PALESTINIAN INTERIM SELF-GOVERNMENT AUTHORITY
JERICHO MUNICIPALITY

TECHNICAL ASSISTANCE AND CAPACITY BUILDING PROJECT FOR THE JERICHO SANITATION PROJECT

PROJECT COMPLETION REPORT

March 2018

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

NJS CONSULTANTS CO., LTD.
YOKOHAMA WATER CO., LTD

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EXECTIVE SUMMERY

1, Outputs of the Project and achievements

The below Table shows the project outputs and indicators and their achievements.

Output	Indicator	Achievement	Activities
Output 1-1	Departments in charge of sewerage works is officially approved in Jericho municipality	Achieved	Former Water Department was approved as Water and Sewerage Department
Output 1-2	Number of full-time staff for sewerage works is more than 14 persons.	Achieved	17 staffs were allocated, of which full-time 15 and concurrent 23.
Output 1-3	The by-law for users of sewerage facilities is enforced.	Partly achieved	Jericho Sewerage By-Law was enacted, the draft penalty clause was prepared, but since approval of PWA and MoLG has not been approved as of February 2018.
Output 1-4	Mid-term management plan is approved by the city council	Partly achieved	Mid-term management plan (2014-2018) was developed and presented to Mayor, modified plan (2014-2020) was prepared but since approval of municipal council has not been secured.
Output 2-1	Carry out trainings /workshops in order to obtain basic knowledge	Achieved	-
Output 2-2	More than 6 persons pass a technical examination for O&M of the WWTP.	Achieved	8 staffs passed the examination
Output 2-3	Hazardous materials exceeding the quality standard do not flow into sewerage facilities	Partly achieved	Discussions for accepting sewage of JAIP started on the wastewater quality
Output 2-4	70% of treated wastewater and 10% of sludge are utilized	Partly achieved	Reuse rates of treated wastewater is 100% and few volume of sludge is using in WWTP as fertilizer
Output 2-5	More than 80% of served population recognizes the need for the WWTP	Achieved	86% of residents recognize the importance of sewerage
Output 3-1	Carry out trainings /workshops in order to obtain basic knowledge	Achieved	-
Output 3-2	More than 4 staffs pass a technical examination for sewer maintenance and connection to public sewer	Achieved	5 staffs passed the examination
Output 3-3	2,000 private sewers are connected to public sewers and 60% of the connected building owners is satisfied with the system	Partly achieved	1,836 households are connected and 89% of users are satisfied
Output 4-1	Carry out trainings /workshops in order to obtain basic knowledge	Achieved	-
Output 4-2	Collection rate of user charge for sewerage facilities exceed 60%	Partly achieved	Collection rate of sewerage tariff is 24% in average of 2017
Output 4-3	Mid-term management plan is approved by the city council	Partly achieved	Same as Output 1-4
Output 4-4	More than 60% of served population recognizes the need for payment of user charge	Achieved	67% of residents are recognized

2. Major Indicators Transition

Regarding the number of sewerage staffs, the number of house connections, the sewerage fee collection ratio and the sewage inflow to WWTP, the transition of major indicators based on activity timing,

secured funds, measures taken etc. are presented as shown below.

2.1 Transition of the Number of Staffs

The following table shows transition of the number of staffs of sewerage works from the beginning of operation of the sewerage facilities.

Working Style	2014/6	2014/8	2015/5	2015/11	2016/7	2017/12
Full-time	6	7	9	10	12	15
Concurrent	5	3	5	4	2	2
Total	11	10	14	14	14	17

2.2 Transition of the Number of House Connection

In order to secure the inflowing sewerage volume of WWTP, it is indispensable to encourage house connection besides the sewer network. The number of house connection and their transition are shown the following table based on the data of Jericho Municipality.

Project	Connection number	Household number	Completion Time
PP-1 (TeCSOM fund)	89	246	August 2014
PP-2 (TecSOM fund)	295	645	December 2015
PP-3 (Jericho own budget)	185	500	February 2017
Other Jericho budget	168	445	On-going
Total	737	1,836	

2.3 Transition of the Sewerage Fee Collection ratio

In Jericho Municipality, collection of sewage fee was started as sewage facilities began to be used. According to the data of Jericho Municipality, the collection rate of sewerage fee and water fee after January 2015 will be as follows. The collection rate is shown as the cumulative amount collected for the amount billed since January 2015.

Duration	Type of Fee	Total Invoice Fee (NIS)	Total Collection Fee (NIS)	Collection Rate (%)
2015/1/1~2015/12/31	Water	7,464,850	5,142,902	68.9
	Sewerage	194,904	18,074	9.3
2015/1/1~2016/12/31	Water	15,175,642	11,234,013	74.0
	Sewerage	332,660	85,261	25.6
2015/1/1~2017/12/31	Water	21,895,219	15,617,075	71.3
	Sewerage	498,372	122,606	24.6

2.4 Transition of Sewage Inflow to WWTP

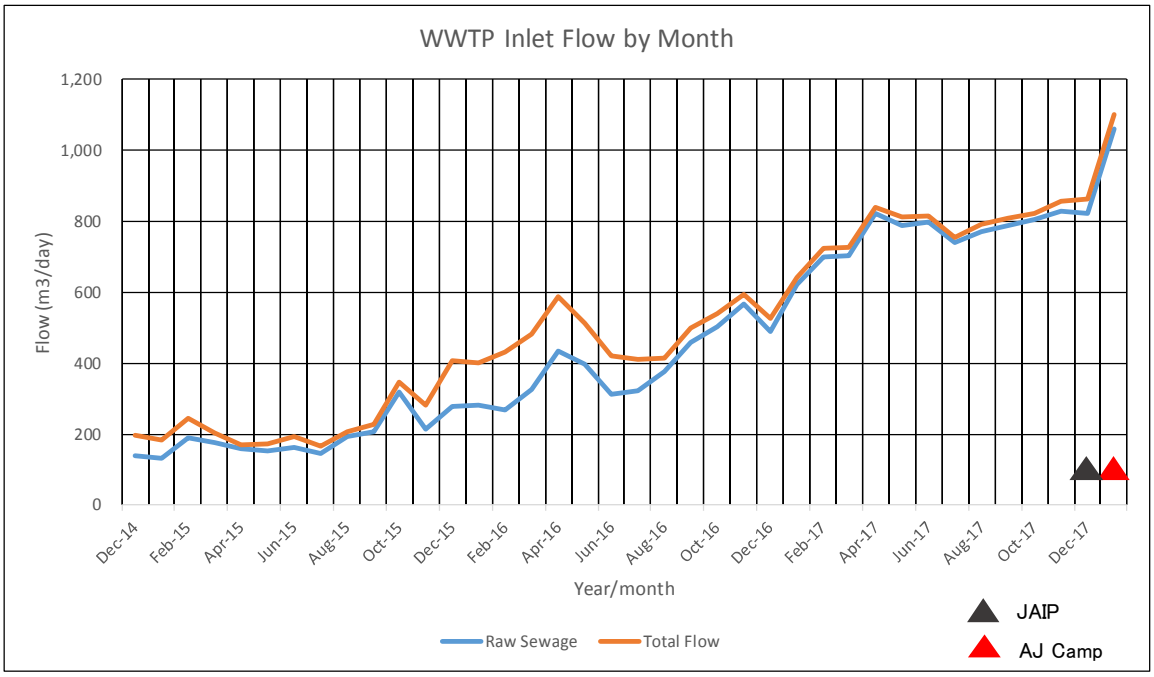
The WWTP of Jericho accepts tanker sludge which is carried in a tanker sludge vehicle besides

generated sewage flowing from Jericho Municipality. From August 2014, WWTP accumulated the average incoming sewage flow every month, and the inflowing sewage volume in January every year is shown below.

Year/Month	Domestic Sewage Flow (m^3/day)	Tanker Sludge Volume (m^3/day)	Total Flow (m^3/day)
January 2015	131	52	183
January 2016	281	119	400
January 2017	620	22	642
January 2018	1,060	41	1,101

The trend of the average sewage inflow to WWTP every month is shown in the below figure. The below figure is also describe the timing of the construction of house connection. The reasons of increasing inflow on January 2018 are effected the following items.

- Starting to receive a part of the wastewater of JAIP
- Starting to receive a part of sewage of AJ Camp



PP-1	March 2014 ～ August 2014
PP-2	January 2015 ～ December 2015
PP-3	May 2016 ～ July 2017
Other Jericho Budget	From January 2016, On-going

3. Expecting Future Action Plan

3.1 Encouragement of Sewerage Tariff Collection Rate

To collect sewerage tariff certainly, it is the most important to operate and manage appropriately under sound financial conditions. It is immediate task to raise the collection rate of sewage tariff to the same level as at least water supply. From December 2017, with the support of TeCSOM, a combined billing system of water supply and sewerage fee was introduced. In this system, in addition to the invoiced amount of the water and sewerage fee in the current month, the total amount of unpaid past is also displayed, and promotion of understanding to the user is aimed.

Furthermore, in Jericho Municipality, under the support of the Japanese counterpart fund, the introduction of pre-paid water meter (PPWM) related to water and sewerage charges of 430 units is preparing the application form to submit to Japan.

3.2 Phased Construction Plan of Sewer and House connection

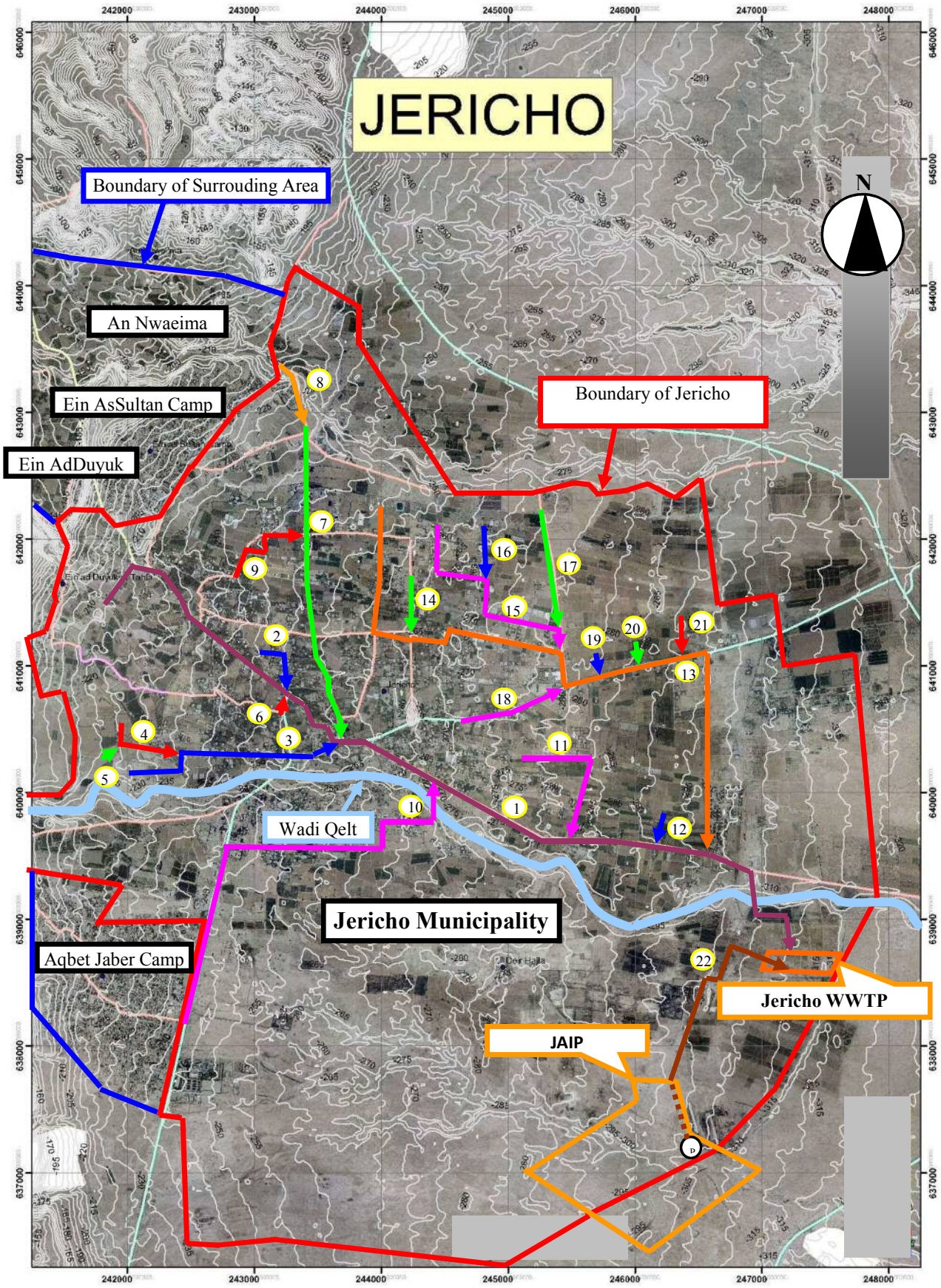
The Phased construction plan of sewer and house connection for Jericho is developed with the following stages. In the stage, the Phase-1 is completed in February 2017.

Stage-2: Development at the end of 2017 (construction of sewers and house connections for apart of AJ Camp by UNRWA)
Stage-3: Development at the end of 2019 (installation of sewers by USAID-1B, sewers and house connections using the funds of Japanese counterpart fund and PA budget and sewers and house connections for the remaining area of AJ Camp by UNRWA)
Stage-4: After 2020 (construction of sewers and house connections in the remaining area of Jericho using the funds of Jericho own budget and other donors)

In the above stages, the Phase-2 and Phase-3 has been secured the funds for construction and on-going works, these stages will be completed until the end of 2019. Regarding the Phase-4, as of February 2018, there is no prospect of funds, and unless the supports by other donors is obtained, the sewerage fee collected by Jericho Municipality will be used for the development of sewerage facilities as a source of funds. The phased construction plan is presented as the following table and the calculation sources for the table is attached in **Appendix A 5-3-1**.

Construction Plan for Jericho Wastewater Network

		Phase-1		Phase-2		Phase-3		Phase-4	
		Municipal Area	Municipal Area	Refugee Camps	Municipal Area	Refugee Camps	Municipal Area	Refugee Camps	Municipal Area
		Completed as of Dec. 2016	Completed as of Feb. 2017	On-going Expected on Dec. 2017		On-going Expected on Dec. 2019		**Future Plan (fund required)**	
Jericho Municipality	Population	23,220	23,220		23,870		25,932		25,932
Total length of Sewer network (Km)	Total	45.3	45.3		45.3		69.3		124.6
	Newly constructed		0.0		0.0		24.0 (USAID 1B)		55.3
No. of Connected Household	Total	891	1,391		1,391		3,888		5,763
	Newly connected	-	500		0		2,497		1,875
Served population	Total	4,010	6,260		6,260		17,497		25,932
	Increased	-	2,250		0		11,237		8,435
Sewage connection ratio (%)		17.3	27.0		26.2		67.5		100.0
Adjacent Refugee Camps	Population			9,336		10,142		14,608	
Served population	Total			3,734		10,142		14,608	
	Increased			-		6,408		4,466	
Sewage connection ratio (%)				40.0		100.0		100.0	
Required budget (USD)	House connection	-	-	-	-	-	1,828,360	688,800	1,302,000
	Sewer	-	-	-	-	-	0	6,772,500	14,516,250
	Total	-	-	-	-	-	1,828,360	7,461,300	15,818,250
Note		Constructed by JICA (PP-1, PP-2) and USAID (1A)	House connection project (PP-3) by municipal budget (0.87M NIS)	UNRWA (AJ Camp: Package-1)		UNRWA (AJ Camp: Package 2-4)	Counterpart fund and PA fund (total budget = 2.1million USD)	Whole area of ES Camp	
Capacity of WWTP (m3/day)		6,600							
Inlet flow of WWTP (m3/day)		526	730	1,129		3,057		4,107	
Occupancy Rate of WWTP (%)		8.0	11.1	17.1		46.3		62.2	
Discharging pollution load (kg/day)									
Assumption				Assumed Out-flow from JAIP: 90m3/day, Tanker sludge: 40m3/day, etc.		Assumed Out-flow from JAIP: 300m3/day, Tanker sludge: 150m3/day, etc.		Assumed Out-flow from JAIP: 400m3/day, Tanker sludge, etc.	



Location Map

note : ○ shows the number of Trunk Sewer

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<<<ABBREVIATION>>>

AFD	Agence Francaise de Developpement
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantity
C/P	Counterpart
COD	Chemical Oxygen Demand
DO	Dissolved Oxygen
DS	Dried Sludge
GIS	Geographic Information System
ISO	International Organization for Standardization
JAIP	Jericho Agro-Industrial Park
JAIPCo	Jericho Agro-Industrial Park Company
JCC	Joint Coordinating Committee
JDECO	Jerusalem District Electricity CO.LTD
JICA	Japan International Cooperation Agency
JM	Jericho Municipality
JS	Japan Sewage Works Agency
M/M	Minutes of Meeting
MLSS	Mixed Liquor Suspended Solids
MoA	Ministry of Agriculture
MoE	Ministry of Environment
MoLG	Ministry of Local Government
NIS	New Israel Sheqel
O&M	Operation and Maintenance
OD	Oxidation Ditch
OJT	On-the job Training
PA	Palestinian Authority
PDM	Project Design Matrix
PIEFZA	Palestinian Industrial Estates and Free Zones Authority
PP	Pilot Project
PR	Public Relations
PWA	Palestine Water Authority
R/D	Record of Discussion
SCADA	Supervisory Control and Data Acquisition

TC	Technical Committee
TDS	Total Dissolved Solid
TeCSOM	Technical Assistance and Capacity Building for Sewerage Operation and Management
UNDP	United Nations Development Programme
UNRWA	United Nations Relief and Works Agency for Palestine Refugees in the Near East
USAID	United States Agency for International Development
WWTP	Wastewater Treatment Plant
YEPB	Environmental Planning Bureau of Yokohama Municipal Government

CHAPTER 1 OUTLINE OF THE PROJECT

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1.1 Background of the Project

The Jericho Jordan Valley Area is located in the world-famous Great Rift Valley. Owing to the topographic conditions, wastewater generated in urban areas does not have any points of discharge, thus, it remains in the valley. The lack of proper wastewater treatment facilities in the area greatly contributes to the contamination of the groundwater vein, which happens to be the sole water source for the water supply system of the Jericho municipality. In January 2010, this situation has become a serious threat to the quality of groundwater.

The perspective of effective use of the limited water source dictates that treated wastewater should be used as a new water source. This can be carried out from the treated wastewater to be generated from agricultural activities that have been planned in this area with the construction of an "Agro-Industrial Park" which is a core project in the "Corridor for Peace and Prosperity" and is being promoted by the Government of Japan.

Based on these circumstances, the Palestinian Authority requested the Jericho Wastewater Collection, Treatment System and Reuse Project in Jericho municipality located in the Jordan River's West Bank Area in August 2008 for Japanese Grand Aid Assistance. In response to the request, the Government of Japan decided to conduct the Preparatory Survey, which was performed by JICA and which examined the target facility construction sites, wastewater treatment methods and so forth. The Exchange of Notes and the Grant Agreement for the Grant Project were all concluded on February 28, 2011.

Subsequently, the Palestinian Authority requested for technical cooperation for the Project. Once again the Government of Japan accepted the request. JICA then conducted the Detailed Planning Survey from November 20, 2011 to December 10, 2011, with both governments coming into agreement with the outline of the Project.

1.2 Objective of the Project

The overall goals and purpose of the Project are as follows;

Overall Goals

Sewerage facilities in Jericho municipality are operated and managed appropriately under sound financial conditions.

Project Purpose

System for operation and management of sewerage works in Jericho municipality is established.

1.3 Target Area

The target area of this Project is Jericho municipality and the surrounding areas included in the Jericho sewerage treatment area (districts of an-Nuway'imah, Ein ad-Duyuk, Ein as-Sultan and Aqabat Jaber refugee camps).

1.4 Outputs of the Project and Activities

Table 1.4.1 shows each Project output and its corresponding verifiable indicators, which have been determined from the baseline and social awareness surveys to be conducted and with subsequent discussion with Counterpart (C/P).

Table 1.4.1 Outputs of the Project and Verifiable Indicators

Outputs	Verifiable Indicator
1. Management plan for sewerage works in Jericho municipality is developed.	1-1 Departments in charge of sewerage works is officially approved in Jericho municipality. 1-2 The number of full-time staff for sewerage works is **more than 14 persons**. 1-3 The by-law for users of sewerage facilities is enforced. 1-4 Mid-term management plan is approved by the city council.
2. Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant (WWTP) is developed.	2-1 **More than 6 persons** pass a technical examination for O&M of the WWTP. 2-2 Hazardous materials exceeding the quality standard do not flow into the sewerage facilities. 2-3 **70% of treated wastewater and 10% of sludge** are utilized. 2-4 **More than 80%** of serviced population recognizes the need for the WWTP.
3. Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed.	3-1 **More than 4 staffs** pass a technical examination for sewer maintenance and promotion for connection to public sewers. 3-2 **2,000 private sewers** (house connections) are connected to public sewers and **60%** of the connected building owners is satisfied with the system.
4. Capacity of Jericho municipality for financial management of sewerage works is developed.	4-1 Collection rate of user charge for sewerage facilities **exceeds 60%**. 4-2 A mid-term financial plan is approved by relevant organizations. 4-3 **More than 60%** of serviced population recognizes the need for payment of user charge. 4-4 Income (subsidy, borrowing, charges, etc.) exceeds expenditure in the management plan.

Project activities for each output are listed in **Table 1.4.2**.

Table1.4.2 Activities for Each Output of the Project

Outputs		Activities
(1)	Management plan for sewerage works in Jericho municipality is developed.	(a) Establish departments for operation and management preparation of sewage works (b) Assign staff in the departments for operation and management of sewage works (c) Draft by-laws for the sewerage facilities users (d) Develop a sewerage management plan for sewage works in Jericho municipality
(2)	Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant (WWTP) is developed.	(a) Carry out trainings/workshops to obtain basic knowledge of the WWTP (b) Prepare O&M (Operation and Maintenance) manuals for the Jericho WWTP and carry out on-the-job trainings (c) Develop an effluent regulation for enterprises connected to sewer networks (d) Utilize the treated water and sludge for agricultural use (e) Share information and experience gained by the Jericho WWTP O&M to related organizations and residents
(3)	Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed.	(a) Carry out trainings/workshops to obtain basic knowledge of the WWTP (b) Prepare O&M manuals for sewer networks and carry out on-the-job trainings (c) Connect private sewers to public sewers in the pilot area (d) Share information and experience gained by the sewer network maintenance to related organizations and residents
(4)	Capacity of Jericho municipality for financial	(a) Carry out trainings/workshops to obtain basic knowledge of the WWTP (b) Develop the structure for sewerage facility tariff

	management of sewerage works is developed.	(c) Develop a mid-term financial plan (d) Share information and experience regarding financial planning to related organizations and residents

1.5 Project Activities and Achievements

The Project was implemented in accordance with the Record of Discussion (R/D) signed on May 9, 2012, between the Authorities concerned of Palestinian authority and JICA. The Project commenced in December 2012, and will be complete in March 2018. The work flow of the Project activities is shown in **Figure 1.5.1**. **Table 1.5.1** summarizes the Project outputs performed according to the indicators set by the Project Design Matrix (PDM). The latest version of the PDM is shown in **Table 1.5.2** and transition and modification of it is attached in **Appendix A 1-5-1**.

Table 1.5.1 Project Outputs Performed to Target Verifiable Indicators by PDM

Output	Activity	Verifiable Indicator	Accomplished Status	Activities	Challenges and Countermeasures to be Taken
1. Organization structure for sewerage work in Jericho municipality is developed.					
1-1	Establish departments for operation and management preparation of sewerage works.	Departments in charge of sewerage works is officially approved in Jericho municipality.	**Achieved**: former Water Department was reorganized as Water and Sewerage Department.	- Studied the current organization structure and job duties in Feb. 2013. - Developed the organization structure of Water and Sewerage Department and staffing plan, of which the former was approved by Mayor in Apr. 2013. - Proposed the organization to improve efficiency of collection rate and approved in Feb. 2017.	**<Issue>** - The liaison system between the departments in charge of sewerage works in the Jericho municipality is lacking **<Recommendation>** - A communication system (regular meeting, circulating the weekly / monthly report for share information) should be established between departments
1-2	Assign staffs in departments for operation and management of sewerage works.	The number of full-time staff for sewerage works is more than 14 persons.	**Achieved**: 17 staffs were allocated, of which full-time 15 and concurrent 23.	- Assessed competency of C/Ps in Apr. 2013, Aug. 2015, Sep. 2017. - Described functions and jobs of each division/section in Feb. 2014. - Clarified current workflow and challenges for meter reading and bill delivery and collection for improving collection ratio of sewerage tariff in Feb. 2016. - Proposed the organization to improve efficiency of collection rate and approved in Feb. 2017. - Recommended employment an additional staffs on GIS and water quality analysis in Sep. 2017.	**<Issue>** - It is expected that shortage of staff will occur when sewage volume increases in the future - Jericho municipality increased the number of staff for collecting water and sewerage tariff, but it is necessary to further increase in preparation for future increasing the number of target households **< Recommendation >** - Jericho municipality should consider the staff increasing and training them through OJT in order to operate sewerage facilities stably in the future - Rebuilding and secure collection system of water and sewerage tariff - To protect WWTP, water quality monitoring team should be established to promptly analyze water quality and conducting on-site inspections regularly at factories
1-3	Draft a by-law for users of the sewerage facilities.	The by-law for users of sewerage facilities is enforced.	**Achieved**: Jericho Sewerage By-Law was enacted in conformity with Palestine Sewerage Law.	- Studied sewerage by-laws of other municipalities i.e. Nablus and Al-Bireh in Apr. 2013. - Developed draft sewerage by-law of JM in Apr. 2013 with steering committee of C/Ps based on standard by-law prepared by PWA. - Replaced drafted by-law by Palestine Sewerage Law after its enactment in Dec. 2013. - Jericho Sewerage By-Law was approved by the municipality council in Mar. 2014. - Penalty system for un-paid was established by the municipality and submitted to PWA and MoLG in Feb. 2017	**< Recommendation >** - The draft penalty clause was prepared for unpaid customers, but since approval of PWA and MoLG has not been approved as of February 2018, follow-ups to these agencies are necessary
1-4	Develop a mid-term management plan for sewerage works in Jericho municipality.	Mid-term management plan is approved by the city council.	**Partly Achieved**: Mid-term management plan was developed and presented to Mayor; connection fee and sewerage tariff as a part of the plan were approved by municipality council.	- Developed mid-term management plan (Strategic Business Plan for 2014-2018) together with steering committee of C/Ps from Jan. to Mar. 2014; made it pubic to all C/Ps before presenting it to Mayor. - Supported implementation of the plan, e.g. bridging related organizations of JM, PIEFZA, Popular Committee of Aqbat Jaber Camp, UNDP, etc. from Feb. 2014. - Implemented annual revision of the plan together with steering committee of C/Ps in Nov. 2015 and Jul. 2016. - Reviewed the sewerage management plan (draft) according to the trend of reviewing the tariff system in Jul. 2015. - Participatory meeting on the medium-term management plan was prepared and held for related organizations including JICA Palestine office (PWA, MoLG, Nablus, Jenin, Al-Bireh) in Jul. 13 2017. - Established a committee to promote sound management and conducted consultations on the theme of penal provisions and prepaid water meters (Nov. 2016 to Feb. 2017). - Extended the target year of the mid-term management plan to 2020 and carried out the necessary update and revision work (Feb. 2017).	**<Issue>** - The budget for water and sewerage in Jericho municipality is weak and it is necessary to secure necessary budget for the future **< Recommendation >** - It is necessary to approve at the city council of the revised medium-term management plan - Jericho municipality should consider to maintain budget for encouraging to expand of sewer network and house connection and renewal of future mechanical and electrical equipment of WWTP - Jericho municipality is expected to implement sewerage works based on the management plan up to 2020, and revise it reflecting the annual sewerage works
2. Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant is developed					
2-1	Carry out trainings /workshops in order to obtain basic knowledge.	-	-	- Lectured and conducted OJT in 11 sessions on the name, function, installation, flow of equipment in WWTP in Oct. to Dec. 2013. - Lectured and conducted OJT on the function and water quality control of WWTP in Oct.-Dec. 2013 and Feb. 2014. - Held workshop on planning operation and function of mechanical and electrical equipment of WWTP in Nov. 2013. - Lectured components, functions and how to operate and maintain of mechanical and electrical equipment of WWTP in Feb.-Mar. 2014. - Did mini-exam. on wastewater treatment flow, equipment layout and electricity distribution flow in Mar. 2014. - Lectured on operation of solar power generation equipment in Mar. 2014. - Conducted OJT on operation in line with starting operation of WWTP in May 2014. - Held workshop on reusing treated wastewater and sludge in Jun. 2014.	

Output	Activity	Verifiable Indicator	Accomplished Status	Activities	Challenges and Countermeasures to be Taken
				- Gave training on water quality testing in Jun.-Jul. 2014, Nov.-Dec. 2014 and May-Jun. 2015. - Did exam. on O&M of mechanical and electricity equipment in WWTP; 5 among 8 participants passed the exam. and remaining 3 passed the re-exam. - Held workshop on reusing treated wastewater and sludge in Jun. 2015. - Workshop on applying to receiving treated wastewater in Feb. 2016. - Technical support for future two series operation of the wastewater treatment plant in May 2017, Jan. 2018	
2-2	Prepare manuals for O&M in the Jericho WWTP and carry out on the job trainings.	More than 6 persons pass a technical examination for O&M of the WWTP.	**Achieved**: 1 engineer, 1 technician and 1 operator passed the examination, while 5 staffs failed for whom the C/Ps arranged supplementary lectures by the initiative of WWTP manager, and finally passed the re-exam.	- Visited preceding municipalities i.e. Al-Bireh, Nablus and Jenin in Apr.-Jun. 2013 and May 2014. - Conducted OJT on operation, keeping record and inspection of WWTP using SCADA in Jun.-Jul. 2014. - Conducted OJT on O&M of WWTP in Jun.-Aug. 2014. - Conducted OJT on preparing daily and monthly report in Jun.-Aug. 2014. - Inspected operation status of WWTP and conducted OJT on its improvement in Oct.-Nov. 2014. - Conducted OJT on keeping record of O&M in WWTP in Feb. 2015. - Conducted OJT on trouble shooting of WWTP in Apr. 2015. - Held meetings on annual maintenance plan of WWTP in Apr. 2015. - Drafted safety and health manual of WWTP; revised O&M manual and troubleshooting manual in Jun. 2015. - Conducted OJT on checking operation status and inspection and maintenance of WWTP in Jun 2015. - Checked operation status of mechanical and electrical equipment in WWTP and gave instructions for improvement in Sep. 2015. - Conducted OJT on water quality control and calibration of measurement equipment in Nov.-Dec. 2015. - Checked status of operation and regular inspection of mechanical and electrical equipment in WWTP, identified challenges and developed countermeasures for improvement in Jun. 2016.	**<Issue>** Although there are few factories that have enormous impact on biological treatment, it is necessary to prepare for cases where unexpectedly high concentrations sewage flow into WWTP **< Recommendation >** - To protect WWTP, water quality monitoring team should be established to promptly analyze water quality and conducting on-site inspections regularly at factories - After the completion of the technology transfer project of TeCSOM, the JICA Expert hope to fully utilize the products (several manuals, technical information, know-how and management plan on sewerage works)
2-3	Develop an effluent regulation to water discharged to sewer networks.	Hazardous materials exceeding the quality standard do not flow into sewerage facilities.	**Achieved**: Only the slaughter house has a potential to discharge wastewater exceeding quality standard, after surveying factories in the city. The slaughter house has its own treatment plant, but wants to connect to pubic sewer in the future, and the Experts advised to install a pre-treatment facility.	- Proposed quality standard of discharged wastewater in May 2013. - Screened target factories for surveying on discharged wastewater, prepared survey sheet and inspected on-site in Feb.-Mar. 2015. - Meeting and consulting with the Jericho Hospital and C/Ps in charge of a new slaughterhouse on water quality and quantity for receiving wastewater from Mar. 2015. - Agreement for acceptance of the JAIP wastewater has been concluded and acceptance started in 2017 - Discussions for accepting sewage of the Aqbat Jaber (AJ) camp started negotiations with the AJ Camp Committee from 2017 and started discharging sewage to Jericho sewer system in Jan. 2018	**<Issue>** - Part of the collected cesspit sludge has not been discharged to WWTP - Jericho municipality has agreed to accept sewage from JAIP, but no agreement has been concluded with AJ camp **< Recommendation >** - From the viewpoint of improvement of living environment and ground water quality conservation, sludge tanker vehicles should be controlled strongly so that collected cesspit sludge is appropriately put into WWTP
2-4	Utilize the treated water and sludge for agricultural use.	70% of treated wastewater and 10% of sludge are utilized.	**Partly Achieved**: reuse rates of treated wastewater and sludge are 100% (83% for agriculture and 17% for WWTP) and few volume of sludge is using in WWTP as fertilizer.	- Visited preceding organizations i.e. Al-Bireh in Jun. 2014, MoA, Agricultural Association and Nablus in Apr.-May 2014 and Jordan in Jun. 2015. - Conducted interview and questionnaire survey to the owners of factories and farms in Apr.-May 2013 and Jun. 2015 respectively. - Prepared, analyzed composition of crops, and handed over to JM of the pilot farm inside WWTP in Nov.-Dec. 2014, Jun. 2015 and Jun. 2016 respectively. - Prior to negotiation, prepared and launched experiment of pilot farm outside of WWTP in Nov.-Dec. 2014, May 2015 and Jun. 2015 respectively. - Visiting the existing facilities in Jordan for the purpose of confirming the possibility of sludge reuse in Jericho WWTP in Apr. 2017. - Meeting with the Ministry of Agriculture on sludge reuse from Oct. 2017.	**<Issue>** - Although the amount of sludge generated at WWTP is small at present, it is necessary to study the disposal method **< Recommendation >** - Jericho municipality should consult with the Ministry of Agriculture and establish an agricultural utilization process of sludge
2-5	Raise public awareness and disseminate experiences on the Jericho WWTP to related organizations.	More than 80% of served population recognizes the need for the WWTP.	**Achieved**: 86% of residents recognize the importance of sewerage, by the survey conducted in Apr. 2014.	- Prepared and distributed flyers, stickers etc. to raise public awareness in Oct. 2013; prepared and distributed pamphlet, calendar and uniforms with logo of TeCSOM in Jan.-Feb. 2013. - Posted an article on the website of JM regarding its sewerage system in Oct. 2013. - Organized public meeting on sewerage system in Oct. 2013. - Conducted questionnaire surveys for customers i.e. as baseline survey in Apr. 2013 and at public meetings in Oct. 2013, Jun. 2015 and Oct. 2015. - Prepared a short movie of sewerage system for the participants in the public meeting in Aug. 2015. - Organized visit tours to WWTP for students in Mar. 2015, for 20 children living in PP area in May 2015 and for 20 women in Oct. 2015. - Tested quality of groundwater in May 2015 and of treated wastewater in May 2015 and Nov. 2015 and composition analysis of heavy metals in sludge in Nov. 2015. - Holding the public meeting for residents of the Aqbat Jabel Camp to promote sewer connection in Feb. 2017.	**<Issue>** - Together with C / P, TeCSOM has carried out public awareness activities to gain understanding from residents about sewerage, and continuous activities are necessary to get further understanding **< Recommendation >** - Jericho municipality should appoint a person in charge of public awareness raising and hold regular public meeting for residents
3. Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed.					
3-1	Carry out trainings /workshops in order to obtain basic knowledge.	-	-	- Held workshop on designing sewer network in Jun. 2013. - Lectured on planning sewerage system and sewer network in Oct. 2014. - Lectured on maintenance and designing of sewer network in Feb. 2014. - Lectured on designing sewer network with mini examination in Jun. 2014.	

