	Observing a high quality reclamation plant of effluent of STP operated in Coagulation, activated carbon treatment and chlorination and considering future application into SANEPAR,
	(Tadotsu to Kobe)		
8/23 (Fri)	Kobe City Higashi-Nada STP "Kobe Biogas" Project	Observation and lecture of " Kobe Biogas" project using refined digestion gas as fuel	Observing the "Kobe Biogas" Project in which digestion gas of sewage sludge is refined and used for the fuel of public bus and considering issues and feasibility of the use of biogas generated from UASB facilities in SANEPAR
	Osaka City Sewage Museum	Observation and lecture of sewage museum	Observing a sewage museum with hand-on display constructed for advertisement of sewage works to citizens and studying the way to make understand of sewage works,
8/24 (Sat)	(Kobe to Mishima to Koyama-cho)		
8/25 (Sun)	(Preparation of report)		
8/26 (Mon)	Shizuoka Prefecture, Suntou District, Koyama-cho, Subashiri STP	Observation and lecture of O&M of middle scale STP	Studying O&M of a middle scale STP operated by OD process,
	Yakult Fuji-Susono Plant	Observation and lecture of industrial wastewater treatment facility with BAF process	Observing an industrial wastewater treatment facility with BAF process using empty bottles of Yakult and considering application of O&M methods into STP of SANEPAR operated in the same process,
	(Susono City to Tokyo)		
8/27 (Tue)	Tokyo Metropolitan Kasai STP	Observation and lecture of O&M of mechanical and electrical equipment in large scale STP	Studying O/M of mechanical and electrical equipment in sewage and sludge treatment facilities in a large scale STP and considering application into O&M of STPs in SANEPAR,
	NSC Head Office	Preparation of report	
8/28 (Wed)	JICA Head Office	Reporting outcome of the training	
	Preparation for departure		
8/29 (Thu)			
	Arrival at Curitiba		

Visiting STPs of various capacities were particularly prudent for the trainees. Especially, small to medium scale treatment plants similar in size to those in SANEPAR provided good references for specification of facilities, operation methods, as well as insights in to O&M.

At the end of the training program, presentations by trainees were made concerning what aspects of the training program they were going implement after returning home.

2.2.3 Output 3

Overseas training for C/P staff was conducted in Japan. This program aimed to give opportunities for having lectures on O&M of WTPs or site visits to WTPs in Japan to the selected standard operation procedure (SOP) team members. The trainees were also expected to fully make use of acquired knowledge to improve their day-to-day O&M work, and to share this acquired knowledge with other SANEPAR staff. Table 2.2-5 gives a list of participants for the training program in Japan.

Table 2.2-5 Member List of Training in Japan

No.	Name	Organization	Position/Specialty	Remarks
1	Mr. Mario Roberto Cunha D'avila	USDO/GPDO	Gerente/Eng° Mecanico	
2	Mr. Alcely José Wosniak	USPD/GGML	Coordenador de Producao/Quimico Industrial	
3	Mr. Marcio Arakaki	USPD/GGML	Analista de Producao/Eng°Químico	
4	Mr. Carlos Eduardo Ferreira da Silva	USAG/GPDO	Técnico Químico	
5	Mr. Fabio Wolanski de Lima	USPD/GGML	Técnico Químico	
6	Mr. Ladislau de Oliveira	URLI/GGML	Operador	

This training program was conducted from December 6th to 20th, 2014. Table 2.2-6 presents the schedule and its detailed contents.

Table 2.2-6 Outline of Training

Date	Venue	Content	Perpose
12/6 (Fri)			
		Leaving Curitiba	
12/7 (Sat)		Leaving Brazil (Sao Paulo-Dubai?)	
12/8 (Sun)			
		Arriving in Japan (Dubai-Tokyo)	
12/9 (Mon)	JICA Tokyo (TIC)	Briefing, program orientation	
	NSC Head Office (2207)	Algae/Cyanobacteria Control in Source Water in Japan, and Overview of advanced water treatment in Japan	To comprehend historical background, policy, practically implemented measures and technology for cotrolling algae/cyanobacteria through case-study in JPN. To comprehend planning & practical introducction of advanced treatment to a water supply utility, including procedure for introducing, practical case study, problemes to be solved and future task in JPN
12/10 (Tue)	Lake Kasumigaura	Visit Lake Kasumigaura (Artificial Lagoon for Lake Restoration & Environmental Science Center)	To comprehend remedial measures against algae at water source and biological treatment as an altenative for advanced treatment technology at WTP, in order to seek possibillities for SANEPAR's future option
	Kasumigaura WTP	Visit Kasumigaura WTP (biological treatment)	
12/11 (Wed)	NSC Head Office (2205)	Asset management of waterworks in Japan	To comprehend historical background, policy, practically implemented measures and outlines for asset management in JPN, in order to itemize/study common/different issue b/w BRA & JPN comparing case study
	Kanamachi WTP	Visit WTP in Tokyo (advanced treatment (ozonation+activated carbon))	To comprehend ozone & GAC treatment as an altenative for advanced treatment technology at WTP, in order to seek possibillities for SANEPAR's future option
12/12 (Thu)	Training Center (Kuhonbutsu)	Non revenue water reduction technology in Japan	To comprehend historical background, policy, practically implemented measures and technology for NRW reduction, in order to itemize/study common/different issue b/w BRA & JPN comparing case study in JPN and problems currently SANEPAR is facing to.
	Training Center (Kuhonbutsu)	Practical training for tnon revenue water reduction technology	To understand technology for NRW reduction through hands-on training for leak detection instruments.
12/13 (Fri)	Ikuta WTP	Visit WTP (high-rate tubidity removal (micro-sand))	To observe high-rate turbidity removal (micro-sand) facility in order to study practical introduction in SANEPAR.
	JICA Tokyo (TIC)	Preparation of presentation	To review the record of lecture and field visit have been done so far.
12/14			
(Sat)		Moving from Tokyo to Kyoto	Moving from Tokyo to Kyoto
12/15		Sight-seeing	To understand Japanese traditional culture through visiting ancient heritages in JPN
(Sun)			
12/16 (Mon)	Controll Center for Small-scale Water Supply System in Head Office	- Visit control center for small-scale water supply system	To comprehend importance of total distibution control from water source to cusumer's end thruough observing actual facility.
	Shin Yamashina WTP	- Outlook of water supply system in Kyoto City. - Visit WTP (powdered activated carbon & CO2 injection) - Visit mega solar power generation facility.	- To comprehend overview of water supply system in Kyoto City. - To study and seek possibility of practical use of advanced WTP and water quality control / monitoring system for SANEPAR through observing actual facilities. - To study and seek possibility of practical use of mega solar power generation facilities for SANEPAR.
	Ohara WTP (small-scale water supply system)	- Outlook of small-scale water supply system in Kyoto City and its control system. - Visit small-scale water supply system	- To comprehend overview of small-scale water supply system in Kyoto City and its control system. - To comprehend practical use of membrane filter for small-scale water supply system. - To understand practical methodology for renewal construction for water supply system without suspension of existing treatment facility.
	Kurama WTP (small-scale water supply system)	Visit small-scale water supply system	To comprehend high-pressure rapid sand filtration system and automated system operation for small-scale water supply system.
12/17 (Tue)	Keage WTP	- Outlook of water safty plan in Kyoto City. - Visit WTP (powdered activated carbon). - Visit water quality control center.	- To conprehend overview of water safty plan in Kyoto City. - To study and seek practical operation of advanced treatment facility in WTP and water quality control / monitoring system for SANEPAR through observing actual facilities.
	Lake Biwa Canal Museum	Visit Lake Biwa Canal Museum	To comprehend case-study for PR activities in Kyoto City Water & Swerage Beaurau
	Training Center	- Operation & maintenance of machanical & electrical facility in Osaka City. - Visit training center of Osaka Bureau of Waterworks	- To comprehend practical way for O&M of M&E facility in Osaka City. - To comprehend how to prepare training plan & carricurrum for staff training through observing actual facility and training at the training center
12/18 (Wed)	Amagasaki WTP	Visit WTP (advanced treatment facilities (GAC)	To comprehend advanced treatment (Ozonation + GAC), in order to study & seek possibilities for SANEPAR's future service.
	JICA Kansai	Preparation for presentation for evaluation meeting	Discuss and summarize the presentation material for reporting for next-day's evaluation meeting among trainees. Presentation material would include at least followings: a) what you have learned thuru training b) What will be the way forward SANEPAR should take for better future service c) what the trainees will do for SANEPAR after coming back to BRA first, and in future d) others
12/19 (Thu)	JICA Kansai	Evaluation meeting, ceremony	
		Preparation for departure	
		Leaving Japan (Kansai→Dubai)	
12/20 (Fri)			
		Arriving in Brazil (Dubai→Sao Paulo)	

Through the positive discussion at each host organization and their presentation at the evaluation meeting that was held on the final day of the training course, trainees seemed to have had a good opportunity to look at the difference of water treatment plants in SANEPAR and Japan or possibility of application of technologies employed in Japanese case to SANEPAR.

2.3 Provision of Equipment

The list of equipment provided by JICA through JET during the project term is as shown in Table 2.3-1, and the list of equipment provided by JICA directly (through JICA Brazilian office) is as shown in Table 2.3-2. The supplemental information including purpose of usage of individual equipment and their relevant activity number are available in those tables. [The amount without bracket shows the actual amount procured, and the amount with bracket shows the converted amount in Brazil Real (BRL) based on the exchange rate as shown under the table.]

Table 2.3-1 Equipment Provided by JICA (delivered through JET)

JFY	*No*	*Equipment*	*Usage*	*Activities used the equipment*	*Model*	*Maker*	*Q'ty*	*Total Price (JPY)(€)*	*Total Price (BRL)*	*Date of Delivery*
First	1	TV camera for primary inspection	Used for primary inspection of sewer pipes	Output 1 1-3,1-5	HANAREWAZA	SENSHIN	1	550,000	(11.489,45)	10, Jan,2013
	2	Portable gas detector	Equipment to measure toxic gas conc. In atmosphere, used for checking working condition	Output 1 1-6 Output 2 2-2	GX-2003TYPE-B	RIKEN	1	188,000	(3.927,30)	10, Jan. 2013
	3	Conductivity Data Logger	Used for measuring rate of infiltration water into sewage	Output 1 1-6 Output 2 2-2	HOBO U24	HOBO	3	262,500	(5.483,60)	10, Jan. 2013
	4	Portable water quality meter for multi parameters	Used for measuring multi-parameters of water quality like pH and DO on the treatment sites	Output 2 2-1、2-4	WQC-24	TOADKK	2	736,000	(15.374,97)	2, Feb. 2013
	5	Portable solid-liquid interface meter	Equipment to measure solid-liquid phase, Used for measuring sludge level accumulated in treatment tanks	Output 2 2-1, 2-4	Check Boy	CENTRAL KAGAKU	2	214,400	(4.478,79)	10, Jan. 2013
	6	Personal Computer (with Monitor)	Used for accumulating data obtained in the project	All activities	Lenovo 57302491	LENOVO	1	-	1.787,00	25, Oct. 2012
Second	7	TV camera for summary inspection	Used for primary inspection of sewer pipe, Added to the TV camera provided in the first fiscal year	Output 1 1-3, 1-5	NEW HANAREWAZA	SENSHIN	2	1,333,080	(29.618,54)	15, Jul. 2013
	8	Ultra-sonic flow meter (for full water pipe)	Used for measuring flow rate in pumping stations	Output 1 1-6 Output 2 2-2	PT-SYS-11-1-SC-A-IO-IR	GE	2	1,669,500	(37.093,16)	15, Jul. 2013
	9	Diffusion type hydrogen sulfide meter	Used for investigation of corrosive atmosphere by H2S gas on the treatment site	Output 2 2-4	GHS-8AT	GASTEC	2	498,960	(11.085,96)	15, Jul. 2013
	10	Ultra-sonic algae controller	Used for investigation of growth control of algae in the water source	Output 3 3-7	XXL+	LG SOUND	1	3,115.00 €	(9.376,15)	18, Nov. 2013

Exchange Rate: BRL R$ 1.00 = JPY 47.87 (February 2013)
: BRL R$ 1.00 = JPY 45.0083 R$1.00 = 3.01€(November 2013)

Table 2.3-2 Equipment Provided by JICA (delivered by JICA Brazilian Office)

JFY	*No.*	*Equipment*	*Usage*		*Model*	*Manufacturer*	*Q'ty*	*Total Price (JPY)*	*Total Price (BRL)*	*Date of Delivery*
Second	11	TV camera for diagnosis of main sewer pipes	Used for diagnosis and detail inspection of sewer pipes	Output 1 1-3, 1-5	ROVVER	Envirosight	1	(12,087,429)	268.560,00	10, Sep. 2013
	12	Equipping vehicle	Vehicle equipped the TV camera above	Output 1 1-3, 1-5	Furgao Fiat Ducatto Cargo2012/2013	FIAT	1	(2,941,740)	68.900,00	30, Jan. 2014
	13	Ultra-sonic flow meter for no full water pipe	Used for measuring flow rate in sewer pipe	Output 1 1-6 Output 2 2-2	FL900	HACH	15	(11,592,021)	257.552,97	7, Nov. 2013

Exchange Rate: BRL R$ 1.00 = JPY 45.0083 (November 2013) for 11, 13
: BRL R$ 1.00 = JPY 42.6958 (January 2014) for 12

2.4 Input from SANEPAR

2.4.1 Counterpart personnel etc.

(1) Project Director

Table 2.4-1 Project director

Name	Position	Term
Mr. Antonio Hallage	Director of Administration Department (President tentative in case of absence)	Oct 2012
Mr. Fernando Ghignone	President	Oct. 2012~Jan. 2015
Mr. Mounir Chaowiche	President	Jan. 2015~Aug. 2015

(2) Project Manager

Table 2.4-2 Project Manager

Name	Position	Term
Mr. Kazushi Shimizu	Planning-operation-development division Chief of Operation-development section	Oct. 2012~Dec. 2012
Mr. Gil Alceu Mochida	Planning-operation-development division Engineer Operation-development section	Jan. 2013~Aug. 2015

Due to the retirement of Mr. Shimizu, the director of investment of SANEPAR nominated Mr. Gil as the project manager.

(3) C/P

Table 2.4-3 C/P

Output		Team	1st FSY	2nd FSY	3rd FSY	4th FSY
1	Maintenance of sewer pipe	SDT Team1)	16 4 (at first)	22	27	27
2	O&M of STP	SOP Team2)	12	16	17	17
3	O&M of WTP	SOP Team3)	15	19	21	21

1): Chosen from USES and USDO of GPDO-DO, URCT-L, URCT-N, URCT-S, USEG and URLI in CGML of DO and also DI
2): Chosen from USES, USEG, USDO and USAV of GPDO-DO, URLI and USEMCT of CGML-DO and also DI
3): Chosen from USAG, USDO and USPD of GPDO-DO and URLI and USEMCT of CGML-DO and also DI

2.4.2 Office Space, Meeting Room

(1) Office Space for JICA Experts

Table 2.4-4 Office Space for JICA Experts

Office	Location	Term
SANEPAR Tarumã Office	Rua Eng Antonio Batista Ribas, Curitiba	Oct. 2012~May 2013
SANEPAR Centro Office	Rua XV De Novembro, 1456 Sala 201 2°. Andar Centro, Curitiba	May 2013~Feb. 2014
SANEPAR Lais Peretti Office	Av. Joao Gualberto, 1259 12 Andar Centro Empresarial Lais Peretti Juveve, Curitiba	Feb. 2014~Aug. 2015

Due to the office consoridation program of SANEPAR, the office of JICA experts changed twice.

(2) Office Facilities

- Desks, side tables and chairs for seven (7) experts, one (1) secretary and three (3)

interpreters
- An extension telephone
- Bookshelves
- Connection to intranet of SANEPAR
- Rooms for meetings, trainings, seminars and workshops

2.4.3 Local Cost

(1) Cost for Output-1 (diagnosis and rehabilitation/renewal of sewage pipe network)

- Sewage pipe cleaning for survey of sewage pipes in the pilot area
- Sewage pipe network survey by TV camera in the pilot area
- Sewage flow measurement in the pilot area, Atuba Sul sewage pipe network and Pontal do Parana sewage pipe network
- Demonstration of non-dig pipe rehabilitation method
- Investigation survey for misconnection of sewage pipes by smoke test and dye water test in the pilot area
- Investigation survey of water quality of the river in the pilot area
- Repair of the sewage pipe in the pilot area

(2) Cost for Output-2 (O&M of STP)

- Water sampling and water analysis of influent and effluent at STPs
- Site survey for 12 target STPs (The target became 11 in the third fiscal year due to exclusion of Belem STP from the target.)
- Monitoring of concrete corrosion by H2S gas
- Diagnosis of concrete neutralization state in STP
- Investigation for sludge drainage from Up-flow Anaerobic Sludge Blanket (UASB) tank
- Investigation for optional polymer dose for sludge dewatering
- Rent for Dissolved Air Floatation (DAF) Pumps at Matinhos and Sao Jorge STP
- Investigation for operation of a DAF pump at Sao Jorge STP and for water quality analysis

(3) Cost forOutput-3 (O&M of WTP)

- Site survey for five (5) water treatment plants
- Investigation survey on injection nozzles for DAF systems at the Irai WTP
- Reconstruction of a DAF basin to separate contact zone and clarification zone at the Irai WTP
- Activity of pilot project for advanced treatment

  – Construction costs, O&M costs and total annualized cost for O3 + GAC(Granulated

Activated Carbon) process at the Irai water treatment plant
- Pilot-scale experiment of algae removal by sonicator
- Pilot-scale experiment of Reverse Osmosis (RO) treatment at the Araucaria industrial WTP

(4) Cost for Installation of Equipment Provided by Project

- Two (2) sets of manual scum skimmers, one (1) flocculator and two (2) sets of motorized scum/sludge collectors for DAF facility on investigation survey at Santa Quiteria STP
- Interior arrangement of a one box car for a self-propelled TV camera

(5) Other Costs

- Expenses for utilities (water, lighting and air-conditioning) of the JICA project room
- Expenses for meetings, seminars and workshops

Transportation fees for field surveys to Guaraquecaba area by boats

Chapter 3 General Activities

3.1 Modification of PDM

Original Project Design Matrix (PDM) had been modified three (3) times during the project term, as shown in Table 3.1-1. The final version of the PDM (PDM_3) is as shown in Table 3.1-2.

Table 3.1-1 History of PDM Modification

Modification		Modification period	Main points of modification
1	$PDM_0 \Rightarrow PDM_1$	The 1st JCC in the 2nd FY, 17 Jun. 2013	Based on the result of the survey on the current condition conducted in the 1st FSY, particles of activity in Output-1 to 3 were revised and added.
2	$PDM_1 \Rightarrow PDM_2$	The 1st JCC in the 3rd FY, 28 Aug. 2014	Indicators of project purposes and outputs shown as XX% in PDM0 were digitized specifically. Number of target STPs was reduced from 12 to 11.
3	$PDM_2 \Rightarrow PDM_3$	The 2nd JCC in the 3rd FY, 12 Feb. 2015	One of the indicator values of the project purposes digitized in PDM_2 was found to be incorrect; hence it was modified.

Table 3.1-2 Final Version of the PDM (PDM_3)

Narrative Summary	Verifiable Indicators	Means of Verification	Important Assumption
Overall Goal Water supply and sewerage service of SANEPAR is improved in the target area of the Project.	1. The coverage of sewerage system becomes 79% in CMA and 60% in coastal area by the end of 2018 (baseline: 72% in CMA, 49.4% in coastal area, 2011). 2. Rehabilitation/renewal plan developed by the Project is implemented by year 2020.	1. SANEPAR's report (annual report etc.) 2. SANEPAR's report	
Project Purpose Operation and maintenance (O&M) of water supply and sewerage systems in SANEPAR is improved in the target area of the Project	1. Performance indicators on O&M of sewage treatment plant (i.e. volume of treated sewage divided by total inflow volume) is improved to 99.18% in CMA. In addition, % of water quality conformity to the treated water quality standard is improved to 37.3% in CMA and 97.6% in the Coastal Area respectively. 2. Performance indicator on O&M of water treatment plant (i.e., % of conformity to the drinking water quality standard of treated water (ICP-Produção: Indice de Conformidade ao Padrão de potabilidade na Producao)) is improved to 100%.	1. Project report, monthly report of SANEPAR 2. Project report, monthly report of SANEPAR	No major changes occur in terms of sewerage and water supply policy in central and state government. Budget of SANEPAR for implementation of rehabilitation/renewal plan is secured.
Outputs 1. Capacity of SANEPAR for operation and maintenance (O&M) of sewage pipe network is strengthened.	1-1 Number of complaints including incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases from the previous year. 1-2 Dissolved oxygen level of the rivers in pilot areas are maintained at least 5 mg/L.	1-1 Project report, SANEPAR Information System (SIS) 1-2 Project report	SANEPAR staffs who are trained in the Project remain in their respective duties.
2. Capacity of SANEPAR for operation and	2-1 Rehabilitation/renewal plan for sewage	2-1 Project report	

maintenance (O&M) of sewage treatment plant is strengthened.	treatment plants developed by the project is approved by the management level of SANEPAR. 2-2 Annual budget plan is elaborated based on the rehabilitation/renewal plan.	2-2 Project report	
3. Capacity of SANEPAR operation and maintenance (O&M) of water treatment plant is strengthened.	3-1 Rehabilitation/renewal plan for water treatment plants developed by the Project is approved by the management level of SANEPAR. 3-2 Annual budget plan, including sludge treatment, is elaborated based on the rehabilitation/renewal plan.	3-1 Project report 3-2 Project report	
Activities of the Project 1-1 Organize diagnosis team for sewage pipe diagnosis team 1-2 Implement baseline survey of O&M of sewage pipe network and identify the issues 1-3 Conduct training courses on O&M and diagnosis of sewage pipe network 1-4 Select pilot areas for sewage pipe diagnosis 1-5 Conduct OJT on sewage pipe network diagnosis using TV camera 1-6 Conduct OJT on monitoring sewage quantity using flowmeter 1-7 Grasp flow volume of sewerage system 1-8 Establish the policy of improvement plan of sewage pipe system	**Inputs** Japanese Side: (1) JICA Experts - Chief advisor/O&M of sewage treatment plant - O&M of sewage pipe network - Sewage pipe diagnosis technology - O&M of water treatment plant - Sewage treatment technology - Water treatment technology - Electric/mechanical engineering (2) Training - Training in Japan (three to five persons/year) (3) Local cost - Cost for workshop/seminar - Cost for training materials (4) Equipment - TV cameras for sewage pipe diagnosis - Ultrasonic flow meters	Brazilian Side: (1) Counterpart personnel - Project director - Project manager - Staff for sewage pipe network diagnosis team - Staff for Standard Operation Procedure (SOP) team for sewage treatment plants - Staff for Standard Operation Procedure (SOP) team for water treatment plants (2) Office space, meeting room - Office space for JICA experts - Office facilities - Internet connections - Rooms for training/workshops (3) Local cost - Cost for diagnosis and rehabilitation/renewal of	

1-9 Analyze results of diagnosis, study rehabilitation or renewal of sewer pipe in pilot areas including non-open trench method, and establish rehabilitation/renewal and improvement plan of it 1-10 Implement rehabilitation, renewal and improvement of sewage pipe network in the pilot areas 1-11 Formulate a draft diagnosis plan for whole sewage pipe network in CMA and coastal area 1-12 Conduct workshop/seminar to disseminate of the results of pilot project and the improvement plan of sewage pipe network 2-1 Conduct a baseline survey on the sewage treatment plants and relay pumping stations in CMA and coastal area 2-2 Establish measurement system for monitoring sewage quantity flowing into sewage treatment plants 2-3 Conduct field survey and experiment for improving issues regarding operation and maintenance of sewage treatment plants 2-4 Conduct measure for improving issues on equipment in sewage treatment plants and pumping stations 2-5 Organize a Standard Operation Procedure (SOP) Team for sewage treatment plants		sewage pipe network - Cost for installation of equipment provided by the Project - Activity cost for the pilot project of advanced water supply and sewage treatment (including equipment, construction, running cost) - Other costs such as customs, value-added tax (VAT), custom clearance, storage, domestic transportation fee of the equipment provided by the Project etc.	

2-6 Conduct training courses on O&M of sewage treatment plants 2-7 Review/develop manual(s) for O&M of sewage treatment plants 2-8 Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations 2-9 Study on introduction of advanced treatment facility for reuse of treated sewage 2-10 (Tentative) Implement a pilot project for advanced treatment 2-11 Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants 2-12 Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants 3-1 Conduct a baseline survey on the WTPs in CMA and coastal area 3-2 Organize a Standard Operation Procedure (SOP) team for WTPs 3-3 Conduct training courses on O&M of WTP 3-4 Review/develop manual(s) for O&M of WTPs		

3-5 Formulate a plan for rehabilitation and renewal of WTPs 3-6 Study on introduction of advanced treatment facility for removal of algae 3-7 (Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in Activity 3-6 3-8 Conduct monitoring of performance indicators (actual results) on O&M of WTPs 3-9 Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of water treatment plants 3-10 Conduct a survey on the improvement of the existing DAF system, and conduct a pilot project for improving the existing DAF system		

Details of each modification are explained in the following subsections.

3.1.1 First Modification

Several activities were added, corrected and integrated under the first modification, and agreed to in the 1st Joint Coordinating Committee (JCC) on 17th, June 2013 of the 2nd FY.

(1) Output-1 (Maintenance of sewer pipe)

As the result of the survey of the current condition of sewer pipe and of its maintenance conducted in the 1st FY, troubles such as blockage by aging of them and the back flow by infiltration were recognized as issues on the O&M of sewage pipe network. To solve these problems investigation, diagnosis, and rehabilitation of them were prepared. As a result of the investigation, it was revealed that the problem was wide-ranging and investigation method and countermeasures were to be also wide-ranging. Especially the problem of sanitary sewer overflow (SSO) in dry weather, that is, large amounts of overflow of sewage is obvious. Modification of activities to a wider range, including investigation and countermeasure of SSO was proposed.

Comparison of particles of activity before and after the revision is as shown in Figure 3.1-1.

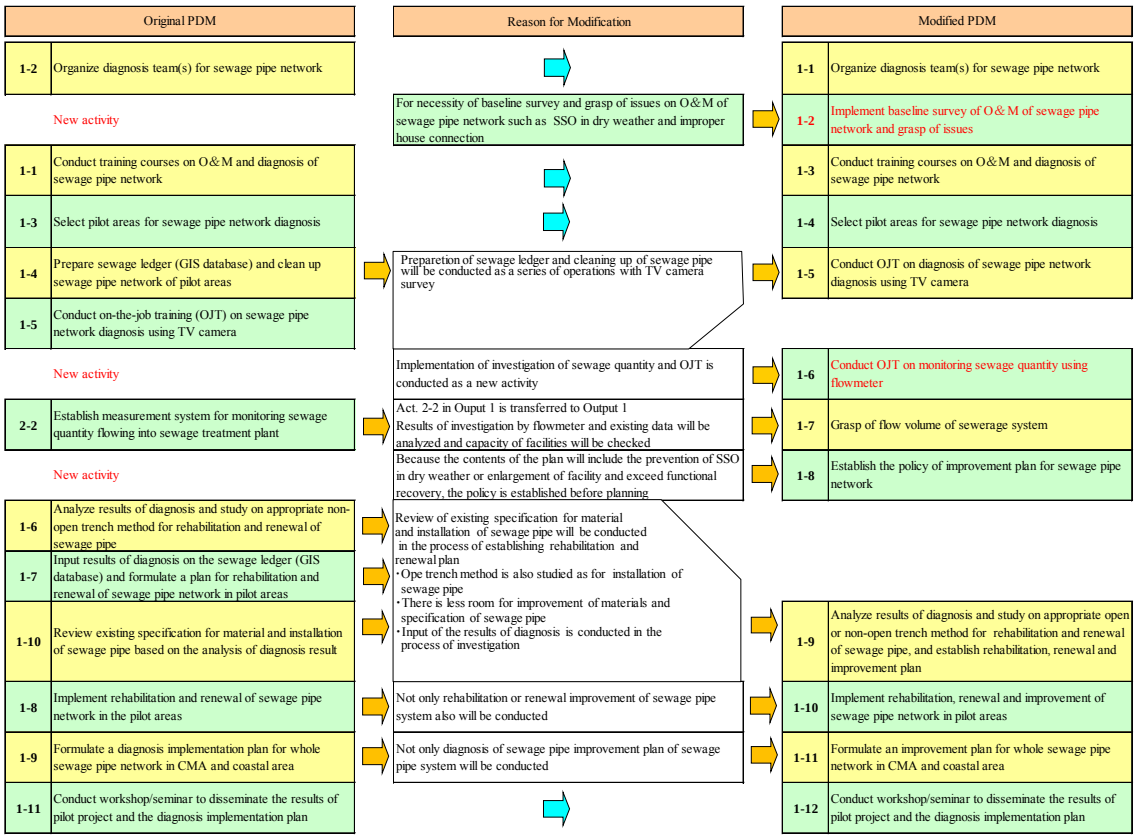


Figure 3.1-1 Comparison of Particles of Activity in Output-1 before and after the Revision

(2) Output-2 (O&M of STP)

In the survey to find the current condition of SANEPAR and STPs conducted in the first fiscal year, the following issues in the PDM were revealed;

i) Present Activity2-2 “Establish measurement system for monitoring sewage quantity flowing into sewage treatment plants” was considered to be appropriate to be implemented in Output-1 together with the flow rate in sewer system and pumping stations comprehensively and Output-2 team will cooperate to the activity in the case of flow rate survey in STPs,

ii) Technical cooperation for issues in O&M of STP and pumping station revealed in the survey were requested,

iii) Technical cooperation for issues in facilities and equipment of STP and pumping stations until rehabilitation programs to be prepared is carried out was requested.

Hence, the new activities were added by revision of PDM. Comparison of particles of activities before and after the revision is as shown in Figure 3.1-2.

Original PDM		Reason for modification	Tentative PDM	
2-1	Conduct a baseline survey on the sewage treatment plants and relay pumping stations in CMA and coastal area		2-1	Conduct a baseline survey on the sewage treatment plants and relay pumping stations in CMA and coastal area
2-2	Establish measurement system for monitoring sewage quantity flowing into sewage treatment plants	This is carried out as an activity of Output-1; however member of Output-2 will cooperate for flow rate survey into STP.	2-2	Support establishment of measurement system for monitoring sewage quantity flowing into sewage treatment plants to be implemented in Output-1.
	New activity	For preparation of renovation plan of STP, appropriate O/M procedure in UASB and floatation process in which a large number of inappropriate issues were found has to considered and actual investigation for improving the current situation is necessary.	2-3	Carry out investigation on improvement of issues regarding O/M of STP revealed in Activity 2-1.
	New activity	For preparation of renovation plan of STP, improvement process for mechanical/electrical facilities and equipment in which a large number of inappropriate issues were found has to considered and actual investigation for realizing improvement has to be carried out.	2-4	Carry out investigation on improvement of issues in facilities and equipment of sewage treatment plants and pumping stations revealed in Activity 2-1.
2-3	Organize a Standard Operation Procedure (SOP) Team for sewage treatment plants		2-5	Organize a Standard Operation Procedure (SOP) Team for sewage treatment plants
2-4	Conduct training courses on O&M of sewage treatment plants		2-6	Conduct training courses on O&M of sewage treatment plants
2-5	Review/develop manual(s) for O&M of sewage treatment plants		2-7	Review/develop manual(s) for O&M of sewage treatment plants
2-6	Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations		2-8	Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations
2-7	Study on introduction of advanced treatment facility for reuse of treated sewage		2-9	Study on introduction of advanced treatment facility for reuse of treated sewage
2-8	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in activity 2-7		2-10	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in activity 2-7
2-9	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants		2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants
2-10	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants		2-12	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants

Figure 3.1-2 Comparison of Particles of Activity in Output-2 before and after the Revision

(3) Output-3 (O&M of WTP)

In the course of the factual survey conducted in the Irai WTP in the first fiscal year, improvement of existing DAF system was found to be the relevant issue and was requested by C/Ps. Therefore, a new activity was added by revision of PDM. Comparison of particles of activities before and after the revision is as shown in Figure 3.1-3.

Original PDM		Reason for Modification	Modified PDM	
3-1	Conduct a baseline survey on the water treatment plants in CMA and coastal area		3-1	Conduct a baseline survey on the water treatment plants in CMA and coastal area
3-2	Organize a Standard Operation Procedure (SOP) Team for water treatment plants		3-2	Organize a Standard Operation Procedure (SOP) Team for water treatment plants
3-3	Conduct training courses on O&M of water treatment plant		3-3	Conduct training courses on O&M of water treatment plant
3-4	Review/develop manual(s) for O&M of water treatment plants		3-4	Review/develop manual(s) for O&M of water treatment plants
3-5	Formulate a plan for rehabilitation and renewal of water treatment plants		3-5	Formulate a plan for rehabilitation and renewal of water treatment plants
3-6	Study on introduction of advanced treatment facility for removal of algae		3-6	Study on introduction of advanced treatment facility for removal of algae
3-7	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in activity 3-6		3-7	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in activity 3-6
3-8	Conduct monitoring of performance indicators (actual results) on O&M of water treatment plants		3-8	Conduct monitoring of performance indicators (actual results) on O&M of water treatment plants
3-9	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of water treatment plants		3-9	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of water treatment plants
New activities		It is necessary to identify removal efficiency of algae, color, turbidity etc. through the improvement of existing DAF system. The results of this activity may provide a valuable reference for activity 3-7.	3-10	Conduct a survey on the improvement of the existing DAF system, and conduct a pilot project for improving the existing DAF system

Figure 3.1-3 Comparison of Particles of Activity in Output-3 before and after the Revision

3.1.2 Second Modification

Indicators of project purposes and outputs shown as XX% in the original PDM (PDM0) were digitized specifically in modification-2. The modification, together with that of the number of target STPs in Output-2, was authorized in the 1st JCC of the 3rd FY held on 28th, August 2014.

(1) Decision of XX% of Indicators

The indicators of each Output in the original PDM were not shown in correct figures but in XX%, and appropriate figures are planned to be substituted according to the progress of the project. The original indicators are as shown in Table 3.1-2.

Table 3.1-3 Index in the Original PDM

Narrative Summary	Verifiable Indicators
Project Purpose Operation and maintenance (O&M) of water supply and sewerage systems in SANEPAR is improved in the target area of the Project	1. Performance indicators on O&M of sewage treatment plant (i.e. sewage treatment index, consumption of electric power and chemicals per m^3 treated water, % of conformity to the treated water quality standard in Brazil) are improved by xx%. 2. Performance indicators on O&M of water treatment plant (i.e. consumption of electric power and chemicals per m^3 produced water, % of conformity to the drinking water quality standard in Brazil) are improved by xx%.
Outputs 1. Capacity of SANEPAR for operation and maintenance (O&M) of sewage pipe network is strengthened.	1-1 Number of incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases by xx%. 1-2 Quantity of infiltration in pilot areas decreases by xx%

Verification to digitize the correct figures became clear by the progress of the activities in the pilot project area in Output-1 and by the progress of the monitoring of the performance indicators (PI) started in the second fiscal year in Output-2 and -3. Hence, the indicators were digitized in the third fiscal year by modifying PDM.

The concrete modifications and the reasons are as follows;

(1)-1 Output 1 (Maintenance of sewer system)

Indicator 1-1 and 1-2 in Output 1 is modified as follows;

Indicator 1-1: Incidents of blockage and/or overflow of sewage pipe networks

[Before the modification]

1-1 Number of incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases by xx%.

[After the modification]

1-1 Number of complaints including incidents of blockage and/or overflow of sewage pipe networks in pilot area decreases from the previous year.

[Reason of the modification]

Because incidents on maintenance of sewer pipe networks are not only blockage and overflow but also discharge of sewage into rivers and streams, and reverse flow into houses, the indicator was modified to "Number of complaints including blockage and/or overflow of sewage pipe networks in pilot area," by carrying out the investigation for improvement of sewer pipe system, including increase of pipe diameter, and measures for misconnection of household pipe.

Although the present target is "decrease from the previous year" due to the difficulty for setting the decrement, target values should be set after the implementation of the project in not only the pilot area but also in the other areas and the verification of the results.

Indicator 1-2: Quantity of infiltration

[Before the modification]

1-2 Quantity of infiltration in pilot area decreases by xx%.

[After the modification]

1-2 Dissolved oxygen level of the rivers in pilot area is maintained at least 5mg/L.

[Reason of the modification]

Besides the infiltration into sewer system in stormy weather, discharge of sewage into rivers and streams even in dry weather conditions due to damage of sewer pipe is considered to be incident on maintenance of the sewer system. Measures for sewage discharge into rivers and streams must be considered urgent, and SANEPAR has considered the river purification as high priority. Hence, the indicator was modified to "dissolved oxygen level" and the target value was set at 5mg/L, which is the minimum guarantee value in the rehabilitation plan of rivers established by SANEPAR.

The modification of above two (2) items was approved in JCC held in February 2014.

(1)-2 Output 2 (O&M of sewage treatment plant)

Indicator of Output 2 was modified as follows;

[Before the modification]

Performance indicators on O&M of sewage treatment plant (i.e. sewage treatment index, consumption of electric power and chemicals per m^3 treated water, % of conformity to the treated water quality standard in Brazil) is improved by xx%.

[After the modification]

Performance indicator on O&M of sewage treatment plant (i.e. volume of treated sewage divided by total inflow volume) is improved to 99.18% in CMA. In addition, % of water quality conformity to the treated water quality standard is improved to 37.3% in CMA and 97.6% in the

Coastal Area.

[Reason of the modification]

a) Performance indicator

In one of the target STPs of the project, influent sewage exceeding the treatment capacity was discharged into the public stream from the weir set in preceding step of screen facility without treatment even in dry weather due to expansion of the treatment area. Consequently, performance indicator (treated sewage volume/inflow sewage volume) in the STP was low. The indicator has been improved by the raising of weir and by improvement of sewer system after the start of the project. SANEPAR has the internal desired value for the indicator, i.e. 99.18% in 2016 and hence, the value should be used.

b) Water quality conformity to the treated water quality standard

Ideally, compliance to quality standards is required at all times. However, due to shortage of treatment capacity caused by increase of influent quantity, and insufficient treatment caused by failures and shortages of equipment, effluent exceeding quality standards is often discharged from mainly large scale STPs in CMA area. In order to improve the situation, SANEPAR introduced a policy to improve conformity rates starting in 2014. Chemical oxygen demand (COD) was set as the indicator and enhancements in efforts made to meet quality criteria were made by each STP. At present, the annual average of the conformity rate in STPs in CMA is set at 37.3% and that of the coastal area is set at 97.6%. The rate will be reconsidered continuously in the case of improvement, renovation, and addition of equipment, ensuring optimum results for the project.

Therefore, the conformity was modified to "% of water quality conformity to the treated water quality standard is improved to 37.3% in CMA and 97.6% in the Coastal Area, respectively."

c) Consumption rate of power and chemicals

At present, many of target STPs are operated under lower rate of power and chemical consumption than required due to failures, poor-quality, and shortages of equipment. When repair, improvement, renovation, and extension of equipment is carried out in the activities of the project, power and chemical consumption will increase proportionately to the increase of operation rate, while effluent quality conformity is improved. Hence, the reduction of power and chemical consumption shown in the original PDM is not strictly observed.

In such target STPs, not reduction of the consumption rate, but the appropriate rate by operating proper equipment required should be prioritized.

(1)-3 Output 3 (O&M of water treatment plant)

Indicator of Output 3 was modified as follows;

[Before the modification]

Performance indicators on O&M of water treatment plant (i.e. consumption of electric power and chemicals per m^3 produced water, % of conformity to the drinking water quality standard in Brazil) are improved by xx%.

[After the modification]

Performance indicator on O&M of water treatment plant (i.e., % of conformity to the drinking water quality standard of treated water (ICP-Produção: Indice de Conformidade ao Padrão de potabilidade na Producao)) is improved to 100%.

[Reason of the modification]

a) Water quality conformity to the treated water quality standard

Ideally, treated water of WTPs has to meet the drinking water quality standards at all times. However, 100% conformity is not attained in WTPs in SANEPAR due to various reasons.

In order to improve the situation, SANEPAR has attempted various measures in the activities within the scope of the project and outside of the project. SOP team has considered that the activities to achieve 100% conformity through implementation of renovation and improvement plan of WTPs have to be carried out continuously. Hence, the PDM was modified as above.

b) Consumption rate of power and chemicals

When repair, improvement, renovation, and extension of facilities and equipment with failures or poor capacity are carried out in the activities of the project, power and chemical consumption will increase proportionately to the increase of operation rate, while quality of drainage from the process as well as that of water produced is improved. As a result, reduction of power and chemical consumption indicated in the original PDM is not achieved. Therefore, the reduction of them is omitted from PDM at present. However, the monitoring of them will be continued because the rate is an important management index and must be maintained at appropriate levels through proper operation of facilities and equipment.

(2) Number of Target STPs under Output-2

[Before the modification]

12 STPs

[After the modification]

11 STPs by omitting Belem STP from the target

[Reason of the modification]

Belem STP (launched in 1979) is the sole STP adopting aerobic treatment process in SANEPAR. The reason why it was originally included in the target STPs of the project was that SANEPAR had a plan to renovate and expand the plant by using the Japanese loan. However, SANEPAR had since changed the policy and prepared the renovation and expansion plan uniquely. In addition, O&M manuals and procedures are already equipped in the STP. Hence, the STP was considered no longer to be a target and was omitted.

3.1.3 Third Modification

One of the values of the indicators of the project purposes and outputs digitized in the modification-2 was found to be incorrect and was revised in the modification-3. Specifically, the performance indicator of O&M of STPs in Curitiba Metropolitan shown as 99.78% in PDM_2 was revised to 99.18% in PDM_3.

Before revision (PDM_2)		After revision (PDM_3)
1. Performance indicators on O&M of sewage treatment plant (i.e. volume of treated sewage divided by total inflow volume) is improved to 99.78% in CMA. In addition, % of water quality conformity to the treated water quality standard is improved to 37.3% in CMA and 97.6% in the Coastal Area respectively.	⇒	1. Performance indicators on O&M of sewage treatment plant (i.e. volume of treated sewage divided by total inflow volume) is improved to 99.18% in CMA. In addition, % of water quality conformity to the treated water quality standard is improved to 37.3% in CMA and 97.6% in the Coastal Area respectively.

3.2 Task Flow and Plan of Operation

3.2.1 Task Flow

Fig. 3.2-1 shows the task flow in the 1st FY. PDM was modified in the 2nd FY based on the result of the activities conducted in the 1st FY and addition and revision of particles of activity in each Output was carried out. Hence, the task flow in the 2nd FY afterwards was modified as shown in Fig. 3.2-2.

In the 1st FY, investigations for the current situation, extraction of issues, and consideration for improvement of issues were conducted in each Output. In the 2nd FY and afterwards, activities of each Output were carried out based on the results of the investigation.

3.2.2 Plan of Operation (PO)

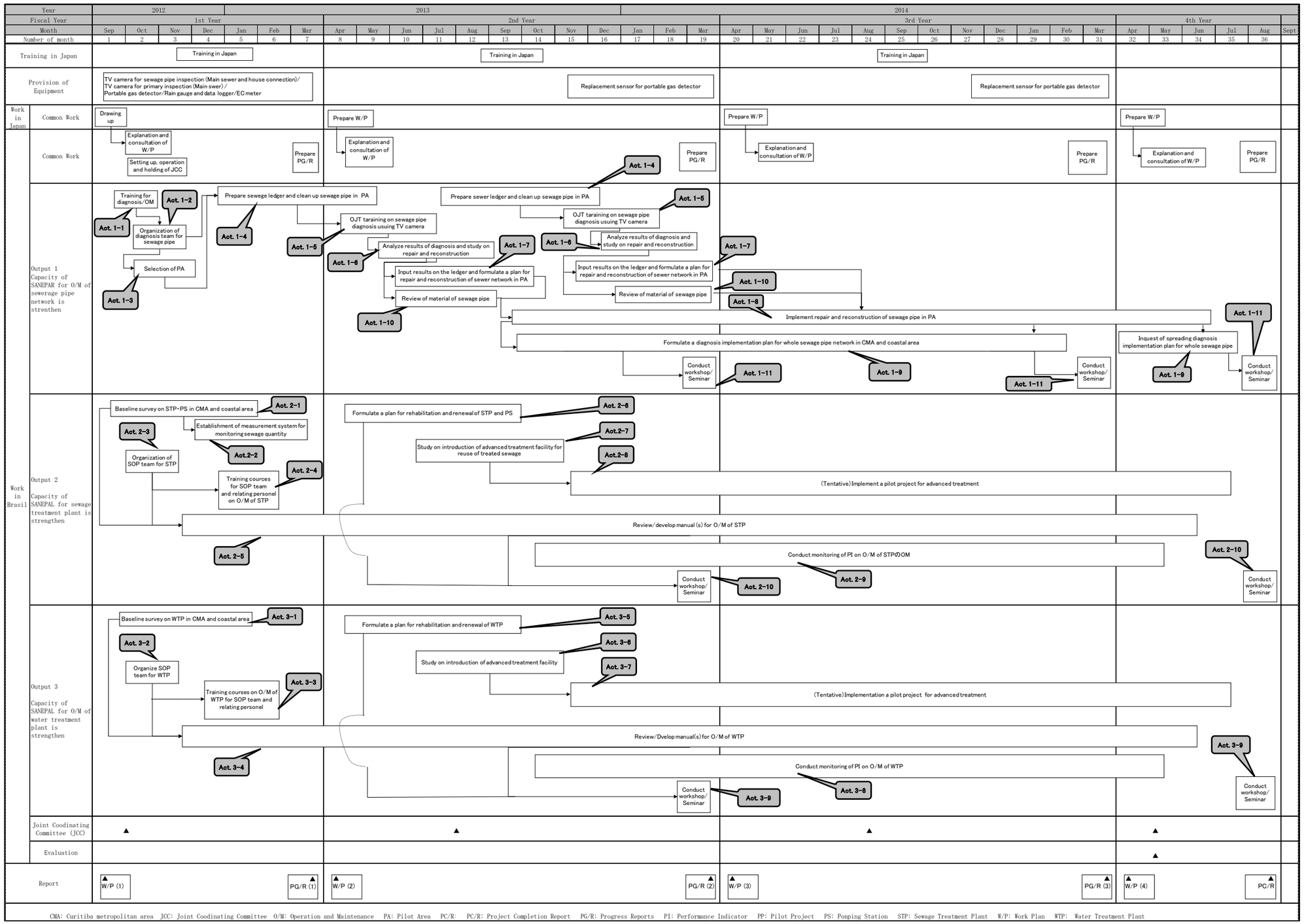
Fig. 3.2-3 shows the original plan of operation (PO) in the 1st FY. Because particles of activity in each Output were added and modified by means of the modification of PDM in the 2nd FY, PO also was modified as shown in Fig. 3.2-4. It is evident by the comparison of red lines and triangles with black ones (planning phase) in the figure that no particular delay or revision of PO is found in each Output, and the project progressed smoothly with positive participation of C/Ps into the project activities.

3.2.3 Policy for Implementation of Activity

The project activities had been implemented based on the following policies indicated in the inception report (IC/R).

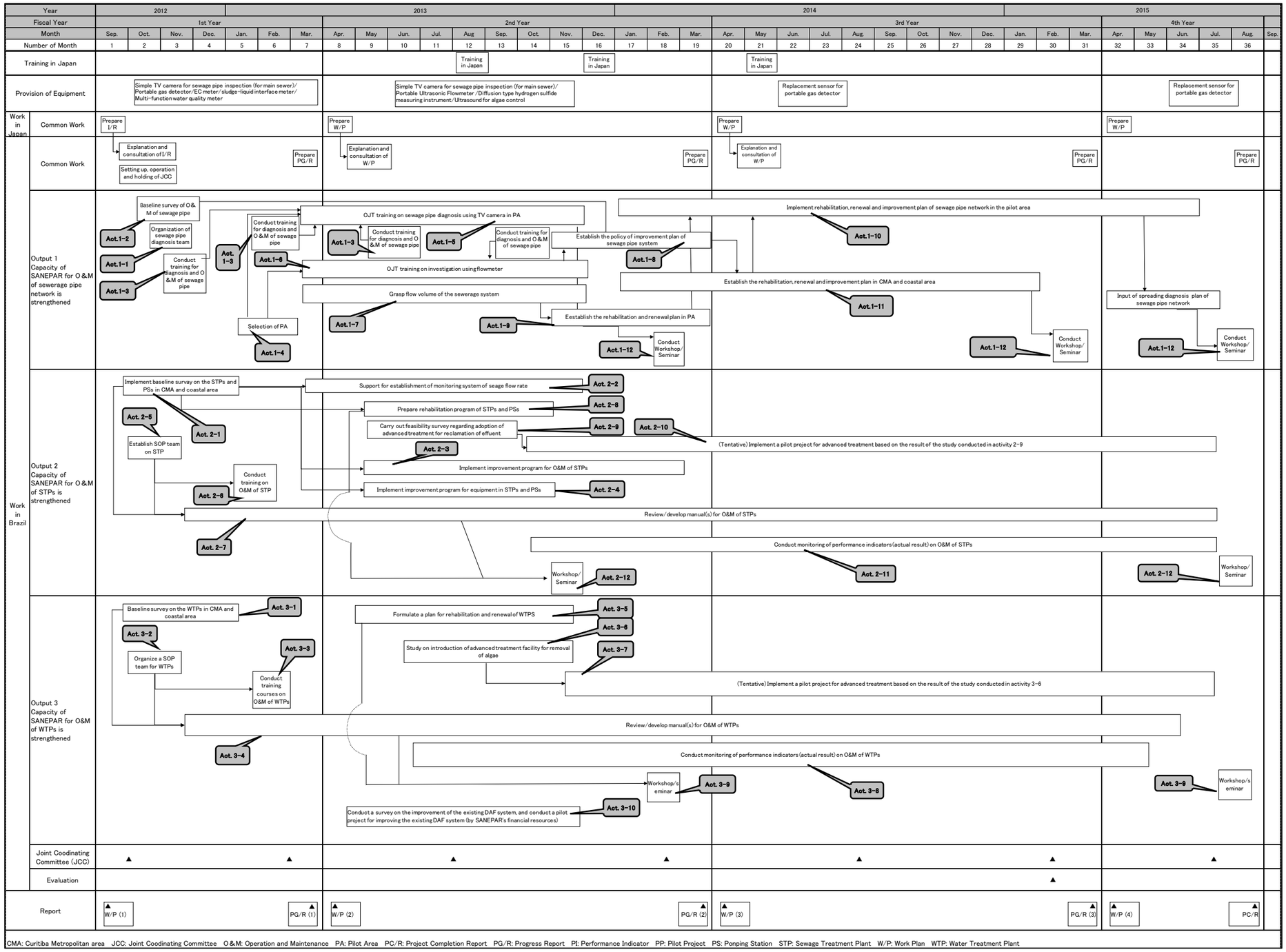
- Facilitation of ownership and sustainability of SANEPAR
- Establishment of smooth management system of the project by holding seminars, weekly meetings in each Output and trainings in Japan

Table 3.2-1 shows the policies, the purposes and the examples of activities implemented in accordance with the policies.