Output	Activity	Verifiable Indicator	Accomplished Status	Activities	Challenges and Countermeasures to be Taken
				- Held workshop on planning sewerage system in Feb. 2015. - Gave training on inspecting sewer using O_2/H_2S concentration meter in Feb. 2015. - Gave training on GIS operation in Mar. 2015. - Held workshop on inspecting and cleaning sewer in Jun. and Sep. 2015. - Conducted OJT on developing sewer cleaning plan using jet flushing machine in Sep. 2015.	
3-2	Prepare manuals for O&M of sewer networks and carry out on the job trainings.	More than 4 staffs pass a technical examination for sewer maintenance and promotion for connection to public sewers.	**Achieved**: 5 among 5 staffs passed the technical exam on sewer maintenance and cleaning.	- Examination on maintenance and cleaning of sewer network in Nov. 2015; 5 among 5 participants passed the exam. - Prepared general layout plan of sewer network after confirming existing and future plan of sewer and developed annual construction plan in Feb. 2016. - Assisted in cleaning sewer using jet flush machine.	**< Recommendation >** - After the completion of the technology transfer project of TeCSOM, the JICA Expert hope to fully utilize the products (several manuals, technical information, know-how and management plan on sewerage works)
3-3	Connect private sewers with public sewers in Pilot Project areas.	2,000 private sewers (house connections) are connected to public sewers and 60% of the connected building owners is satisfied with the system.	**Not Achieved**: 1,836 HHs were connected through the connection work by JM, of which 1,179 by PP and 657 by the budget of JM 89% of users is satisfied with the system.	- Visited fields and identified the prioritized area for PP in Apr.-May 2013. - Outsourced the designing for 1st phase PP in May 2013; outsourced D/D and supportive work for bidding in Oct. 2013; started construction and conducted construction supervision together with C/Ps in Mar. 2014; completed the construction in Jul. 2014. - Visited fields for 2nd phase PP in Jan.-Feb. 2014; outsourced D/D and supportive work for bidding in Apr. 2014; started construction and conducted construction supervision together with C/Ps in Jan. 2015.	**< Recommendation >** - It is necessary to reliably collect the construction cost of the in-house connection pipe in the Pilot Project area installed by the TeCSOM Project
3-4	Raise public awareness and disseminate experience on the sewer networks to related organizations.			- Prepared flyers, sign boards, etc. and distributed them at pubic meetings in Apr. 2014. - Organized public meetings on sewer connection and tariff payment for residents within 1st phase PP area in October 2013 and Feb. 2015 and for 50 ladies in Oct. 2015. - Door-to-door visit from Nov. 2015; radio broadcasting of mayor's message in Dec. 2015. - Assessed the capacity of existing sewer to receive wastewater to be discharged from Jericho Gate in Jan. 2015. - Visited sites and explained the current status of sewer connection in Jericho for the engineers hired by UNRWA, prior to the construction of sewer network in Aqbat Jaber Camp by UNRWA in Jun. 2016. - Meeting with USAID, AFD and other donors to promote sewerage network development and house connections from Jun. 2016 - At the 2nd TC meeting, other municipalities (Al-Bireh, Abedilla) in the West Bank were invited and exchanging the opinions together in Jan. 2018	**<Issue>** - Together with C / P, TeCSOM has carried out public awareness activities to gain understanding from residents about sewerage, and continuous activities are necessary to get further understanding **< Recommendation >** - Jericho municipality should appoint a person in charge of public awareness raising and hold regular public meeting for residents - Jericho municipality should conclude an agreement with AJ Camp as soon as possible regarding the sewerage tariff, the quality of receiving water, and the responsibility of maintaining the pipe
4. Capacity of Jericho municipality for financial management of sewerage works is developed.					
4-1	Carry out trainings /workshops in order to obtain basic knowledge.	-	-	- Gave steering committee of C/Ps hands-on lectures on the detailed methodology of calculating sewerage tariff and financial simulation in Oct. 2013, Mar. 2014 and Feb. 2016. - Organized a participatory meeting on sewerage financial management plan in Jul. 2016.	
4-2	Develop structure of user charge for sewerage facilities.	Collection rate of user charge for sewerage facilities exceed 60%.	**Not Achieved**: Collection rate of sewerage tariff is 24% in average of 2017.	- Developed the scheme of connection fee with the steering committee of C/Ps; the connection fee is in accordance with building area and intended to recover 100% of cost from pubic connection pit to receiving pit in Sep. 2013. - Developed scheme of sewerage tariff with steering committee of C/Ps, of which increasing volumetric tariff with fixed charge was proposed to recover 100% of O&M cost of WWTP; after discussion with PWA, unified volumetric charge without fixed charge and single category of customers was adopted in Sep. 2013. - Gave hands-on lectures on the methodology of calculating connection fee and sewerage tariff in Oct. 2013. - Persuaded with PWA and C/Ps several members of city council who objected to proposed sewerage tariff and connection fee in Feb.-Mar. 2014. - Halved sewerage tariff and connection fee temporarily after assessing financial effect in Jul.-Aug. 2015. - Visited JSC West Jenin and Nablus municipality in Jun. 2016 to inspect the practice of introducing prepaid water meters. - Changing the format of the bill from individual system of water and sewerage bills to the combined system of them with clearly indicating the total amount of unpaid debt in Dec. 2017 - Support for preparation of application for setting up 430 Prepaid Water Meters supported by Japan	**<Issue>** - It is difficult to grasp the status of tariff collection related to sewerage by month, and the recognition of the collection rate of staff is low **< Recommendation >** - Jericho municipality should prepare a report on the monthly financial situation to submit the mayor and share information at relevant departments
4-3	Develop a mid-term financial plan.	- A mid-term financial plan is approved by relevant organizations. - Income (subsidy, borrowing, charges etc.) exceeds expenditure in the management plan.	**Not Achieved**: - First draft of financial plan got an oral approval by PWA, but later revisions with considerable modifications were not discussed with PWA. - 3.7 mNIS accumulated deficit and 0.47 mNIS annual deficit are prospected except capital income /expenditure at the end of 2020 according to revised plan.		**<Issue>** - Bulk water users (especially government agencies) occupying a large proportion by monthly invoiced amount has not been collected - Jericho municipality increased the number of staff for collecting water and sewerage tariff, but it is necessary to further increase in preparation for future increasing the number of target households - The budget for water and sewerage in Jericho municipality is weak and it is necessary to secure necessary budget for the future **< Recommendation >** - To ensure sound financial condition, Jericho municipality should surely collect water and sewerage tariffs from bulk water users - Rebuilding and secure collection system of water and

Output	Activity	Verifiable Indicator	Accomplished Status	Activities	Challenges and Countermeasures to be Taken
					sewerage tariff - It is necessary to reliably collect the construction cost of the in-house connection pipe in the Pilot Project area installed by the TeCSOM Project - Jericho municipality is expected to implement sewerage works based on the management plan up to 2020, and revise it reflecting the annual sewerage works
4-4	Raise public awareness and disseminate experiences on financial planning to related organizations.	More than 60% of served population recognizes the need for payment of user charge.	**Achieved**: 67% of residents are positive towards the payment of sewerage tariff, according to the survey in April 2014.	- Conducted a survey on willingness to pay sewerage tariff and to connect to sewer in Jun. 2013. - Organized public meetings for 50 residents in Jun. 2015 and 30 imams in Feb. 2016. - Prepared a pamphlet featuring the temporary discount as well as the objective of sewerage tariff and connection fee in Feb. 2016. - Discussed with JAIP on the connection fee and sewerage tariff from Feb. 2014 to Jul. 2016.	**<Issue>** - Together with C / P, TeCSOM has carried out public awareness activities to gain understanding from residents about sewerage, and continuous activities are necessary to get further understanding **< Recommendation >** - Jericho municipality should appoint a person in charge of public awareness raising and hold regular public meeting for residents

Table 1.5.2 Final Version of PDM

Narrative Summary	Objectively Verifiable Indicators	Means of Verification				Important Assumption
Overall Goal Sewerage facilities in Jericho municipality are operated and managed appropriately under sound financial condition.	1) Annual income exceeds annual expenditure 2) Effluent from wastewater treatment plant become below effluent standard	1) Financial statements 2) Record of operation				
Project Purpose System for operation and management of sewerage works in Jericho municipality is established.	1) Departments in charge of sewerage works is officially approved in Jericho municipality 2) The by-law for users of sewerage facilities is enforced 3) O&M of sewerage facilities is conducted based on manuals and plans 4) Sewerage works are managed based on a management plan	1) Official letter for approval of department in charge of sewerage works in Jericho municipality 2) By-law for users of sewerage facilities 3) Manuals and plans for sewage works 4) Record of O&M 5) Financial statements 6) Mid-term management plan				More than 80% of C/P continue working in the organization. The number of farmers do not decrease drastically.
Outputs (1) Management plan for sewerage works in Jericho municipality is developed	1) Departments in charge of sewerage works is officially approved in Jericho municipality 2) The number of full-time staff for sewerage works is more than **14 persons** 3) The by-law for users of sewerage facilities is enforced 4) Mid-term management plan is approved by the city council	1st year Item: 1) Organization structure and staffing of sewerage works; 2) Preparation of by-law; 3) Level of public awareness and public relation	Verification:	In and after 2nd year Item: 1) Staffing of sewerage works; 2) Level of public awareness and public relation; 3) Promotion of sewer connection and tariff collection; 4) Regulation practice for discharge from factories	Verification:	
(2) Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant (WWTP) is developed	1) More than **6 persons** pass a technical examination for O&M of the WWTP 2) Hazardous materials exceeding the quality standard do not flow into sewerage facilities 3) **70 %** of treated wastewater and **10 %** of sludge are utilized 4) More than **80 %** of served population recognizes the need for the WWTP	1) DOK on mechanism of wastewater wastewater 2) DOK on wastewater treatment system 3) DOK on functions of facilities and equipment in WWTP 4) Preparation level of plant ledger DOK : "Depth of Knowledge"	Examination on 1), 2) and 3). Re-exams if below given criteria	1) DOK on functions of facilities and equipment in WWTP 2) Degree of skill for operating equipment 3) Degree of skill for measurement using metering device and DOK on the meaning of measured data 4) Appropriate trouble shooting 5) Preparation level of record of daily operation 6) Level of implementation of treated wastewater and sludge re-use 7) Preparation level of plant ledger	Examination on 1), 2) and 3). Re-exams if below given criteria	
(3) Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed.	1) More than **4 staffs** pass a technical examination for sewer maintenance and promotion for connection to public sewers 2) **2,000** private sewers (house connections) are connected to public sewers and **60 %** of the connected building owners is ~~are~~ satisfied with the system	1) DOK on sewer system 2) DOK on sewer network planning 3) DOK on hydrology 4) Preparation level of sewer ledger	Examination on 1), 2) and 3). Re-exams if below given criteria	1) DOK on sewer system 2) DOK on sewer network maintenance 3) Appropriate trouble shooting 4) Preparation level of inspection, repair, etc. 5) Preparation level of sewer ledger	Examination on 1) and 2). Re-exams if below given criteria	
(4) Capacity of Jericho municipality for financial management of sewerage works is developed.	1) Collection rate of user charge for sewerage facilities exceed **60 %** 2) A mid-term financial plan is approved by relevant organizations 3) More than **60 %** of served population recognizes the need for payment of user charge 4) Income (subsidy, borrowing, charges, etc.) exceeds expenditure in the management plan	1) DOK on accounting and financial statements	Examination on 1). Re-exams if below given criteria	1) DOK on accounting and financial statements 2) Volume of treated wastewater and number of connected households 3) Income and collection rate of tariff 4) Preparation level of financial statements 5) Preparation level of mid-term management plan	Examination on 1). Re-exams if below given criteria	
Activities (1.1) Establish departments for operation and management preparation of sewerage works (1.2) Assigns staffs in departments for operation and management of sewerage works (1.3) Draft a by-law for users of the sewerage facilities (1.4) Develop a mid-term management plan for sewerage works in Jericho municipality (2.1) Carry out trainings/workshops in order to obtain basic knowledge (2.2) Prepare manuals for O&M in the Jericho WWTP and carry out on the job trainings (2.3) Develop an effluent regulation to water discharged to sewer networks (2.4) Utilize the treated water and sludge for agricultural use (2.5) Raise public awareness and disseminate experiences on the Jericho WWTP to related organizations	**Inputs** Palestinian side: 1) Safeness and security for the project team 2) Suitable office space with necessary equipment 3) Human resource allocation for representative of the C/P, and supporting staffs in related department 4) Arrangement of duty free for equipment which the project team bring in Palestine 5) Support and arrangement for money sending and bringing project budget in Palestine 6) Arrangement or required material and information, and coordination with related organization 7) Arrangement of permission for taking local materials out of Palestine 8) Arrangement of duty free for the project team and foreigner registration of the project team 9) Arrangement for project activities in private properties and restricted area	Japanese side: 1) Expert (Chief advisor/Institutional Operation/Legal System) 2) Expert (Deputy chief advisor/Reuse of Treated Wastewater and Sludge 3) Expert (Operation and Maintenance of WWTP (mechanical-1)) 4) Expert (Operation and Maintenance of WWTP (mechanical-2)) 5) Expert (Operation and Maintenance of WWTP (mechanical-3)) 6) Expert (Operation and Maintenance of WWTP (electrical)) 7) Expert (Water Quality Management/Sewer Network Construction and Maintenance-1) 8) Expert (Sewer Network Construction and maintenance-2) 9) Expert (Awareness Raising/Project Coordinator) 10) Expert (Financial Management)				
(3.1) Carry out trainings/workshops in order to obtain basic knowledge (3.2) Prepare manuals for O&M of sewer networks and carry out on the job trainings (3.3) Connecting private sewers with public sewers in Pilot Project areas (3.4) Raise public awareness and disseminate experiences on the sewer networks to related organizations (4.1) Carry out trainings/workshops in order to obtain basic knowledge (4.2) Develop structure of user charge for sewerage facilities (4.3) Develop a mid-term financial plan (4.4) Raise public awareness and disseminate experiences on financial planning to related organizations		Deliverable Manuals: 1) Manual and trouble shooting of water quality management 2) Manual and trouble shooting of mechanical equipment 3) Manual and trouble shooting of electrical equipment 4) Safety and hygienic manuals for sewerage works 5) Completion report of Pilot Project 6) Manual and trouble shooting of pipe connection for each house 7) Operation and maintenance manual of pipe lines 8) Financial planning manual				Pre-condition: Security situation continues stable and do not affect the project activities.

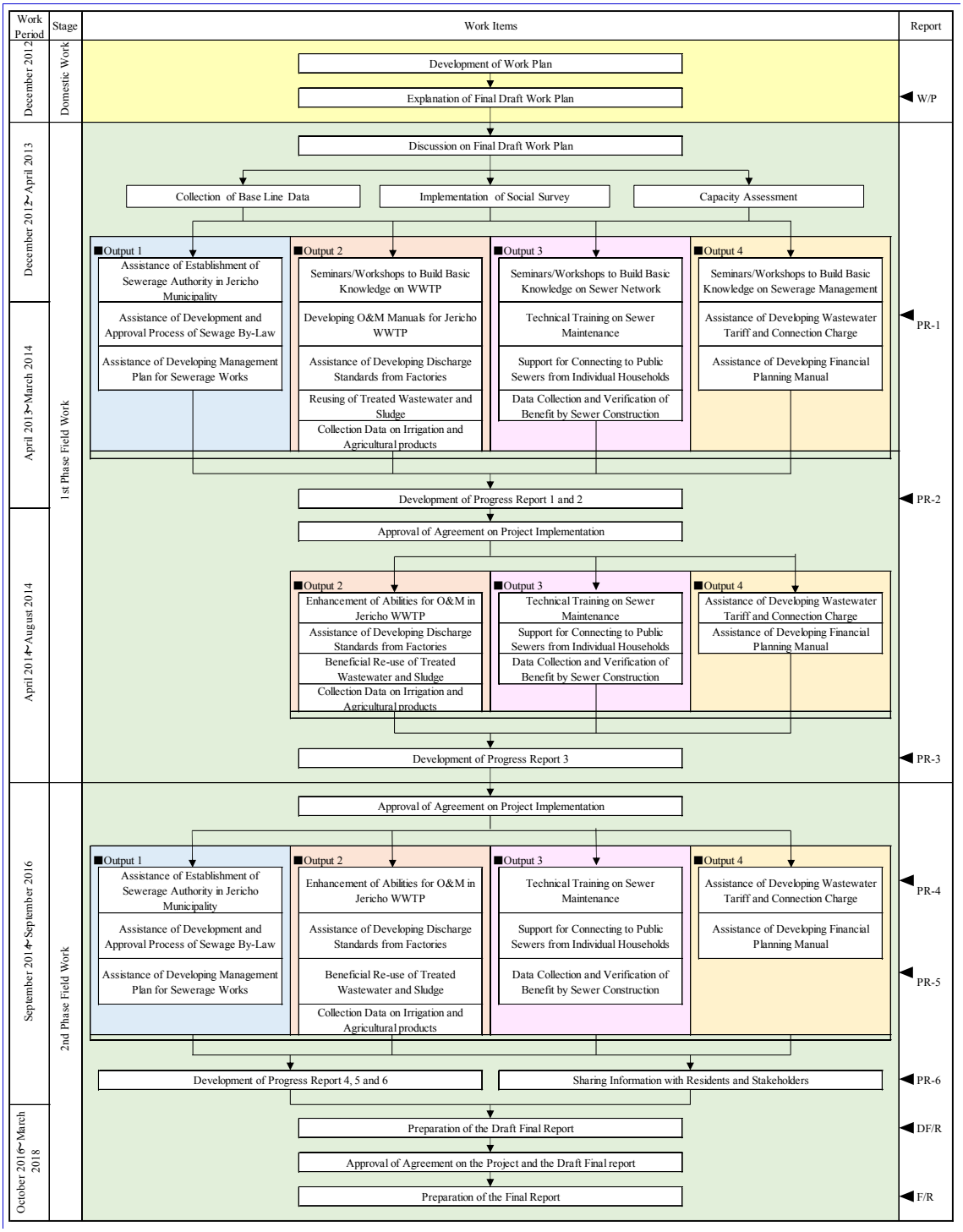


Figure 1.5.1 Work Flow of the project

1.6 Project Period

The Project period is 56 months, from December 2012 to March 2018. The 1st Phase Project is 21 months (from December 2012 to August 2014), and 2nd Phase is 42 months (from October 2014 to March 2018).

1.7 JICA Expert Team and C/P Members

The JICA Expert Team consists of 12 members whom are to be dispatched from Japan. The member list is shown in **Table 1.7.1**, and dispatched period is shown in **Table 1.7.2**. The C/P consisted by Jericho side members are show in **Table 1.7.3**. The actual activities of C/Ps by output is shown in **Table 1.7.4**.

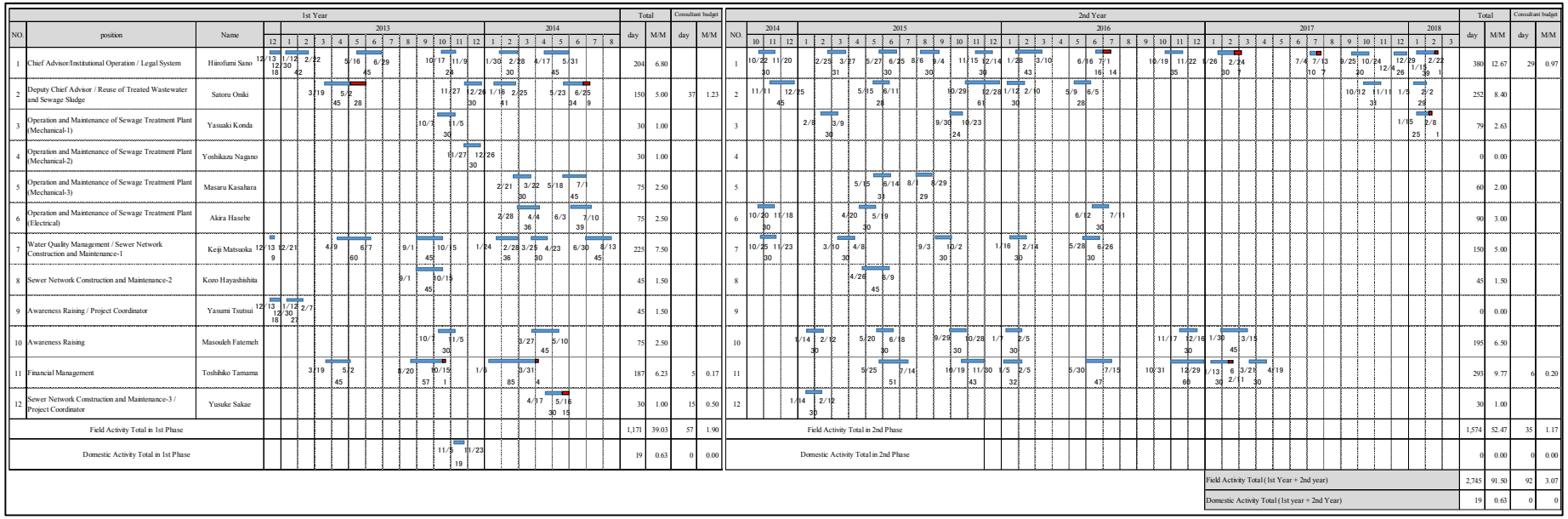
Table 1.7.1 JICA Expert Team Members

Name		Position	Company
1	Mr. Hirofumi Sano	Chief Advisor / Institutional Operation / Legal System	NJS Consultants Co., Ltd
2	Mr. Satoru Oniki	Deputy Chief Advisor / Reuse of Treated Wastewater and Sewage Sludge	NJS Consultants Co., Ltd
3	Mr. Yasuaki Konda	Operation and Maintenance of Sewerage Treatment Plant (Mechanical)-1	NJS Consultants Co., Ltd
4	Mr. Yoshikazu Nagano	Operation and Maintenance of Sewerage Treatment Plant (Mechanical)-2	Yokohama Water Co., Ltd
5	Mr. Masaru Kasahara	Operation and Maintenance of Sewerage Treatment Plant (Mechanical)-3	NJS Consultants Co., Ltd
6	Mr. Akira Hasebe	Operation and Maintenance of Sewerage Treatment Plant (Electrical)	NJS Consultants Co., Ltd
7	Mr. Keiji Matsuoka	Water Quality Management / Sewer Network Construction and Maintenance -1	NJS Consultants Co., Ltd
8	Mr. Kozo Hayashishita	Sewer Network Construction and Maintenance -2	Yokohama Water Co., Ltd
9	Ms. Yasumi Tsutsui	Awareness Raising / Project Coordinator	NJS Consultants Co., Ltd
10	Ms. Masouleh Fatemeh	Awareness Raising	NJS Consultants Co., Ltd
11	Mr. Toshihiko Tamama	Financial Management	NJS Consultants Co., Ltd
12	Mr. Yusuke Sakae	Sewer Network Construction and Maintenance -3 / Project Coordinator	NJS Consultants Co., Ltd

Table 1.7.3 C/P Members

Output		C/P	
		Name	Occupation
Project Chief		Mr. Basel Hijazi	Head of Engineering Dept.
1	Establishment of organization base for departments in charge of sewage works	Mr. Ghazi A. Al-Naji	Advisor to the Mayor for Water & Wastewater Dept.
		Mr. Iyad Hamdan	Chief of Quality Section
		Mr. Mohammed Fetyani	Head of Water & Wastewater Dept.
		Mr. Ibrahim Abu Seiba	Chief of Sewerage Section
2	Development of the capacity of Jericho municipality for O&M of the WWTP	Mr. Ibrahim Abu Seiba	Chief of Sewerage Section
		Mr. Mohammed Awajneh	Mechanical Technician
		Mr. Omran Khalaf	WWTP Operator
		Mr. Maher Al Swaidy	Electrical Technician
3	Development of the capacity of Jericho municipality for O&M of sewer network and promotion for house connection to public sewers	Mr. Mohammed Fetyani	Head of Water and Wastewater Dept.
		Mr. Mohammed Isayed	Chief of Engineering Dept.
		Mr. Ibrahim Abu Seiba	Chief of Sewerage Section
		Mr. Majdi Al-Ghouj	Civil Engineer
4	Public awareness	Mr. Mohammed Isayed	Chief of Engineering Dept.
		Ms. Wiam Irekat	Head of Culture and Public Relations Dept.
		Mr. Mohammed Azmuty	Sub-Section Chief of Public Relations Dept.
	Development of financial management ability	Mr. Mohammed Abu Muhsen	Head of Financial Planning Dept.
		Mr. Abed Habad	Chief of Revenues Collection Management Section

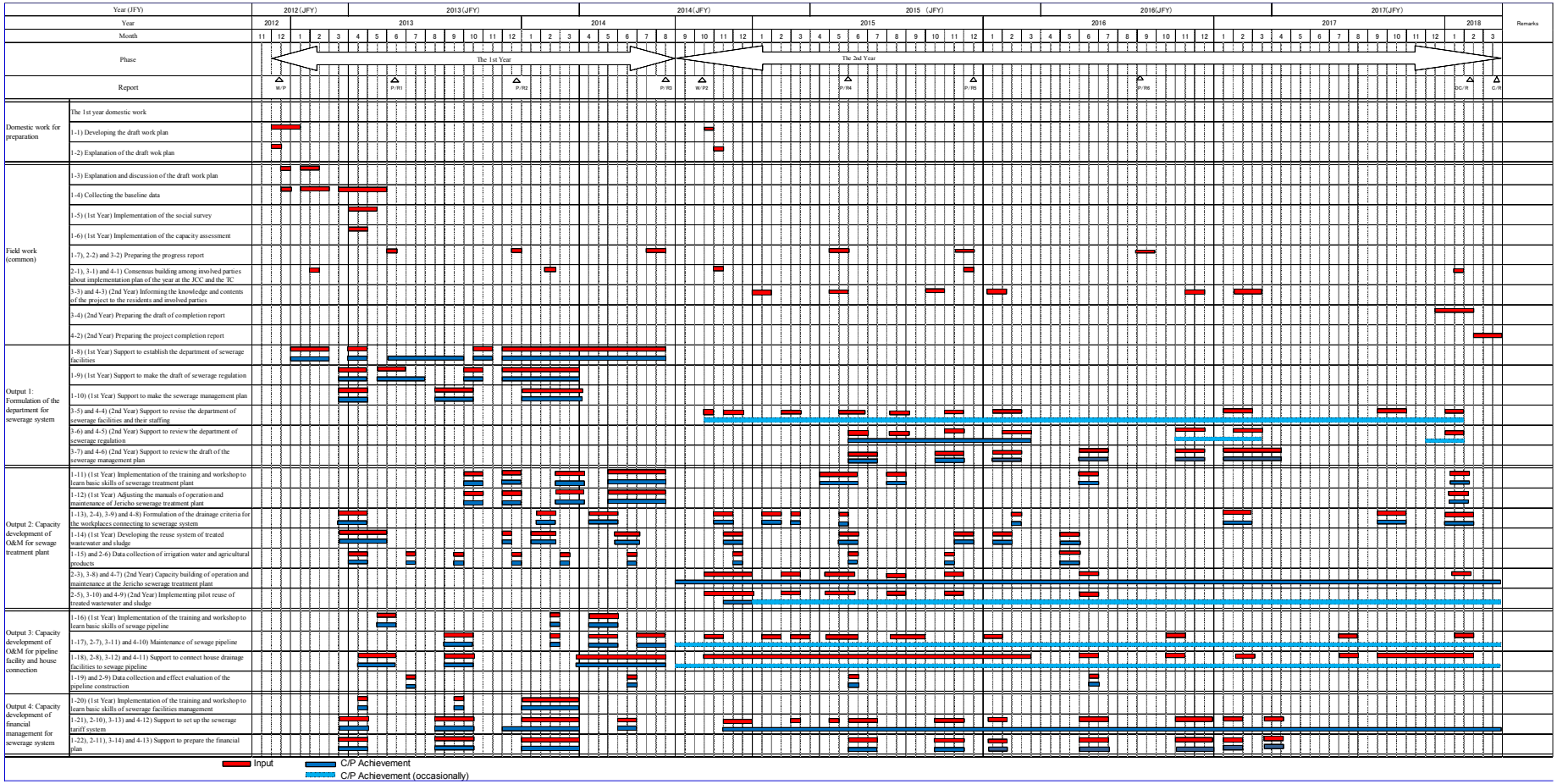
Table 1.7.2 Dispatched Period of JICA Expert Members



NO.	position	Name	1st Year Total day	1st Year Total M/M	1st Year Consultant budget day	1st Year Consultant budget M/M	2nd Year Total day	2nd Year Total M/M	2nd Year Consultant budget day	2nd Year Consultant budget M/M
1	Chief Advisor/Institutional Operation / Legal System	Hirofumi Sano	204	6.80			380	12.67	29	0.97
2	Deputy Chief Advisor / Reuse of Treated Wastewater and Sewage Sludge	Satoru Oniki	150	5.00	37	1.23	252	8.40		
3	Operation and Maintenance of Sewage Treatment Plant (Mechanical-1)	Yasuaki Konda	30	1.00			79	2.63		
4	Operation and Maintenance of Sewage Treatment Plant (Mechanical-2)	Yoshikazu Nagano	30	1.00			0	0.00		
5	Operation and Maintenance of Sewage Treatment Plant (Mechanical-3)	Masaru Kasahara	75	2.50			60	2.00		
6	Operation and Maintenance of Sewage Treatment Plant (Electrical)	Akira Hasebe	75	2.50			90	3.00		
7	Water Quality Management / Sewer Network Construction and Maintenance-1	Keiji Matsuoka	225	7.50			150	5.00		
8	Sewer Network Construction and Maintenance-2	Kozo Hayashishita	45	1.50			45	1.50		
9	Awareness Raising / Project Coordinator	Yasumi Tsutsui	45	1.50			0	0.00		
10	Awareness Raising	Masouleh Fatemeh	75	2.50			195	6.50		
11	Financial Management	Toshihiko Tamama	187	6.23	5	0.17	293	9.77	6	0.20
12	Sewer Network Construction and Maintenance-3 / Project Coordinator	Yusuke Sakae	30	1.00	15	0.50	30	1.00		
Field Activity Total in 1st Phase			1,171	39.03	57	1.90	Field Activity Total in 2nd Phase			
Domestic Activity Total in 1st Phase			19	0.63	0	0.00	Domestic Activity Total in 2nd Phase			
							Field Activity Total (1st Year + 2nd year)			
							Domestic Activity Total (1st year + 2nd Year)			

	1st Year Total			2nd Year Total		
	day	M/M		day	M/M	
Field Activity Total (1st Year + 2nd year)	2,745	91.50	92	3.07		
Domestic Activity Total (1st year + 2nd Year)	19	0.63	0	0		

Table 1.7.4 Actual Activities of C/Ps by Output



CHAPTER 2

ACTIVITIES AND OUTPUTS OF THE PROJECT

CHAPTER 2 ACTIVITIES AND OUTPUTS OF THE PROJECT

【OVERALL OUTPUT】

2.1 Development and Discussion on the Work Plan

The draft work plan of the project was developed, based on analysis of the documents and data available in Japan, data collected in the preparatory survey, detailed design and construction of the "Jericho Wastewater Collection, Treatment System and Reuse Project" (hereinafter "The Grant Aid Project). The JICA Expert team attended the JICA meeting to explain the draft work plan prior to dispatch. The draft work plan was also discussed by the JICA Expert Team with the C/P, JICA Palestine Office and the relevant authorities.

2.2 JCC and TC Meeting

JCC was conducted five times during the work period as shown in **Table 2.2.1**. **Figure 2.2.1** show photos in the Fourth JCC Meeting. Also attendees and conference materials to the conference are shown in **Appendix A 2-2-1**.

Table 2.2.1 Summary of JCC

Phase	Number/Date	Attendance (person)	Organization	Main Topics
Phase-1	First: 2013/02/04	16	JM, PWA, MoLG, MoA, MoEA, JICA	Explanation and approval of the Project outline and PDM indicator
	Second: 2014/02/19	16	JM, PWA, MoA, JICA	Progress and evaluation on the past activities and explanation and approval of changes in PDM indicator
Phase-2	Third: 2014/11/16	18	JM, PWA, MoA, JICA	Achievement of technology transfer in the Phase-1 and the content of activities in the Phase-2
	Fourth: 2015/12/02	18	JM, PWA, MoLG, MoA, JICA	Progress and achievement of PDM indicator and suggestion on the future activities
	Fifth: 2018/1/29	19	JM, PWA, MoLG, MoA, MoE, JICA	Presentation on achievement of the project by C/P and recommendation for future by the JICA Expert

Figure 2.2.1 View of the 4th JCC Meeting

Regarding TC, the 1st meeting was held by attendees of 15 people (JM, MoLG, PWA, JICA) on January 27, 2013. For subsequent TCs, instead of holding the weekly meetings for discussions and follow-up on task extraction and resolution were carried out, and no TC meeting was held. Prior to the completion of the project, the 2nd TC meeting was held by attendees of 26 people (JM, MoA, MoE, JICA, Al-Bihle and other municipality) on January 30, 2018. Attendant List and meeting materials for the TCs meeting are shown in **Appendix A 2-2-2**.

2.3 Collection of Baseline Data

2.3.1 Data Collection on the Existing Organization

The data of the existing organizational structure and number of staffs of the Jericho, Al-Bireh and Nublus municipalities were collected in cooperation with the C/P and the job description for each department, section in Jericho municipality was prepared by the C/P. In addition, the information of the current financial situation and collection ratio of water tariff in Jericho municipality were collected through the C/P in order to set up the sewerage tariff. The collected data is attached in **Appendix A 2-3-1**.

2.3.2 Data Collection by the Local Consultant (Outsourcing)

(1) Groundwater Quality Survey

The main sewers has been constructed by the JICA Grant-Aid Project and the branch sewers has also been constructed by USAID. Moreover, the house connections project under the TeCSOM as the Pilot Project has been completed and the branch sewers and the house connections funded by the Japanese Government and the Palestine Authority are implementing. The groundwater quality survey was conducted out to a local consultant in order to analyze the data before and after the sewer construction (reduction of untreated wastewater amount). This is to verify the effect of the construction of sewers and house connections.

This survey was conducted twice in each of the phase-1 and the Phase-2, four times in total, and the outline of the survey is shown in **Table 2.3.1**. The location of the well to be sampled is shown in **Figure 2.3.1**, and the information on the well is shown in **Table 2.3.2**. The results of analysis for water quality 3 parameters (2013 - 2016) are shown in **Figure 2.3.2 - Figure 2.3.4**. Also, a survey report is shown in **Appendix A 2-3-2**.

Table 2.3.1 Outline of the Groundwater Quality Survey

Phase	No.	Sampling Date	Number of Sampling Well	Water Quality Parameter
Phase-1	1st	June 2013	12	3 items（COD、NO_3-N、E. Coli.）
	2nd	June 2014	Ditto	Ditto
Phase-2	3rd	May 2015	Ditto	Ditto
	4th	June 2016	Ditto	Ditto

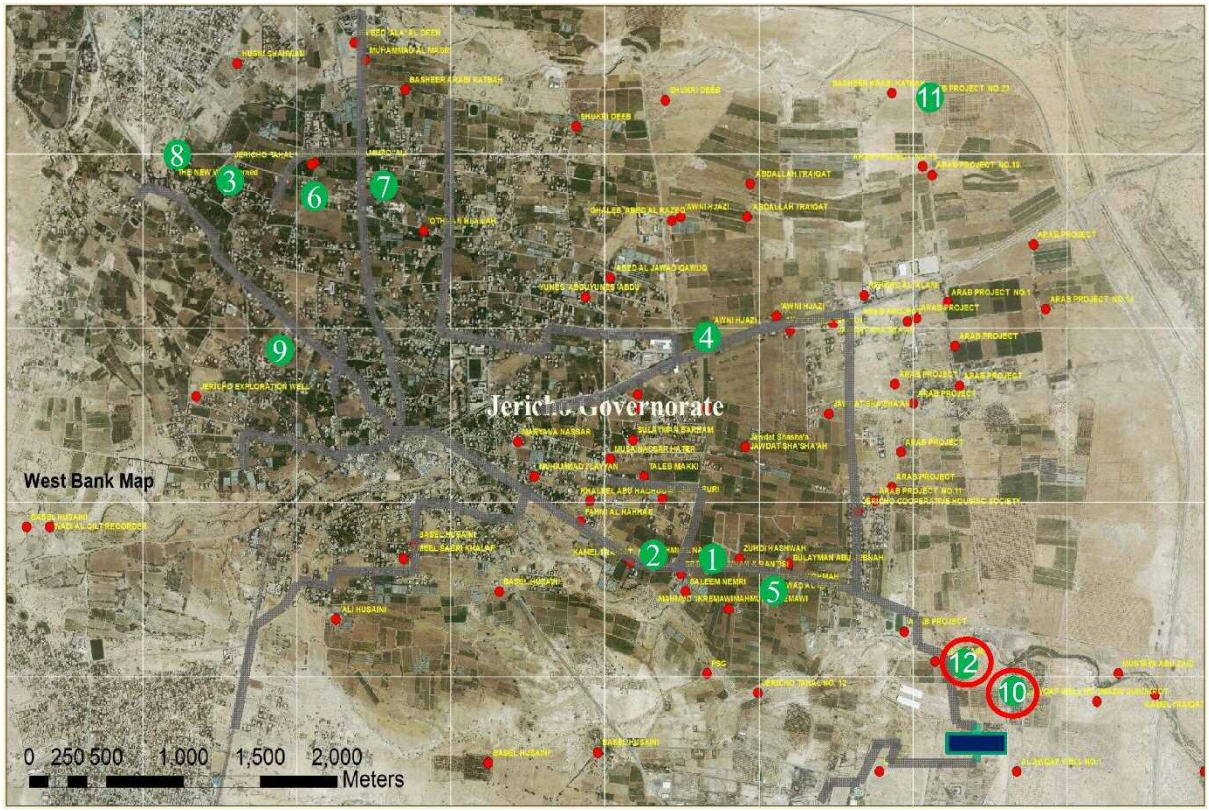


Figure 2.3.1 Location of the Sampling Wells

Table 2.3.2 Well Information

No.	Point-Name	Well Depth (m)	Water Use	Well ID
1	Sbeeru Hanhan &Rantisi	57	Agricultural	19-13/006
2	Fahmi al nahhas	126	Agricultural	19-13/048
3	Samed	120	Agricultural	19-14/026A
4	Awni HJazi	100	Agricultural	19-14/037
5	Jawad Almasri & Mahmoud	137	Agricultural	19-13/015A
6	Kaled Dabes	No data	Agricultural	
7	Dwedar	120	Agricultural	
8	A'aen Al Soultan	Surface	Domestic/Agriculture	
9	Kalel Fehmi Ghanem	217	Domestic	
10	Majed Al Tarifi	55	Agricultural	
11	Arab Project No.23	100	Agricultural	19-14/081
12	Ismael A'daaq	No data	Agricultural	

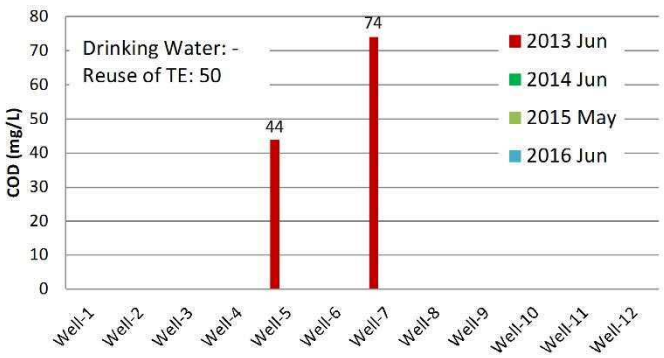


Figure 2.3.2 Result of COD Analysis

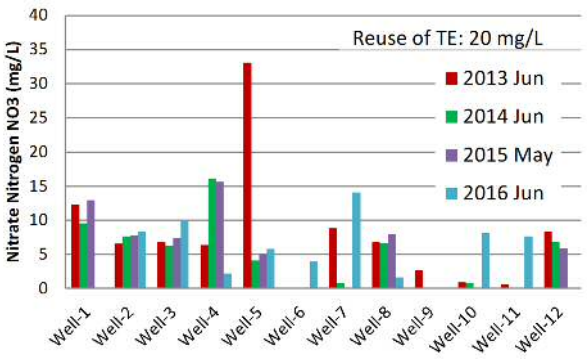


Figure 2.3.3 Result of NO_3-NAnalysis

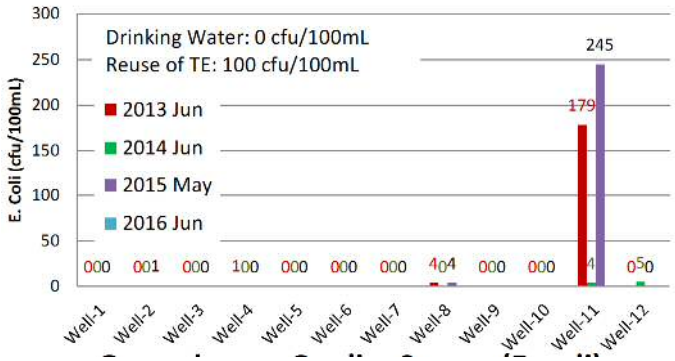


Figure 2.3.4 Result of E. Coli. Analysis

In the measurement result of COD, it was detected in 2013, but it has not been detected after that. Nitrate nitrogen (NO3-N) has an increase or decrease in the numerical value depending on the well, but no clear influence of the constructed sewers. The reason seems to be due to insufficient treatment efficiency from Cesspit infiltrating to underground in situations where the sewers and house connections are not sufficiently constructed. For E. coli, it is largely detected only by well No. 11.

(2) Baseline Survey (Phase-1)

For the areas with a possibility of using treated water for irrigation, the quality survey of groundwater was conducted before and after starting of the WWTP operation, for verifying the effect of wastewater treatment. The outline of the sub-contract is shown in **Table 2.3.3**.

Table 2.3.3 Outline of the Baseline Survey

Phase	No.	Sampling Date	Number of Sampling Well	Parameter
Phase-1	1st	Jun. 2013	Well No. 10 and 12	37 items
	2nd	Sep. 2013	Ditto	Ditto
	3rd	Dec. 2013	Ditto	Ditto
	4th	Mar. 2014	Ditto	Ditto
	5th	Jun. 2014	Ditto	Ditto

The sampling point is shown in **Figure 2.3.1**, and the results of the water quality analysis are mentioned in "**2.15 Data Collection on Irrigation and Agricultural Products**".

(3) Baseline Survey (Phase-2)

After wastewater Treatment Plant began operation, the treated wastewater is planned to be reused as agricultural water, and the survey was conducted to confirm the water quality of treated wastewater as agricultural water. The outline of the survey is shown in **Table 2.3.4**.

Table 2.3.4 Outline of the Baseline Survey (Phase-2)

Phase	No.	Sampling Date	Sampling Point	Parameter
Phase-2	1st	Dec. 2014	Effluent Point	37 items
	2nd	May 2015	Ditto	Ditto
	3rd	Oct. 2015	Ditto	Ditto
	4th	Mar. 2016	Ditto	Ditto

The sampling point is shown in **Figure 2.3.1**, and the results of the water quality analysis are mentioned in "**2.15 Data Collection on Irrigation and Agricultural Products**".

(4) Offensive Odor Survey

The Jericho WWTP started operation in June 2014. In the northern part of the WWTP surroundings, there are cowsheds and waste disposal sites which cause offensive odor. The odor can even be recognized in the WWTP site, depending on wind directions.

It is expected that complaints may be made to the wastewater treatment plant (WWTP) from residents against the offensive odor caused from not only the WWTP, but also the cowsheds and waste disposal sites. The objective of the offensive odor survey is to clarify that the odor cause is not always the WWTP. Therefore, the survey was conducted to collect odor data as basic information regarding the WWTP environment. The outline of the survey is shown below.

- ✧ Number of water sampling : 5 locations (the boundary of the WWTP)
- ✧ Water quality parameters : 3 parameters (NH_3, TVOC, and H_2S)
- ✧ Sampling time : June 7, 2014

The survey result is shown below. The locations, parameters, etc. are attached in **Appendix A 2-3-3**.