CMA: Curitiba metropolitan area JCC: Joint Coodinating Committee O/M: Operation and Maintenance PA: Pilot Area PC/R: PC/R: Project Completion Report PG/R: Progress Reports PI: Performance Indicator PP: Pilot Project PS: Pomping Station STP: Sewage Treatment Plant W/P: Work Plan WTP: Water Treatment Plant

Figure 3.2-1 Task Flow in the 1st FY before the Modification of PDM



CMA: Curitiba Metropolitan area JCC: Joint Coodinating Committee O&M: Operation and Maintenance PA: Pilot Area PC/R: Project Completion Report PG/R: Progress Report PI: Performance Indicator PP: Pilot Project PS: Ponping Station STP: Sewage Treatment Plant W/P: Work Plan WTP: Water Treatment Plant

Figure 3.2-2 Task Flow in the 2nd FY after the Modification of PDM

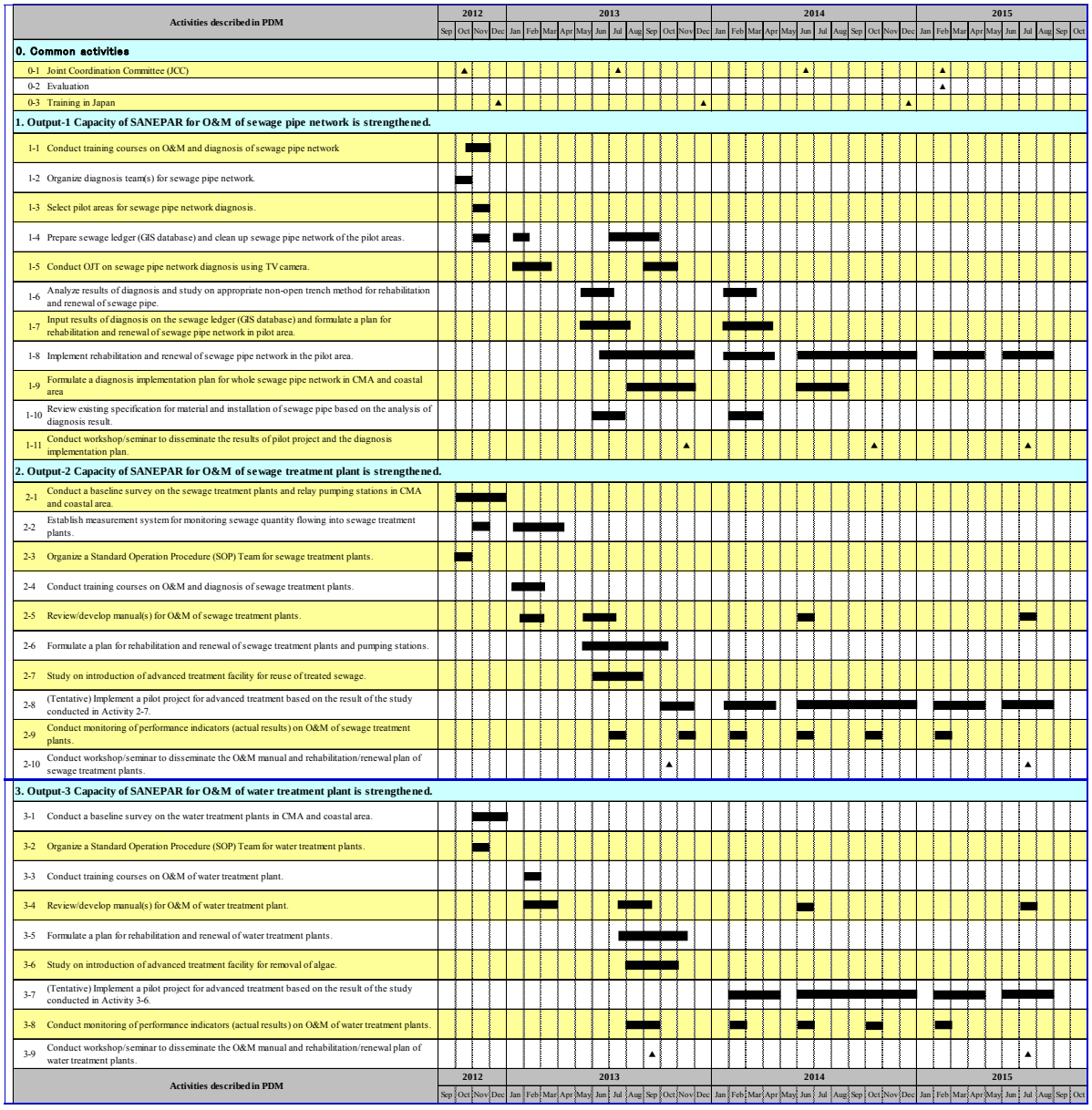


Figure 3.2-3 PO in the 1st FY before the Modification of PDM

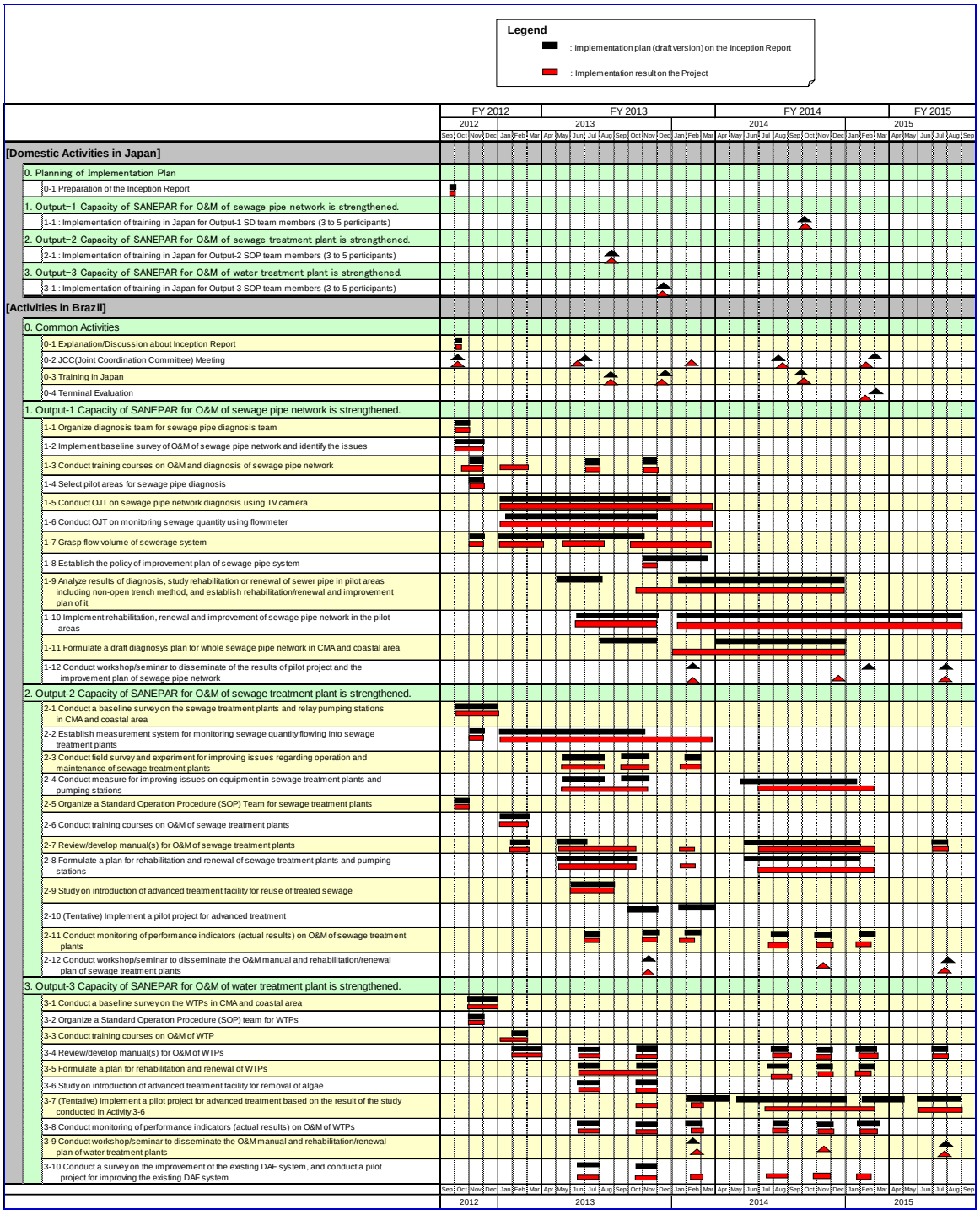


Figure 3.2-4 PO in the 2nd FY after the Modification of PDM

Table 3.2-1 Policies, Purposes and Examples of Activity Implemented in accordance with the Policies

Policy	Purpose	Examples of activity implemented in accordance with the policies	Output
Progress of ownership and self-sustaining development of SANEPAR	When the project activities are implemented based on the ownership and sustainability, SANEPAR will understand the issues in sewer networks, STPs and WTPs and will be able to involve in improvement of the issues by themselves.	Sustainability of SANEPAR was encouraged by nominating C/P as trainer in the seminars held in the project。	Common
		Although diagnosis, rehabilitation, renewal and improvement plan of sewer pipe in the pilot area was commenced under the instruction of JICA expert team, it has been implemented continuously as the inherent job of SANEPAR and implementation system already is established after the end of the project.	Output 1: Maintenance of sewer pipe
		At the beginning, PI monitoring was carried out only in the target STPs; however it was commenced in all STPs in SANEPAR during the project term and sustainability of SANEPAR was progressed.	Output 2: O&M of STP
		Pilot project of advanced treatment in WTP was conducted continuously by C/Ps even in the absence of JICA expert team and implementation system of experiment and research required is already established in SANEPAR.	Output 3: O&M of WTP
		Because O&M manual was considered to be hard to prepare in all STPs and WTPs in the project term, the process that it was first prepared in major STPs and WTPs as examples and then prepared in the other STPs and WTPs by SANEPAR independently referring to the examples.	Output 2 and 3: O&M of STP and WTP
		Renovation plan of STPs and WTPs was prepared under the instruction of JICA expert team; however it was already approved by SANEPAR as their plan and was executed.	
		In the experiment for functional recovery of on-site equipment, , C/Ps improved equipment, operated, maintained and collected data independently based on the proposal of JICA expert team.	
Formulation of efficient management system of the project by implementing seminars, weekly meeting held in each output and training in Japan etc.	By sharing knowledge's obtained in various seminars, trainings in Japan, weekly meeting held by each output and on-site OJT not only within C/P but also with many other staff of SANEPAR, capacity development of staff involved in O&M is progressed. And C/Ps who obtained knowledge directly in the project will instruct other staff after the end of the project.	Capacity development of staff was promoted by imparting knowledge and information regarding remedy for issues, O&M manual and renovation plan of facilities and equipment.	Common
		Participants of training in Japan reported the results of the training for many staff of SANEPAR and knowledge and information etc. was shared within them.	
		The project was promoted by holding weekly meeting in SDT and SOP team of each output with gathering staff cross-functionally; hence basis for considering issues cross-functionally was established.	
		Weekly meeting was held in each output during the stay of JICA expert team and capacity development of SANEPAR staff was improved by sharing knowledge and information.	

3.3 Contents of Activities in Each FY

3.3.1 Contents of Activities in First Fiscal Year

The main contents of activities in the first fiscal year are as follows;

- In Japan:
  - Preparation of the inception report
- In Brazil:
  - Briefing and discussion of the inception report
  - Establishment of team organization
  - Conducting activity items in the first fiscal year shown in Table 3.3-1.
  - Implementation of seminar in each output

In order to implement the above, JET carried out activities from 1st October to 30th November 2012, and 9th January to 8th March 2013 in Parana.

Table 3.3-1 Activity Items in the First Fiscal Year

1. Output-1: Capacity of SANEPAR for O&M of sewage pipe network is strengthened.	
Ex-1-1	Conduct training courses on O&M and diagnosis of sewage pipe network
Ex-1-2	Organize diagnosis team(s) for sewage pipe network
Ex-1-3	Select pilot areas for sewage pipe network diagnosis
Ex-1-4	Prepare sewage ledger (GIS database) and clean up sewage pipe network on the pilot area
2. Output-2: Capacity of SANEPAR for O&M of sewage treatment plant is strengthened.	
2-1	Conduct a baseline survey on the sewage treatment plants and relay pumping stations in CMA and coastal area
Ex-2-2	Establish measurement system for monitoring sewage quantity flowing into sewage treatment plants
Ex-2-3	Organize a Standard Operation Procedure (SOP) Team for sewage treatment plants
Ex-2-4	Conduct training courses on O&M of sewage treatment plants
Ex-2-5	Review/develop manual(s) for O&M of sewage treatment plants
3. Output-3: Capacity of SANEPAR for O&M of water treatment plant is strengthened.	
3-1	Conduct a baseline survey on the water treatment plants in CMA and coastal area
3-2	Organize a Standard Operation Procedure (SOP) Team for water treatment plants
3-3	Conduct training courses on O&M of water treatment plants
3-4	Review/develop manual(s) for O&M of water treatment plants

3.3.2 Contents of Activities in Second Fiscal Year

The main contents of activities in the first fiscal year are as follows;

- In Japan:

- Preparation of the work plan

➢ In Brazil:

- Briefing and discussion of the work plan
- Conducting activity items in the second fiscal year shown in Table 3.3-2.
- Implementation of seminar in each output

In order to implement the above, JET carried out activities from 28th May to 2nd August, 24th September to 22nd November 2012, and 15th January to 5th March 2013.

Table 3.3-2 Activity Items in the Second Fiscal Year

1. Output-1: Capacity of SANEPAR for O&M of sewage pipe network is strengthened.	
1-3	Conduct training courses on O&M and diagnosis of sewage pipe network
1-6	Conduct OJT on monitoring sewage quantity using flowmeter
1-7	Grasp of flow volume of sewage system
1-8	Establish the policy of improvement plan for sewage pipe network
1-9	Analyze results of diagnosis and study on appropriate open and non-open trench method for rehabilitation and renewal of sewage pipe, and establish rehabilitation, renewal and improvement plan
1-10	Implement rehabilitation, renewal and improvement of sewage pipe network in pilot area
1-11	Formulate an improvement plan for whole sewage pipe network in CMA and coastal area
1-12	Conduct workshop/seminar to disseminate the results of pilot project and diagnosis implementation plan
2. Output-2: Capacity of SANEPAR for O&M of sewage treatment plant is strengthened.	
2-2	Support establishing measurement system for monitoring sewage quantity in sewage system
2-3	Conduct field survey and experiment for improving issues regarding operation and maintenance of sewage treatment plants
2-4	Conduct effort for improving issues on equipment in sewage treatment plants and pumping stations
2-7	Review/develop manual(s) for O&M of sewage treatment plants
2-8	Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations
2-9	Study on introduction of advanced treatment facility for reuse of treated sewage
2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants
2-12	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants
3. Output-3: Capacity of SANEPAR for O&M of water treatment plant is strengthened.	
3-4	Review/develop manual(s) for O&M of water treatment plants
3-5	Formulate a plan for rehabilitation and renewal of water treatment plants
3-6	Study on introduction of advanced treatment facility for removal of algae
3-7	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in Activity 3-6
3-8	Conduct monitoring of performance indicators (actual results) on O&M of water treatment plants
3-9	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of water treatment plants
3-10	Conduct a survey on the improvement of the existing DAF system, and conduct a pilot project for improving the existing DAF system

3.3.3 Contents of Activities in Third Fiscal Year

The main contents of activities in the third fiscal year are as follows;

- In Japan:
  - Preparation of the work plan
  - Implementation of the training in Japan for trainees in Output-1
- In Brazil:
  - Briefing and discussion of the work plan
  - Conducting activity items in the third fiscal year shown in Table 3.3-3.
  - Implementation of seminar in each output

In order to implement the above, JET carried out activities from 22nd July to 4th September, 4th November to 11th December 2014, and 24th January to 4th March 2015.

Table 3.3-3 Activity Items in the Third Fiscal Year

1. Output-1: Capacity of SANEPAR for O&M of sewage pipe network is strengthened.	
1-9 1-10	Implement rehabilitation, renewal and improvement of sewage pipe network in pilot areas (Implement continuous support)
1-11	Formulate an improvement plan for whole sewage pipe network in CMA and coastal area (Implement continuous support)
1-12	Conduct workshop/seminar to disseminate the results of pilot project and diagnosis implementation plan
2. Output-2: Capacity of SANEPAR for O&M of sewage treatment plant is strengthened.	
2-4	Conduct effort for improving issues on equipment in sewage treatment plants and pumping stations (Implement continuous support)
2-7	Review/develop manual(s) for O&M of sewage treatment plants (Implement continuous support)
2-8	Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations (Implement continuous support)
2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants
3. Output-3: Capacity of SANEPAR for O&M of water treatment plant is strengthened.	
3-4	Review/develop manual(s) for O&M of water treatment plants (Implement continuous support)
3-5	Formulate a plan for rehabilitation and renewal of water treatment plants (Implement continuous support)
3-7	Implement a pilot project for advanced treatment based on the result of the study conducted in Activity 3-6 (Implement continuous support)
3-8	Conduct monitoring of performance indicators (actual results) on O&M of water treatment plants

3.3.4 Contents of Activities in the Fourth Fiscal Year

The main contents of activities in the fourth fiscal year are as follows;

- In Japan:
  - Preparation of the work plan
- In Brazil:

- Briefing and discussion of the work plan
- Conducting activity items in the fourth fiscal year shown in Table 3.3-4.
- Implementation of seminar in each output

In order to implement the above, JET carried out activities from June to July 2015 in Parana.

Table 3.3-4 Activity Items in the Fourth Fiscal Year

1. Output-1: Capacity of SANEPAR for O&M of sewage pipe network is strengthened.	
1-10	Implement rehabilitation, renewal and improvement of sewage pipe network in pilot areas (Implement continuous support in consideration of notices and result of activities until the previous FSY)
1-12	Conduct workshop/seminar to disseminate the results of pilot project and diagnosis implementation plan
2. Output-2: Capacity of SANEPAR for O&M of sewage treatment plant is strengthened.	
2-7	Review/develop manual(s) for O&M of sewage treatment plants (Implement continuous support in consideration of notices and result of activities until the previous FSY)
2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants (Implement continuous support)
2-12	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants
3. Output-3: Capacity of SANEPAR for O&M of water treatment plant is strengthened.	
3-4	Review/develop manual(s) for O&M of water treatment plants (Implement continuous support in consideration of notices and result of activities until the previous FSY)
3-7	Implement a pilot project for advanced treatment based on the result of the study conducted in Activity 3-6 (Implement continuous support)
3-8	Conduct monitoring of performance indicators (actual results) on O&M of water treatment plants
3-9	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of water treatment plants

Chapter 4 Activities for Output 1

4.1 Output Expected

The outputs expected under Project are shown in Table 4.1-1.

Table 4.1-1 Outputs Expected

Year	Activity No.	Outputs to be achieved in each year	Indicator
1st	1-1	Organize diagnosis team for sewage pipe diagnosis team	1-1 Number of complaints including incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases from the previous year. 1-2 Dissolved oxygen level of the rivers in pilot areas are maintained at least 5 mg/L.
	1-2	Implement baseline survey of O&M of sewage pipe network and identify the issues	
	1-3	Conduct training courses on O&M and diagnosis of sewage pipe network	
	1-4	Select pilot areas for sewage pipe diagnosis	
	1-6,1-7	Conduct OJT on monitoring sewage quantity using flowmeter and grasp flow volume of sewerage system	
2nd	1-3	Conduct training courses on O&M and diagnosis of sewage pipe network (Continual)	
	1-5	Conduct OJT on sewage pipe network diagnosis using TV camera	
	1-6,1-7	Conduct OJT on monitoring sewage quantity using flowmeter and grasp flow volume of sewerage system (Continual)	
	1-8,1-9 1-10	Establish the policy after analyze the results of diagnosis, and establish and implement rehabilitation, renewal and improvement plan in pilot areas	
	1-11	Support technically for planning of the sewage pipe diagnosis plan in CMA and coastal area	
	1-12	Conduct workshop/seminar to disseminate of the results of pilot project and the improvement plan of sewage pipe network	
3rd	1-9, 1-10	Support technically for the establishment and implementation of rehabilitation, renewal and improvement plan in pilot areas	
	1-11	Support technically for planning of the sewage pipe diagnosis plan in CMA and coastal area	
	1-12	Conduct workshop/seminar to disseminate of the results of pilot project and the improvement plan of sewage pipe network	
4th	1-10	Support technically for the implementation of repair, reconstruction and improvement plan in PA (Continuous support will be determined considering points of concern and activities in previous years.)	
	1-12	Conduct workshop/seminar to disseminate of the results of pilot project and the improvement plan of sewage pipe network	

4.2 Result of Activities

4.2.1 (Activity 1-1) Establishment of Sewage Pipe Diagnosis Team

(1) Purpose and Significance of Activity

The sewage pipe diagnosis team (SDT) is the organization of C/P side to promote the project actually with JICA team. In Output-1 SDT conducts investigation with TV camera and flow meter, diagnosis and planning of sewer pipe network with cooperation of JET.

(2) Methodology and Procedure of Activity

With the aim of member of SDT to join the project voluntarily and to promote it, following method to manage SDT is adopted. Weekly meeting will be held in every week in which members of SDT act at the center, grasping every plan of activities and progress on O&M of sewage pipe network. In the meeting method of promoting project is discussed, problems and issues are understood, solutions are studied and progress is confirmed.

(3) Result of Activity

Because SANEPAR selected 4 C/Ps before arriving of JET, the SDT is formed rapidly. Nearly every week weekly meeting was held and it amounts 11 times in the first fiscal year. Although in October and November number of participants was few, in January and February, when many personnel gets the summer vacation, member of meeting was plenty joining personnel of surrogate. Also number of C/Ps was increased to 11 from 4 at the beginning and the system is fulfilling at the end of first fiscal year. It should be noted that evaluation of C/P is conducted for 4 C/Ps initially selected. This activity was completed in the first fiscal year. See Table 4.2-1.

Table 4.2-1 Member of SDT in Output-1

Name	Title	Period	By year			
			1	2	3	4
Mr. Claudio Luiz Piccolotto Simon	Advisor for Director of Operation	Oct. 2012 to present	○	○	○	○
Ms. Luciana Dolci Alves Balbinott	Coordinator of water and sewage pipe network, URCT-L/GGML	Oct. 2012 to present	○	○	○	○
Ms. Daniela Martini	Engineer, URCT-L/GGML	Feb.2014 to present		○	○	○
Ms.Carolina Proença Araujo Rosin	Technical staff of architecture, URCT-L/GGML	Oct. 2014 to present			○	○
Mr. Cesar Augusto Ruppi	Coordinator of water and sewage pipe network, URCT-L/GGML	Jan.2013 to present	○	○	○	○
Mr. Nelson Mori	Assistant of sewage pipe network, URCT-L/ GGML	Jan.2013 to present	○	○	○	○
Mr. Eraldo Vitorino	Coordinator of water and sewage pipe network, URLI/GGML	Oct. 2012 to present	○	○	○	○
Mr. Fabio Daia Zuza	Assistant of sewage pipe network, URLI/GGML	Jun. 2013 to present		○	○	○
Mr. Antonio Benedito Belchior Lara Pupo	Assistant of sewage pipe network, URLI/GGML	Jun. 2014 to present			○	○
Mr. Ernani Jose Ramme	Engineer, USEG/GGML	Oct. 2012 to present	○	○	○	○
Mr. Murilo Bertolino	Engineer, USEG/GGML	Jan.2013 to present	○	○	○	○

Name	Title	Period	By year			
			1	2	3	4
Ms. Flavia Marcela Lago	Engineer, USPE/DI	Jun. 2013 to present		○	○	○
Mr. Robson de Paula Waltrick	Engineer, USEMCT/GGML	Jun. 2014 to present			○	○
Mr. Demetrius Mestre Dallalama	Engineer, USES/GPDO	Nov. 2014 to present			○	○
Mr. Jefferson Skroch	Engineer, USHI/DMA	Nov. 2014 to present			○	○
Mr. Juliano Campos Pereira	Technical staff of architecture, USEG/DO	Jan.2013 to present	○	○	○	○
Mr. Jeovani Almeida	Technical staff, USEG/DO	Jan.2014 to present		○	○	○
Mr. Antonio Wilian de Sousa	Technical staff, USEG/DO	Jan.2013 to present	○	○	○	○
Mr. Anderson Magnuski Pinheiro	Technical staff, USEG/DO	Jan.2013 to present	○	○	○	○
Mr. Sidinei Bono Caetano	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Mr. Wanderson Angelo de Oliveira	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Ms. Roselis Augusta de Oliveira	Officer of socio-environmental education, USEA/DMA	Jan.2013 to present		○	○	○
Ms. Juliana Gonçalves Brandani	Officer of socio-environmental education, USEA/DMA	Jan.2014 to present		○	○	○
Mr. Jakson Alves	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Mr. Leonid Bresjnev Rodrigues Pires	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Mr. Benito Heitor Brudeck Zambão	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Mr. Natanael Manarine da Silva	Technical staff, URCTL/DO	Jan.2013 to present	○	○	○	○
Total by year			16	22	27	27

(4) Tasks to Be Addressed

To promote the first stage of this project, strengthen of the capacity of SANEPAR for O&M of sewage pipe network system has been built fulfilling and good result will be expected. On the other hand, in the second stage of the project planning of rehabilitation and implementation of it will be related to investment department, when members of SDT should be modified.

(5) Actions to Be Taken

After January 2016 (initial of fiscal year of 2016 in Brazil), rehabilitation plan will be implemented. In the early time of the fiscal year of 2015 system of the project should be

enriched.

4.2.2 （Activity 1-2） Implement Baseline Survey of O&M of Sewage Pipe Network and Identify Issues

(1) Purpose and Significance of Activity

Because the river water pollution caused by the leakage of sewage, that is more than assumption from sewer pipe line, the shortage of sewage pipe line capacity and the problem of cross-connection that causes infiltration have been found, the survey of actual condition of sewage pipe line network system to grasp the issues was added to the activities.

(2) Methodology and Procedure of Activity

JET will collect information data by hearing from the person concerned and field survey.

(3) Result of the Activity

The following results were obtained concerning to the present conditions and issues of the O&M of sewage pipe network.

(3)-1 Actual State of O&M of Sewage Pipe Network and Issues

Actual state of O&M of sewage pipe network is as follows:

- Ledger of sewage pipe network employs advanced system using GIS and Auto Cad.
- Particularly notable activities are " Investigation of cross connection" and "Investigation of sewage pipe network (more than 300mm of diameter)"
- SANEPAR has a certain amount of technical capacity considering from the fact that SANEPAR possesses 1 insert type TV camera (10 more cameras are purchased at the end of February 2013) and 3 portable flow meters which are utilized for flow volume measurement.
- Sewage pipe with blockage is cleansed by high-pressure washing car. Herein, from the fact that the Brazilian federal law imposes strict conditions on confined spaces safety management work, a worker is not in principle turn on within the manhole. For this reason it is presumed that cleaning of sewage pipe will be finished without determine the cause of the trouble, and fundamental measures for blockage have not been taken.

(3)-2 Issues on O&M of Sewage Pipe Network

Following issues on O&M of sewage pipe network are found out.

- Causes of blockage of sewage pipe are mainly flowing matters such as oil or garbage. And other causes are problems in structure such as damaged sewage pipe and projection of house connection, as otherwise intrusion of roots.
- Primary cause of reverse flow in rainy weather is infiltration of rain water. It is possible that remote cause of it is rack of sewage pipe capacity. Particularly SANEPAR adopts 150mm (In Japan 200mm is adopted) as minimum diameter of sewage pipe and smaller margin of safety, that may cause problem.
- SSO (Sanitary Sewer Overflow) in dry weather may causes from overflow of sewage by blockage and damage of sewer and without connection of houses.
- Considering from SANEPAR presuming that about 40% of used water is not reaches to wastewater treatment plant in Belem River Basin, SSO causes from not only outflow of sewage pipe but also houses without connection to sewage pipe.
- Sewage pipe network investigation team reported that 18% of manholes in the ledger are not found which may make progress on the project difficult.

This activity was completed in the first fiscal year. Results of the investigation are attached in Annex A4-1.

(4) Tasks to Be Addressed

It is needed to collect information.

(5) Actions to Be Taken

Information collection will be continued.

4.2.3 （Activity 1-3） Implementation of Technical Training on Diagnosis and O&M of Sewage Pipe Network

(1) Purpose and Significance of Activity

In this project aiming at the improvement of O&M of sewage pipe network trainings of this field to personnel in charge of it is important measures and must be conducted more precisely and effectively.

(2) Methodology and Procedure of Activity

Training course on O&M and diagnosis of sewage pipe network aiming at improvement of the capacity of personnel will be conducted efficiently and effectively combining OJT, seminar, participatory training by brain storming, and itinerating seminar that will be conducted at field offices to site worker.

In the first year seminar, brain storming and OJT are conducted.

In the second fiscal year aiming at efficient and effective capacity building of personals, itinerant seminars at the 4 offices managing sewage pipe network in each area covering the project area were implemented.

(3) Result of Activity

In the first fiscal year by seminar format training courses JET introduced technology and method of O&M of sewage pipe network in Japan and C/Ps reported operations of SANEPAR. In brain storming format which theme was “back flow of sewage”, one C/P was nominated as facilitator and C/Ps discussed freely about first cause, secondary cause and finally fundamental cause. In OJT to study use of simple TV camera, personnel in both CMA and coastal area studied how to use the equipment in a short term.

In the second fiscal year visiting seminars at 4 regional offices to where JICA experts visited were carried out once in each office. Many personnel at the offices involving to SDT have studied at the seminars in the first year of this project. So at URLI (the office of coastal area) the theme of seminar were selected on the request of personal of the office and at URCTL (the office of eastern part of CMA) brain-storming was carried out on sewage pipe diagnosis standard special for SANEPAR after the presentation of Japanese standard by JICA expert. In the seminars at the 2 offices which personals do not involved to SDT the same contents presented as in that of the first year were selected. Effective training was carried out because of the contents according to the level of trainees and of the enlargement of the number of trainees by the style of itinerant seminar.

Implemented training courses are shown in Table 4.2-2. This activity was completed in the second fiscal year.

Lecture by JICA expert

Training by brain-storming

Presentation of output of the project by C/P

Implementation of visiting seminar

Table 4.2-2 Training Courses Conducted (Seminar and Brain-storming)

Year	Date	Theme and Title	Number of Participant	Classification
1st fiscal Year	23/11/2012	Investigation of infiltration , Analysis of amount of sewage flow	5	Seminar
	23/11/2012	Back flow of sewage and cause of it	5	Brain-storming
	28/2/2013	Plan of activity of JICA project, O&M of sewage pipe in Japan, Information management of sewage pipe system in SANEPAR, Flow volume measurement of sewage pipe system	35	Seminar
	01/03/2013	Measurement method of sewage flow of pumping station	4	Seminar
	05/03/2013	Analysis method of data of flow meter	5	Seminar
2nd fiscal year	28/6/2013	Visiting seminar at URLI Theme; Counter measure for infiltration, Safety management, O&M of sewer system, Non-dig Pipe rehabilitation method, Micro tunneling method	19	Seminar
	28/10/2013	Visiting seminar at URCTL Theme; Stormwater management, Sewer diagnosis – lecture and brain-storming	15	Seminar, Brain-storming
	7/11/2013	Visiting seminar at URCTS Theme; Activities at URCTS, Sewer O&M in Japan, Non-dig Pipe rehabilitation method, Sewer diagnosis standard, Sewer diagnosis at pilot area	32	Seminar

	11/11/2013	Visiting seminar at URCTN Theme; Activities at URCTN, Sewer O&M in Japan, Non-dig Pipe rehabilitation method, Sewer diagnosis standard, Sewer diagnosis at pilot area	25	Seminar

(4) Tasks to Be Addressed

Because personnel of SANEPAR from engineer to site worker has high motivation and ability, it seems self-sustaining improvement is rather easy. At this itinerant seminar in the second fiscal year the continuous holding of this seminar was requested.

(5) Actions to Be Taken

It is desired to carry out the continuous training in future by SDT, not by JICA expert team.

4.2.4 (Activity 1-4) Select Pilot Areas for Sewage Pipe Diagnosis

(1) Purpose and Significance of Activity

It is necessary to select pilot areas where sewage pipe line will be diagnosed and a rehabilitation plan of it will be established. It was noted that it must be selected to keep a logical way of thinking considering each condition, and SDT will be interested with understanding on the contents of the project after a discussion.

(2) Methodology and Procedure of Activity

It was decided to determine the pilot area in CMA with discussion of both SDT and JICA expert team considering following conditions.

It should be selected from the area of the jurisdiction of URCTL.

- It should be an area where aged sewage pipes – mainly ceramic pipes – are installed.
- It should be selected from the area, or river, where PRRU is working to identify the improvement effect of the water environment of the river, and to perform the action of the environmental education.
- It should be an area with an average traffic etc. excluding the central area with difficulty of a survey of sewage pipe network.
- It was decided to determine the pilot area in the coastal area from that installed with ceramic pipes.

(3) Result of Activity

As a pilot area for sewage pipe diagnosis in CMA a part of the Areiaozinho river basin in the

Belem river basin was selected. Outline of the survey area is shown in Table 4.2-3 and the position figure is illustrated in Figure 4.2-1.

Table 4.2-3 Outline of Pilot Area (Areaozinho river basin)

Item	Contents
Area	About 279.0 ha
Longitude of sewage pipe	About 64.6 km

Figure 4.2-1 Survey Area of CMA (Rio Areaozinho)

Figure 4.2-2 Survey Area of Coastal Area (Matinhos)

For the pilot area in the coastal area, the area installed with ceramic pipes is limited to one part of Matinhos and Morretes districts. All the area with ceramic pipes in Matinhos is selected because many problems occur there and the survey can be executed even in that quantity. See Figure 4.2-2.

For the flow volume survey of the activity 1-6, in CMA all the area of the Atuba Sul STP basin was selected because many pumping station were constructed and the survey is rather easy, and in the coastal area one part of the Pontal do Parana STP basin because it is said there is a problem of infiltration.

The investigation and diagnosis were implemented based on the role of C/Ps shown in Table 4.2-4. As the result of the definition, C/P has participated positively to the activities and consideration.

Table 4.2-4 Role of C/Ps in the Pilot Area Survey (CMA)

Item	Role of C/Ps
i) Inspection of pipe	Pipes smaller than 300mm: Role of URCT-L Pipes larger than 300mm: Role of USEG
ii) House connection survey	Role of existing mal-connection survey team in URCT-L
iii) Flow rate survey	Role of UESG
iv) River water quality survey	Collaboration with PRRU in progress consultation

(4) Tasks to Be Addressed

The river in the pilot area is contaminated as shown in the picture. In the survey and diagnosis of sewage pipes improvement of the river water environment, that is measures for the leakage of sewer pipes, should be noted.

Contaminated river water in the pilot area

(5) Actions to Be Taken

It is needed to make efforts to raise awareness of residents and staffs of SANEPAR by the cooperation with the activity of PRRU, residents' enlightenment and community participation type of environmental education.

4.2.5 (Activity 1-5) Conduct OJT on Sewage Pipe Network Diagnosis Using TV Camera

(1) Purpose and Significance of Activity

In the C/P organization the visual inspection could not be carried out formerly because they did not have a TV camera and do not creep in manhole usually. And therefore in case of obstruction of sewer pipe, a pipe cleaning would be carried out without finding out causes of it, such as the breakage or injection of house connection, resulting frequent occurring of obstruction by same causes. The preventive repair and rehabilitation of sewage pipes will be carried out by sewage pipe diagnosis using injection type TV camera procured by C/P organization, simple TV camera and self-propelled TV camera donated by JICA. And also SDT will be able to investigate and diagnose sewage pipe network through OJT training.

(2) Methodology and Procedure of Activity

In the first fiscal year, the handling procedure of camera for simple TV camera was instructed for C/Ps in CMA and the coastal area by OJT. In the first and second fiscal year the survey and diagnosis of sewage pipes using TV camera by C/Ps will be supported.

As for the strategy of investigation of sewage pipe, the primary diagnosis at manholes using simple TV camera is carried out at all the line and the secondary diagnosis is carried out at more reduced line as illustrated in Figure 4.2-3. The secondary diagnosis is carried out using injection type TV camera to monitor the sewage pipe between manholes, and the necessity of repair or reconstruction will be decided.

In the OJT process of investigation, how to use TV camera, how to organize the data and other notes were instructed firstly, and SDT conducted them in field with adequate instruction by JET secondly. As for the diagnosis of sewage pipe the sewage pipe diagnosis table was newly established by arranging the conventional format of SANEPAR after presentation of Japanese diagnosis method and diagnosis table by JET. Sewage pipe diagnosis standard was established after obtaining the common consensus through discussion using brain storming aiming to establish the appropriate standard suitable for C/P organization.

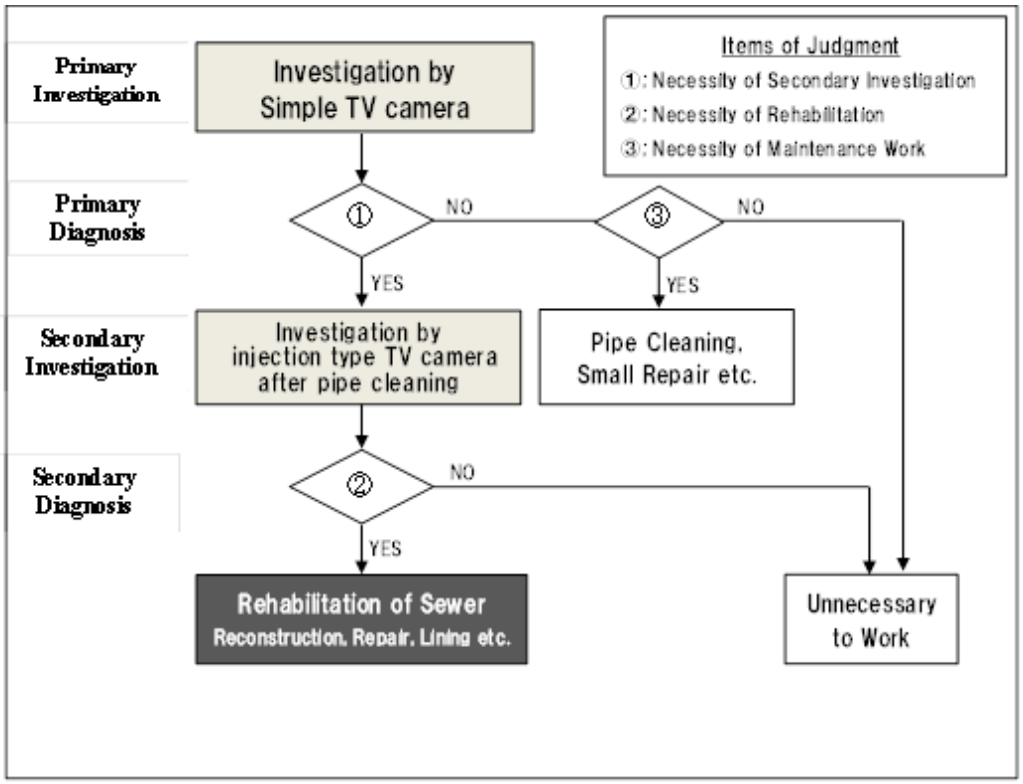


Figure 4.2-3 Flow Diagram of Sewage Pipe Diagnosis

(3) Result of Activity

OJT of a simple TV camera at the coastal area is shown in the picture.

Twice of OJTs for both of CMA and the coastal area were carried out. In the monthly meeting, the advantage of use of camera was presented. Participants in the meeting recognized simple operation procedure and clear image of sewage pipe. The following pictures show the image of the camera.

OJT for Site Investigation with TV Camera

Investigation by Simple TV camera

Sewage pipe without problem

Injection of house connection

Adhered oil

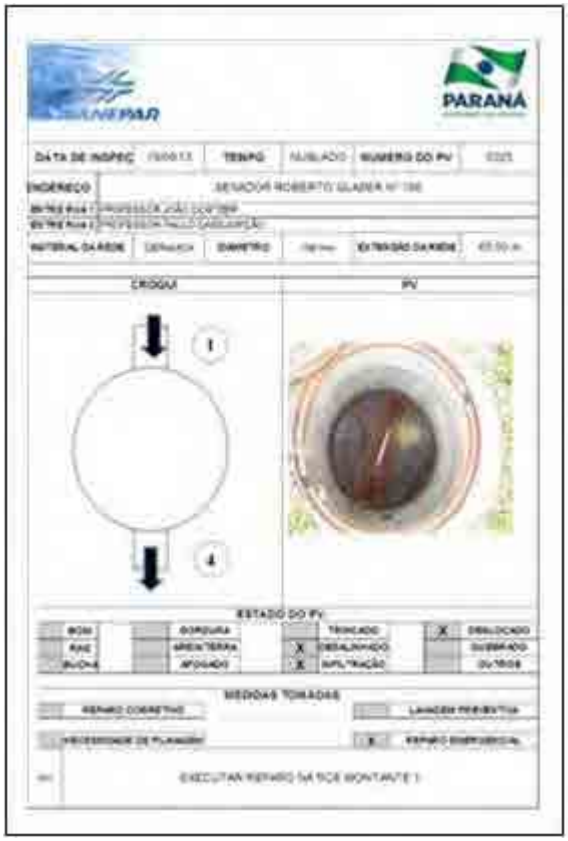
The photographed images by simple TV camera

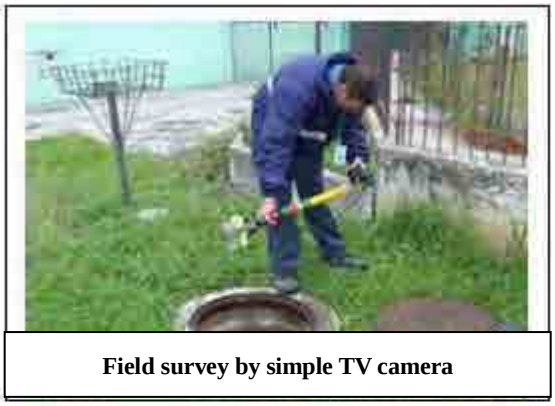
Table 4.2-5 Implementation Date of OJT on TV Camera

Classification		Implementation Date
Simple TV camera	CMA	7/6/2013, 12/6/2013, 19/6/2013, 3/7/2013, 10/7/2013, 22/10/2013, 4/11/2013, 5/11/2013
	Coastal Area	11/6/2013, 28/6/2013, 22/10/2013
Self-propelled TV camera		7/10/2013, 8/10/2013, 11/10/2013

Through appropriate OJT by JET, SDT members came to be able to implement the survey of sewage pipes with TV camera by themselves even in a period even when experts are absent. As a result the primary survey, the secondary survey and the diagnosis of sewage pipes were implemented and finished by second fiscal year in the pilot areas. Figure 4.2-4 shows a

diagnosis table by a simple TV camera, photograph shows a survey by a simple TV camera, Figure 4.2-5 shows the criteria for sewage pipe diagnosis by TV camera – an insert type and an auto-propelled type – and photograph shows surveys by an insert type TV camera and a self-propelled type TV camera. The date of OJT is shown in Table 4.2-5.





Field survey by simple TV camera

Field survey by simple TV camera

Figure 4.2-4 Diagnosis Table by Simple TV Camera

Criteria for Sewage Pipe Diagnosis				
Structural Problems				
No.	Category of Problems	A	B	C
1	Corrosion of pipe	Exposition of rebar	Exposition of material of gravel	To be monitored
2	Corruption (crack displacement damage)	Depression (crack, depression)	Crack in general	To be monitored
3	Infiltration	Spouting out	Flowing out	To be monitored
4	Displacement of joint	Totally departing	Little departing	To be monitored
5	Invation of root	More than about 50% of cross section	Less than about 50% of cross section	To be monitored
6	Sagging of pipe	More than about 50% of all span	Less than about 50% of all span	To be monitored
7	Overflow to Cannel/ River	Big insidence	Small incidence	To be monitored
	Point	5	2	0
Problems on Maintenance (By reference)				
		A	B	C
11	Injection of house connection	More than about 50% of diameter	Less than about 50% of diameter	To be monitored
12	Oil	More than about 30% of cross section	Less than about 30% of cross section	To be monitored
13	Deposition of sand or soil	More than about 50% of cross section	Less than about 50% of cross section	To be monitored
14	Deposition of rubbish	More than about 50% of cross section	Less than about 50% of cross section	To be monitored
15	Section of pipe	Totally submerged	100% to 75% submerged	To be monitored

※ Each structural problem found out is ranked to A, B, C, and each rank has weighted point. The points for all the problems in one span of pipe line between manholes are summed up. Each span of sewage pipe is diagnosed by this points.

※ Date of problems on maintenance will not be used for diagnosis. Those will be resolved by maintenance works individually.

Figure 4.2-5 Criteria of Sewage Pipe Diagnosis by TV Camera (insert type and self-propelled type)

Field survey of sewage pipe by insert type TV camera

OJT on self-propelled TV camera

(4) Tasks to Be Addressed

It will be an issue how to spread the obtained knowhow of SDT in the investigation method

widely to personals of C/P organization.

(5) Actions to Be Taken

Although in the workshop/seminar implemented at Feb.21st some of the contents of this project were understood by the participants, it will be needed to carry out in the more practical transmission method. It is recommended to hold the periodical meeting and to interchange information periodically by 3 offices in CMA including 2 offices that are not the member of SDT.

4.2.6 （Activity 1-6, 1-7） Conduct OJT on Monitoring Sewage Quantity Using Flowmeter and Grasp Flow Volume of Sewerage System

(1) Pilot Area of Sewage Pipe Investigation (Areiaozinho basin)

(1)-1 Purpose and Significance of Activity（Common to the three initiatives ）

The personals of C/P organization will be able to plan and implement the measurement of sewage volume at gravity sewers and pumped pipe using 15 ultrasonic flowmeters for open channel and 2 ultrasonic flowmeters for full flow donated by JICA. And also the capacity of whole sewerage system will be evaluated grasping the flow volume of STP, pumping stations and sewage pipe system. Especially in the sewage pipe system infiltration volume at dry and wet weather and runoff volume from sanitary sewers will be estimated.

(1)-2 Methodology and Procedure of Activity

An ultrasonic flowmeter was installed at 1 available manhole in pilot area of CMA, Areiaozinho basin, and the sewage flow volume was investigated for 3 weeks including period with significant rainfall. The survey point is illustrated in Figure 4.2-6.

(1)-3 Result of Activity

Because the personals of USEG have similar equipment and experience to use them, JICA experts did not do OJT on basic operation method but did OJT on adequate installation condition of them or more actual notes at investigation as follows. The situation of OJT is shown in the following photographs.

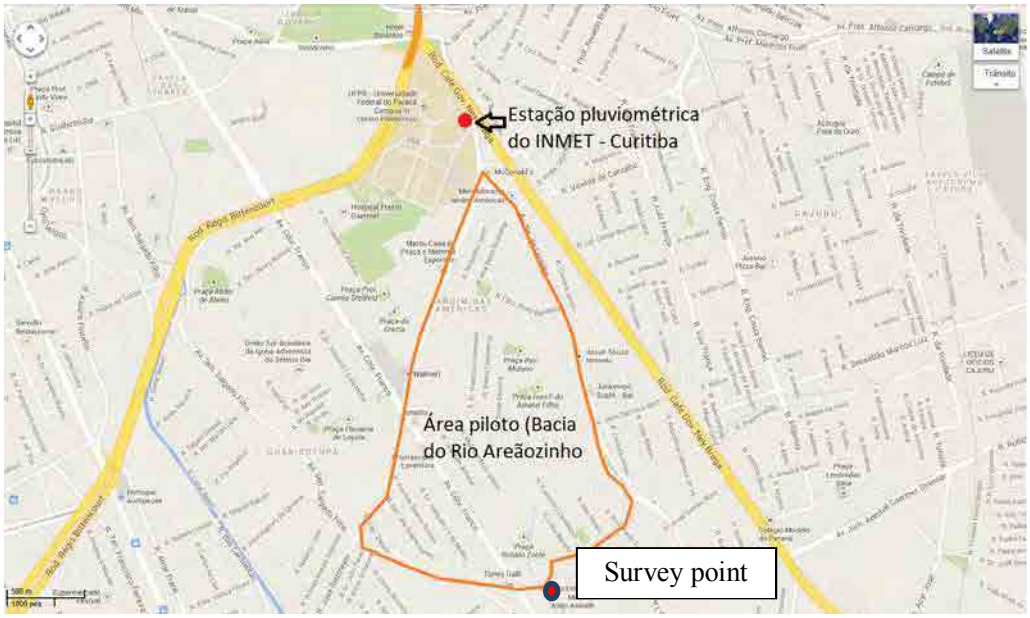


Figure 4.2-6 Survey Area and Flow Volume Survey Point

- The setting position of a sensor considering the shape of the water surface - upper stream side or down-stream side, distance from the mouth of the pipe -
- The protection of a sensor avoiding the adhesion of the garbage
- Securing of security
- The method of data analysis – handling of lost data

The investigation of sewage flow volume for 3 weeks including the period of rainfall was conducted, that shows 3 times of flow volume at peak when influenced by rainfall of 13 mm compared with it at dry weather. The results of the investigation are shown in Figure 4.2-7 and Figure 4.2-8.