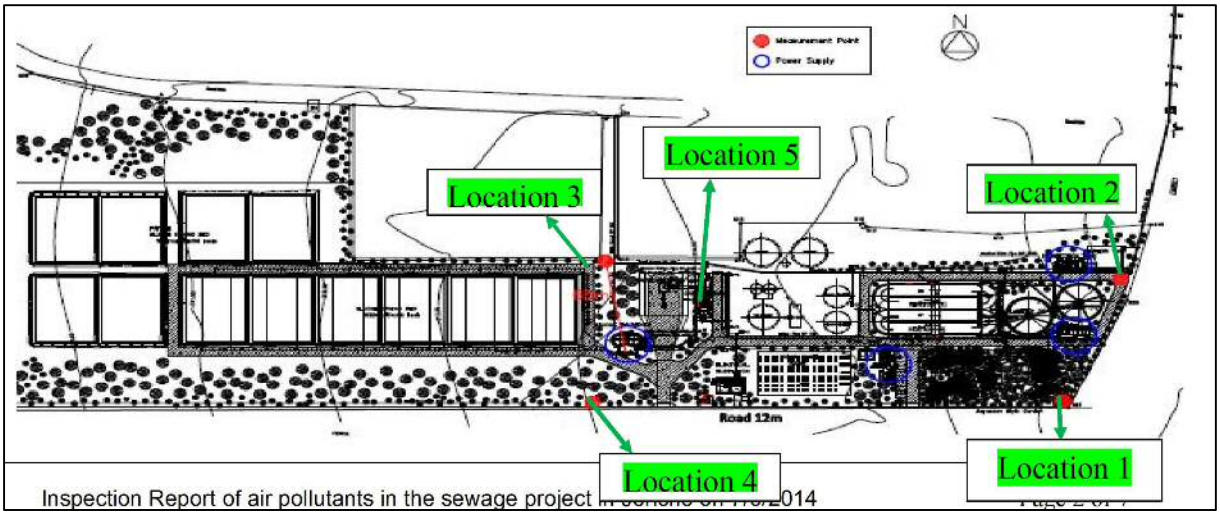


Figure 2.3.5 Sampling Points for Measuring Odor

Table 2.3.5 Offensive Odor Survey Result

Location		NH_3 (ppm)	TVOC (ppb)	H_2S (ppm)	Temp (℃)	RH (%RH)
No.1	Average	0.03	0.0	0.0	29.4	40.9
	Max	0.10	0.0	0.0	30.4	42.3
No.2	Average	0.05	0.0	0.0	32.3	37.5
	Max	0.20	0.0	0.0	34.1	41.0
No.3	Average	0.08	0.0	0.0	33.0	35.4
	Max	0.20	0.0	0.0	35.4	37.6
No.4	Average	0.13	0.0	0.0	33.4	33.2
	Max	0.30	0.0	0.0	40.8	36.5
No.5	Average	0.45	1,384	0.81	32.3	34.4
	Max	0.80	3,513	2.46	33.7	36.6
Palestine Standard 803[1)]		0.02<	-	0.01<	-	-

1: PS 803 / 2005; Air pollution emissions from stationary sources
2: PS 801 / 2010; Ambient Air Quality
H2S for 1 hour reading <0.03 mg /m^3 for maximum three times in a day and for 24 hour reading <0.01 mg /m^3.

The No. 5 point is the grid chamber where the odor of raw sewage is strong. According to the results, strong odor was not detected in the points of No.1 to No.4, and especially the values for TVOC and H_2S showed zero. Since the wind direction was from south to north on the sampling day, all points were not affected by the cowsheds and waste disposal sites. Although No.2 and No.3 are to the leeward of the WWTP, strong odor was not detected. However, in case that complaints are voiced from residents, it is necessary to specify the odor source and wind direction because odor detection is also influenced by the wind direction.

2.4 Social Survey

2.4.1 Objective

The social survey was carried out to evaluate the sustainability of the WWTP operation in Jericho. Respondents were selected from Jericho Municipality and the surrounding areas.

2.4.2 Items and Methodology of the Survey

Survey items are basic information (income, occupation, etc.), environment and satisfaction level around the current wastewater in the house, willingness to pay on sewage tariff, connection intention to connect sewer, opinions for wastewater and sludge reuse, etc.

The survey was carried out using an Arabic questionnaire. The survey team visited each respondent's house, read the questions, and wrote down their answers. The draft questionnaire was prepared in English after discussions between the Jericho Municipality and the JICA Expert team. The final draft was translated to Arabic. The number of surveyed household was 150 in total: 100 households from Jericho Municipality, and 50 households from the surrounding areas. Gender of respondents was 48 males and 52 females in Jericho, 18 males and 32 females in the surrounding area.

2.4.3 Result

All of the major results are shown below, and the details are shown in **Appendix A 2-4-1**.

(1) Residents' understanding of the role and importance of the WWTP in Jericho

64% of the respondents recognized the importance of the WWTP in Jericho. On the other hand, 40% of the respondents mentioned several problems are caused by the WWTP construction, such as traffic jams in the Jericho city center area.

(2) Affordable Price for Sewerage Tariff

Since the sewer service was not started at the time of surveying, many of respondents had "No idea" (61%) for affordable price of sewage tariff. On the other hand, 37% answered that they would pay if the price is "Lower than 50% of the current water tariff".

(3) Opinions for Using Treated Wastewater and Sludge

69% of the respondents had positive opinions for using the treated wastewater, and thought it could be used as "Agricultural water" (52%), and "Water for fountains, waterways, and ponds" (12%). On the other hand, 21% had negative opinions. The reasons were "Dirty" (20%), "Bad for health" (20%), "Dislike" (17%), and "Against religious belief" (17%). For re-use of sludge, only 40 % of the respondents were positive.

(4) Future Awareness Activities

Respondents wanted information which has direct impact on their livings, such as "Awareness raising" (96%), "Price of sewage tariff" (34%), and "Period of construction of the WWTP" (25%).

2.4.4 Conclusion

Only 64% percent of the respondents acknowledged importance/necessity of the WWTP in Jericho, therefore further activity of awareness and publicity is important. However, since 40% of the residents have complains regarding the difficulties caused by the Project, it is necessary gain the residents' understandings and corporation for construction of the WWTP. Most of the respondents do not have any idea about the affordable price of sewage tariff. This was expected since the sewerage system is not commonly known yet. On the other hand, less than half of the respondents are positive for re-use of the sludge.

2.4.5 Highlights of the Result

The summary of the results is shown in **Table 2.4.1**.

Table 2.4.1 Summary of the results of the Survey

Percentage of Respondents Recognizing the Importance of the WWTP in Jericho.		64%
Affordable Amount for Sewerage Tariff *	No Idea	61%
	Lower Than 50% of Current Water Tariff	37%
Current Water Tariff (Monthly Average)	85.64 NIS	
Level of Monthly Income*	1,001-2,000NIS	48%
	2,001-3,000NIS	29%
Percentage of Respondents Positive for Re-use of Treated Sewer Water	69%	
Percentage of Respondents Positive for Re-use of Sludge	40%	
Top 3 Things to Learn in Awareness Activities	Information for Awareness Raising	97%
	Sewerage Tariff	34%
	Construction Period	25%

2.4.6 Issues Pointed Out by Social Survey

Several issues were revealed by the social survey. One of them is that many of the residents do not have basic information of the WWTP. Respondents are interested in information such as the construction period of the WWTP, and re-use of treated wastewater and sludge. Respondents prefer to obtain information by local radios and public meetings according to the results of the social survey. In the remaining project period, using local radios and public meetings will be an effective methods for awareness activities.

2.5 Capacity Assessment (C/A)

C/A was implemented for the purpose of evaluating current capacity of the staffs. The target personnel to be evaluated were C/Ps and related officers to the Project. C/A was carried out in three stages. The first implementation in April 2013 at the First Stage, personnel change within the municipality and new employment occurred later, so the second addition was carried out in August 2015 as the Second Stage. In September 2017, the third round was implemented for the key staffs of municipality in C/P.

2.5.1 Implementation Method

The capacity of each individual C/P members was assessed both in the general skill/competency and in the technical knowledge/skill, by conducting a questionnaire survey asking all C/Ps to fill out the questionnaire sheet prepared by the Experts, along with a subsequent individual interview and dialogue with each C/P and the Experts. The assessment score of each C/P was defined by comparing his/her own definition and that of the Team.

The general skill/competency was visualized by mapping on two dimensional matrices of object and activity, based on the competency model as shown in **Figure 2.5.1**.

		Axis of Action Pattern			
		Consistency	Interactive	Harmony of difference	Creative
Axis of Item	Self-management	Self-control	Pliability	Utilizing experience and human network	Self-revolution
	Communication	Building trustable relationship	Coordination of people	Leadership in team	Educate next generation
	Achievement	Keen to the result	Sharing the image of result	Maximize the result using acquired resource	Creation of new result
	Process	Rapid & accurate action	Coordination of team work	Making strategy	Creation of new method
	Logic	Logical thinking	Presentation	Making structure	Creation of new concept
	Information	Comprehensiveness of data collection	Sharing/transmission of information	Analysis of information	Transmission of new information

Figure 2.5.1 Evaluation Matrix by Competency Model

2.5.2 Target Personnel

Table 2.5.1 shows the subjects of C/A. In the First Phase C/A, some C/Ps were evaluated only for interviews due to not enough time.

Table 2.5.1 Target Personnel for Assessment

No.	Name	1st C/A	2nd C/A	3rd C/A
1	Basel Hijazi	○		
2	Ghazi Al-Naji	○		
3	Iyad Hamdan	◎		◎
4	Mohammed Fetyani	○		◎
5	Ibrahim Abu Seiba	◎		◎
6	Omran Khalaf		◎	◎
7	Mohammed Awajneh	◎		
8	Maher Al Swaidy	◎		◎
9	Hanan Yaghi		◎	
10	Adan Ashoor		◎	
11	Ibrahim Jalaytah		◎	
12	Ramadan Jalaytah		◎	
13	Mosa Barahmeh		◎	
14	Mohammed Isayed	◎		
15	Majdi Al Ghouj		◎	◎
16	Thaer Dodeen		◎	
17	Wiam Irekat	◎		
18	Mohammed Azmuty	○		
19	Mohammed Abu Muhsen	◎		◎
20	Baha Al Shareef	◎		
21	Abdul Haddad		◎	
Total		12	9	7

○ Assess by the interview
◎ Assess by the questionnaire and interview

2.5.3 Evaluation Results

(1) First Implementation

The averaged assessed score of 8 persons in 12 members of the C/Ps are shown in **Figure 2.5.2**, which shows the present low level of knowledge and skill for operation and maintenance of the WWTP and the pipeline network. It suggests an urgent need to give the C/Ps a series of lecturing sessions covering basic knowledge of the above field, in order to prepare future practice. This is because even the knowledge /skill of engineers otherwise will remain to be below the apprentice level in most of the technical field. The results are attached in **Appendix A 2-5-1**.

General Skill/ Competency

	Consistent	Interactive	Integrating and Organizing	Creative	Average
Self management	3.6	3.7	3.8	3.7	3.7
Communication	3.8	3.8	3.8	3.8	3.8
Achievement	3.7	3.9	3.6	3.6	3.7
Process	3.8	3.9	3.6	3.5	3.7
Logic	3.4	3.1	2.9	2.8	3.0
Information	3.4	3.7	3.8	3.6	3.6
Average	3.6	3.7	3.6	3.5	3.6

Specific Knowledge/ Skill

	Knowledge		Skill		Average
General	Sewerage system	2.3	Computer	3.7	3.3
			Reporting	3.8	
			Human relationships	3.5	
			Keeping records	3.5	
			English	2.9	
O&M of WWTP	Treatment components	2.0	Operation of mechanical equipment	1.7	1.6
	Treatment mechanism	1.8	Operation of electrical devices	1.5	
	Mechanical engineering	1.8	Reading wiring diagram	1.6	
	Testing equipment	1.7	Reading and interpreting meters	1.6	
	Electrical engineering	1.8	Recording operating conditions	1.6	
	Electrical safety	1.7	Sampling water	1.5	
	Chemistry	1.4	Analyzing water	1.4	
	Process control	1.5	Keeping lab. inventories	1.4	
Construction and O&M of Network	Sewer components	2.3	Designing sewer	1.8	2.2
	Sewer planning	2.2	Interpreting drawings	2.4	
	Civil engineering	2.3			
	Hydrology	2.2			
	Pipe materials and construction	2.4			
	Topographic survey	2.1			
Financial management and public relations	Basic accounting	2.5	Preparing budgets and financial statements	2.6	2.8
	Cash management	2.3	Analyzing financial reports	2.6	
	Payroll	2.4	Verbal presentations	3.3	
	Customers relations	2.8	Dealing customers in strained conditions	3.3	
			Resolving disputes on site	3.1	
Average		2.1		2.4	2.3

Figure 2.5.2 Averaged Result of Capacity Assessment of C/Ps (8 persons)

(2) Second Implementation

The average evaluation result for the 9 C/P staffs are as shown in **Figure 2.5.3**. The knowledge / skill related to WWTP and pipeline O&M, financial management and public awareness were poor, all scoring around 2 points. The work skill level of the technical staff is also low; therefore a systemized training for basic knowledge at an early stage is required. The evaluation results for all 9 individuals are shown in **Appendix A 2-5-2**.

General Skill/ Competency

	Consistent	Interactive	Integrating and Organizing	Creative	Average
Self management	3.6	3.6	3.1	3.4	3.4
Communication	3.3	3.1	3.1	2.8	3.1
Achievement	3.3	3.4	3.3	3.1	3.3
Process	3.8	3.3	2.7	2.9	3.2
Logic	3.4	2.8	2.6	2.3	2.8
Information	3.0	3.3	3.1	3.0	3.1
Average	3.4	3.3	3.0	2.9	3.2

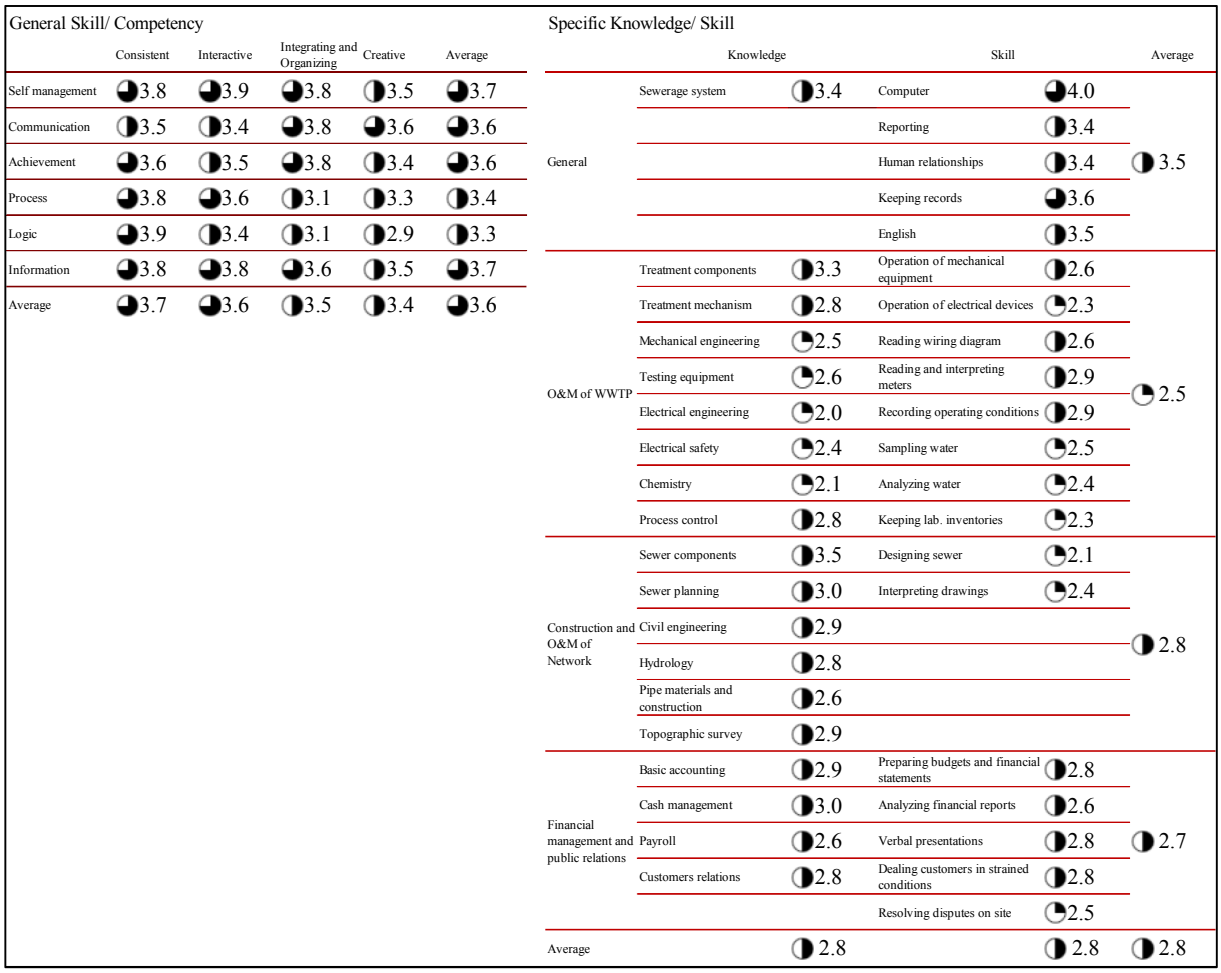
Specific Knowledge/ Skill

	Knowledge		Skill		Average
General	Sewerage system	2.7	Computer	2.9	2.8
			Reporting	2.6	
			Human relationships	3.0	
			Keeping records	3.1	
			English	2.8	
O&M of WWTP	Treatment components	2.9	Operation of mechanical equipment	2.1	2.0
	Treatment mechanism	2.3	Operation of electrical devices	1.7	
	Mechanical engineering	1.9	Reading wiring diagram	2.0	
	Testing equipment	1.4	Reading and interpreting meters	2.3	
	Electrical engineering	1.4	Recording operating conditions	2.3	
	Electrical safety	1.7	Sampling water	2.6	
	Chemistry	1.8	Analyzing water	1.8	
	Process control	1.9	Keeping lab. inventories	2.3	
Construction and O&M of Network	Sewer components	2.8	Designing sewer	1.6	1.9
	Sewer planning	1.8	Interpreting drawings	1.8	
	Civil engineering	1.8			
	Hydrology	1.8			
	Pipe materials and construction	1.9			
	Topographic survey	1.8			
Financial management and public relations	Basic accounting	1.8	Preparing budgets and financial statements	1.9	2.0
	Cash management	2.2	Analyzing financial reports	2.1	
	Payroll	2.1	Verbal presentations	1.9	
	Customers relations	1.9	Dealing customers in strained conditions	2.1	
			Resolving disputes on site	2.1	
Average		2.0		2.2	2.1

Figure 2.5.3 Results of Capacity Assessment (Average of the added 9 Staffs)

(3) Third Implementation

The Third Stage of C/A was carried out at the end of the Project in September 2017 with the aim of evaluating the level of capacity improvement after technology transfer by the JICA Experts for the C/P implemented in the First and Second Stages. The average evaluation result for the 7 C/P staffs are as shown in **Figure 2.5.4**.



General Skill/ Competency

	Consistent	Interactive	Integrating and Organizing	Creative	Average
Self management	3.8	3.9	3.8	3.5	3.7
Communication	3.5	3.4	3.8	3.6	3.6
Achievement	3.6	3.5	3.8	3.4	3.6
Process	3.8	3.6	3.1	3.3	3.4
Logic	3.9	3.4	3.1	2.9	3.3
Information	3.8	3.8	3.6	3.5	3.7
Average	3.7	3.6	3.5	3.4	3.6

Specific Knowledge/ Skill

	Knowledge		Skill		Average
General	Sewerage system	3.4	Computer	4.0	3.5
			Reporting	3.4	
			Human relationships	3.4	
			Keeping records	3.6	
			English	3.5	
O&M of WWTP	Treatment components	3.3	Operation of mechanical equipment	2.6	2.5
	Treatment mechanism	2.8	Operation of electrical devices	2.3	
	Mechanical engineering	2.5	Reading wiring diagram	2.6	
	Testing equipment	2.6	Reading and interpreting meters	2.9	
	Electrical engineering	2.0	Recording operating conditions	2.9	
	Electrical safety	2.4	Sampling water	2.5	
	Chemistry	2.1	Analyzing water	2.4	
	Process control	2.8	Keeping lab. inventories	2.3	
Construction and O&M of Network	Sewer components	3.5	Designing sewer	2.1	2.8
	Sewer planning	3.0	Interpreting drawings	2.4	
	Civil engineering	2.9			
	Hydrology	2.8			
	Pipe materials and construction	2.6			
	Topographic survey	2.9			
Financial management and public relations	Basic accounting	2.9	Preparing budgets and financial statements	2.8	2.7
	Cash management	3.0	Analyzing financial reports	2.6	
	Payroll	2.6	Verbal presentations	2.8	
	Customers relations	2.8	Dealing customers in strained conditions	2.8	
			Resolving disputes on site	2.5	
Average		2.8		2.8	2.8

Figure 2.5.4 Results of Capacity Assessment (7 Staffs)

(4) Analysis on the Evaluation Results

Table 2.5.2 shows the results of the first to the third capacity assessment and the trend of improvement in capacity of C/P. According to it, it is understood that the value of skill and knowledge of the third from the first on the whole items is large, and the capacity was improved through the Project. However, the reason why the value of the second implementation is declining that the target staffs at this time were low experience staff and workers for maintenance of the sewerage facility.

Table 2.5.2 Result of C/A Evaluation

Time	General	WWTP O&M	Pipe O&M	Finance	Average
1st	3.3	1.6	2.2	2.8	2.3
2nd	2.8	2.0	1.9	2.0	2.1
Third	3.6	2.5	2.8	2.7	2.8

2.6 Awareness Raising and Public Relations

2.6.1 Purpose of the Activity

Awareness raising and public relations implementation are essential to promote sewer connection, tariff

collection, treated wastewater reuse and sludge utilization, through gaining understandings by residents and customers. Therefore, it is necessary to conduct awareness raising activities and understanding about the influence and effect of sewerage project on beneficiaries. Specifically, the JICA Expert supports C/Ps to create the explanatory materials on the effectiveness of enlightenment activities for residents such as improvement of water quality of underground obtained by sewerage project and efficient use of water supply sources, and assist C/Ps with obtain the understanding of sewerage system by visiting wastewater treatment plants by residents and visiting treated wastewater and sludge reuse facilities. The activities of public awareness is attached to **Appendix A 2-6-1**.

2.6.2 Awareness Raising

(1) Project Nickname

The Project nickname, TeCSOM (Technical assistance for capacity building sewerage system operation management) was given in the Project in order to memorize and disseminate the name and the objective easily. The Project logotype was also made in cooperation with the C/P. The logo is Sunbird which inhabits in Jericho. **Figure 2.6.1** shows the Project Nickname.

Figure 2.6.1 Project Nickname

(2) Preparation of Awareness Raising Materials

1) Pamphlet

A double-sided A5 size pamphlet was published in Arabic. The purpose of the pamphlet was to raise public attention to the benefits of the Project for the beneficiaries and that how the community could contribute to the success of the Project by paying the sewerage fee. It also mentioned that the treated wastewater is safe to use or to be discharged into the public waterbody and environment. The pamphlet could be utilized at any public meetings in addition to distributing it among the residents. An image of the pamphlets in Arabic and English are shown in **Figure 2.6.2**.

Figure 2.6.2 Image of Pamphlet in Arabic and English

Calendars for the year 2015, 2016 and 2017 were printed and distributed along with the existing materials which also included the application form and the application procedure for new applicants at the door-to-door visits (refer to **Figure 2.6.3**).

A label for the movie CD -which was previously prepared for TeCSOM project- was designed and printed on the CDs. The CDs are used for distribution among the residents. New flyers were designed and printed for distribution; one of the flyers informs residents on how the sewage fees are used for the maintenance with a message to invite people to connect. The other flyer spreads information about the 50% discount from 13 NIS to 7NIS. **Figure 2.6.4** shows additional materials.

وحدة خدمات الجمهور
متطلبات وإجراءات الإشتراك بخدمة الصرف الصحي

نوع الخدمة: شبك صرف صحي	الفترة الزمنية: 20 يوم
الدائرة: دائرة المياه والصرف الصحي	القسم: قسم الصرف الصحي

المتطلبات:

الرقم	المتطلب
.1	صورة عن الهوية.
.2	وجود رخصة بناء/للبناء القائم.
.3	إثبات ملكية (سند تسجيل أو وكالة دوريه مع بيان كيفية انتقال الملكية للمسلمة)
.4	وجود إشتراك مياه شرب، تحديد مصدر مياه الشرب/للبناء القائم.

مراحل عملية الشبك (الإجراءات)

الرقم	القسم	الإجراء	الفترة الزمنية
.1	مركز خدمات الجمهور.	إستقبال وتعبئة البيانات والمرفقات الخاصة بطلب التبك.	--
.2	قسم الصرف الصحي/شعبة التبكات والوصلات المنزلية بالتعاون مع مكتب البلدية.	زيارة الموقع، تحديد التفاصيل والمتطلبات الفنية لعملية التبك، تحديد نقطة إتجاه التبك، المواد المطلوب/ الإمكانية الفنية للتبك، تكلفة عملية التبك.	10
.3	مركز خدمات الجمهور/المواطن	دفع الرسوم المطلوبة.	--
.4	قسم الصرف الصحي/شعبة التبكات والوصلات المنزلية	تنفيذ عملية التبك.	10

Figure 2.6.3 Sewerage Calendar and Application Form and Procedure to Connect to Sewer

Figure 2.6.4 Additional PR Materials

2) Sticker

The sticker (refer to **Figure 2.6.5**) was designed with the C/P in order to explain the Project's main messages in an easy and quick way. In addition to the name of the Project, logos of JICA and the

Municipality of Jericho, the pamphlet contained the below messages with emphasized fonts and colors in Arabic:

- *Let's have a cesspit-free Jericho*
- *Please support an environmentally clean city*

It was a 3.5 in 20 cm sticker with curves so it could be peeled off easily and be pasted on desks, windows, doors, car windows, etc. The Expert recommended the C/P to distribute the sticker with the pamphlet at schools, shops, clinics, and authorities including the Municipality. Some of the stickers have been already distributed at the public meetings along with other materials and more are available for distribution.

Figure 2.6.5 Sticker of the TeCSOM Project

3) Information Sheet

An information sheet was prepared to be distributed at meetings and also within the community. It was an A4 size paper in Arabic with pictures. It requested the community to avoid draining cooking oil and fat into the kitchen sink. The purpose was to make the community aware of ways to prevent clogging the sewer pipes and help building a functioning wastewater treatment system. The information sheet explained five easy steps on how to discharge the oils and fats. The sheet was distributed at the public meeting. The C/P was also advised to pass the information sheet at any proper opportunities such as meetings with parents and university students. **Figure 2.6.6** is the information sheet in Arabic and in English for reference.

Figure 2.6.6 Information Sheet (Introduction of Disposal Method of Edible Oil)

4) Preparation of Exhibition Materials

The general sewerage plan (A120 × 84 cm) and photo board (6 pieces with A3 size) were exhibited in the meeting room of the WWTP so that visitors can see the outline of Jericho sewerage project. In the planned map, the WWTP and main sewers constructed by JICA Grant Aid and the Pilot Project by TeCSOM and the proposed sewer branch line required by other donor's financial cooperation are displayed. Six photos show wastewater treatment facilities, treated wastewater reuse experiment facility and Japanese garden. **Figure 2.6.7** shows the exhibition material.

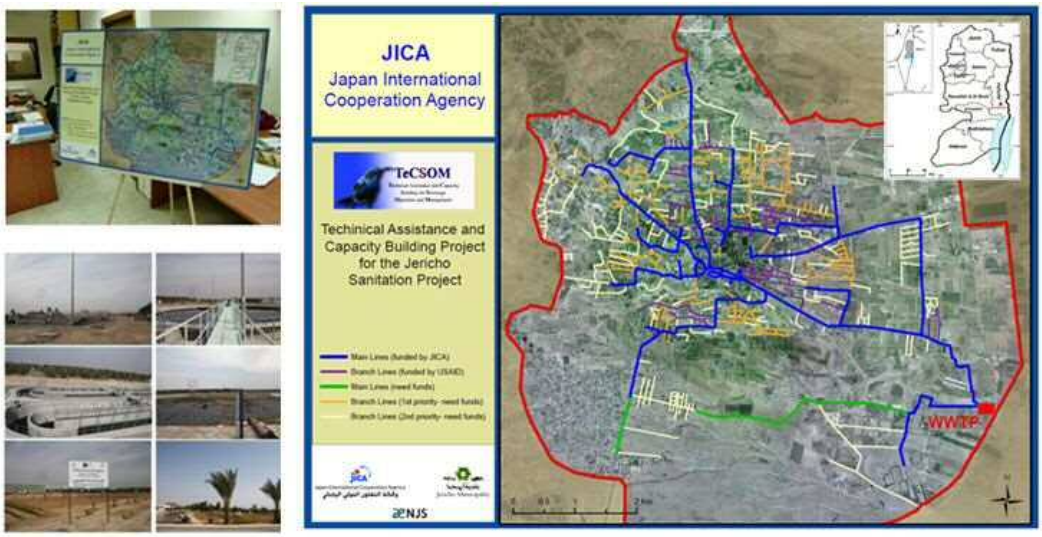


Figure 2.6.7 Exhibition Material

5) Preparation of Project vest

Total of 10 vests as shown in **Figure 2.6.8** were prepared for the Project engineers at the WWTP and construction sites for safety and public awareness. The Project related logos including TeCSOM, JICA, Municipality of Jericho, and NJS were printed in the back of the vests which also help promote the Project among the public especially when worn at construction sites or public meetings. It also informs the public that the construction work is led by JICA.

Figure 2.6.8 Project Vest

6) Additional Preparation of Awareness Raising Materials

The awareness materials included some new ones, updates, and re-prints of the existing ones as follows:

- Key holder (new) (completed)
- Flyer with information on the discounted rates (new) (ordered for re-prints)
- Calendar 2016 (ordered for re-prints)
- Q&A catalogues (updated)(ordered for re-prints)
- Magnets sheets (ordered for re-prints)
- Other flyers (ordered for re-prints)

As of total of April 14, 2017 a total of 2,650 PR materials were printed for distribution at WWTP tours, public meetings and workshops, and Door to Door (D-t-D) visits. They included kids' cards, discount flyers, other flyers, key chains, fridge magnets, and folders. In addition to updating and re-printing of the previous PR materials, the followings were new PR products:

- A total of 500 wall calendars for the year 2017 were printed and distributed along with other existing materials at the door-to-door visits for billed customers, also at the time of survey for unconnected houses (refer to **Figure 2.6.9**).
- A total of 300 door stickers were prepared to notify owners who were absent at the time of unconnected house survey to contact the Municipality for a survey re-visit (refer to **Figure 2.6.10**).

Figure 2.6.9 Calendars for 2017

Figure 2.6.10 Absentee Notification

(3) Radio Message and Project Film

In late 2015 the mayor of Jericho made radio announcements mainly to promote house connection and fee payments. Though not easily measurable- the following two ways were used to measure the effectiveness of this PR activity by C/P:

1) Some residents at the door-to-door visits were asked if the heard the Mayor`s radio message; Out of 20 people who were asked only 4 people (20%) responded yes. This shows a very low rate of the effectiveness.

2) The message was published on Facebook on the January 30 as an audio post. It received 39 "likes" (as of Feb 1st) which means these numbers of people heard it.

C/P should periodically broadcast the audio message and continue posting it on the Municipality`s FB so it stands on top of the other FB posts. It should also be published on the Municipality website.

(4) Increased Use of Facebook and Website

Media like TV, newspapers, the Municipality website and Facebook are effective tools for disseminating the Project information. Although, C/P had been posting news on the Project as part of its PR activities on Facebook before the PR Expert's visit, most of the news was in form of photos with general titles with no or little descriptions. The Expert recommend the C/P to add informative descriptions when posting the Project news and JICA Experts activities, also actively reply to the visitors' comments or questions as well. In addition, it was suggested that the C/P use the website and Facebook virtual space for announcing any up-coming public meetings.

During the month activities, local and national newspapers like Al-Haya and Al-Ayyam published news on the Project meetings and gatherings as well. Local TV channels recorded and interviewed the Project team members. Several news was also published on the website and was posted on the Facebook.

Figure 2.6.11 is an example use of Facebook where the news on the Project's educational activity for children was posted (https://www.facebook.com/profile.php?id=100006692049556&notif_t=friend_confirmed).

It received 11 "likes" and several supportive comments only within two hours of posting. It also shows C/P's replies to the comments.

Figure 2.6.11 Facebook of Educational Activity for Children

(5) Public Meeting

1) TeCSOM Public Meeting

C/Ps conducted several public meetings (within neighborhoods) to inform locals more about the Project coverage area, the negative environmental impacts of the existing cesspit tank system, the fees for public sewer connections and usage. It was also discussed how fairly the fees were estimated and the possibility of financial assistance by the Municipality for those who may need support. Technical matters of house connections such as elevated lands and neighbor disputes were also addressed at the meetings. A total of 270 attended the 7 evening meetings within the Pilot Project areas (compared with only 30 participants at the last campaign's public meeting held in October 2013). The attendance number ranged from 23 to 70 people with an average of 37.

The meeting (refer to **Figure 2.6.12**) was held on February 4, 2015 to inform the public about the Project progress, also to promote house connections and tariff payments. The C/P was advised by the Expert in planning the meeting content, organization, and location. As a result, the meeting was held in a

popular restaurant. The meeting included presentation of updated information (such as connection procedure and Project progress), distributions of printed materials (Q/A pamphlets, information sheets and calendars), and also an open discussion session. Due to the C/P's careful selection of a more convenient location for the meeting the number of attendees improved by three times (63 attendees). The comfortable setting of the public meeting was also effective in encouraging the attendees to stay till the end and participate in the final discussion session.

The major concerns discussed in the meeting were about the connection cost and relative high sewerage fee compared with other municipalities like Ramallah and Nablus. The C/P explained the fairness of the cost and ensured the attendees that the fee has been decided after a careful examination of TeCSOM operation and maintenance expenses.

Figure 2.6.12 Public Meeting (February 4. 2015)

2) Public Meeting for the Pilot Project (PP) Area

The residents of the project's 1st pilot project area (central city area) were invited to the meeting (refer to **Figure 2.6.13**). The purpose was to present the information on the project development, address connection matters especially with the newer buildings in the PP area, and the users' responsibilities such as paying the sewerage fee and proper usage. The Mayor and a number of the Project team members from both C/P and JICA presented information in the form of speeches and power point slides. The attendees' questions showed that more information on the connection procedure, and the tariff amount and the calculation method need to be addressed to the public. Such information is still under development and should be available to the public as soon as it is finalized.

The number of participants at the meeting showed a considerable increase compare with the previous public meeting. A carefully selection of the meeting day and time by PR staff and sending out more invitation letters were perhaps among the reasons. The pamphlet, sticker, and information sheet were

also distributed at the meeting along with the presence of the local news and TV reporters.

Figure 2.6.13 Public Meeting for the PP Area

3) Public Meeting with Women

A number of 20 women participated in the public meeting (refer to **Figure 2.6.14**) where four members of both C/P and the JICA Expert Team presented information on the Project in form of speeches and power point slides. The pamphlet and information sheet were also distributed at the meeting.

At the meeting several topics were covered and discussed. The speakers discussed how the septic/cesspit system could create environmental issues and that how the up-coming sewer system will work. The meeting also covered information on the project phases and matters related to household connections and the community support for the project success. The proper use of the sewer network and ways to avoid any misuses were also among the discussed topics.

Some other public awareness activities were also integrated into the meeting. For example, the event was photographed and the news was published on two newspapers. The C/P's head of engineering department and, the project manager from JICA were interviewed for a TV channel. The event was posted on the website and Facebook along with photos and a description which received many comments.

Figure 2.6.14 Public Meeting for Women

4) Project Announcements

The campaign also included announcements at places such as mosques and schools. C/Ps were able to successfully plan announcements at schools in the mornings and at mosques after the Friday prays. The Christians representative at the city council was also advised to request the priests for such announcements.

(6) WWTP Tour

1) WWTP Tour for School Children

The purpose the tours (organized by C/P) was not only to educate the school children but also to promote the Project objective among the parents through their children (refer to **Figure 2.6.15**).

The tours were set up for several schools visits in the Project area. There were eight visits by a total of 200 students (**Table 2.6.1**). At the WWTP's conference room, students were first presented by power point slides of information about TeCSOM and the Project benefits. A display corner was also set up at the conference room with the large map showing the Project area. Samples of the raw and final treated sewage were displayed for visitors to learn about the treatment process. After a Q/A session, visitors toured the WWTP and planted trees or released fish in the pond at the Japanese garden as symbolic samples of treated wastewater re-use. Even after that, C/Ps independently organized tours of elementary school students and recently, a tour of 50 people was held on March 4, 2017 (see **Figure 2.6.16**).

Table 2.6.1 Number of Students Who Visited WWTP by School and Grade/Age

Schools	Grade	Age	Gender	Number
Francesca Sister	6th	12	girls	27
	7th	13	mix	30
	8th	14	mix	26
Terra Santa	6th	13	boys	20
	7th	13	mix	27
Zahrat Al-Mdan	8th	14	mix	20
Raval Al-Gad	6th	12	mix	27
	7th	13	mix	23
Total				200

Figure 2.6.15 WWTP Tour for School Children

Figure 2.6.16 WWTP Tour in Mar. 4, 2017

2) Touring Workshop for WWTP Staff

The purpose of the workshop was to enhance the C/P's public awareness skills in conducting WWTP educational tours including tour organization and presentation materials. The workshop was held after the JICA Expert's observation of the first few schools tours and the need for improvement. Three of the WWTP's engineers and the PR staff attended the workshop at the WWTP. The workshop provided feedback, advice, and recommendations to improve the preparation of the conference/presentation room for the visitors, children-friendly power point slides and presentation duration, speech skills to attract the audience interests (such as voice excitement, smile and eye contact, interactive Q/A sessions), simplified explanations of the equipment work and treatment process, also safety measures taken for the young visitors while touring the site.

The next WWTP tours showed that the workshop was greatly effective. In addition to the high

improvement in the presentation slides and speech skills, the staff was further organized and prepared for the tours. The tours received positive feedback from schools principles. Several other schools requested for such tours after seeing the news on the Municipality's Facebook. The WWTP engineers and the PR staff were also advised to prepare for adult visitors with additional information like how the collected tariff is used to cover the costs of the WWTP's maintenance and management.

3) Educational Workshop at School by WWTP Staff

Carrying out educational workshops at schools (refer to **Figure 2.6.17**) was another effective way to communicate with the parents through their children. Two workshops were conducted at Rawal-Al-Gad school for a total of 50 students of the 6th and 7th grade classes of science and technology. An engineer from WWTP presented information on TeCSOM such as its positive environmental impact, transfer of sewage to the WWTP, and proper use of the new sewerage. After the presentation and a Q/A session, students were given stationary (paper and color pencils) to draw their understandings of TeCSOM. They also wrote short messages on the drawings about the Project and its benefits for the city. The PR staff facilitated the workshop by organizing and managing the visit. The drawings were exhibited at the WWTP for visitors. These drawings can also be bound (as a book) and be circulated at the TeCSOM public meetings. Some drawings can also be mailed out to the residents as a creative way to promote the Project and house connections.

Figure 2.6.17 Educational Workshop at School

4) Neighborhood Residents Visit

The public awareness event was held on June 6th, 2015 (refer to **Figure 2.6.18**). A total of 50 residents of the Al-Arab neighborhood (near central Jericho) attended the introductory presentation at the WWTP's conference room and an afterward Q&A session followed by a tour of the treatment process and facilities. The visitors were from the PP areas and were connected to the sewer network or to be

connected soon. The purpose of the visit was to expand payment promotion for connection expenses and tariff fee through discussions and also observation of the treatment process, organization, costs, and managements. The Mayor, C/P members, and the WWTP operators answered the questions, discussed the matters, and addressed the concerns. The JICA experts also were available for support and facilitating.

The following were some matters discussed by the attendees:

- The tariff fee reduction due to the higher water consumption in Jericho.
- Cancelation or reduction of the connection fee of 13 NIS/m^2.
- Suggesting expansion of the Project up to the house connection for all for free by JICA as the donor.

Figure 2.6.18 Tour of Neighborhood Residents

5) Farmers' visit

A number of 32 farmers were invited on June 15th, 2015 to visit the WWTP with a focus of treated wastewater reuse. The purpose was to share experience of the selected farmers who visited Jordon for wastewater re-use. After an introductory presentation by the WWTP manager who also attended the Jordon tour, an open discussion was hold. The selected farmers shared the following learning with their other fellow farmers:

- It is economically beneficial to them using the treated wastewater.
- Jordanian Government helps and assists farmers in reusing the treated wastewater by offering the treated water for free for the first few years. Now, the water is provided by some fees to farms especially those near the WWTP. The treated wastewater at Jericho WWTP has higher quality than the visited Jordanian WWTP so it will be better for irrigation.
- More connections in Jericho is needed in order to increase the wastewater which can in turn reduce the cost of treated wastewater.

- It is important to properly use the treated wastewater as that water should not touch the plant.

6) Women's visit

This event was carried out on October 19th, 2015. A total of 15 women attended the tour of WWTP. Like other visits, engineer at WWTP, head of WWTP, and PR staff of the Municipality guided the tour.

Figure 2.6.19 Tour of Women

(7) Awareness Workshop for Women

This workshop (refer to **Figure 2.6.20**) was held on October 12th, 2015 with 50 female attendees with presentation by the head of WWTP, engineers for the sewer connection work, and PR staff from the Municipality. Discussed topics included brief introduction on the Project, WWTP work process, house connections and tariff fees, system protection, and the new discount rates for the sewer connection fee and tariff. Question on the connection matters, new discounts and future, environmental impacts of the project in future were also answered by the workshop lecturers.

Figure 2.6.20 Awareness Workshop for Women

(8) Educational Activity for Kids

The Municipality manages and supports an after-school program at its Kids Club. The club has some volunteer teachers that provide different activities such as sports, musical, traditional, recreational,

theatre, scouting, rangers, in addition to different and various social activities for children. The club is equipped with a set of devices and educational tools some of which are a TV set, Video, puppet theatre, and plenty of educational and mind urging games.

The C/P staff set up an educational activity at the Kids Club with 20-22 children. The purpose was to explain about the City's current and future sewerage system and that why the Project is necessary for the City. Several cartoon images were utilized to teach topics such as reducing wastewater in daily life, where all the dirty water goes, what a septic tank and sewerage system are, and why Jericho needs a sewer system with a wastewater treatment plant. The activity was not only based on simplifying complex information but also utilized the question and answer method to involve children into the learning process.

Figure 2.6.15 are the material (refer to **Figure 2.6.21**) used for the event, and some photos (**Figure 2.6.22**) taken during the activity. A customized version of such images could be produced as laminated picture cards to use at future educational events with kids.

Figure 2.6.21 Event Material for Kids

Figure 2.6.22 Event Material and Photos of Educational Activity for Kids

2.6.3 Capacity Building and C/P Achievements

As mentioned earlier, the purpose of the Expert's visit was to assist C/P's PR department on the mission of raising public awareness for the Municipality's new sewerage system. Such assistance resulted in strengthening and enhancing the Department's existing capacities and resources including but not limited to the following areas.

(1) Assessment and Cooperation

Prompt assessment of the existing resources (within the Municipality and the community) helped the PR department plan and deliver successful public awareness events. Such assessment, for example, assisted the C/Ps in planning TeCSOM neighbourhood meetings in joint with the Municipality's other on-going project (Clean City project) meetings. Other example included conducting the TeCSOM public meeting in cooperation with the city's Chamber of Commerce and the Director of Education. These resulted in raising the number of participants and the quality for the meetings.

(2) Re-assessment and Learning

During the campaign there were times that the PR staff needed to re-assess the community resources in order to choose the best available option. In public awareness material production, for example, such re-assessment helped dismiss a less qualified designing/publishing company and select a more qualified and reliable one. This was a learning process of responding effectively in solving a problem when an issue rises.

(3) Improving Inter-departmental Communication

During the campaign, the PR staff put a considerable amount of efforts to enhance its communication with the other departments and the TeCSOM team members within the Municipality. This was important in sharing and preparing the sewerage system information. It helped the PR department in preparing awareness materials like the Q/A pamphlets and flyers or assigning expert speakers at the meetings.

2.6.4 Awareness Survey

(1) The 1st Awareness Survey

The survey purpose was to assess the current community support for the Municipality's sanitation project and understand their legal obligations. It also aimed to target awareness issues that need further attention in the next TeCSOM campaigns and activities. Not initially planned but the survey, somewhat, provided a measure to evaluate how successful the past awareness activities were.

The survey was an effective tool to learn about the resident's attitude towards TeCSOM and matters that need to be further discussed in the future campaigns. A high percentage of the respondents admitted the importance of the Municipality's sewerage project and intend to connect to the sewer network.

More than half of the surveyed people had no objections for the service payment but some required financial assistance. Expectedly, most of the surveyed people were unaware of their legal obligations about house connections and tariff payments. This matter need to be addressed in next campaigns.

Even though respondents and population are different, a comparative analysis of the awareness survey and the past social survey shows that the public awareness activities have successfully raised the community support and recognition of the Municipality's public sewer and the WWTP projects (**Figure 2.6.23**). Details are mentioned in **Appendix A 2-6-2**.

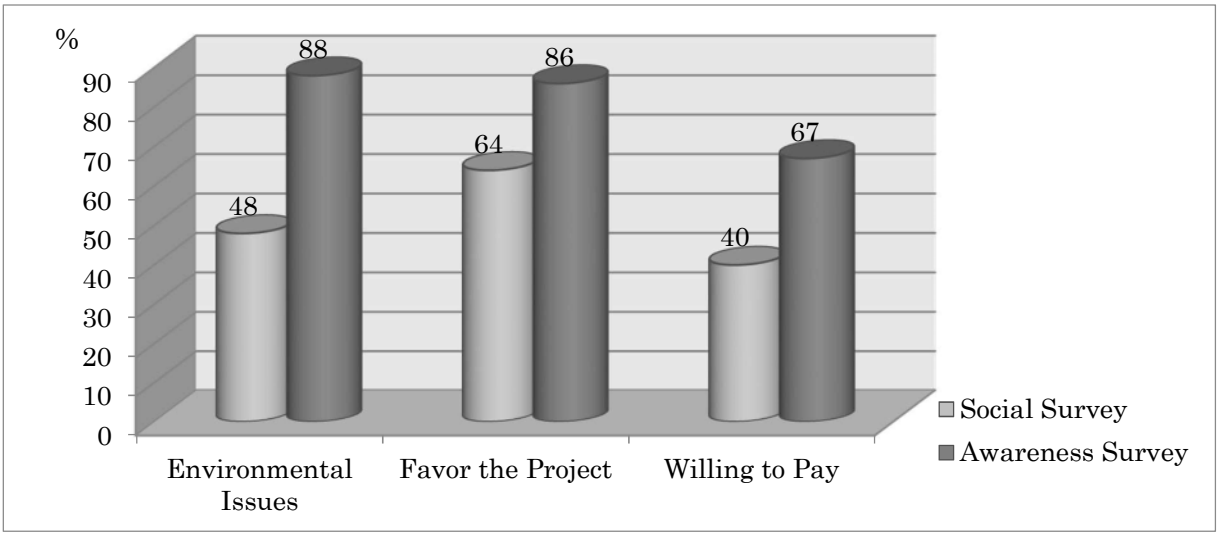


Figure 2.6.23 Comparative Results of Responses to the Awareness and Social Surveys

(2) The 2nd Awareness Survey

This survey was conducted to mainly evaluate the current sanitation issues, customer satisfaction with the system, and willing to pay for the service. It was conducted for connected customers within the PP area and along the mail pipes outside the PP area. A total of 105 were surveyed within the PP area (75 customers) and along the main network pipelines (30 customers). **Table 2.6.2** below provides more details on the findings.

The main findings for the PP area included:

- 86.6% of the surveyed people are satisfied with the new sewerage system.
- 86% of the surveyed people understand that they need to pay for the property connection to the sewer network.
- 98% of the surveyed people are willing to pay for the monthly sewage bill.

Table 2.6.2 The 2nd Awareness Survey

1. Current Sanitation Issues

1-1	Do you know using cesspit causes environmental problems at present and future?	**PP Area**	**Main Trunk**	**Average**
		Yes: 88.5	Yes: 90%	89%
1-2	What is the problem about sanitary condition in your household? *(Multiple answers allowed)*	Overflow: 28% Leakage: 16% Obstacle to Bath: 15% Insect: 48% Dirtiness/Uncleanness: 21% Bad smell: 38% No Problem: 30% Other: 1%		

2. General Understanding

2-1	Do you agree that it is an important and good project and Jericho needs it?	**PP Area**	**Main Trunk**	**Average**
		Yes: 91.5%	Yes: 100%	**96%**
2-2	Are you satisfied with the new sewerage system? i.e. disappearance of bad smell from cesspits, no insects or rats, more space due to the cesspit backfill, or cleaner environment in the city.	Yes: 90%	Yes: 83.3%	**86.6%**

3. Agree to Connect and Pay the Connection Fee

3-1	In case you own the building; do you understand that you need to pay for your property connection to the sewer network? (*agree to connect and pay*)	Yes: 83%	Yes: 88%	**86%**
3-2	Currently, connection fee is 13NIS/m^2. Do you agree?	Yes: 34%	Yes: 23%	28.5%
3-3	If not, how much you agree to pay?	4.6 NIS	3.4 NIS	4.0 NIS
3-4	Which plan will you be able to pay the connection fee to the Municipality during the first year?	1 pay: 13% 3 pays: 7% 6 pays: 13% 9 pays: 9% 12 pays: 58%		

4. Agree to Pay for Sewerage Charge

4-1	When you connect, are you going to pay for your monthly sewage bill?	**PP Area**	**Main Trunk**	**Average**
		Yes: 96%	Yes: 100%	**98%**
4-2	If answered "No", what is the reason?			
4-3	How much are you willing to pay for your sewage fee for every month?	34.0 NIS	43.5 NIS	38.7 NIS

(3) The 3rd Awareness Survey

This main purpose of this survey was to evaluate public awareness about the discounted rates and that if the discounts improves the willingness to connect and pay for the tariff. **Table 2.6.3** below provides

more details on the findings.

A total of 20 questionnaires were distributed among the PP area residents and 18 were returned.

- 89% of the surveyed people are satisfied with the new sewerage system.
- 100% of the surveyed people are willing to pay for the discounted property connection to the sewer network.
- 100% of the surveyed people are willing to pay for the monthly sewage bill.

Table 2.6.3 The 3rd Awareness Survey

1. Current Sanitation Issues

1-1	Do you know using cesspit causes environmental problems at present and future?	Yes 11(61%)	No 7(39%)
1-2	What is the problem about sanitary condition in your household? *(Multiple answers allowed)*	□ Overflow 3(17%) □ Leakage 1(5.5%) □ Obstacle to Bath 2(11%) □ Insect 4(22%) □ Dirtiness/Uncleanness 1(5.5%) □ Bad Smell 5(28%) □ No Problem 11(61%) □ Other 2(11%)	
1-3	How much is the average monthly discharge for your cesspit?	…….. NIS per month	

2. General Understanding

2-1	Do you agree that it is an important and good project and Jericho needs it?	Yes 17 (95%)	No 1 (5%)
2-2	Are you satisfied with the new sewerage system? i.e. disappearance of bad smell from cesspits, no insects or rats, more space due to the cesspit backfill, or cleaner environment in the city.	Yes 16 **(89%)**	No 2(11%)
2-3	In case you own the building; do you understand that you need to pay for your property connection to the public sewer network?	Yes 18 (100%)	No 0 (0%)

3. House Connection Cost

3-1	The original house connection fee is 13NIS/m2. However, the Municipality has decided to offer 50% discounts for house connection fee if you connect by end of 2016. So it will be 7NIS/m if you connect your house by 2016. Will you connect your house by 2016 with this discount?	Yes 18 **(100%)**	No 0 (0%)
2-4	Which plan will you be able to pay the connection fee to the Municipality during the first year?	1 payment 2 (11%) 3 payments 1(5.5%) 9 payments 4(22%) 6 payments 3(17%) 12 payments 8(44.5%)	

4. Monthly Tariff

4-2	Do you know that you need to pay tariff every month (based on your consumption volume) for using the sewerage system to cover the operation and management cost?	Yes 13(72%)	No 5(18%)
4-2	The original fee for monthly tariff is 1NIS/m^3. However, the Municipality has decided to offer 50% discounts for discharging your sewage but only up to 2016. So it will be 0.5NIS/m^3. Will you pay your monthly usage of the sewer system with this discount?	Yes 18**(100%)**	No 0(0%)

(4) Comparison of the Projects Social Surveys Results

Figure 2.6.24 below provides total results of the Project`s initial social survey (before conducting any major public awareness) and the three awareness surveys. As seen the overall awareness activities has gradually improved the public`s attitude towards the Project. Some of the missing columns in the chart indicate that no data was collected during the survey.

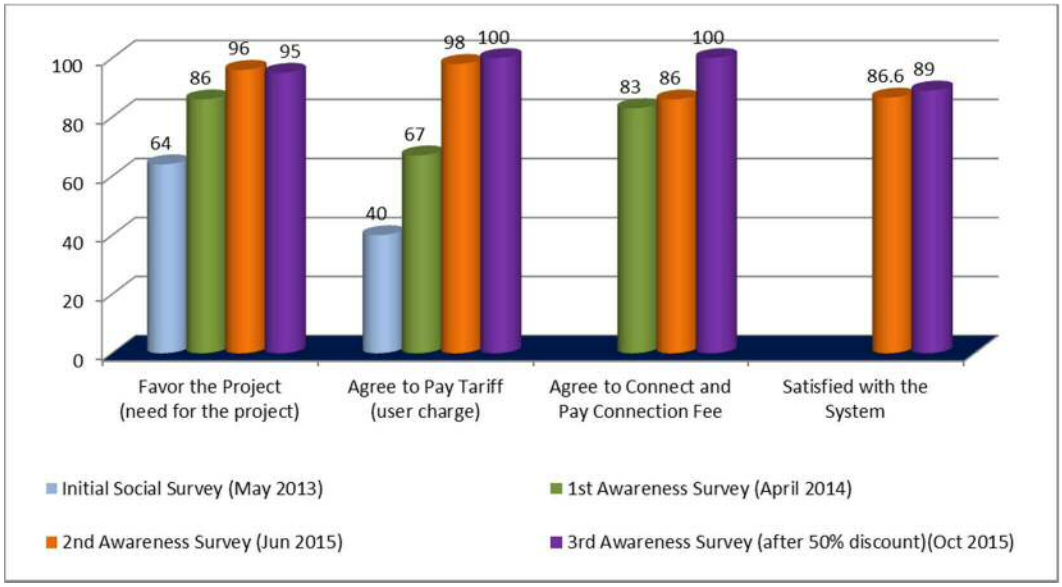


Figure 2.6.24 Result Comparison of the Projects Social Surveys in Percentage

Note: The 2nd Awareness survey was conducted specifically for only connected customers.

2.6.5 Preparation of Project Film

To promote the sewer connection and tariff fee payment, the Municipality prepared a film of the overall Project work and the WWTP. A draft version was shown on the Project weekly meeting with counterparts on October 26th 2015 for comments and suggestions. It is about a 15 minutes film and could be used at public awareness meetings, be distributed among the residents and schools or other institutes. The final version now is approved by the counterparts and is ready to be used.

2.6.6 Door-to-Door (D-t-D) Visit for Promotion of House Connection

(1) Begging Stage of D-t-D (Dec. 2015 to Dec. 2016)

Connection to sewer should be accelerated from domestic and commercial buildings located within the sewerage serviced area, in order to increase the inflow wastewater into the WWTP which started operation in June 2014. The connection work to the main sewer should in principle be constructed by land owners. But the inflow wastewater to WWTP remains around 300-400 m^3/d in average after one year since the starting of its operation, and it has become the critical issue to enhance the household connection by house owners.

The JICA`s evaluation suggested to conduct intensive "Door-to-Door Visit" to promote house connections in order to achieve the remaining 755 connections out of the 2,000 initial target connections by July 2016 (around 100 households per month). The evaluation also advised to explain necessity of house connection by showing the actual cost of household connection at the time of "Door-to-Door Visit". JICA also recommended to further promote payment by those already connected by the Project to ensure fairness among the citizens. Thus the Experts assisted the C/Ps in the following activities to contribute to the achievement of the recommendations:

- To facilitate and assist the C/Ps to further promote house connection (outside of the Pilot Project area) with planning, organizing, and performing public awareness activities particularly door-to-door visits;
- To promote tariff payment and awareness of new discounted tariff by helping the C/Ps in producing related PR materials such as flyers and information sheets;
- To facilitate the C/Ps with conducting public meetings with community leaders (mosque imams) to promote house connection fees within the Project areas.

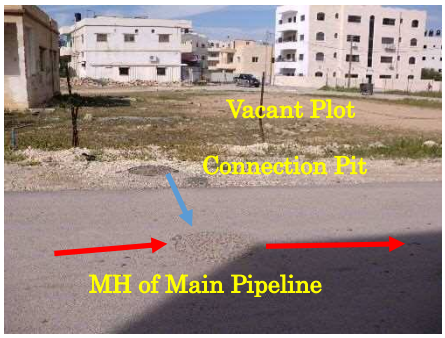
The JICA Experts and the C/Ps visited houses and met with house owners within the USAID and JICA pipeline areas to promote new house connections. A team consisted of C/P's PR staff and engineer and the Experts conducted the visits. The C/Ps explained and encouraged people to connect their houses. The Experts added when needed. The team explained the application process, approximated costs, and where to apply. PR staff made follow-up phone calls to the visitors after some days as reminders. PR materials were distributed at the doors.

As shown in **Table 2.6.4** from December 2015 to January 2016 a total of 210 visits were completed which corresponds to the JICA's recommended 100 household visits/per month, followed by 150 visits in February. Almost all of the visitors agreed to connect. The targeted visits were around 750, but the C/Ps and the Experts found through the field visits that in the targeted area:

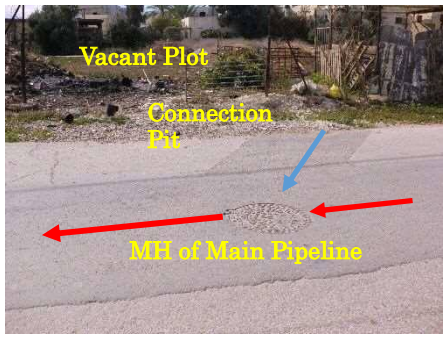
- Some premises are vacant though connection pit has been installed (refer to **Figure 2.6.25**);
- Second houses are existing where the owners come back to Jericho only weekends.

As a result, the number of responding houses is estimated to be around half of the target i.e. 375, whereas

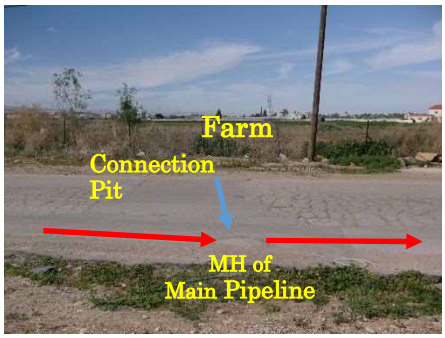
the number of visited houses amounts to 364 as shown in **Table 2.6.4**, which means that almost all the responding houses were visited.



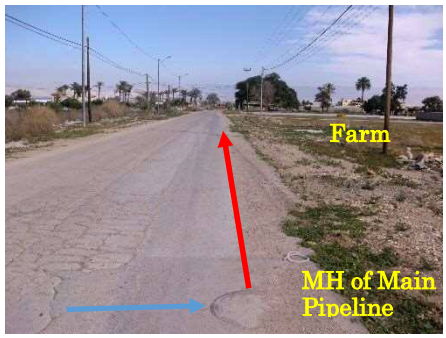
Example of Connection Pit By USAID-1



Example of Connection Pit By USAID-1



Example of Connection Pit Along JICA Trunk-1



Example of Connection Pit Along JICA Trunk-1

Figure 2.6.25 Vacant Premise Conditions with installed Connection Pit

An inquiry from the C/Ps on May 3rd 2016 shows that out of all of the total visits of 364 households 54 applied to connection, 15 paid the connection fee, and only 8 have been connected. This result does not look promising for house connection promotion. The C/Ps need to take door-to-door activity by themselves and speed up connections for those who apply, and/or to be proactive in more effective ways for house connection promotion.

Table 2.6.4 Status of Door-to-Door Visits

Status	C/Ps with Experts Presence	Only C/Ps Team				Total
	Dec. 2015 - Jan. 2016	Feb. 2016	Mar. 2016	Apr. 2016	May 2016	
# of Visited Days	18	15	1	0	0	34
# of Visits	210	150	4	0	0	364
# of Agreed to Connect	195	136	4	0	0	335
# of Follow-up Calls	63	0	0	56	0	119
# of Applied Applicants	54 as of May 3rd					54
# of Paid Applicants	15 as of May 3rd					15
# of Connected Houses	8 as of May 3rd					8

The JICA Experts and the C/Ps visited all 364 households by the first half of March 2016, which are identified to be responding. The Experts requested the C/Ps to extend the visit to non-responding households as well as to do follow up calls for the visited households.

(2) Modified Stage of D-t-D (Jan. 2017 ~ Mar. 2017)

In response to the inadequate results at the end of 2016 since the beginning of December 2015 with the aim of promoting connection to the sewer network and raising the collection rate of sewerage fees, D-t-D activity conducting together with the JICA Expert was applied intensively in 2017.

As a result, C/P understood the importance and the procedure of D-t-D for promoting the connection to the sewer network and the tariff collection more than ever. In the second half of 2017, in response to the staff of the Customer Service Section being pointed out as the chief charge, a dedicated team was organized together with the engineer of municipality without the JICA Expert, and D-t-D continued independently by the organized team have become possible.

The purpose of this activity is the following two items.

1. To promote new connections by conducting door to door (D-t-D) visits to buildings that have access to sewer network but have not been connected due to non-technical reasons such as family or neighbor disputes, lack of fund, procrastination, etc.
2. To promote connection by resolving technical issues of buildings that have access to sewer network but have not been connected due to the buildings level to the street, far distance from the closest manhole or connection pit, etc.

The initial challenge for this promotion method was lack of data and map on unconnected houses. To start above promotion method there was a need of data on the buildings connection status along the sewer network, and a map showing location of unconnected buildings. This data and map could help pinpoint the unconnected buildings for D-t-D visits. However, no reliable data or map was available. As a result, a survey was thus planned. The questionnaire-base survey was planned to collect the followings:

- number of buildings not connected to sewer network
- attributes of the buildings
- reasons for not being connected
- to map locations of the buildings

Details included:

1) Building attributes and other information

- owner's name
- type of building and its usage (residential, shop, mosques, church, school, mix use, etc.)
- number of floor

- number of households
- water meter(s) number
- level of building to the street (lower, same, higher level)
- distance to closest manhole or connection pit
- estimated internal length for cost estimation
- reasons for not been connected yet
- sketch of the building location if not already on the reference map.

2) Data entry in GIS.

3) Locations of unconnected houses for D-t-D visits; visits by PR staff if a building was unconnected due to non-technical reasons, and visits by the sewage department engineers if the building was unconnected due to technical reasons.

The questionnaire form, survey team and their tasks, door sticker notice for absent owners, a sample GIS map of the surveyed houses are attached to **Appendix A 2-6-3**. The survey is still on going and is expected to be completed soon. As of the April 28, 2017, a total of 1,015 buildings (with 1,076 water meters) have been surveyed and related data has been entered to the GIS database.

Although a public awareness of D-t-D visits was initially planned to be carried out along with the survey findings, it was delayed due to recent development in the Project. A new fund by JICA and PA was released shortly after the survey started. This fund could make it possible for many unconnected houses to be connected without advance payments (just like those within the PP1 and PP2 areas) and thus no need for promoting private house connections. For this reason, C/P decided to pause the D-t-D activity plan. The survey data and GIS maps, however, are valuable sources of new data on un-connected buildings which is used by the Municipality of Jericho in tendering document for house connection with the new fund release.

2.6.7 Promote Payments of Sewerage Fee within PP Areas

Since the door-to-door was time consuming for both the C/Ps and the JICA Experts and no more staff were available for this activity during the month, the C/Ps decided to get help from Imams to promote connection fee payment. A public meeting (refer to **Figure 2.6.26**) with all mosque Imams was thus conducted:

- On Feb 2 2016; about 30-35 Imams attended.
- TeCSOM members and the Mayor explained the Project and requested those Imams within the Pilot Project area to encourage the prayers to pay the connection fee. The Imams from outside of the Pilot Project area, however, were requested to encourage new house connections and monthly payments.
- The Imams showed positive attitude toward the request. To make the effort more formal, the Imams will receive an official letter from the Ministry of Endowment`s director for the above

request with cooperation with JM. PR materials were distributed at the meeting as well.


Figure 2.6.26 Public Meeting with all Imams

This activity aimed to encourage owners of connected buildings - within PP1 and PP2- to pay their due connection fees. The D-t-D team needed the following information to start this promotion activity:

- A list of current customers,
- Letter of Request for Payment issued by Jericho Municipality with the due amount.

The activity, however, was delayed because the JM was in the process of conducting a re-calculation of internal cost for each connected building before issuance of the Letter of Request for Payment. Once some of these letters were prepared by JM, the team started D-t-D (refer to **Figure 2.6.27**) visits to not only hand the letters but also encourage the owners to pay.

Figure 2.6.27 D-t-D Visit in PP Area

As of April 28, 2017, a total of 83 letters of payment request were handed to customers by the D-t- D team. The team included the JICA Expert, PR staff of JM, and a bill attendant. The team talked with the owners and explained how the cost was calculated and requested them to pay the due amounts. The

team handed in some PR materials including the discount flyers and let the owners know that an option of monthly installment was available at the municipality if they wish.

According to an inquiry from the JM`s Customer Service department, 5 out of 36 visited customers (as of March 11) paid their connection fees. JM was recommended to renew this inquiry by the Customer Service department as more progress goes on with the D-t-D visits.

2.6.8 Public Awareness at the Aqbat Jaber Camp

To raise awareness on importance of the Aqbat Jaber camp's up-coming sewer network project, the JICA Expert provided assistance on public awareness activities to the Camp. The Jericho Municipality accepted to help the Camp`s PR activity as the advisor when they need. After several preparation and discussion meetings with the Camp`s public committee office, URWA, and JICA, following activities were conducted in February - March 2017:

(1) Public Meeting for the Camp residents

The public meeting (refer to **Figure 2.6.28**) was held on February 25, 2017. President of the Camp's committee, PR staff of Jericho Municipality, and the Camp's sewer project engineer from UNRWA presented information about the project and encouraged the attendees to cooperate during the construction and house connection. A total of 30 attended the meeting. A Q/A session was held in end of the meeting. The questions were about the project durations, the fee payments, use of the treated waste water, and connection for houses with levels lower than the street. **Appendix A 2-6-4** provides the meeting agenda, and details on the questions and answers.

Figure 2.6.28 Public Meeting at the Aqbat Jabel Camp

(2) Workshop for Women Residents of the Camp

The purpose of the workshop was to raise awareness on Camp`s new sewer project, positive impacts of the project on the daily life of the residents, health, and the Camp's environment. The workshop was held on March 7, 2017 (refer to **Figure 2.6.29**) and included presentations on the Jericho's sewerage project, the Jericho WWTP, and technical aspects of the Aqbat Jaber sewer network project, followed by a group discussion to strengthen the participants understanding of the Project. A total of 30 women attended the meeting. For the group discussion, attendees were divided to three groups and asked to discuss and share their thoughts on assigned topics.

The discussion topics/questions were different for each group:

Group A: Negative impacts of cesspit tanks on environment and health

Group B: Benefits of sewer network and treatment plant for environment and better life

Group C: Support and help success of the Aqbat Jaber's up-coming sewer network.

The answers were varied for each group.

<Answers to the Group A question>:

1. Cesspit tank takes a large space of the house area and also negatively affects the house foundation.
2. Dangerous to children.
3. Cesspit tank pollutes groundwater, environment, and crops.
4. Cesspit tanks bring a lot of insects. Emptying cesspit tank costs much.

<Answers to the Group B question>:

1. Prevents danger on our health.
2. Prevents bad smell of cesspit tanks.
3. The space of the filled cesspit tank could then be used for other purposes such as an extra room or for gardening.
4. Cleaner courtyards and houses.
5. Re-use of treated waste water for farm irrigation.

<Answers to the Group C question>:

1. Everyone should be responsible and cooperate.
2. We should cooperate when neighbor pipelines have to pass through our properties.
3. We should care for our children on the street construction sites to prevent any falling or possible injuries.
4. We should not drain solid waste or oil in the sewer network.
5. If we face any problems in the system, we should notify the Committee office.

Appendix A 2-6-5 provides the workshop agenda.

Figure 2.6.28 Workshop for Women Residents of the Camp

(3) WWTP Tour for Residents of the Camp

The purpose of this PR activity was to raise awareness about the waste water treatment process. This event was held on April 11, 2017. A total of 30 women from the Camp (and some children) joined the tour. Attendees were shown a movie of the TeCSOM project followed by a tour of the WWTP including the SCADA system, the laboratory and the treatment process. The participants left the tour with a positive view of being connected to the sewer network.

2.6.9 World Water Day Exhibition in 2015

This event (refer to **Figure 2.6.30**) was held for all water supply/sewerage related parties of Palestine, including the Gaza Strip. The event program is shown in **Appendix A 2-6-6**.

Date: March 25, 2015 (10:00-13:00)

Place: Moevenpick Hotel in Ramallah

Attendants: Representative of Palestine Authority, President of PWA, Parties from local governments, Donors (JICA, USAID, etc.)

The various educational materials prepared were displayed and disseminated findings and the contents of the TeCSOM were informed to relevant organizations.

	
Guide board at entrance	Roll-up Material prepared by the TeCSOM
	
JICA Booth	Exhibited Materials prepared by the TeCSOM
	
Opening Ceremony	Panel Discussion

図 2.6.30　World Water Day Exhibition

【OUTPUT-1】

2.7 Support for Establishment of Water and Sewerage Department

2.7.1 Current Structure of Jericho Municipality

Figure 2.7.1 shows the structure of the Jericho municipality. There are seven departments and a council with 15 personnel under the Mayor. Responsibility of each section, which explained by C/P, is shown in **Appendix A 2-7-1**. Within the seven departments, one is for water supply and sanitation and the number of personnel in charge is 51 persons. There are four sections, which are water supply, irrigation water, O&M of water supply pipes, and Sanitation, in Department of Water Supply and Sanitation,

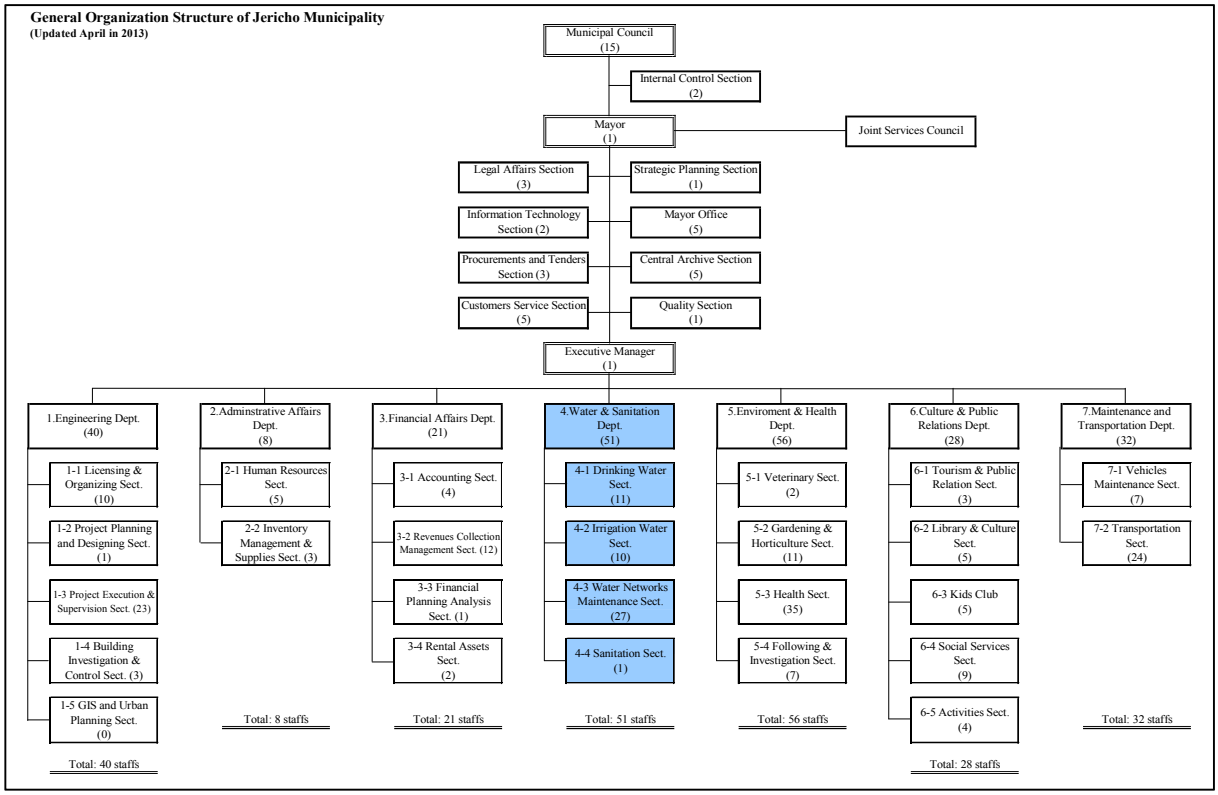


Figure 2.7.1 Current Structure of Jericho Municipality

2.7.2 Basic Policy of Establishment of Sewerage Department

This activity support the establishment of a department will be in charge of O&M for the new WWTP and sewers. Firstly, the JICA Expert and the C/P visited Al-Bielh municipality and Nabulus municipality where sewerage system is already introduced. The reason was to obtain the organization structure of department in charge, and had discussion.

The draft structure for the sewerage operation was prepared with PWA, MoLG and C/P referring the examples of Al-Bielh and Nabulus municipalities. The draft plan was finalized with opinions from the Jericho municipality and advice from MoLG. The sewage section will be organized within current Department of Water and Sanitation, but the name will change to the Department of Water and Sewerage.

However, the new Department of Water and Sewerage will be in charge of technical issues only, and other service, which is customer service, tariff collection, meter reading and its maintenance, record management planning will be taken care by other department as same before.

2.7.3 New Department of Water and Sewerage

Figure 2.7.2 shows the final plan of the structure of the new Department of Water and Sewerage. The final plan was already approved by the C/P after several discussions and also approved by the mayor of the Jericho municipality on June 22, 2013 (refer to attached **Appendix A 2-7-2**). **Table 2.7.1** shows type and numbers of personnel in charge of sewerage operation. Fourteen personnel are necessary to be allocated by the operation start of the WWTP (April 2014).

Table 2.7.1 Type and Numbers of Personnel for Sewerage Operation

Type of Work		N. of Personnel (Unit: Person)
Chief of Sewer Section		1
In Charge of Sewer Piping		2
In Charge of Household Connection		2
Operation of the WWTP	Manager	1
	Operator	2 (including labor)
	O&M	1 for Equipment 1 for Electric
	Water Quality	1
	Security Guard	3 in 3-shift system
Total		14

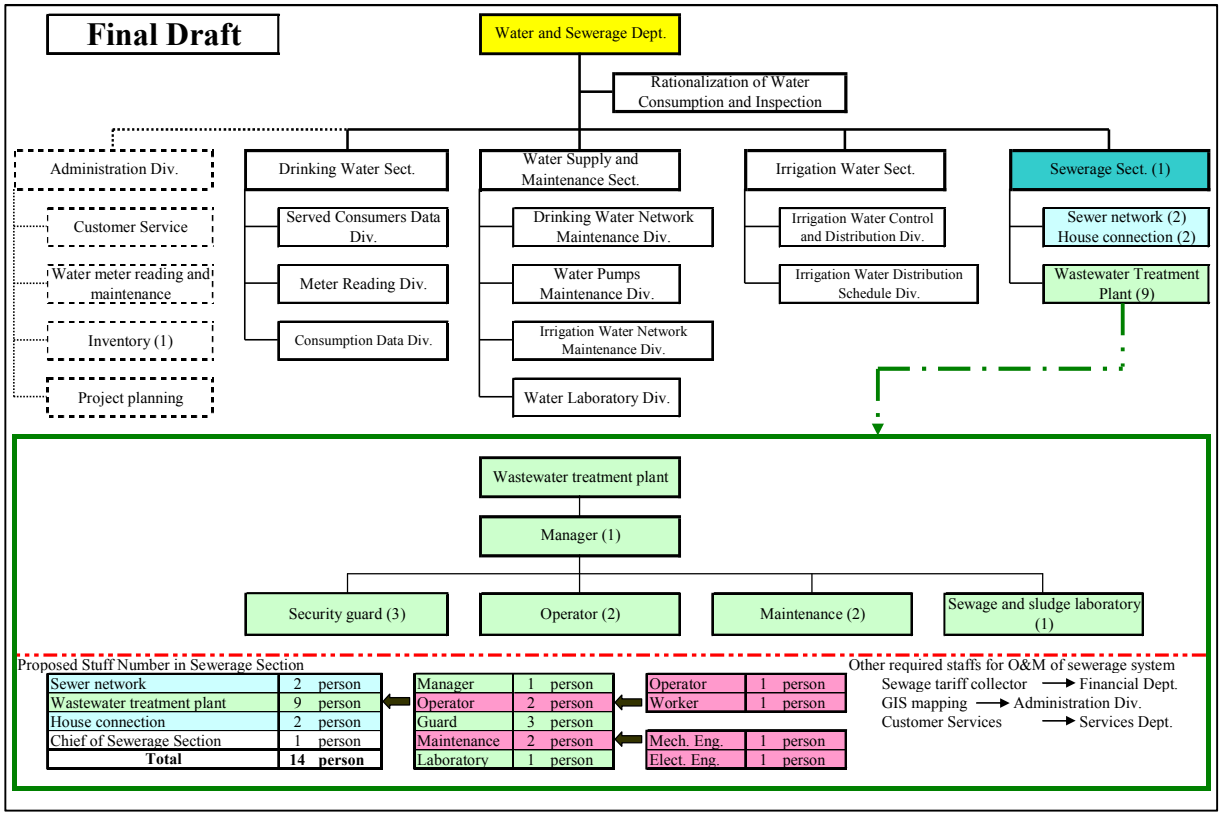


Figure 2.7.2 Structures of Department of Water and Sewerage (Final)

2.7.4 Staff Assignment of Sewerage Section

(1) Beginning of Establishment

Regarding the staff assignment within the sewerage section, Jericho Municipality basically decided the arrangement in **Table 2.7.2** and commenced the operation in accordance with the policy to dispose by transfer from other departments.

Table2.7.2 Necessary Personnel for Each Post (As of service commencement in May 2014)

Post		Number of Personnel	Person in Charge	Full-time/ Concurrent	Assign Date
Sewerage Section Chief		1	Mr. Ibrahim Abu Seiba	Full-time	
Sewer Network		2	Mr. Mohammed Fetyani	Concurrent	
			Mr. Mohammed Isayed	Concurrent	2015
House Connection		2	Mr. Mohammed Fetyani	Concurrent	2015
			Mr. Mohammed Isayed	Concurrent	
Wastewater Treatment Plant	Manager	1	Mr. Ibrahim Abu Seiba	Full-time	
	Operator	1	Mr. Nasser Issawi	Concurrent	
	Worker	1	-	Full-time	May, 2014
	Maintenance	Mechanical:1	Mr. Mohammed Awajneh	Full-time	
		Electrical 1	Mr. Maher Swaidy	Concurrent	
	Laboratory	1	Mr. Ata Shtawy	Concurrent	
	Security Guard	3	-	Full-time	May, 2014
Total		14			

A shortage of manpower may occur upon service commencement, mainly due to the many concurrent staffs and the high necessity for house connection. The worker and security guards are to be transferred from other departments, therefore basic training such as treatment facility names and locations as well as emergency countermeasures will be necessary. The JICA Expert Team has requested to Jericho Municipality for a prompt personnel arrangement for assigning full-time staff and undetermined posts. The newly assigned personnel were the operator and laboratory, who were requested to attend the weekly meeting to understand the Project outline, objective and other information and also to participate in training courses conducted by the JICA Experts.