The date of implementation of OJT of a flowmeter is shown in Table 4.2-6.

Table 4.2-6 Implementation Date of OJT Training on Flowmeter

Classification		Date of Implementation
Ultrasonic flowmeter for full flow	CMA	19/6/2013, 28/6/2013, 7/9/2013, 7/10/2013, 11/7/2013, 12/7/2013, 16/7/2013
	Coastal Area	28/6/2013, 2/7/2013, 8/7/2013, 21/10/2013, 29/10/2013, 6/11/2013
Ultrasonic flowmeter for open channel	CMA	27/1/2014, 11/2/2014
	Coastal Area	20/2/2014

The results of flow volume survey using EC meter are shown in Annex A4-2.

OJT of flowmeter for full-flow

OJT of installation of sensor of flowmeter

Installation of flowmeter at sewage pipe

Main body of flowmeter installed in manhole

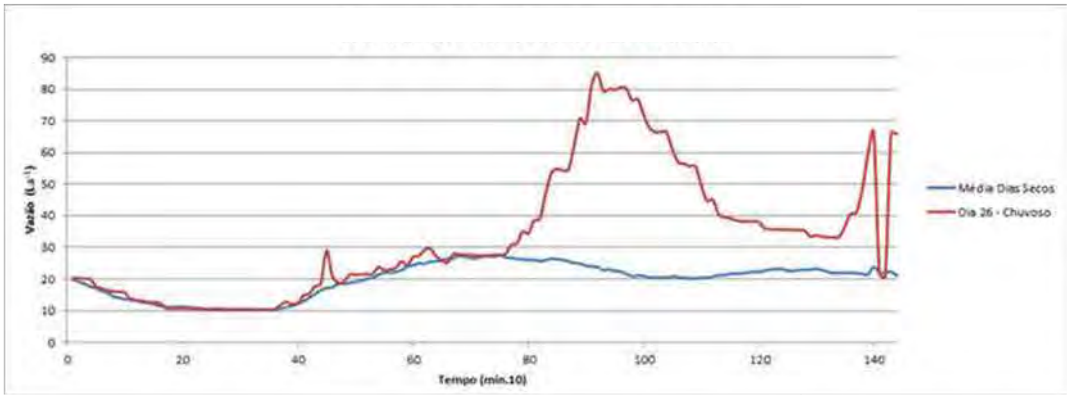


Figure 4.2-7 Result of Flow Volume Survey in Wet Weather in the Pilot Area in CMA

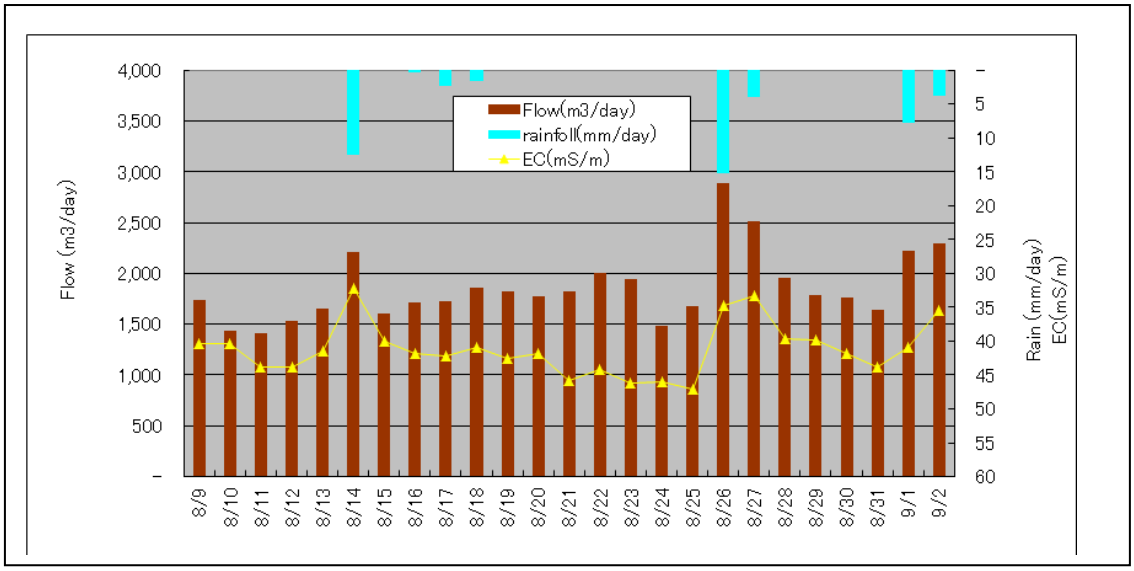


Figure 4.2-8 Result of Flow Volume Survey in the Pilot Area in CMA and Rainfall

(1)-4 Tasks to Be Addressed

One flowmeter was installed at only one site because there are very few intermediate and trunk sewers where flowmeter can be installed at this area. And so the analysis of flow volume relating with sewage pipe diagnosis could not be carried out. But supposed volume of infiltration of rainwater in advance was measured.

It will be needed to implement the re-measurement of sewage flow volume after repair and reconstruction works in order to verify the effects of them.

(1)-5 Actions to Be Taken

Continuous measurement of sewage flow volume by C/P organization is proposed. However because the reduction of infiltration of rainwater will need to implement the countermeasure for improvement of house connection, the time to verify the effect of works is ahead quite time.

(2) Flow Measurement in Pilot Area (Atuba Sul Basin Area)

(2)-1 Purpose and Significance of Activity（Common to the three initiatives ）

Same as (1)-1.

(2)-2 Methodology and Procedure of Activity

The OJT training on the installation and measurement method of ultrasonic flowmeter for full

flow at 15 pumping stations in this area targeting the personals of electro mechanics in CMA was implemented.

Integrating the data of one STP and 2 pumping stations with installation of flowmeter to the data for two months at 8 trunk sewers and one by-pass channel at STP measured by ultrasonic flowmeters for open channel, the flow volume of the whole sewerage system of Atuba was grasped. It should be noted that the installation of flowmeters at pumping stations for long time was not implemented because of the fear for the theft of them. The site map of the flow volume investigation of targeted area is shown in Figure 4.2-9 and the flow diagram of sewage pipe network system is shown in Figure 4.2-10.

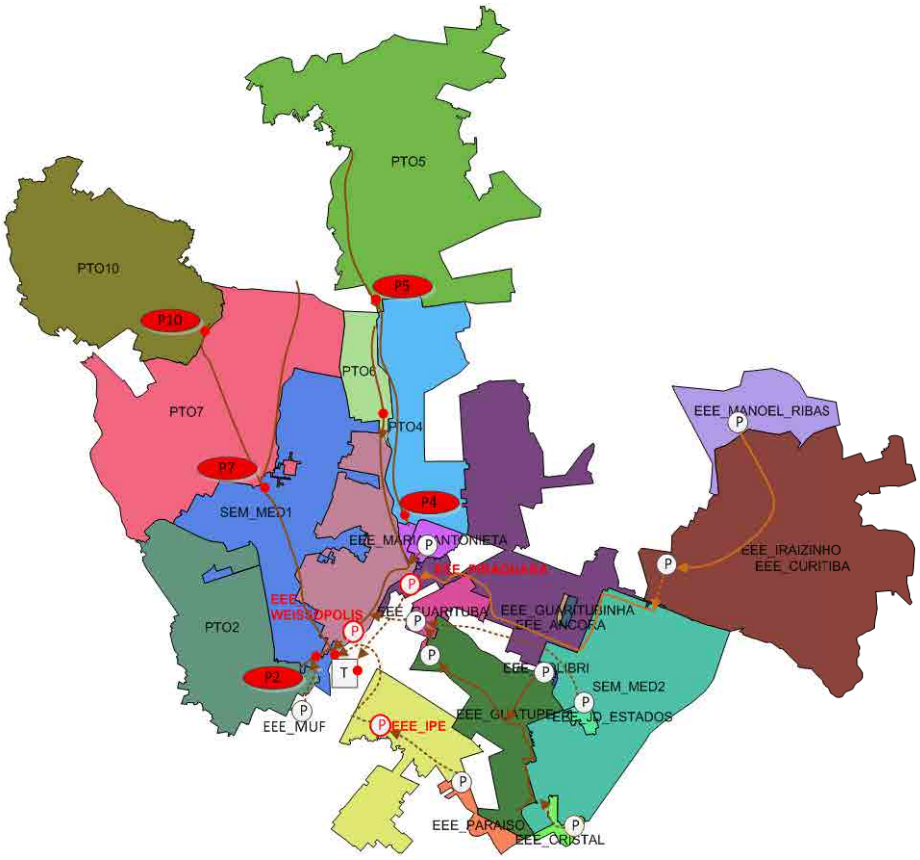


Figure 4.2-9 Targeted Area of Flow Volume Investigation in Atuba Sul STP Basin

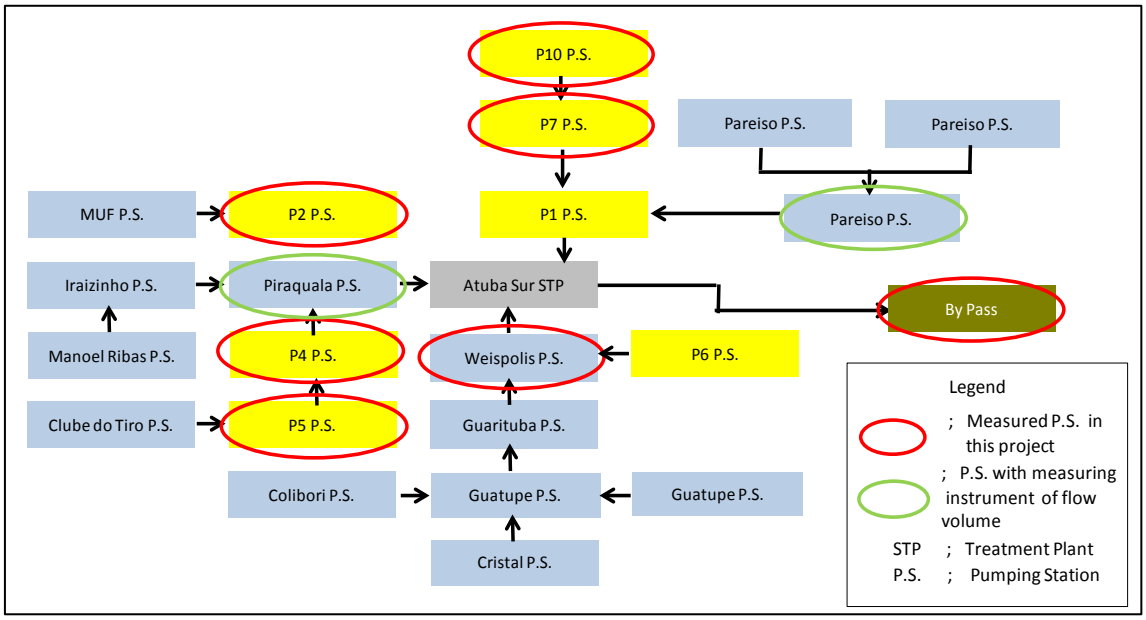


Figure 4.2-10 Flow Diagram of Sewer System in Dry Weather in Atuba Sul STP Basin

(2)-3 Result of Activity

(a) Capacity Development of C/Ps

OJT training on the confirmation of pump performance and the operation method of flowmeter by measuring flow volume for a couple of hours at 15 pumping stations in Atuba Sul basin was implemented. As a result the personals of USEM (at CMA, electro mechanics) mastered the operation method of the flowmeter. On the other hand correcting the issues found out in the actual measurement of flow volume, the ability of O&M of pump facility was heighten.

(b) Grasp of Flow rate of Whole Sewerage System

JET showed detail method of analysis using the data that C/P team measured – see attached Annex. C/P team grasped the flow volume of all the system in both dry and wet weather adding the original technique – see attached Annex. These works indicated following results.

- Regarding to the flow balance in dry weather, the obtained inflow volume to the Atuba Sul STP was 1,015.71 L/s that correspond to the capacity of this STP of 1,120 L/s.
- In the Atuba Sul STP basin an obvious overflow to the river was not investigated in dry weather.
- The padding of the weir at the grit chamber of the Atuba Sul STP improved SSO condition with no overflow until about 10mm precipitation although previously overflow was observed even in dry weather.
- Overflow to the river was observed in wet weather.

The result of the analysis is shown in the attached Annex A4-3.

(2)-4 Tasks to Be Addressed

The works of this activity improved the capacity of C/Ps in flow volume measurement, in maintenance of mechanical facilities and in O&M of sewage pipe network. It is recommended to use the results of this activity and improve the O&M capacity of the whole sewerage system.

(2)-5 Actions to Be Taken

The donated instruments will be maintained and used by USEG. USEG has been surveying flow volume in this project area by a basin unit of STPs. In the Belem STP basin, that is a priority area of sewage pipe diagnosis plan, it is estimated that there is the biggest volume of sewage overflow to rivers in dry weather. It is recommended to survey flow volume continuously at the concerned basin including the pilot area, and to confirm the outcome of the project.

(3) Pilot Area of Sewage Pipe Investigation（Coastal Area）

(3)-1 Purpose and Significance of Activity（Common to the three initiatives ）

Are the same as those of (1)-1.

(3)-2 Methodology and Procedure of Activity

The OJT training on the installation and measurement method of ultrasonic flowmeter for full flow at 5 pumping stations in this area targeting the personals of electro mechanics in coastal area was implemented.

The basin of Pontal do Parana STP was selected as the pilot area of flow volume measurement at coastal area, where the issue of infiltration by high groundwater level is pointed put. The sewage of trunk sewers is pumped by 6 pumping stations. Inflow to STP is transmitted only from the Ipanema pumping station and flow volume of it is measured at STP. The 4 pumping stations were selected from 5 stations except for Ipanema to install flowmeter and flow rate was measured using 2 ultrasonic flowmeters. The term of measurement for each station was determined as one week. The EC (Electric Conductivity) value is measured to estimate the infiltration volume. The site map of the investigated pumping stations is illustrated in Figure 4.2-11.

(3)-3 Result of Activity

As shown in Figure 4.2-12 analysis of the data of inflow rate at STP shows that the infiltration volume at dry weather is not high and significant increases of inflow rate were observed in case of more than 10mm rainfall. The results of the flow volume measurement shows that some increases of flow volume were observed corresponding to rainfalls but in some cases increase of flow volume was not observed because of the effect of the storage at pumping stations. The obtained results are summarized as follows.

- At the Shangri-La pumping station, the daily average water consume volume was nearly equal to the capacity of a pump in February 2014, that caused rise of the water level until 4.0m at the inlet of the station in wet weather. This phenomenon revealed the issue of the insufficient capacity of pump itself.
- At the Teresinha pumping station, the daily average water consume volume was nearly equal to the capacity of one pump. Because in this station two pumps can be operated in wet weather, the water level has not been raised much.
- At the Atami pumping station, although more infiltration of rain water was observed, no problem has occurred because of a big allowance in the capacity of pumps.
- In this area the volume of the infiltration of rainwater in wet weather corresponds to that in Japan, and is not so big compared with other areas.

The results of the investigation are shown in attached Annex A4-4.

Figure 4.2-11 Pumping Stations Targeted for Investigation of Flow Volume in Pontal do Parana

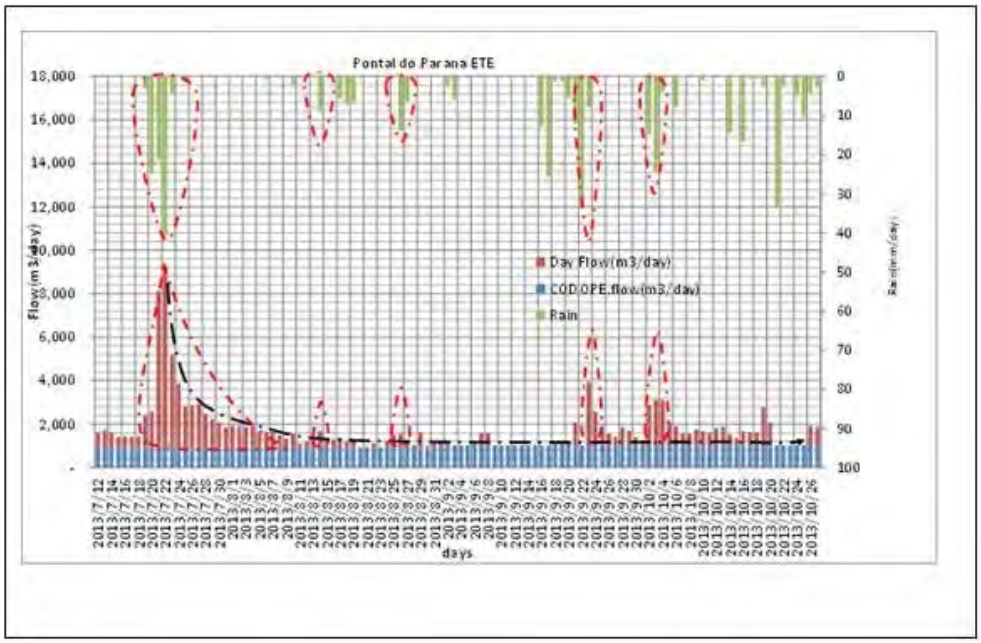


Figure 4.2-12 Infiltration Volume to Pontal do Parana STP in Wet Weather

(3)-4 Tasks to Be Addressed

In the coastal area the sewage volume at summer season (December, January) differs from another season. And so it is desired to collect the data at summer season because in this investigation the measurement was implemented at October when the flow volume is rather small.

There is a need for enhancement of a capacity of the pumping stations of which lack of capacity was confirmed

(3)-5 Actions to Be Taken

It is recommended to investigate a flow volume of pumping stations continuously to confirm the causes of the problems, to develop a plan to implement the enhancement of a capacity of pumping stations with lack of capacity, and to ensure the budget for it.

4.2.7 （Activity 1-8,1-9,1-10） Establish Policy after Analyze Results of Diagnosis, and Establish and Implement Rehabilitation, Renewal and Improvement Plan in Pilot Areas

(1) Purpose and Significance of Activity

Aiming at the preventive O&M of sewage pipe network it is important to implement planned rehabilitation and reconstruction of aged sewage pipe. Furthermore the size up of the diameter

of sewage pipes with insufficient capacity and the improvement of irregular house connection are needed. It is important to identify the policy to implement works of improvement of sewage pipe network. The planning of them and the implementation of works are supported.

(2) Methodology and Procedure of Activity

(2)-1 Decision of Policy for Sewage Pipe Improvement Plan

Following policy for the sewage pipe improvement plan was decided considering the priority of C/P organization and after discussing with SDT it was approved at JCC. In future SANEPAR will manage the sewage pipe network under this policy.

Policy for sewage pipe improvement plan –

1 To strengthen the organization, to purchase equipment and to ensure budget

2 To rehabilitate and reconstruct aged sewage pipes in plan

3 To size up sewage pipes with insufficient capacity

4 To eliminate irregular house connection

5 To implement the preventive O&M of sewage pipes

(2)-2 Implementation of Sewage Pipe Diagnosis

JET will support the implementation of sewage pipe diagnosis based on the data of sewage pipe inspection.

- To implement sewage pipe diagnosis based on the results of inspection by TV camera using criteria for diagnosis established in the second fiscal year and to fill the results in the ledger.
- To grasp present condition of cross-connections based on the dying test and smoke test and to fill the results in the ledger. To grasp housings not connected to sewage pipe because of without sewage pipe in a front road etc.
- To calculate the flow volume of sewage in the pilot area and to check the capacity of it.

(2)-3 Formulate Rehabilitation/renewal and Improvement Plan of Sewage Pipe Network

JET supports the formulation of rehabilitation/renewal and improvement plan of sewage pipe network. This plan includes rehabilitation/renewal of sewage pipe network, and improvement

plan containing measures for cross-connections and newly construction of sewage pipe at a road without sewage pipe. Tangible methods of activities are as follows;

- To classify the sewage pipe network of the target into 3 categories; entire renewal, partial repair and measures unnecessary.
- To formulate measures for cross-connections for each categories
- To formulate construction plan of sewage pipe at a road without sewage pipe
- To formulate size-up plan of sewage pipes with small capacity based on a result of the calculation of flow rate and sanitary sewer overflow in wet weather

(2)-4 Implementation of Rehabilitation/renewal and Improvement Plan of Sewage Pipe Network

Emergency response works will be implemented. In the technical support for implementation of rehabilitation/renewal and improvement plan of sewage pipe network, technologies of pipe rehabilitation method and micro-tunneling method will be presented and applicability of them in Brazil will be considered.

(3) Result of Activity

(3)-1 Implementation of Sewage Pipe Diagnosis

C/Ps have become to be able to diagnose a sewage pipe network using the results of sewage pipe inspection by TV camera based on criteria of diagnosis of them and be able to fill the results of them in the ledger. And also they have become to be able to calculate flow volume of sewage pipes. In the pilot area of CMA sewage pipes with 64,724km were diagnosed. In the follows the results in the pilot area in CMA are described. Figure 4.2-13 shows classified ranking filled in the ledger based on the diagnosis of sewage pipe network for one example.

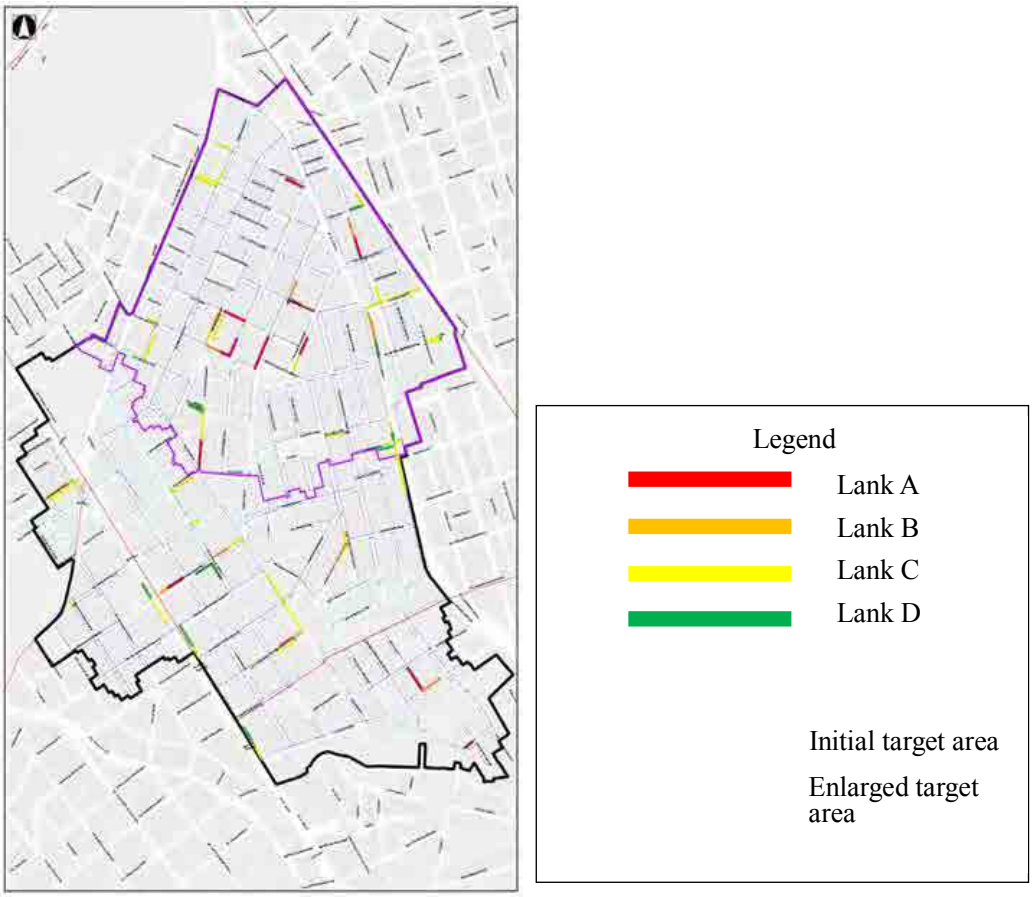


Figure 4.2-13 Result of Sewage Pipe Diagnosis

(3)-2 Formulation of Rehabilitation/renewal and Improvement Plan of Sewage Pipe Network

C/Ps have been able to formulate rehabilitation/renewal and improvement plan and plan of measures for cross-connections.

(a) Size-up plan of sewage pipe

Although there is no sewage pipe with a lack of capacity for planned flow rate based on a calculation, actually issues occur by infiltration of rain water in wet weather. The plan for size-up of sewage pipes in the minimum spans needed was formulated. Extension of intervals with needs of size-up and the estimated cost are shown in Table 4.2-7 and Figure 4.2-14.

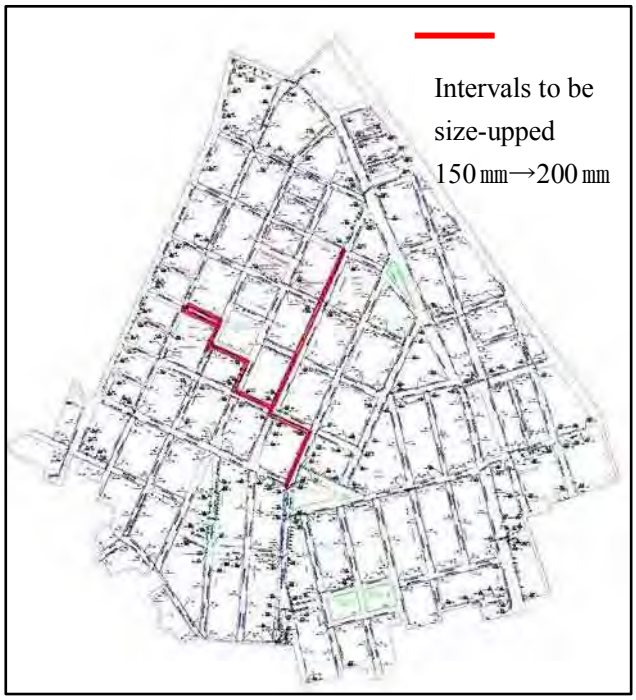


Figure 4.2-14 Pipes for Size-up in the Pilot Area

Table 4.2-7 Extension and Estimated Cost of Sewage Pipe to be Size-upped

Existing diameter	Diameter after size-up	Extension	Estimated cost
150 ㎜	200 ㎜	1,129m	R$ 317,700

(b) Renewal plan of sewage pipe network

Based on the results of sewage pipe diagnosis inter-manholes judged to be renewed are selected. They don't include intervals that will be size-upped. The extension and construction cost of sewage pipe to be renewed are shown in Table 4.2-8.

Table 4.2-8 Extension and Construction Cost of Sewage Pipes to be Renewed

Diameter	Extension	Estimated cost
150 ㎜	1,841m	R$ 313,500

(c) Rehabilitation plan of sewage pipe network

Points with structural problems of rank A in the intervals not to be size-upped or renewed will be rehabilitated partially. Number and cost of the points with need of rehabilitation are shown in Table 4.2-9.

Table 4.2-9 Numbers Cost of Points to be Rehabilitated

	Points with problems of rank	Estimated cost	Remarks
Numbers of points to be rehabilitated	102	R$ 35,700	Cracks, Breakage, Displacement of joint, Slackened etc.

(d) New construction plan of sewage pipe

At the sections identified to be without sewage pipe, sewage pipe with a length of 985m will be constructed.

(e) Measures for cross-connection

As measures for cross-connection, a pilot survey of the smoke test was implemented in the pilot area. In this survey SANEPAR performed inspection by the practice of an instrument using glycerin and water which is inferior in the function to send smoke but is rather safer. SANEPAR is intending to use this for smoke test in the other areas.

SANEPAR also is intending to enact the surcharge system of fines to the houses with cross-connection in order to dissolve the problem of them in cooperation with the environmental section of the city hall.

Equipment for smoke test

Leakage of smoke from road surface

(f) Sewage pipe rehabilitation/renewal plan in the coastal area

In the districts installed with ceramic sewage pipe in Matinhos sewage pipe network was inspected and diagnosed. Compared with CMA they are so damaged that 83% of the inspected intervals is diagnosed to be renewed. The results of diagnosis are shown in the Table 4.2-10.

Table 4.2-10 Results of Sewage Pipe Diagnosis

Ranks	Extension(m)	Remarks
Ⅰ.More than 21 points	10,985.60	Considered to be renewed
Ⅱ. Less than 20 points	1,138.97	Partially repaired and observed
Ⅲ.0 points	970.40	No measures
Total	13,223.17	

※ Extensions exclude areas that are renewed and not necessary for sewage pipe diagnosis.

※ Numerical value of the criteria was decided by C/Ps comparing a mumerical value with the condition of continuing of points with problems to be repaired etc..

Established plan is shown in the attached Annex A11-1.

(2)-3 Implementation of Rehabilitation/renewal and Improvement Plan of Sewage Pipe Network

(a) Implementation of emergency response works

Construction works shown in the Table 4.2-11 have done as emergency response.

Table 4.2-11 Implemented Emergency Response Works

Contents of works	2012	2013	2014	Total
Repair of manholes	35	105	119	259
Construction of manholes	1	7	15	23
Repair of sewage pipes	21	82	248	351

(b) Construction of a sewage pipe in the section without sewage pipe service

In a section without sewage pipe service found by a cross-connection survey, SANEPAR decided to construct a sewage pipe bearing a construction expense even in the case that inhabitants have to bear it because of the long distance construction. In the intervals of 985m without sewage pipe sewage pipes are under construction.

(c) Spread of pipe rehabilitation method and micro-tunneling methods

1) Implementation of training scheme

C/Ps learned the technologies of pipe rehabilitation methods and micro-tunneling in the training in Japan by method of lectures and site visits. What has been learned was transferred to other persons after returned to Brazil. Especially on pipe rehabilitation method they learned by a demonstration on the ground and by visiting to actual construction site, and transferred them by using video picture.

2) Implementation of demonstration construction of partial rehabilitation method

Demonstration of non-dig partial pipe rehabilitation method using fiberglass and resin-based adhesive was performed on the sewage pipes in pilot area of CMA to verify such method available in Brazil. 3 pipes with different diameter were rehabilitated of which one could not obtain a good result. The method itself seems to have no problem but there seems to be problems of check of the site conditions and a pre-treatment method. And therefore JICA expert established a consideration document on this demonstration.

Demonstration construction of pipe rehabilitation method

Demonstration construction of pipe rehabilitation method

The established consideration document is shown in the attached Annex A4-5.

Pipe burst method was considered as a pipe rehabilitation method that can be used in Brazil.

(4) Tasks to Be Addressed

- Additional inspections such as smoking test are needed because in some area that this test has not been implemented. Considering the results of additional inspections, the plan should be reviewed.
- Technical experiences are not sufficient to adopt sewage pipe rehabilitation methods.
- In this moment sufficient budget is not obtained and so it is desired to obtain a sufficient budget to implement the plan of this project positioning this project a priority project.

(5) Actions to Be Taken

- SANEPAR will implement additional inspections and SDT will continue to review the plan.
- Consideration of non-dig pipe rehabilitation method such as demonstrative construction of pipe burst method as an available method in Brazil has been implemented.
- In the coastal area the budget for 3 years to renew the sewage pipes targeted to be renewed is obtained.
- In CMA C/Ps will demand the budged needed and JET will explain the importance to obtain the needed budget.

4.2.8 (Activity 1-11） Support Technically for Planning of Draft Sewage Pipe Diagnosis Plan in CMA and Coastal Area

(1) Purpose and Significance of Activity

It is important to broaden the rehabilitation, renewal and improvement plan of sewage pipe system established for the pilot area to all the project area – CMA and coastal area. Firstly the reduction of O&M cost in a long term can be realized and secondly polluted urban rivers caused by leakage of sewage or cross-connection can be rehabilitated.

(2) Methodology and Procedure of Activity

After review and rearrange the method implemented in the pilot area a diagnosis method will be renewed. And also criteria will be reviewed.

From all the area of CMA and coast the area to be diagnosed will be determined.

Priority of the project will be determined for each STP basin evaluating discharge volume of sewage in dry weather and infiltration volume of rain water in wet weather based on the investigation of flow volume. On the other hand priority of river basins will be considered from the point of view of the improvement of river water quality.

(3) Result of Activity

The procedure used in the pilot area was rearranged and following procedure was admitted.

- ①Smoke test, ②Inspection by a simple TV camera
- ③Inspection of river water quality can be carried out in parallel with ① and ②.
- The results of ①, ②, ③ are summed up and intervals to be inspected by TV camera are determined.

The criteria established for sewage pipe diagnosis are so detailed to diagnose them by insert type TV camera used in ordinary inspection that more simplified criteria was established.

The area constructed with ceramic pipe in the area of the master plan is selected to be diagnosed from all the sewered area excluding newly constructed area of sewage pipe. The targeted area of the master plan includes 5 WTPs basins, Belem, Padhilha Sul, Cic Xisto, Santa Quiteria and Atuba Sul. In the coastal area targeted area of diagnosis is that with ceramic pipe. However in Matinhos district diagnosis of ceramic pipe has been finished during the pilot project in the two targeted areas of Matinhos and Morretes. Therefore the targeted area include only Morretes district. Sewered area in CMA, targeted area of the master plan and area with

ceramic pipe are shown in the Figure 4.2-15.

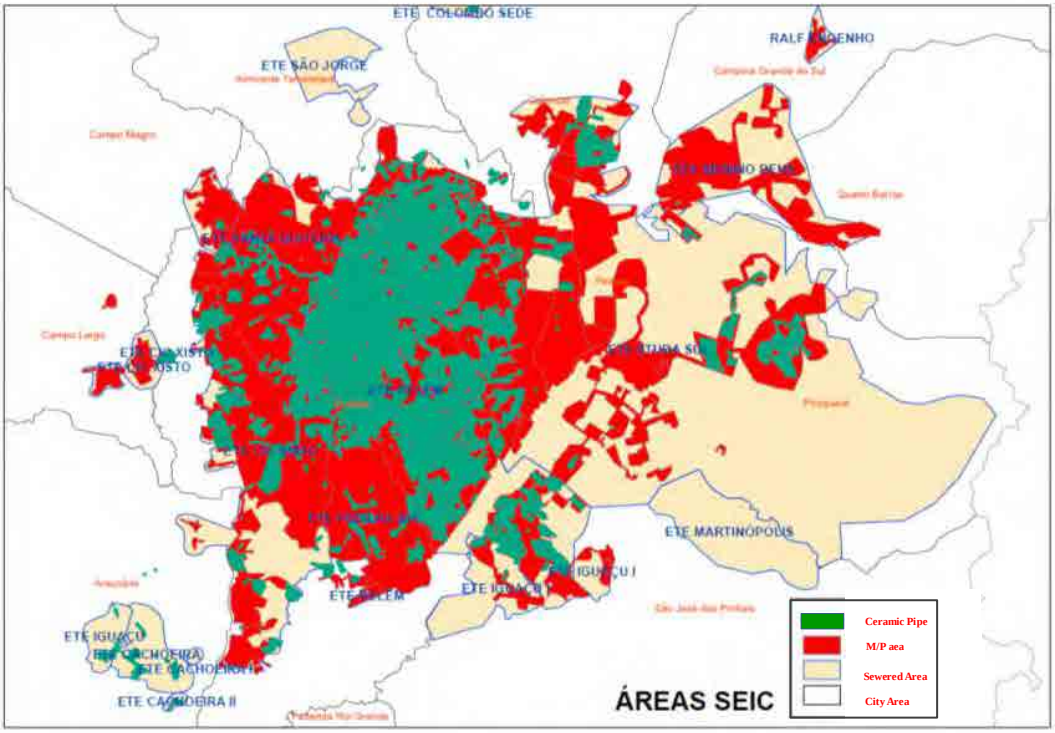


Figure 4.2-15 Sewered Area, Targeted Area of M/P and Area with Ceramic Pipe

Priority of the project will be determined for each WTP basin evaluating discharge volume of sewage in dry weather and infiltration volume of rain water in wet weather based on the investigations of flow volume. The priority order is ① Belem, ② Padilha Sul, ③ Cic Xisto, ④ Santa Quiteria, ⑤Atuba Sul.

Only for the Belem basin the basin was divided to smaller basins and prioritized, that are the 10 small basins divided for investigation of flow volume.

In the city central area it may be difficult to use the same method as used in the pilot area because the conditions are different. Task forth team for city central area, consists of related units including 3 regional offices organized and started the activities and advised by the JET.

Established diagnosis plan is shown in the attached Annex A11-2.

(4) Tasks to Be Addressed

It is an issue to formulate a sewage pipe inspection and diagnosis plan in the areas of the regional offices that are not included to SDT.

To implement the sewage pipe inspection and diagnosis provided equipment by JICA has been used and existing stuffs have been committed with doing ordinary jobs. But in this diagnosis plan enlarged to all the project area, it is needed to obtain equipment, manpower and budget for outsourcing. But in 2015 sufficient budget is not obtained.

(5) Actions to Be Taken

As mentioned before the task forth team for the city central area composed of 2 regional offices that not included in SDT. Through the activity of it one regional office committed SDT will implement transfer training including a method to handle equipment. In this efforts sewage pipe diagnosis in CMA will be carried out smoothly.

4.2.9 (Activity 1-12) Conduct Workshop/seminar to Disseminate of Results of Pilot Project and Sewage Pipe Rehabilitation/renewal and Improvement Plan

(1) Purpose and Significance of Activity

It is important to disseminate the results of pilot project and sewage pipe rehabilitation/renewal and improvement plan to the persons of the units of the C/P organization that are not participate the project in order that C/P organization implement the project proactively.

(2) Methodology and Procedure of Activity

In the second fiscal year it was determined to implement the workshop/seminar hosted by SDT as follows;

- The leader of SDT presides and almost all the presentations are carried out by members of SDT.
- The seminar is divided to 3 sessions, each of them is chaired by members of SDT, and sufficient time is spared for discussion.
- JET will make a comment or advice in each session.
- Members of 2 offices which do not join this project make a presentation and actively participate in the discussion.
- In the third fiscal year Workshop/seminar will be carried out with the following contents;
- Report of training in Japan of Output 1
- Introduction of asset-management in Japan
- To be carried out as common workshop/seminar of Outputs 1,2,and 3

(3) Result of Activity

In the second fiscal year the workshop/seminar was implemented at February 21st /2014 with assist ace of 70 participants, which contents are shown in Table 4.2-12.

Table 4.2-12 Contents of Workshop/Seminar in the Second Fiscal Year – Output-1

Date	February 21st /2014
Participants	70
Contents	
9:00 – 9:05 Opening speech	
Session 1 Flow volume survey by flowmeter	Chairman; Ernani
10:05 – 9:35 Survey in CMA	USEG
9:35 – 10:00 Survey in coastal area	USEM, URLI
10:00 – 10:15 Estimation of infiltration volume by EC meter	JET
10:15 – 10:45 Discussion	
10:45 – 11:15 Coffee break	
Session 2 Activities of revitalization of urban river and citizen awareness	Chairman; Piccolotto
11:15 – 11:30 Activities of PRRU in the pilot area	USHI
11:30 – 12:00 Activities of environmental education in the pilot area	USEA
Session 3Session 3 Survey and diagnosis of sewage pipe network	Chairman; Cesar
13:30 – 14:00 Survey of sewage pipe by TV camera	URCTL
14:00 – 14:20 Survey of sewage pipe by self-propelled TV camera	USEG
14:20 – 14:40 Results of smoke test	URCT-L
14:40 – 15:00 Activities in URCT-N	URCTN
15:00 – 15:20 Activities in URCT-S	URCTS
15:20 – 15:50 Coffee break	
15:50 – 16:30 Discussion	
Theme; survey method, diagnosis method, preventive O&M sewage pipe implementation of pipe rehabilitation plan in pilot area, implementation of pipe diagnosis plan in the project area	
Closing remarks	Leader of SDT
	

In the third fiscal year workshop/seminar was carried out at November 19th with assistance of 36 persons which contents are shown in Table 4.2-13.

Table 4.2-13 Contents of Workshop/seminar in the Third Fiscal Year - Output 1

Date and time	November 19th 2014
Participants	36 (C/Ps of Output 1,2, 3 and others)
Contents	
10:00 – 10:10 Opening Remarks	
10:10 – 11:00 Report of the training in Japan of Output 1	(C/P of Output 1)
11:00 – 12:00 General aspect of asset management and asset management of sewers	(Dairaku)
12:00 – 13:30 Lunch	
13:30 – 14:15 Risk management of sewage facilities by stock management	(Hayashi)
14:15 – 15:00 Long life planning of mechanical equipment	(Obara)
15:00 – 15:30 Coffee break	
15:30 – 16:15 Efforts of asset management of water works facilities in Japan	(Kawamura)

In the fourth fiscal year workshop/seminar was carried out at July 10th with assistance of 73 persons which contents are shown in Table 4.2-14.

Through implementation of these 3 workshop/seminars, above mentioned purpose was attained.

Table 4.2-14 Contents of Workshop/seminar in the Fourth Fiscal Year - Output 1

Date	July 10th /2015
Participants	73
Contents	
8:30 Opening remarks	Director of GGML
9:00 − 9:45 Survey of sewage pipe using self-propelled TV camera and flowmeter	USEG
9:45 − 10:15 Survey by TV camera	URCT-L-Maintenance
10:15 − 11:00 Diagnosis and renewal plan of sewage pipe network	URCT-L-Operation
11:00 − 11:30 Data base of data obtained by survey of sewage pipe network	USTI
13:30 − 14:00 Evaluation of capacity of existing sewage pipe and size-up plan of them	USPE
14:00 − 14:30 Activities of PRRU in the pilot area	USHI
14:30 − 15:00 Flow volume of pumping stations in the coastal area	URLI、USEM-CT
15:00 − 15:30 Activities of " River School" in the pilot area	USEA
15:30 − 16:00 Activities of Task Forth in the city central area	USEG
16:00 － 16:15 Comments and proposal for future activities	JET

(4) Tasks to Be Addressed

In the workshop/seminar of 2nd and 3rd fiscal year, participants outside the project area were not so many because spread to the stuffs inside the project area is also important.

(5) Actions to Be Taken

In the workshop/seminar in the fourth fiscal year, staffs inside the project area participated at the seminar hall and staffs outside the project area participated in the teleconference. By these activities the purpose of this activity has been attained.

Chapter 5 Activities for Output 2

5.1 Output Expected

The outcomes expected under the Project are as shown in Table 5.1-1.

Table 5.1-1 Output Expected

Year	Activity No.	Outputs to be achieved in each year	Indicator
1st	2-1	Conduct a baseline survey on the sewage treatment plants and relay pumping stations in CMA and coastal area	2-1 Repair and rehabilitation program prepared in the project is approved by management level of SANEPAR. 2-2 Annual budget plan based on the repair and rehabilitation program is considered.
	2-2	Establish measurement system for monitoring sewage quantity flowing into sewage treatment plants	
	2-5	Organize a Standard Operation Procedure (SOP) Team for sewage treatment plants	
	2-6	Conduct training courses on O&M of sewage treatment plants	
	2-7	Review/develop manual(s) for O&M of sewage treatment plants	
2nd	2-2	Support establishing measurement system for monitoring sewage quantity in sewage system	
	2-3	Conduct field survey and experiment for improving issues regarding operation and maintenance of sewage treatment plants	
	2-4	Conduct measure for improving issues on equipment in sewage treatment plants and pumping stations	
	2-7	Review/develop manual(s) for O&M of sewage treatment plants	
	2-8	Formulate a plan for rehabilitation and renewal of sewage treatment plants and pumping stations	
	2-9	Study on introduction of advanced treatment facility for reuse of treated sewage	
	2-10	(Tentative) Implement a pilot project for advanced treatment	
	2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants	
	2-12	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants	
3rd	2-7	Develop manual(s) for O&M of sewage treatment plants (Continual implementation of support is considered based on the points revealed in the previous year and result of activity,)	
	2-10	Pilot project in advanced treatment is supported continuously when adoption of advanced treatment is considered to be available.	
	2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants	
4th	2-7	Develop manual(s) for O&M of sewage treatment plants (Continual implementation of support is considered based on the points revealed in the previous year and result of activity,)	
	2-10	Pilot project in advanced treatment is supported continuously when adoption of advanced treatment is considered to be available.	
	2-11	Conduct monitoring of performance indicators (actual results) on O&M of sewage treatment plants	
	2-12	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of sewage treatment plants	

5.2 Contents of Activities

5.2.1 (Activity 2-1) Conduct a Baseline Survey on Sewage Treatment Plants and Relay Pumping Stations in CMA and Coastal Area

(1) Significance of Activity

On-site survey along with interviewing operators of each treatment facilities will be carried out in order to understand actual situation and to find issues in the 12 target STP of this project

(2) Methodology of Activity

A baseline survey for obtaining operation and treatment condition of the target STPs was first carried out in cooperation with SOP team and issues provided in the survey were analyzed. Based on the baseline survey, detail surveys and analysis of issues obtained were implemented for each STP and pumping station.

(3) Result of Activity

The result of the baseline and detail survey for the target STPs and pumping stations and the analysis of the result are shown as follows;

(3)-1 Baseline Survey of STPs

The baseline survey was carried out for the 12 target STPs shown in Table 5.2-1. The result of the baseline survey is as shown in Annex A5-1.

Table 5.2-1 Target STPs

STP	Treatment Capacity		Treatment Process
Sao Jorge	70 L/sec	(6,048 m^3/day)	UASB + DAF
Santa Quiteria	450 L/sec	(38,880 m^3/day)	UASB + DAF
CIC Xisto	490 L/sec	(42,336 m^3/day)	UASB + lagoon (no aeration)
Atuba Sul	1,120 L/sec	(96,768 m^3/day)	UASB + DAF
Fazenda Rio Grande	210 L/sec	(18,144 m^3/day)	UASB + Lagoon (aeration)
Padilha Sul	420 L/sec	(36,288 m^3/day)	UASB + Lagoon （no aeration）
Belem	840 L/sec	(72,576 m^3/day)	OD
Guaraquecaba	30 L/sec	(2,592 m^3/day)	UASB + BAF
Guaratuba	210 L/sec	(18,144 m^3/day)	UASB + Lagoon (aeration)
Matinhos	210 L/sec	(18,144 m^3/day)	UASB + DAF
Morretes	35 L/sec	3,024 m^3/day)	UASB + BAF
Pontal do Parana	140 L/sec	3,024 m^3/day)	UASB + DAF

(3)-2 Detail Survey and Analysis in Target STPs

Following to the baseline survey, detail surveys and analysis of the result of surveys were conducted for concrete structure, facilities and equipment in the target STPs and remedies against the issues found were proposed.

(3)-2-1 Detail Survey and Analysis of Concrete Structure

In the baseline survey, progress of severe concrete corrosion was found in some STPs; hence the detail survey for all target STPs was carried out. The result of the survey was integrated in the table form shown in Table 5.2-2 as a sample. The detail result of the survey is shown in Annex A5-2.

The result also is arranged to a table shown in Table 5.2-3. It is apparent in the table that problem of concrete was mainly found in UASB of STPs in CMA. In the UASB tank, concrete in gas layer particularly has problem. Hydrogen sulfide gas generated in the tank is oxidized to sulfuric acid in the gas layer and causes concrete corrosion and urgent measure is required in the STPs. Concrete condition in liquid phase was diagnosed in Padilha Sul STP as an activity of Activity 2-8 and was found that neutralization of concrete has progressed only 1cm and no measure is required. UASB in the coastal area has been operated with taking off the concrete covers of the tank; hence H2S gas is not stagnasted in the tank and the progression of concrete corrosion seems to be few.

Concrete problem was found in DAF facility in Santa Quiteria STP other than UASB, which is supposed to be caused by high concentration of hydrogen sulfide in the effluent of UASB led into DAF.

Table 5.2-2 Example of a Part of the Data Sheet of Detail Survey Regarding Concrete Structure

Name of ETE Matinhos	Treatment Process : UASB + DAF	Location:		Day of visit	July 8th, 2013

Start of UASB operation: 2008 , **Start of secondary treatment operation**: 2008 **Treatment Capacity**: 210 liter/sec (18144 m^3/day)

Name of facility	Dimensions (L[m]×W [m]×H [m])	Situation of deterioration	Needs of rehabilitation and renewal	Photo No.
Influent chamber		• No serious deteriorated damage was found	• Seems to have no urgent need for rehabilitation and renewal	No.1 No.2
UASB inlet distribution		• No serious deteriorated damage was found	• Seems to have no urgent need for rehabilitation and renewal	No.3 No.4
UASB stairs		• No serious deteriorated damage was found	• Seems to have no urgent need for rehabilitation and renewal	No.5
UASB	• 21m×21m×4.55mH ×6units • Total volume 6006m3	• No serious deteriorated damage was found	• Seems to have need for corrosion-proof covering for effluent conduit	UASB No.1 No.6, No.7 UASB No.3 No.8 No.9
Thickener		• No serious deteriorated damage was found	• Seems to have no urgent need for rehabilitation and renewal	No.13

No. 1 Influent Chamber

No. 2 Influent Chamber

No. 3 UASB Inlet Distribution

No. 4 UASB Inlet Distribution

No. 5 UASB No.3

Table 5.2-3 Result of Detail Survey for Concrete Structure of Target STPs

		Pretreatment				UASB		Post treatment			OD		Effluent conduit	Sludge treatment				
		Inflow conduit gate	Lift pump	Screen	Grit chamber	Distributor	UASB tank	Floatation	Lagoon	BAF	OD tank	Settling tank		Sludge thickener	Pump room	Dehydrator room	Sludge stock yard	Sludge drying bed
CMA	Sao Jorge	N	N	N	N	N	Y	N	-	-	-	-	N	-	-	-	-	N
	Santa Quiteria	N	N	N	N	N	Y	Y	-	-	-	-	N	N	N	N	-	-
	CIC Xist	N	-	N	N	N	Y	-	N	-	-	-	N	N	-	N	N	-
	Atuba Sul	N	N	-	N	N	Y	N	-	-	-	-	N	N	-	N	N	-
	Faz. Rio Grande	N	-	-	N	N	N	-	N	-	-	-	N	N	-	N	N	-
	Padilha Sul	N	-	N	N	N	Y	-	N	-	-	-	N	N	N	N	N	-
	Belem	N	N	N	N	-	-	-	-	-	N	N	N	N	N	N	N	-
Coastal area	Guaraquecaba	N	-	-	-	N	N	-	-	N	-	-	N	-	-	-	-	N
	Guaratuba	N	-	N	N	N	N	-	N	-	-	-	N	N	-	N	N	N
	Matinhos	N	-	-	-	N	N	N	-	-	-	-	N	N	-	-	N	N
	Morretes	N	-	N	N	N	N	-	-	N	-	-	N	N	-	N	N	-
	Pontal do Parana	N	-	-	-	N	N	N	-	-	-	-	N	N	-	-	N	N

N: No problem、 Y: Corrosion

(3)-2-2 Detail Survey and Analysis of Facilities and Equipment of STPs

Based on the result of the baseline survey, the detail survey and analysis of the result of the survey was carries out for facilities and equipment of target STPs. The result of the survey was integrated in the table form shown in Table 5.2-4 as a sample. The result of all 12 STPs are as attached in Annex A5-2. The result also is arranged to a table shown in Table 5.2-5.

Differing from concrete corrosion, problems were found in STPs in the coastal area too. Main problem found is the generation of rust indicated in C in the table. The problem of rust can be easily prevented by periodic anti-corrosive coat; hence as a first step of preventive maintenance, a checking sheet for site inspection was prepared in a part of Activity 2-7 "Preparation of O&M manual" and started to use.

"Problem like outage" indicated as T in the table are there not only in large scale STP in CMA but also in small scale one in the coastal area. Grit chamber and DAF, post-treatment of UASB has many "T". Only one unit of grit chamber is there in all target STPs and quality and quantity loading in the tank is too high in many STPs, which makes insufficient removal of grit from the tank and makes outage. Therefore, additional construction of grit chamber was proposed in Activity 2-8 "Preparation of rehabilitation plan". In the DAF facility, outage was found to have occurred by the trouble of agitators, froth collectors and air-liquid mixing equipment etc. and activities for improving them was carried out in Activity 2-3 "Improvement of issues in O&M of STPs", and Activity 2-4 "Improvement of issues in facilities and equipment of STPs and pumping stations" in cooperation with C/Ps.

Table **5.2-4** Example of a **A**art of the **D**ate **S**heet of **D**etail **S**urvey of **F**acility and **E**quipment of STP

SANEPAR **Nome de ETE:**	ETE Guaratuba (método de tratamento : UASB + LAGOA (com aeração))	**Local:**	Região do litoral do Paraná	**Data da pesquisa:**	24 de Octubro de 2012

Início da operação: 2005

Capacidade de tratamento : Max.: 252.7 / Nor.: 181.45 / 28.6 litro/seg (Max.: 21,833 / Nor. 15,677 / Min. 2,471 m^3/dia)

Nome da instalação	Nome da instalação/ equipamento	Dados da instalação	Situação atual da instalação / equipamento	Necessidade de reparo / melhoria / renovação e seu motivo	Foto No.
Instalação de entrada de força	Transformador instalado em poste	•	• O aspecto externo está bom.	• Há necessidade de inspeção periódica.	a
	Painel de entrada e transformação de força	•	• O aspecto externo está bom.	• Há necessidade de inspeção periódica.	b
Removedor de detritos	Tubo de entrada.	•	• Os parafusos de flange estão enferrujados. Além disso, o interior do tanque de influxo está inteiramente enferrujado.	• Há necessidade de trocar os parafusos e de aplicação da pintura de manutenção.	aj
	Comporta de bypass de descarga.	•	• O aspecto externo está bom.	• Há necessidade de inspeção periódica.	c
	Comporta de distribuição	•	• O aspecto externo está bom.	• Há necessidade de inspeção periódica.	d

a. Guaratuba Transformador instalado em poste

c. Guaratuba Comporta bypass de descarga.

d. Guaratuba Comporta de distribuição.

e. Guaratuba Gradiamento fino.

f. Guaratuba Removedor automático de

Table 5.2-5 Result of Detail Survey for Facilities and Equipment of Target STPs

				Sao Jorge	Santa Quiteria	CIC Xist	Atuba Sul	Faz. Rio Grande	Padilha Sul	Belem	Guaraquecaba	Guaratuba	Matinhos	Morretes	Pontal do Parana
				CMA							Coastal area				
Power substation				N	N	N	C	-	N	-	N	N	N	N	N
Lift pump	Gate			C	C	T	C	N	N	N	-	-	-	-	-
	Coarse screen			N	N	N	T	N	N	-	-	-	-	-	-
	Lift pump			N	C	C	T	N	N	C	-	-	-	-	-
Screen	Gate			C	N	C	C	N	C	N	N	C	N	C	C
	Fine screen			N	N	N	N	N	N	N	N	T	N	N	N
Grit chamber				-	C	T	T	C	C	N	-	C	T	-	T
UASB	Distributor			-	C	-	C	N	-	-	C	N	N	N	N
	Reaction tank			N	C	C	C	N	C	-	N	C	N	N	N
Post treatment	DAF	Floatation facility		C	T	-	T	-	-	-	-	-	C	-	T
		Mixing facility		N	N	-	T	-	-	-	-	-	T	-	N
	Lagoon	Aerator		-	-	N	-	N	N	-	-	T	-	-	-
	BAF	Reaction tank		-	-	-	-	-	-	-	N	-	-	N	-
		Settling tank		-	-	-	-	-	-	-	N	-	-	C	-
OD				-	-	-	-	-	-	N	-	-	-	-	-
Effluent conduit				N	-	N	N	N	-	-	N	N	N	C	N
Sludge treatment	Sludge thickener			-	N	-	C	N	N	N	-	N	-	-	-
	Dehydrator			-	N	-	T	N	N	N	-	-	-	-	-

N: No problem, C: Generation of rust, T: Problem like outage

(3)-3 Detail Survey and Analysis of Pumping Stations

Based on the result of the baseline survey, the detail survey and analysis of the result of the survey was carries out for pumping stations. The result of the survey was integrated in the table form shown in Table 5.2-7 as a sample. "Trouble like outage" shown as T in the table is found only in Ipanema pumping station. Although an automatic screen facility is installed in the station, it has not been functioned due to designing problem; therefore renovation to much simpler screen basket was proposed.

"Generation of rust" shown as C in the table is found in many stations; however the condition in those stations is not serious and can be measured by periodical anti-corrosion coat. "Aging deterioration" shown as AD in the table is found in Maria Antonieta station. Rehabilitation of the station has to be conducted in accordance with the rehabilitation plan of SANEPAR.

(3)-4 Tasks to Be Addressed

The problems in each STP and pumping station are not only what were found in the survey implemented in the project but will increase in the future due to the aged deterioration of the facilities and equipment; hence the survey should be conducted continuously after the end of the project.

(3)-5 Actions to Be Taken

The detail survey of STPs and pumping stations is the significant data for the preparation of renovation plan of STPs and pumping stations. And the survey should be carried out not only by the staff of the operation control department but also by the staff of the investment department which is in charge of the renovation plan should participate to it. Hence, the activities of SOP team established in the project should be continued and the survey should be conducted with the leadership of the team.

Table 5.2-6 Example of Date Sheet of Detail Survey of Pumping Stations

Nome da EEE da SANEPAR:	EEE Weissopolis do sistema ETE Atuba Sul	**Local:**	Região Metropolitana de

Início da operação: ano Capacidade de bombeamento : Max.: / Nor. / Min. litro/seg (Max.: / Nor.: / Min.: m^3/dia)

Nome da instalação	**Nome da instalação/ equipamento**	**Dados da instalação / equipamento**	**Situação atual da instalação / equipamento**
Instalação elétrica	Transformador instalado em poste.	•	• O aspecto externo está bom.
	Cabine de entrada de força	•	• O aspecto externo está bom.
	Painel de controle da bomba	•	• O aspecto externo está bom.
Instalação de remoção de detritos	Comporta de entrada	•	• O aspecto externo está bom.

a. Transformador instalado em poste.

b. Instalação da bomba e casa de instalação elétrica

c. Painel de controle da bomba

Table 5.2-7 Result of Detail Survey of Pumping Stations

Area	Name of pumping station	Power substation			Screen facility			Pump facility			
		Pole transformer	Incoming panel	Control panel	Inflow gate	Screen basket	Bar screen	Relay pump	Check valve	Delivery valve	Pipe
Atuba Sul	Colibri	-	N	N	C	-	C	N	N	N	N
	Cristal	-	N	N	N	-	-	N	N	N	N
	Jardim dos Estados	-	N	N	C	-	-	-	-	-	-
	Guatupe	-	N	N	-	-	-	N	-	C	N
	Clube do Tiro	-	N	N	N	-	N	C	C	C	C
	Guarituba	-	N	N	N	C	-	C	N	N	N
	Maria Antonieta	N	AD	AD	-	-	-	C	N	N	N
	Weissopolis	N	N	N	N	-	-	C	N	N	N
	Manoel Ribas	N	N	N	N	-	-	C	N	N	N
	Iraizinho	N	N	N	N	-	-	C	N	N	N
	Piraquara	-	N	N	C	N	C	C	N	N	N
	Paraiso	-	N	N	N	-	-	C	N	N	N
	Ipe	N	N	N	N	-	-	C	N	N	N
	MUF	N	N	N	N	-	N	C	N	N	N
Pontal do Parana	Canoas	-	N	N	-	C	-	C	N	N	N
	Santa Terezinha	-	N	N	-	C	-	C	-	N	N
	Ipanema	N	N	N	C	-	T	C	N	N	N
	Shangri-la	-	N	N	-	N	-	C	N	N	C
	Atami	N	N	N	C	-	-	C	C	N	N
	Pontal do Sul	-	N	N	-	-	-	C	C	N	N

N: No problem, C: Generation of rust, T: Trouble like outage, AD: Aging deterioration

5.2.2 (Activity 2-2) Establish Measurement System for Monitoring Sewage Quantity Flowing into Sewage Treatment Plants

Flow rate into STPs was considered proper to be monitored together with that in sewer system and into pumping stations; hence Activity2-2 for establishing measurement system of sewage quantity was transferred to Output-1 and implemented as Activity 1-7 “Support for establishing the measurement system for monitoring of sewage quantity in sewage system”. SOP Team

member of Output-2 cooperated for SDT Team of Output-1 when flow rate into STPs was necessary to obtain

Discharging quantity of pumping stations in Atuba Sul sewage system and Pontal de Parana system, which is selected for the target of Activity 2-7 and inflow quantity into the relevant STPs was measured in cooperation with C/P in Output 1.

The method how to set and how to use the two ultrasonic flow meter prepared by JICA, was instructed by OJT and as the result, C/P could measure the flow rate individually.

5.2.3 (Activity 2-3) Conduct Field Survey and Experiment for Improving Issues Regarding Operation and Maintenance of Sewage Treatment Plants

Various issues caused by inappropriate designing, construction and O&M were found in the baseline survey of target STPs and pumping stations conducted in the first fiscal year and many target STPs were suffered from hard O&M and/or inferior effluent quality. SANEPAR requested to JICA expert team the improvement of such situation at the end of the first fiscal year and a new activity to improve the situation, i.e. Activity 2-3 was decided to conduct by modifying PDM.

Based on sufficient discussion with C/P, 7 items shown in Table 5.2-8 were conducted in the activity.

Table 5.2-8 Aspects Conducted to Improve Issues Regarding O&M of STPs

Facility		Issues STPs were suffered	Item surveyed	Fiscal year surveyed
Concrete structure		Concrete corrosion	Monitoring of corrosive environment by H2S	2nd
			Diagnosis of concrete deterioration	2nd
UASB		Appropriate control of sludge in UASB	Experiment of sludge removal from UASB tank	2nd
Post treatment	DAF	Improvement of effluent quality	Experiment for introduction effect and proper operation condition of DAF pump	2nd ~3rd
	Lagoon		Experiment for simple filtration process for improvement of effluent	2nd
	BAF		Study for retention time in BAF tank	2nd
Sludge dehydrator		Improvement of moisture content of dewatered sludge	Experiment for selection method and appropriate dose of coagulant	2nd

(1) Monitoring of Corrosive Environment by H2S

(1)-1 Purpose and Significance of Activity

Most of target STPs of the project adopt UASB which causes emission of higher concentration of hydrogen-sulfide (H_2S) that promotes corrosion problems in many treatment facilities. However, H_2S concentration which links to the corrosion in the treatment facilities in the gas phase generally changes in wide ranges as being influenced by emission strength variations from the inside or by air current changes. So, average value can be obtained only by long term continuous monitoring

(1)-2 Methodology and Procedure of Activity

As JICA grant equipment, two sets of portable H_2S monitor that has a long experience in sewage works in Japan were provided. Monitoring, communication with personal computer to provide monitored value and display a trend graph was conducted with C/P by OJT.

Portable H_2S monitor

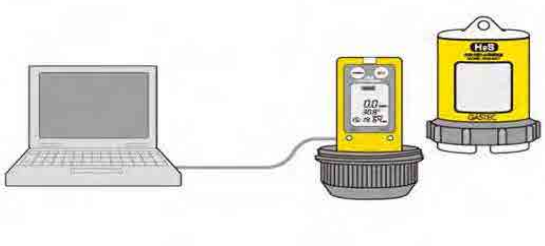


Image for accumulation of data into computer by taking off the cover and connecting to PC

(1)-3 Result of Activity

Among target sewage treatment plants, Santa Quiteria STP and Atuba Sul STP were selected as demonstration sites to install hydrogen-sulfide monitor. Demonstration could reveal actual conditions of high concentration hydrogen sulfide appearances in the long time course.

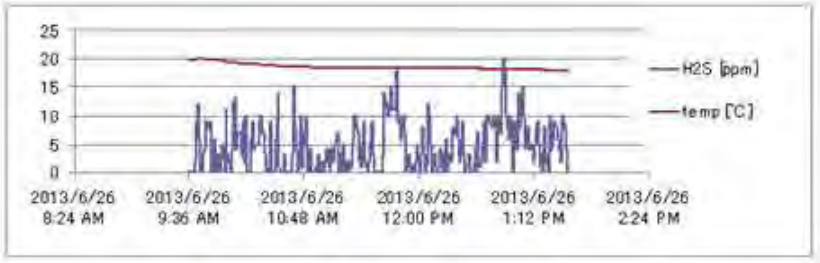


Figure 5.2-1 H_2S Monitoring Result at Santa Quiteria Outlet of No.4 UASB (June 26, 2013)

(1)-4 Tasks to Be Addressed

Even after finishing the project, monitoring of the generation of H_2S in each STP should be continued for the prevention of concrete corrosion and improvement of the working condition.

(1)-5 Actions to Be Taken

The activities of SOP team established in the project should be continued and cross-sectional survey and consideration should be conducted.

(2) Concrete deterioration diagnosis methods for STP

(2)-1 Purpose and Significance of Activity

In the case of this project where most of the treatment plants adopt anaerobic process called UASB, number of hydrogen sulfide emission sites are many and its concentrations high. Thus causes shorter life of many instruments and accelerates corrosion on concrete structure of sewage treatment plants. This work aims further to introduce Japanese ways of diagnosis method to measure extent of concrete corrosion in order to spread technique of locating required part for repair.

(2)-2 Methodology and Procedure of Activity

JICA team instructed the basic method for measuring carbonation depth of concrete to C/P by OJT.

(2)-3 Result of Activity

One of the UASB tanks under operation was selected and drained the sludge for examination. On 9th July 2013, demonstration was made in Padilha Sul STP. It was done before many engineers of relevant fields. JICA expert team showed practical ways of examination to measure

concrete deterioration. Research was also made for degree of corrosion inside the UASB tank. JICA expert team also showed "Procedure of concrete deterioration diagnosis" as an overview of the diagnosis work to obtain understanding.

Entering UASB

Drilling side wall

Measure the depth

(2)-4 Tasks to Be Addressed

Even after finishing the project, the condition of concrete corrosion in each STP should be measured periodically for making basic data of the renovation program of the STP.

(2)-5 Action to Be Taken

The measurement of concrete corrosion is not easy to manage only for the staff in STP and should be conducted together with the staff in the investment department who has relatively high knowledge. Hence, the activities of SOP team established in the project should be continued with participation of the staff having the knowledge together with the staff in STPs is recommended.

(3) Experiment of Sludge Removal from UASB Tank

(3)-1 Purpose and Significance of Activity

No O&M manual for removal of sludge from UASB tank has been used in the target STPs and the removal frequency is determined by each STP individually. For example, sludge removal is seldom carried out in Atuba Sul STP while it is done once every month in STPs in the coastal area. Hence, field experiment whether such removal process is proper or not was carried out in order to make awareness of the issues for each STP.

(3)-2 Methodology and Procedure of Activity

The experiment was conducted by the staff in Atuba Sul STP from March to June 2013 when JICA expert team was absent. UASB tank of No.5 and No.13 in Atuba Sul STP was comparatively used. Sludge was not removed from No.5 tank while was removed from No.13

tank once every week and the effluent quality was compared.

(3)-3 Result of Activity

Figure 5.2-3 shows the fluctuation of the depth of sludge in the two tanks. The sludge-liquid interface in No.5 tank rose because of no sludge removal while that in No.13 dropped because of sludge removal. Figure 5.2-4 shows the fluctuation of the effluent COD concentration in the two tanks. The figure indicates that effluent quality in No.5 tank in which no sludge removal was carried out is better.

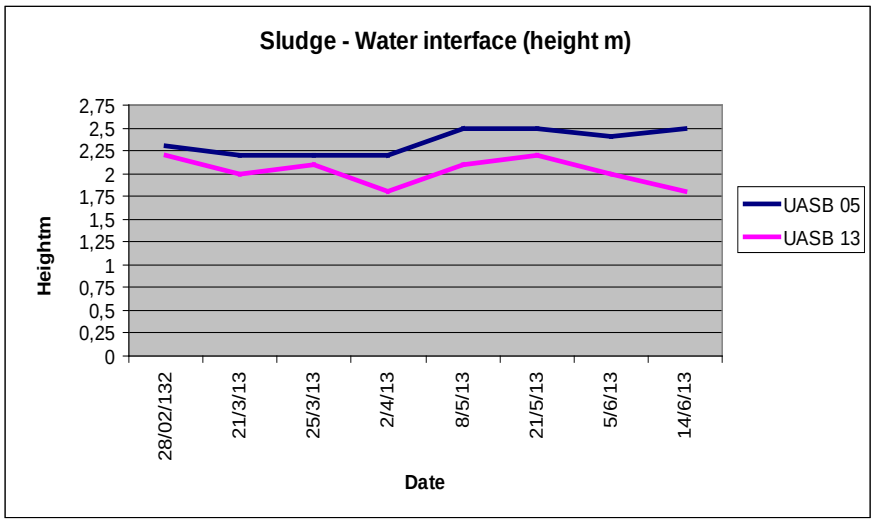


Figure 5.2-2 Fluctuation of Sludge-liquid Interface of Two Tanks

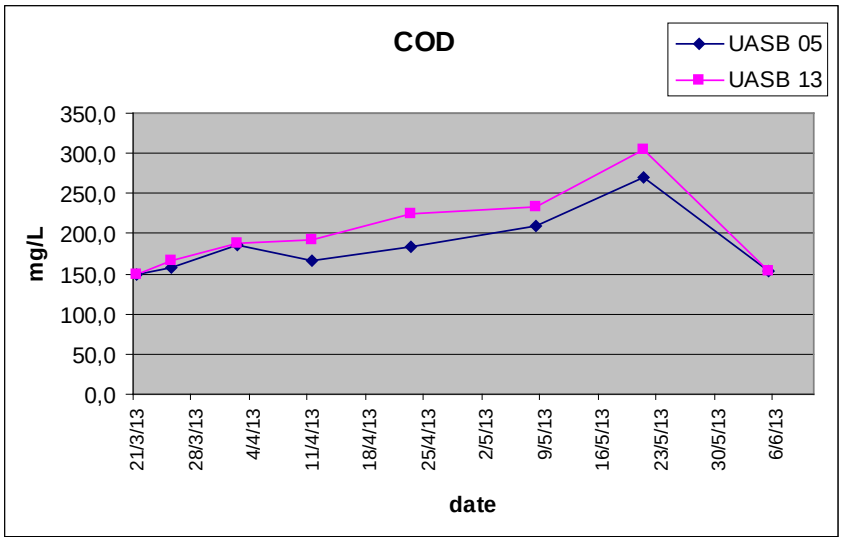


Figure 5.2-3 Fluctuation of Water Quality in Two Tanks

At least in Atuba Sul STP, frequent sludge removal was found to makes bad influence for the treatment. On the other hand, sufficient treatment is achieved in the STPs in the coastal area by sludge removal of once a month. According to C/P in Atuba Sul STP who carried out the experiment, the deterioration of effluent quality by frequent sludge removal was caused by circulation of sludge removed due to poor sludge treatment capacity.

(3)-4 Tasks to Be Addressed

Even after the end of the project, the survey regarding the withdrawal of the sludge from UASB tank in each STP should be conducted periodically and the optimum condition of the withdrawal should be found in each STP.

(3)-5 Actions to Be Taken

The activities of SOP team established in the project should be continued and the team should instruct the way to conduct survey and arrange data obtained.

(4) Investigation Regarding Efficiency of Adoption of DAF Pump and Appropriate Operation Condition

(4)-1 Purpose and Significance of Activity

The floatation process has been used as the post treatment process of UASB in 5 STPs out of 12 target STPs as shown below;

Table 5.2-9 Treatment Capacity

Name of STP	Treatment Capacity
Atuba Sul	96,768m^3/day
Santa Quiteria	36,288m^3/day
Sao Jorge	6,048m^3/day
Matinhos	18,144m^3/day
Pontal do Parana	12,096m^3/day

In these STPs, saturated water made by mixing of pressured air and effluent of DAF in the pressured tank are diffused into the DAF tank and flocs containing air is removed by floatation. Because the floatation efficiency is poor and the effluent quality becomes poor, strainer elements installed in the suction pipe of pressure pump are removed due to avoid clogging. And SS contained in the effluent is accumulated in the pressure tank and air and water is not mixed

well; hence saturated water for generating micro-babble is produced. Then the floatation process had hardly been operated in the 3 STPs other than Atuba Sul and Santa Quiteria.

(4)-2 Methodology and Procedure of Activity

In order to improve such situation, in August 2012, DAF pump with high air-water mixing capacity was equipped in Matinhos STP in place of pressure tank tentatively. Operation of the pump was found to be easy and operation time became long by the adoption. However, adequate evaluation of the adoption was not carried out mainly because the STP is located in the coastal area and is a little bit far from CMA.

In August 2013, SANEPAR subsequently adopted the pump in the Sao Jorge STP located in CMA. Then the evaluation has been carried out within the project activity in cooperation with staff in the electrical-mechanical section in CMA and the coastal area (USEM).

The evaluation will be divided into two main subjects, i.e. the result of adoption and the optimum operation condition.

(4)-3 Result of Activity

The result of the adoption usually has to be evaluated by comparative investigation using 2 DAF lines; however the SRP has only one line, and the floatation process had hardly operated before the adoption of the pump; hence the comparison of the data before and after the adoption also is not able to be obtained. (Matinhos STP has 2 lines; however the conventional process is already out of operation and the comparative investigation is not able to be carried out.) Hence, the result of the adoption has to be concluded that it is “High” due to the following reasons at this moment.

- Before the adoption: Hardly operated because the operation of the pressured tank process was complicated and unstable.
- After the adoption: Easy and long-term operation is available by using only DAF pump.

In STP where more than two floatation line are under operation like Atuba Sul and Santa Quiteria, comparative investigation is possible when DAF pump is installed in a line; however according to SANEPAR, no pump suitable for such large scale STP is commercialized at present and further consideration is required for implementing the comparative investigation.

DAF pump

Floatation scum

The verification of adoption of the DAF pump in Sao Jorge sewage treatment plant was carried out.

- There are many opinions from staff of Sao Jorge sewage treatment plant that the adoption of DAF pump made much less troubles of air-water mixing process. This means that the effect of the adoption of DAF pump is also high in the point view of O&M.
- The verification by the comparison of effluent water quality of dissolved air floatation process before and after the improvement was carried out.

The effluent water quality data of dissolved air floatation process before and after the improvement in Sao Jorge sewage treatment plant is shown in Figure 5.2-4.

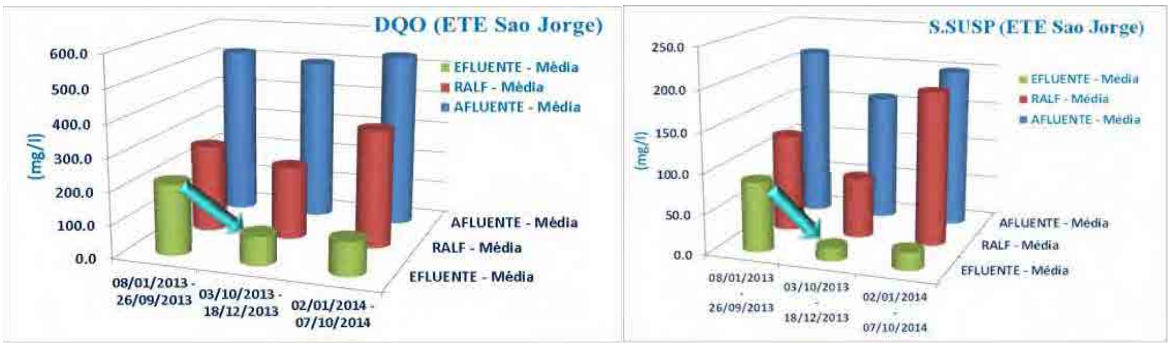


Figure 5.2-4 Improvement of Effluent Water Quality by the Adoption of DAF Pump

The improvement of scum scrapers and the adoption of DAF pump made stable operation of dissolved air floatation process. Accordingly, effluent water quality became much better. The investigation for the suitable operation condition of DAF pump has been continuing and the result is shown in Figure 5.2-5.Operators continue the investigation and found suitable operation condition of the pump by themselves. The suitable operation condition that the ratio between influent water flow and air-saturated water flow (recirculation water ratio) should be 0.2 to 0.25 and the ratio between air flow saturated and DAF pump flow (air-water ratio) should

be 0.04 to 0.05 respectively are found.

Figure 5.2-5 Operation of DAF Pump

On the other hand, a small-size DAF pump for Sao Jorge sewage treatment plant cannot be adapted for large-scale sewage treatment plant such as Atuba Sul and Santa Quiteria. It was confirmed that one set of pump can be adopted for one module of dissolved air floatation process if the large size DAF pump manufactured by a Japanese pump manufacturer is adopted.

(4)-4 Tasks to Be Addressed

There will be no issues for the adoption of DAF pumps for small-scale and medium-scale sewage treatment plants if the execution budget is ensured according to the rehabilitation and renewal plan.

On the other hand, large-size DAF pumps for Atuba Sul sewage treatment plant and Santa Quiteria sewage treatment plant which are required to improve effluent water quality cannot be manufactured in Brazil. It was confirmed that a Japanese pump maker manufactures large-size pumps at present. However, the life cycle cost (hereinafter, LCC) of the large-size DAF pump is higher than that of the existing air-water mixing unit as a result studied by the SOP team member.

There is a requirement that a Japanese pump maker should have an agent or a representative in Brazil for after-sales service of the pump. The study says that the large-size DAF pump manufactured in Japan is expensive and the cost reduction is required in order to spread the pump in Brazil.

(4)-5 Actions to Be Taken

Suggestion of technical development of large-size DAF pumps to DAF pump manufacturers in Brazil is considered. However, the technical development requires much time and cost. The

possibility having an agent or a representative in Brazil for after-sales service of the pump will be asked to the Japanese pump manufacturer.

Moreover, detailed study of LCCs of the existing air-water mixing unit and the large-size DAF pump by SOP team members will be required. At present, The LCC of the DAF pump is higher. Some costs of equipment for PARANASAN Project are adopted for the existing unit.

(5) Experiment for Simple Filtration Process for Improvement of Effluent

(5)-1 Purpose and Significance of Activity

SANEPAR recently started conversion to aerobic lagoon from traditional anaerobic ones by introducing aerators to meet the need for odor countermeasures in Padilha Sul. However, even in those cases, removal rate of nitrogen and phosphorus will still remain poor because anaerobic process (UASB) survives as the preceding process. By those influences, lagoons will suffer from the increase of SS and COD concentrations through growth of algae.

Because the growth of algae in lagoon has been a urgent issue, the environmental authority of Parana State has asked SANEPAR to improve the effluent quality of the lagoon and the experiment to improve the situation was conducted in cooperation with C/Ps.

(5)-2 Methodology and Procedure of Activity

In considering countermeasures, the process should require minimum manpower and chemical supply and "high rate fiber media filtration" which has used in sewage reclamation plants and in pond purification in Japan was selected as the improvement process

Through conduct of research among manufacture's catalogues of the process capable for long term automatic operation, a small scale experiment of "high rate fiber media filtration" as shown in Figure 5.2-6 and Photo was conducted for three lagoon effluents, i.e. Rolandia and Cascavel STP containing high concentration of algae and Padilha Sul STP containing less in order to observe its feasibility.

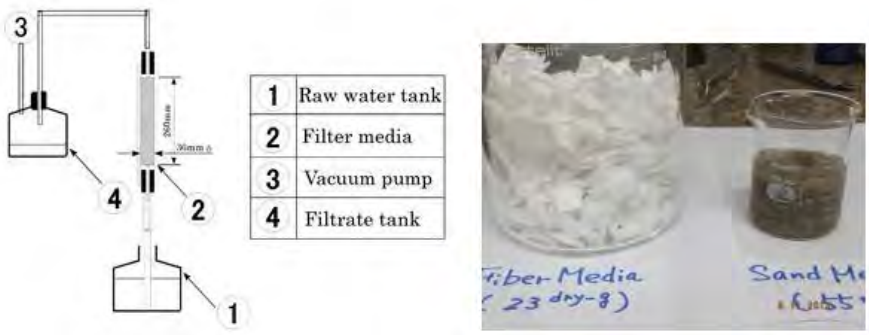


Figure 5.2-6 Experimental Apparatus and Filtering Media

(5)-3 Result of Activity

The results revealed that "fiber media filtration" proved high removal performances for samples with remarkable algae growth such as 97% (Rolandia) and 86% (Cascavel). 66% of high performance was found for the effluent of Padilha Sul in which the growth was not remarkable. As for COD removals, similar trend was confirmed and the removal ratios as 61% (Rolandia), 50% (Cascavel) and 28% (Padilha Sul) were observed.

As for the difference of SS removal rates, microscopic photos which were taken after fixing raw water by Lugol's solution revealed the size of microorganisms which existed as SS seemed much different.

From the knowledge obtained, it became clear that proposed “fiber media high rate filtration” was proved to be much efficient process for improving SS and COD than conventional sand filtration for lagoons having problems with algae growth. However, in adopting actual facilities, size measurement works for target lagoon effluent is mandatory.

(5)-4 Tasks to Be Addressed

Deterioration of the effluent quality by the generation of algae has been a big issue in the STPs with lagoon in SANEPAR. Hence, not only the simple filtration process conducted in the project but also many other processes to control the generqation have to be surveyed.

(5)-5 Tasks to Be Taken

The activites of SOP team established in the project should be continued and varios control processes of generation of algae should be surveyed by the leadership of the team.

(6) Study for Retention Time in BAF Tank

(6)-1 Purpose and Significance of Activity

Two STPs, Guaraquecaba and Morretes adopt bio-filter as post treatment process of UASB. By the detail survey of STPs done in the first fiscal year, the conditions became obvious that proper treatment performances were not obtained even with a consideration of short operational experience and unstable treatment

(6)-2 Methodology and Procedure of Activity

The study was made based on the result of effluent quality analysis for 24 hours composite samples done in the first fiscal year. Improvement plan for BAF was considered in cooperation with C/Ps by comparing design parameters with Japanese ones and with Japanese practices.

(6)-3 Result of Activity

By the detail survey done in Morretes, BAF at present achieves poorer performance than Japanese practice as its removal rate shows COD 47%, SS 66%, while 90% is attained generally in Japan.

The major cause was supposed to come from high BOD volumetric loading of 1.03kgBOD/m^3day which is three times as higher as Japanese design criteria (0.3kgBOD/m^3day), although the criteria for clarifier satisfies Japanese criteria.

From those considerations, an improvement plan to expand 2 BAF units was proposed as shown in Figure 5.2-7.

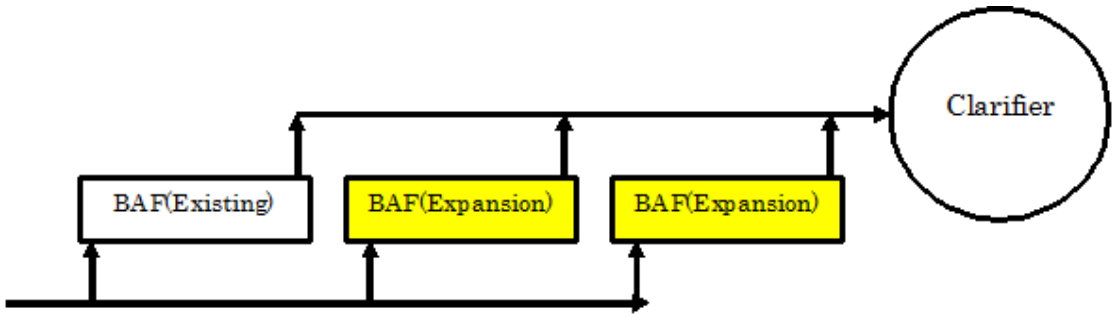


Figure 5.2-7 Proposal of Expansion of BAF Units

(6)-4 Tasks to Be Addressed

The Japanese design standard of the BAF process was introduced in the project and SANEPAR should conduct the survey regarding the optimum retention time in the BAF tank in each STP.

(6)-5 Actions to Be Taken

The activities of SOP team established in the project should be continued and the survey should be conducted by the leadership of the team.

(7) Experiment for Selection Method and Appropriate Dose of Coagulant

(7)-1 Purpose and Significance of Activity

Sludge treatment and disposal has been one of the major problems in SANEPAR. Insufficient dewatering capacity in particular has been of serious matter and need for its efficient operation has been mandated in each STP. The JICA team promoted "Measuring Dewatering Property" and "Dewatering performance test" that should be practiced by an actual machine in a scope of establishing a systematic polymer selection procedure and by doing those SANEPAR would acquire more efficient operation techniques as well.

(7)-2 Methodology and Procedure of Activity

"Measuring Dewatering Property" by beaker test was implemented by using "Filter kit" as shown in Figure 5.2-8 and Photo. "Dewatering performance" test was done for a full scale dewatering machine manufactured by PIERALISI that was installed in Santa Quiteria STP as shown in Photo. The test was done to examine moisture content of sludge cake and supernatant SS under varying "sludge supply amount" and "polymer dose rate".

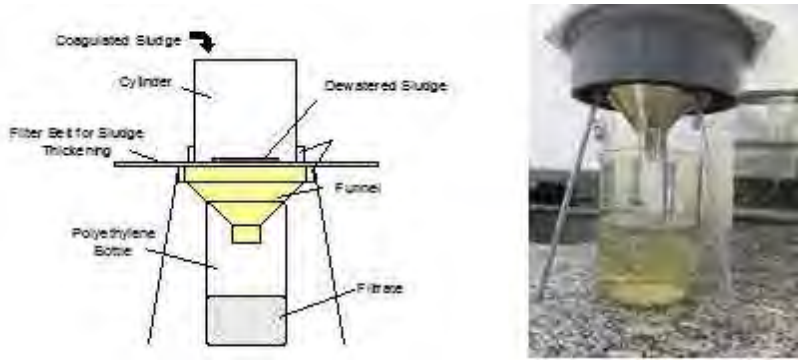


Figure 5.2-8 Dewatering Test Kit and Dewatering Test Kit

Centrifugal Dewatering Machine in Santa Quiteria STP

(7)-3 Result of Activity

Five polymer products, i.e. "Flonex 4350 HS (SNF)" ,"Superfloc 8396 (Kemira)" ,"Superfloc 8398 (Kemira)" ,"Proestal 50,005 (Ashland)", "Superfloc 8392 (Kemira)" were used in the test.

Result showed that "Superfloc 8392 (Kemira)", the one SANEPAR now under use was proved fine property as that stable solid recovery and moisture content was achieved by polymer dose rate over 0.4% as shown in Figure 5.2-9. However, as shown in Figure 5.2-10 even if dose rate has been increased as high as 0.6%, maximum solid loading can be raised only as high as 0.13 DS-ton/hr.

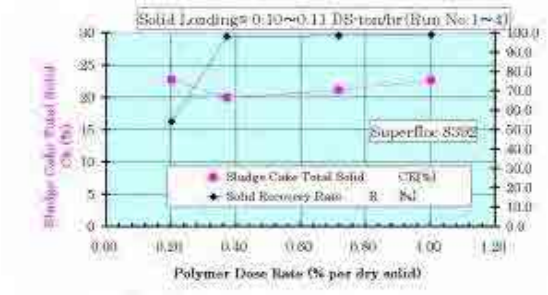


Figure 5.2-9 Dewatering Machine Performance by dosage

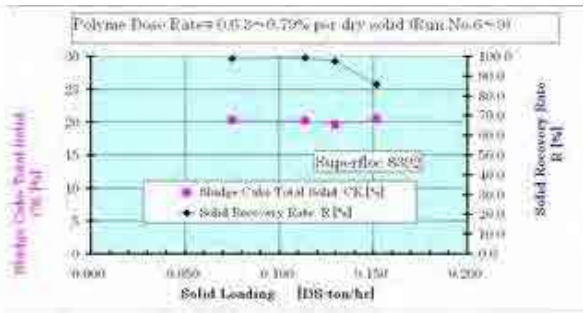


Figure 5.2-10 Dewatering Machine Performance by loading

Among the tested polymers however, more effective than conventional one was found as it was shown in Figure 5.2-11. It can make proper dewatering at solid loading 0.2DS-ton/hr with dosing rate 0.4%, which means to have possibility to improve dewatering performance than present one.

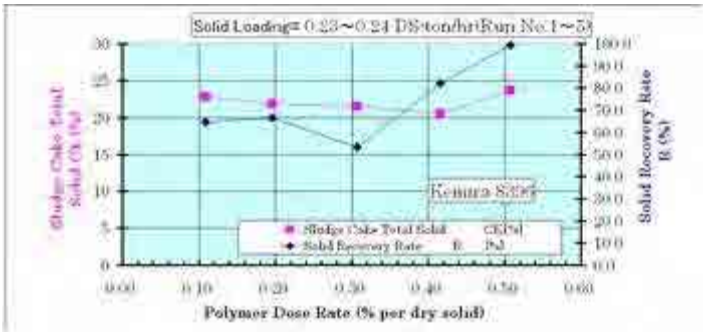


Figure 5.2-11 Dewatering Machine Performance (Kemira 8398)

(7)-4 Tasks to Be Addressed

SANEPAR understood the process of the selection of coagulant and the decision of its dosage rate through the activity; however the optimum coagulant and the optimum dosage rate may fluctuate with the change of sludge condition. Hence, the decision of coagulant and its dosage by using the process instructed in the project should be conducted in each STP.

(7)-5 Actions to Be Taken

The survey for the selection of coagulant and the decision of its dosage should be implemented in STP as a unit; however the shortage of technical staff is found in some STPs and the SOP team eatablished in the project should be continued and control the survey.

5.2.4 (Activity 2-4) Assistance for Issues of Electrical and Mechanical Equipment Remained to Be Solved in Sewage Treatment Plants and Pumping Stations

In the field surveys implemented in the first fiscal year at sewage treatment plants and pumping stations, equipment which was under breakdown caused by inappropriate designing and/or setting and were difficult to be operated and maintained were found. Since it takes much time for implementation of a renewal plan which can resolve these problems completely, rehabilitation and/or modification of these equipment were required. This activity was requested by SANEAPR in the first fiscal year and implemented in the second and third fiscal years.

USEM staff of CMA joined the SOP Team, since this activity was difficult to be performed by the former SOP Team members who were in charge of operation and maintenance mainly.

Accordingly, as the result of sufficient consideration with C/Ps, following subjects of the DAF facility with high priority were chosen.

- Modification of scum collectors in DAF tanks
- Modification of mixing tanks of DAF facility

- Air-water mixing unit for dissolved air floatation (DAF) process

(1) Modification of Scum Collectors in DAF Tanks

(1)-1 Purpose and Significance of Activity

In the field surveys implemented in the first fiscal year, the main problem of shutdown of DAF facility is cleared as frequent troubles of scum collectors of DAF tanks. Reducing troubles of scum collectors makes effluent water quality better.

(1)-2 Methodology and Procedure of Activity

Serious accidents like drop of collector into the tank, had occurred frequently in the large scale STPs in CMA because the collector is wider than that in the coastal area and a slight difference of the movement of the chain set in both sides of the collector made it drop into the tank. Hence, censors were set on the chain in the first fiscal year in order to stop the movement of the collector before its drop.

Collector dropped into tank (before improve)

Censor on the chain (after improve)

(1)-3 Results of Activity

The efficiency of the censors was continuously invested in the second fiscal year and it became obvious that no serious accident has occurred after the sensors were set.

The sensors were replaced with non-contact type sensors and improved in the third fiscal year.

Existing collectors (after improved)

New sensors (after improved)

(1)-4 Tasks to Be Addressed

The difference of the movement of the chains has to be solved because the set of the censors is not the resolution of the difference.

(1)-5 Actions to Be Taken

JICA team recommends the use of a monorail type collector which is used in Japan.

(2) Modification of Mixing Tanks of DAF Facility

(2)-1 Purpose and Significance of Activity

Sludge is mainly discharged from DAF facility. Long shutdown of DAF facility makes effluent water quality worse consequently.

Originally, coagulant was designed to be dosed into the rapid agitation tank and coagulation floc grows in the succeeding 3 slow agitators. However, a large amount of scum floated on the surface of the rapid and slow agitators and the operation of the facility became hard; hence the dosing point of coagulant was moved to the last slow agitator. However, no sufficient size flocs were formed, which might cause the deterioration of the effluent quality.

Dissolved air floatation process becomes stable and effluent water quality becomes better respectively, by means of improving dissolved air floatation facility. The improvement work in collaboration with design section, procurement section and O&M section as the methodology of improvement are accepted.

(2)-2 Methodology and Procedure of Activity

The following 2 aspects was decided to be investigated in consideration with SOP team

- Improvement of determining coagulant dosage
- Improvement of function of agitators

The amount of coagulant dosage has been same as that determined at the commencement of the facility; however the amount has to be altered in proportion to the influent quantity and quality. Therefore, the appropriate equipment required for proper dosing of coagulant, dosing process and dosing quantity has been investigated in cooperation with SOP team in the second fiscal year.

On the other hand, shortage of agitation capacity is considered to be one of the causes of the floatation of scum on the agitation tanks; therefore a flocculator was designed in cooperation with a mechanical engineer in SOP team and made the bidding for purchasing of the flocculator designed.

Formation of coagulant floc and floatation condition of scum etc. was investigated in the third fiscal year by setting the agitators in Santa Quiteria STP.

Mixing tank of DAF facility (before improved)

(Near side: rapid mixing tank / Far side: flocculation tanks)

Coagulant dosing pipe (before improved)

The experiment facility is the module 1 of DAF facility in Santa Quiteria sewage treatment plant.

Coagulant is dosed in the rapid mixing tank of DAF facility and influent water is rapidly mixed by the rapid mixer. The flocculator which was designed by the SOP team member with support of the JICA expert was installed at the 1st stage of flocculation basins and micro flocs grow up to bigger ones by the flocculator. Furthermore, the discharge method of floating flocs and sedimented flocs (sludge) produced in the 2nd and 3rd flocculation basins was studied by the SOP team member and the JICA expert. According to the result of the study, discharge units for floating flocs (pipe skimmers) and drainage units for sedimented flocs (floating sludge collector with sedimented sludge mixer) were installed in each basin. By the result of data analysis of effluent water quality from the DAF facility before and after the improvement, the effect was verified.


Flocculator installed in the 1st stage of flocculation basins in the 3rd fiscal year (after improved)




(2nd flocculation basin after improved) **(3rd flocculation basin after improved)**

Improved flocculation basins installed equipment in the 3rd fiscal year

(2)-3 Results of Activity

As a result of supporting by JICA team, SOP team member could understand the process to determine the maximum, average and minimum dosing quantity of coagulant by using jar-tester; thereby they could calculate the proper dosing quantity of coagulant in proportion to the influent sewage quantity into the DAF tank.

Coagulant was dosed in the 3rd flocculation basin until now, since a large amount of floating flocs (sludge) which became to scums made the operation of DAF facility stop. By this reason,

flocs could not grow bigger due to lack of enough mixing and effluent water quality was not good.

By means of the improvement of coagulant dosage and flocculation, bigger flocs are produced in flocculation basins and discharged as floating flocs and sedimented flocs in flocculation basins. Consequently, the load to floatation process could be reduced since suspended flocs could be reduced to floatation basins. The better effluent water quality can be expected if air-water mixing unit will be improved. The result of effluent water quality from floatation basins before and after the improvement is shown in Figure 5.2-12.

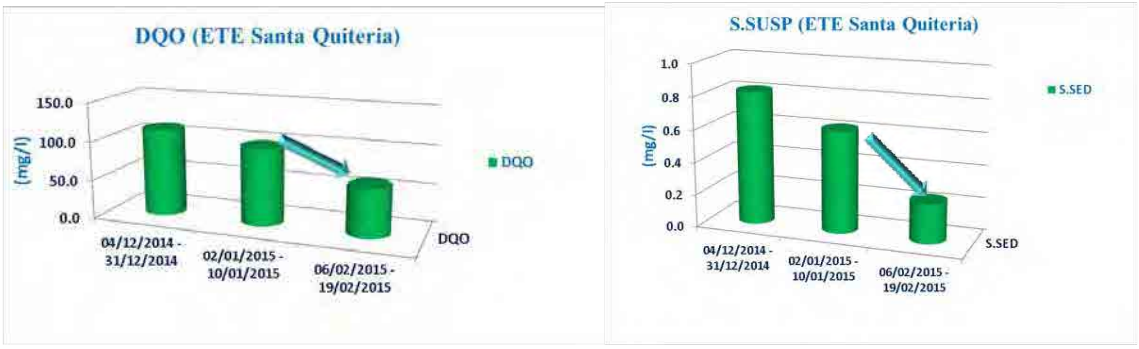


Figure 5.2-12 Effluent Water Quality from Floatation Basins before and after Improvement

On the other hand, as the individual activity of SANEPAR, baffle plates were newly set in floatation basins as shown below for the improvement of floatation efficiency. This improvement will be expected for Santa Quiteria sewage treatment plant.

Floatation basin improved in the 3rd fiscal year (Atuba Sul sewage treatment plant)

(2)-4 Tasks to Be Addressed

Since sludge is discharged to drain manholes in the plant, the sludge is transported to sludge thickening tank by a submersible pump which is set in a manhole, in addition to sludge transportation pumps of DAF facility. Manholes and drain pipes shall be maintained not to be

clogged by sludge. And also, equipment in flocculation basins should be continuously operated so that floating sludge do not become scum and hardened. Floating flocs cannot be discharged in case of lower water level in flocculation basins since the type of pipe skimmers is fixed type.

(2)-5 Actions to Be Taken

Since equipment for flocculation basins are controlled by inverter units, they can operate at suitable condition with suitable speed. Showering in pipe skimmers is provided to advance discharging flow of floating sludge and settled sludge flow and its density maintain suitable by the opening of drain valve. The water level in flocculation basins maintains not to be lower by adjusting openings of stop gates to floatation basins. These are proposed to the SOP team.

5.2.5 (Activity2-5) Organize Standard Operation Procedure (SOP) Team for Sewage Treatment Plants

SOP Team is a group of SANEPAR side for implementing the project activities in collaboration with the JICA team. In Output-2, SOP Team carried out i) Collection and analysis of data in SANEPAR, ii) Preparation of papers like O&M manual and iii) Field examination and survey, in cooperation with JICA team.

Originally, SOP Team in Output-2 was planned to be formulated after the dispatch of the JICA team into SANEPAR; however the Team was already formulated before the dispatch. The team members shown in Table 5.2-10 were the staff in the O&M control section, the STPs and the laboratory, who had sufficient knowledge and experience; consequently, the project was commenced smoothly.

Table 5.2-10 List of SOP Team Member of Output 2

Name	Title	Period	By year			
			1	2	3	4
Mr. Gil Alceu Mochida	Civil Engineer, USES	October 2012 to present	○	○	○	○
Mr. Arilson Mendes	Technologist for Industrial Electronics, Industrial Coordinator, URLI	October 2012 to present	○	○	○	○
Mr. Cleverson Roberto Bogo	Civil Engineer, USES	October 2012 to present	○	○	○	○
Mr. Gilmar Javorski Gomes Da Cruz	Chemist, USES	October 2012 to present	○	○	○	○
Ms. Cynthia Castro Correa Malaghini	Chemist & Biochemist, UPLI	October 2012 to present	○	○	○	○
Ms. Jacqueline Shirado	Environmental Engineer, USEG	October 2012 to present	○	○	○	○
Mr. Marino Kumegawa	Chemical Technician, USEG	October 2012 to present	○	○	○	○

Name	Title	Period	By year			
Mr. Laercio Mateus Squiba	Operator, USEG	October 2012 to present	○	○	○	○
Mr. Humberto Carlos Jusi	Civil Engineer, DI	October 2012 to present	○	○	○	○
Mr. Fabian Brotto Monteiro	Civil Engineer, DI	October 2012 to present	○	○	○	○
Ms. Rosilete Busato	Civil Engineer, DI	October 2012 to present	○	○	○	○
Mr. Decio Juergensen	DI Civil Engineer, DI	October 2012 to present	○	○	○	○
Ms. Angelica de Lima de Araujo	Industrial Chemistry, USEG	October 2013 to present		○	○	○
Mr. Robson de Paula Waltick	Mechanical Engineer, USEM-CT	October 2013 to present		○	○	○
Mr. Adalton Rodrigues	Sanitation Technician, USES	October 2013 to present		○	○	○
Mr. Eduardo Massahiro Ishisato	Chemical Technician, USEG	July 2014 to present			○	○
Mr. Alex Augusto Cordeiro	Operator, USEG	October 2013 to present		○	○	○
Total by year			12	16	17	17

Staff of USEM-CT (Electrical-mechanical section of CMA) and Atuba Sul STP joined to the SOP team from October 2013 and the activities for preparing O&M manual and PI monitoring etc. could be implemented much smoothly.