After the personnel were settled, the Jericho Municipality Quality Section and Sewerage Section Manager took the initiative in making the job descriptions for the Sewerage Section. A draft as of December 2013 is shown in **Appendix A 2-7-3**.

(2) Staff Assignment as of August 2014

In the end of 2013, the positions of sewer network, house connection, operator, worker, maintenance and laboratory in the Sewerage Section were not appointed and/or occupied as full-time. As the result of discussions with C/Ps and the Mayor, the WWTP has started operation under the structure of full-time and concurrent staffs except operator, worker and maintenance for the following reasons;

- Financial predicament in Jericho Municipality
- Shortfall in human resources for special fields in Palestine
- High priority personnel arrangement of technical staff for the WWTP operation start

The Jericho Municipality has recruited two mechanical and electrical technicians by newspaper advertisements. As the result of accumulated discussions between the C/Ps and the Mayor, Jericho Municipal council recognized the importance of the WWTP O&M, and the new staffs were hired. As of August 1, 2014, personnel assignment in the Sewerage Section is shown in **Table 2.7.3**.

1) A new full-time staff was assigned in the laboratory since concurrent assignment was difficult
2) Since three workers & security guards were newly assigned, in addition to the JICA Experts another engineer was employed to instruct WWTP O&M to C/Ps for 2 months.
3) The security guards work in 3 shifts at the WWTP

The job descriptions in the Sewerage Section were approved by the Mayor before the WWTP started operation.

Table 2.7.3 Personnel Assignment for Each Post (As of August 1, 2014)

Post		Number of Personnel	Person in Charge	Full-time/ Concurrent	Assign Date
Sewerage Section Chief		1	Mr. Ibrahim Abu Seiba	Full-time	
Sewer Network		2	Mr. Mohammed Fetyani	Concurrent	
			Mr. Mohammed Isayed	Concurrent	2015
House Connection		2	Mr. Mohammed Fetyani	Concurrent	2015
			Mr. Mohammed Isayed	Concurrent	
Wastewater Treatment Plant	Manager	1	Mr. Ibrahim Abu Seiba	Full-time	
	Operator	1	Mr. Omran Khalaf	Full-time	
	Worker & Security Guard	3 (3 shifts)	Adan Ashoor	Full-time	
			Ibrahim Jalayta		
			Ibrahim Ghrouf		
	Maintenance	Mechanical: 2	Mr. Mohammed Awajneh	Full-time	
			A	Full-time	July, 2014
		Electrical: 2	Mr. Maher Al Swaidy	Concurrent	
			B	Full-time	July, 2014
	Laboratory	1	Mr. Kakeb Al-Arred	Full-time	
Total		15			

(3) Staff Assignment as of May 2015

The Jericho municipality's sewerage section at the department of water supply and sewerage was officially approved by the mayor, established and staffed in 2014. Initially, only minimum staff necessary to start the facility operations was placed (a total of 8 full-time/part-time staff) due to the lack of both financial and human resources. The number has been, however, growing since. **Table 2.7.4** shows the assignments as of May 20, 2015. Of total 15 staffs, 9 are full-time workers and 6 are part-time workers whom also hold other positions in the Municipality.

Table2.7.4 Number of Staff per Position (As of May 8, 2015)

Position		Number	Name	Work type	Assignment
Water supply/Sewerage department manager		1	Mr. Mohammed Fetyani	Full-time	
Sewerage section manager/ WWTP manager		1	Mr. Ibrahim Abu Seiba	Full-time	
Sewage pipe installation/ House connection		2	Mr. Mohammed Isayed	Part-time	
			Mr. Majdi Jalaytah	Part-time	
WTP operation	Operator	1	Mr. Omran Khalaf	Full-time	March 2015 (official)
	Inspection/O&M	Mechanical:1	Mr. Mohammed Awajneh	Part-time	
		Electrical:2	Mr. Maher Swaidy	Part-time	
			Technician	Full-time	2015 (planned)
	Worker/guard	4 (4 work shifts)	Mr. Adan Ashoor	Full-time	
			Mr. Ibrahim Jalayta	Full-time	
			Mr.Ramadan Jalaytah	Full-time	
			Mr. Mosa Barahmeh	Full-time	
	Water quality analysis	1	Mr. Ata Shtawy	Part-time	
		2	Trainees A	Part-time	
			Trainees B	Full-time	employment contract
Total		15	Breakdown: 9 full-time, 6 part-time		

The current issue of the organization is that the 2 staff members in charge of sewer pipe installation/house connection are part-time workers, and therefore the technology transfer is slow. There are no apparent problems with the current WWTP O&M, however an increase of operators, Inspection/O&M, Water quality analysis and workers shall be required in the future when the wastewater inflow increases and the sludge treatment officially starts.

(4) Staff Assignment as of November 2015

Table 2.7.5 shows the staff allocation as of November 2, 2015. This Table shows that there are 16 staffs in total, according to their positions, but several staffs hold multiple posts; therefore currently there are 12 full-time staffs, 4 persons working with other posts of the Municipality, and 1 contract worker (under training).

Table 2.7.5 Staff Number by Position (as of November 2, 2015)

Position	Number	Name	Work type	Assignment
Head of Water supply/Sewerage Department	1	Mr. Mohammed Fetyani	Full-time	
Sewerage section manager	1	Mr. Ibrahim Abu Seiba	Full-time	
Sewage pipe installation/ House connection	4	Mr. Ibrahim Abu Seiba	Full-time	Duplication
		Mr. Majdi Mohammad Al-Ghouj	Full-time	
		Mr. Thaer Dodeen	Concurrent	
		Mr. Mohammed	Concurrent	

			Mehsen Jalayta		
WWTP operation	Manager	1	Mr. Ibrahim Abu Seiba	Full-time	Duplication
	Operator	1	Mr. Omran Khalaf	Full-time	
	Inspection/O&M	Mechanical:1	Mr. Mohammed Awajneh	Concurrent	
		Electrical:1	Mr. Maher Swaidy	Full-time	
	Worker/guard	4 (4 work shifts)	Mr. Adan Ashoor	Full-time	
			Mr. Ibrahim Jalayta	Full-time	
			Mr.RamadanJalaytah	Full-time	
			Mr. MosaBarahmeh	Full-time	
	Water quality analysis	2	Mr. Ata Shtawi	Concurrent	
			Ms HananYaghi (under training)	Full-time	employment contract
Total (number of post)		16	Breakdown: 12 full-time (2 duplication), 4concurrent		
Sewerage Tariff/fee		1	Mr. Abdul Fatah Haddad	Full-time	

1) Mr. Ibrahim Abu Seiba works in Sewage pipe installation/House connection Division and WWTP Manager
2) "Concurrent" signifies that the staff has part-time work with another Section.

To manage these plans, it will be necessary to add a full-time operator and O&M/water quality test specialist. The Jericho Municipality is planning to hire 5 full-time staffs within the 2016 budget.

(5) Staff Assignment as of July 2016

The staff allocation as of July 10, 2016 is shown in **Table 2.7.6**. **Table 2.2.1** shows a total of 16 staffs, however, several staffs are assigned to more than two jobs. Currently there are 12 full-time staffs, and two staffs who also hold other posts in the city office.

Table 2.7.6 Number of Staffs and Positions (As of July 10, 2016)

Position		Number	Name	Work type	Assignment
Head of Water supply/Sewerage Department		1	Mr. Mohammed Fetyani	Full-time	
Sewerage section manager		1	Mr. Ibrahim Abu Seiba	Full-time	
Sewage pipe installation/ House connection		5	Mr. Ibrahim Abu Seiba	Full-time	Duplication
			Mr. Majdi Mohammad Al-Ghouj	Full-time	
			Mr. Ahmad Jalyta	Full-time	
			Mr. Esa Sliman	Full-time	
			Mr. Mosa Naif	Full-time	
WWTP operation	Manager	1	Mr. Ibrahim Abu Seiba	Full-time	Duplication
	Operator	1	Mr. Omran Khalaf	Full-time	
	Inspection/O&M	Mechanical:1	Mr. Mohammed Awajneh	Concurrent	
		Electrical:1	Mr. Maher Swaidy	Full-time	
	Worker/guard	4 (4 work shifts)	Mr. Adan Ashoor	Full-time	
			Mr. Ibrahim Jalayta	Full-time	
			Mr.RamadanJalaytah	Full-time	

			Mr. MosaBarahmeh	Full-time	
	Water quality analysis	1	Mr. Ata Shtawi	Concurrent	
Total (number of post)		16	Breakdown: 14 full-time (2 duplication), 2 concurrent		
Sewerage Tariff/fee		1	Mr. Abdul Fatah Haddad	Full-time	

1) Mr. Ibrahim Abu Seiba is assigned as Sewage pipe installation/House connection Division and WWTP Manager
2) "Concurrent" means that the person also holds posts in other sections

Since December 2015, the number of staffs for sewage pipe connection/House connection has been increased and all staffs are working full-time. There are no apparent problems regarding the current O&M of the sewage facilities. However, an increase of the inflow sewage amount and full-scale sludge treatment are planned in the future, so it shall be necessary to assign additional staffs for full-time operators, maintenance, management and water quality tests.

(6) Issued Letter of Employment Recommendation

Two Junior Engineers who have contracted for employment in the TeCSOM are expected to become a beneficial force for the Jericho Municipality in the future. A letter (refer to **Appendix A 2-7-4**) of recommendation for employment of staff from the JICA expert to the Mayor was issued. The recommended two persons are shown in **Table 2.7.7**.

Table 2.7.7 List of Recommended Persons

Name	Expected beneficiaries
Ms. Hanan Yaghi	It is expected to engage full-time in place of current concurrent staff (water quality analyzes and concurrent work are necessary).
Ms. Sondos E. Shaalan	It is expected to engage input and editing works of sewer network, house connection, water meter using GIS at the municipality's PC, and infrastructure management at GIS (land owner, taxation situation, electric power usage etc.) is expected.

(7) Staff Assignment as of December 2017

The staff assignment as of December 15, 2017 is shown in **Table 2.7.8**. **Table 2.7.8** shows a total of 17 staffs and there are 15 full-time staffs, and two staffs who also hold other posts in the municipality office.

Table 2.7.8 Staff Number by Position (as of December 15, 2017)

Position	Number	Name	Work type	Assignment
Head of Water supply/Sewerage Department	1	Mr. Mohammed Fetyani	Full-time	
Sewerage section manager/ WWTP manager and Sewer network	1	Mr. Ibrahim Abu Seiba	Full-time	
Sewage pipe installation / house connection	4	Mr. Majdi Mohammad Al-Ghouj	Full-time	
		Mr. Ahmad Jalayta	Full-time	
		Mr. Mosa Naif	Full-time	

			Mr. Isa Sharari	Full-time	
WWTP operation	Operator	1	Mr. Omran Khalaf	Full-time	
	Inspection/O&M	Mechanical:1	Mr. Mohammed Awajneh	Part-time	
		Electrical:1	Mr. Maher Swaidy	Full-time	
	Worker/guard	6 (4 work shifts)	Mr. Adnan Ashoor	Full-time	
			Mr. Ibrahim Jalayta	Full-time	
			Mr. Ramadan Jalaytah	Full-time	
			Mr. Mosa Barahmeh	Full-time	
			Mr. Ehab Nemer	Full-time	
			Mr. Ismail Barahmeh	Full-time	
	Water quality analysis	2	Mr. Ata Shtawi	Part-time	
			Mr. Moafasim Awajneh	Full-time	
Total		17	Breakdown: 15 full-time, 2 part-time		
Sewerage Tariff/fee		1	Mr. Abdul Fatah Haddad	Full-time	

2.8 Assistance in Preparation the Draft Sewerage By-Law

2.8.1 Development of Draft Sewerage By-Law

It is the first time for the municipality of Jericho to develop a sewerage by-law, and there are no experienced persons in the municipality to develop and/or amend it. The C/P with the JICA Expert Team, therefore, firstly visited the municipalities of Al-Bireh and Nabulus to collect the current by-laws for reference. Moreover the JICA Expert Team developed the first draft of the by-law after collecting the standard by-law and regulation from PWA.

The Arabic version of the draft was prepared in addition to the English one, because the final by-law should be written in Arabic.

1) The Sewerage By-Law for the municipality of _ _ _ for the year 2000 (PWA)
2) Rule of Connecting Houses and Premises to the Public Sewer Network of Providers of Services of Water and Wastewater (July 2010, PWA & MoLG)
3) The Sewerage System for the Al-Bireh municipality No.(1) for year 2000 (Al-Bireh municipality)

The draft was prepared considering in particular the following two points:

- Forced connection to public sewers (article #6)

  An independent article was provided for the connection enforcement, which was thought to be the key issue to improve the connection rate.
- Establishment of private sewers (article #5)

  The owners or occupants of any property areas were stipulated to be responsible for establishing private sewers, and the owners of property were to be allowed for any private sewers to cross the neighboring plots near them in case of impossible connection.

2.8.2 Discussion with the C/P

The draft by-law was revised two times after scrutinized investigations and comments by the C/P and the subsequent revision by the JICA Expert Team. Moreover, the steering members were appointed by the C/P comprising one engineer and four personnel from administration and financial sections, once the third draft was developed. The JICA Expert Team, then, developed the fourth based on their comments on the third draft. The remaining issues are as follows:

- The definition of the "property area", "Sewage/wastewater" and "public sewers";
- The connection from any property area to public sewer;
- The abolishment of cesspits;
- The exemption of wastewater tariff;
- The penalties for the nonpayment of wastewater tariff.

The fourth draft was finally approved by the steering members except the wastewater tariff scheme drafted by the JICA Expert Team. The latest version of the draft is shown in **Appendix A 2-8-1** as of June 2013.

2.8.3 Approval Process of the Proposed Sewerage By-Law

The JICA Expert Team has been working on the draft Sewerage By-Law with the cooperation of the C/P working group. The final draft was made upon the finalization of the sewerage fee and house connection fee system, and has gained basic agreement from the approval organization, PWA. A draft as of December 2013 is shown in **Appendix A 2-8-2**. The approval process of the proposal is to proceed as shown in **Figure 2.8.1**.

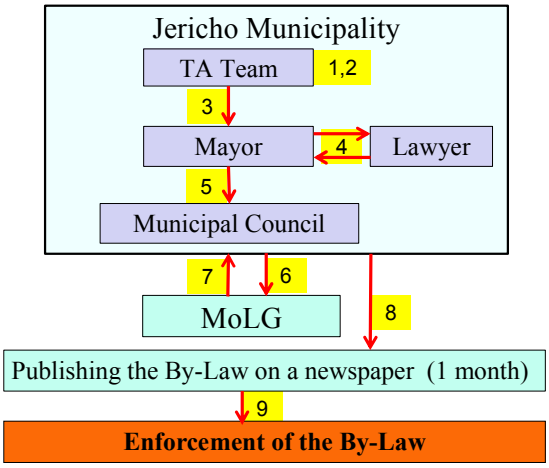


Figure 2.8.1 Approval Flowchart of the Sewerage By-Law

【Sewerage By-Law Approval Process】

1. Jericho TA Team and PWA approved the draft By-Law
2. Make an Arabic version (Translation by Jericho staff)

3. Submit/explain to the Mayor of Jericho Municipality
4. Consult with the legal advisor of Jericho Municipality
5. Submit/gain approval from the Jericho Municipal Council
6. Submit MoLG (Ministry of Local Government)
7. Gain approval from MoLG
8. Make an announcement of the By-Law in local newspapers (for one month)
9. Enforcement of the Sewerage By-Law

The finalized draft stated above was rejected by the Municipality Council in end of December 2013 for affordability of wastewater tariff and connection fee. Thus C/Ps, assisted by the Experts, launched the revision of proposed wastewater tariff and connection fee scheme as well as the financial plan, and a series of renegotiations with PWA which has the authority of approving tariff scheme.

As for the text of the by-law, the "Rule of Connecting Houses and Premises to the Public Sewerage Network of Providers of Services of Water and Wastewater" as mentioned in section **2.8.1,** #2, which was one of the references for preparing the former draft, was authorized as a law and was made public on the website of MoLG on January 28, 2014 (only the authentic version in Arabic). Since this rule is applied to all municipalities without exception, and no alteration of the text and word is allowed, the text of the former draft was completely replaced by this rule. This rule is written partly in more general terms than the former draft prepared by Jericho Municipality, but the scope is almost same.

The new draft of sewerage by-law thus was prepared, and combined with the revised wastewater tariff and connection fee, was submitted to the Municipality Council. It was approved on March 12, 2014, and gained further approval by PWA and MoLG.

2.8.4 Assistance in Revising Sewerage By-Law

The Sewerage By-law was approved by Jericho municipality assembly during the Phase 1 period. The following issues on usage charge, however, aroused after the start of the sewerage facility operation. To solve the issues, further discussions shall be held with Jericho mayor, the assembly, and the C/P to revise the tariff rate or connection fee, if necessary.

- Revision of Wastewater Tariff (the residents' opinions are that the rate is high, and the necessity of lowering the rate is to be discussed)
- Revision of connection charge (the residents' opinions are that the rate is high is stronger than that of the Wastewater Tariff, and the necessity of lowering the rate is to be discussed)

Since any revision of various charges could affect the Jericho municipality's sewerage management plan, careful debates are required.

Although the sewerage by-law should completely be in accordance with the law "the system of

connecting houses and buildings to the public sewerage network" which was made effective in December 2013, there is some room to suggest the necessary amendment to the relevant PA organization i.e. PWA and MoLG. For example, the exemption of wastewater tariff shall be applied only to the amount of depleting water for commercial and industrial purposes such as that entered in the process of production and never discharged to the sewerage system. But this should be extended to those quantities of water which are used for domestic purposes and not discharged into the sewerage system such as irrigation and air conditioning, because in Jericho the share of such amount of water is measured to be as high as 45% of total volume supplied for domestic purpose. Any points that need amendment shall be discussed with the C/Ps and be identified, before being recommended to PWA and MoLG. Subsequently, it was finalized in consultation with C / P and submitted for approval from PWA and MoLG, but it was not approved as of December 2017.

Particularly the intervention of the Municipality towards the compulsory connection and the penalty against the non-connection and non-payment should be strengthened, and the related clauses should be supplemented or amended.

Activities of the penal provisions are as follows, and the penal provisions are shown in **Appendix A 2-8-3**.

November 2016: Investigation work started by legal experts (local employment)

December 2016: After consultation with JICA experts and Jericho City draft

January - February 2017: Discussion of Penal Provisions Proposed with PA (PWA and MoLG)

March 2017: Legal expert consults with Jericho City to finalize the draft

These points were already discussed and agreed with the C/Ps at the participatory meeting of the Strategic Business Plan held on 13th July 2016.

2.9 Assistance in Preparation Sewerage Management Plan

2.9.1 Development Process

The sewerage management plan was developed as an integrated program including the financial plan and wastewater tariff scheme, according to the flowchart as shown in **Figure 2.9.1**. The meetings held during the development process are shown in **Table 2.9.1**.

As for collection of the existing plans at other municipalities, only the Municipality of Nablus has the equivalent among the 3 injured municipalities (i.e. the municipalities of Nablus, Jenin and Al-Bireh). The Municipality of Nablus's plan was analyzed and the result was reflected onto the plan of Jericho Municipality.

Regarding the Jericho Agro-Industrial Park (JAIP) and Aqbat Jaber Camp, the wastewater volume to be discharged to the Jericho Sewerage System is so large and will exercise a great influence upon the financial plan of the Jericho Sewerage System; a series of information exchanges and discussions with related parties was conducted from the early stages of development process.

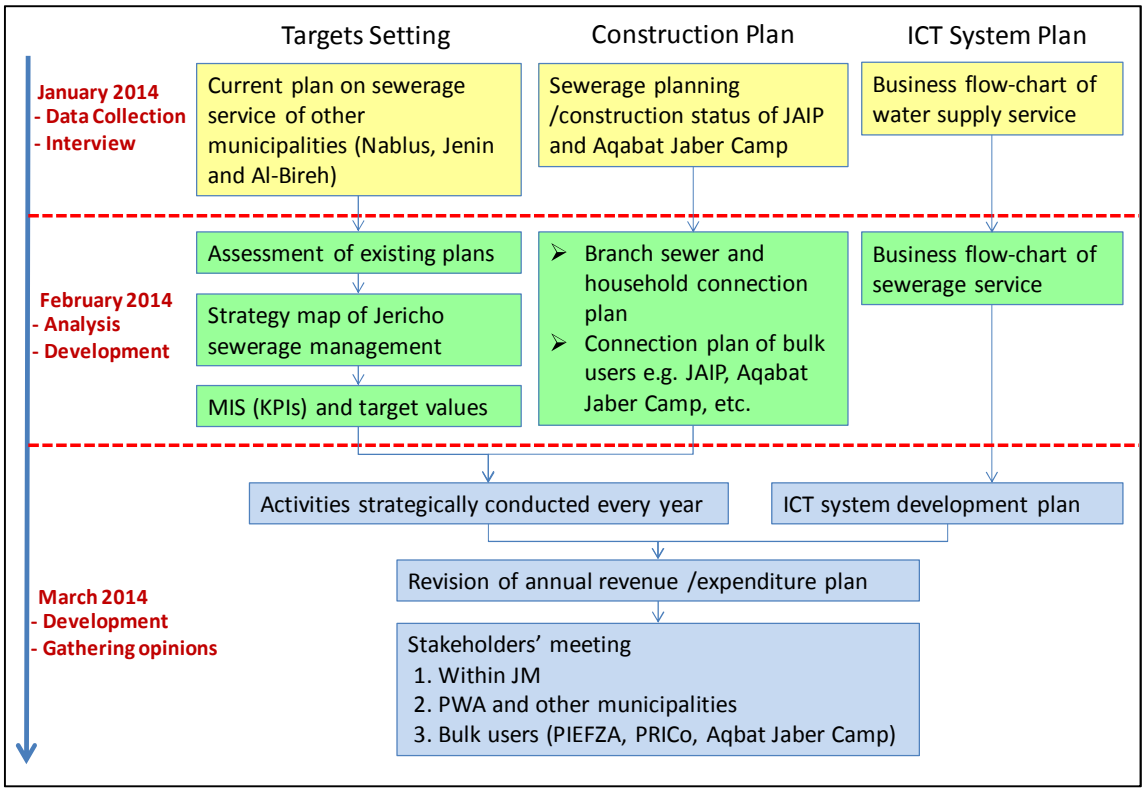


Figure 2.9.1 Flow Chart for Developing Sewerage Management Plan

Table 2.9.1 Meetings for Developing Sewerage Management Plan

Objective	Date	Participants other than JICA Experts	Agenda
Discussion within the Municipality	15 Jan 2014	C/Ps	Development process, allocation of roles among C/Ps and establishment of working team
	28 Jan 2014	C/Ps	Progress status of development work
	30 Jan 2014	PWA and C/Ps	Revision of financial plan, connection fee and sewerage tariff
	January to March 2014	C/Ps (Finance and Others)	
	9 Feb 2014	Mayor and C/P (Finance)	
	February to March 2014	Jericho Municipality (C/Ps, Chief of ICT Section and Staff in charge of GIS) and Developers of Existing ICT System)	Development/renovation program of ICT system in the Municipality related to sewerage service
	3 Mar 2014 20 Mar 2014 17 Mar 2014	C/Ps (Working Team)	Draft of sewerage management plan
	10 Mar 2014	PWA, Opposing members of Municipality Council and C/Ps	Revised draft of connection fee and wastewater tariff
	24 Mar 2014	C/Ps	Outline of sewerage management plan
	29 Mar 2014	Mayor of Jericho and C/Ps	Outline of sewerage management plan
Coordination with Stakeholders on the Connection of JAIP	21 Jan 2014	PIEFZA	Progress status of connecting JAIP to Jericho sewerage system
	27 Jan 2014	PIEFZA, PRICo and Jericho Municipality (Mayor, Deputy Mayor, C/Ps and others)	Wastewater tariff to be applied to JAIP and O&M entity of sewerage facilities within JAIP

Objective	Date	Participants other than JICA Experts	Agenda
	6 Feb 2014	UNDP and C/Ps	Plan of connecting JAIP to Jericho sewerage system
	15 Feb 2014	4 Factories around JAIP and C/P	Wastewater volume discharged from 4 factories around JAIP and request to connect to Jericho sewerage system
	5 Mar 2014	PIEFZA, PRICo, UNDP and C/P	Occupation of land along the periphery of JAIP to discharge wastewater from 4 factories around JAIP to Jericho Sewerage System
	March 2014	C/Ps	Draft MoU between PIEFZA and Jericho Municipality upon the sewerage system in JAIP
	31 Mar 2014	PIEFZA	
Coordination with Aqbat Jaber Camp on the Sewerage Plan	23 Jan 2014	PWA, Water Supply and Sanitation Division of Camp's Popular Committee (PCSAJC), CEP (engineering consultants in charge of planning and design) and C/Ps	Progress status of sewerage plan in the Camp, funded by Besancon City and Neuchatel City
	29 Jan 2014	CEP	Partnership between the Camp and Jericho Municipality on sewerage service
	25 Feb 2014	JICA Palestine Office and CEP	
	15 Mar 2014	PWA, PCSAJC, CEP, Residents in the Camp and C/Ps	Public meeting on the draft of sewerage plan in the Camp
Interview on the Business Process of Water Supply Service in Jericho Municipality	11 Feb 2014	Jericho Municipality (Responsible Persons of Billing and Customer Management for Water Supply Service and C/P)	Present workflow and challenges in the water supply service of Jericho Municipality
	12 Feb 2014	Jericho Municipality (Responsible Person of Engineering for Water Supply Service and C/P)	
	18 Feb 2014	Jericho Municipality (Responsible Person of Financial Department and C/P)	

2.9.2 Outline of the Plan

The sewerage management plan, named "Strategic Business Plan 2014-2018 for Managing Jericho Sewerage System" was developed as a rolling 5 year plan from 2014 to 2018. The outline of activities that should be strategically conducted during this period is shown in **Table 2.9.2**. The complete plan text is attached in **Appendix A 2-9-1**.

Table 2.9.2 Outline of Planned Activities for the Next 5 Years in the Jericho Sewerage Service

Direct means	Activities	Present status and challenges as of March 2014	Target to be achieved /Specific activities				
			2014	2015	2016	2017	2018
Increase the number of sewerage connections	Ensure the commitment from donors to fund the designing and construction of branch sewer	◆Phase1 PP has just started, to be completed end Jun 2014 ◆Phase 2 PP will start from Nov 2014 to Apr 2015 ◆Construction using Palestenian budget will start from Nov 2014 to Apr 2015, with design funded by USAID	600m^3/d at the end of year; 200 connection applications/year	2,000m^3/d at the end of year; 1,200 connection applications/year (1,400 connections accumulated)	4,000m^3/d at the end of year; 1,200 connection applications/year (2,600 connections accumulated)	6,000m^3/d at the end of year; 1,200 connection applications/year (3,800 connections accumulated)	8,000m^3/d at the end of year; 1,200 connection applications/year (5,000 connections accumulated)
	Prepare and implement public awareness campaigns for smooth connection and payment of connection fee without delay	◆Public meetings held 3 times, but with no explanation of connection fee and wastewater tariff	Public meetings; PR on various media	Public meetings; PR on various media	Public meetings; PR on various media	Public meetings; PR on various media	Public meetings; PR on various media
	Cooperate with the Popular Committee of Aqbat Jaber Camp to accelerate sewer construction and connection in the Camp	◆Design: funded by Besancon City in France and Neuchtel City in Switzerland; conducted by PWA and CEP; completion mid-May 2014 ◆Wastewater volume 1,150m^3/d in 2015; Sewer length 35km; Estimated construction cost 4,123.6 tUSD ◆Construction: fund commitment not yet offered ◆Early agreement with JM and the Committee needed on administrative, technical and financial issues	Basic agreement by May; Continuous information exchange and dialogue afterwards	Cooperation on PR activities for connection and tariff payment			
	Cooperate with PIEFZA and PRICO to accelerate sewer connection in JAIP	◆Two factories (Reehana and Palolea) will start operation in March or April; expected wastewater c.a. 63m^3/d ◆Expected wastewater from JAIP in 2014 amounts 638m^3/d ◆UNDP will construct 300m gravitiy sewer and 30m^3*3 reservoir tanks by mid or end Apr 2014; pumping station and pressure mains by Dec 2014 ◆Early agreement with JM and PIEFZA/PRICO needed on administrative, technical and financial issues ◆4 factories around JAIP discharge wastewater amouting 12m^3/d; gravity sewer connection is possible along the north-western periphery of JAIP	Agreement by May particularly on wastewater tariff				
Make many customers pay their bills without delay	Accurate and quick transfer and processing of cusotmers' complaints using extended "Workflow System"	◆Existing Workflow System has no function to deal with sewerage service; renovation needed ◆Existing Al-Ghassan System has no function to deal with connection fee	Implement minimum version-up of Workflow System for sewerage				
	Accurate and smooth transaction of new connection information using extended "Workflow System"		Develop sub-system for managing connection fee				
	Accurate and smooth transaction of meter reading information using new "Sewerage Tariff System"	◆Mobile billing system in operation, linked to existing billing system and printable hand-held units	Develop built-in system for managing sewerage fee		Develop built-in system for managing reused wastewater fee		
	Strengthen the activities towards non-payment of connection fees and sewerage tariff		Public meetings; PR on various media	Public meetings; PR on various media; Verify collection rate, develop countermeasures if necessary (including installement /reduction /exemption in By-Law)	Public meetings; PR on various media	Public meetings; PR on various media	Public meetings; PR on various media
Implement efficient and effective operations	Implement phased hike of wastewater tariff and connection fee in line with the price increase	◆Present wastewater tariff does not recover capital cost (depreciation) ◆Accrual accouting is essential for proper cost allocation; Al-Ghassan system must be renovated to deal with accrual accounting	Negotiate sales price with JDECo generated from solar panels; Renovate Al-Ghassan for accrual accounting, cost center, data export, linking to GIS, fixed assets inventory etc.		Verify and if necessary prepare revision draft of wastewater tariff and connection fee		Verify and prepare draft of revised wastewater tariff and connection fee
	Develop and implement reuse scheme of treated wastewater and sludge at reasonable price	◆Farm experiment in WWTP and treated wastewater quality will be tested before lauching supply to outside users	Farm experiment after June; Treated wastewater quality test; Information disclosure on treated wastewater and sewage sludge	Farm experiment; Treated wastewater quality test; Information disclosure on treated wastewater and sewage sludge	Develop reuse tariff; Start supplying; Reuse rate more than 75%	Reuse rate more than 75%; Conduct F/S for introducing advanced treatment	Reuse rate more than 75%; Introduce advanced treatment apparatus
	Preventive and periodic maintenance utilizing asset inventory database and record of repair work	◆No management function for fixed assets in current Al-Ghassan System ◆No function for dealing with technical reportings in current Workflow System; renovation needed ◆Lack of trained staff and expired license of ArcGIS	Develop program for GIS reactivation and system renovation by end Mar; Purchase hardware &software for GIS; GIS staff training as end-users; Develop preventive maintenance plan for WWTP and sewer network	Fill in data from as-built drawings of sewer network into GIS; Renovate Workflow System for daily technical reporting; Develop software for WWTP assets inventory management; Review and revise sewer inspection/cleaning program; Purchase necessary equipment e.g. high pressure cleaning vehicle	Develop support software for sewer network management using GIS	Make full use of support software for sewer network management and WWTP assets inventory management	Develop repair plan for another 5 years, after analyzing and evaluating historical repair data
	Systematic training is designed and implemented on O&M of facilities for the staff of Sewerage Section	◆Training being conducted with JICA TA team	Training on basics and OJT of O&M	OJT of O&M; Training for handling sewer maintenance appratus	14, full-time, regular and trained staff; Develop business continuity & emergency management plan	14, full-time, regular and trained staff	14, full-time, regular and trained staff; OJT of O&M for advanced treatment

2.9.3 Assistance in the First Revising Sewerage Management Plan

Since the sewerage management plan ("Strategic Business Plan 2014-2018 for Managing Jericho Sewerage System") was developed as an annual rolling plan, the JICA Experts assisted the C/Ps in revising the plan by means of: (a) monitoring the implementation status of the plan and (b) analyzing and verifying the reason and/or background of the gap between the plan and the implementation status. The revised plan (refer to **Appendix A 2-9-2**) was shared with the C/Ps in November 2015.

2.9.4 Assistance in the Second Revising Sewerage Management Plan

The JICA Experts assisted the C/Ps in revising the plan as the rolling for 2016 by means of (a) monitoring the implementation status of the plan; (b) analyzing and verifying the reason and/or background of the gap between the plan and the implementation status; and (c) extending the covered period up to 2020. The revised plan ("Strategic Business Plan 2014-2020 for Managing Jericho Sewerage System") was shared with the C/Ps in July 2016 (refer to **Appendix A 2-9-3**). The financial prospect is still not good even in 2020 as shown in **Figure 2.9.2**, when the operating deficit is expected to be around 470 tNIS (12.5 mJPY with 26.7 JPY/NIS) for the single fiscal year. The chief reason of this is the low rate of sewer connection tariff collection.

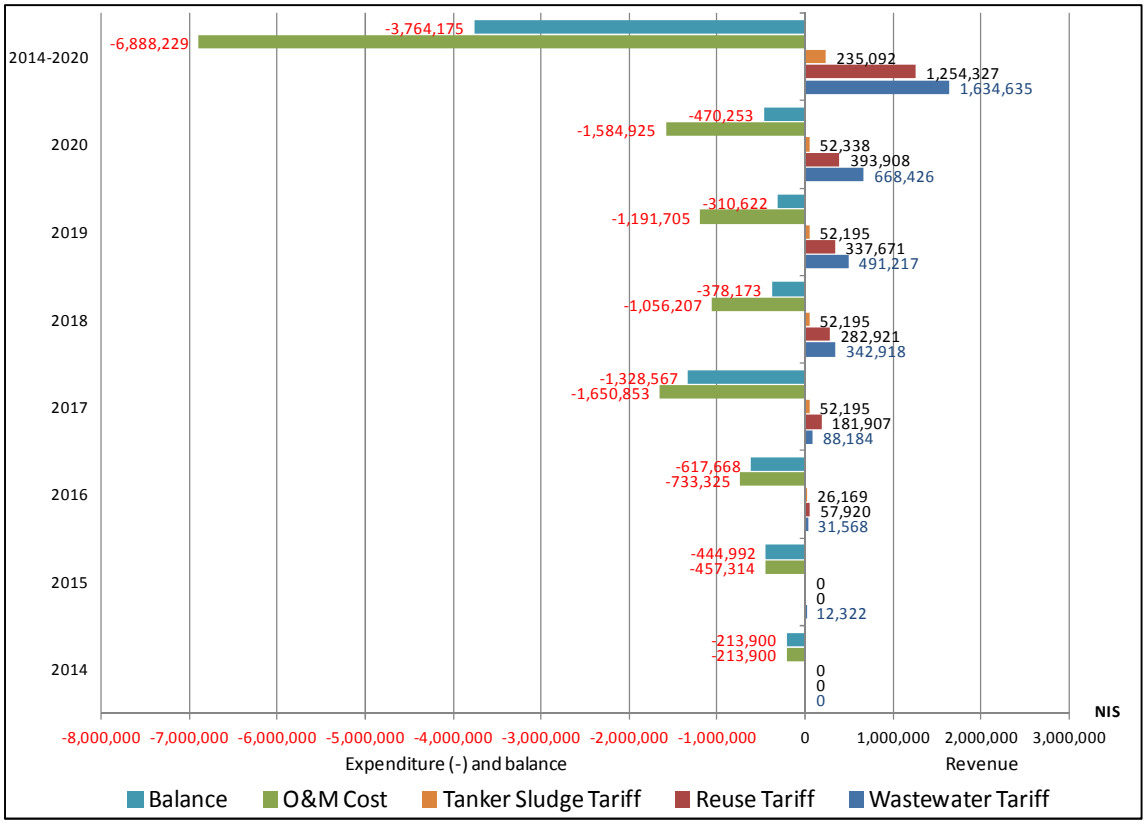


Figure 2.9.2 Cost Recovery Prospect from 2014 to 2020

A workshop (participatory meeting) on the Strategic Business Plan was held on 13th July 2016, aiming

to seek the effective countermeasures to solve the challenges that the Jericho Municipality is facing e.g. the low rate of sewer connection and wastewater tariff collection, by sharing and discussing the practice of Jericho Municipality and other institutions. The MoLG, PWA and the municipalities of Nabulus, Jenin and Al-Bireh together with the JICA Palestine Office and the Jericho Municipality were invited to join, but the attended participants from outside of the Jericho Municipality were limited to the MoLG and JICA Palestine Office (refer to **Figure 2.9.3**).


Figure 2.9.3 Snapshots of Participatory Meeting held on 13th July 2016

2.9.5 Assistance in the Third Revising Sewerage Management Plan

This upgrade includes the adoption of modified accrual accounting method in place of the current cash basis accounting, and after its introduction Jericho municipality should prepare the balance sheet, profit-loss statement, cash-flow statement and other necessary financial documents. As the regular annual rolling of the Strategic Business Plan 2014-2020 for Managing Jericho Sewerage System"), the JICA Experts assists the C/Ps in revising and updating the plan, mainly focusing on the preparation of financial statements stated above.

【OUTPUT-2】

2.10 Training and Workshop for Basic Knowledge of Wastewater Treatment Plant

2.10.1 Objective

From the results of individual capacity assessment of the C/P, the average of basic technical knowledge of sewerage was not good. It was necessary for the C/Ps to gain basic knowledge for wastewater treatment plant operation and maintenance before the service commencement, and also for the C/Ps to acquire basic knowledge for O&M and management.

A Japanese training course in November, 2013 was conducted to systematically acquire basic knowledge, but to supply the lack of time and lateness of the stage, beforehand trainings and workshops were planned for basic knowledge acquisition.

2.10.2 Mechanical and Electrical Training and Workshop (Activity until Dec. 2013)

(1) Current Situation and Training Plans for Mechanical/Electrical Equipment

The mechanical/electrical equipment installation to the wastewater treatment plant construction site (the grant aid project) had started in October 2013. The completion for mechanical installation was the end of January 2014, for electrical installation was the end of February 2014 and test operation was due to start at the end of April 2014.

The training was follow the schedule of the Project, and was to be carried out by an On-the-job (OJT) style using equipment (blower, collector, return sludge pump, etc.) and drawings, rather than a classroom lecture. Also, five mechanical/electrical personnel from the C/P engineering/managing staff were assigned to the Project (within four are assigned to the new Sewerage Section).

(2) Mechanical/Electrical Equipment Related Schedules

The mechanical/electrical training was carried out from October 10th to November 2nd, 2013. This period was determined considering the equipment installation status. Four people participated in this course; three people from the C/Ps (Mr. Ibrahim Abu Seiba: leader/mechanical engineer, Mr. Mohammed Awajneh: mechanical engineer and Mr. Maher Al Swaidy: electrical engineer) and one person from the Jericho Municipal office (Mr. Omran Khalaf: mechanical engineer/temporary employee). The Jericho Municipal office is planning to participate in the training courses as a means for human resources development, to train core mechanical/electrical engineers for wastewater treatment plant operation and maintenance. The daily activities are shown in **Appendix A 2-10-1**.

After this training, an O&M training using the O&M manual was carried out for one month staring at the end of November. In addition to the four participants, Mr. Nasser Issawi (electrical technician) joined newly. Mr. Ibrahim Abu Seiba held discussions with the other members using the Arabic language, and this helped to deepen the understandings and form a sense of solidarity.

The sense of responsibility among the members has also increased, as they were willing to take over the O&M after the hand-over in May 2014 independently.

The O&M manual (mechanical/electrical equipment) received from the construction contractor has been reviewed and revised for practical use. With the cooperation of the C/Ps, further improvement and application have been discussed.

Installation of mechanical/electrical equipment (generator, SCADA monitor, chlorine feeder, etc.) to the wastewater treatment plant construction site was scheduled in the near future. Therefore, the operation and maintenance details of actual equipment were to be acquired with the C/Ps at the wastewater treatment plant.

(3) Guidance of the Equipment Flow Diagram and Equipment Manufacture Approval Drawing

The flow diagram and confirmed approval drawings of equipment has been provided from the construction contractor. The JICA Expert Team provided guidance for each equipment, marking the drawings with colored pens to explain the wastewater flow, sludge flow, equipment functions, structure, etc. Explanation for each treatment process was given at the lectures, and the attendees from the C/Ps confirmed the information among themselves to gain mutual apprehension.

(4) Guidance of Wastewater Treatment Theory

The JICA Expert Team provided guidance on mechanical/electric equipment and treatment process using materials extracted from wastewater O&M reference documents. Lectures upon the necessity of grit chambers maintenance and O&M of mechanical/electric equipment were given. The new Sewerage Section Chief, Mr. Ibrahim Abu Seiba, has studied the basic theories at university, and helped the C/Ps by providing supplementary explanation in Arabic and holding lively discussions with the engineers. This enabled an improvement in the C/Ps technical and knowledge levels and also provided TOT effect.

At the beginning, the attendees from the C/Ps had insufficient knowledge of the oxidation ditch process (hereinafter referred as to “OD process”) adopted in Jericho Municipality. Therefore they were able to study the activated sludge process related to the OD process, and its relation with each facility.

(5) Practical Knowledge Acquisition by Discussion with Manufacture Engineers as the Site

The civil construction is mostly finished at the wastewater treatment plant site, but the construction for the pumps and blower are still in the final stages. The installation for outdoor equipment and control panels has started.

The major large-scaled equipment, namely, the two sludge collectors for the final sedimentation tank, the propeller mixer for the reactor and eight local panels were mostly installed at the beginning of November 2013, and currently the adjustment is in process. Upon a request from the Municipal Office and mechanical/electric personnel, the JICA Expert Team used this opportunity to gain knowledge of

the equipment structure and installation status at the site. The Team accompanied the C/P to the site several times to receive explanations of the equipment (blower, collector, return sludge pump, etc.) from the manufactures using approval drawings, and also gave specific guidance to the C/P using the drawings and actual equipment.

(6) Workshop for Mechanical/Electrical Facilities

A presentation of the mechanical/electrical facilities (**Appendix A 2-10-2**) was given in the beginning of November 2013. The training attendee C/P members stood as the lecturers and gave explanations using the drawings and theories gained in the training to the other staff in a style of technology transfer. The material used in said presentation is based on the Jericho wastewater treatment plant which is under construction and includes actual facility drawings and equipment images, therefore it will be useful for future presentation opportunities for explanation. Many questions aroused from Mr. Basel Hijazi (the TA Team Leader, Mr. Ghazi A. Al-Naji (Director of the Water and Sewerage Department) and other civil engineers, which in turn improved the C/Ps (lecturers) comprehension of problems through TOT. They are currently training under a strong awareness of the issues. The issues mentioned in (8) are occurring at the wastewater treatment plant in the neighboring Al-Bireh City, so it will be necessary for the Jericho wastewater treatment plant to consider said points in the O&M activities.

(7) Training Considering the Current Situation of Al-Bireh Wastewater Treatment Plant

The personnel of Jericho wastewater treatment plant had visited the neighboring Al-Bireh's treatment plant in the beginning stages of the Project. According to the interviews, the below points are considered as major issues.

- A breakdown of the sludge dewatering unit
- The gravity thickener is single-tank and there are no spare tanks, therefore it cannot be stopped for long periods for inspection or cleaning (this process normally requires three days)
- Scum generates due to the unsatisfactory function of the aeration in the tank
- A breakdown of the ultraviolet disinfection (from before)

The Jericho wastewater treatment plant O&M methods are to cope with the above issues by the following measures.

- No sludge dewatering unit is to be installed, due to the sufficiently large area
- Make a large drying bed
- Arranged two spare tanks for the gravity thickener
- Adopt a superior energy-saving aeration method for the reactor
- Adopt a simple disinfection system using industrial sodium hypochlorite made in Palestine. Chemical amount, feeding rate and feeding device O&M will be necessary.

(8) Advance Training for the Training Course in Japan in November 2013

Basic mechanical/electrical lectures were given before the training starts in Japan, for easy understanding at the Japanese facilities. As an example, basic knowledge of the personnel system in the wastewater treatment plants and sewer maintenance was provided to be able to discuss the matter at the training destination.

2.10.3 Mechanical and Electrical Training and Workshop (Activity until Aug. 2014)

(1) Policy and outline of the trainings

In this term, based on the knowledge and experience gained through the lecture trainings before, more practical and high-priority trainings have been selectively given to the counterparts in order to promote them to operate the WWTP independently after the handing over. Especially the trainings after completion of mechanical and electrical equipment installation have provided opportunities for the counterparts to repeat their daily work such as actual operation of each machine and patrolling the site with daily record and inspection format.

As for expert assignment in this term, JICA Experts (mechanical and electrical maintenance) have been to Jericho twice respectively and given technical trainings to the counterpart. The first training was conducted in the period from February 2014 to April 2014 before completion of the mechanical and electrical equipment installation. The second training was conducted in the period from May 2014 to July 2014 around completion and handing over of the plant. For the purpose of securing the consistency between the mechanical and electrical training contents, assignment of both mechanical and electrical experts was arranged to keep several periods overlapped.

(2) Major contents of the trainings

1) From February 2014 to April 2014

a. Reviewing mechanical flow sheet and intelligibility check of the counterpart

Location of equipment and its functions are restudied in a lecture on mechanical flow sheet to review all contents the counterparts had learnt by the end of last year. The Experts prepared an easy test to check intelligibility of each member of the counterparts and the counterparts filled out the test format by themselves such as process flow of waste water and sludge. The plant manager, understood the flow well and completed the test form smoothly. However, the other C/Ps like the mechanical technician, the electrical technician and the operator seemed to have some questions and misunderstandings so all the members including the Experts had discussion together after the test to share the questions and give a supplementary explanation. In the discussion, Mr. Ibrahim actively took a role as a trainer and gave some advice to the other members in Arabic.

b. Inspection of equipment installation

Site inspection of equipment installation was conducted for the related shop drawings and construction

guidelines to the counterparts. The purpose was to ensure that C/Ps understand check points of equipment fault and maintenance works. Particularly, they conducted the site inspection with the experts inside OD reactor, which would not be available to be inspected after start of the WWTP operation.

c. Understanding outlines of electrical facilities

Several lectures for electrical facilities were given to the counterparts to ensure they gain general knowledge of electrical equipment functions. It was the first training by the Experts for electrical maintenance.

It is commonly known that electrical facilities are difficult to be understood by beginners. In the lectures, the Expert used presentation material with plenty of actual pictures of the equipment and animation to make sure that C/Ps have general images of the equipment structure and respective functions. In addition, as opportunity of output, in charge of O&M of C/Ps (electrical technician) took a role of trainer at the end of the lectures and reviewed the lecture and gave another explanation to the other members of C/Ps on a platform.

2) From May 2014 to July 2014

a. Learning actual operation and maintenance method of actual equipment

Site trainings have been repeatedly conducted to give instruction about not only basic operation method of equipment such as a pump and blower but also daily maintenance work such as disposal of grit and screenings at the grit chamber. It aimed to give the C/Ps as many opportunities to actually operate the equipment as possible in complying with request from the C/Ps. The more opportunities to operate equipment the counterparts had, the more practical knowledge such as check points before and after the operation and site inspection they had through questions answered by the Experts at the site.

The C/Ps are now skilled enough to monitor and change some parameters of equipment automatic operation on SCADA (Supervisory Control and Data Acquisition) by themselves as a result of training given by the Experts and engineers from the construction constructor.

b. Learning maintenance operation method of seldom-used equipment

In the beginning stage of the WWTP operation with limited amount of influent water, there will be some equipment to be seldom used. Some of the equipment, especially the one to be submerged in water for a long period, can be deteriorated by water intrusion which could cause decrease of insulation resistance. In order to keep rated performance of the equipment, it is recommended to give a regularly maintenance. As for the equipment like mentioned above, site trainings have been given to the counterparts to instruct about not only the basic operation method but also the maintenance operation to be conducted regularly. Based on discussions with C/Ps, items of daily maintenance operation are listed on daily record format to prevent operators from omitting the site works.

c. Preparation of daily/weekly record and site inspection format

Formats of daily/weekly record, site inspection and other documents for operation and maintenance work have been already prepared as soft data which operators can print out, manage and arrange them on SCADA when they need.

The daily record includes items of daily maintenance work and maintenance operation in addition to general data such as water quality, flow amount and so on. It is considered for the operators to be able to complete their daily site work by filling only one sheet. As for a monthly report format, it has been still modified and finalized with C/Ps although a draft of the format was prepared in advance.

The site inspection sheet clearly shows check items for the mechanical technician and the electrical technician, respectively. As a result of discussions with C/Ps, frequency of the site inspection work by filling out the sheet was decided to by on a weekly basis in the beginning stage because of the limited amount of influent, insufficient personnel of C/Ps and its work continuity. However, it was also agreed that the technicians shall at least patrol the site daily and be in charge of maintenance of their facilities.

The manager, operator, mechanical technician and electrical technician of C/Ps repeated the patrol and site inspections with the Experts filling out the daily record and inspection sheet. Almost all their requests to make their regular works easier and the formats were improved properly. As a result, the C/Ps have been skilled enough to implement the daily patrol and site inspection with the formats by themselves. In the future, they will be required to gain more skills in revising and modifying the formats by themselves according to the actual operating condition of the plant.

(3) Evaluation for current operation and maintenance abilities of C/Ps

C/Ps have gained enough skills to do daily routine works such as basic operation of equipment, site inspection and report making. Furthermore, they simple know how to recover power failure, operation of the generator, assembly/disassembly of some easy instrument and troubleshooting works for the problem caused by foreign matters. For their next step, they are expected to revise the daily record and site inspection formats on their own when the influent amount increases, also to make them more comfortable to use in their practical scene.

However, skills of regular inspection and regular maintenance works to be conducted semiannually or annually need more time for them to get used to due to insufficient amount of repeated site training so far.

In addition, C/Ps have not improved enough to discuss, consider and try to find optimum operation method by themselves, for instance from treatment process and power saving points of views, although they are skilled enough to conduct routine works smoothly.

On the other hand, the skills of theoretical consideration are not possible to be practically acquired without any experience of operation and maintenance works at the site. In the next stage, in order to promote capacity development of the counterparts efficiently, it will be required to provide stepwise site training and necessary discussions with them in accordance with the actual transition of the WWTP

operation based on increase of influent amount.

(4) Training on water analysis

Regarding the training of water analysis in the laboratory at the WWTP, the hired water analysis experts (chemists from An-Najah National University) instructed water sampling and measurement methods to C/Ps using the water analytical instruments procured by the Grant Aid Project. Duration of the trainings was 2 months (total 7 days training). The C/Ps are expected to conduct sampling and measurement for wastewater since the C/Ps learned basic use on the instruments.

2.11 Capacity Building of Jericho WWTP Operation and Maintenance

2.11.1 Capacity Building of WWTP Operation and Maintenance (Activity until May 2015)

(1) Training Policy and the JICA Expert Team Assignment

Technical trainings for practical operation and maintenance of the treatment plant were conducted last July in order to make it easy for the C/P to take over and operate the system themselves. By the time of handing over of the treatment plant to the municipality, the JICA Expert Team provided as many opportunities as possible for the C/P to actually operate relevant equipment and to get used to their daily work such as site inspection and making O&M records. As a result, the C/P has been operating the treatment plant successfully since the handing over time. Especially for ordinal operation and daily maintenance of facilities, they have quite achieved a satisfactory level so far.

In Phase 2 of the Project, the trainings will more focus on the C/P capacity building in order to sustainably modify and develop skills on operating the treatment plant by themselves in addition to the enhancement of staff organization. In concrete terms, there are several trainings which have been implemented such as review of the operation method and site inspection contents along with increase of inflow, arrangement and purchase of required consumables and spare parts, internal technical trainings among the staff, and so on.

The JICA Expert Team has completed the technical trainings twice since the beginning of Phase 2, which were implemented in October-November in 2014 and February-March in 2015, and now are giving the 3rd training to the C/Ps. The JICA Expert Team assignments have been arranged from the point of view to provide technical trainings to the C/P as efficiently as possible.

(2) Strengthen O&M Capability

1) Operation status of WWTP

Jericho WWTP was started to operate by the staff of Jericho municipality from August 2014 and it has been operated well. Major operation indexes for seven (7) months from August 2014 to March 2015 are shown in **Table 2.11.1**.

Table 2.11.1 Monthly Fluctuation of Major Operation Indexes

Month	Inflow	Outflow	Airflow	Return Sludge	JDECO	Solar	To Grid	Consumption	MLSS	W. Temp.
	m3/d	m3/d	m3/d	m3/d	kWh/d	kWh/d	kWh/d	kWh/d	mg/L	°C
Aug.	298	232	1,199	2,791	509	558	262	805	1,637	31
Sep.	213	175	1,502	2,281	442	564	227	780	2,728	31
Oct.	172	164	1,707	1,700	414	500	205	709	2,945	28
Nov.	221	224	1,595	1,841	381	362	159	581	3,103	23
Dec.	178	208	1,501	1,883	340	356	169	526	3,147	21
Jan.	160	155	1,368	1,661	366	314	142	546	3,189	17
Feb.	209	214	1,335	1,655	464	428	169	723	3,333	17
Mar.	244	239	1,788	1,944	549	530	243	837	3,246	20

Figure 2.11.1 and **Figure 2.11.2** show the above tendency divided into common operation and power indexes.

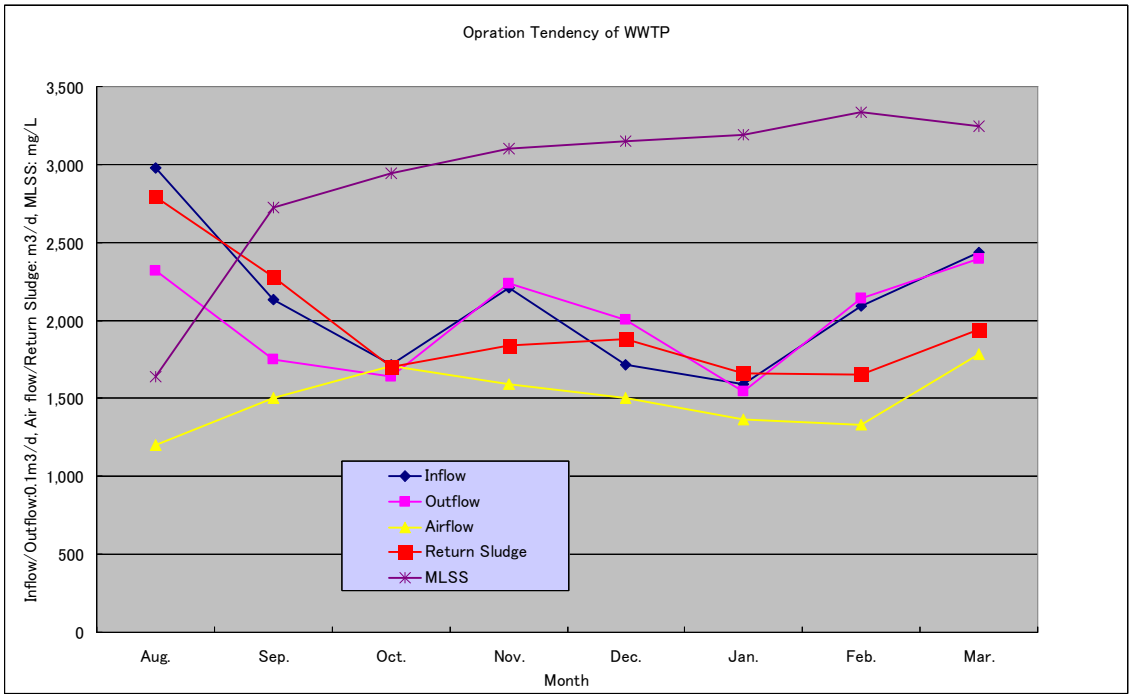


Figure 2.11.1 Monthly Fluctuation of Common Operation Indexes

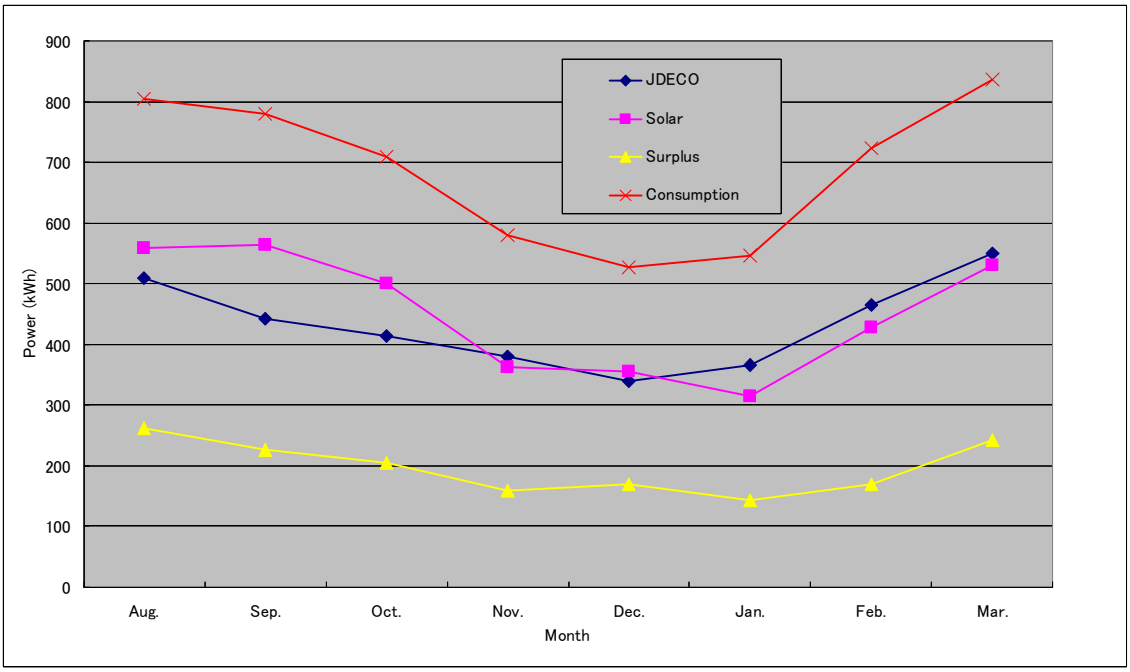


Figure 2.11.2 Monthly Fluctuation of Power Index

The operation status is summarized as follows:

- The value of inflow and outflow shall be almost same, but inflow values were much larger than outflow. The reason is considered being accumulated scum at the inflow measuring weir and the both flow rates indicated almost same value by October by an improvement of operation method.
- Inflow is coming from about 90 buildings connected by the 1st phase Pilot Project and tanker trucks with the average volume of 200m^3/day.
- The daily return sludge flow has been operated manually and the operation is in well-condition with 1,700m^3/day of volume on current inflow condition.
- The daily airflow is basically proportional to inflow Biochemical oxygen demand (BOD) loading because it is automatically controlled to keep a certain Dissolved Oxygen (DO) value range.
- MLSS is not kept to exceed 3,000mg/L largely carrying out sludge treatment once per a month. Around 1,000 m^3 of sludge with 3,000mg/L of density withdrawn from clarifier is treated for one sludge treatment, and the SS recovery rate at the sludge thickener is assumed to be 90%. In this case, treated average SS density by monthly inflow is calculated as below:
  - Dried sludge (DS) amount dried at drying bed: 1,000m^3 x 3kg/m^3 x 0.9 =2,700kg
  - Monthly inflow: 200m^3/d x 30 days/month =6,000m3/month
  - Average treated SS: 2,700kg/DS / 6,000mg/L= 450mg/L
- The peak power consumption in August is 800kWh/day and that in winter season is less than 600kWh/day. The difference is caused by use of air conditioner. The large increase of

consumption from February is caused by 150kWh of consumption increased number of mixers at the reactor from 2 to 4 units.

- Maximum power generation by solar panels has reached around 700kWh/day while the average monthly generation was 600kWh in the summer season. However, it has been considerably low during winter season from November to January due to the majority of cloudy days.
- Excessive power which is returned to the grit of Jerusalem District Electricity CO.LTD (JDECO) has been from 150 to 250kWh, relatively stable.

2) Confirmation of Current Operating Condition of the Treatment Plant

a. Grit Chamber

Both 2 trains of the facility are operated and maintained properly by the C/P. The C/P understands the function and importance of the facility to remove grits, screenings and scums in this process for the purpose of protecting the equipment at the following process. It has been confirmed that the facility is functioning well since each container for grits and screenings, the capacity 0.1m^3 is filled and disposed every week.

b. Reactor

According to the amount of inflow, only the No.1 reactor has been operated since the treatment plant started to be in service. The MLSS of the reactor is recorded more than 3,000mg/L and the condition of sedimentation at the clarifier appears to be satisfactory. It is considered that currently the reactor is functioning properly due to sufficient quality of effluent. The 4 mixers in the reactor are continuously operated for 24 hours. And, the blowers are efficiently operated in auto mode with low electrical consumption based on the value of dissolved oxygen and timer. Besides, the air pressure values of the membrane diffusers are within the range of satisfactory operation.

The reactor is the crucial facility for the sewage treatment process. As the result of the Expert inspection, it has been confirmed that the reactor is functioning well and operating properly by the C/P.

c. Clarifier and disinfection facilities

As same as the reactor; only No.1 clarifier has been operated since the beginning of the service. The facility still has enough capacity in regards to the current amount of inflow, so the quality of effluent is in a quite satisfactory condition. In fact, the analysis result of effluent shows less than 1 mg/L about SS. The effluent is being released to the Wadi after it is properly dosed with disinfectant. Treated wastewater is reused for irrigation and amenity use and excess treated wastewater is discharged to the Wadi.

d. Sludge treatment facility

Currently, the excess sludge is sent to the drying bed and dried once a month through the sludge thickening process. As the amount of inflow increases from now on, operation frequency of the facility will also increase.

e. SCADA

The C/P has already acquired the relevant skills of SCADA system to monitor the operating condition of the plant and arrange the setting values for automatic operation. However, there seems to be some minor incipient defects. The C/P tries to do trouble-shootings for those defects themselves by contacting the contractor when needed.

f. Maintenance operation of equipment not yet utilized in service

Performance of the equipment submerged in water might deteriorate such as degradation of insulating resistance in case that the equipment is not used much for a while due to the small amount of inflow. For the purpose of maintaining original performance of the equipment, it needs to be manually operated on a regular basis to prevent unused time period from lasting long. The equipment concerned in the plant is properly given the required maintenance operation on a daily and regular basis and the C/P makes reports for those actions in an appropriate manner.

g. Staff arrangement

In the current situation of the staff, the plant manager takes responsibility of summarizing comprehensive report of plant operation and management and gives instructions to all of the members belonging to the plant. The operator actually operates mechanical and electrical equipment at the site and utilizing SCADA system as an operator. In case of the regular maintenance and emergency, the mechanical engineer and the electrical engineer come to the plant and cope with the relevant issues.

Furthermore, 3 workers are working at the plant on a two-shift schedule, 12 hours a day for each. Those workers are taking a roll of not only daily work such as making daily O&M records and cleaning the site but also are as the security guards. Considering the situation that the task volume for the workers grows as the inflow increases, it is being requested to hire another worker to share their site works.

The plant manager and operator are actively taking trainer rolls to give technical training on the plant operation to the workers. It is expected that they would acquire technical skills enough to properly use analysis kit and complete daily O&M record format themselves.

h. General condition of operation and management of the plant

Based on the knowledge provided in the technical trainings by the JICA Expert Team, the facilities in the plant have been operated and maintained without any major troubles by the C/P so far. Also, the

quality of effluent appears fine. It can be considered as a sufficient level of achievement.
On the other hand, the JICA Expert Team provided some additional instructions and modifications on how to implement regular inspections and maintenance. The reason was some relevant formats that have not yet been used even though the JICA Expert Team provided the drafts before. How the C/P implement it and utilizes the format needs to be monitored for the following months. In addition, some minor defects such as small leakage from the pipes are dealt with by the local sub-contractor as needed. Those defects are planned to be modified by the time of 1 year defect, June 2015.

3) O&M records and inspection sheets

Daily and weekly O&M records, inspection sheets and other formats and documents for O&M activities are stored in the SCADA system as soft data which the operator can utilize and print them out as needed. The daily O&M record includes not only the basic fundamental information such as flow amount and water quality but also a check list of daily maintenance operations and activities which shall be completed by the operator and workers every day. The record has been utilized in a good manner and properly stored by both the hard copies and soft data. On the other hand, even though the weekly and monthly O&M formats had not been in use by the last February, it has been confirmed that the C/P will start to utilize them from the beginning of March according to the instructions from the JICA Expert Team. The facility inspection sheets for regularly checking electrical current, pressure and other conditions of equipment were also started to be in use from the beginning of March after the JICA Expert Team promoted again the C/P's awareness about importance of making the regular inspection records. Even though the regular inspection format does not have to be filled every day in the current situation basically both operator and engineers shall take responsibility for the conditions of the equipment and implement site inspection for it on a daily basis. The C/P members have been already skilled enough to implement the regular inspection themselves and now actually do it regularly. They are trying to modify their formats as needed according to the actual practices at the site through the discussion with the JICA Expert Team.

4) Rearrangement of lubricant list

The C/P re-arranged the lubricant list submitted by the contractor for the actual usage in the local condition in cooperation with the department of procurement in the municipality. The list is expected to add the information about lubricant supplier, prices, and the required days to be procured. Some types of lubricant need to be procured soon. For this reason, the C/P is planning to arrange those lubricants in order of the priority after researching the prices. For the further achievement, an annual plan for the procurement and budget securement will be prepared considering the operating time period of the equipment.

5) Actual troubleshooting of reactor mixer

In order to solve the problem with abnormal noise from the reactor mixer, troubleshooting has been implemented according to the troubleshooting flow explained in the manufacturer's manual. After lifting up the mixer from the reactor and washing it out, it was visually inspected for any mechanical defects such as damaged parts and oil leakage, and was given retightening of the shaft connection bolts. When it was retried to operate just after the troubleshooting mentioned above, the abnormal noise disappeared and the mixer seemed to operate properly. Therefore, it can be considered as the reason for the noise that the relevant bolts were loosen or some obstacles such as sludge or grit were stuck at the shaft or cable interrupting the rotation. The C/P took note of the details and countermeasures of this trouble on an accident report. If the similar trouble happens soon, it might be better to do the inspection inside the shaft by means of disassembling. The C/P is required to continue the daily inspection and preventive maintenance like this time to prevent any minor troubles from becoming major ones in advance.

6) Actual regular maintenance work of clarifier and generator

The clarifier has four points of oil injection. Although one of the points showed oil level less than the low level gauge, it was left as it was because the C/P did not know how to fill the oil to the point. At first, the JICA Expert Team provided instructions to the C/P to read and check the relevant drawings of the equipment and manufactures' manual to find a solution themselves instead of teaching how to fill it soon. Then, the C/P actually found the solution for that and completed the regular maintenance work themselves. Having more experience to solve the problem themselves like this time, it can be considered that C/P would be able to have more confidence and will gradually get used to considering troubleshooting themselves instead of just waiting for the additional advice or work from the JICA Expert Team or the manufacturers. Besides, it is also high time for engine oil of generator to be replaced and currently the C/P is making arrangement of purchasing it. As mentioned above, it can be observed that the C/P is steadily performing the tasks one by one. On the other hand, for the further achievement, it is required to take more initiative to solve the problem timely and properly themselves according to the manufactures' manual.

7) Troubleshooting of grit collector

There had been noise issue from the motor of grit collector since the handing over to the municipality which finally resulted in stopping by the detection of over load. In this case, even though normally it could be restarted after the thermos detector equipped inside the motor is recovered, the motor however could not restart. At first, the operator and engineer removed the motor from the load to check the operating behavior without the load but it did not restart. Then, they inspected the condition of relevant parts and devices such as terminals and cables at the motor side and measured current, voltage, and insulation resistance values at the electrical room. As a result of the inspection and troubleshooting,

the motor was properly restarted after 2 hours. As a conclusion, it was considered that the problem was caused by the over current by thermal relay inside the electrical panel which could not be recovered soon like the one inside the motor. As seen above, the C/P has been gaining skills to detect the causes and is expected to continuously implement preventive maintenance and troubleshooting at an early stage.

8) Efficient operation of solar generation system

There is a format prepared by the JICA Expert to show actual operation time and pattern on a day for all equipment. Using the format, the operator is trying to modify the operation schedule of all the equipment such as the blowers which consume the most electricity in the treatment plant in order to take advantage of the difference of unit price for electricity according to the time zone as much as possible. Last November, the contract about surplus to the grid was finally made between the Jericho municipality and JDECO. The electrical tariff for consumption and surplus according to the season and time zone was determined with it even though there are still some discussions needed to be done on how to deal with the surplus storage before the contract.

As for the overview of operation, the power consumption of JDECO supply and generation from the solar system has been nearly equal for the 7 months from August 2014 to March 2015. In summer season, monthly average of the daily power generation from the solar system reached approximately 600kWh/d while it became less than 400kWh/d in winter season from November to January due to increase in number of cloudy days and shortened hours of daylight. However, the total power consumption of the treatment plant also decreased last winter because air conditioners were not used as much as in the summer so it resulted that the surplus from the plant to the grit has been relatively stable through the term in the rage of 150-250kWh/d.

In fact, almost all facilities in the treatment plant are operated by the power generation from solar system in daytime. It has a large impact on cost saving of the plant operation and helps the finance of Municipality especially because of the high price of electricity in Jericho. Besides, it is expected the surplus power to the grid will be utilized as power storage which also leads to more cost saving. Therefore, it can be thought that the solar system will make more contribution particularly by the time the inflow amount increases up to a certain extent.

2.11.2 Capacity Building of WWTP Operation and Maintenance (Activity until Dec. 2015)

(1) Training Policy and the JICA Expert Team Assignment

Through the training provided in Phase 1 and Phase 2 of the project so far, the C/P has already acquired enough skills to do ordinal operation and daily maintenance of facilities by themselves. As a result, the treatment plant has been being successfully operated and maintained since the handing over time.

In Phase 2 of the Project, the trainings will more focus on the C/P capacity building in order to sustainably modify and develop the skills on operating the treatment plant on their own in addition to the enhancement of staff organization. In concrete terms, there are several trainings in practice such

as review of the operation method and site inspection contents along with increase of inflow, arrangement and purchase of required consumables and spare parts, internal technical trainings among the staff, and so on.

The JICA Expert Team has completed several technical trainings in October-November in 2014, February, May, August and October in 2015. The JICA Expert Team assignments have been arranged from the point of view to provide technical trainings to the C/P as efficiently as possible.

(2) Training Contents and Achievement

1) Operation status of WWTP

Jericho WWTP was started to operate by the staff of Jericho municipality from August 2014 and it has been operated well. Major operation indexes from August 2014 to August 2015 are shown in **Table 2.11.2**.

Table 2.11.2 Monthly Fluctuation of Major Operation Indexes

Year	Month	Inflow	Outflow	Airflow	Return Sludge	JDECO	Solar	To Grid	Consum -ption	MLSS	W. Temp.
		m3/d	m3/d	m3/d	m3/d	kWh/d	kWh/d	kWh/d	kWh/d	mg/L	°C
2014	Aug.	298	232	1,199	2,791	509	558	262	805	1,637	31
	Sep.	213	175	1,502	2,281	442	564	227	780	2,728	31
	Oct.	172	164	1,707	1,700	414	500	205	709	2,945	28
	Nov.	221	224	1,595	1,841	381	362	159	581	3,103	23
	Dec.	178	208	1,501	1,883	340	356	169	526	3,147	21
2015	Jan.	160	155	1,368	1,661	366	314	142	546	3,189	17
	Feb.	209	214	1,335	1,655	464	428	169	723	3,333	17
	Mar.	244	239	1,788	1,944	549	530	243	837	3,246	20
	Apr.	167	125	2,384	1,743	410	552	302	660	3,053	23
	May	168	133	2,684	1,704	408	587	292	728	2,852	26
	June	162	111	2,215	1,397	418	610	276	751	2,413	29
	July	153	126	2,216	1,472	432	593	301	724	2,065	30
	Aug.	194	148	2,269	1,609	489	545	233	798	2,083	32

Figure 2.11.3 and **Figure 2.11.4** show the above tendency divided into common operation and power indexes.

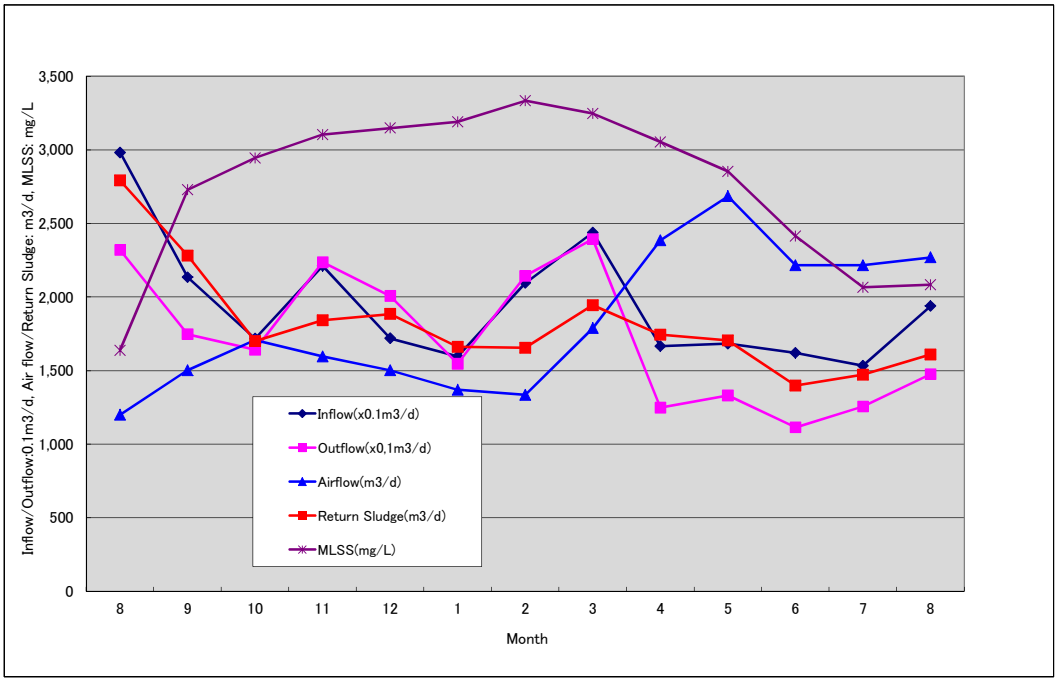


Figure 2.11.3 Monthly Fluctuation of Common Operation Indexes

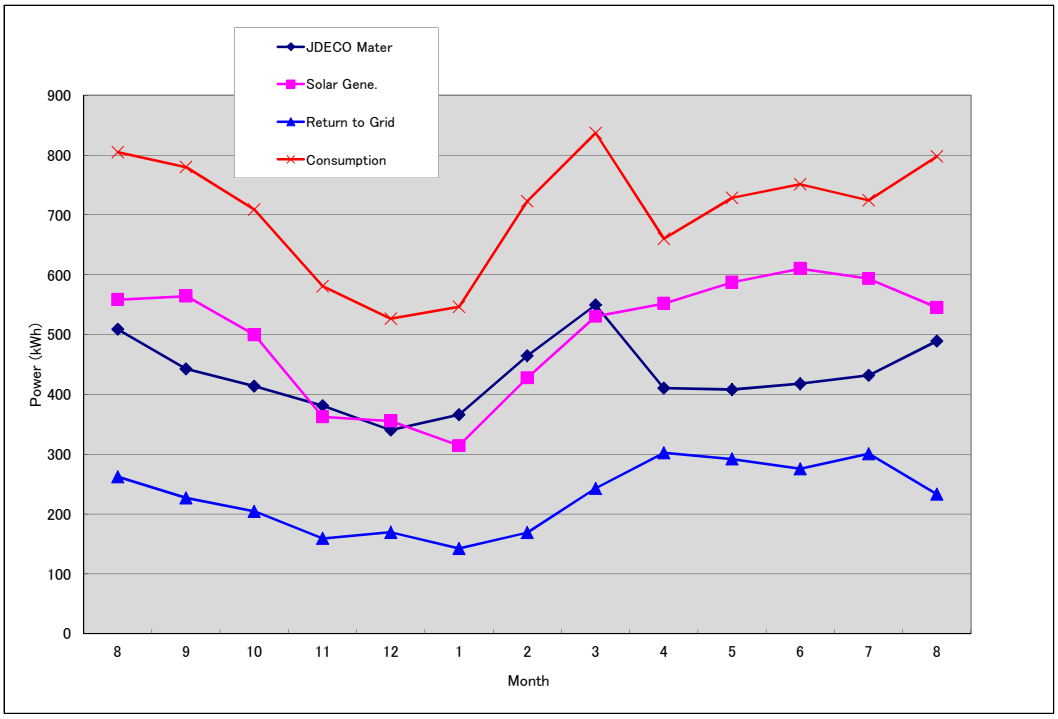


Figure 2.11.4 Monthly Fluctuation of Power Index

The operation status is summarized as follows:

- The inflow and outflow volume should be almost same but the data of some months was much different. Major reason is considered that too small overflow depth due to too small flow

causes inaccurate measurement results. To solve this problem, the width of weir will be temporally narrower.

- The volume of return sludge was simply controlled by operating return sludge pump manually for 3-7 hours and then the volume is not related to other operation factors.
- The airflow volume was basically in proportion to BOD and T-N loadings and the daily volumes were 1,200-2,700m^3. It means 35-79min/day (= {1,200-2,700m^3}/34m^3/min of blower airflow) of blower operation.
- The chlorine injection has been done 3-4 litter/day since December 2014 because it was revealed that the number of fecal coliform colony exceeded standard A.
  - ✧ The injection rate is as shown below:
    - Inflow 187m3/day, injection 3.3L/day, specific gravity of hypo-chloride is 1.2, effective chloride 12%
    - (3-4 L/day x 1.2kg/L x 0.12 Cl) /187 m3/d/1000 = 2.54 mg/L
- Sludge treatment was implemented to keep MLSS value more than 3,000mg/L from September 2014 to May 2015 and has been repeated once a month to keep it more than 2,000mg/L since June 2015.
- The power consumption in winter from November 2014 to January 2015 was less than 600kWh/day while in the other season it records in the 600-800kWh range. The difference is caused by use of air conditioner. The large increase of consumption in February and Mach in 2014 was caused by additional 150kWh consumption due to the number increase of operating mixers at the reactor from 2 to 4 units.
- Maximum power generation by solar system has reached around 700kWh/day while the average monthly generation was 600kWh in the summer season. However, it generates considerably low power during winter season due to the majority of cloudy days and weakness of solar radiation.
- Surplus power which is returned to the grit of JDECO has been stably generated in the 150 to 300kWh range. Especially from April to July in 2015, the solar system was operated in a high efficiency condition so actually it can be seen that solar generation power recorded the higher values than the power receiving from JDECO.