Basically, SOP Team has held weekly meeting in collaboration with JICA team to confirm the result of the activities carried out and to consider the implementation process of the activities to be planned in the next week.

5.2.6 (Activity2-6) Conduct Training Courses on O&M of Sewage Treatment Plants

The activities of the project is basically executed by the collaboration with SOP and JICA Team; however the cooperation of the staff in the targeting STPs is inevitable for implementing the survey in STPs and the preparation of O&M manual etc. Consequently, a seminar introducing the significance of the project, information regarding O&M of STP and new sewage technologies appropriate for SANEPAR was held for targeting the staff in STPs.

The program of the seminar was determined in collaboration with SOP and JICA Team and the preparation of the presentation papers were shared. Because all the staff in STPs cannot join the seminar in one time, it was planned to be held in two days with same program. The program is as shown in Table 5.2-11.

Table 5.2-11 Program of Seminar Regarding O&M of STP

Date	26 (Tue) and 27 (Wed), February 2013	
Venue	Meeting room, Training center of SANEPAR	
Time	Subject	Presenter
08:30~08:35	Opening address	SOP team Mr. Gil
08:35~08:45	Activities of the project	JICA Expert Mr. Hayashi
08:45~09:30	Result of basic survey: Issues in the targeting 12 STPs	JICA Expert Mr. Takeshima
09:30~10:00	(Coffee break)	-
10:00~10:30	Result of basic survey: Treatment efficiency in the 12 STPs	JICA Expert Mr. Takeshima
10:30~12:00	Reference survey of UASB process in sewage treatment	SOP team 7 members
12:00~13:30	(Lunch)	-
13:30~14:15	Introduction of technology: DHS process	JICA Expert Mr. Takeshima
14:15~14:35	Introduction of technology: Wetland	JICA Expert Mr. Takeshima
14:35~14:55	Introduction of technology: Dewatering truck	JICA Expert Mr. Takeshima
14:55~15:30	(Coffee break)	-
15:30~15:50	Provision of O&M manual in SANEPAR	SOP team Mr. Jirmar
15:50~16:10	O&M of electrical and mechanical equipment	JICA Expert Mr. Obara
16:10~16:45	O&M in STP in Japan: Machinery in settling tank	JICA Expert Mr. Takeshima
16:45~17:15	Appropriate method of O&M of STP	JICA Expert Mr. Takeshima

Number of participants and their belongings are as shown in Table 5.2-12. Participants mainly were from targeting 12 STPs; however staff in the investment department in charge of planning and designing of STP was interested in new technologies and O&M of STP in Japan and they also participated. Although the primary outcome of the seminar is the improvement of knowledge of participants, that of SOP team who understood the contents of references regarding UASB technology and presented appropriately also is the significant outcome. Knowledge obtained by SOP team member was utilized in their STP site.

Table 5.2-12 Participants of Seminar

Date		Number	Main belongings
The first	26, Feb. (Tue)	49	Sewage Section, Operation Development Section, Compatibility Evaluation Section of Planning/Operation/Development Division, Operation Management Department
The second	27, Feb. (Wed)	45	Sewage Section, Coastal Area Section, Curitiba Electrical/Mechanical Section of Metropolitan/Coastal Area Division, Operation Management Department Investment Department

The 1st day





The 2nd day









5.2.7 (Activity 2-7) Review/develop Manual(s) for O&M of Sewage Treatment Plants

(1) Purpose and Significance of Activity

In the process of implementing the activity, SOP team members reviewed the existing O&M manual in cooperation with JICA team and prepared the manual by technical support of the JICA team. Hence C/Ps can revise the manual voluntarily even after the end of the project and as a result staff in STPs can operate and maintain facilities in STPs efficiently by using the manual.

(2) Methodology and Procedure of Activity

Activity was carried out in accordance with the plan shown in Table 5.2-13 at the beginning of the project, and the existing manuals in SANEPR were reviewed and lacking sorts of manual were identified in the first fiscal year. Based on the result of the review, preparation of O&M manual for all target STPs was planned to be launched in the second fiscal year; however after discussion with SOP team, the plan was revised so as to prepare a manual in Atuba Sul STP as an example in the first place and to prepare it in the other target STPs basing on the example in the third fiscal year as shown in Table 5.2-14. The main reason of the revise was that the

number of staff who worked for the preparation was short in all target STPs other than Atuba Sul and the preparation work referring to the example was considered to be efficient.

Table 5.2-13 Original Plan of Preparation of O&M Manual

FY	Activities for preparation of O&M manual
1st	Review of existing manuals and identification of lacking sorts
2nd	Preparation of manual for satisfying the lacking sorts Hold of seminar for disseminating the manual prepared
3rd	Continued improvement of manual prepared
4th	Continued improvement Hold of seminar for disseminating the manual improved

Table 5.2-14 Revised Plan of Preparation of O&M Manual

FY	Activities for preparation of O&M manual
1st	1. Review of existing manuals and identification of lacking sorts
2nd	2. Preparation of O&M manual in Atuba Sul STP as an example 3. Hold of seminar for disseminating the manual prepared
3rd	4. Preparation of O&M manual in the other STPs based on the manual prepared in Atuba Sul STP as an example 5. Continued improvement of O&M manual prepared for Atuba Sul STP by using on site
4th	6. Continued improvement of O&M manual in STPs 7. Hold of seminar for disseminating the manual improved

(3) Result of Activity

(3)-1 Review of Existing Manual

The existing O&M manual in the target STPs were reviewed in the first fiscal year. It was found in the review that so called “Work instruction” which indicates operation and maintenance process of facilities and equipment in STP specifically was not lined up while general basic manuals were already as shown in Table 5.2-15 and inappropriate O&M was carried out in several facilities and equipment. After due consideration, the work instruction was decided to be prepared for each target STP in cooperation with SOP and JICA team.

Table 5.2-15 Result of Review of Existing O&M Manuals

Manual		Contents	Utilization condition
Existing manual	O&M manual	General O&M process of each facility and equipment is indicated.	It is kept in computer and is not usually used on site.
	Items and frequency of on-site work	On-site jobs required and the minimum frequency is indicated.	It is only kept in computer but the maintenance works are conducted according to it.
	Parameters and frequency of sewage analysis	Parameters and frequency analyzed in laboratory in STP and the central laboratory are indicated.	Laboratory works are carried out in accordance with it.
	Guideline for daily and monthly report	Guideline for preparing daily and monthly O&M report is indicated.	It is prepared according to the manual.
lacking sorts	Work instruction	No work instruction indicating detail work for each facility and equipment	—

(3)-2 Preparation of O&M manual in Atuba Sul STP

In Atuba Sul STP, the chief and main staff of the STP engaged in preparation of O&M manual as the example for all other STPs in the second fiscal year and a first edition was completed. Because prompt completion was prioritized for the preparation of the first edition, addition of photos and figures on it was postponed.

(3)-3 Hold of Seminar for Disseminating Manual Prepared

The first edition of O&M manual in Atuba Sul STP was introduced for disseminating to other STPs in the seminar held in 7th and 14th July 2013 as one of the activities of 2-12. The detail of the seminar is shown in the section of Activity 2-12.

Presentation in the seminar

Participants of the seminar

(3)-4 Preparation of O&M Manual in the Other STPs Based on Manual Prepared in Atuba Sul STP as an Example

As a result of consideration with SOP team, preparation of O&M manual in the other STPs based on that prepared in Atuba Sul STP was decided to be conducted in Santa Quiteria and Padlha Sul STP in CMA and Matinhos and Morretes STP in the first place and then conducted in the rest STPs. The preparation condition is as shown in Table 5.2-16.

Table 5.2-16 Preparation Condition of O&M Manual in the Target STPs

Target STP		2nd FY	3rd FY	4th FY
CMA	Atuba Sul	Completion of 1st edition	Document registration after improvement	Continual improvement
	Padilha Sul	—	Start preparation in the beginning of FY Completion and document registration	
	Santa Quiteria	—		
	Sao Jorge	—	Start preparation in the later of FY Completion and waiting registration	Document registration Continual improvement
	Faz. Rio Grande	—		
	CIC Xist	—	Start preparation in the later of FY Under preparation	Completion and registration
Coastal area	Matinhos	—	Start preparation in the beginning of FY Completion and document registration	Continual improvement
	Morretes	—	Start preparation in the beginning of FY Completion and waiting registration	Document registration Continual improvement
	Guaratuba	—	Start preparation in the later of FY Under preparation	Completion and registration
	Pontal do Parana	—		
	Guaraquecaba	—		

In 3 STPs in the coastal area, the preparation was not completed in the 3rd fiscal year mainly because staff involving in the preparation worked not only in 5 target STPs but also WTPs simultaneously and was hard for managing the preparation work.

(3)-5 Continuing Improvements of O&M Manual Prepared for Atuba Sul STP by On-site Use

O&M manual in Atuba Sul STP was registered as the document of SANEPAR after editing of the first edition by adding photos and numeric values into blank parts. Manual registered was translated into English and is attached as Annex A11-3.

The preparation of a check sheet for maintenance of pumps, motors and sludge dehydration machine etc. was also conducted in Atuba Sul STP from the 3rd fiscal year. The check sheet was completed as shown in the photo and started to be used in January 2015. The sheet is the most basic matter to involving in preventive maintenance for STPs of SANEPAR and the start

of use indicates the first step of the preventive maintenance.

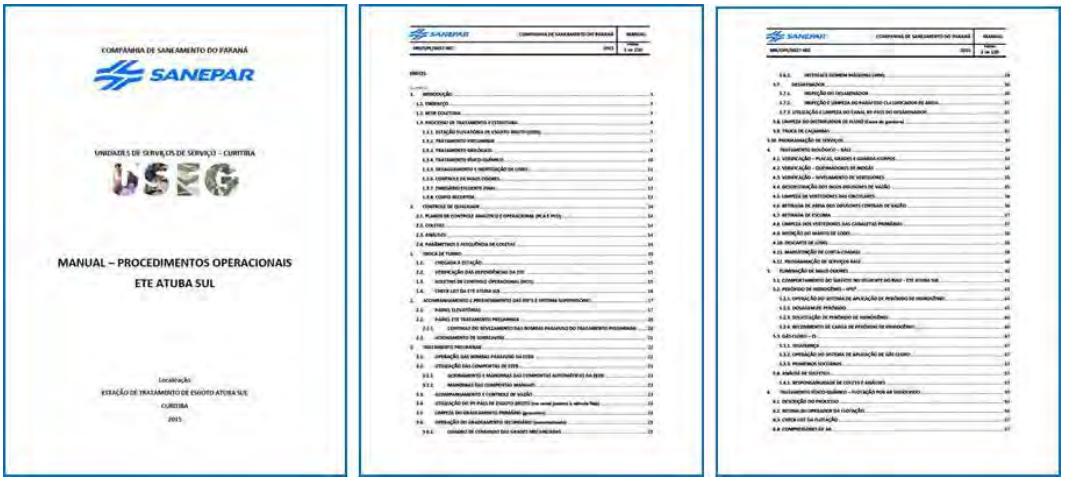
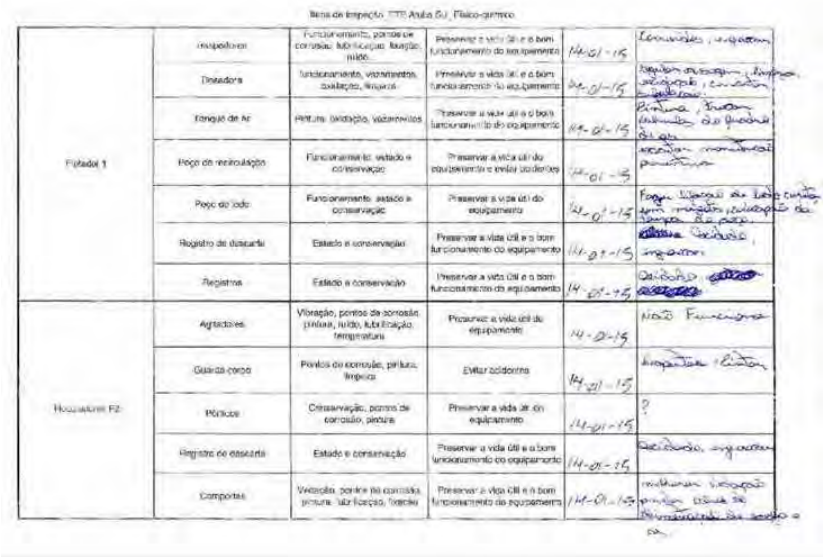

COMPANHIA DE SANEAMENTO DO PARANÁ
SANEPAR
UNIDADES DE SERVIÇOS DE SERVIÇO - CURITIBA
USEG
MANUAL – PROCEDIMENTOS OPERACIONAIS
ETE ATUBA SUL

Table of Contents of O&M Manual in Atuba Sul STP


Ficha de Inspeção - ETE Atuba Sul - Físico-química

Flotador 1	Inspeção ver	Funcionamento, pontos de corrosão, lubrificação, fixação, ruído	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
	Dosadora	funcionamento, vazamentos, oxidação, limpeza	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
	Tanque de Ar	Pintura, oxidação, vazamentos	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
	Poço de recirculação	Funcionamento, estado e conservação	Preservar a vida útil do equipamento e evitar acidentes	14-01-15
	Poço do lodo	Funcionamento, estado e conservação	Preservar a vida útil do equipamento	14-01-15
	Registro de descarga	Estado e conservação	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
	Registros	Estado e conservação	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
Floculadores FZ	Agitadores	Vibração, pontos de corrosão, pintura, ruído, lubrificação, temperatura	Preservar a vida útil do equipamento	14-01-15
	Guarda corpo	Pontos de corrosão, pintura, limpeza	Evitar acidentes	14-01-15
	Pórticos	Conservação, pontos de corrosão, pintura	Preservar a vida útil do equipamento	14-01-15
	Registro de descarga	Estado e conservação	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15
	Comportas	Vedação, pontos de corrosão, pintura, lubrificação, fixação	Preservar a vida útil e o bom funcionamento do equipamento	14-01-15

Check Sheet Prepared and Started Using in Atuba Sul STP (an extract)

(3)-6 Continued Improvement of O&M Manual in STPs

As shown in Table 5.2-16, the preparation works already completed in many target STPs in the 3rd fiscal year and they are waiting for the registration as a document of SANEPAR. Use of the manual will start after the registration. It should be noted that the manual registered has to be improved by continued addition and revises.

(3)-7 Hold of Seminar for Disseminating Manual Improved

A seminar for progressing of preparation of O&M manual in STPs other than the target ones base on the manuals registered was held in 15 July 2015 by using TV meeting process in order for participating many staff of SANEPAR. The detail of the seminar is shown in the section of Activity 2-12.

(4) Tasks to Be Addressed

The O&M manual has to be improved continuously even after the end of the project by operation condition of facilities and equipment existing and/or newly adopted by renovation.

Although check sheets for maintenance of on-site facilities/equipment were prepared and commenced using in order to introduce preventive maintenance, if trouble found is left without any measure due to short of budget, it is concerned that motivation of staff to use the sheets will be reduced.

(5) Actions to Be Taken

In order to improve the O&M manual continuously, improvement works has not to be relied only on the staff of STPs but on a team with authorized chief, like SOP team in the project and the work has to be conducted systematically.

Secure of O&M budget including that for preventive maintenance has been a big issue in SANEPAR. In order to improve such situation, short and mid-term financial plan based on the financial plan of the long term renovation plan prepared in the project has to be executed and implemented.

5.2.8 (Activity 2-8) Formulate a Plan for Rehabilitation and Renewal of Sewage Treatment Plants and Pumping Stations

(1) Purpose and Significance of Activity

SANEPAR obtains the capacity to renovate the facilities and equipment not only in target STPs of the project but also all other STPs and pumping stations in Parana State even after the end of the project.

(2) Methodology and Procedure of Activity

Basic guideline of renovation plan in anticipation of the future vision of STPs in the target STPs will be prepared at first. Then, the simple renovation plan and/or the improvement plan of existing facilities and equipment, which is the first stage of the guideline, will be prepared.

In order to prevent trouble and aging in a short period after installation, determination process of specification of equipment like capacity, function and material etc. and also choosing process of equipment was considered with C/Ps. And based on the operation and maintenance records of Atuba Sul STP as a model case, aspects should be mentioned in tender document including installation works were defined in consideration of capacity, function and material etc.

(3) Result of Activity

(3)-1 Preparation of Basic Guideline

The basic guideline of renovation plan in 30 years, i.e. until 2043 for the target STPs of the project was prepared in cooperation of SANEPAR and JICA team. The detail is as attached in Annex A11-4.

The basic guideline is divided to three stages as follows;

The first stage:

Effluent standard will be complied by implementing, (1) repairing, improvement and renovation of equipment in non-operation condition due to trouble and poor efficiency and (2) extension of facilities of STPs where treatment capacity is insufficient.

The second stage:

Renovation of treatment facilities by aerobic process with combination of conventional activated sludge (CAS) and MBR process shall be commenced in 4 STPs in CMA area where effluent pollutant loading is exceedingly larger than other STPs.

The third stage:

Centralization of sludge treatment shall be promoted.

Figure 5.2-13 shows an example of layout of treatment facilities under adoption of aerobic process with combination of CAS and MBR into the existing Atuba Sul STP.

Content of the basic guideline was explained for the main staff of the investigation and the operation division of SANEPAR including the director of the investment division in 30th October 2013 and was considered within the main staff in the both division in 13th November. 2013. As the result of the explanation and consideration, the guideline of the renovation plan was approved by the management level of SANEPAR except for the conversion plan of treatment process from anaerobic to aerobic process, which was considered in the sewage M/P prepared by SANEPAR.

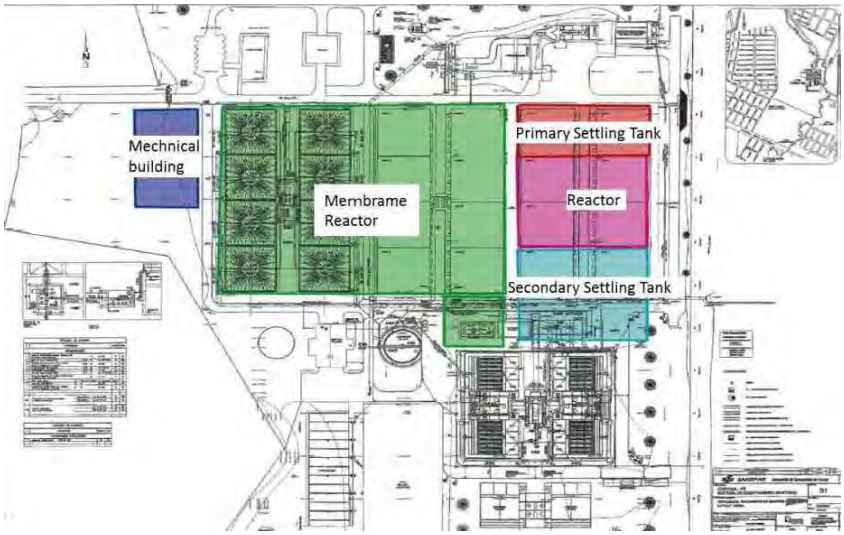


Figure 5.2-13 Layouts in the Case of Adoption of Aerobic Process into the Existing Anaerobic Process (Atuba Sul STP)

(3)-2 Preparation of Renovation Plan of Mechanical and Electrical Equipment and Concrete

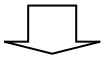
The renovation plan of equipment is now under preparation based on the evaluation data of mechanical and electrical equipment obtained in target STPs and pumping stations in cooperation of SANEPAR staff and JICA team as in Annex A5-2. Table 5.2-17 shows an example of the evaluation data of equipment in influent facilities in Atuba Sul STP.

Investigation of concrete condition in water phase was carried out in Padilha Sul STP and no serious damage was found. On the other hand, concrete condition in gaseous layer of the various tanks was investigated in all target STPs and many pumping station and serious deterioration was observed in many STPs as shown in evaluation sheets attached in Annex A5-3.

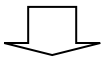
The procedure of the preparation of renovation plan of STPs and pumping stations is as follows;

Preparation of draft renovation plan from 2014 to 2043

Explanation of the draft plan to the main staff of investment and operation dept. (30th Oct. 2013)



Technical consideration of the draft plan within the main staff of investment & operation dept. (13th Nov. 2013)



Approval of the approach and procedure for preparation of renovation plan by management revel of SANEPAR (Mar. 2014)

Preparation of mid-term renovation and financial plan by extracting 5syears from the draft plan conducted by SANEPAR

Table 5.2-17 Evaluation Data of Equipment in Influent Facilities in Atuba Sul STP

Nome da Estação de Tratamento SANEPAR:	ETE Atuba Sul (Método de tratamento: UASB + FAD)	**Local:**	Área Metropolitana de Curitiba, Paraná.	**Datas de pesquisa:**	Dias 5, 15 e 16 de outubro de 2012, 5 de fevereiro de 2013

Início da Operação UASB em 1998 Operação FAD em 2009

Capacidade de tratamento: Max.: 1.680 / Norm.: 1.120 / Min.: 600 litros/seg (Max.: 145.152 / Norm.: 96.768 / Min.: 51.840 m^3/dia)

Nome da instalação	Nome da instalação/ equipamento	Dados da instalação	Situação atual da instalação / equipamento	Necessidade de reparo / melhoria / renovação e seu motivo	Foto No.
Instalação de entrada e transformador de energia elétrica	Painel de entrada e transformador de energia elétrica da ETE	•	• Devido ao H_2S originado da instalação UASB, os fios elétricos estão corroídos. • Devido ao H_2S originado da instalação UASB, os dispositivos que ficam no interior do painel de entrada e transformador de força estão corroídos.	• Há necessidade de evitar o espalhamento do H_2S que é originado do processo anaeróbio como o UASB. • Utilizar aditivo no afluente destinado a conter a ocorrência de gás sulfídrico.	az
Instalação da bomba de recalque	Instalação da entrada e transformador de força da bomba de recalque	•	• Os dispositivos do interior do painel de entrada e transformador de energia estão corroídos devido à ocorrência de H_2S nas instalações UASB. • Os dispositivos do interior do painel de entrada e transformaçdor de energia estão corroídos devido à ocorrência de H_2S nas instalações UASB.	• Há necessidade de evitar o espalhamento do H_2S que é originado do processo anaeróbio como o UASB. • Utilizar aditivo no afluente destinado a conter a ocorrência de gás sulfídrico.	ba

a. Comporta de entrada e gradeamento grosseiro de Atuba Sul

b. Painel de controle da comporta de entrada de Atuba Sul

c. Bomba de recalque de Atuba Sul

d. Tracionador elétrico e redutor de velocidade do tracionador da bomba de recalque de Atuba Sul

e. Painel de controle da bomba de recalque de Atuba Sul

(3)-3 Consideration Regarding Selection of Equipment Model

Because restoration of equipment under outage and/or functional deterioration was found to be the relevant issue to solve, the automatic screen facility in Atuba Sul STP was renovated in 2014 as one of the renovation program. And belt-press dehydrator also was renovated to centrifugal one. In the choice of equipment, capacity, function and material etc. were considered with C/P. Photos before and after the renovation are shown below;

 **Automatic screen (before renovation)**	 **Automatic screen (after renovation)**
 **Belt-press dehydrator (before renovation)**	 **Centrifugal dehydrator (after renovation)**

As mentioned in Activity 2-4, alteration of floating sludge collector and floating sludge separation tank in DAF facility was carried out and separation efficiency was improved. In Santa Quiteria STP, alteration of agitation tank of DAF facility was implemented as the experiment of SOP team and effluent quality was improved.

The result of the alteration was reflected to the renovation plan in Sao Jorge, Pontal do Parana and Matinhos STP and the tendering document of equipment to be used was considered with C/Ps.

In addition to the selection of equipment model, introduction of pre-evaluation system of installation works contractors was also considered because inferior installation works of equipment was found in some STPs.

(4) Tasks to Be Addressed

Although SANEPAR already prepared mid-term renovation plan, it cannot be put into practice if the budget required is not prepared.

(5) Actions to Be Taken

A stable management base of SANEPAR is of importance and a stable financial condition of SANEPAR has to be continued.

5.2.9 (Activity 2-9) Study on Introduction of Advanced Treatment Facility for Reuse of Treated Sewage

(1) Purpose and Significance of Activity

Curitiba city, where average altitude ranges 900m, has been origins of major rivers. That is why the city has to obtain water resource from Assungui river which is approximately 100 km near the boundary of Parana state. The altitude difference ranges up to 500m. Water resources are lifted over altitude difference and are used for drinking water resource. To those problems, SANEPAR has an idea to upgrade effluent water quality of CIC Xisto STP drastically and utilize its effluent as industrial water and would reduce water resource now used for industrial use and keep it for future population increase.

Based on those background for the needs of reclaimed water, a feasibility study to upgrade existing final effluent of CIC Xist STP and supply it as industrial water was conducted to make clear what kind of problems are assumed as well as what consideration of solution strategy and expected expenses were required.

(2) Methodology and Procedure of Activity

Reuse water produced by advanced treatment process of sewage treatment of CIC Xisto STP is to be supplied to nearby factories which locate 2.2 km apart from CIC Xisto STP. Scale of project was supposed 400 l/sec (34,560 m^3/day)

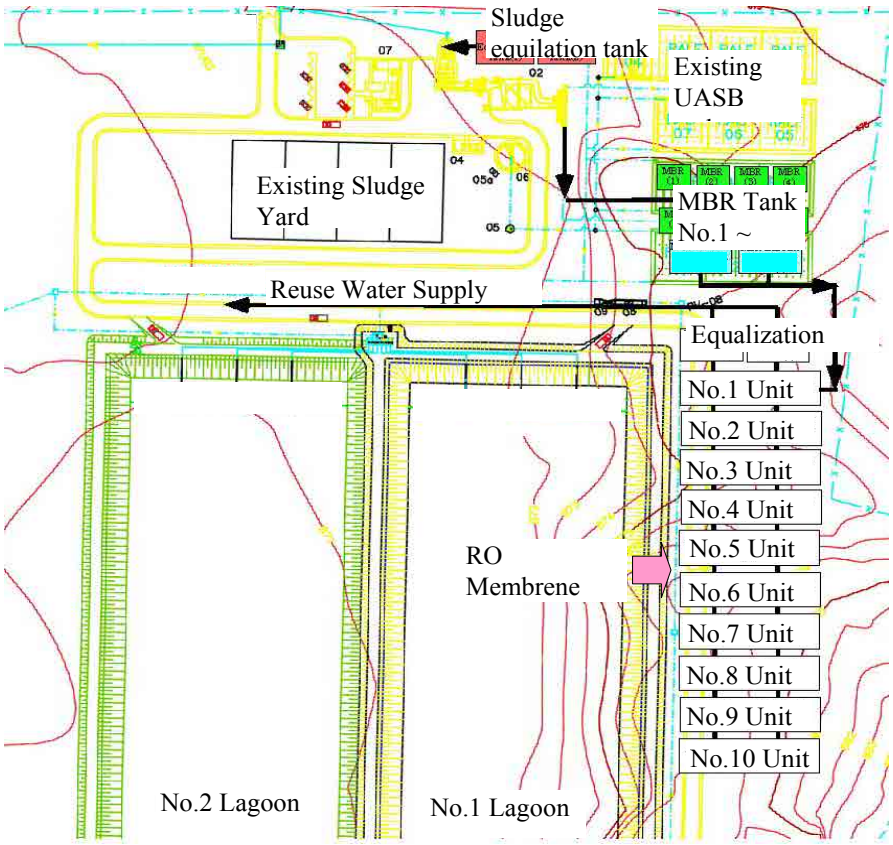


Figure 5.2-14 Supposed Facility Layout

(3) Result of Activity

Detail of the study was attached to Annex A11-5.

As an advanced treatment plant, Plan locates "Influent equalization tanks (two) "near the existing pumping well and utilize existing distribution tank for UASBs to supply sewage to "Membrane Bioreactors (8 tanks)" which are to be newly constructed.

In the other hand, effluent from MBR should be stored in "Effluent reservoir of MBR (2 tanks)" temporally and pumped up to "RO membrane separation facilities (10 units)". The permeate from RO membrane should be stored into "Reclaimed water reservoir (2 tanks)" and finally pumped down to users. Above results were summarized in Table 5.2-18.

The results show that in this case, construction cost would need JPY16,732,000,000 by referring cost estimation formula used in Japan, while unit price to produce $1m^3$ of reclaimed water should be JPY 111.2. However, the cost does not include man power or repair work cost.

Cost breakdown shows that Membrane Bioreactor occupies 57%, RO Membrane Separation

27% and water pipe and pumping equipment needs 13%.

On the other hand, existing unit charge for $1m^3$ industrial water has been set as R$2.4, which is equivalent to JPY103 as 1R$=42.95JPY assumed. In this example the unit cost for producing $1m^3$ estimates JPY103 which should demand further to take into account the expenses of management and other, should require further cost increase. The industrialization of the project would require substantial charge rate increase as a result.

Table 5.2-18 Results of Cost Estimation for Introducing Advanced Treatment Facilities for Reclaimed Water Use

	Construction Cost	Operation and Maintenance Cost	Note
Raw water equalization tank	JPY144,000,000	JPY 0.5 /$m^{3*)}$	*) Amount of depreciation
Membrane Bioreactor	JPY 9,580,000,000	JPY 50.2 /m^3	
Membrane Bioreactor effluent reservoir.	JPY144,000,000	JPY 0.5 /$m^{3*)}$	*) Amount of depreciation
RO Membrane Separation Facility	JPY 4,580,000,000	JPY 52.4 /m^3	
Reclaimed Water Reservoir	JPY144,000,000	JPY 0.5 /$m^{3*)}$	*) Amount of depreciation
Water Pipe and Pumping Equipment	JPY 2,140,000,000	JPY 7.1 /$m^{3*)}$	*) Amount of depreciation
Total	JPY16,732,000,000	JPY 111.2 /m^3	

Through those considerations, this project has to face the conclusion that it has many difficult aspects of cost and others to attain practical implementation.

However, substantial needs to secure drinking water resource for Curitiba are still remaining and it should be solved by other schemes.

To meet those needs, a supposition might be proposed as it proceeds to upgrade supply water quality of existing Araucaria WTP, practically an introduction of "RO membrane separation facility" which can reduce ABS and saline concentrations. Reported example also shows RO membrane can reduce ABS by 80%.

In this case as values listed in the table, the industrial water additional cost for introducing RO membrane separation for full capacity has been calculated as JPY52.4 for $1m^3$, JPY26.2 for half the capacity that may be worth, while to study its feasibility instead.

Based on the result mentioned above, Activity 2-10 “Implement a pilot project for advanced treatment” was decided not to be implemented and a research of membrane process in Araucaria

WTP was planned to be carried out instead as one of the activities of Activity 3-7 of Output 3.

5.2.10 (Activity 2-10) Implement a Pilot Project for Advanced Treatment

Based on the result of Activity 2-9 "Study on introduction of advanced treatment facility for reuse of treated sewage" feasibility for introducing advanced treatment of membrane treatment into STP was found to be low due to too high introduction and O&M cost; hence Activity 2-10 was decided not to be implemented. Instead, research for membrane treatment had been conducted in Araucaria WTP as one of the activities on Activity 3-7 in Output 3.

5.2.11 (Activity 2-11) Conduct Monitoring of Performance Indicators (actual results) on O&M of Sewage Treatment Plants

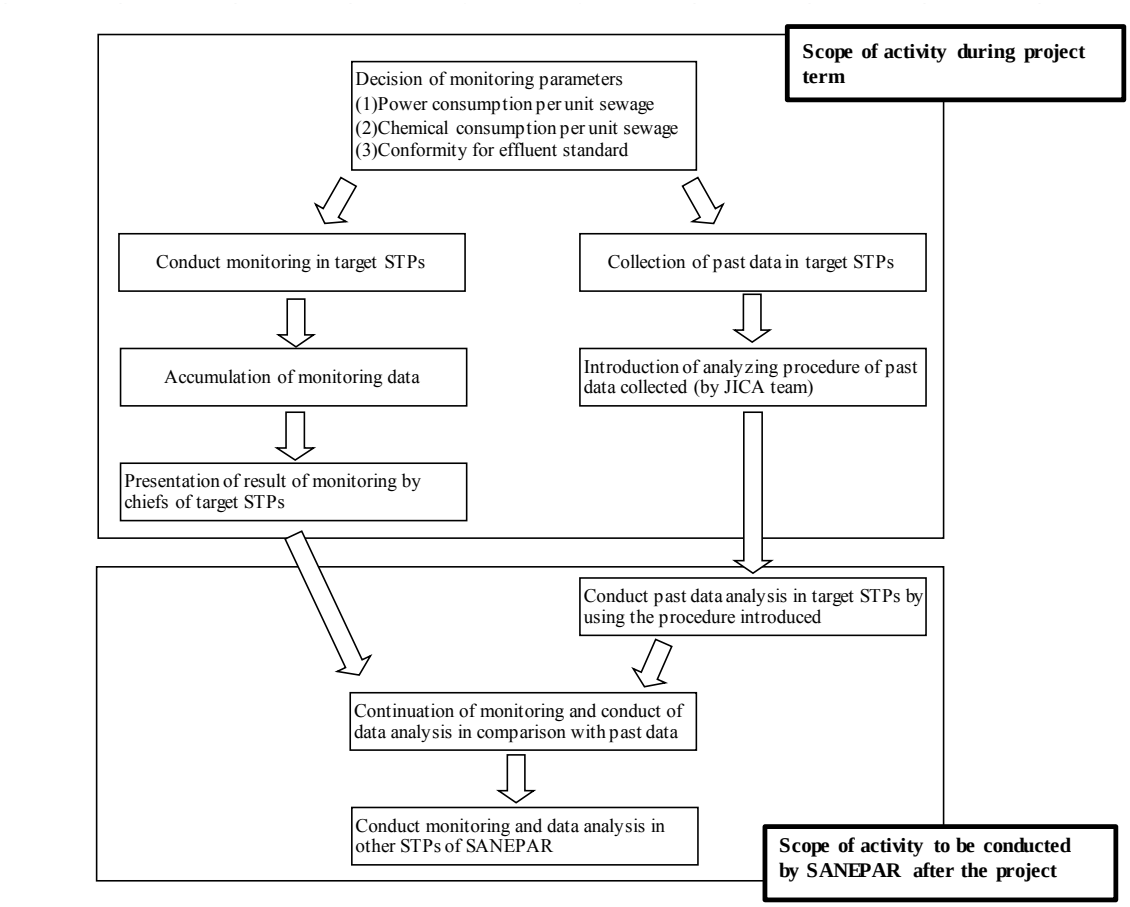
(1) Purpose and Significance of Activity

Monitoring of performance indicator (PI) and analysis of monitoring result will make SANEPAR possible to (1) control consumption of energy and chemicals appropriately and (2) recognize the result of improvement or renovation of facility or equipment.

(2) Methodology and Procedure of Activity

Although SANEPAR has monitored the three indicators used in the project, i.e. (1) Power consumption per unit sewage quantity, (2) Chemical consumption per unit sewage quantity and (3) Compliance rate of effluent standard in all STPs of SANEPAR including the target ones, the data obtained by the monitoring has not been analyzed. Therefore, JICA team instructed and advised for the analysis of the result of monitoring in order to make SANEPAR analyze the result continuously after the end of the project.

The activity was carried out following process:



(3) Result of the Activity

(3)-1 Conduct of Monitoring and Accumulation of Data

(3)-1-1 Commence of monitoring

In the weekly meeting with SOP team held in June 2013, Power consumption per unit sewage quantity, Chemical consumption per unit sewage quantity and Compliance rate of effluent was chosen as the monitoring parameters and the monitoring started in all target STPs.

(3)-1-2 Monitoring and analyzing parameters

As shown in Figure 5.2-15 and Figure 5.2-16, the power and chemical consumption ratio in 2011 against that planned is quite low. In Atuba Sul STP, the ratio of power consumption is 50% and that of chemical (coagulant for sludge dewatering) is only 11% due to outage of mechanical equipment. What is important in target STPs is to make close actual consumption to that planned in the first place. Hence, it was decided in the meeting with SOP team data analysis

of the power and chemical consumption rate was not carried out for the time being while monitoring of them was continued.

Power consumption rate in Belem STP and chemical consumption rate in Sao Jorge STP is not shown in the figures because no data was obtained.

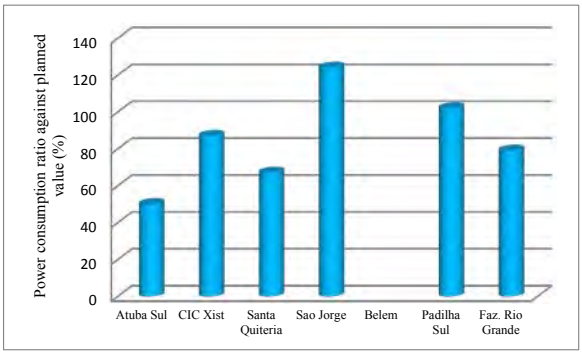


Figure 5.2-15 Power Consumption Rate in STPs in CMA

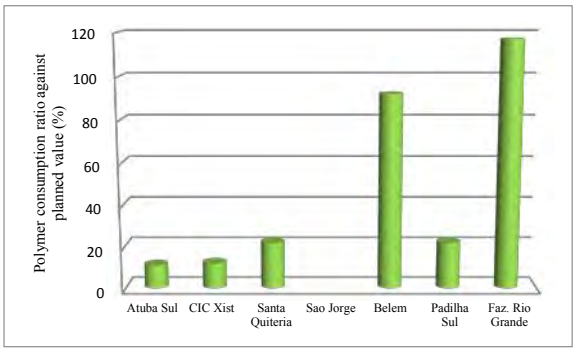


Figure 5.2-16 Chemical Consumption Rate in STPs in CMA

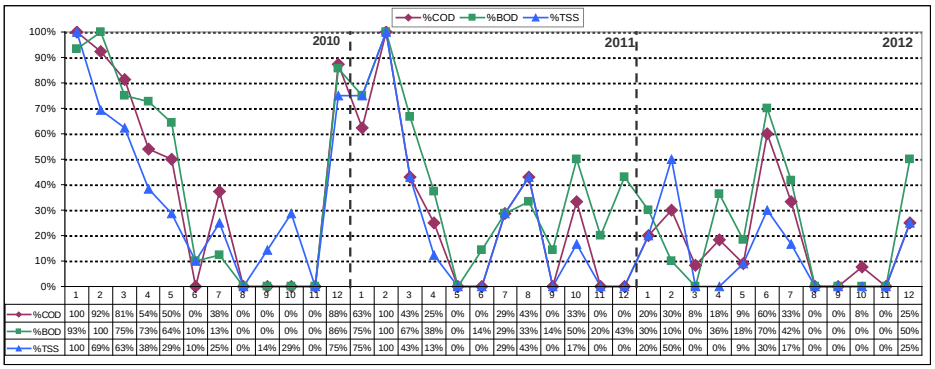
(3)-2 Presentation of Result of Monitoring

In order to make each target STP recognize the data obtained by the monitoring and to share the date within the target STPs, a meeting was held in 24th November 2014 and chiefs of target STPs presented the PI data collected. Because it was the first attempt and was conducted without fixing of reporting style, there found some superiority and inferiority between STPs; however each chief of STP could learn the better way of data analysis and presentation.



(3)-3 Collection of Past Data

Not only collection of current monitoring data but also that of past data has been carried out in the project in order to analyze the data in time series. Figure 5.2-17 shows the fluctuation of the compliance rate of the effluent standard in the past two years in Atuba Sul STP, which was prepared by SOP team as an example for analyzing the result of monitoring. According to the team, the rate was high in the rainy period, i.e. January to February 2010 and December 2010 to February 2011. However the comment of the team was not based on the actual precipitation data; therefore preparation of correlation between precipitation data and conformity rate should be analyzed.



	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
%COD	100	92%	81%	54%	50%	0%	38%	0%	0%	0%	0%	88%	63%	100	43%	25%	0%	0%	29%	43%	0%	33%	0%	0%	20%	30%	8%	18%	9%	60%	33%	0%	0%	8%	0%	25%
%BOD	93%	100	75%	73%	64%	10%	13%	0%	0%	0%	0%	86%	75%	100	67%	38%	0%	14%	29%	33%	14%	50%	20%	43%	30%	10%	0%	36%	18%	70%	42%	0%	0%	0%	0%	50%
%TSS	100	69%	63%	38%	29%	10%	25%	0%	14%	29%	0%	75%	75%	100	43%	13%	0%	0%	29%	43%	0%	17%	0%	0%	20%	50%	0%	0%	9%	30%	17%	0%	0%	0%	0%	25%

Figure 5.2-17 Fluctuation of Compliance Rate of Effluent Standard in Atuba Sul STP (2010 to 2012)

(3)-4 Introduction of Analyzing Procedure of Past Data Collected

Although data of various PI parameters has been collected in STPs in SANEPAR, almost no data analysis was conducted and no feedback to O&M of STP. Hence, as a part of the instruction of data analysis procedure, JICA team prepared a draft of annual fluctuation of three PI and influent quality in the target 12 STPs from 2010 to 2013 and presented to SOP team. The team will revise and edit the draft and will compile a report.

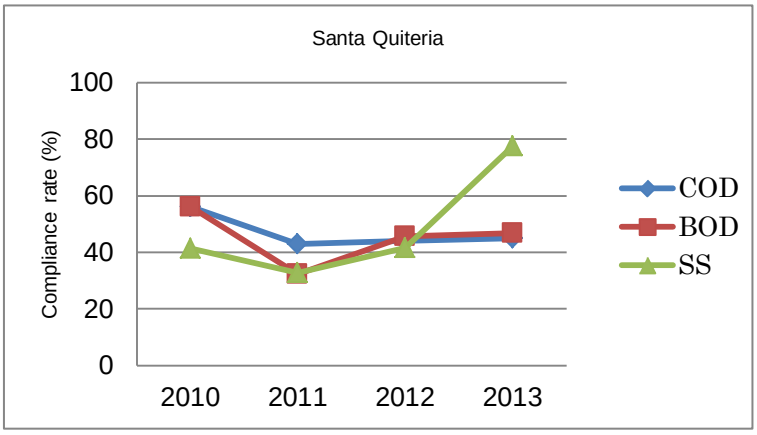


Figure 5.2-18 Example of Analyzing Procedure of Past Data Proposed by JICA Team (Conformity Rate for Effluent Standard in Santa Quiteria STP)

(4) Tasks to Be Addressed

SANEPAR has a plan to start monitoring of the conformity of effluent standard by setting COD as indicator for all STPs in PARANA State and Activity 2-11 will surely be continued even after the end of the project. It should be noted that a large amount of data will be accumulated and a way to use the data should be established promptly.

Operation control factors in UASB process adopted in SANEPAR are exceedingly smaller than that in activated sludge process; hence improvement of facilities and equipment is required besides control of operation factors for improving values of PI.

(5) Actions to Be Taken

In order to establish the way to use the data, meetings to report and discuss the result of PI monitoring in which chiefs of all STP in SANEPAR get together is recommended to hold to share the information.

Staff in STP should pay attention how the PI values vary as the progress of repair, improvement and renovation of facilities and/or equipment in each STP and subsequent renovation plans should reflect the result of PI analysis.

5.2.12 (Activity 2-12) Workshop and Seminar

Workshop/seminar of Activity 2-12 was held twice, in the second and the forth fiscal year. The detail of them is as below:

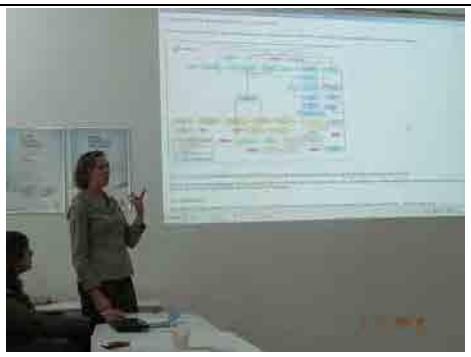
(1) The First Seminar

Originally, a seminar was planned to disseminate the tentative renovation plan of pumping stations and STPs and the first edition of O&M manual of Atuba Sul STP, both of them completed in the second fiscal year. And the seminar was held in November 2013; however the renovation plan was decided to be omitted from the subject of the seminar because SANEPAR considered disseminating the renovation plan to the operation and maintenance staff of STPs to be premature. Instead of the renovation plan, the results of the training in Japan on the Output-2 held in August 2013 were presented in the seminar. The renovation plan was lectured and disseminated for the staff of STP in the second seminar held in July 2015.

The state of implementation of the seminar like date and program, etc. is as shown in Table 5.2-19.

Table 5.2-19 State of Implementation of the Seminar

Date	7th (Thu) and 14th (Thu) November, 2013 (Twice in same program)		
Subject	The results of the training in Japan on the Output-2 O&M manual in Atuba Sul STP		
Participant	Staff in STPs in the Parana state, Staff in the operation control division 42 in 7th November 40 in 14th November		
Program			
Time	Presenter	Belonging	Subject
08:30～09:00	Gil Mochida Kiyohiko Hayashi	USDO JICA team	Opening address
09:00～09:30	Jacqueline Shirado	USEG	Result of the training in Japan
09:30～10:00	Arilson Mendos	URLI	Result of the training in Japan
10:00～10:30	(Coffee break)		
10:30～11:00	Marino Kumegawa	USEG	Result of the training in Japan
11:00～11:30	Alceu Pedrazzi	USEM	Result of the training in Japan
11:30～12:00	Laercio Squiba	USEG	Result of the training in Japan
12:00～13:30	(Lunch)		
13:30～14:00	Cyntia Malaghini	USAV	Process of preparing O&M manual Manual regarding laboratory works
14:00～14:20	Angelica Araujo	USEG	Outline of Atuba Sul STP Manual for screen and grit chamber
14:20～14:40	Alex Cordeiro	USEG	Manual for floatation facility
14:40～15:10	Laercio Squiba	USEG	Manual for sludge dewatering
15:10～15:30	Robson Waltrick	USEM	Manual for E/M equipment
15:30～16:00	Gil Mochida Kiyohiko Hayashi	USDO JICA team	Closing address

	
Presentation at the seminar	**Participants of seminar**

(2) The Second Seminar

The second seminar was held in 15th July 2015 aiming wide dissemination of the renovation plan of STPs and pumping stations supported preparation in the project, O&M manual in Atuba Sul STP etc., the result of activities for improving issues found in the on-site equipment and the information regarding sludge control in UASB tank.

Especially in the second seminar, staff on O&M of STP not only in CMA and the coastal area but also Paranavai in northern and Pato Branco in western Parana could participate to the seminar by using TV meeting system.

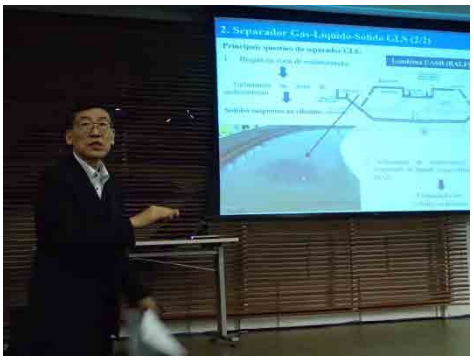
The state of implementation of the seminar like date and program, etc. is as shown in Table 5.2-20.

Table 5.2-20 State of Implementation of the Second Seminar

Date	15th (Wed) July, 2015		
Subject	O&M manual in Atuba Sul STP etc. Result of activities for improving issues found in on-site equipment Information regarding sludge control in UASB tank Renovation plan of STPs and pumping stations		
Participant	Staff in STPs in the Parana state, Staff in the operation control division Number of participants: 87 (including 39 in TV meeting system)		
Program			
Time	Presenter	Belonging	Subject
14:30～14:10	Gil Mochida Kiyohiko Hayashi	USDO JET	Opening address
14:10～14:55	Angelica de Lima de Araujo Alex Augusto Cordeiro	USEG	O&M manual of STPs
14:55～15:25	Robson de Paula Waltick	USEM	Result of activities for improving issues found in on-site equipment
15:25～15:40	(Coffee break)		
15:40～16:40	Ryunan Matsue	JET	Sludge control in UASB tank
16:40～17:00	Cleverson Roberto Bogo	USDO	Renovation plan of STPs and pumping stations
17:00～17:10	Gil Mochida	USDO	Closing address

	Kiyohiko Hayashi	JET	



Presentation at the seminar

Participants of the seminar

Chapter 6 Activities for Output 3

6.1 Output Expected

The outcomes expected under the Project are as shown in Table 6.1-1.

Table 6.1-1 Output Expected

Year	Activity No.	Outputs to be achieved in each year	Indicator
1st	3-1	Conduct a baseline survey on the WTPs in CMA and coastal area	3-1 Rehabilitation/renewal plan for water treatment plants developed by the Project is approved by the management level of SANEPAR. 3-2 Annual budget plan, including sludge treatment, is elaborated based on the rehabilitation /renewal plan.
	3-2	Organize a Standard Operation Procedure (SOP) team for WTPs	
	3-3	Conduct training courses on O&M of WTP for operators including SOP members	
	3-4	Review/develop manual(s) for O&M of WTPs	
2nd	3-4	Review/develop manual(s) for O&M of WTPs (continuation)	
	3-5	Formulate a plan for rehabilitation and renewal of WTPs	
	3-6	Study on introduction of advanced treatment facility for removal of algae	
	3-7	(Tentative) Implement a pilot project for advanced treatment based on the result of the study conducted in Activity 3-6	
	3-8	Conduct monitoring of performance indicators (actual results) on O&M of WTPs	
	3-9	Conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of WTPs	
	3-10	Conduct a survey on the improvement of the existing DAF system, and conduct a pilot project for improving the existing DAF system (by SANEPAR's financial resources)	
3rd	3-4	Develop manual(s) for O&M of WTPs (provide support continuously by considering the results of previous fiscal year)	
	3-5	Provide supports to decide suitable specification and to select appropriate equipment in accordance with the formulated rehabilitation and renewal plan (provide support continuously by considering the results of previous fiscal year)	
	3-7	Implement the pilot project for advanced treatment (provide support continuously by considering the results of previous fiscal year)	
	3-8	Conduct monitoring of performance indicators (actual results) on O&M of WTPs	
4th	3-4	Develop manual(s) for O&M of WTPs (provide support continuously by considering the results of previous fiscal year)	
	3-7	Implement the pilot project for advanced treatment (provide support continuously by considering the results of previous fiscal year)	
	3-8	Conduct monitoring of performance indicators (actual results) on O&M of WTPs	
	3-9	Provide supports to conduct workshop/seminar to disseminate the O&M manual and rehabilitation/renewal plan of WTPs	

The “Activity 3-10 (technical assistance regarding DAF system improvement at Irai WTP)” had

been so planned as to be completed in the second FY. However, C/P (SOP team) and JET continued this activity as one of the necessary activities till the end of the Project in response to C/P's needs.