2) Current Operating Condition of Each Facility

a. Grit Chamber

Both 2 trains of the facility are operated and maintained properly by the C/P. The C/P understands the function and importance of the facility to remove grits, screenings and scums in this process for the purpose of protecting the equipment at the following process. It has been confirmed that the facility is functioning well since each container for grits and screenings, the capacity 0.1m^3 is filled and disposed every week. However, 2 grit collectors are out of order now. Even though the C/P tried to fix them

with the Experts based on the instruction from the manufacturer, they have not been recovered yet. Therefore, the Contractor are dealing with this issue as a defect and the replacement work would be completed in December, 2015.

b. Reactor

According to small amount of inflow, only No.1 reactor has been operated since the treatment plant started to be in service. The MLSS of the reactor is recorded more than 3,000mg/L and the condition of sedimentation at the clarifier appears to be satisfactory. It is considered that currently the reactor is functioning properly due to sufficient quality of effluent. The 2 mixers out of 4 in the reactor are continuously operated for 24 hours while the other 2 mixers are operated manually by the C/P at intervals. And, the blowers are efficiently operated in auto mode with low electrical consumption based on the value of dissolved oxygen and timer. Besides, the air pressure values of the membrane diffusers are within the range of satisfactory operation.

The reactor is the crucial facility for the sewage treatment process. As the result of the Expert inspection, it has been confirmed that the reactor is functioning well and operating properly by the C/P.

c. Clarifier and disinfection facilities

As same as the reactor; only No.1 clarifier has been operated since the beginning of the service. The facility still has enough capacity in regards to the current amount of inflow, so the quality of effluent is in a quite satisfactory condition. In fact, the analysis result of effluent shows less than 1 mg/L about SS. The effluent is being released to the Wadi after it is properly dosed with disinfectant. Treated wastewater is reused for irrigation and amenity use and excess treated wastewater is discharged to the Wadi.

d. Sludge treatment facility

Currently, the excess sludge is sent to the drying bed and dried once a month through the sludge thickening process. As the amount of inflow increases from now on, operation frequency of the facility will also increase.

e. SCADA

The C/P has already acquired the relevant skills of SCADA system to monitor the operating condition of the plant, arrange the setting values for automatic operation and making daily operation record. Although there used to be some minor defects in the beginning stage of the plant operation, all of the defects and initial failures have been solved by the C/P efforts and the Contractor's repair work through the defects liability period.

Currently, daily operation records are well-organized as data in SCADA so they can be easily browsed anytime. And under the instruction by the plant manager, security of SCADA is managed carefully by

means of user password system which gives a user authorization to only an operator and locking the SCADA room during the night shift while the operator is away.

f. Maintenance operation of equipment not yet utilized in service

Performance of the equipment submerged in water might deteriorate such as degradation of insulating resistance in case that the equipment is not used much for a while due to the small amount of inflow. For the purpose of maintaining original performance of the equipment, it needs to be manually operated on a regular basis to prevent unused time period from lasting long. The equipment concerned in the plant is properly given the required maintenance operation on a daily and regular basis and the C/P makes reports for those actions in an appropriate manner.

g. Staff arrangement

In the current situation of the staff, the plant manager takes responsibility of summarizing comprehensive report of the plant operation and management and gives instructions to all of the members belonging to the plant. The operator actually operates mechanical and electrical equipment at the site and utilizing SCADA system as an operator. In case of the regular maintenance and emergency, the mechanical and the electrical technicians come to the plant and cope with the relevant issues.

Furthermore, 4 workers are working at the plant on a three-shift schedule, 8 hours a day for each. Those workers are taking a roll of not only daily work such as making daily O&M records and cleaning the site but also are as the security guards. In the beginning stage of the plant operation, there used to be only 2 workers assigned on a two-shift schedule, 12 hours a day for each. Comparison to the previous situation, it is confirmed that working environment at the plant has been steadily improved.

Besides, the plant manager and operator are actively giving technical trainings on the plant operation to the workers. As a result, not only an engineer and operator but also workers have already acquired technical skills enough to properly use analysis kit and complete daily O&M record format themselves. A sample of the daily O&M record made by the worker is shown on **Appendix A 2-11-1**.

h. General condition of operation and management of the plant

Based on the knowledge provided in the technical trainings by the JICA Expert Team, the facilities in the plant have been operated and maintained properly by the C/P so far. Also, the quality of effluent appears fine. As a result of instruction by the Experts, now that O&M and inspection records are also organized in the proper way. On the other hand, there are still some defected to be modified by the Contractor and they are supposed to be completed by December, 2015.

The treatment plant has been already operated for more than a year since the service start so the operation data has been accumulated enough to be used as reference. Therefore, the C/P is now expected to get to be able to do consideration and modification work themselves based on the past records such as

operation schedule of the facilities according to the seasonal and hourly variation of demand and whether, anticipating right time to prepare spare parts and budget to be required and reflecting those on an annual maintenance plan in addition to the ordinal works which the C/P has been familiar with.

3) Implementation and review of O&M records and inspection sheets

The C/P has already achieved a decent satisfactory level of skills to operate the facilities and complete related daily works such as site inspections and issuing daily reports. In addition, they have been also gaining skills to conduct some troubleshooting by themselves such as generator operation in conditions of power failure or disassembling equipment to remove inside objects which are causing abnormal noises. In this stage, they are focusing on update and modification of report and inspection formats as needed according to the increase in sewage inflow.

As a result of site training, now that regular inspection and maintenance on a half-yearly or yearly basis can also be conducted in a better manner although there used to be some mistakes or lack of knowledge about the tasks such as insulation resistance test of electrical equipment and mechanical inspection for vibration, pressure and so on. The regular site inspection and record taking has been being implemented properly and regularly by C/P as shown in **Appendix A 2-11-2**.

Besides, the latest daily and weekly O&M records, inspection sheets and other formats and documents for O&M activities are stored in the SCADA system as soft data which the operator can utilize and print them out as needed. The records has been utilized and stored in a good manner by both the hard copies and soft data.

The site inspection utilizing the formats has been implemented regularly and continuously by the C/P since the handing over. They have been modifying the formats as needed according to the actual practices at the site through the discussion with the Expert.

4) Rearrangement of lubricant list

The C/P has modified the lubricant list submitted by the Contractor before for the actual usage in the local condition. Based on ISO number of the required lubricant, information about local lubricant supplier, prices, and the required days to be procured have been added on the list and it has become an updated practical version considering local supply chains.

Although replacement of lubricant of sludge collector and generator was an emergent issue, based on the updated list, the C/P has procured the lubricant for sludge collector in cooperation with the department of procurement in the municipality and replaced it themselves. In addition, the lubricant for generator is also being ordered. It can be seen as an important step of capacity building to secure sustainability on the plant operation that proper materials and equipment are procured through a local market and replaced by the C/P themselves

Currently, the C/P is preparing the annual maintenance plan. On the process of making the annual plan, by utilizing the past records, it is required to anticipate operation time of each load in order to consider

right time to procure the proper lubricants and prepare budgets for them.

5) Updating the annual maintenance plan

Even though there was a draft maintenance plan originally submitted by the Contractor showing the estimated budget to be required and its schedule, it tended to use imported materials from Japan and included the cost of maintenance works which can be implemented by the C/P themselves, such as replacement of lubricant, overhaul of motors and its supervision.

Therefore, the plant manager has been contacting with manufactures shown in the vender list in order to collect information and revised quotations. Then, the plan has been being modified and updated with consideration of taking advantage of local materials instead of imported materials, reviewing the required schedule for the replacement of the relevant parts or lubricant based on the assumption of actual operation time of each equipment. As a part of achievement, some spare parts for pumps such as bearing, V-belt and O-ring, which were originally planned to be imported from Japan, have been confirmed to be able to be substituted by products through local suppliers.

6) Actual troubleshooting of reactor mixer

In order to solve the problem with abnormal noise from the reactor mixer, troubleshooting has been implemented according to the troubleshooting flow explained in the manufacturer's manual. After lifting up the mixer from the reactor and washing it out, it was visually inspected for any mechanical defects such as damaged parts and oil leakage, and was given retightening of the shaft connection bolts. When it was retried to operate just after the troubleshooting mentioned above, the abnormal noise disappeared and the mixer seemed to operate properly. Therefore, it can be considered as the reason for the noise that the relevant bolts were loosen or some obstacles such as sludge or grit were stuck at the shaft or cable interrupting the rotation. The C/P took note of the details and countermeasures of this trouble on an accident report. If the similar trouble happens soon, it might be better to do the inspection inside the shaft by means of disassembling. The C/P is required to continue the daily inspection and preventive maintenance like this time to prevent any minor troubles from becoming major ones in advance.

7) Actual regular maintenance work of clarifier and generator

The clarifier has four points of oil injection. Although one of the points showed oil level less than the low level gauge, it was left as it was because the C/P did not know how to fill the oil to the point. At first, the JICA Expert Team provided instructions to the C/P to read and check the relevant drawings of the equipment and manufactures' manual to find a solution themselves instead of teaching how to fill it soon. Then, the C/P actually found the solution for that and completed the regular maintenance work themselves. Having more experience to solve the problem themselves like this time, it can be considered that C/P would be able to have more confidence and will gradually get used to considering

troubleshooting themselves instead of just waiting for the additional advice or work from the JICA Expert Team or the manufacturers. Besides, it is also high time for engine oil of generator to be replaced and currently the C/P is making arrangement of purchasing it. As mentioned above, it can be observed that the C/P is steadily performing the tasks one by one. On the other hand, for the further achievement, it is required to take more initiative to solve the problem timely and properly themselves according to the manufactures' manual.

8) Troubleshooting of grit collector

There had been noise issue from the motor of grit collector since the handing over to the municipality which finally resulted in stopping by the detection of over load. In this case, even though normally it could be restarted after the thermos detector equipped inside the motor is recovered, the motor however could not restart. At first, the operator and engineer removed the motor from the load to check the operating behavior without the load but it did not restart. Then, they inspected the condition of relevant parts and devices such as terminals and cables at the motor side and measured current, voltage, and insulation resistance values at the electrical room. As a result of the inspection and troubleshooting, the motor was properly restarted after 2 hours. As a conclusion, it was considered that the problem was caused by the over current by thermal relay inside the electrical panel which could not be recovered soon like the one inside the motor. As seen above, the C/P has been gaining skills to detect the causes and is expected to continuously implement preventive maintenance and troubleshooting at an early stage.

9) Efficient operation of solar generation system

How to operate the loads has been decided by C/P considering an actual operation time of each load and solar generation pattern on a day. In November 2015, the contract about surplus to the grid was made between the Jericho municipality and JDECO. The electrical tariff for consumption and surplus according to the season, date and time zone was determined.

As for benefit of surplus to customers, it is calculated based on the amount of surplus power multiplied by the selling tariff which is a little cheaper than the buying tariff and reduced from the electricity bill afterwards. C/P regularly considers and decides operation schedule of the loads by comparing economic benefit gained by selling surplus power with consuming solar power internally for the plant since the selling tariff is linked with the buying tariff along with seasons and time.

As a record of operation, the treatment plant consumed approximately 198,000 kWh for 9 month from January to September 2015 while about 76,000 kWh was generated by the solar facility. It means more or less 38% of purchasing electricity has been reduced by the solar generation system.

Because inflow of the plant has not increased largely yet, almost all electricity consumption of the plant in daytime can be managed by the solar generation. It remarkably contributes on electrical cost saving since the electrical tariff is considerably high in Jericho. Besides, it should be considered as well that surplus power to the grid, which could be gained stably in summer with crucially high tariff, can also

largely contribute on it. For a while till the inflow amount increases up to a certain level, it can be expected the solar system would continue the large contribution to reduction of plant operation cost.

2.11.3 Capacity Building of WWTP Operation and Maintenance (Activity until Sep. 2016)

(1) Training Policy and the JICA Expert Team Assignment

Through the training provided in Phase 1 and Phase 2 of the project so far, the C/P has already acquired enough skills to do ordinal operation and daily maintenance of facilities by themselves. As a result, the treatment plant has been successfully operating and being maintained since the handing over time.

In Phase 2 of the Project, the trainings has been more focusing on the C/P capacity building in order to sustainably modify and develop the skills on operating the treatment plant on their own in addition to the enhancement of staff organization. In concrete terms, there are several trainings in practice such as review of the operation method and site inspection contents along with increase of inflow, arrangement and purchase of required consumables and spare parts, troubleshooting to the defective equipment, internal technical trainings among the staff, and so on.

The JICA Expert Team has completed several technical trainings in October-November in 2014, February, May, August, and October in 2015 and July in 2016. The JICA Expert Team assignments have been arranged from the point of view to provide technical trainings to the C/P as successively efficiently as possible.

(2) Training Contents and Achievement

1) Operation status of WWTP

a. Number of connection to sewer

The number of connection at the end of May 2016 to the sewer network is shown in **Table 2.11.3**.

Table 2.11.3 Number of connected Buildings and Families

Category	Buildings	Families
1st PP Area	89	246
2ne PP Area	295	645
Other Area	76	233
Total	460	1,124

b. Operation method of WWTP

Energy saving is the most cared factor for the operation of WWTP, and then one reactor and one clarifier is only operated out of two of each because of the small amount of inflow compare to the design flow. In addition, since the aeration is carried out intermittently coping to the oxygen demand, the operation time of blower, of which power consumption is the largest, is operated minimum automatically as shown in **Figure 2.11.5**.

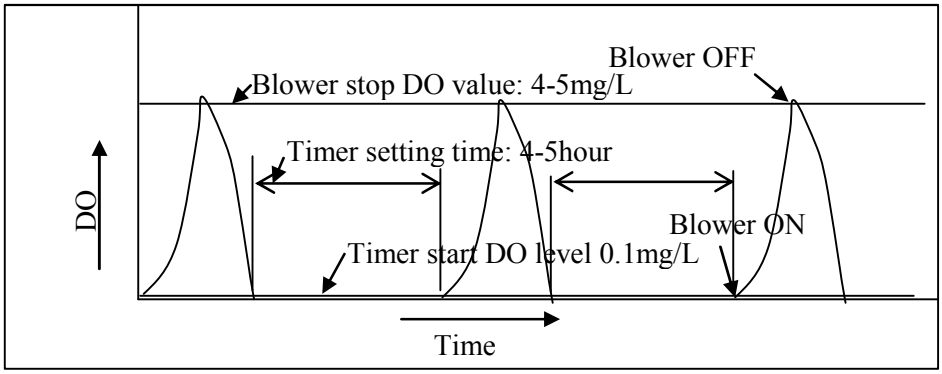


Figure 2.11.5 Operation Method of Blower

The return sludge pump operation time from clarifier to reactor has been limited for around two (2) hours as minimum requirement for treatment even though it is usually operated constantly.

c. Operation situation

General items and power factors of operation status are shown in **Figure 2.11.6** and **2.11.7**, respectively, after August 2014 when the operation started at constant condition. After January 2016, although the air consumption largely increased as the increasing of sewage inflow, it was observed that the power consumption was not so largely increased. The operation status is summarized as followings.

i) Sewage inflow is composed by sewer inflow and tanker wastewater and the both have largely increased from the beginning of 2016.

ii) As shown in **Table 2.11.4**, the ratio of winter and spring seasons of water supply/sewage discharge was 0.5 and 0.68, after completion of connection for the Pilot Project from beginning of 2016.

iii) The daily airflow amount has much increased as the increasing of inflow mount.

iv) SVI indicates settlement tendency of sludge in clarifier, of which the value less than 100 is good while over 100 is doubtful, and it became large from March 2016 but recovered by some procedures after May.

v) Power factors, such as meter record of electricity company (JEDCO), solar panel generation, return power to grid, power consumption are indicated in the figure. The consumption of summer is larger while that of winter is smaller, because the power consumption of air conditioner has been over 200kWh/d in summer.

vi) The beginning one year and the last one year of power consumption per inflow amount has been 3.57 and 2.04 kWh/m^3, much decreased, because the consumption of common facilities such as screen, lighting and air conditioner does not increase.

vii) The cost benefit of solar panel is large, of which annual cost benefit exceeds 100, 000 NIS on current power tariff system. The benefit is not only direct reduction of power consumption but also the refund amount to return excess power to grid. The power consumption with cost for data of the

beginning/last one year and future assumption are shown in **Table 2.11.5**.

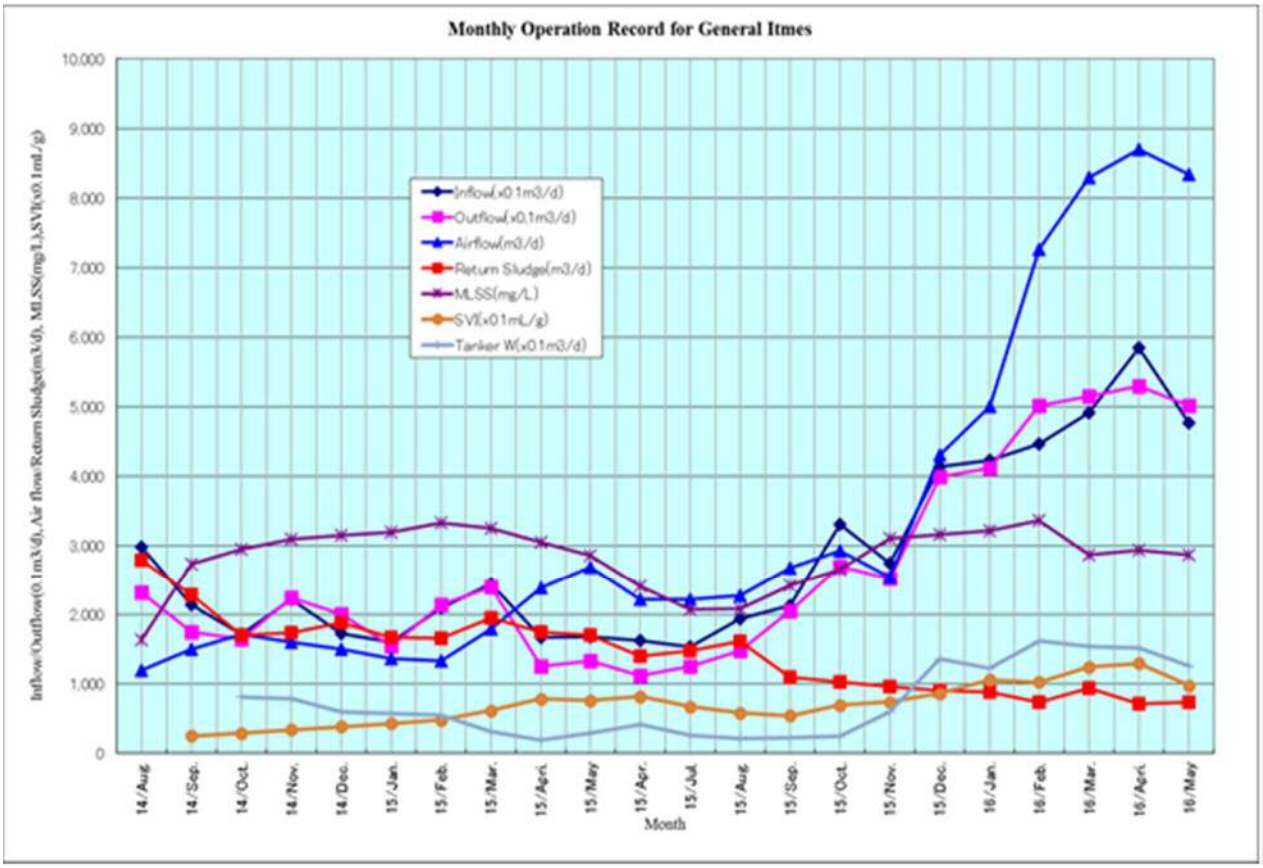


Figure 2.11.6 Operation Status of Monthly Average General Items

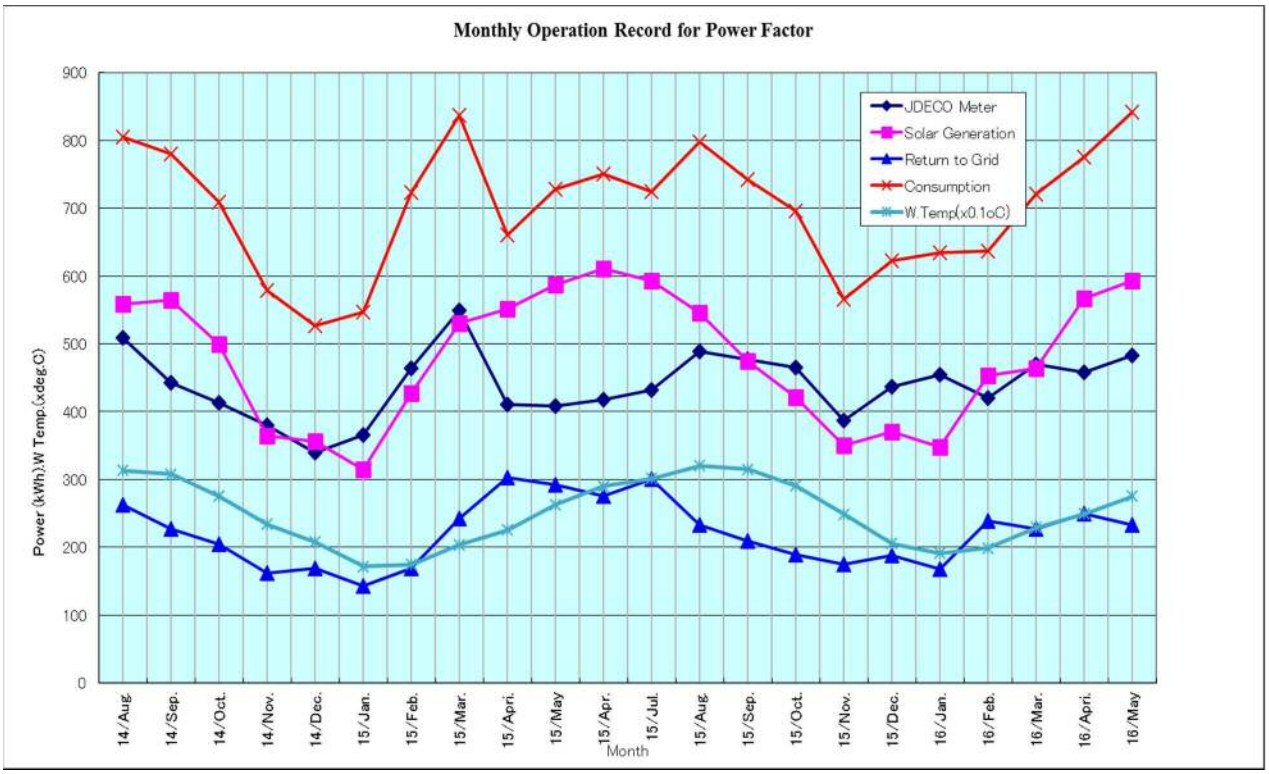


Figure 2.11.7 Operation Status of Monthly Average Power Factors

Table 2.11.4 Water Supply to be connected users and Inflow WW to WWTP

Item	Jan.-Feb. 2016	Mar.-Apr. 2016
All Water supply(m^3/d)	5,176	5,577
Water Supply to PP1 and PP2	582	567
Sewage to WWTP(m^3/d)	293	386
S/W	0.50	0.68
Meter number	389	389

Table 2.11.5 Expected Relation between Inflow and Power Consumption/Costs

Daily Flow (m^3/d)	187	467	1,000	1,500	2,000	2,500	3,000	3,500
Power Consumption(kWh/d)	669	740	983	1,225	1,468	1,710	1,953	2,196
Annual Electricity Cost(NIS)	46,515	54,730	78,000	117,000	162,000	206,000	251,000	296,000
Per Flow Consumption (kWh/m^3)	3.58	1.58	0.98	0.82	0.73	0.68	0.65	0.63
Per Flow Cost (NIS/m^3)	0.68	0.32	0.21	0.21	0.22	0.23	0.23	0.23

On the sludge treatment, excess sludge of 1,000m^3 is withdrawn from clarifier one or two times per month and transferred to the sludge thickener. It is discharged to a sludge drying bed after thickened 6-7 times in the thickener and taken out nearby drying beds after dry with water contents of 30-40%. The average solid generation ratio to inflow of 554g/inflow m^3 is much larger than Japanese average of around 150g/m^3 and it means the inflow concentration of BOD and SS is very large. The treated water is always good with high transparency.

d. Operation guidance based on the operation data

On the operation of WWTP, inflow wastewater is well treated and generated sludge is properly treated/disposed. In addition, since the power consumption controlled minimum by the limit of proper operation, there is no room to improve at current condition.

On March 2016, increasing of SVI with generated filamentous bacteria had taken place, and the inhibition of the bacteria is important target although it was not harmful at the condition of small inflow. For the countermeasure of this, it was solved to change the stoppage time span, shown in **Figure 2.11.5**, from 3 hours to 5 hours, which was shorten by the operation engineer. By the increase of anoxic time zone as a method of inhibition of filamentous bacteria, the bacteria was decreased and SVI was improved.

2) Current Operating Condition of Each Facility

a. Grit Chamber

Both 2 trains of the facility are operated and maintained properly by the C/P. The C/P understands the function and importance of the facility to remove grits, screenings and scums in this process for the purpose of protecting the equipment at the following process. It has been confirmed that the facility is functioning well since each container for grits and screenings, the capacity 0.1m^3 is filled and regularly disposed every second week to month using the wrecker truck owned by the municipality. The 2 grit

collectors which were out of order before have been operating since repair work was completed by the contractor in December, 2015. However, the C/P gives inquiry again to the contractor to solve the problems because one of the 2 grit collectors still makes abnormal noise sometimes.

b. Reactor

According to small amount of inflow, only No.1 reactor has been operated since the treatment plant started to be in service. The MLSS of the reactor is recorded within a range of 2,500mg/L to 3,500mg/L and the condition of sedimentation at the clarifier appears to be satisfactory. It is considered that currently the reactor is functioning properly because of sufficient quality of effluent. The 2 mixers out of 4 in the reactor are continuously operated for 24 hours while the other 2 mixers are operated manually by the C/P at intervals. And, the blowers are efficiently operated in auto mode with low electrical consumption based on the value of dissolved oxygen and timer. On the other hand, the pressure values of 2 diffusers out of the 10 seem to decrease and it indicates possibility of either physical damage to the diffusers or air leakage from the welding points of riser pipes. It is required to do trouble-shooting as soon as possible even though it still does not cause a big trouble in process by means of manual adjustment of pressure valve.

It can be considered that C/P himself can manage and solve this problem since C/P has already inquired to the contractor and obtained the working procedure about this issue. However, due to lack of experience of repair work of the equipment, the Expert makes recommendation for C/P to order the work only for the first time to the local contractor with actual experience of the same work at the site in the construction stage.

c. Clarifier and Disinfection Facilities

As same as the reactor; only No.1 clarifier has been operated since the beginning of the service. The facility still has enough capacity in regards to the current amount of inflow, so the quality of effluent is in a quite satisfactory condition. The effluent is being released to the Wadi after it is properly dosed with disinfectant. In addition, there are 3 reuse pumps installed at the irrigation tank by the farmers nearby and they willingly utilize the pumps on a daily basis for their irrigation. Therefore, amount of treated wastewater discharged to the Wadi is currently really limited.

d. Sludge Treatment Facility

Currently, the excess sludge is sent to the drying bed and dried once a month after the sludge thickening process. As the amount of inflow increases from now on, operation frequency of the facility will also increase.

e. SCADA

The C/P has already acquired the relevant skills of SCADA system to monitor the operating condition

of the plant, arrange the setting values for automatic operation and making daily operation record. Daily operation records has been well-organized as soft data in SCADA so they can be easily browsed anytime.

In addition, the C/P has installed CCTV system by himself for enhancement of the plant security. Currently, all the facility in the plant can be lively monitored from both the plant manager's room and SCADA room. The operator takes advantage of the system and does double check of wastewater tankers' record.

f. Maintenance operation of equipment not yet utilized in service

Performance of the equipment submerged in water might deteriorate such as degradation of insulating resistance in case that the equipment is not used much for a while due to the small amount of inflow. For the purpose of maintaining original performance of the equipment, it needs to be manually operated on a regular basis to prevent unused time period from lasting long. The equipment concerned in the plant is properly given the required maintenance operation on a daily and regular basis and the C/P makes reports for those actions in an appropriate manner.

g. Staff arrangement

Another worker was newly hired in February 2015. The plant is organized and operated well by total 9 members of the plant staff.

In the current situation, the plant manager takes responsibility of summarizing comprehensive report of the plant operation and management and gives instructions to all of the members belonging to the plant. The operator actually operates mechanical and electrical equipment at the site and utilizes SCADA system as an operator. In case of the regular maintenance and emergency, the mechanical and the electrical technicians come to the plant and cope with the relevant issues. Furthermore, 5 workers are working at the plant on a three-shift schedule, 8 hours a day for each. 2 workers are working together in the day time shift due to the large amount of tasks while 1 worker out of the 5 takes a day off. Those workers are taking a roll of not only daily work such as making daily O&M records and cleaning the site but also are as the security guards.

The operation records and daily maintenance have been well managed even in the period that some members of the plant staff had to leave the plant due to a visit to Mecca and attending JICA training program held in Japan. It means that the C/P has been establishing the staff management in a good manner to cover the tasks mutually even if there are some members absent.

Besides, the plant manager and operator are actively attending the daily inspections with the workers and giving on-the-job training to them. They are also managing the operation risks by means of giving limited permission to the beginner staff and prohibits them from operating the particular equipment.

h. General condition of operation and management of the plant

Based on the knowledge provided in the technical trainings by the JICA Expert Team, the facilities in the plant have been operated and maintained properly by the C/P so far. Also, the quality of effluent appears fine. As a result of instruction by the Experts, now that O&M and inspection records are also organized in the proper way.

Plant operation capacity of the C/P has been developed enough to consider and improve the operation schedule depending on daily and seasonal demand fluctuation by themselves. Furthermore, they are trying to apply a practical operation such as adjusting operation time of return sludge pump based on measured MLSS of return sludge instead of just following theoretical instruction on a general guideline.

The treatment plant has been already operated for more than two years since the service started so the operation data has been accumulated enough to be used as reference. Therefore, the C/P is now expected to be able to make a schedule for material procurement and maintenance by themselves from the long-termed point of view based on the past annual records.

3) Implementation and review of O&M records and inspection sheets

The C/P has already achieved a decent satisfactory level of skills to operate the facilities and complete related daily works such as site inspections and issuing daily reports. Those reports are managed by the plant manager and operator with respective responsibility. In addition, the C/P has been willingly conducting troubleshooting of equipment whenever needed, the regular inspection and maintenance on a half-yearly or yearly basis.

However, it was seen that the staff starts to be too familiar with their work. It seems to cause some excessive simplifications on their tasks such as completing the inspection format with only tick marks instead of actual measured values which were supposed to be filled in. The actual measured values are necessary to be recorded in order to evaluate the current condition and deterioration of equipment by comparing them with the previous ones. Therefore, the Expert has given the instruction again to the plant manager and staff in charge of the inspection about the original purpose and importance of recording the values.

4) Trial operation in the ultimate operation mode with two reactors and clarifiers

Due to the limited amount of inflow to the plant, single reactor and clarifier have been operated so far. The C/P will be required to shift the current single operation mode to the ultimate operation mode with the two reactors and clarifiers in case that the inflow increases by themselves. Therefore, trial operation of the ultimate mode has been conducted and necessary procedure for it has been confirmed under the instruction of the Expert.

First, how the blowers and valve actuators would be automatically operated after the operation shift was instructed to the C/P referring to the functional operation diagram. Then, on-the-job training has been conducted at the site in the orders as shown below.

A) Installation of a DO meter to No.2 reactor and do its test operation.
B) Open the manual valve at the header pipe for air supply.
C) Settings of local control panel and MCC of air blowers.
D) Change the operation setting on SCADA from initial mode to ultimate mode.
E) Value settings of DO and timers and trial operation.

During the trial operation, C/P actively tried to change the setting values for automatic control and confirmed how they actually worked. In addition, C/P tried to clear up doubts about possible problems in the actual operation by means of discussions with the Expert.
Sufficient understanding about the actual operation has been found through the discussion and contents of the C/P's questions. The C/P also showed their ability to smoothly complete necessary actions at the site without passive attitude during the training. Therefore, it can be evaluated the C/P has become skilled enough to shift the current single operation mode to the ultimate operation mode by themselves.

5) Update the annual maintenance plan and develop the budget plan

Even though there was a maintenance plan originally submitted by the Contractor showing the estimated budget to be required and its schedule, it tended to apply imported materials from Japan and included the cost of maintenance works which can be implemented by the C/P themselves, such as replacement of lubricant, overhaul of motors and its supervision. Therefore, the plant manager is giving some revisions to and developing the plan to make it more suitable for the actual local situation.
The draft maintenance plan for a short term has been already developed by the C/P and under trial implementation. The C/P has been contacting with local manufactures/suppliers to check availability of equivalent parts and actually started purchasing what they have found in the market nearby.
The necessary consumables for daily operation of the plant such as regents for water quality test and liquid sodium hypochlorite for disinfection have been already purchased a few times by the C/P considering the remained amount and required period of the procurement. The alternatives for almost all types of lubricant oil also have been selected from the local market and quotation for them is in the hand of C/P. As a part of remarked achievement so far, replacement of lubricant oil of the sludge collector in the clarifier was completed last year and engine oil of generator is in a process of procurement.
On the other hand, the budget plan to implement the maintenance works has not been developed yet. It might be caused by less necessity and priority the C/P felt because it does not directly affect the plant operation which has functioned well so far and there are still sufficient amount of spare parts originally provided by the contractor. However, in order to quantitatively assesse the operating condition of the plant and enhance its sustainability, the Expert gave the instruction to the C/P again about importance of development and implementation of the maintenance plan and budget plan for a longer term.

6) Achievement of troubleshooting conducted by the C/P

The achievement of actual troubleshooting conducted by the C/P is introduced below. It shows that the C/P is gaining capability of finding the cause of a problem and implementing necessary actions. It is expected to continue the regular inspection and immediate actions to solve the problem in the early stage so that major problem does not occur.

a. Overload of grit collector

No.1 grit collector, which had operated continuously for 24 hours, stopped due to overload. On this occasion, the C/P followed the troubleshooting procedure as shown below and solve the problem on their own.

A) Reset the alarm on the MCC in the electrical room and tried to restart it but the same overload arises immediately.
B) Checked insulation resistance and resistance of each wire but found no fault with them.
C) Checked operation of the motor apart from its screw and found that the motor itself can operate independently although it makes a little noise.
D) Discharged the wastewater from the grit chamber by a vacuum and checked the condition around the screw. Accumulative sludge which might cause the overload was found.
E) Removed the accumulative sludge and restarted the motor. Then, there was no more overload and it got back to a normal operation.

However, there is still some noise with it so the C/P is giving another inquiry to the manufacturer to make the situation better.

b. Defect of inflow meter

The accumulative value of inflow turned to zero on SCADA and it kept the same continuously. On this occasion, the C/P followed the troubleshooting procedure as shown below and solve the problem on their own.

A) Checked the trend graph of inflow on SCADA and found not only the accumulative value but also instantaneous value indicated zero.
B) Checked the display of transmitter at the site and found that both values were properly indicated on it.
C) Checked insulation resistance and resistance of cable for the inflow meter in the electrical room and found fault with the cable.
D) Removed the cable from the transmitter and replaced it with a new one. In that work, the C/P found an exact fault point on the cable caused by a mouse so replaced only the relevant fault part.
E) Confirmed both the accumulative value and instantaneous value indicated properly on SCADA.

Currently, the C/P is considering a countermeasure to prevent mice from coming and staying near the cable path.

7) Efficient operation for electricity bill reduction and meeting with JDECO

How to operate the loads has been decided by C/P considering an actual operation time of each load and solar generation pattern on a day in order to make the most of the solar system. As one of the achievement, the electricity bill from October to December 2015 resulted in zero thanks to the cost reduction given by JDECO based on the surplus energy to the grid stored in summer season. For a while till the inflow amount increases up to a certain level, it can be expected the solar system would continue the large contribution on reduction of plant operation cost.

However, there is a non-negligible difference between the actual cost reduction given by JDECO and estimated reduction cost based on the operation record and calculation formula mentioned in the contract between the municipality and JDECO. According to the calculation, the C/P is supposed to gain more benefit of the cost reduction than the actual one they have received so far.

Therefore, the Expert instructed the C/P to have a meeting with JDECO to clarify the cause of gap on the reduction cost with showing the past data.

2.11.4 Lectures for Basic Knowledge of WWTP and Evaluation of Technical Level of C/P

(1) Understanding the manufactures' manual

Based on discussions with C/P, the Expert chose some necessary parts of the manufacturer's manuals for operation and maintenance such as trouble shooting and gave instruction and training according to them. Considering the fact that the technician and workers are not familiar with English, some necessary parts of the manuals extracted by the Expert have been translated in Arabic.

(2) Discussion and implementation of appropriate plant operation in regard to the water quality and amount

Training for future operation according to increase of inflow was conducted. In the training, method of setting values of operation time and number of equipment was instructed based on capacity calculations. The Expert and C/P made technical discussions about right time to transfer to the operation method for two reactors and final clarifiers at the same time.

(3) Conduct a technical assessment test related to O&M of the treatment plant

A technical assessment test has been conducted in order to assess the technical level of C/P belonging to the treatment plant. The test consists of 2 parts, writing section and practical section. Passing score for the writing test was set as 60 while the pass-fail judgement for practical test was done by the Expert seeing whether each C/P is able to complete his roll respectively without any delay and mistakes. Out line and result of the test are shown below.

Technical Test（Writing）

1) Outline

A same test has been given to all 8 persons belonging to the plant, an engineer, two technicians, an operator and 4 workers for the purpose of enhancing average level of their technical knowledge. Questionnaires on the test are composed of a basic part asking outlines of facilities and daily work and a practical part which requires knowledge to improve operation.

2) Result

The engineer, the technician and the operator have passed the test while the other 5 members failed with slightly less scores than the passing score. The test result is shown in **Table 2.11.6** and **Table 2.11.7** below and answering sheets for the test by C/P are shown in **Appendix A 2-11-3**.

Even the failed members gained the score 40-50, which can be seen some achievement although some of them have disadvantage such as language skill or experience of academic study or short period of working in the treatment plant.

The engineer as a plant manager conducted supplemental lectures to the failed members. Then, the additional test was conducted again and all the members have passed the test eventually.

Table 2.11.6 Writing Test Result（Basic Knowledge）

Result of basic test for WWTP O&M team									
Name		Mr.Ibrahim	Mr.Omran	Mr.Mohammed	Mr.Maher	Mr.Ibrahim A	Mr.Ramadan	Mr.Adnan	Mr.Mousa
		Engineer (C)	Operator (M)	Leader of M Technician	Leader of E Technician	Worker	Worker	Worker	Worker
QB-1	5	5	5	5	5	2	0	2	1
	5	5	3	0	0	0	2	0	0
QB-2	5	5	5	3	3	3	2	3	1
QB-3	5	5	5	3	3	2	2	2	2
QB-4	5	5	5	2	5	2	2	2	2
	5	5	5	0	5	0	2	2	0
	5	4	4	2	4	4	4	4	0
QB-5	3	3	3	0	1	1	1	1	1
	3	3	3	0	0	1	1	1	1
	3	3	3	0	0	0	0	0	0
	3	3	0	1	0	0	0	0	0
	3	0	0	1	0	0	0	0	0
QB-6	5	5	5	5	5	5	5	5	5
	5	3	3	3	3	3	3	3	3
QB-7	5	5	3	3	5	3	5	3	5
	5	5	5	0	0	0	5	0	5
QB-8	5	5	5	5	5	5	5	5	5
	5	3	3	3	0	3	3	3	0
	5	5	5	0	5	5	5	0	5
QB-9	5	5	5	3	5	5	5	3	5
	5	5	5	5	5	5	5	5	5
	5	5	5	5	5	5	0	0	0
Amount	**100**	**92**	**85**	**49**	**64**	**54**	**57**	**44**	**46**
		Pass	Pass		Pass				
Note) C: Civil, M: Mechanical, E: Electrical.									