6.2 Result of Activities

6.2.1 (Activity 3-1) Baseline Survey on WTPs in CMA and Coastal Area

(1) Purpose and Significance of Activity

Purpose of this activity is to comprehend the actual situation and problems regarding O&M for the target five WTPs through visual inspection of the facilities and interview with the concerned O&M staff.

(2) Methodology and Procedure of Activity

By using the following methods, baseline survey on five target WTPs in CMA and coastal area was conducted.

① Collection of existing data and information;

② Field survey on all facilities;

③ Interview with C/Ps of SANEPAR (including technical discussion meeting etc.);

④ Simple water quality survey on each treatment process unit of Praia de Leste and Irai WTPs, and

⑤ Analysis on the raw water and treated water quality data provided by SANEPAR

(3) Result of Activity

Through this activity, present situation and major issues to be tackled with in the target WTPs were identified and those are summarized in Table 6.2-1.

Table 6.2-1 Major Issues of the Existing WTPs

WTP	Major Issues
Irai (Capacity: 3,200 L/s, Process: Coagulation + DAF + Filtration)	• Recently, cyanobacteria bloom was identified sometimes in Irai Dam although the water quality has been improved comparing with that of 2001. • The results of additional water quality survey indicated that the removal efficiency of color and turbidity in the existing DAF system was poor, which resulted in high pressure on subsequent filtration system. • Poor float removal due to mechanical failure of existing screw conveyor system.
Praia de Leste (Capacity: 780 L/s, Process: Coagulation + Sedimentation + Filtration)	• The results of simple water quality survey indicated that color was removed effectively by the existing treatment system. • Over dosage of coagulants may be applied (Jar Test). • Untreated backwashed water is discharged into river due to dewatering machine's trouble.
Saiguacu (Capacity: 265 L/s, Process: Coagulation + Sedimentation + Filtration)	• Based on the data base, color has been removed effectively by the existing treatment system. However, sometimes turbidity of treated water is over the standard. • Untreated backwashed water is discharged into river due to dewatering machine's trouble.
Morretes (Capacity: 35 L/s, Process: Direction filtration)	• Turbidity and color increase in wet weather conditions. • No feedback from central laboratory for water quality analysis results. • Residual chlorine concentration (3.3 mg/L on average) in treated water is higher than its normal level.
Guaraguecaba (Capacity: 15 L/s, Process: Direction filtration)	• Turbidity increase in wet weather conditions. • No feedback from central laboratory for water quality analysis results.

(4) Tasks to Be Addressed

Tasks to be addressed are summarized in Table 6.2-1.

(5) Actions to Be Taken

JET discussed with the C/Ps about major issues of the existing water treatment plants and available countermeasures. The results of discussion are summarized in Table 3.4-9.

Table 6.2-2 Results of Discussion on Actions to Be Taken

WTP	Possible Countermeasures
Irai	• Algae control in source (such as application of ultrasonic waves) • Introduction of DAF pump, injection nozzles and contact zone. • Change float removal type (from mechanical to hydraulic system) and improvement of existing screw conveyor system.
Praia de Leste	• Optimization of coagulation and sedimentation (reduction of coagulants dosage etc.) • Application of sludge drying bed Or new dewatering machine
Saiguacu	• Cleaning sedimentation basin appropriately to prevent carryover of floc. • Application of sludge drying bed or new dewatering machine.
Morretes	• Construction of raw water storage tank or treated water reservoir. • Establishment of feedback system from central laboratory for water quality analysis results.

WTP	Possible Countermeasures
Guaraguecaba	• Construction of raw water storage tank or treated water reservoir. • Establishment of feedback system from central laboratory for water quality analysis results.

6.2.2 (Activity 3-2) Organization of a Standard Operation Procedure (SOP) Team for WTPs

(1) Purpose and Significance of Activity

SOP team members were nominated from SANEPAR in order to conduct activities defined under the Project in collaboration with the JET. The tasks for the SOP team for the Output 3 are to conduct Project's activities including preparation of O&M manual for WTP, preparation of rehabilitation & renewal plan, and implementation of pilot experiment for advanced treatment process.

(2) Methodology and Procedure of Activity

With the support of JET, a series of weekly meetings were held once a week. These weekly meetings were used to share the results of activities performed and actions to be taken in the following week between JET and the SOP team.

(3) Result of Activity

Key members of SOP team are as shown in Table 6.2-3.

Table 6.2-3 Key Members of SOP Team for Output 3

SOP team	Agenor Zarpelon	SOP team leader, USAG
	Rita de Cassia Gomy Becker	Irai WTP, USPD
	Alcely Jose Wosmiak	Chemistry of WTP, USPD
	Arilson Mendes	WTPs in Coastal Area, URLI
	Wandir Nogueria Rocha	Assist SOP leader, USAG
	Carlos Eduardo Frreira da Silva	Assist SOP leader, USAG
	Carlos Rattimann	Assist SOP leader, USAG
	Fabio Wolanski de Lima	Assist Ms. Rita and Mr. Alcely, USPD
	Celia Caramuru Cezar	Assist Ms. Rita, USPD
	Ladislau A. de Oliveria	Assist Mr. Arilson, URLI
	Marcio Arakaki	Assist Ms. Rita and Mr. Alcely, USPD

(4) Tasks to Be Addressed

In order to carry a formulated renewal & rehabilitation plan and pilot experiment into practice, DI (in charge of investment) and CETS (in charge of technological development) are necessary.

However, there were no members from those sections in the SOP team at the initial stage of the Project in the first fiscal year.

(5) Actions to Be Taken

For the above reason, concerned staffs from DI and CETS were invited the SOP team as needed basis. However, to ensure smooth internal approval or coordination in SANEPAR, participation of staffs from the both sections is required on a continuous basis. Therefore, to carry on the activities even after the completion of the Project, it is desirable for SANEPAR to encourage participation to the SOP team not only from DO (in charge of O&M) but also DI and CETS.

6.2.3 (Activity 3-3) Implementation of Training on O&M of WTP

(1) Purpose and Significance of Activity

Basically, actual activities of the project have been conducted by the members of SOP team and JET. However, cooperation of O&M operators is necessary for conducting survey on five target WTPs and developing O&M manuals. In order to introduce technology of advanced treatment for removing algae and toxins as well as O&M of WTP, a seminar was planned for operators of WTPs including SOP members.

(2) Methodology and Procedure of Activity

For the first seminar held in the first fiscal year, the JET and the SOP team jointly organized the seminar and prepared seminar material. Considering the fact that 1) The treatment processes applied in the WTPs of coastal area and Irai WTP are different, and 2) Cost for transportation and accommodation may be a burden to C/P staff, the seminars were separately held in Curitiba and coastal area respectively.

After the second fiscal year, the SOP team proactively took initiative in organizing and preparing seminars on O&M of WTP.

(3) Result of Activity

The program of the seminar is summarized in Table 6.2-4 and Table 6.2-5. Photos of the seminars are showed as followings.

Table 6.2-4 Program of the Seminar for O&M of WTP (for Coastal WTPs)

Date	Feb. 21 (Thu.), 2013	
Venue	Meeting room of Matinhos STP	
Participants	21 (Operators of WTPs in coastal area, SOP members, SANEPAR staff etc.)	
Time	Contents	Presenter

09:10-09:15	Opening address	SOP team Mr. Wandir
09:15-09:30	Outline of the project and purposes and schedule of Output 3	JICA Expert Mr.Hayashi
09:30-09:50	Purposes and tasks of water treatment	SOP team Mr. Wandir
09:50-10:20	Appropriate coagulation and flocculation	JICA Expert Mr.Uchida (Mr.Obara)
10:20-11:20	Color, Fe, Mn Treatment and THM countermeasures in WTP	JICA Expert Mr.Uchida (Mr.Matue)
11:20-12:00	Discussion	
12:00-13:00	(Lunch)	—
13:00-13:30	O&M manual review & improvement	SOP team Mr. Fabio
13:30-14:10	O&M for electrical/mechanical equipment and instrument	JICA Expert Mr.Obara
14:10-15:00	Discussion	
Main topics & comments	1) Analysis water quality parameters and results interpretation of Jar test 2) Countermeasures for flow rate variation 3) By products of ClO_2 4) O&M manual formation (simple and easy-to-use style, figures and photos should be applied)	
Attempted measures to facilitate active discussion	1) Preparation of tailor-made presentation material that considered present conditions and problems to be tackled for individual WTPs. 2) Analysis exercise to interpret the result of Jar-Test using actual data obtained through practical O&M of WTP	

Coastal Area

Table 6.2-5 Program of the Seminar for O&M of WTP (for Irai WTP)

Date	Feb. 25 (Mon.), 2013	
Venue	Meeting room of SANEPAR training center	
Participants	16 (Operators of Irai WTP, SOP members, SANEPAR staff etc.)	
Time	Contents	Presenter
08:30-08:45	Opening address	SOP team Mr. Wandir
08:45-09:05	Outline of the project and purposes and schedule of Output 3	JICA Expert Mr.Hayashi
09:05-09:35	Purposes and tasks of water treatment	SOP team Mr. Wandir
09:35-10:00	Appropriate coagulation and flocculation	JICA Expert Mr.Uchida (Mr.Obara)
10:00-11:20	Cyanobacteria and control technologies in source water	JICA Expert Mr.Matue
11:20-12:00	Discussion	
12:00-13:30	(Lunch)	―
13:30-14:30	Cyanobacteria, cyanotoxins and their removal technologies in WTP	JICA Expert Mr.Matue
14:30-15:00	Discussion	
15:00-15:30	O&M manual review & improvement	SOP team Mr. Fabio
15:30-16:10	O&M for electrical/mechanical equipment and instrument	JICA Expert Mr.Obara
16:10-16:30	Discussion	
Main topics & comments	1) Mechanism and effect range of ultrasonic waves, procurement of sonicator 2) Contact zone for saturated water and floc 3) Measuring method of air bubble size in DAF system 4) DAF pump 5) Necessary water quantity for hydraulic float removal system 6) Process and efficiency of ozonation and GAC 7) O&M manual format etc.	
Attempted measures to facilitate active discussion	1) Incorporate water quality monitoring result for Irai Dam and possible proposed measures into the presentation material. 2) Analysis of problem and proposal of measures to be taken for the existing DAF system in Irai WTP. 3) Introducing participatory approach in the sessions in order to facilitate active debate among problem-conscious staffs.	

Curitiba

The content of the seminars held in the second fiscal year and after are summarized in Table 6.2-6.

Table 6.2-6 Seminars/OJTs Held in and after the Second Fiscal Year

Year	Date	Major topic of the Seminar	Number of attendants	Type
2nd FY	18/Jul/2013	A simple method to measure concentration of organic substances in raw water and treated water.	4	OJT
3rd FY	13/Nov/2014	• Energy-saving efforts in O&M of water supply facilities. • Removal of humic acid using magnetic ion exchange resin (MIEX resin). • A simple method for fluorine removal. • Problems in WTP operation in Coastal Area and its countermeasures.	53	Seminar

(4) Tasks to Be Addressed

Some operators could not attend the seminar/OJT due to difficulties in coordinating his/her working shift.

(5) Actions to Be Taken

To increase places and opportunities for operators to attend seminars/OJTs as much as they can, special considerations should be given such as a) holding same seminars/OJTs in different places, and/or b) dispatching trainer(s) to the site where operators can easily attend without being disturbed by their working shift.

6.2.4 (Activity 3-4) Review/Development of manual(s) for O&M of WTP

(1) Purpose and Significance of Activity

The main contents of the "Activity 3-4" are: a) joint review of existing available O&M manual by C/P (SOP team) and JET, and b) preparation, trial use and updating the O&M manual. These activities aim to help SOP team to operate target WTPs effectively by using prepared O&M manual, and to update the O&M manual even after withdrawal of JET.

(2) Methodology and Procedure of Activity

The SOP team continued to collect the information on existing documented procedures and manuals for WTPs of Iraí and Iguacu to review the contents under the assistance of JET during the first and the second fiscal year. The findings of review are summarized in the following table.

Table 6.2-7 Summary of Findings for Review of Existing Manuals

Irai WTP	WTPs in Coastal Area
- Change over for process or chemical are not properly updated (e.g., disinfectant process has been changed from chlorine dioxide to liquid chlorine gas) - Several changes including sludge disposal and plant water distribution are not properly mentioned. - Name of equipment is available however no information on practical procedure for maintenance. - The existing manuals are not practically/effectively utilized due to poor appearance and over-sized volume.	- Manual does not exist. - Only documented procedures on water quality analysis are fragmentally exists.

Considering the above result of review of existing manuals, SOP team and JET concluded that the manual for the target WTPs should be prepared with the following ways.

- The manual should be operator-friendly, by using photos and figures as much as possible.
- The manual should be separately prepared for Iraí WTP (DAFF process) and for WTPs in coastal area (conventional coagulation, flocculation sedimentation and filtration process).
- As for the manual for Irai WTP, the existing manual should be fully utilized so the SOP team can save time and work volume to prepare the manual. Only necessary addition/correction should be done to update the existing manual.
- As for the manual for four WTPs in coastal area, manual for Praia de Leste WTP should be prepared first. Then manuals for other three WTPs will be prepared with reference to the Praia de Leste's manual as an example.
- The contents of manual should be as follows:

  – Outline (overall description of WTP and function)

- Treatment process (including treatment flow and role of each process)
- Water quality management (including sampling points, frequency of sampling, procedure for water quality analysis, decision of dosage rate for chemicals and procedure for Jar test)
- Operation (including operation of facility/equipment and decision of volume of chemical)
- Reference material (including definition of terms, catalogues and technical reports)

(3) Result of Activity

In line with the above orientation, the SOP team continues preparation of the draft version of O&M manuals for WTPs of Irai (see Annex A11-6) and Praia de Leste, with the assistance of JET. Following activities have been done during the Project period.

- The draft version of O&M manual for Irai WTP was distributed to the operators of Irai WTP, and the manual for Praia de Leste WTP for the operators of WTPs in the coastal area (WTPs of Praia de Leste, Morretes, Saiguacu and Guaraquecaba), in order to collect their feedbacks to update the draft version of the O&M manuals.
- A seminar on O&M manual was held to share current problems and difficulties in actual operation of WTPs especially for operators of WTPs in coastal area, including target WTPs in coastal area (WTPs of Praia de Leste, Morretes, Saiguacu and Guaraquecaba) and other WTPs in this area. In addition, comments and feedbacks of the draft version of O&M manual, and other technical topics which the operators were concerned about were discussed at the seminar.
- The updated manuals that are reflecting comments and feedbacks by operators are being used in WTPs of Irai and Praia de Leste.
- With reference to the manual for Praia de Leste WTP, draft version of the manuals have been prepared in the WTPs of Saiguacu, Morretes and Guaraquecaba.

(4) Tasks to Be Addressed

How to and who (which position) will update the O&M manuals that have been prepared and updated under the activities of the Project are the main concern about ensuring sustainability of future improvement of the manuals after the withdrawal of JET.

(5) Actions to Be Taken

Since the beginning of the Project, SANEPAR and JET have jointly held seminars to disseminate the importance of improvement of O&M manuals (including shortcoming of the existing manuals, indicating an area of improvement, and necessity of improvement of manuals

for practical use) to the operators of WTPs and other concerning staff of SANEPAR. It is recommended that the same sort of seminar should be held for the purpose of ensuring further dissemination of the O&M manuals and decide who (which position) will be responsible for the updating of O&M manual after completion of the Project. Since SANEPAR is also beware of the importance of future updating and further dissemination of O&M manual to other WTPs, SANEPAR has decided that the SOP members who played principal role for this activity will take initiatives in those tasks, acting as facilitators to duplicate similar activities. Following figure illustrates immediate role-sharing among concerned sections under DO.

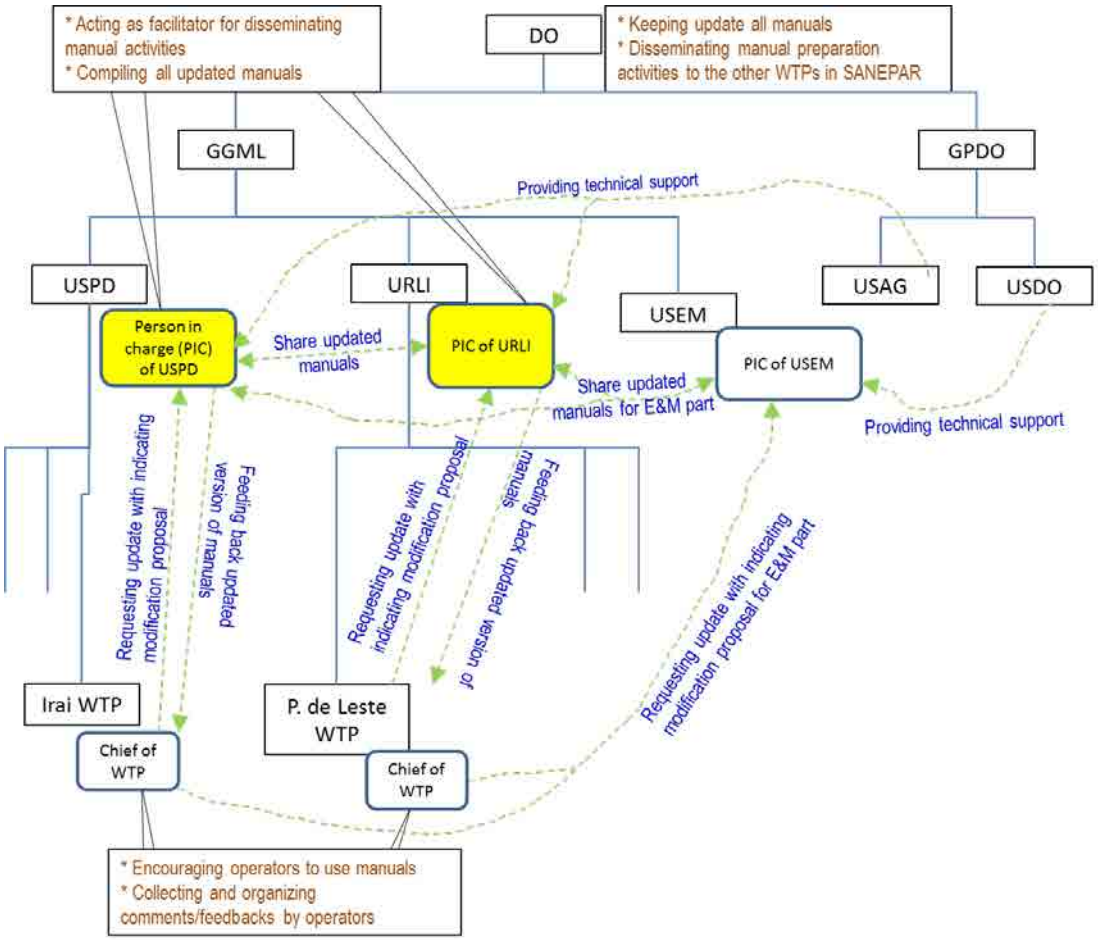


Figure 6.2-1 Role-sharing for Activities for O&M Manual after the Project

In SANEPAR, documents regarding instructions and procedure that can be referred for O&M are stored on its systems in electronic data. It is recommended that at least one set of manual should be printed out so that it can be always available even in case of system failure which may be caused by accidents or disasters.

6.2.5 (Activity 3-5) Assistance of Implementation of Rehabilitation and Renewal Plan

(1) Purpose and Significance of Activity

SAPEPAR has drafted a master plan, "Sistema de Abastecimento de Agua Integrado de Curitiba" (SAIC), for Curitiba Metropolitan Area (CMA) with its target year up to 2040. This master plan presents expansion plan of supply system in order to catch up potential demand increase in the future. However, the master plan does not include rehabilitation or renewal plan to maintain sound function for individual water treatment plants (WTPs).

With the above mentioned background, following activities have been conducted under the Project.

- Rehabilitation and renewal plan is for the purpose of mid- & long-term planning for rehabilitation and renewal for WTPs of Iraí, Praia de Leste, Saiguaçú, Morretes, Guaraqueçaba.
- Preparation of the Rehabilitation & Renewal Plan aims to reveal the prospect of mid- & long-term disbursement with respect to rehabilitation and renewal works for target WTPs.
- Preparation of the Rehabilitation & Renewal Plan also aims to reflect the viewpoints and opinions of staff who are engaged in daily operation and maintenance works through proactive discussion among DI's staff (in charge for planning/investment) and DO's staff (in charge for operation & maintenance).

(2) Methodology and Procedure of Activity

The rehabilitation and renewal plan has been prepared proactively by the SOP (Standard Operation Procedure) Team members for Output 3 (Operation and Maintenance for WTPs) with the assistance of JET. The members of SOP Team for Output 3 consists of DO (Diretoria de Operaçoes: in charge for operation & maintenance) and DI (Diretoria de Investimentos: in charge for planning & investment) of SANEPAR staff.

Procedure and schedule of the Rehabilitation & Renewal Plan has been prepared based on the discussion among SOP Team and JET. The procedure for the preparation is as follows.

- Sharing same view on procedure & policy between executives of DO & DI of SANEPAR, SOP Team and JET (obtaining consensus among the parties concerned before starting work) .
- Identification of target facilities/equipment, and collecting/organizing basic information on facilities & equipment (e.g., specifications, drawings, interview with operational staff).
- Evaluation for necessity of rehabilitation/renewal and severity of deteriorated conditions of target facilities/equipment from the physical and functional aspects.

- Preparing draft plan (including discussion on timing & cost for rehabilitation & renewal)
- Obtain approval by executives of DO & DI on draft plan.

(3) Result of Activity

With reference to the result of the diagnosis work, the SOP team has reviewed the contents of the rehabilitation and renewal plan including necessary work and its work volume, equipment to be procured, its priorities and its preliminary cost in accordance with the above basic policy. "Manual de Obras de Saneamento, 4a ed.", which provides the standard price and method of cost estimation for SANEPAR's project, and/or otherwise actual record on works/procurement for past project at the targeted WTPs or at the other similar scale WTPs are referred to in cost estimation.

Further, priorities are given in the following manner.

- Priority 1: to be implemented between 2015 and 2017
- Priority 2: to be implemented between 2017 and 2020
- Priority 3: to be implemented between 2020 and 2023

Following tables outlines the contents of the Rehabilitation & Renewal Plan for each WTP. The final output, which includes result of the diagnosis of existing facility/equipment and rehabilitation & renewal plan, are available in Annex A11-7.

Table 6.2-8 Outline of Rehabilitation & Renewal Plan - Iraí WTP

Civil

Priority	Target facilities/equipments	R$
1	Sludge treatment facility	2,000,000
1	Modification of existing DAFF	3,200,000
1	Floated sludge tank	500,000
2	Chemical and powdered activated carbon house	400,000
2	Filter	2,500,000
2	Control room	450,000
3	Intake facility	80,000
3	Flocculators	800,000
	Total	***9,930,000***
	Priority 1	5,700,000
	Priority 2	3,350,000
	Priority 3	880,000

Electromechanical

Priority	Target facilities/equipments	R$
1	Saturator	900,000
1	Sludge removal (Scraper)	3,000,000
1	Sludge removal (washing water return pump)	240,000
1	Chemicals (Aluminum sulfate dosing facility)	650,000
1	Sludge dewatering (Sludge dewatering facility)	6,000,000
2	Quiick mixer	75,000
2	Others	395,000
3	Slow mixer	300,000
1	Supervision and Control - OCC: Operation Control Center - PLC : Programmable Logical Controllers - FMS Profibus Communication Protocol	490,000
3	Supervision and Control - Asi Communication Protocol - PA Profibus Communication Protocol - DP Communication Protocol	1,665,000
	Total	***13,715,000***
	Priority 1	11,280,000
	Priority 2	470,000
	Priority 3	1,965,000

Table 6.2-9 Outline of Rehabilitation & Renewal Plan - Praia de Leste WTP

Civil

Priority	Target facilities/equipments	R$
1	Intake	720,000
1	Sedimentation basin	850,000
1	Filters	430,000
1	Sludge treatment	90,000
2	Flocculation basin	180,000
3	Treated water reservoir at the WTP	480,000
3	"Chemical house:	610,000
	Total	***3,360,000***
	Priority 1	2,090,000
	Priority 2	180,000
	Priority 3	1,090,000

Electromechanical

Priority	Target facilities/equipments	R$
1	Sludge dewatering facility	480,000
1	Washing water / Sludge reuse tank	160,000
2	Chemicals Facility	94,000
2	Various maintenances	50,000
1	Supervision and Control - OCC: Operation Control Center	60,000
2	Supervision and Control - PLC : Programmable Logical Controllers - Asi Communication Protocol - DP Communication Protocol - Communication equipment / Sensor connection boxes / Solenoid islands	315,000
3	Supervision and Control - PA Profibus Communication Protocol	70,000
	Total	***1,229,000***
	Priority 1	700,000
	Priority 2	459,000
	Priority 3	70,000

Table 6.2-10 Outline of Rehabilitation & Renewal Plan - Morretes WTP

Civil

Priority	Target facilities/equipments	R$
1	Sludge Treatment	60,000
2	Intake facility	100,000
2	Upflow filter unit	70,000
3	Clear water reservoir	100,000

Priority	Target facilities/equipments	R$
3	Chemical house	150,000

Total	***480,000***
Priority 1	60,000
Priority 2	170,000
Priority 3	250,000

Electromechanical

Priority	Target facilities/equipments	R$
1	Chemical injection facility	45,000
2	Various maintenance	35,500

Total	***80,500***
Priority 1	45,000
Priority 2	35,500
Priority 3	0

Table 6.2-11 Outline of Rehabilitation & Renewal Plan - Saiguaçú WTP

Civil

Priority	Target facilities/equipments	R$
1	Sludge Treatment	60,000
1	Clear water reservoir	240,000
2	Sedimentation basin	435,000
2	Filters	285,000
3	Intake facility (parshall flume)	15,000
3	Flocculation basin	700,000
3	Chemical house	940,000

Total	***2,675,000***
Priority 1	300,000
Priority 2	720,000
Priority 3	1,655,000

Electromechanical

Priority	Target facilities/equipments	R$
1	Installation of the sludge dewatering equipment	215,000
2	Washing water / Sludge reuse tank	25,000
1	Chemical injection facility - Rotâmetro dosagem de Cloro Gás - Clorador - Tubulações de dosagem de cloro - Bombas de dosagem PAC	135,000

Priority	Target facilities/equipments	R$
2	Chemical injection facility - Sistema de dosagem de Cal- bombas dosadoras / agitadores - Sistema de dosagem de Cal- Válvulas pneumáticas / posicionadores - Bomba de arraste sistema de dióxido de cloro - Tubulação bombas de arraste sistema de dióxido de cloro - Tanque de ácido fluorssilicico - Bombas de dosagem Acido fluorssilicico - Tanques de PAC	162,000
3	Chemical injection facility - Chlorination house	3,000
1	Various maintenances - Outsource the maintenance of damaged equipment (High priority)	9,500
2	Various maintenances - Outsource the maintenance of damaged equipment (Medium priority)	28,000
3	Various maintenances - Outsource the maintenance of damaged equipment (Low priority)	5,000
1	Supervision and Control - communication equipment / control valves / solenoid islands	15,000
2	Supervision and Control - OCC: Operation Control Center - PLC : Programmable Logical Controllers - Asi Communication Protocol	210,000
3	Supervision and Control - PA Profibus Communication Protocol	100,000
	Total	***907,500***
	Priority 1	374,500
	Priority 2	425,000
	Priority 3	108,000

Table 6.2-12 Outline of Rehabilitation & Renewal Plan - Guaraqueçaba WTP

Civil

Priority	Target facilities/equipments	R$
1	Sludge Treatment	30,000
2	Upflow filter unit	54,000
3	Clear water reservoir	80,000
3	Chemical house	150,000
	Total	***314,000***
	Priority 1	30,000
	Priority 2	54,000
	Priority 3	230,000

Electromechanical

Priority	*Target facilities/equipments*	*Priority*
1	Chemical injection facility	75,000
2	Intake pumps	75,000
2	Various maintenances	40,000
	Total	***190,000***
	Priority 1	75,000
	Priority 2	115,000
	Priority 3	0

(4) Tasks to Be Addressed

SANEPAR has repeatedly been suffered from deterioration and breakdown of existing electromechanical equipment due to mismatching of specification. Without giving full attention to specification (e.g., required capacity, function and material) of electromechanical equipment to be procured, same failure will be repeated. Accordingly, follow up activities (implementation of the rehabilitation and renewal plan, especially for how to determine specification of electromechanical equipment to be procured) were conducted in the 3rd fiscal year.

(5) Actions to Be Taken

Following activities should be continued after the completion of the Project.

- Discussion to identify problems and/or points to be improved among concerned staff of the target 5 WTPs.
- Preparation of draft tendering document for future procurement (if draft tender documents are always available, responsible staff can secure enough time to brush up the content of the tender document prior to the purchase order).

6.2.6 (Activity 3-6) Supporting Implementation of Advanced Treatment Pilot Project

(1) Purpose and Significance of Activity

Recently (such as in 2012), cyanobacteria bloom was identified sometimes in Iraí dam although the water quality has been improved comparing with that of 2001. In order to remove algae/cyanobacteria of raw water, a dissolved air flotation (DAF) process has been applied. However, there are some limitations for the process to remove T&O, THM precursor and dissolved cyanotoxins. Therefore, it is necessary to carry out a study on introduction of advanced treatment facility.

(2) Methodology and Procedure of Activity

The objectives of the study are to select optimal advanced treatment process for existing Iraí WTP and to conduct a feasibility study on the selected advanced treatment process from the point of view of effectiveness, economy, operation and maintenance requirements. Following chart illustrates procedure of the feasibility study.

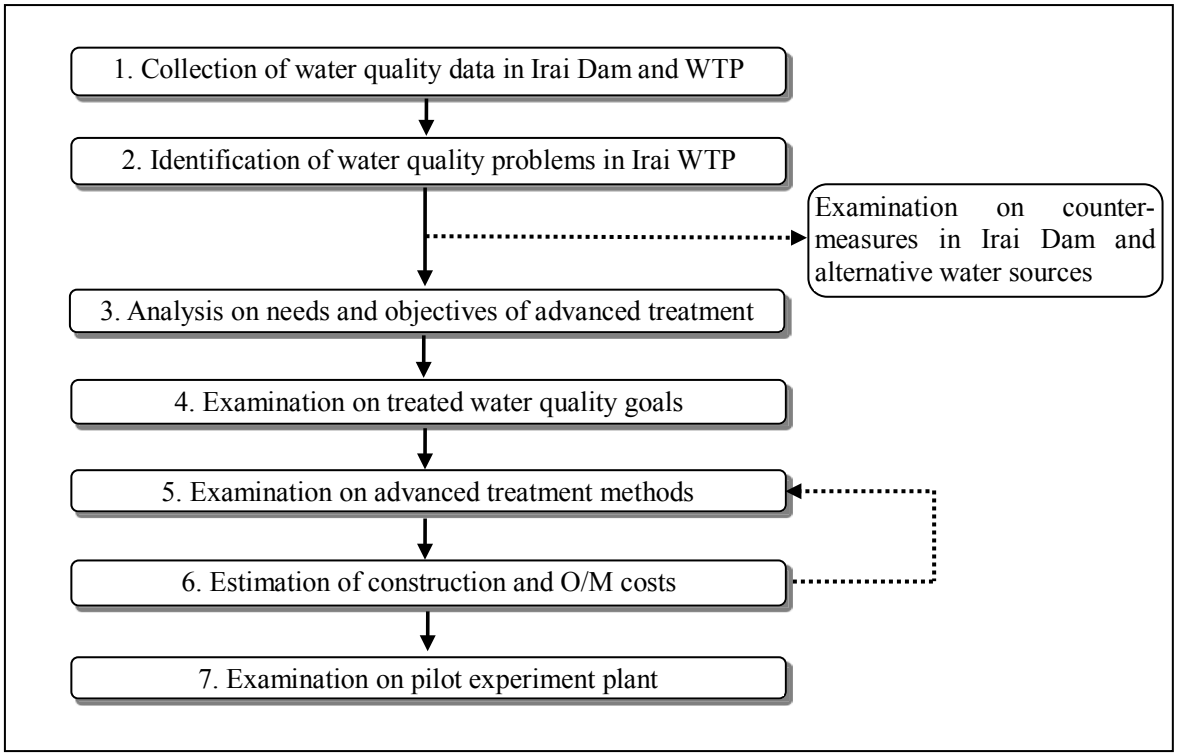


Figure 6.2-2 Procedure for the Study

(3) Result of Activity

Ozonation (O3), granular activated carbon (GAC), O3+GAC, nanofiltration (NF) membrane are selected and compacted from the point of view of efficacy, by-productions formation, required O&M levels and land requirement etc. Finally O3+GAC is selected as optimal advance treatment process for achieving water quality goal. Details of the study are shown in the report for "Feasibility Study on Introduction of Advanced Treatment Facility for Removal Algae" that is attached to this report as Annex A11-8.

Construction costs, O&M costs and total annualized costs for O3+GAC C process are summarized in the following table. In case of introduction of the advanced treatment, O&M cost and total annualized costs will be increased up to app. 0.2 R$/$m^3$ and 0.4 R$/$m^3$. From the point of view of economic and financial, O3+GAC process is feasible

Table 6.2-13 Summary of Costs Estimation (price in 2013)

Items	Contents	Remarks
Construction costs	160.4 million R$	
O&M costs	0.195 R$/$m^3$	Current production cost is app. 0.2 R$/$m^3$.
Total annualized costs	0.373 R$/$m^3$	Including O&M costs and annualized capital costs

(4) Tasks to Be Addressed

A preliminary cost for introduction of advanced treatment facilities may be forecasted by using cost function. However, without appropriate number of case studies, accuracy of the cost function cannot be secured. Since there are little case studies in Brazil, actual cases examples in Japan were referred in defining cost function formula.

(5) Actions to Be Taken

In case SANEPAR conducts similar study in future, it is recommended that SANEPAR should collect information on other case examples available in Brazil so it can improve accuracy of cost function formula.

6.2.7 (Activity 3-7) Supporting Implementation of Advanced Treatment Pilot Project

(1) Reverse Osmosis RO Treatment Experiment at Araucaria Industrial WTP

(1)-1 Purpose and Significance of Activity

In the second fiscal year, a feasibility study was done based on the existing reports and revealed favorable conclusions that when Reverse Osmosis (later called "RO") of a relatively low pressure would be able to reduce 99% of salinity with total cost around ¥26 /m^3 (0.6R$/$m^3$).

From these results, a pilot plant was set in Araucaria WTP to obtain countermeasures against substantial improvement of water quality of the industrial water plant. The experiment started from April 2014 to inspect 1) effectiveness of introduction of Reverse Osmosis Process, 2) its problems, 3) their solutions and 4) estimated cost.

(1)-2 Methodology and Procedure of Activity

The plant was provided by SANEPAR through lease. It consists of two sets of low pressure RO membranes (Product of Nitto Denko Hydranautics, Product Type ESPA1-4040, Diameter 100mm, Length 1m, Membrane Area 7.9m^2, Spiral Bound Element) that equipped a pump (1.1kW) and a unit of cartridge filter as a protection for the RO.

Raw water was taken from the supply pipe of service main of the Araucaria industrial water directly. The water was introduced to the plant after pretreatment of granular activated carbon (GAC). Incidentally, Sodium Bisulfite solution is dosed by a pump at the point just before the inlet to the plant because the raw water contains residual Chlorine Dioxide.

Before the experiment, JET discussed with C/Ps of SANEPAR about the selection of measuring items and measurement frequency. All of the works including confirmation of situations of the plant, obtaining operational records as well as analyzing water quality results were done by C/Ps of SANEPAR. Outline of the plant is shown in Figure 6.2-3.

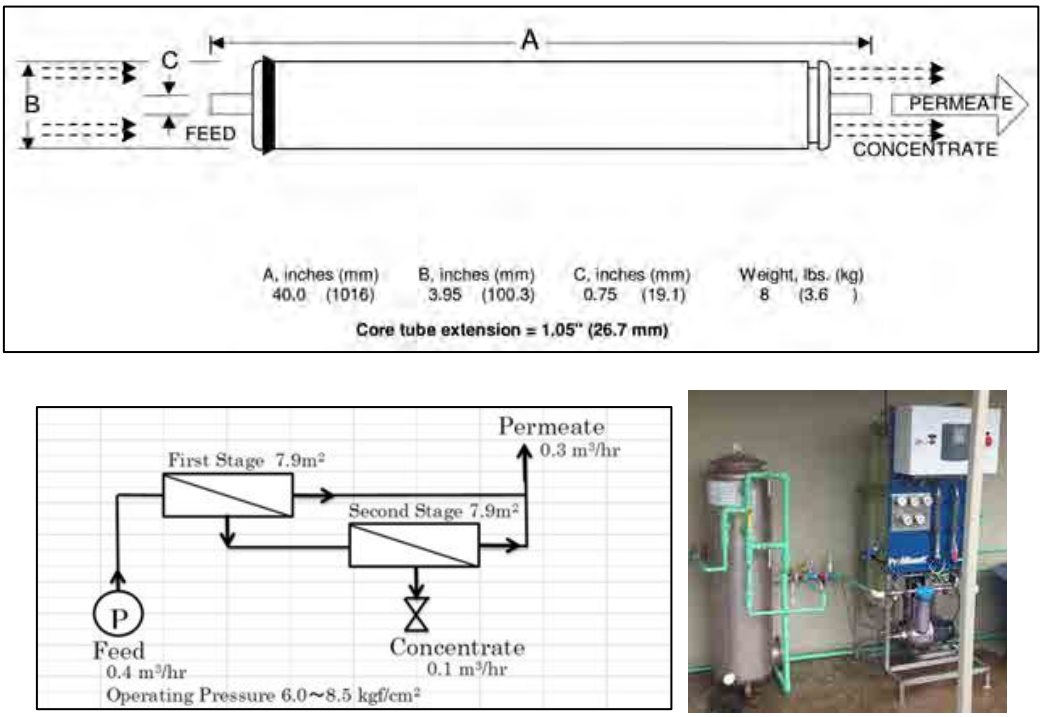


Figure 6.2-3 Outline of Test Plant

(1)-3 Results of Activity

Results of RO Test (Operational Conditions)

As the test is still going on, evaluation work was done from the treatment performance from April 14, 2014 to September 12, 2014 when Araucaria WTP was obliged to stop operation.

Average operational conditions were summarized in Table 6.2-14. At first, raw water supply pressure was increased as to keep amount of permeate constant. However, as those operations caused a rapid increase of supply pressure, operation mode had to be changed to the constant supply pressure mode.

Table 6.2-14 Average Operational Parameters

Parameter	Value
Operating Pressure [kgf/cm^2]	5.650
Flow Rate (Raw Water) [m^3/hr]	0.380
Flow Rate (Permeate) [m^3/hr]	0.280
Flow Rate (Concentrate) [m^3/hr]	0.100
Recovery [-]	0.740
Flux [m^3/m^{2}d]	0.420
Permeability Coefficient K [(m^3/m^{2}d)/(kgf/cm^2)]	0.076

Basically, chemical cleaning was to be done when difference of pressure between raw water supply pressure and concentrate was raised above 15% or saline concentration raised (around 10%). Consequently, chemical cleaning was done for three times. Caustic soda and hydrochloric acid were used as the reagents of chemical cleaning.

Dosing rate of sodium bisulfite and others during the period as well as chemical cleaning were summarized in Table 6.2-15. Incidentally, a slime inhibitor was tested near the end of the period. However, as the long term plant suspension took place just after that, evaluation for the slime inhibitor is not included in this report because of the insufficient test period.

Table 6.2-15 Average Chemical Dosing Rate

Reagent	Prepared Solution for Dosing [%]	Dose Flow [mL/h]	Frequency	Mean Dose Rate [mg/L-Raw Water]	Note
Continuous Dosing					
Sodium Bisulfite SBS ($NaHSO_3$)	2L in 50L Solution	200	Continuous	20	Except From 03/09/14 to 12/09/14
KURIVERTER IK-110 (Slime Inhibitor)	2.5L in 50L Solution	200	Temporally	25	From 03/09/14 to 12/09/14
Chemical Cleaning					
NaOH(Chemical Cleaning Agent)		60 mL/each time	Once a month		
HCl(Chemical Cleaning Agent)		200 mL/each time	Once a month		

Results of RO Test (Performance Evaluation)

Pressure change and practice of chemical cleaning in the period were shown in Figure 6.2-4, flow rate in Figure 6.2-5, electric conductivity in Figure 6.2-6.

As shown in these three figures, operational conditions showed somewhat changes. However, relatively stable conditions were obtained thereafter. After 100 days of operation, rapid decrease of permeability was occurred. Unfortunately, because insufficient data were obtained during those days, major cause could not be identified. The clogging of the first stage of RO element is considered to be the main cause because the pressure of the first stage RO element rose rapidly during that period as shown in Figure 6.2-7.

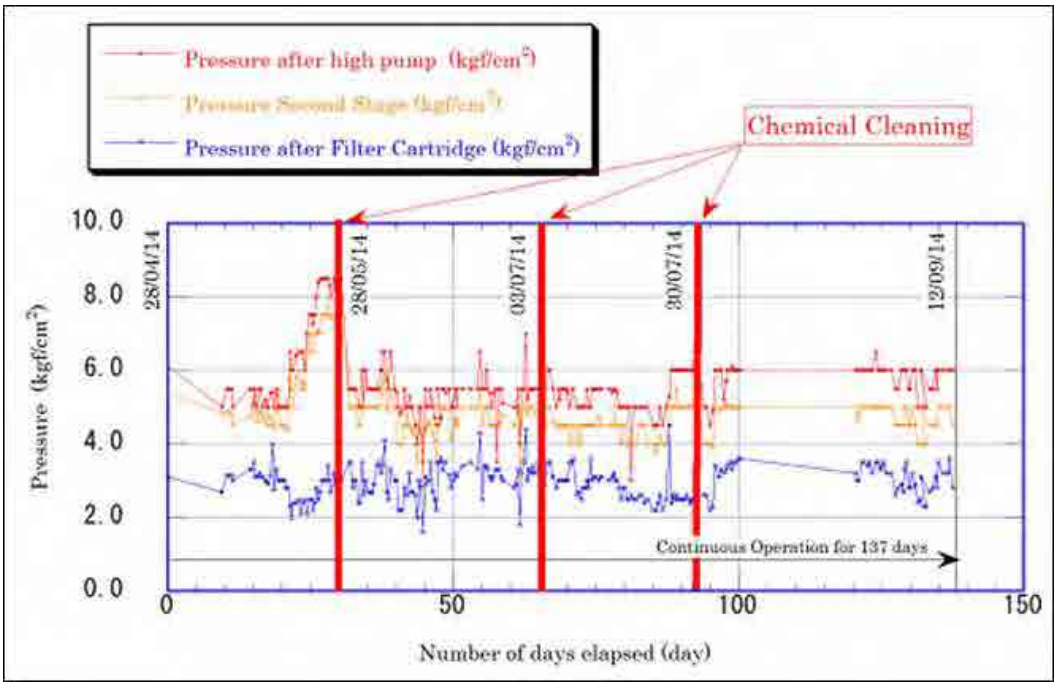


Figure 6.2-4 Operation Progress (Pressure Trend)

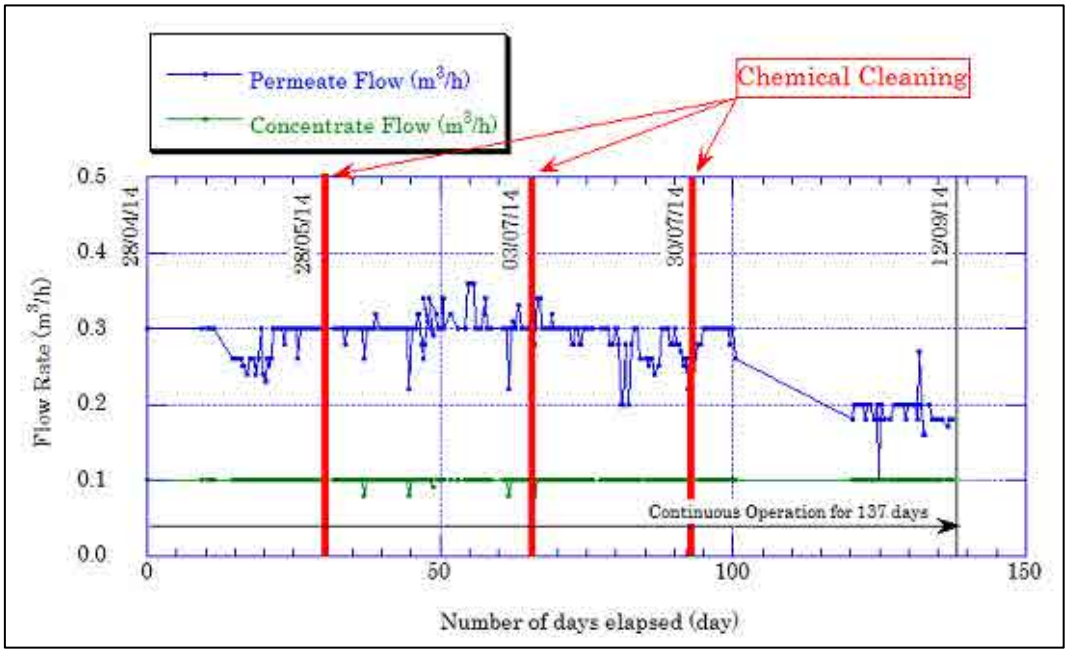


Figure 6.2-5 Operation Progress (Flow Rate Trend)

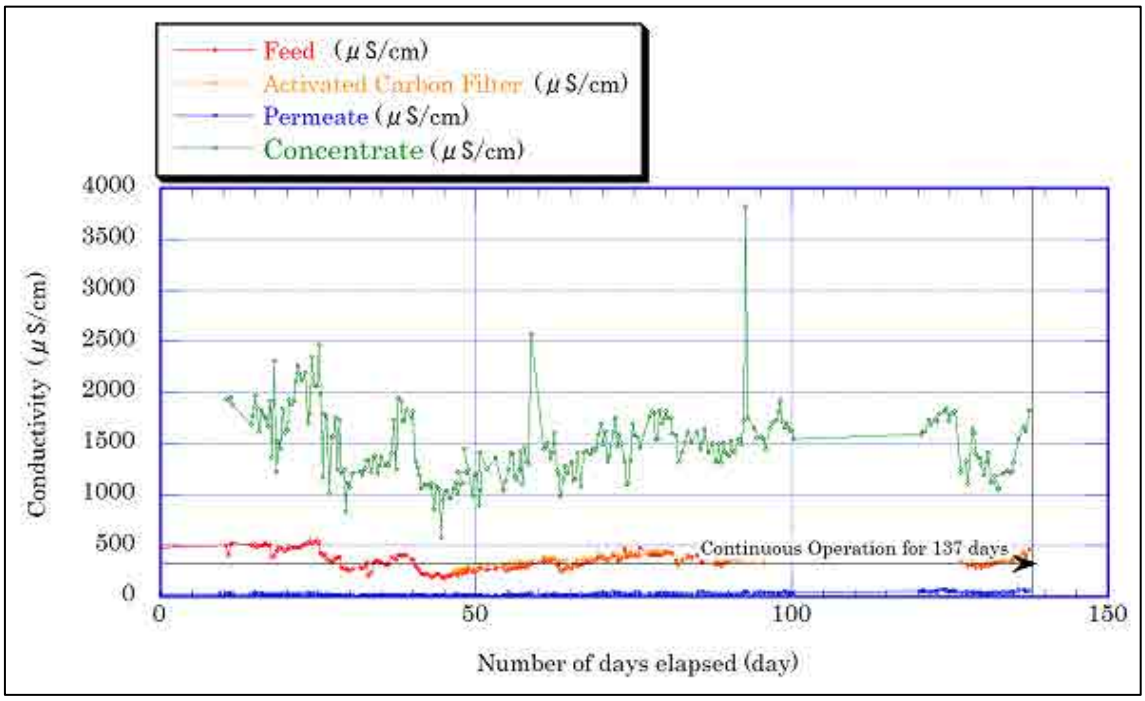


Figure 6.2-6 Operation Progress (Electric Conductivity Trend)

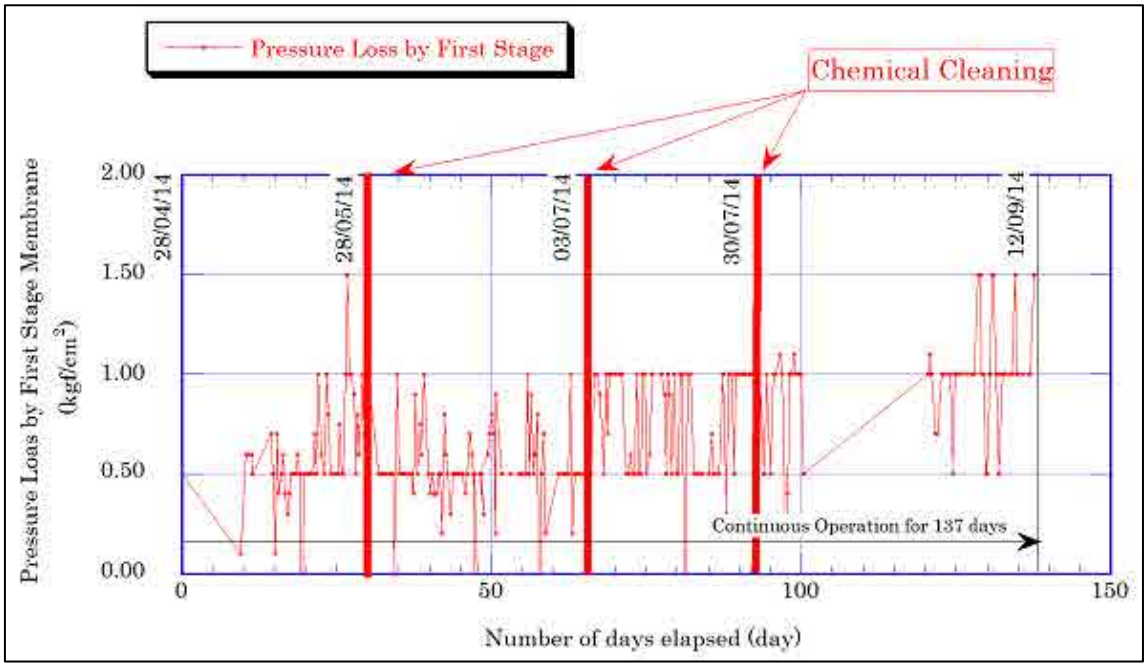


Figure 6.2-7 Operation Progress (Pressure Drop in the First Stage Membrane)

Average removal rates in the period are shown in Figure 6.2-8 while removal trend of major

components are shown in Figure 6.2-9 and Figure 6.2-10.

From those two figures, we can see that in GAC the highest treated component is ABS (79%), then Color (55%), Fluoride (39%), Turbidity (35%). By RO membrane alone, the highest treated component is Hardness (97%), then Chloride･Conductivity (93%), Fluoride (87%), Color (84%), Turbidity (56%). By combination of granular activated carbon (GAC) and RO, we obtained as the highest treated component of ABS (98%), then Hardness (97%), Chloride･Conductivity (93%), Color (93%) and Turbidity (71%). Thus almost all the separation performance was established as high as to the assumption at the beginning.

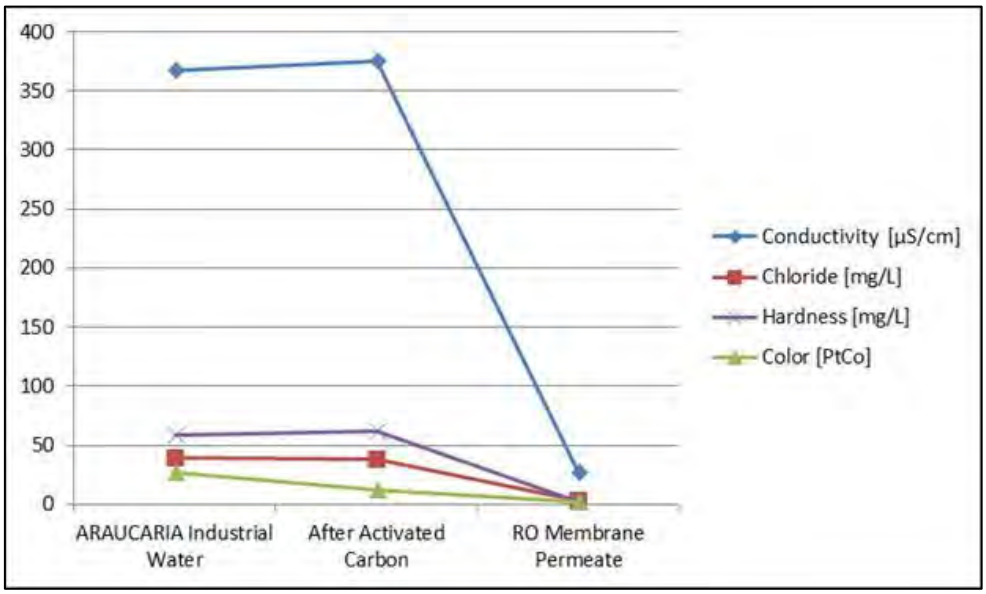


Figure 6.2-8 Average Removal Rate

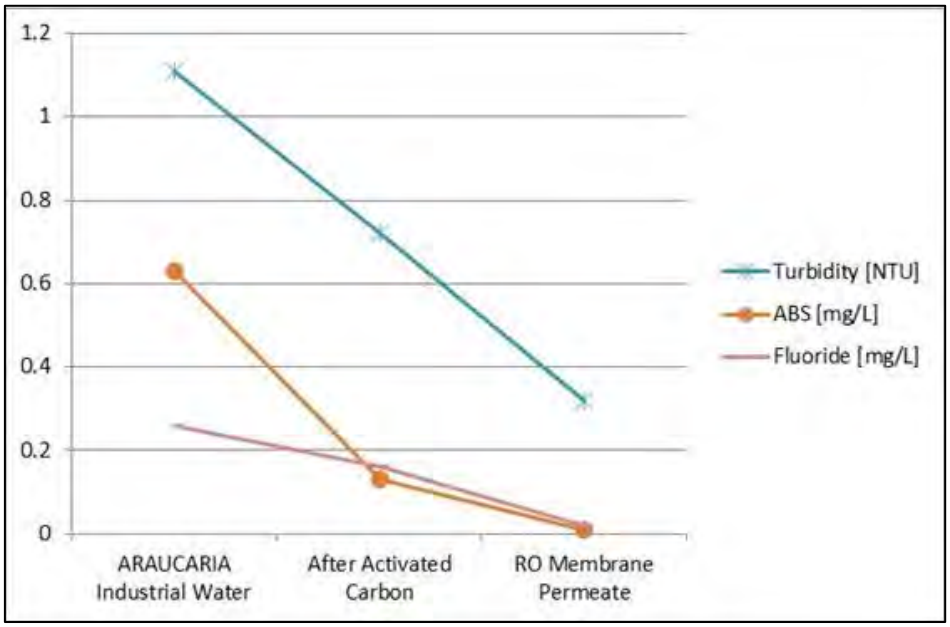


Figure 6.2-9 Removal Trend of Major Components (Conductivity, Chloride, Hardness, Color)

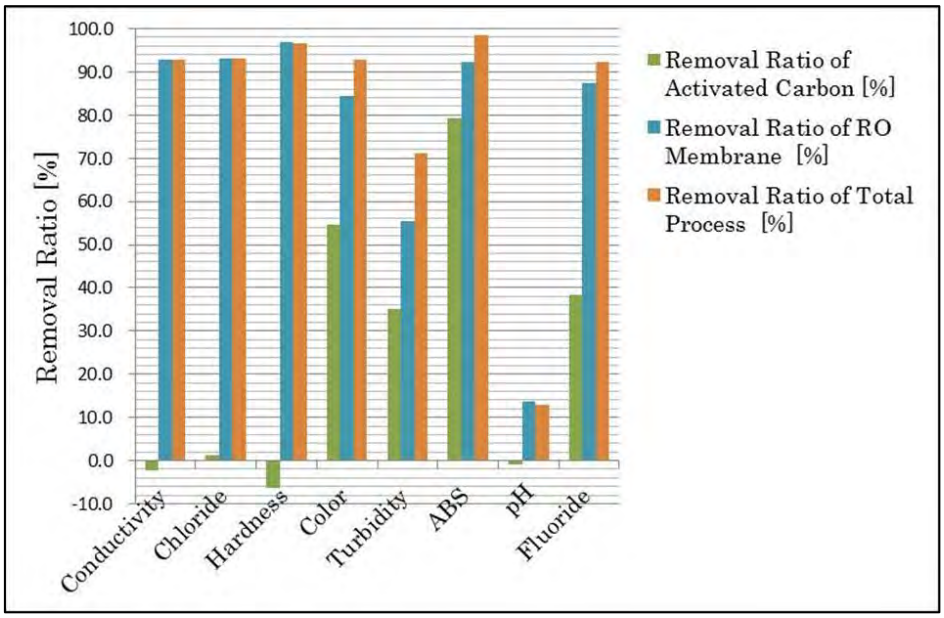


Figure 6.2-10 Removal Trend of Major Components (Turbidity, ABS, Fluoride)

(1)-4 Tasks to Be Addressed

Results of RO Test (Cost Evaluation)

Cost evaluation was done by the assumptions as listed below.

- Power consumption is based on the equipped pump output (1.1kW)
- Electric charge rate is 0.326 R$/kWh
- Activated carbon (30kg) has to be replaced every year.
- Cost of activated carbon is 10.5 R$/kg
- Dose rate of sodium bisulfite is 20 mg/L-raw water.
- Cost of sodium bisulfite is 3.14 R$/kg
- Dose rate of slime inhibitor is 25 mg/L-raw water (one week dosing for each month)
- Reagents for chemical cleaning are NaOH and HCL
- RO membrane has to be replaced every year
- Cost of RO membrane is 202 R$/$m^2$

The calculated result showed that it requires 2.92R$ to produce 1m^3 of final permeate as shown in Figure 6.2-11. This unit cost reaches 2.65 times of current unit cost (1.10R$/$m^3$) of Araucaria WTP. Therefore, it is necessary to examine how to reduce cost.

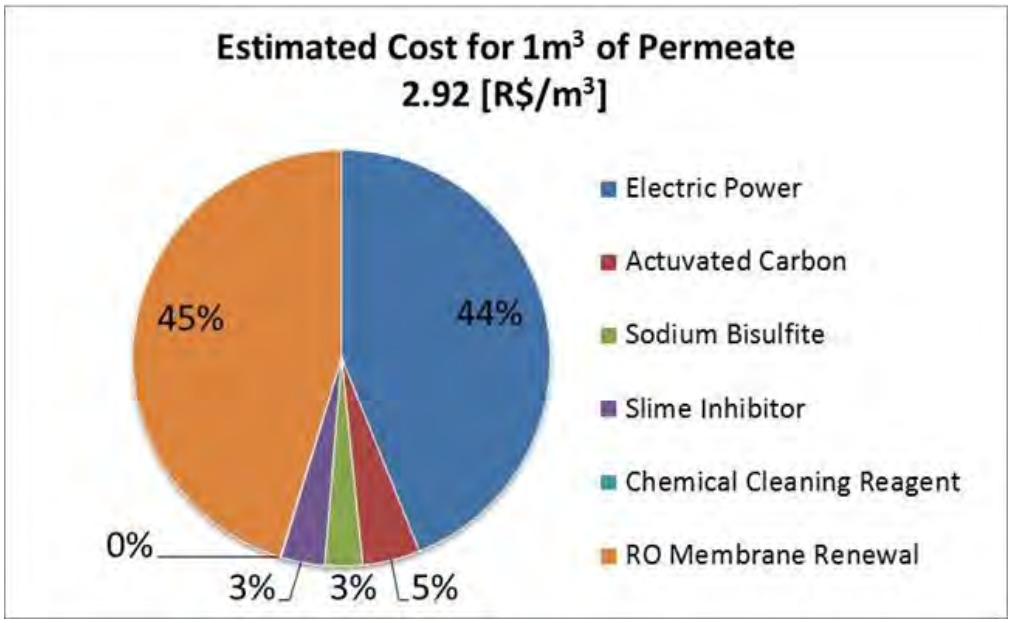


Figure 6.2-11 Tentative Evaluation Result of Operation Cost

(1)-5 Actions to Be Taken

To solve the tasks and issues mentioned above, following items were reviewed as possible cost reduction countermeasures.

- Method of estimating power cost should be changed.

- Reevaluate life of activated carbon based on a Japanese standard for ABS adsorption of activated carbon.
- Omitting addition of sodium bisulfite due to application of activated carbon.
- Life of RO membrane should be expanded to two years

The result describes that the cost can be reduced from 2.92R$/$m^3$ to 0.953R$/$m^3$ as shown in Figure 6.2-12. This cost is close to the value estimated in the F/S report (0.6R$/$m^3$). As a conclusion, RO membrane separation process could be a feasible process for upgrading water quality of Araucaria WTP if through long-term experiment it can be proved that the life of RO membrane can be extended to two years by using slime inhibitors.

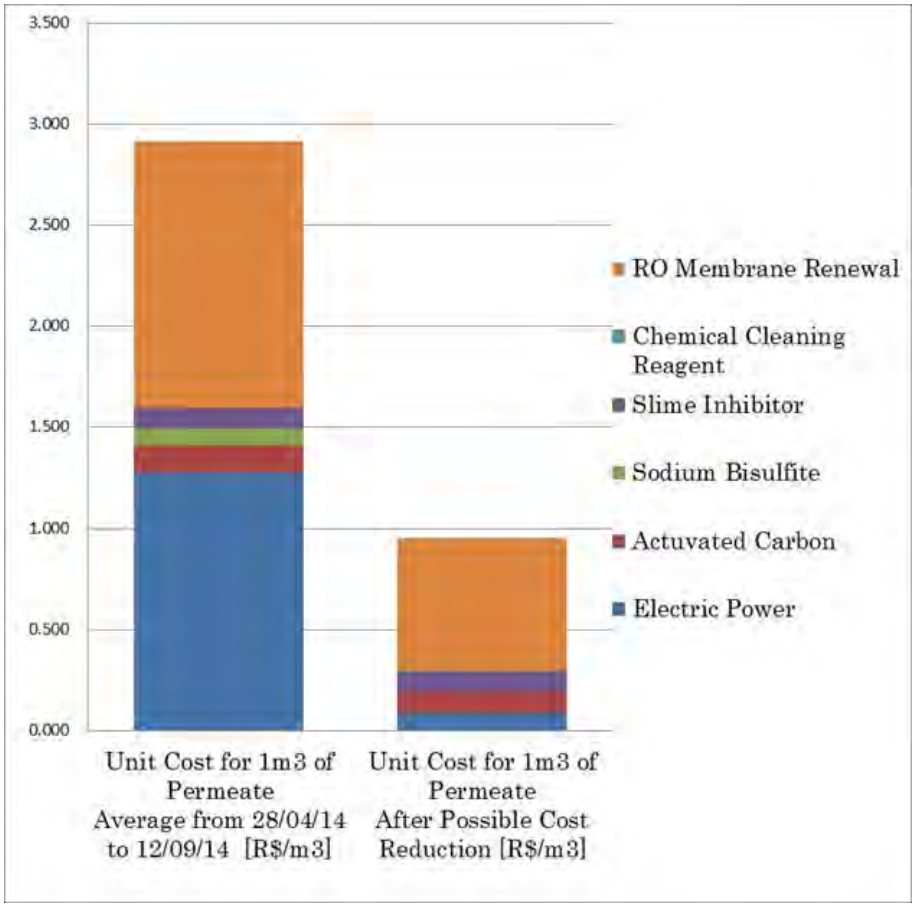


Figure 6.2-12 Possibility to Reduce Operation Cost

(2) Ozonation and Granular Activated Carbon Advanced Treatment

(2)-1 Purpose and Significance of Activity

Recently (such as in 2012 to 2014), cyanobacteria bloom was identified sometimes in Irai Dam although the water quality has been improved comparing with that of 2001. In order to remove algae/cyanobacteria of raw water, a dissolved air flotation (DAF) process has been applied. However, there are some limitations for the process to remove color, taste and odor (T&O), THM precursor and dissolved cyanotoxins. During the second fiscal year, a feasibility study (F/S) on introduction of advanced treatment facility was conducted. As a results, ozonation and granular activated carbon (GAC) process was selected as advanced treatment process of the pilot project. By Sep. of 2014, SANEPAR has constructed a pilot plant of O_3+GAC within Irai WTP by SANEPAR's financial sources.

(2)-2 Methodology and Procedure of Activity

The outlines of the pilot plant for O_3+GAC advanced treatment are summarized in following table and photos.

Table 6.2-16 Outline of the Pilot Plant in Irai WTP for O_3+GAC Advanced Treatment

Items	Contents	Remarks
Capacity of the plant	10 m^3/hr	Raw water: filtered water of Irai WTP
O_3 contact tower	H=7 m, diameter=0.3 m	
O_3 generator	30 g/hr	Existing one
Raw materials of O_3 generation	High purity oxygen	
GAC tower	H=4 m, diameter=0.8 m	Fixed bed reactor, hight of GAC bed is app. 2m

Right: O_3 contacting tank; Left: GAC filter

Field measurement and sampling for pilot advanced treatment experiment by SOP member

Pilot Plant and Activities for O_3+GAC Advanced Treatment

(2)-3 Result of Activity

The results of the pilot experiment for O_3+GAC advanced treatment during Oct. 2014 are summarized in the following table.

Table 6.2-17 Major Results of Pilot Experiment Using O_3+GAC Advanced Treatment

Item	Raw Water (Filtered Water)	After O_3	After GAC	O_3+GAC
Turbidity (NTU)	0.39	0.39	0.25	-
Removal (%)	-	0.4%	37%	37%
Color (Pt-Co)	2.5	0.1	0.3	-
Removal (%)	-	95%	-	89%
UV_{254} (cm^{-1})	0.026	0.007	0.004	-
Removal (%)	-	72%	42%	84%
COD (mg/L)	14.4	8.7	<5.0	
Removal (%)	-	40%	>43%	>65%
THM (μ g/L)	<0.5	<0.5	<0.5	-
Removal (%)	-	-	-	-
Cyanobacteria (cells/mL)	0	0	0	-
Removal (%)	-	-	-	-
Microcystins (μ g/L)	<0.1	<0.1	<0.1	-
Removal (%)	-	-	-	-
Saxitoxins (μ g/L)	<0.02	<0.02	<0.02	-
Removal (%)	-	-	-	-
Operation conditions: 1) Q=5 m^3/hr; 2) O_3 dosage=2 mg/L; 3) SV=5 hr^{-1}; GAC contact time=12 min				

The results of the pilot experiment for O_3+GAC advanced treatment indicated that turbidity, color, COD and UV254 can be reduced 37%, 89%, 65%, 84%, respectively. Moreover, cyanobacteria, microcystins and THM in the raw water of advanced treatment were lower than detected level of analysis method. Therefore, the efficiency of the advanced treatment could not be identified.

(2)-4 Tasks to Be Addressed

a) How to obtain suitable raw water of advanced treatment in order to identify the efficiency for removing cyanobacteria, microcystins and THM etc. (Recently, raw water of Irai WTP is in-taken from Irai Dam and Piraquara Dam where the water quality problems are not serious. Therefore, water quality of treated water by existing DAF and filtration process is good.)

b) Improvement of analysis system (because at this moment, the central laboratory of

SANEPAR does not have the analysis equipment of 2-MIB, geosmin and by-products of ozonation treatment. Therefore, some samples have to be sent to other laboratories for analyzing these parameters.)

(2)-5 Actions to Be Taken

a) Conducting the experiment until poor raw water quality presenting in Irai WTP, or using artificial raw water by adding odor materials and cyanotoxins etc.

b) Introduction of analysis equipment for analyzing 2-MIB, Geosmin and by-products of ozonation treatment.

(3) Pilot Experiment of Sonicator for Controlling Cyanobacteria

(3)-1 Purpose and Significance of Activity

In order to take a countermeasures against taste and odor (T&O) and cyanotoxins etc. issues generated from cyanobacteria in source water, in the second fiscal year JICA provided one set of sonicator to SANEPAR. At same time, By Oct. of 2014, SANEPAR has constructed a pilot plant of sonicator by SANEPAR's financial sources. The pilot experiment of sonicator for controlling cyanobacteria is started from Nov. of 2014.

(3)-2 Methodology and Procedure of Activity

The outlines of the pilot plant for sonicator for controlling cyanobacteria are summarized in following table and photos.

Table 6.2-18 Outline of the Pilot Plant of Sonicator Experiment

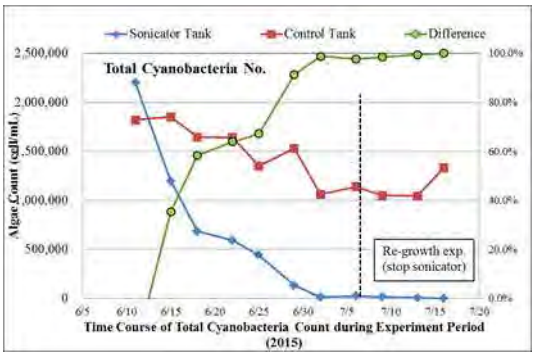
Items	Contents	Remarks
Capacity of the plant	5 m^3×2 tanks	One for experiment and one for control
Sonicator	e-XXL、LG SONIC (20 W/h)	Provided by JICA
Raw water for experiment	Irai Dam	*Microcystis* is dominant specie

	
Right tank: with sonicator; Left tank: whitout sonicator	The sonicator is installed on the surface of water

Pilot Plant and Activities for Sonicator Experiment

(3)-3 Result of Activity

The results of the pilot experiment for sonicator from Jun. to Jul. of 2015 are summarized in the following figures.



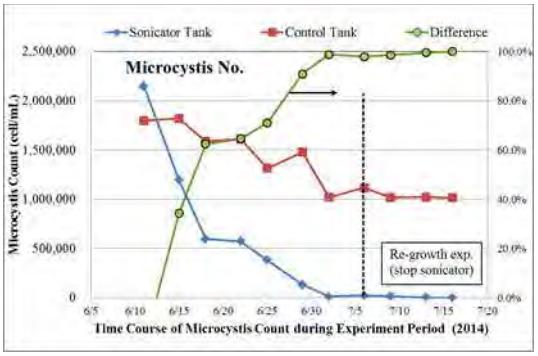


Figure 6.2-13 Major Results of Pilot Experiment of Sonicator

The results of the pilot experiment of sonicator (operated about five weeks) indicated that total cyanobacteria and Microcystis (which may produce "Microcystin" that is highly toxic to humans and animals) can be reduced about 97%. Regrowth experiment is conducted by stopping the operation of sonicator from 5th Jul. of 2015 and the results of regrowth experiment showed that regrowth of total cyanobacteria and Microcystis was not identified.

(3)-4 Tasks to Be Addressed

a) Pilot experiment in Irai Dam

b) Application in Irai Dam

(3)-5 Actions to Be Taken

a) Conducting an experiment in Irai Dam

b) Determining quantity and installation method of sonicator, estimating the costs, establishing O/M and monitoring system, based on the pilot experiment in Irai Dam

6.2.8 (Activity 3-8) Technical Assistance for Monitoring of PI

(1) Purpose and Significance of Activity

The main purpose of monitoring and analysis of PI of WTPs is to comprehend following items to ensure appropriate and effective O&M of WTPs.

- To monitor energy and chemical consumption for better and effective O&M.
- To verify the effect of improvement/renovation/rehabilitation of facilities/equipment of WTP.
- To monitor whether WTPs are being properly operated or maintained.

(2) Methodology and Procedure of Activity

SANEPAR has a database of PI data including power consumption, chemical consumption and water quality compliance percentage at the exit of filter. This activity intends to facilitate effective use and analysis of such accumulated data, for the purpose of better O&M. This activity also intends to ensure continuation of the activity even after the withdrawal of JET.

(3) Result of Activity

PI data (for power consumption, chemical consumption and water quality compliance percentage at the exit of filter for target WTPs) have been retrieved from the database, and sorted out for analysis since the beginning of the Project by C/P, with the assistance of JET. The collected and organized data are available in Annex A6-1. C/P and JET confirmed that the PI data for power consumption and chemical consumption should be dealt with the following manner.

- If the necessary work for rehabilitation/renewal/replacement/upgrade would be implemented for the purpose of improvement of treatment process at the WTP, which have several shortcomings such as capacity, defective equipment, lack of necessary equipment, quality of treated water or effluent of the plant may be improved. At the same time, however, chemical and/or power consumption of the WTP may be increased as a result of

the work. Therefore, the PI data for power consumption and chemical consumption will be excluded from the indices of PDM that will be evaluated to measure the effect of the Project.

- However, C/P and JET also confirmed that the both indices (power and chemical consumption) are to be continuously monitored under the Project's activity for effective O&M, since those are still important indices in terms of business operation of SANEPAR.

(4) Tasks to Be Addressed

Following issues to be addressed have been raised since the beginning of the activity.

- One of the main reasons to fail to achieve 100% of compliance rate at the exit of filter is overrun of turbidity and color.
- Overrun or shortcoming of fluorine is also observed sometimes.
- However, as there are no cases for violating total coliforms or e-coli, it is considered that hygienic security is guaranteed at all WTPs.

(5) Actions to Be Taken

The SOP team will continue monitoring to seek the possibilities to achieve 100% for water quality compliance rate at the exit of filter and its practical countermeasure under the Project's activity (e.g., experiment of DAF system improvement at Irai WTP under the "Activity 3-10", review of chemical dosage rate, and implementation of rehabilitation/renewal plan that was prepared under the "Activity 3-5").

6.2.9 (Activity 3-9) Workshop and Seminar

(1) Purpose and Significance of Activity

A seminar was organized by SANEPAR in order to share the contents of Project's activities especially on O&M manual and rehabilitation and renewal plan among operators in other WTPs than target five WTPs.

(2) Methodology and Procedure of Activity

In order to respect the ownership of C/P, organizing of seminar, preparation of presentation material and presentations were done under the SANEPAR's initiative, with assistance of JET. In addition, In order to facilitate dissemination of experience and lessons learnt through Project's activities, operators of other WTPs than the target 5 WTPs were also encouraged to

participate in the seminar.

(3) Result of Activity

The outline of the seminars conducted under this activity is summarized in Table 6.2-19.

Table 6.2-19 Outline of the Seminars under the Activity 3-9

	Number of participant	Date & time	Venue	Main topics of the seminar
2nd FY	43	18/Feb/2014 10:00 − 15:30	Sala Miringuava, Centro de Treinamento, SANEPAR, Rua Engenheiros Rebouças, 1376, Curitiba, PR	・ O&M manual for WTP (General) ・ O&M manual for WTP (E&M) ・ Rehabilitation/renewal plans for WTPs (Civil) ・ Rehabilitation/renewal plans for WTPs (M&E) ・ Overseas training in Japan
3rd FY	53	13/Nov/2014	SESC Caiobá − Matinhos	・ Problems and difficulties being encountered in actual O&M at WTPs in coastal area (including not only target WTPs, but also other WTPs in coastal area) ・ Feedbacks and comment on the draft version of O&M manual for Praia de Leste WTP ・ Presentation by JET on technical topics on water supply
4th FY	34	16th Jul. 2015	Taruma	・ O/M manual for target WTPs and dissemination to other WTPs ・ Rehabilitation/renewal plans for target WTPs and dissemination to other WTPs ・ Pilot experiment of reverse osmosis RO treatment at Araucaria Industrial WTP ・ Improvement of the existing DAF system at Irai WTP

(4) Tasks to Be Addressed

At present, number of participants from the outside of the target five WTPs are not many as expected.

(5) Actions to Be Taken

- Operators from the outside of the target five WTPs should be continuously encouraged to participate seminar in future.
- SANEPAR should make full use of SOP team members (e.g., entrusting a role of lecturer or trainer for seminars/workshops, dispatching SOP members to other WTP) so that they can take initiative in disseminating experiences and knowledge obtained through the Project's activities regarding O&M manual preparation and rehabilitation & renewal plan

to other SANEPAR staff.

6.2.10 Activity (3-10) Survey on Improvement of Existing DAF System, and Conduct a Pilot Project for Improving Existing DAF System

(1) Purpose and Significance of Activity

The results of additional water quality survey indicated that the removal efficiency of color and turbidity in the existing DAF system was poor due to design issues, which resulted in high loads on subsequent filtration system. In order to improve (regain its original capacity of 3,200 L/s) the existing DAF system, technical assistance including for improvement of operation and related pilot-scale experiments (try & error approach for different types of injection nozzle, modification of existing DAF system) were conducted.

(2) Methodology and Procedure of Activity

a) Conducting try & error approach for using various types of injection nozzle.

b) Modification of existing one DAF basin (separating contact zone and clarification zone) at SANEPAR's own expense.

c) Conducting water quality survey on No. 8 and No. 7 DAF basins to evaluate the efficiency of separating contact zone and clarification zone.

d) Analyzing the operation records of backwash cycle and monthly backwash number at each DAF basin.

e) Improvement of operation of DAF system,

(3) Result of Activity

Table 6.2-20 shows the results of experiment using different types of injection nozzle conducted in the 2nd fiscal year to 4th fiscal year.

Table 6.2-20 Summary of the Result of Nozzle Experiment

Item	Existing Injection1) (Perforated Pipe, 2.4mm)		Nozzle Procured from Japan (4mm) 1)		Nozzle Fabricated by SOP Team2)		Target
	Results	Evaluation	Results	Evaluation	Results	Evaluation	
Micro-bubbles, μm	60-80	○	50-60	○	50-60	○	<100
Micro-bubble conc., No./mL	4-7×10^4	×	5-7 × 104	×	3-4 × 105	○	>2 × 105
Big bubbles	Yes	×	Yes	×	Few	○	Non
Turbulence	Yes	×	Yes	×	Few	○	Non

1) Experiment in 2nd fiscal year and 3rd fiscal year before modification of saturation tank.

2) Experiment in 4th fiscal year after modification of saturation tank.

Injection nozzle (procured in Japan and Brazil)

Pilot plant for introduction of injection nozzles

Pilot Plant and Activities for DAF Improvement Experiment

In addition, Table 6.2-21 and Table 6.2-22 present the results of experiment to verify the effect of separating contact zone from clarification zone at the existing DAF basin in 3rd fiscal year.

Table 6.2-21 Outline of the Result of Verification Experiment for Modification of DAF

Facility	Removal of Turbidity	Removal of Color	Removal of UV254	Remarks
DAF basin No. 8	80-83%	82-83%	73-82%	Contact zone and clarification zone was separated through reconstruction.
DAF basin No. 7	76-87%	81-84%	77-79%	Not being reconstructed.

Table 6.2-22 Analysis of Backwash Recycle and Monthly Backwash Number (Aug. to Dec. 2014)

Facility	Average Backwash Recycle	Improvement of Backwash Recycle	Monthly Backwash No.	Improvement of Backwash No.	Remarks
DAF basin No. 8	17.7(hr)	17%	37.7 times	13%	Contact zone and clarification zone was separated through reconstruction.
DAF basin No. 5-7	15.1(hr)	-	43.3 times	-	Not being reconstructed and same module with No.8

The results of water quality survey indicated that no significant improvements are identified due to separation of contact zone and clarification zone. On the other hand, the results of analyzing the operation records for each facility presented that backwash recycle and monthly backwash number at No. 8 DAF basin are improved by 17% and 13% due to separation of contact zone and clarification zone.

Based on the results of 2nd fiscal year and 3rd fiscal year, a new operation method of saturation tank is proposed by JET for applying DAF basin No. 5-7 (Model 2) in 4th fiscal year. Table 6.2-23 shows analysis results of improvement performance after introducing the proposed operation method.

Table 6.2-23 Analysis of Improvement Performance of Proposed Operation Method (DAF basin No. 5-7）

Item	Average Backwash Recycle per Basin	Monthly Backwash No. per Basin	Increase of Production (whole WTP)1)	Saved Water Quantity for Backwashing1)	Remarks
Before	15.1(hr)	43.3 times			Aug. to Dec. 2014
After	21.9 (hr)	31.6 times			Apr. to Jun. 2015
Improvement	45%	27%	2,120 m^3/d[2)]	2,500 m^3/d[3)]	

1) Calculated by using: average filtration rate=240m^3/m^2/day (or 10m^3/m^2/hr), filter bed area=68m^2, filter number=16 filters, backwashing time=30min, backwashing water quantity=400 m^3/per backwash.

2) 240×68×16×[(43.3-31.6)/30] ×(30/60) /24=2,120m^3/d

3) [(43.3-31.6)/30] ×16×400=2,500 m^3/d

The results in Table 6.2-23 indicated that efficiency of filtration could be improved significantly by improving the DAF system. Consequently, treated water production of the WTP can be increased and O/M costs of the WTP can be reduced due to reduction of backwashing water quantity, recycle rate and power consumption.

(4) Tasks to Be Addressed

a) The detailed effects of new method for saturation tank operation should be confirmed.

b) Other improving measures have to be examined.

c) Improvement of all other modules.

(5) Actions to Be Taken

a) A survey on the DAF basins of Module 2 should be conducted to confirm the effect of new operation method on saturation tank including water quality improvement, reduction of backwashing water quantity, recycle rate and power consumption etc.

b) Conducting a feasibility study (including examinations of initial investment, O/M costs and easiness, and impacts on existing facilities etc.) on other improving measures (such as introduction of DAF pump etc.) and conducting pilot experiment to confirm their performance.

c) Implementing the optimum improvement method to all other modules and modifying O/M manual.

Chapter 7 Issues, Efforts and Lessons Learned

Following subsections summarize issues (difficulties/challenges) that have been identified, specific efforts to solve or mitigate problems/difficulties encountered, and lessons learned that have been obtained through the Project's activities.

7.1 Issues (Difficulties/Challenges)

(1) Need for Improvement of Communication between Planning and O&M Section

In SANEPAR, lack of communication between the DI (in charge of design and planning of STPs and WTPs) and DO (in charge of O&M) hinders smooth feedback of problems/troubles (including problems/troubles attributed to quality of design and/or workmanship of construction works) identified by O&M side to design and planning side. It is true that there could be no perfect design or construction work. However, JET believes that feedback of those troubles/problems under good communication relationship between both sections will help improve design and construction works for future projects. Therefore, it is necessary for SANEPAR to encourage good communication between design/planning section and O&M section so that it can improve their future projects including new construction, renewal, and rehabilitation works.

(2) Need for Improvement of Management System in O&M of STPs and WTPs

In STPs and WTPs of SANEPAR, operation works are under the jurisdiction of the chief of the plant. On the other hand, maintenance works of equipment are under the jurisdiction of other departments that are beyond the jurisdiction of the plant's chief. Under such circumstance, staffs of maintenance section do their site works without supervision/control of the plant's chief. Such command line differences may be very dangerous and this situation may trigger serious accidents at project sites.

In case it is difficult to assign maintenance staff under the plant's chief for the time being, following measures are recommended.

- Revise relevant regulations of SANEPAR so that the plant's chief can supervise maintenance staffs who are assigned for maintenance work for the plant.
- In case it is difficult to practice the above measure, draw up a set of such rules that require maintenance staffs to report their work schedule to the plant's chief, and to obtain his/her prior consent. In addition, post up the announcement of work schedule for operation section and maintenance section so that all the concerned staff, including subcontractors at the site can share information on site works to be done at the plant.

(3) Need for Appropriate Budget Allocation for O&M Works

In SANEPAR, existence of the problems on O&M of STP and sewage pipe network has been widely recognized. However, sufficient budget and adequate organization have not been secured to tackle those issues. Consequently, those problems have developed as time proceeded due to further deterioration of aged facilities. Despite this situation, appropriate amount of budget has not been allocated for O&M works for STPs and sewage pipe network. This is mainly because insufficiency of treatment performance at STPs and leakage of sewage from pipeline have not directly affected the quality of public services.

Through the Project's activities, JET has raised the importance of adequate O&M and routine inspection/maintenance works to extend life of facilities, adding that these works can bring various benefits including cost-savings in the medium- and long-term, and improvement of water environment. As a result, C/P became aware of the importance and significance of preventive O&M and consolidation of implementation organization, and necessary budget has been partly secured.

(4) Sustainability of Project

SANEPAR has already undertaken the following activities in order to disseminate the outcomes obtained through the Project's activities. Accordingly, it is considered that sustainability of the Project is ensured.

- Before the commencement of the Project, concerned departments/sections had dealt with their various issues to be tackled individually in principle under vertically-structured organizational setup. Through the Project's activities, however, C/P gradually demonstrated understandings of the importance of tackling issues through cross-sectional approaches, and this attitude has been widely supported among staffs in SANEPAR. For example, SANEPAR has already decided to undertake improvement measures to deal with sludge disposal and treatment at WTPs and equipment at STPs through such a cross-sectional approach.
- Under the activities of Output, a task-force team, consisting of personnel from the relevant regional offices and sections in the Project area, has already organized to address directly the urgent problems that are attributed to aged pipes in the central part of the CMA. In this way, SANEPAR has already started expanding its undertakings based on the Project activities.
- The SOP teams under Output 2 and Output 3 are to continue their activities regarding update of O&M manuals for the target STPs/WTPs, and they will work to duplicate similar activities to the other STPs/WTPs of SANEPAR, even after the completion of the Project.
- As for the rehabilitation and renewal plans for STPs/WTPs that have been prepared under

the Project, the executives of SANEPAR have become aware of the importance and necessity of a long-term plan. As the first step, SANEPAR revised the period of the mid-term plan from three-year to five-year so that it can take the longer view on its planning.

7.2 Specific Efforts

(1) Re-organizing C/P Members

Initially, SANEPAR nominated executive staff responsible for management of sewage pipe network as C/P members for the activities to be carried out under Output 1. However, staffs responsible for maintenance of sewage pipe network (who were expected to conduct investigation of pipelines under the Project) were not included in the list of the C/P. Therefore, JET proposed inclusion of responsible staff for supervising maintenance works in the C/P members to SANEPAR. Furthermore, JET requested SANEPAR to include relevant staff of actual site works of pipeline investigations in the regular weekly meeting, in order to share necessary information. As a result, those members were officially recognized as the C/P member, and this arrangement has facilitated smooth implementation of the Project's activities.

JET believes that active participation of the site staff should be encouraged to accelerate C/P's motivation and ownership for the Project. In this Project, C/P's responses to JET's advice were generally adequate and such C/P's attitude brought good outcomes for the Project.

(2) Organizing Visiting-lectures to Share Outcome of Project to SANEPAR Staff other than C/P

Under the activities of Output 1, SDT (SDT) conducted series of works including pipeline network diagnosis to draft up renewal plan focusing only on the selected pilot area. However, SANEPAR should duplicate these activities in the entire Project area and Parana State eventually. However, the method for its completion was an important challenge for the Project. To deal with this question, JET organized visiting-lectures aimed at regional office staff who are out of the C/P members at the early stage of the Project. This program was intended to explain methodology, philosophy and outcomes of the Project to the target staff as well as to facilitate smooth communication among JET, C/P staff, and those target staff. JET believes that this program helped staff other than C/P members to understand the contents of the Project, and to duplicate the Project's activity to the entire Project area.

(3) Organizing Regular Meetings

Regular weekly meetings were organized under Output 1, Output 2 and Output 3 respectively, to share necessary information including progress and schedule of the activities among JET and

C/P members. These meetings provided good opportunities including discovering potential needs of C/P, exchanging information, and facilitation smooth implementation of activities under the Project.

In addition, during JET's assignment period, monthly meetings were organized to share information including progress and schedule of overall Project's activities, convening all JET members and C/P members. These meetings helped all concerned members to be familiar with the situation and progress of the other Outputs and entire Project.

(4) Flexible Response to Site Characteristics and C/P's Needs

During implementation of the Project, JET made efforts to conduct Project activities with a flexible attitude. Even some activities that were not listed in the original PDM and PO were considered, taking into account site characteristics and C/P's needs. JET believes that this attitude fostered trusting relationship between C/P and JET.

For example, the results of baseline survey on the Irai WTP indicated that the performance of existing DAF system was not satisfied. JET continued technical cooperation on this issue based on C/P's request and actual situation although this item had not been included in the original PDM. As a result, the length of filter runs has been improved by as much as 45% by improving DAF system operation method. This method can be also applied to other DAF basins of Irai WTP and other WTPs where DAF system is used, because C/Ps who were involved with this activity have understood the mechanism of improvement through various on-the-job training.

(5) Making Full Use of Experience and Knowledge of Public Utility Management in Arrangement of Training in Japan

The training programs in Japan were successfully completed under a limited time schedule. One of the factors of success in these programs may be that the Project was able to win full cooperation from Japanese host public utilities, by making full use of experience and knowledge of JET members who have work experience in public utility business management in Japan.

(6) Development and Trial Use of Evaluation Method for Capacity Development in Sewerage Sector

The main purpose of this Project is capacity development of C/P on O&M of water supply and sewerage facilities. However, there are few case studies and little know-how regarding capacity development, especially in the sewerage sector. Under this circumstance, JET tried to list up appropriate indicators to assess capacity of sewerage business operation, O&M of STP, and O&M of sewage pipeline network, and to develop methodology of evaluation in the course of

the Project.

In future similar projects, it is recommended that capacity assessment should be done at the initial stage of the projects to gain an understanding of the baseline capacities of C/P and business operation statuses. With this as a starting point, technical cooperation projects can identify weak points to focus the project's activities. The outcomes obtained through this activity have been applied to another technical cooperation project (Project for Capacity Development on Operation and Maintenance in the Sewerage System in Rio de Janeiro)

7.3 Lessons

(1) Necessity of Training in Japan for SANEPAR's Management Strata

In this Project, training courses in Japan for Output 1, Output 2 and Output 3 were planned and conducted respectively. Those training courses were targeted only for operators and engineers of each Output and not intended for the management strata.

However, from the viewpoint of more effective implementation of the project, a training course in Japan for management strata should have also been arranged at the initial stage of the Project in order to foster their understanding of the significance of the Project and learn the organizational operation of Japanese public utilities of water supply and sewage.

Chapter 8 Achievement Level of Project Purposes

8.1 Project Purposes and Indicators of Each Output

The project purposes and indicators of each Output originally were not shown by numeric value but by xx% and its digitization was needed. Some indicators in the original PDM (PDM0) were found to be inappropriate through the progress of the project. Hence, specific digitization of indicators and alteration of indicator items were carried out by modifying PDM. Project purposes and indicators of each output in the final PDM (PDM_3) is as shown in Table 8.1-1.

Table 8.1-1 Project Purposes and Indicators of Each Output in the Final PDM_3

Narrative Summary	Verifiable Indicators
Project Purpose Operation and maintenance (O&M) of water supply and sewerage systems in SANEPAR is improved in the target area of the Project	1. Performance indicators on O&M of sewage treatment plant (i.e. volume of treated sewage divided by total inflow volume) is improved to 99.18% in CMA. In addition, % of water quality conformity to the treated water quality standard is improved tO37.3% in CMA and 97.6% in the Coastal Area respectively. 2. Performance indicator on O&M of water treatment plant (i.e., % of conformity to the drinking water quality standard of treated water (ICP-Produção: Indice de Conformidade ao Padrão de potabilidade na Producao)) is improved to 100%.
Outputs 1. Capacity of SANEPAR for operation and maintenance (O&M) of sewage pipe network is strengthened.	1-1 Number of complaints including incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases from the previous year. 1-2 Dissolved oxygen level of the rivers in pilot areas are maintained at least 5 mg/L.
2. Capacity of SANEPAR for operation and maintenance (O&M) of sewage treatment plant is strengthened.	2-1 Rehabilitation/renewal plan for sewage treatment plants developed by the project is approved by the management level of SANEPAR. 2-2 Annual budget plan is elaborated based on the rehabilitation/renewal plan.
3. Capacity of SANEPAR operation and maintenance (O&M) of water treatment plant is strengthened.	3-1 Rehabilitation/renewal plan for water treatment plants developed by the Project is approved by the management level of SANEPAR. 3-2 Annual budget plan, including sludge treatment, is elaborated based on the rehabilitation/renewal plan.

8.2 Achievement Level of Project Purposes

8.2.1 Performance Indicator of O&M of STP

Actual value of performance indicator of O&M of STP (Effluent quantity/Influent quantity)

from 2012 to April 2015 is as shown in Table 8.2-1.

Table 8.2-1 Change of Performance Indicator of O&M of STP

Year	Performance indicator (%)
2012	98.61
2013	98.23
2014	98.73
2015	99.79 (Data from January to April)

As shown in the above table, the target value with the 99.18% has been achieved as of the end of the Project.

8.2.2 Conformity to the Effluent Standard of STP

The conformity to the effluent standard of STP in CMA and the coastal area reaches the set rate, according to the data until May 2015 as shown in Table 8.2-2. However it should be noted that the value might possibly drop sharply due to several reasons including; (1) low sewage treatment efficiency due to overloading of treatment capacity in many large-scale STPs, (2) insufficient sewage treatment due to frequent occurrence of trouble in mechanical and electrical equipment and (3) low sludge treatment capacity. On the other hand, the main reason of attainment of conformity in the coastal area is thought to be sufficient treatment due to low influent quantity compared to the treatment capacity.

Table 8.2-2 Conformity to Effluent Standard of STP

	Set value	2011	2012	2013	2014	May 2015
CMA	37.3	―	41.65	32.19	30.00	38.89
Coastal area	97.6	99.17	99.39	98.15	98.89	100

(: %)

8.2.3 Performance Indicator of O&M of WTP

The treated water quality at the outlet of each WTP fulfills the drinking water quality standard (turbidity, color, residual chlorine, fluoride, total coliform, E-coli) at 100%. In addition, the average compliance rate for quality control standard at all WTPs, which is stricter than the drinking water quality standard, are 99.86% to 99.95% on average during 2010 to 2014 as shown in Table 8.2-3. This fact indicates that the treated water quality for all WTPs is maintained at desired levels.

Table 8.2-3 Average Compliance Rate for Quality Control Standard at the Outlet of All WTPs (2010 to 2014)

WTP	Average compliance rate (%)
Irai	99.93
Praia de Leste	99.87
Morretes	99.95
Saiguacu	99.86
Guaraquecaba	99.90

8.3 Indicators of Each Output

8.3.1 Output 1

(1) Number of Complaints in the Pilot Areas

The indicator of "1-1 Number of complaints including incidents of blockage and/or overflow of sewage pipe networks in pilot areas decreases from the previous year.", has not been able to reach its target level by the end of the Project, as shown in the Table 8.3-1. In the pilot area, several factors including under-sized pipe diameter, breakage in pipe body, and cross-connection accelerate incidents of blockage and/or overflow in sewer pipe networks, and these results in receiving many public complaints. One of the main reasons why the C/P could not reduce the number of complaints compared to the previous year is that the number of the complaints get influenced by the annual rainfall pattern easily (and therefore the direct reason for the recent trend that the total annual number of complaints are increasing may be mainly due to increase of events of intense rainfall in recent years).

Overflow of the sewage pipe causes from infiltlation of rain water in wet weather. The causes of infiltlation are cross-connection in a house and in a road area, infiltration of ground water. These causes have been disclosed by smoke-test implemented preliminarily at one part of the pilot area. The points with problems found out by this survey have been repaired and a survey at all the pilot area has been planned.

However, it is expected that implementation of several measures (e.g., rehabilitation projects including pipe replacement with larger diameter pipes, and elimination of cross-connections) will facilitate reduction of total annual number of complaints.

Table 8.3-1 Yearly Change of Total Annual Number of Complaints in the Pilot Area

Year	2010	2011	2012	2013	2014
Total number of complaints	197	253	243	315	353

Table 8.3-2 Yearly Change of Total Number of Days with Intense Rainfall Event (50 mm and over)

Year	2010	2011	2012	2013	2014
Total number of days with intense rainfall event (50 mm and over)	5	5	12	15	16

(2) Dissolved Oxygen of Rivers in the Pilot Areas

The indicator of "1-2 Dissolved oxygen level of the rivers in pilot areas are maintained at least 5 mg/L.", has not been able to reach its target level by the end of the Project, as shown in the Table 8.3-3.

Table 8.3-3 Dissolved Oxygen (mg/L) of Rivers in the Pilot Areas

	Before the Project	After commencement of the Project					
	Jun/2012	Jun/2013	Jan/2014	Feb/2014	Dec/2014	Feb/2015	Jul/2015
At 500m upstream from the most downstream in the Pilot Area	3.40	2.90	2.55	1.62	6.72	6.21	5.48
At the most downstream in the Pilot Area	2.30	2.20	2.02	2.40	3.68	3.64	4.78

In order to address deterioration of water quality, which is attributed to leakage at broken part of sewer pipes, SANEPAR has implemented "Plano de Revitalização dos Rios Urbanos (a revitalization plan for urban river)", setting dissolved oxygen level of urban rivers to maintain 5 mg/L or over. Accordingly, JET and C/P adopted same target (5 mg/L or over) at the most downstream of the rivers in the Pilot Area.

In the Pilot Areas, SANEPAR has actively implemented the rehabilitation works of damaged sewer pipes part by part to address the above-mentioned leakage problems since the year of 2014 as shown in Table 8.3-4. The result indicates that the dissolved oxygen levels at the most downstream in the Pilot Area gradually improved (increased), and reached as high as 4.78 mg/L in July 2015.

In addition, the dissolved oxygen levels at the 500m upstream from the most downstream, which were monitored to supplement the above result, demonstrate that they are more than 5 mg/L after December 2014. Therefore, it is regarded the target has been virtually achieved in some locations.

Nevertheless, there are some areas that are not yet reaching the target level. The main reason for it may be the leakage at the vulnerable parts of the sewer pipes that are not yet rehabilitated or renewed. In general, diameters of sewer pipes in the Pilot Area are undersized, and this will lead system pressure increase in the event of rain. This may eventually cause leakage easily at the

physically vulnerable part of the pipes.

However, SANEPAR intends to implement the rehabilitation/renewal plan prepared under the Project, which includes pipe renewal with part by part, and pipe replacement with larger diameter. Accordingly, it is expected that the dissolved oxygen level may be improved (increased) as the rehabilitation/renewal plan being implemented steadily.

Table 8.3-4 Total Annual Number of Rehabilitation Works in the Pilot Area

Year	2012	2013	2014
Total number of rehabilitation works	21	78	247

8.3.2 Output 2

(1) Approval of Rehabilitation/renewal Plan of STP

The indicator has been fulfilled. The Project made the long term plan for rehabilitation/renewal of sewage treatment plant during the next 30 years, which are from 2014 to 2043, and consecutively made the five (5) year plan of the rehabilitation/renewal on the basis of the long term plan. The Project already presented the contents of the long term plan in 2013 to the director of investment bureau including some other management strata personnel of the investment bureau and operation bureau, and received the consent of the plan's concepts and its direction.

(2) Annual Budget Planning of Rehabilitation/renewal Plan

Indicator that annual budget plan is elaborated based on the rehabilitation/renewal plan has been fulfilled. Annual budget plan of five (5) years from 2015 to 2019 based on the 30 years rehabilitation/renewal plan was prepared by SANEPAR and has been implemented in order after the approval of the board of directors.

8.3.3 Output 3

(1) Approval of Rehabilitation/renewal Plan of WTP

The indicator has been fulfilled. Under the acknowledgement of SANEPAR management strata, the Project made the Rehabilitation/renewal plan extending to the year 2040 for the CMA. The plan shows the necessary actions by three phases on the basis of their priorities; Priority 1: to be implemented between 2015 and 2017, Priority 2: to be implemented between 2017 and 2020, and Priority 3: to be implemented between 2020 and 2023. The Project has already presented

the contents of the plan to the director of investment bureau, and received the consent of the plan's concepts and its direction.

(2) Annual Budget Planning of Rehabilitation/renewal Plan

Indicator that annual budget plan is elaborated based on the rehabilitation/renewal plan has been fulfilled. Annual budget plan of five (5) years from 2015 to 2019 based on the rehabilitation/renewal plan was prepared by SANEPAR and has been implemented in order after the approval of the board of directors.

Chapter 9 Recommendation for Achieving Overall Goal

9.1 Overall Goal and Its Indicators

The overall goal and its indicators are as shown in Table 9.1-1.

Table 9.1-1 Overall Goal and Its Indicators

Subject	Indicators
Overall goal Water supply and sewerage service of SANEPAR is improved in the target area.	1. The coverage of sewerage system becomes 79% in CMA and 60% in coastal area by the end of 2018 (baseline: 72% in CMA, 49.4% in coastal area, 2011). 2. Rehabilitation/ renewal plan developed by the Project is implemented by year 2020.

9.2 Indicator 1 "The coverage of sewerage system becomes 79% in CMA and 60% in coastal area by the end of 2018."

9.2.1 Progress for Achieving Indicators

Indicator 1 "The coverage of sewerage system becomes 79% in CMA and 60% in coastal area by the end of 2018" will probably be achieved in CMA in 2018, and in coastal area in 2017, as shown in Table 9.2-1, Table 9.2-2 and Figure 9.2-1, Figure 9.2-2.

Table 9.2-1 Increase of Coverage Rate of Sewerage System in CMA

Year	Coverage rate (%)
2012	73.06
2013	74.04
2014	74.91
2015	75.74
2016	76.83
2017	77.83
2018	78.79

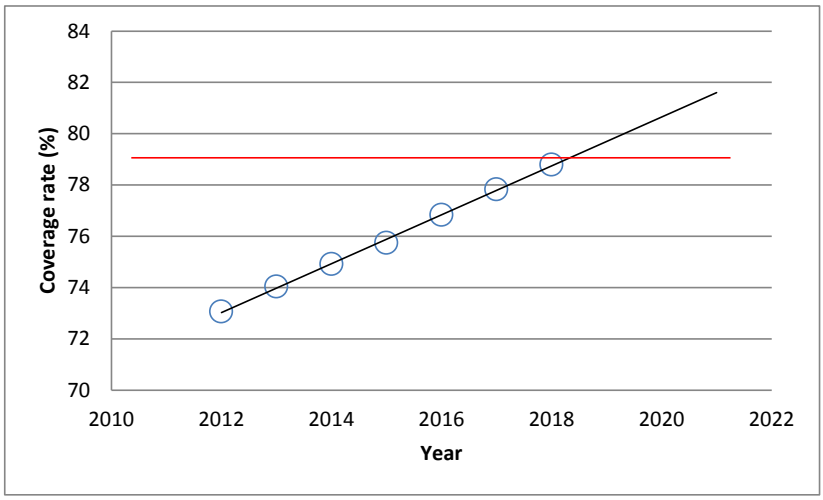


Figure 9.2-1 Increase of Coverage Rate of Sewerage System in CMA

Table 9.2-2 Increase of Coverage Rate of Sewerage System in Coastal Area

Year	Coverage rate (%)
2012	43.52
2013	47.17
2014	50.99
2015	51.27
2016	56.62
2017	61.00

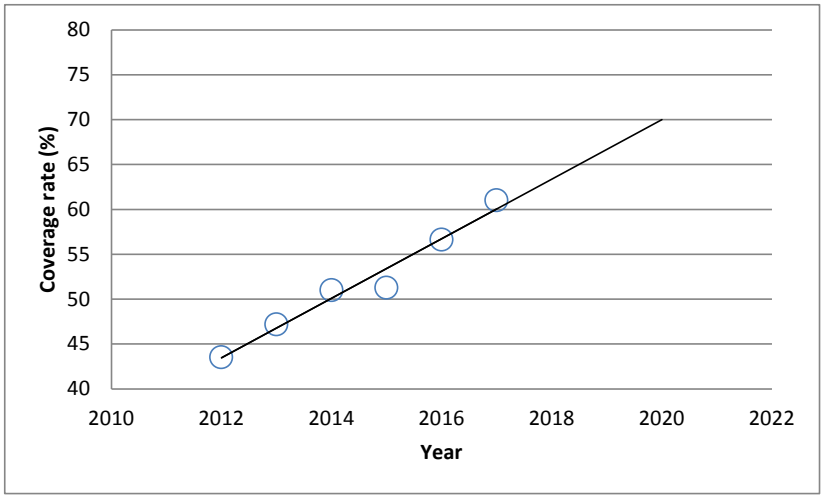


Figure 9.2-2 Increase of Coverage Rate of Sewerage System in Coastal Area

9.2.2 Recommendation for Achieving Indicator

Although the coverage rate of sewage system has been increasing consistently in CMA and coastal area, as shown in the tables and figures, extension of facilities and improvement of

equipment capacities will become necessary to comply to the effluent standards and to continue efficient treatment because quantity of sewage generated will increase in proportion to the increase of coverage rate.

For the existing sewer pipes, leakage of sewage from the pipes and infiltration of ground water or storm water into the pipes are apt to occur due to the aging of pipes. Hence, restoration of aging pipes by repair and/or renovation is necessary to keep the sewer pipe network functioning effectively.

9.3 Indicator 2 "Rehabilitation/ renewal plan developed by the Project is implemented by year 2020."

9.3.1 Progress for Achieving Indicator

SANEPAR has made steady progress concerning indicator 2 "Rehabilitation/ renewal plan developed by the Project is implemented by year 2020."

Short term repair program has been already carried out in order, within the budget scale. As for mid- and long-term repair and renovation programs for sewage facilities, the five-year plan from 2015 to 2019 was prepared based on the sewage M/P in CMA created in 2014 founded on the results of JICA project, also has been implemented in order. On the other hand, as for water treatment facilities, a five-year plan based on the existing M/P was prepared in the project, and has been implemented in order.

9.3.2 Recommendation for Achieving Indicator

In order to achieve the overall goal, sufficient budget and human resources are crucial.

Budget deficiencies may not be a particular problem because SANEPAR has considered the capitalization by stock listing of SANEPAR, as well as the loan from CAIXA ECONOMICA FEDERAL. On the other hand, reduction and leveling of budget implementation has to be considered by adoption of asset management in renovation program and life cycle cost (LCC) in repair and/or renovation of equipment.

Facilities and equipment for which functional improvement will be achieved by repair and/or renovation will show accelerated aging and failure frequency when appropriate and sufficient maintenance is not implemented. Therefore, dissemination of the preventative maintenance methods that were studied in the project activities will be crucial for all STPs and WTPs.

SANEPAR has carried out human resource development positively through frequent training conducted in the training center. However, for improving on-site job of water and sewage works

of SANEPAR, not only on-desk training but also on the job training (OJT) is significant. For example, when new equipment is installed and when new staff is dispatched for a site, systematic OJT with appropriate textbooks must be conducted. Engineers of manufacturers of equipment supplied for STPs and/or WTPs will be appropriate as trainers for OJT.

Many of the project activities have been conducted by gathering human resources cross-sectionally in SANEPAR organization. For example, activities regarding O&M of STP and WTP were conducted with staff not only in sewage section, water section of DO, but also in mechanical/electrical section of CMA. Pilot project of Output 1 and Output 3 and activities regarding repair and renovation of facilities were conducted with participation of staff in DI who were in charge of budget, planning and designing besides staff in DO. Various kinds of technologies, knowledge and experiences are required for the management of water and sewage works. Hence, cross-sectional participation and management of activities is considered to be quite efficient and is desirable to be continued even after the end of the project.

Chapter 10 JCC and Other Meetings

10.1 Basic Policy of Holding Meetings

As mentioned in "Policy for implementation of activity" of "3.2 Task flow and plan of operation", JCC and other meetings were held periodically in order to make smooth the communication between JET and C/P, and to develop ability of SANEPAR staff including C/P. Meetings held periodically are as shown in Table 10.1-1.

Table 10.1-1 Meetings Held Periodically in the Project

Purpose	Participants	Frequency
JCC		
*Approval of PO in each year, *Approval of result of activities in each year, * Approval of PO in the next year,	*Management level of SANEPAR including the project-director *JICA Brazil Office *Japanese Consulate in Curitiba *C/P in each Output *JET	Twice a year
Monthly meeting		
*Reporting of result of activities, *Discussion regarding PO in the next dispatch of the expert team, *Orientation of project activities for the superiors of C/P, *Share of information and knowledge in C/P	*C/Ps and their superiors *JET	Once every dispatch of the expert team
Weekly meeting		
*Reporting of the result of activities in the previous week, *Discussion regarding PO in the next week, *Offering of information and knowledge from the expert team,	*C/P in each Output *JET in each Output	Held by each Output, Once a week basically

10.1.1 JCC

JCC was held twice every FY i.e. in the beginning and in the end of every FY with the participation of the management level of SANEPAR including the project director and JICA Brazil Office etc. PO of the certain FY was approved in the first JCC of the year and the result of activities in the certain FY and PO of the next FY were approved in the second JCC.

10.1.2 Monthly Meeting

Monthly meetings were held at the end of every dispatch of JET with the participation of C/Ps of Output -1 tO3 and JET. The result of activities in the dispatch and the PO in the next dispatch were discussed in these meetings.

The meetings were held for understanding of project activities within the superiors of C/P, as

well as to share information within C/Ps of the three Outputs. However, due to busyness, the participation of the superiors except for a few directors of divisions was insufficient.

In spite of the insufficient participation of the superiors, the meetings were effective for the progress of the project activities because C/Ps of three Outputs participated together in the meetings and understood the contents and the progress of activities of the other Outputs.

10.1.3 Weekly Meeting

Weekly meetings were held by each Output once every week during the dispatch of JET. The result of activities in the previous week was reported, the PO in the next week was discussed, and also the information and knowledge was offered from the expert team in the meeting.

At the beginning of the project, some C/Ps were concerned that there might not be subject matters to be discussed in the meetings being held every week. However, in proportion to the progress of the project, subjects requiring discussion increased and active discussion was made in the meetings.

10.2 Result of JCC

10.2.1 First Fiscal Year

(1) Kick-off Meeting

The kick-off meeting was held on 3rd October 2012 (Wednesday) at the meeting room of the training center of SANEPAR, as shown in Table 10.2-1. The basic policy of implementation of the project, activities of each Output, and the Plan of Operation was proposed from JET and was approved by SANEPAR.

Table 10.2-1 Kick-off Meeting

Date	3, October 2012, 14:00~16:40		
Venue	Training center of SANEPAR		
Participants	Organization	Name	Position
	SANEPAR	Antonio Hallage	Actual CEO (Administrative Director)
		Paulo Alberto Dedavid	Operation Director
		Joan Martinho Cleto Reis Junior	Investment Director
		Pericies Weber	Environment and Social Action Director
		Celso Luis Thomaz	Metropolitan Region General Manager
		Luis Carlos Blume	Chief of Operation Planning and Development Division
		Kazushi Shimizu	Chief of Operation Development Section
		Agenor Zarpelon	Chief of Water Process Section
		Rita de Cassia Gorny Becher	Chief of Production Section
		Gil Alceu Mochida	Civil Engineer
		Claudio L.Piccolotto	Operation Staff
		Arilson Mendes	Coastal Side Regional Coordinator
		Eraldo Vitorino	Coastal Side Regional Staff
		Luciana Dolci Balbinott	East Region Coordinator (Curitiba)
	JICA Brazil Office	Taku Ishimaru	Vice director
		Christiane Hatano	Project coordinator
	JICA Team	Kiyohiko Hayashi	Team Leader /O&M of Sewage Treatment Plant
		Takashi Dairaku	O&M of Sewage Pipe Network
		Kenji Uchida	Sewage Pipe Diagnosis Technology
		Tadashi Takeshima	Sewage Treatment Technology
		Kozo Obara	Electric/Mechanical Engineering
	Interpreter	Jorge Ninomiya	
		Motoko Tomita	
Subjects	1.Presentation of the inception report by JET (1) Basic policy of the project implementation (2) Activities of the three outputs (3) Plan of operation of each output 2. Discussion		

(2) The First JCC

The first JCC was held on 20th February 2013, as shown in Table 10.2-2, and the result of activities in the first fiscal year was reported from JET and was approved.

Table 10.2-2 Contents of the First JCC

Date	20, February 2013, 14:00~16:00
Venue	Training center of SANEPAR
Participants	

Organization	Name	Position
SANEPAR	Antonio Hallage	Actual CEO (Administrative Director)
	Paulo Alberto Dedavid	Operation Director
	Joan Martinho Cleto Reis Junior	Investment Director
	Luis Carlos Blume	Chief of Operation Planning and Development Division
	Rita de Cassia Gorny Becher	Chief of Production Section
	Gil Alceu Mochida	Civil Engineer
	Claudio L.Piccolotto	Operation Staff
	Luciana Dolci Alves	East Region Coordinator (Curitiba)
	Francisco Calros Vieira Marques	Sewetrage Section
	Romilson Goncalves	URLI
	Sebastiana Weinhardt	USDO
	Wandir Nogueira	Water Section
	Decio Jurgensen	Investment Department
	Mario Penna Guedes	Investment Department
	Thays Renata	USCS
	Josiane M. Steffons	UP
	Joao Henrique	USCS
Japanese Consulate General	Nana Kawamoto	Vice-consulate
JICA Brazil Office	Satoshi Murosawa	Chief representative
	Taku Ishimaru	Vice director
	Christiane Hatano	Project coordinator
JICA Team	Kiyohiko Hayashi	Team Leader/O&M of Sewage Treatment Plant
	Takashi Dairaku	O&M of Sewage Pipe Network
	Kenji Uchida	Sewage Pipe Diagnosis Technology
	Tadashi Takeshima	Sewage Treatment Technology
	Kozo Obara	Electric/Mechanical Engineering
	Ryunan Matsue	Water Treatment Technology
Interpreter	Jorge Ninomiya	
	Motoko Tomita	
	Ritsuko Shigetomi	

Subjects	1. Address by Mr. Hallage CEO of SANEPAR 2. Address by Mr. Ishimaru, Senior Representative of JICA Brazil Office 3. Reporting by JET member (1) Outline of the result of activities in the first fiscal year (2) Result of activities in Output-1 (3) Result of activities in Output-2 (4) Result of activities in Output-3 4. Discussion

10.2.2 Second Fiscal Year

(1) The Second JCC

Two (2) JCC meetings were held in the second fiscal year. The second JCC was held on 17th June 2013, as shown in Table 10.2-3. The work plan in the second fiscal year was explained, and the modification of PDM0 was proposed from JET and was approved.

Table 10.2-3 Contents of the Second JCC

Date	17th June 2013, 14:00~16:00		
Venue	Training center of SANEPAR		
Participants	Organization	Name	Position
	SANEPAR	Joao Martinho Cleto Reis Junior	Director of Investment Department
		Luiz Carlos Blime	Manager of OPD Division
		Gil Alceu Mochida	Project manager
		Claudio Luiz Piccolotto	Staff of Operation Division
		Marisa S.S. Caprioglione	USPE
		Marcelo Abraao Perini	API
		Sebastiana Weinhardt	USDO
	JICA Brazil Office	Taku Ishimaru	Senior Representative of JICA Brazil Office
	JET	Kiyohiko Hayashi	Team Leader/O&M of STP
		Takashi Dairaku	Maintenance of Sewer System
		Uchida Kenji	Sewer Pipe Diagnosis
		Tadashi Takeshima	Sewage Treatment Technology
		Kozo Obara	Mechanical/Electrical Technology
	Interpreter	Jorge Ninomiya	
		Motoko Tomita	
Subjects	1. Reporting by JET member (1) Outline of the work plan in the second fiscal year (2) Work plan in Output-1 (3) Work plan in Output-2 (4) Work plan in Output-3 (5) Proposal and approval for modification of PDM(PDM0 → PDM1) 2. Discussion		

(2) The Third JCC

The third JCC was held on 12th February 2014, as shown in Table 20.2-4. The result of activities in the second fiscal year and the draft work plan in the third fiscal year were reported from JET and were approved.

Table 10.2-4 Contents of the Third JCC

Date	12th February 2014, 09:00~12:00		
Venue	Training center of SANEPAR		
Participants	Organization	Name	Post
	SANEPAR	Fernando Ghignone	President
		Joan Martinho C. Reis Jr	Director of Investment Department
		Celso Luis Thomaz	GGML
		Decio Jurgensen	DI
		Francisco Carlos Viera Marques	USEG
		Mario R. C. D'Avila	USDO
		Romilson Goncalves	URLI
		Gil A. Mochida	USES
		Wandir Nogueira Rocha	USAG
		Marcia Schuchardt	USAG
		Pedro Augusto Mikowski	USEMCT
		Claudia Trindade	APE
		Solange B. Serpe	DMA-USGA
		Alcely Jose Wosniak	USPD
		Marisa Capriglioni	USPE
		Charles Carneiro	APD
		Luis Cesar Barea	USPE
		Valter Gelbcke	USPE
		Andrey Rosa	USPE
		Vanessa Galperin	USPE
		Sebastiana Weinhardt De Araujo	USES
	JICA Brazil	Ryo Ishiguro	Representante JICA
	JICA Team	Kiyohiko Hayashi	Leader/O&M of STP
		Takashi Dairaku	Sewage Pipe Maintenance
		Kenji Uchida	Sewage Pipe Diagnosis
		Tadashi Takeshima	Sewage Treatment Technology
		Tetsuji Kawamura	O&M of WTP
	Intérprete	Jorge Ninomiya	
		Ritsuko Shigetomi	
		Motoko Tomita	
Subjects	1. Reporting by JET member (1) Outline of the results of activities in the second fiscal year (2) Results of activities in the second fiscal year and work plan in the third fiscal year in Output-1 (3) Results of activities in the second fiscal year and work plan in the third fiscal year in Output-2 (4) Results of activities in the second fiscal year and work plan in the third fiscal year in Output-3 2. Discussion		

10.2.3 Third Fiscal Year

(1) The Fourth JCC

The fourth and the fifth JCC meetings were held in the third fiscal year. The fourth JCC was held on 28th August 2014. The result of the activities in the first dispatch of JET, as well as the work plan in the third fiscal year were reported by JET and were approved by SANEPAR. The modification of PDM1 to PDM_2 also was proposed by the team and was approved.

Table 10.2-5 Contents of the Fourth JCC

Date	28th August 2014, 14:30～16:30		
Venue	Meeting room in SANEPAR Training Center		
Participants	SANEPAR	Fernando Eugenio Ghignone	President
		Paulo Alberto Dedavid	Director of DO
		Decio Jurgensen	DI
		Wagner Schuchardt	DI
		Mario Roberto Cunha D avila	USDO
		Gil Alceu Mochida	USES
		Claudio Luiz Piccolotto Simon	USES
		Demetrius Mestre Dallalana	USES
		Sebastiana Weinhardt de Araujo	USES
		Adriana Verchai de Lima Lobo	USPD
		Marcio Arakaki	USPD
		Rita de Cassia Gorny Becher	USPD
		Celso Luiz Thomaz	GGML
		Cleverson Roberto Bogo	USEG
		Francisco Carlos Vieira Marques	USEG
		Alex Augusto Cordeiro	USEG
		Angelica de Lima Araujo	USEG
		Marino Kumegawa	USEG
		Laercio Mateus Squiba	USEG
		Murilo Bertolino	USEG
		Wandir Nogueira Rocha	USAG
		Carlos Antonio Rattmann	USAG
		Carlos Eduardo Ferreira da Silva	USAG
		Luciana Dolci Alves Balbinott	URCTL
		Carolina Proenca Araujo Rosin	URCTL
		Daniela Martini	URCTL
		Nelson Mori	URCTL
		Cesar Augusto Rupp	URCTL
		Julio Jose Brandalize	URCTL
		Romilson Goncalves	URLI
		Ladislau A de Oliveira	URLI
		Antonio Benedito Belchior Lara Pupo	URLI
		Eraldo Vitorino	URLI
		Flavia Marcela Lago	USPE
		Pedro Augusto Mikowski	USEMCT
		Robson de Paula Waltrick	USEM
		Jacqueline Shirado	APD
	JICA Brazil Office	Takeshi Nagata	Senior Representative
		Christiane Hiroko Hatano	Project Coordinator
	Japanese Consulate General	Akira Ichioka	Consul
	JICA Team	Kiyohiko Hayashi	Team leader/O&M of STP
		Takashi Dairaku	O&M of sewer system
		Kenji Uchida	Diagnosis of sewer pipe
		Tadashi Takeshima	Sewage treatment technology
		Kozo Obara	Electrical/mechanical technology
		Ryunan Matsue	Water treatment technology
	Interpreter	Jorge Ninomiya	
		Motoko Tomita Yeboles	
		Ritsuko Shiguetomi	
Subjects	1. Reporting by JET member (1) Outline of the work plan in the third fiscal year (2) Work plan and the result of activities in the first assignment term in Ouutput-1 (3) Work plan and the result of activities in the first assignment term in Ouutput-2 (4) Work plan and the result of activities in the first assignment term in Ouutput-3 (5) Modification of PDM_1 2. Discussion		

(2) The Fifth JCC

The fifth JCC was held on 12th February 2015, as shown in Table 10.2-6 and the result of the terminal evaluation of the project was reported from the evaluation team and was approved by

SANEPAR.

Table 10.2-6 Contents of the Fifth JCC

Date	12th February 2015, 9:00～11:00		
Venue	SANEPAR Training Center		
Participants	SANEPAR	Mounir Chaowiche	President
		Paulo Alberto Dedavid	DO
		João Martinho C. Reis Jr	DI
		Marcelo Abraao Perini	API/DI
		Decio Jurgensen	DI
		Wagner Schuchardt	DI
		Luiz Carlos Blume	GPDO
		Edgard Faust Filho	USES
		Gil Alceu Mochida	USES
		Claudio Luiz Piccolotto Simon	USES
		Sebastiana Weinhardt de Araujo	USES
		Alcely Jose Wosniak	USPD
		Celso Luiz Thomaz	GGML
		Francisco Carlos Vieira Marques	USEG
		Wandir Nogueira Rocha	USAG
		Luciana Dolci Alves Balbinott	URCTL
		Julio Jose Brandalize	URCTL
		Romilson Goncalves	URLI
		Pedro Augusto Mikowski	USEMCT
		Sergio Wippel	USPO
	Aguas Parana	Olga Polatti	
	Japanese Consulate General	Toshio Ikeda	Consul general
		Akira Ichioka	Consul
	JICA HQ	Kazunao Shibata	Director
		Hatsuka Naito	Assistant Director
		Ken Okumura	Dupty Assistant Director
	SANOSOGOKIKAKU	Jun Totsukawa	
	JICA Brazil Office	Ryu Ishiguro	Representative
	JICA Expert Team	Kiyohiko Hayashi	Team leader/O&M of STP
		Takashi Dairaku	O&M of sewer system
		Tadashi Takeshima	Sewage treatment technology
		Kozo Obara	Eletrical/mechanical technology
		Ryunan Matsue	Water treatment technology
		Tetsuji Kawamura	Water treatment technology
	Interpreter	Jorge Ninomiya	
		Motoko Tomita Yeboles	
		Ritsuko Shiguetomi	
		Yoshiko Sakamoto	
Subjects	1.Opening remark 2.Reporting result of terminal evaluation (Joint Evaluation team) 3.Question and answers 4.Wrap-up discussion and confirmation 5.Signing of minutes of meeting 6.Closing remark		

10.2.4 Fourth Fiscal Year

(1) The Sixth JCC

The sixth JCC was held on 22 July 2015, as shown in Table 10.2-7. The result of activities in the fourth fiscal year was reported, and also the result of the three years project was summarized.

Table 10.2-7 Contents of the Sixth JCC

Date	22nd June 2013, 15:00~17:15		
Venue	Training center of SANEPAR		
Participants	Organization	Name	Position
	SANEPAR	Mounir Chaowiche	President Director (Diretor Presidente)
		João Martinho Cleto Reis Junior	Director of Investment (Diretor Investimentos)
		Paulo Alberto Dedavid	Director of Operation (Director Operações)
		Decio Jurgensen	DI
		Gil Alceu Mochida	USES
		Claudio Luiz Piccolotto Simon	USES
		Celso Luis Thomaz	GGML
		Cleverson Roberto Bogo	USEG
		Wandir Nogueira Rocha	USAG
		Romilson Gonçalves	URLI
		Eraldo Vitorino	URLI
		Ladislau de Oliveira	URLI
		Sebastiana Wenhardt de Araujo	USES
		Luiz Leandro de Vicente	URLI
		Marisa Capriglioni	USPE
		Ana Cecilia P. Souza	USPE
	Japanese Consulate General	Akira Ichioka	Consul
	JICA Brazil Office	Taku Ishimaru	Senior Representative, JICA Brazil, JICA
	JET	Kiyohiko Hayashi	Team leader/O&M of STP, JET
		Takashi Dairaku	O&M of sewer system, JET
		Ryunan Matsue	Water treatment technology, JET
		Tetsuji Kawamura	O&M of WTP, JET
	Interpreter	Jorge Ninomiya	
		Motoko Tomita	
		Ritsuko Shiguetomi	
Subjects	(1) Opening address (by Japanese Consulate General, JICA Brazil, JET, and SANEPAR) (2) Report on overall activities under the Project (by JET) (3) Result of the Project (by SANEPAR), and signing ceremony for minutes of meeting of the JCC (4) Closing address (by SANEPAR)		

10.3 Result of Monthly Meeting

Main C/Ps in SANEPAR and JET members in all three outputs came together in the training center of SANEPAR and held the monthly meetings. The result of activities at that dispatch of the expert team and the plan of activities in the next dispatch were reported in the meetings. The contents of the meetings were reported to the management level of SANEPAR from the project manager, chairman of the meeting. Implementation status of the monthly meetings is as follows:

10.3.1 First Fiscal Year

Implementation status of the monthly meetings in the first fiscal year is as shown in Table 10.3-1.

Table 10.3-1 Monthly Meeting in the First Fiscal Year

Y	M	D		Time	Subjects
2012	11	5	Mon	08:30~12:30	1. Introduction of the project 2. Report of activities in October
	11	25	Mon	08:30~12:30	1. Report of activities in November 2. Report of action plan in the first fiscal year
2013	2	18	Mon	14:00~17:00	Report of the result of activities in the first fiscal year

10.3.2 Second Fiscal Year

Implementation status of the monthly meetings in the second fiscal year is as shown in Table 10.3-2.

Table 10.3-2 Monthly Meeting in the Second Fiscal Year

Y	M	D		Time	Subjects
2012	Jul	15	Mon	14:00~17:00	Report of the result of activities in the first dispatch term
	Nov	18	Mon	14:00~17:00	Report of the result of activities in the second dispatch term

The result of activities in the third dispatch of JET was reported in the third JCC held in 12th February 2014. Hence, no monthly meetings were held in that term.

10.3.3 Third Fiscal Year

Implementation status of the monthly meetings in the third fiscal year is as shown in Table 10.3-3.

Table 10.3-3 Monthly Meeting in the Third Fiscal Year

Y	M	D		Time	Subjects
2014	Nov.	27	Thu	14:00~16:30	Report of the result of activities in the second dispatch term

The result of activities in the first dispatch term of the expert team was reported in the fourth JCC held on 28th August 2014, and that in the third dispatch term was reported in weekly meeting of each Output. Hence, no monthly meetings were held in both terms.

10.3.4 Fourth Fiscal Year

The result of activities in the dispatch of the expert team in the fourth fiscal year was reported in the sixth JCC. Hence, no monthly meetings were held.

10.4 Weekly Meeting

SANEPAR C/Ps and JICA experts in each output of the project came together once a week and reported the result of the activities in the week before and considered the future works in the next week. Brain storming also was held several times in each output in the weekly meeting to confirm the issues existed in the target water and sewage facilities and to consider the solutions of those issues. Implementation status of the weekly meetings in each output is as shown below:

10.4.1 First Fiscal Year

(1) Output-1 (O&M of Sewage Pipe Network)

Table 10.4-1 Meeting on Output-1 in the First Fiscal Year

Date	Classification	The main agenda
【2012】		
October 4	Meeting	Explanation of actual condition of O&M of
October 8	Meeting	Explanation of ledger system
October 9	Meeting	Site visit of Operation of GIS and TV camera
October 10	Meeting	Equipment procurement of TV camera
October 11	Weekly Meeting	Planning of the project
October 16	Meeting	Investigation of flow volume
October 19	Weekly Meeting	Equipment procurement
October 26	Weekly Meeting	Theme of Monthly Meeting
October 31	Meeting	Explanation of coastal area
November 1	Weekly Meeting	Explanation of Electro-Mechanics Team
November 6	Meeting	Site visit of sewer pipe cleaning
November 7	Meeting	Site visit of operation of pumping station
November 8	Weekly Meeting	Plan for Monthly Meeting
November 23	Weekly Meeting	Brain-storming, Seminar on Japanese sewerage system
【2013】		
January 17	Meeting	Data collection of pumping stations
January 23	Meeting	Explanation of ledger system (CODOP)
January 24	Weekly Meeting	Plan of Operation of this assignment and seminar
January 30	Meeting	Urban River Rehabilitation Plan
January 31	Meeting	Explanation of O&M office of east Curitiba
February 1	Weekly Meeting	Selection of Pilot Area
February 5	Meeting	Investigation of Pilot Area and flow volume
February 6	Meeting	Explanation on SANEGIS

Date	Classification	The main agenda
February 8	Weekly Meeting	Division of roles of investigation
February 15	Weekly Meeting	Thema of JCC and Monthly meeting
February 19	Meeting	Equipment procurement
March 4	Meeting	Preliminal investigation of Pilot Area
March 5	Weekly Meeting	Future Schedule

(2) Output-2 (O&M of STP)

Table 10.4-2 Meetings in Output-2 in the First Fiscal Year

Date	Sort of meeting	Main subjects
【2012】		
19th October	Weekly meeting	Explanation of project, Preparation of survey schedule for target 12 STPs
22nd October	Discussion	Data collection, Preparation of water sampling schedule in STPs
25th October	Weekly meeting	Discussion about detail contents of the project activities
26th October	Discussion	Selection of survey subjects, Consideration of site survey schedule
1st November	Weekly meeting	Treatment flow chart of STP, Discussion about seminar to be held in Feb. 2013
9th November	Weekly meeting	Discussion about O&M manual, Brain-storming about issues in O&M of STP
14th November	Weekly meeting	Discussion about the result of brain-storming and activities in the next week
26th November	Weekly meeting	Brain-storming about solving process of issues in O&M of STP
【2013】		
22nd January	Weekly meeting	Discussion about result of water quality survey in STPs, Discussion about subjects of seminar
5th February	Weekly meeting	Discussion about seminar, Discussion about on-site survey by use of equipment provided
15th February	Weekly meeting	Consideration about Monthly Meeting and JCC
22nd February	Weekly meeting	Discussion about subjects of on-site research
28th February	Weekly meeting	Discussion about activity schedule in the next fiscal year

(3) Output-3 (O&M of WTP)

Table 10.4-3 Meeting in Output-3 in the First Fiscal Year

Date	Sort of meeting	Main subjects
【2012】		
9th Nov.	Weekly meeting	Organizing SOP team, activities of next week etc.
【2013】		
22nd Jan.	Weekly meeting	Draft program of seminar, O&M manual of WTP
31st Jan.	Weekly meeting	Participants selection and program of the seminar, survey schedule etc.
7th Feb.	Weekly meeting	Review and preparation of O&M manual, algae situation in Irai WTP
7th Feb.	Discussion	Algae situation in Irai Dam, issues of existing DAF system in Irai WTP
14th Feb.	Weekly meeting	Preparation of the seminar, monthly meeting and JCC
14th Feb.	Discussion	Introduction of presentation materials for the seminar
27th Feb.	Weekly meeting	Policy of advanced treatment for removing algae, study team, improvement of existing DAF process

(4) Sub-Group of "Electrical/Mechanical Technology"

The sub-group of Electrical/Mechanical Technology was formed, mainly selected from USEM of GGML, in the second dispatch term of the expert team and carried out activities with JICA expert in charge of Electrical/Mechanical technology. Implementation status of the weekly meeting of the sub-group is as shown in Table xx. The sub-group was dismissed at the beginning of the second fiscal year due to too much pressure for USEM member. A member of USEM joined to each Output to participate to the activities from the second fiscal year.

Table 10.4-4 Meetings in Sub-Group of "Electrical/Mechanical Technology"

Date	Sort of meeting	Main subjects
【2013】		
29th January	Weekly meeting	Explanation of project, Discussion about schedule for target 3 STPs and 2 WTPs
19th February	Weekly meeting	Presentation of survey report of STPs and WTPs by C/P and discussion
4th March	Weekly meeting	Presentation of survey report of STPs and WTPs by C/P and discussion, discussion about activity plan during JICA expert's absence

10.4.2 Second Fiscal Year

(1) Output-1 (O&M of Sewage Pipe Network)

Table 10.4-5 Meeting on Output-1 in the Second Fiscal Year

Date	Sort of Meeting	Main Subjects
【2013】		
3rd Jun.	Discussion	Activities in the fiscal year of 2013
5th Jun.	Discussion	Progress of sewer investigation by TV camera
6th Jun.	Discussion	Methodology of flow rate measurement
7th Jun.	Weekly Meeting	Activities and schedule of the project
11th Jun	Discussion	Progress of sewer investigation in coastal area
12th Jun.	Discussion	Water quality of the river in pilot area
14th Jun.	Weekly Meeting	The number of complaints and classification of them
21st Jun.	Discussion	Outline of M/P under establishing
24th Jun.	Weekly Meeting	Sewer diagnosis by TV camera
26th Jun.	Discussion	Progress of sewer investigation by TV camera
3rd Jul.	Discussion	Study on the water quality of Belem river – Catholic Univ.
4th Jul.	Weekly Meeting	Presentation of monthly meeting
5th Jul.	Discussion	Detail of M/P under establishing
9th Jul.	Discussion	Explanation of the project – Environmental department of city office
11th Jul.	Discussion	Detail explanation of M/P on trunk sewers and pumping stations
12th Jul.	Weekly Meeting	Presentation at monthly meeting
27th Sep.	Weekly Meeting	Progress of sewer investigation by TV camera
4th Oct.	Weekly Meeting	Presentation of sewerage M/P in CMA
16th Oct.	Discussion	Policy of the activities for next year – GGML
18th Oct.	Weekly Meeting	Report of investigation at coastal area
22th Oct.	Discussion	Activity of environmental education in pilot area
24th Oct.	Discussion	Activities in URCTN
25th Oct.	Weekly Meeting	Results of smoke test at pilot area in CMA

Date	Sort of Meeting	Main Subjects
31st Oct.	Discussion	Activities in URCTS
1st Nov.	Weekly Meeting	Report of activity of environmental education in pilot area
8th Nov.	Weekly Meeting	Presentation of monthly meeting
14th Nov.	Weekly Meeting	Results of demonstration of pipe lining method
【2014 年】		
28th Jan.	Discussion	Study on the rank up of sewers with small capacity
29th Jan.	Discussion	Progress of sewer investigation in coastal area
31st Jan.	Weekly Meeting	Activities of this assignment and workshop/seminar
3rd Feb.	Discussion	Registering the results of sewer diagnosis to the ledger
4th Feb.	Discussion	Involvement to workshop/seminar – URCTL
6th Feb.	Discussion	Involvement to workshop/seminar – URCTN, URCTS,USEG
7th Feb.	Weekly Meeting	Presentation of the study on the demonstration of pipe lining, and method to analyze the data measured by EC meter
11th Feb.	Discussion	Activities of the next fiscal year (GGML)
13th Feb.	Discussion	Registering the results of diagnosis to the ledger
14th Feb.	Weekly Meeting	Confirmation of presentations of workshop/seminar
24th Feb.	Weekly Meeting	Activities of SDT while absence of JICA Experts

(2) Output-2 (O&M of STP)

Table 10.4-6 Meetings in Output-2 in the Second Fiscal Year

Date	Sort of meeting	Main subjects
【2013】		
5th June	Weekly meeting	Selection of persons for implementing each activity, Consideration regarding training in Japan
13th June	Weekly meeting	Consideration regarding monitoring parameters of PI and control method of sludge in UASB tank,
20th June	Weekly meeting	Consideration of monitoring indicators of PI and table of contents of O&M manual,
21st June	Discussion	Discussion regarding implementation method of concrete diagnosis,
27th June	Weekly meeting	Selection of monitoring indicators of PI
27th June	Discussion	Technical discussion regarding preparation of O&M manual in Atuba Sul STP,
4th July	Weekly meeting	Consideration regarding progress of preparation of O&M manual and treatment process of sludge accumulated in lagoon,
11th July	Weekly meeting	Consideration regarding investigation for improving dewatering efficiency of sludge
18th July	Weekly meeting	Consideration regarding progress of preparation of O&M manual and treatment process of sludge accumulated in lagoon,
25th July	Weekly meeting	Consideration regarding the activities in the next term, activities during the absence of JET and improvement of floatation process,
3rd October	Weekly meeting	Consideration of progress condition of preparation of O&M manual
3rd October	Discussion	Technical discussion regarding the renovation plan of STPs with design engineers,
10th October	Weekly meeting	Consideration regarding investigation of sludge accumulation condition in lagoon, monitoring condition of PI and schedule of seminar,
10th October	Discussion	Technical discussion regarding the renovation plan of STPs with design engineers,

Date	Sort of meeting	Main subjects
24th October	Weekly meeting	Consideration regarding contents of seminar,
30th October	Briefing	Briefing for management level of SANEPAR regarding the renovation plan of STPs
31st October	Weekly meeting	Consideration of monitoring and data analysis of PI,
7th November	Seminar	Seminar on O&M manual and training in Japan (the first time)
12th November	Weekly meeting	Reporting on PI monitoring and consideration regarding the monthly meeting,
13th November	Discussion	Technical discussion regarding the renovation of STPs with designing and operation engineers,
14th November	Seminar	Seminar on O&M manual and training in Japan (the second time)
【2014】		
21st January	Weekly meeting	Consideration regarding the activities in the third term,
30th January	Weekly meeting	Consideration regarding preparation of O&M manual and monitoring of PI,
6th February	Weekly meeting	Consideration of technical evaluation of UASDB+DAF process and data collection of PI monitoring,
13th February	Weekly meeting	Consideration regarding the schedule of preparation of O&M manual in STPs other than Atuba Sul and the dosing process of coagulant into floatation tank,
14th February	Discussion	Technical discussion about renovation plan of mechanical and electrical equipment in STPs,
18th February	Discussion	Technical discussion about concrete diagnosis
20th February	Weekly meeting	Consideration regarding activities during the absence of JET and those in the next fiscal year,

(3) Output-3 (O&M of WTP)

Table 10.4-7 Meeting for Output-3 in the Second Fiscal Year

Date	Sort of Meeting	Main subjects
【2013】		
21st Jun.	Discussion	Confirming the activities of 1st year and explanation of activities of 2nd year. Needs of training in Japan etc.
24th Jun.	Discussion	M/P of Curitiba water supply, design life of civil facilities etc.
26th Jun.	Weekly meeting	Structure of O/M manual, nozzle experiment plan, training in Japan, advanced treatment and future schedule etc.
27th Jun.	Discussion	Policy of O&M manual preparation, PI calculation method
1st Jul.	Discussion	Araucaria industrial WTP and its advanced treatment etc.
3rd Jul.	Weekly meeting	Progress, issues and measures of O/M manual Iraí WTP, procurement of advanced treatment facilities etc.
10th Jul.	Weekly meeting	Sample of rehabilitation plan of WTP, M/P of Iraí WTP, nozzle pilot experiment equipment, monthly meeting etc.
17th Jul.	Weekly meeting	Results of monthly meeting, evaluation format of civil facilities of WTPs, PI data of Praia de Laste WTP
24th Jul.	Weekly meeting	O/M manual of Iraí WTP, approval of the rehabilitation plan, water quality, PI data, training in Japan
26th Jul.	Discussion	Training in Japan, rehabilitation plan for E&M, Araucaria WTP details
30th Jul.	Weekly meeting	By-production of ozonation, schedule of JET, works during period of JET absence
16th Oct.	Weekly meeting	Confirming progress of each activity and nozzle experiment schedule, training in Japan.
18th Oct.	Discussion	RO advanced treatment for Araucaria industrial WTP
23rd Oct.	Weekly meeting	Confirming progress of each activity, results of nozzle experiment,

		sonicator
30th Oct.	Discussion	RO pilot project in Araucaria industrial WTP
30th Oct.	Weekly meeting	Confirming progress of each activity, instruction of rehabilitation plan of WTPs etc.
6th Nov.	Weekly meeting	Preparation of monthly meeting, sonicator pilot project
6th Nov.	Discussion	Calculation method of PI, production costs of treated water in Iraí WTP
13th Nov.	Weekly meeting	Preparation of monthly meeting, F/S of advanced treatment, improvement of existing DAF system
【2014】		
5th Feb.	Weekly meeting	Confirming progress of each activity, activity contents during this assignment period, RO advanced treatment
12th Feb.	Weekly meeting	Confirming progress of each activity, O3+GAC advanced treatment and RO advanced treatment
19th Feb.	Weekly meeting	Confirming progress of each activity,
26th Feb.	Weekly meeting	Confirming progress of each activity, future activities in third fiscal year

10.4.3 Third Fiscal Year

(1) Output-1 (O&M of Sewage Pipe Network)

Table 10.4-8 Meeting on Output-1 in the Third Fiscal Year

Date	Classification	The main agenda
【2014 】		
August 4th	Weekly meeting	Activities of 2014
August 6th	Meeting	Urban river revitalization plan
August 8th	Weekly meeting	Estimation of flow volume in pilot area
August 13th	Meeting	Meeting with GGML
August 14th	Meeting	Meeting with environmental bureau of city government
August 15th	Weekly meeting	Results of sewage pipe diagnosis in pilot area
August 19th	Meeting	Meeting with USPE on the M/P of sewage works
August 21st	Meeting	Kick off of task force team of central district
August 22nd	Weekly meeting	Cloud GIS system
August 27th	Meeting	Task forth for central district
August 29th	Weekly meeting	Environmental education in the pilot area
November 7th	Weekly meeting	Report of training in Japan
November 14th	Weekly meeting	Development of tool for sewage pipe management
November 17th	Meeting	Meeting with GGML
November 21st	Weekly meeting	Concept of sewage pipe diagnosis plan in the project area
November 26th	Meeting	Task forth for central district
November 28th	Weekly meeting	Concept to establish size-up plan in the pilot area
【2015】		
February 6th	Weekly meeting	Rehabilitation/renewal plan and diagnosis plan
February 13th	Weekly meeting	Implementation of Rehabilitation/renewal plan
February 24th	Meeting	Task forth for central district

(2) Output-2 (O&M of STP)

Table 10.4-9 Meetings in Output-2 in the Third Fiscal Year

Date	Sort of meeting	Main subjects
【2014】		
31st July	Weekly meeting	Consideration of the activities in the third fiscal year and the progress of the preparation of O&M manual,
7th August	Weekly meeting	Consideration of the progress of PI monitoring,
14th August	Weekly meeting	Consideration of the preparation of O&M manual, Reporting of the result of experiment regarding the mixer set in the DAF in Santa Quiteria STP,
18th August	Discussion	Discussion regarding the preparation of O&M manual in Atuba Sul STP,
21st August	Weekly meeting	Consideration of the renovation program of STPs prepared by SANEPAR, Consideration of the modification of PDM,
1st September	Weekly meeting	Consideration of the activities in the next term,
7th November	Discussion	Discussion regarding the preparation of the checking sheet for maintenance of facilities in Atuba Sul STP,
11th November	Weekly meeting	Consideration of the result of PI monitoring after September, the preparation of O&M manual, reporting of the result of experiment of DAF pump and the activities in November,
19th November	Seminar	Seminar regarding asset management of STPs,
20th November	Weekly meeting	Preparation of the meeting for reporting PI monitoring, consideration of the process to promote the preparation of O&M manual and reporting of renovation program of STPs,
24th November	Workshop	The result of PI monitoring reported by the chief of STPs,
28th November	Workshop	Operation of UASB process,
【2015】		
30th January	Weekly meeting	Discussion regarding the preparation of O&M manual and PI monitoring
12th February	Weekly meeting	Consideration regarding activities during the absence of JET and those in the next fiscal year,

(3) Output-3 (O&M of WTP)

Table 10.4-10 Meeting for Output-3 in the Third Fiscal Year

Date	Sort of Meeting	Main subjects
【2014】		
6th Aug.	Weekly Meeting	Confirming the activities of 2nd year and explanation of activities of 3rd year
8th Aug.	Discussion	Confirming the progress and results of RO pilot project in Araucaria industrial WTP
13th Aug.	Weekly Meeting	Confirming progress of O/M manual preparation for each WTP, discussion about pilot experiment of cyanobacteria control using sonicator, issues for implementing rehabilitation & renewal plan prepared in Mar. 2014, etc.
13th Aug.	Discussion	Experiment equipment for adding slime inhibitor (KURIVERTER IK 110)
14th Aug.	Discussion	Monitoring of performance indicators (actual results) on O&M in coastal WTPs
15th Aug.	Discussion	Evaluation indicators about RO pilot experiment in Araucaria WTP
20th Aug.	Weekly Meeting	Confirming progress of O/M manual preparation for each WTP, discussion

Date	Sort of Meeting	Main subjects
		about pilot experiment of cyanobacteria control using sonicator, issues for implementing rehabilitation & renewal plan prepared in Mar. 2014, etc.
22nd Aug.	Discussion	Presentation contents of seminar in coastal area
26th Aug.	Discussion	Presentation contents of JCC
27th Aug.	Weekly Meeting	Confirming progress of implementing rehabilitation & renewal plan, the results of RO pilot experiment, procurement of oxygen cylinder for O3 generator, JCC materials etc.
29th Aug.	Discussion	RO membrane selection for next pilot experiment for Araucaria WTP
1st Sep.	Discussion	Installation of sonicator pilot experiment for cyanobacterial control
3rd Sep.	Weekly Meeting	Follow up of RO pilot experiment etc.
6th Nov.	Weekly Meeting	Confirming the progress of each activity during JET absent period and follow-up issues for seminar of 13th Nov. in coastal area
12th Nov.	Weekly Meeting	Discussion about contents of O&M manual, PI monitoring, presentation materials of seminars in coastal area and asset management, O3+GAC pilot experiment, sonicator pilot experiment of cyanobacterial control, the results of DAF experiment etc.
18th Nov.	Discussion	Sampling, field measurement, laboratory analysis for sonicator pilot experiment of cyanobacterial control
20th Nov.	Discussion	The results of DAF improvement survey in Irai WTP
21st Nov.	Weekly Meeting	Discussion about contents of O&M manual, PI monitoring, etc.
26th Nov.	Weekly Meeting	Following-up issues for implementing rehabilitation & renewal plan prepared in Mar. 2014, etc.
28th Nov.	Discussion	PI monitoring etc.
1st Dec.	Discussion	DAF improvement survey in Irai WTP, implementation schedule of O3+GAC pilot experiment and sonicator pilot experiment of cyanobacterial control
3rd Dec.	Weekly Meeting	Discussion for working contents during JET absent period and terminal evaluation
【2015】		
26th Jan.	Discussion	Evaluating the results of pilot RO advanced treatment experiment in Araucaria WTP
4th Feb.	Weekly Meeting	Confirming the progress of each activity from the beginning of Dec. 2014 to the end of Jan. 2015, future schedule for each activity etc.
11th Feb.	Weekly Meeting	Modifying contents of O&M manual, following-up issues of for implementing rehabilitation & renewal plan, O3+GAC pilot experiment, explanation the results of sonicator pilot experiment of cyanobacterial control, PI monitoring etc.
18th Feb.	Weekly Meeting	Reporting the activity results in 3rd fiscal year and sharing the results of pilot experiment, future plan for 4th fiscal year etc.
25th Feb.	Weekly Meeting	Experiment results of DAG improvement in Irai WTP, confirming the schedule of pilot advanced treatment experiment, activity plan during 4th fiscal year etc.

10.4.4 Fourth Fiscal Year

(1) Output-1 (O&M of Sewage Pipe Network)

Table 10.4-11 Meetings for Output-1 in the Fourth Fiscal Year

Date	Classification	The main agenda
【2015】		
July 3rd	Weekly meeting	Activities of each area and workshop/seminar
July 17th	Weekly meeting	Activities in the future

(2) Output-2 (O&M of STP)

Table 10.4-12 Meetings for Output-2 in the Fourth Fiscal Year

Date	Sort of meeting	Main subjects
【2015】		
2nd July	Weekly meeting	Confirmation of the progress of the preparation of O&M manual./ , Discussion on the program of the final seminar
9th July	Weekly meeting	Discussion on the renovation plan of STPs / Discussion on the content of the final seminar
16th July	Weekly meeting	Discussion on the result of seminar held in 15th July / Future activities after the completion of the Project.

(3) Output-3 (O&M of WTP)

Table 10.4-13 Meetings for Output-3 in the Fourth Fiscal Year

Date	Sort of meeting	Main subjects
【2015】		
1st July	Weekly meeting	Confirming the progress of each activity from the beginning of Mar. 2015 to the end of June. 2015, and future schedule for each activity etc.
8h July	Weekly meeting	Discussion on the content of presentation for the final seminar
15th July	Weekly meeting	Discussion on the content of presentation for the final seminar/ Future activities after the completion of the Project.

Chapter 11 Final Outputs

11.1 Final Outputs of the Project

The final outputs delivered under the Project are listed in the following table.

Table 11.1-1 List of the Final Outputs

Output	Title	Corresponding annex number
Output 1	Rehabilitation, Renewal and Improvement Plan of Sewage Pipe Network	A11-1
	Sewage Pipe Network Diagnosis Plan in CMA and Coastal Area (Draft)	A11-2
Output 2	Operation and Maintenance Manual for STP	A11-3
	Renovation Plan of Sewage Treatment Plants	A11-4
	Results of Feasibility Study for Introducing Advanced Treatment to Use Reclaimed Water	A11-5
Output 3	O&M Manual for WTP	A11-6
	Rehabilitation and Renewal Plan for Water Treatment Plants for Iraí , Praia De Leste, Saiguaçú, Morretes and Guaraqueçaba	A11-7
	Feasibility Study on Introduction of Advanced Treatment Facility for Removal Algae	A11-8