Table 2.11.7 Writing Test Result（Practical Knowledge）

Result of practical test for WWTP O&M team									
Name		Mr.Ibrahim	Mr.Omran	Mr.Mohammed	Mr.Maher	Mr.Ibrahim A	Mr.Ramadan	Mr.Adnan	Mr.Mousa
		Engineer (C)	Operator (M)	Leader of M Technician	Leader of E Technician	Worker	Worker	Worker	Worker
QP-1	10	10	10	5	10	0	0	0	0
	10	10	10	10	10	10	10	10	10
	10	10	10	10	10	10	10	10	10
	10	10	10	0	10	0	0	0	0
QP-2	10	10	10	10	10	10	10	10	10
	10	0	0	0	0	0	0	0	0
	10	0	0	0	0	0	0	0	0
QP-3	10	5	5	3	3	3	3	3	3
QP-4	5	3	5	3	3	3	3	3	3
	5	0	0	0	0	0	0	0	0
QP-5	5	5	5	3	5	3	5	5	5
	5	3	0	0	0	0	0	0	0
Amount	**100**	**66**	**65**	**44**	**61**	**39**	**41**	**41**	**41**
		Pass	Pass		Pass				
Note) C: Civil, M: Mechanical, E: Electrical.									

Technical Test（Practical Work）

1) Outline

Daily operation tasks of the treatment plant are implemented by the engineer, technicians, operator and workers respectively according to work divisions of responsibility. In the practical test, the Expert graded them by evaluating whether each member can complete their own work smoothly and properly. The main tasks for each member are introduced as sample below.

Engineer：

Proper operation and maintenance of the treatment plant, efficient operation of solar generation system, procurement and budget arrangement of lubricants, making monthly reports, updating the annual maintenance plan, inquiry to manufacturers, preparation of necessary documents to be required.

Operator：

Proper operation and maintenance of the treatment plant, efficient operation of solar generation system, management of power consumption, operating and maintenance instruction to the workers, monitoring and daily report management by SCADA system, preparation of necessary documents to be required.

Technician：

Implementation of regular maintenance of mechanical/electrical equipment, making and management of regular inspection sheets, understanding purpose and structure of each equipment, actual maintenance and repair work in case of trouble with the equipment.

Worker：

Daily site inspection, making daily records, cleaning and management of grit chamber and sludge drying beds, reporting the site conditions to the engineer and operator.

2) Result

It has been confirmed that all the 8 members are able to implement their respective and responsible works smoothly and actively so the Expert has given all the members the passing grade in the practical test. As a next step, the members are now required not only to improve own responsible work but also to actively enhance their technical skills and knowledge as a team in order to get able to operate the plant efficiently and safely even by anybody of the members, for instance, in case that some members in charge are absent for a while.

2.12 Preparation of O&M Manuals for Jericho Wastewater Treatment Plant

2.12.1 Basic Policy for Manual Preparation

The O&M manual provided by the construction contractor was to be revised for practical use through OJT and training courses. The Project training purpose was to make sure C/Ps sufficiently understand the manual.

The activities agreed upon with C/Ps are shown in **Figure 2.12.1**. The aim was to understand the manual in December 2013, and to revise it to meet C/P's needs before the plant commencement. Additional improvements will continue after the operation starts, considering the experience gained through actual O&M to complete a practical manual for daily use. Upon the preparation of the manual, the following points will require consideration.

- Follow the sequential order of the wastewater treatment process and sludge treatment process
- Specify the important points for inspection and O&M
- Lay emphasis on site operation; the current manual focuses on each individual facility
- The final purpose is to create a manual centered upon wastewater treatment process (aeration control), linked to individual facility operation
- Prepare an Emergency Management manual (countermeasures for malfunctions of the facilities, power failures, etc.)

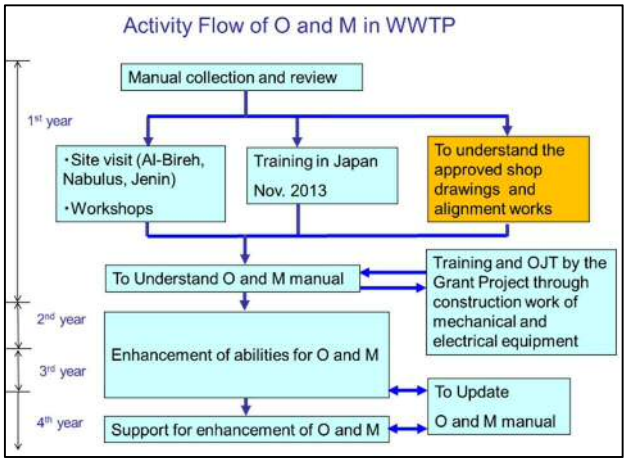


Figure 2.12.1 Activities for Manual Preparation

2.12.2 Preparation of Operation and Maintenance Manual

The Jericho WWTP operation and maintenance manual, which had been submitted by the construction contractor, has been continuously modified so as to make it more practical for the counterparts through the trainings so far. However, the manual does not explain some fundamentals in detail such as maintenance method of equipment, and basic knowledge of electrical facilities. To make up for those items, additional materials have also been also provided as required in the trainings such as respective manufacturers' manuals and supplemental presentation materials.

For the purpose of not only helping the operation and maintenance work of the counterparts but also as contribution to educational training of new employees by themselves, the related manuals and materials utilized so far have been reorganized as a series of revised operation and maintenance manual. The revised manual includes the daily record and site inspection formats which have been improved through the discussions with C/Ps in addition to the supplemental materials.

However, the revised manual still need to be improved as the operation abilities of C/Ps progress and the future influent amount increases. In the next phase of the technical assistance project, utilizing the revised manual as a basic text, more practical revisions will be added to it based on the actual experience of operation and maintenance works at the site.

2.13 Assistance of Developing Discharge Standard from Factories

2.13.1 Study Process of Developing Discharge Standard from Factories

The draft of the discharge standard from factories was proposed based on the present discharge standards in the Al-Bireh and Nabulus municipalities and the standard by-law of the PWA. Said draft is described in the draft of Sewerage By-Law for Jericho Municipality, and is one of the important clauses.

The drafts of standard values for each water quality item were confirmed by comparison with the Japanese standard values. In case of the violation of the discharge standard, penalties and establishment of devices for pre-treatment of wastewater are stipulated in the draft by-law. The JICA Expert Team explained to C/Ps about the significance of a discharge standard in the process of making the draft by-law. The C/P team and JICA Expert Team studied and discussed the water quality items and discharge standard, and finalized the draft discharged standard. Although there is a commercial area in Jericho City, there are no factories that use or discharge heavy metals.

2.13.2 Discharge Standard from Factories

It was announced that a new sewerage by-law was standardized by the Ministry of Local Government (MoLG) in January 2014. The discharge standard was simultaneously stipulated in the by-law. After approval of the by-law in Jericho Municipality, discharge from factories shall be monitored based on this discharge standard. **Table 2.13.1** shows the stipulated discharge standard.

Table 2.13.1 Discharge Standard (Sewerage By-Law)

Item	Standard Value	Japan Tokyo (Reference[1]) Average Discharge Amount: Over 50m³/day
Water Temperature	65℃	Less than 45℃
pH	5.0－9.5	5.0－9.0
Oil, Grease	100 mg/L	30 mg/L
Cyanide	2 mg/L	1 mg/L
Phenol	10 mg/L	5 mg/L
Sulfur	2 mg/L	-
MBAS (Methylene Blue Active Substance)	40 mg/L	-
Mineral Oil	20 mg/L	5 mg/L
Sulfate (SO_4)	1,000 mg/L	-
Chloride (Cl)	500 mg/L	-
Fluoride	60 mg/L	8 mg/L
Total Suspended Solid(TSS)	600 mg/L	Less than 600 mg/L
Chemical Oxygen Demand (COD)	2,000 mg/L	-
Sodium	500 mg/L	-
Total Chrome*	5 mg/L	2 mg/L
Copper*	4.5 mg/L	3 mg/L
Tin	10 mg/L	-
Beryllium	5 mg/L	-
Nickel*	4 mg/L	-
Cadmium*	1 mg/L	0.1 mg/L
Arsenic	5 mg/L	0.1 mg/L
Barium	10 mg/L	-
Lead*	0.6 mg/L	0.1 mg/L
Manganese	10 mg/L	10 mg/L
Silver*	1 mg/L	-
Boron	5 mg/L	10 mg/L
Mercury*	0.5 mg/L	0.005 mg/L
Ferrum	50 mg/L	10 mg/L
Zinc	15 mg/L	2 mg/L
Cobalt*	0.05 mg/L	-
Silicon*	0.05 mg/L	-
Lithium	5 mg/L	-
Vanadium*	0.1 mg/L	-
Aluminium	10 mg/L	-

2.13.3 Factory Investigation

Questionnaire forms to register monitoring methods etc. for planned or existing factories which are expected to connect to sewers has been prepared with C/P to observe the discharge standard required by the Sewerage By-law. The questionnaire form for factories is shown in **Appendix A 2-13-1**.

Survey items and methods which are included in the questionnaire form are as follows. This form shall be revised appropriately by the operational phase.

Survey items in the questionnaire form for factories:

- Outline of factories, such as industrial category and staff number

- Water source and used water volume for each purpose
- Pre-treatment facility and method
- Actual discharge method
- Wastewater quality and expected discharge volume

Survey methods"

- Survey will be conducted twice a year, by half-scale once a year.
- Owner of the factory should measure the wastewater quality required by the Sewerage By-law and submit the analytical report to Jericho municipality.

Survey has been started in two sites tentatively. State of the survey is shown in **Figure 2.13.1**.

Figure 2.13.1 State of the Survey (Upper: Butchery, Lower: Food Processing Factory)

2.13.4 Factory (Jericho Hospital) Investigation

Jericho Hospital was built in the 1990's by Japanese Aid and is highly valued by the citizens. The hospital's wastewater is treated by the treatment facility which was built along with the hospital, and the treated wastewater is discharged in Wadi located at the side of the hospital grounds. There are two systems of inflow to the wastewater treatment facility, one for general wastewater from the hospital and another for the wastewater from laboratories which include chemical wastes. The chemical wastewater is first treated at the pretreatment system and then is mixed with the general wastewater for biological

treatment. The average sewage amount is 100m3/day.

Figure 2.13.2 Wastewater Treatment Facility

Figure 2.13.3 Pretreatment Facility for Chemical

Developing houses are under construction on the other side of Wadi, which the treated wastewater is being deposited, and the hospital is receiving complaints about foul odors and other issues of the hospital wastewater. Therefore, the hospital decided to stop the operation of the wastewater treatment facility and submitted a request to connect to the Jericho Municipal Sewage System.

There are following alternatives are recommended for connecting the wastewater to Jericho sewer network.

Option-1: Although it is a route plan connecting to the existing No. 10 trunk line in the Jerusalem road, pumping by a pump on topography is required

Option-2: Although it is a route plan to connect to the existing No. 19 trunk with gravity flow, considering the topography (ground height), including a route without housing of about 2 km

The estimated cost is shown in **Table 2.13.2**. In Case-1, beside of pressure pipe from pumping station, extension of the sewage pipe (about 800 m) is required to connect the existing Trunk No.10, but this construction is being developed with the support of UNRWA by Japanese funds It is being implemented as part of the project in the Aqbat Jaber Camp.

Table 2.13.2 Estimated Construction Cost for Jericho Hospital Wastewater Connection

(unit: USD, m)

Item	Quantity	Unit Cost	Construction Cost	Remarks
Pump Station	1	20,000	20,000	including mechanical and electrical equipment
Pressure Main	910	60	54,600	Installation to the Jerusalem Road
Supplementary	1		10,000	
Total			84,600	

2.13.5 Factory (Jericho Agro Industrial Park) Investigation

There is the Jericho Agro Industrial Park (JAIP) which is being developed with support from Japan, and some factories have started operation since 2017. On August 11, 2016, JAIP signed an agreement with Jericho municipality for connecting to public sewer on the wastewater quality, sewerage fee, etc. (refer to **Appendix A 2-13-2**). In addition, the layout plan of JAIP is shown in **Appendix A 2-13-3**.

The wastewater from JAIP is connected to the Trunk No.19 via a pumping station constructed by UNDP. As a result of meeting with the developer (JAIPCO) who has jurisdiction over each business office of JAIP concerning the situation of waste water reception based on the agreement, the following subjects were found.

- Some factories that discharge wastewater exceeding the acceptance standard prescribed in the Sewerage By-law need to install pretreatment facilities but are not properly installed and operated
- Data on wastewater quality and flow has not been reported to Jericho municipality
- Payment of sewerage fee to Jericho municipality from JAIP has not been started

Especially when wastewater exceeding the acceptance standard is entered to at WWTP, there is a possibility of seriously affecting the microorganisms of biological treatment and causing a decline in function, so JAIP and Jericho City should monitor water quality.

2.13.6 Factory (Jericho Slaughter House) Investigation

In Jericho municipality, an aged slaughterhouse is used. Currently slaughterhouses are divided into two blocks (livestock such as chicken, sheep and cattle), the maximum daily treatment is 1,150 chickens, 11 sheep and 5 cattle.

After slaughtering these, after washing away all blood and residues with water, it is stored in cesspit and taken out with a vacuum car. However, since cesspit is not properly operated, it means that there are many complaints from neighborhood against the stench caused by animal oil and other scum.

As of 2017, the slaughterhouses are planned to be replaced by the French AFD Fund, and the facility also includes the installation of pretreatment facilities for wastewater. Jericho municipality plan to accept wastewater, and it is important to monitor so that public sewer accept the wastewater standard value as cleared by appropriate pretreatment.

2.14 Utilization of Treated Wastewater and Sludge

2.14.1 Current Reuse and Data Collection

(1) Investigation of Reuse

The JICA Expert Team and the C/P visited the Al-Bireh and Nabulus municipalities, conducted surveys based on interviews regarding current reuse of treated wastewater, sludge and final disposal. In Al-

Bireh city, treated wastewater has been used for sprinkle water in the Wastewater Treatment Plant site, flushing for sewers by water tankers and irrigation for roadside green, free of charge. The treated wastewater has been also used experimentally for the crops for cultivation in a vinyl greenhouse at the site. Excess treated wastewater is discharged to the Wadi near the WWTP. Sewage sludge as thickened sludge is carried to a landfill site and for disposal.

The Nabulus municipality has studied treated wastewater for reusing which is generated from the WWTP and it will be operated in July 2013. While the municipality has a plan of disposal by landfill for sewage sludge, reuse of sludge as compost has also been studied.

The JICA Expert Team visited the Ministry of Agriculture in Ramallah and collected information and materials of water quality/sludge standard for reuse. The C/P and the JICA Expert Team conducted surveys based on interviews regarding reuse of treated wastewater and sludge with Ministry of Agriculture at the Jericho branch office.

(2) Possibility Survey of Treated Wastewater and Sludge in Jericho

The C/P and the JICA Expert conducted a survey of current agricultural industry and their water demand based on the collected information from Ministry of Agriculture. The C/P and the JICA Expert conducted surveys based on interviews with farmers and a private company in the Jericho municipality regarding potential demands of treated wastewater and sludge. The reason for choosing the company for an interview was that it had already shown its interest in using treated wastewater of the Ministry of Agriculture. The result of the interview survey showed, the forms and the private company want to take affirmative stance to use treated wastewater, their notions of purchasing of it were confirmed. Since presently cultivation of date palms is currently popular with famers in Jericho city, a demand of treated wastewater is comparatively high.

On the other hand, the result of interview survey showed that farmers have an evasion of using sewage sludge reuse as fertilizer because sludge is derived from human waste. The C/P also feels apprehensive about this issue, and it seems that finding demands of the sludge is more difficult than it of treated wastewater.

According to the social survey results, mentioned earlier, 69 % of the respondents know that re-use of wastewater is something useful, 50 % of the respondents want to use treated wastewater for agriculture purpose. Regarding reuse of sewage sludge, although 53 % of the respondents know it, only 36 % wants to use it for fertilizing purpose.

The association, however, manifests interest in reuse of treated wastewater and sludge. It is highly possible to use it over for agriculture purpose under control of standards such as contents of heavy metals.

2.14.2 Water Quality Standard for Agricultural Use

The JICA Expert discussed with the Ministry of Agriculture regarding the draft reuse of treated wastewater in Water Quality Standard for Agricultural Use. This Standard is to be established by the

Ministry of Environmental Protection, the Ministry of Health, the Ministry of Agriculture and PWA and the Standard and Specification Institution.

The standard values are currently under discussion, and are to be agreed through workshops and presented to the Council. The draft Guidelines and Standards for Wastewater Reuse has been revised several times, and the JICA Expert Team obtained the latest version to comprehend the contents with the C/Ps. Important values, such as quality test items, test frequency and test result reports will be necessary to be discussed with the Director of the Water and Sewerage Department, the Sewerage Section Chief and personnel of the water quality management. Selection of the items which can be tested in Jericho Municipality, and which will need to be outsourced and its budget are to be discussed. The draft Water Quality Standard for Agricultural Use is shown in **Appendix A 2-14-1**.

2.14.3 Experimental Farm for Treated Wastewater Reuse

The JICA Expert Team has discussed a reuse plan with C/Ps, and held a workshop on the reuse of the treated wastewater and sewage sludge to the C/Ps in June 2014.

Before providing the treated wastewater to farmers outside of the WWTP, the Expert Team shall run an experimental farm called the Pilot Plant, and then the JICA Expert Team and C/Ps will simultaneously confirm whether the treated wastewater quality meets the standard. An experimental farm outside of the WWTP will be studied in parallel with the Pilot Plant. Before providing and/or selling the treated wastewater to users, the Expert Team explained that C/Ps are obliged to disclose information of the results regarding the treated wastewater quality test and sewage sludge (soil) test. It shall guarantee the treated wastewater quality by meeting the reuse standard, and avoid conflicts, such as reduction/ deterioration of products and occurrence of plant withering, between Jericho Municipality (supplier) and farmers (users). The user side can judge whether to use treated wastewater/sewage sludge on their farms based on the information. The Pilot Plant plan is shown in **Appendix A 2-14-2**.

The draft implementation schedule of the Pilot Plant both inside and outside of the WWTP is shown as below,

1. Conduct treated wastewater quality test and sewage sludge (soil) test
2. Record the tested water quality and compare to the (draft) Palestine Reuse Standard
3. Set and implement the Pilot Plant in the WWTP (setting the experimental farm will start in early October since it is the timing for cultivating palm dates)
4. Conduct a questionnaire survey with farmers about the test results in Jericho
5. Information disclosure of the treated wastewater quality by a website and/or a municipal bulletin board
6. Hold joint workshops with related organizations and stakeholder meetings
7. Cooperate with neighbor farmers at the WWTP and the experimental farm outside of the WWTP
8. Finally, provide/sell the treated wastewater and/or sewage sludge to farmers

An essential factor is securing the necessary quantity of effluent. The commencement timing of an experimental farm outside of the WWTP will depend on the effluent amount.

Regarding the reuse priority of the treated wastewater, the first priority is for the maintenance of the WWTP, and then the second is for the watering of the gardens and the Pilot Plant in the WWTP. Afterwards, the excess treated wastewater can be provided to farmers. The JICA Expert Team and the C/Ps consider necessary to monitor the Pilot Plant and collect data for at least one year to show the evidence of safe treated wastewater. **Figure 2.14.1** shows the Pilot Plant area.

The JICA Expert has contacted a cooperative candidate (farmer) who can provide a palm date farm as an experimental field. The conditions are that JICA provides a pump and distribution pipes. In the second year of the Project, the JICA Expert Team will discuss the experimental farm outside the WWTP with JICA, C/Ps and the farmer.

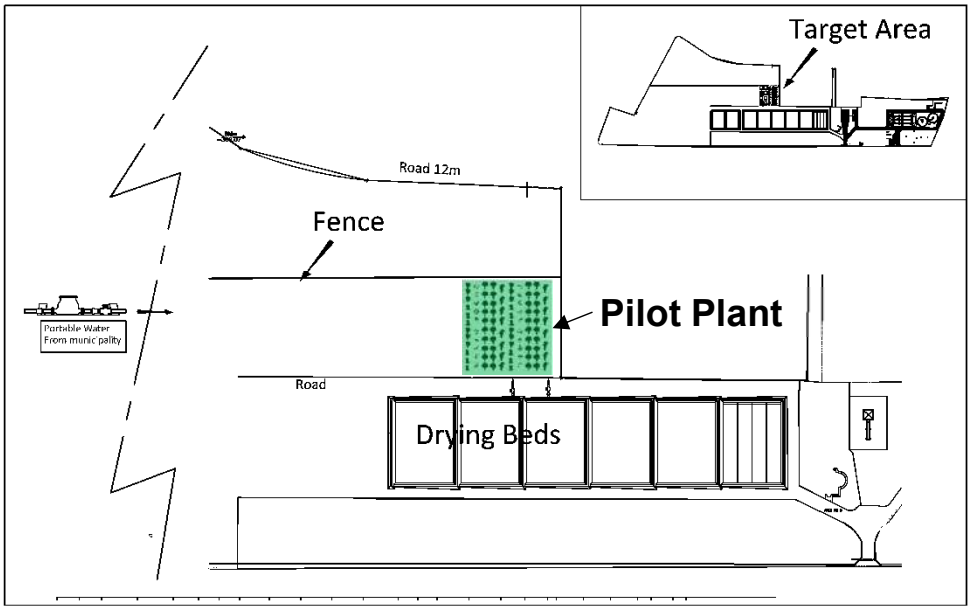
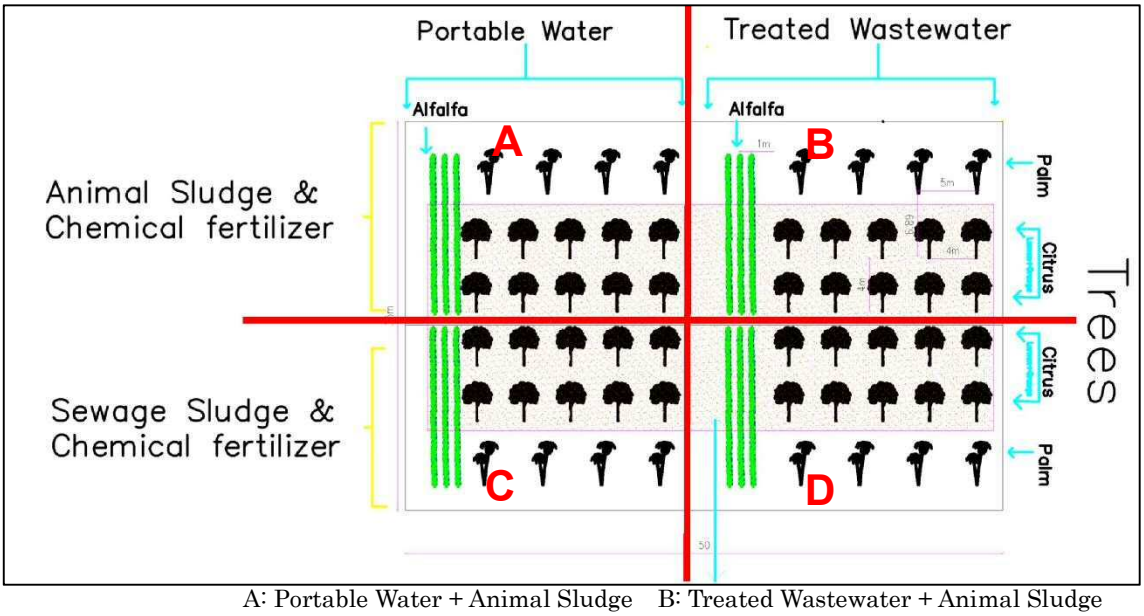


Figure 2.14.1 Pilot Plant

2.14.4 Pilot Plant (Internal Experimental Farm at the WWTP)

The Pilot Plant at the WWTP was set for experimental reuse of the treated wastewater and sewage sludge after discussions with the C/P. The Pilot Plant has four comparative experimental fields of portable water, treated wastewater, animal sludge, and sewage sludge to examine the treated wastewater influence. **Figure 2.142** shows the four fields in the Pilot Plant and **Table 2.14.1** shows the outline of the Pilot Plant.



A: Portable Water + Animal Sludge B: Treated Wastewater + Animal Sludge
C: Portable Water + Sewage Sludge D: Treated Wastewater + Sewage Sludge

Figure 2.14.2 Pilot Plant Outline (4 Classified Farms)

Table 2.14.1 Pilot Plant Outline

Item	Information	Remarks
Location	Next to the sludge drying bed at the WWTP	
Area	Approximately 1,750 m^2	
Products	Date palm: 16 trees, Lemon: 20 trees, Orange: 20 trees, Cone, Alfalfa	Date palm is a young tree, cone and alfalfa raise plant from seeds
Soil	Soil for date palm used is the surplus soil from the WWTP Soil for lemon and orange brought from outside (fertile soil)	Procurement of soil from Jericho city
Comparative Farm Fields	A: Portable Water + Animal Sludge B: Treated Wastewater + Animal Sludge C: Portable Water + Sewage Sludge D: Treated Wastewater + Sewage Sludge	Refer to Figure 2.6.1
Monitoring Item	Irrigation volume, product growth	Installation of water meters, Patrol maintenance by an employed famer

The draft implementation schedule of the Pilot Plant both internal (at the WWTP) and external (outside the WWTP) is shown below:

1. Set and implement the Pilot Plant at the Jericho WWTP
2. Conduct treated wastewater quality test and sewage sludge (soil) test
3. Record the water quality test result and compare it with the (draft) Palestine Reuse Standard
4. Hold participatory meeting(s) with related organizations and stakeholders
5. Conduct a questionnaire survey with the participators about the test results
6. Set up Pilot Farms (in addition to the Pilot Plant at the WWTP). It includes to cooperate with owners of the farms within the vicinity of the WWTP to implement experimental farms.
7. Disclose the treated wastewater quality information by the municipal bulletin board and/or the

website

8. Finally, provide/sell the treated wastewater and/or sewage sludge

The Pilot Plant operation began in December 2014 and the activities of No 1 to 6 (from the above schedule) have been already implemented (**Appendix A -14-3**).

2.14.5 Participatory Meeting/Workshop

(1) First Participatory Meeting

The first participatory meeting was held at the Jericho WWTP administration building on the 21st of December, 2014 (refer to **Figure 2.14.3**). The total 17 participants mainly were from the Ministry of Agriculture, Agriculture Cooperatives Association, Environmental Quality Authority (under the Ministry of Environment), Ubaidyeh Municipality, JICA, and An-Najah National University.

The outlines of the Jericho sewerage project and Jericho WWTP were explained by the Jericho municipality staff. The JICA Expert explained alternative reuse of treated wastewater and sewage sludge, the quality test results and the outline of the Pilot Plant. The handout of power point slides is shown in **Appendix A 2-14-4**.

The meeting attendees were also requested to participate in a questionnaire survey on treated wastewater and sludge reuse. The survey questions are shown in **Table 2.14.2** and the results ae presented as **Appendix A 2-14-5**. A review of the result indicates that the participants agreed that it is possible to provide/sell the treated wastewater if the quality meets the Reuse Standard. While, regarding sewage sludge while respondents have an understanding of tis reuse, they believe that is necessary to guarantee safety and quality of it. Essential factors are regular quality test and its information disclosure.

Figure 2.14.3 First Participatory Meeting held on 21st December, 2014

Table 2.14.2 Results of Questionnaire on Reuse of Treated Wastewater and Sewage Sludge

	Question	Answer
1. Perception of Treated Wastewater Reuse		
1-1	Reuse of treated wastewater is useful	Yes: 10 (6), No: 0
1-2	What kind of reuse is acceptable (multiple answers allowed)	Date palm irrigation: 9 (6) Landscape irrigation: 8 (6) Amenity use: 3 (2)
1-3	In case treated wastewater quality is disclosed and meets the reuse standard, the treated wastewater is usable.	Yes: 6 (3) No: 0 (0)
1-4	When treated wastewater is sold, you buy/use it.	Yes: 8 (5) No: 1 (1) No idea: 2 (1)
2. Perception of Sewage Sludge Reuse		
2-1	You know dry sewage sludge can be used for fertilizer of agricultural products.	Yes: 10 (6) No: 1 (0)
2-2	You agree with reuse of the dry sewage sludge.	Yes: 9 (6) No: 2 (1)
2-3	In case of "No" on 2-2, rejection reasons? (multiple answers allowed)	・Unclear whether heavy metal contents meet the standard: 1 (1) ・Dirty and/or hygienic care: 2 (1)
2-4	In case the sludge meets the reuse standard, you use it as fertilizer.	Yes: 9 (5) No: 1 (1)
2-5	When the sludge is sold, you buy/use it.	Yes: 6 (3) No: 4 (3)

( ): stakeholder's answer except the Jericho municipality staff

(2) Second Participatory Meeting

The second participatory meeting (workshop) was held at the Jericho library on June 4th, 2014 (refer to **Figure 2.14.4**). The total 32 participants mainly were from the Ministry of Agriculture, PWA, agriculture farm owners, date palm factory, Ubaidyeh municipality, and Jericho municipality.

The outlines of the Jericho sewerage project and Jericho WWTP were explained by the Jericho municipality staff. The JICA Expert explained alternative reuse of treated wastewater and sewage sludge, the quality test results and the outline of the Pilot Plant.

Questionnaires on treated wastewater and sludge reuse were conducted to the attendees. The survey questions are shown in **Table 2.14.3**. The result indicates that the participants agreed that it is possible to use/buy the treated wastewater if the quality meets the Reuse Standard. While, regarding sewage sludge reuse, although respondents have an understanding of its reuse, they think it is necessary to guarantee safety and quality of it. Essential factors are regular quality test and its information disclosure.

Table 2.14.3 Results of Questionnaire on Reuse of Treated Wastewater and Sewage Sludge

	Question	Answer	
1. Perception of Treated Wastewater Reuse		Dec. 21, 2014	Jun 4, 2015
1-1	Reuse of treated wastewater is useful	Yes: 10 (6), No: 0	Yes: 13 (10), No: 0
1-2	What kind of reuse is acceptable (multiple answers allowed)	Date palm irrigation: 9 (6) Landscape irrigation: 8 (6) Amenity use: 3 (2)	12 (9) 10 (7) 4 (3)
1-3	When treated wastewater is sold, you buy/use it.	Yes: 8 (5) No: 1 (1) No idea: 2 (1)	Yes: 6 (5) No: 2 (2) No idea: 4 (3)
2. Perception of Sewage Sludge Reuse			
2-1	You know dry sewage sludge can be used for fertilizer of agricultural products.	Yes: 10 (6) No: 1 (0)	Yes: 11 (8) No: 2 (2)
2-2	You agree with reuse of the dry sewage sludge.	Yes: 9 (6) No: 2 (1)	Yes: 9 (7) No: 2 (2)
2-3	In case of "No" on 2-2, rejection reasons? (multiple answers allowed)	・Unclear whether heavy metal contents meet the standard: 1 (1) ・Dirty and/or hygienic care: 2 (1)	・Unclear whether heavy metal contents meet the standard: 1 (1) ・Dirty and/or hygienic care: 0 ・Dislike: 2 (2) ・Smell: 1 (1) ・Unsafety: 1 (1) ・Religious belief: 1 (1)
2-4	In case the sludge meets the reuse standard, you use it as fertilizer.	Yes: 9 (5) No: 1 (1)	Yes: 7 (6) No: 4 (3)
2-5	When the sludge is sold, you buy/use it.	Yes: 6 (3) No: 4 (3)	Yes: 8 (6) No: 4 (3)

( ): stakeholder's answer except the Jericho municipality staff

Figure 2.14.4 Second Participatory Meeting held on 4th June, 2015

(3) Workshop

The Mayor of Jericho submitted the draft unit price to the council committee on February 2, 2016, and the committee agreed on the price, 0.5 NIS/m^3. In this stage, TeCSOM had the workshop on reuse of treated wastewater and sewage sludge with 16 participants (MoA, NGO, Municipality of Ubeidyeh etc.)

on February 7, 2016. The power point slides are shown in **Appendix A 2-14-6**. In the workshop, not only the quality of treated wastewater and sludge but also the license procedure and the responsibilities among Jericho municipality, the MoA and farm owner were explained to the attendees. The valid duration of the reuse license (reusing the treated wastewater) was discussed. The farm owners requested Jericho municipality to set the valid period of 25 years, so that the investments may correspond to the expenses of distribution pipes and pump for treated wastewater which are imposed upon the users (farm owners) in the draft agreement.

2.14.6 Pilot Plant (External Experimental Farm)

A cooperate farm owner provided an external experimental farm near the WWTP where approximately two hundred date palm trees are planted. The Pilot Farm as an experimental farm will be implemented from June 2015 and the agreement has been already signed among the farm owner, Jericho municipality and JICA Expert. **Appendix A 2-14-7** shows the agreement. The location of the Pilot Farm is shown in **Figure 2.14.5**.

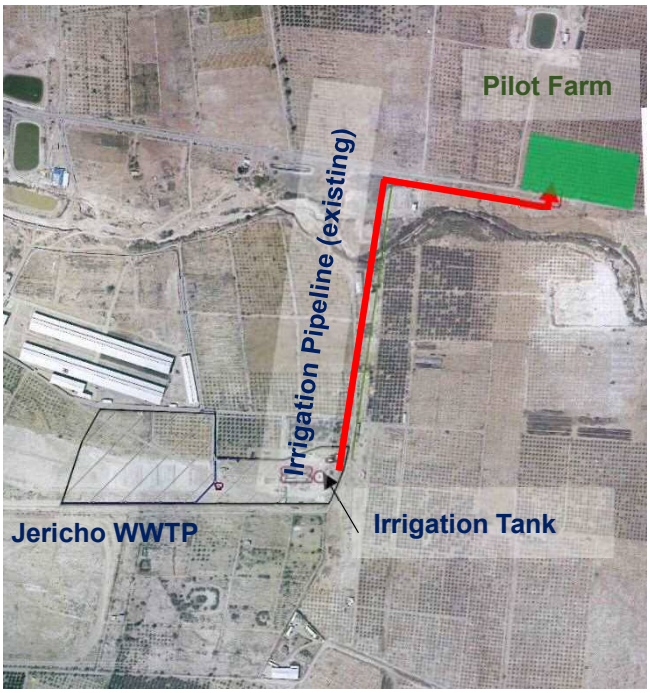


Figure 2.14.5 Pilot Farm

2.14.7 Promotion Plan of Treated Wastewater Reuse

The questionnaire surveys on treated wastewater reuse were conducted to the attendees twice in the participatory meetings (workshop). Potential demands for treated wastewater is high since the results were positive.

The design wastewater flow (daily average 6,540 m^3/day) in the sewerage plan is equivalent to approximately 89 ha for date palm fields for irrigation. There are date palm fields, approximately 200 ha around the WWTP. When the questionnaire survey on treated wastewater reuse was conducted to 8 farm owners, the result shows all owners would like to use the treated wastewater for date palm for irrigation. Therefore, there is high demand for irrigation when the water quality meets the Reuse Standard. The date palm fields are shown in **Figure2.14.6**.

The following actions are necessary to promote the treated wastewater reuse.

1. Implementation of periodical treated wastewater quality test and its information disclosure
2. Disclosure of the plants growth (date palm) in the Pilot Plant and Pilot Farm
3. Disclosure of safe products from the Pilot Plant

Figure 2.14.6 Date Palm Fields around the WWTP

2.14.8 Promotion of Sewage Sludge Reuse

The C/P (Mr. Ibrahim Abu Seiba, Sewerage Section Cheif) and JICA Expert had a meeting with MoA (Mr. Husam Yasen, Head of Fertilizer Department, and Mr. Emad Khlief, Director) to discuss sludge reuse on November 10, 2015. MoA's intention regarding the sludge reuse is the followings,

a) MoA intends to use sludge as fertilizer. As the back ground of formulation of the sludge reuse

standard, MoA expects that sludge reuse roles not only to secure damping site capacity for sludge disposal but also to reduce a disposal cost since damping sites are limited against generated and accumulated sludge.

b) In case of treated wastewater reuse, although most farm owners had negative opinions initially, MoA had explained them the importance and benefit of the reuse in several workshops. The result of workshops, treated wastewater reuse has been recognized gradually. Regarding the sludge reuse, MoA will explain users in the same way.

c) The impediment factors for reusing sludge may be mainly unsafe (perhaps detrimental to health) and unclean/evasion from human waste.

d) There is no budget and specific plan to disseminate and/or implement sludge reuse as a pilot in MoA at present. MoA may study the reuse.

e) MoA informs municipalities of the authorized Reuse Standard.

f) The processes and responsibilities for procedure, guarantee of quality/quantity and safety has not been studied/formulated yet. However, MoA begins studying these subjects.

Since Jericho municipality has been implementing the Pilot Plant and Pilot Farm, the municipality cooperates with MoA by providing the data of treated wastewater quality and product growth.

2.14.9 Current Reuse of Treated Wastewater and Sewage Sludge

(1) Reuse of Treated Wastewater

The draft License Procedure for the reuse of treated wastewater which was developed by JICA Expert and the C/P was confirmed by the MoA. The MoA basically agreed on the procedure, the rules and the responsibilities of the MoA. The MoA in Jericho office also intends to conduct the monitoring and advising to farm owners according to circumstances.

Since September 2016, three farmers started reuse of treated wastewater, and as of June 2017 the inflowing sewerage volume is gradually increasing, it is distributed to five farmers. Each farmer installs the treated wastewater distribution pump and pipes with own expense and uses them. **Table 2.14.4** shows the reuse situation of treated wastewater.

Table 2.14.4 Current Reuse of Treated Wastewater

Month/Year	Inlet Flow (m3/month)	Reusing Volume (m3/month)	Reusing Rate (%)	Number of Farmer
Sep. 2016	14,950	15,091	100.9	3
Oct. 2016	16,730	16,501	98.6	3
Dec. 2016	16,300	17,466	107.2	4
Apr. 2017	25,180	18,784	74.6	5
May 2017	25,140	17,962	71.4	5
Jun. 2017	24,410	17,898	73.3	5

Except five farm owners who already have the license, although other six farm owners have been applying for the Reuse License to the MoA, the MoA suspends to issue the license due to the wastewater volume limitation. The MoA may issue it according to the increase of wastewater. The information of Farm, the license procedure, application and the license are shown in **Appendix A 2-14-8**.

(2) Reuse of Sewage Sludge

In the first, Jericho municipality and the MoA agreed on the implementation of the internal experimental farm (as a pilot) in cooperation with NARC (National Agricultural Research Center) in the WWTP to reuse the treated wastewater and sludge. Terms of the experimental farm such as required area, plant type and period shall be studied among Jericho municipality, the MoA and NARC. **Appendix A 2-14-9** shows the Minute of Meeting between Jericho Municipality and MoA.

In the second stage, the MoA shall permit to provide the sludge for the Samed Land (Jericho municipality property) since the MoA would like to implement the verification experiment first under their control. The experiment plan for reusing sludge was prepared in February 2018 and started discussion with Jericho municipality. The outline of the project is shown below.

Project duration : three years
Project place : Jericho WWTP
Candidate tree for experiment : citrus
Estimated project cost : 16,720 USD (MoA calculation)
Experiment methodology : divide land into 4 blocks

Block-1	Treated wastewater and sludge
Block-2	Water supply and sludge
Block-3	Treated wastewater only
Block-4	Water supply and organic fertilizer
Block-5	Water supply only

2.14.10 Selling Price of Treated Wastewater and Handover Letter of Pilot Plant

The current tariff is set for one year, the unit price and the agreement shall be renewed every year according to the Mayor's letter issued on February 2, 2016. The letter of the Mayor on the treated wastewater unit price and the handover letter of the Pilot Plant are shown in **Appendix A 2-14-10.**

2.15 Data Collection on Irrigation and Agricultural Products

2.15.1 Groundwater Quality Survey

Totally five times Sampling and testing was conducted in June, September, December 2013 and March June 2014, May and November 2015. The treated wastewater quality was then compared with the water quality data of two wells located near the WWTP. Adaptation to agricultural use of treated wastewater is verified based on the Palestine Reuse Standard. Water parameters for the test are the 37

items which are stipulated in the Reuse Standard including organic, nutritive, pathogenic, salt and heavy metal items. The groundwater quality survey was contracted out to a local consultant. The locations of the target two wells are shown in **Figure 2.15.1**. **Table 2.15.1** shows the water quality results.

The values highlighted with yellow color in **Table 2.15.1** show exceeded the water quality levels. These items are Total Dissolved Solid (TDS), Phenol, Chloride, Sulfate, Sodium, Manganese, Sodium Adsorption Ratio (SAR) and Boron. The cause and influence to human health of these items are shown in **Table 2.15.2**.

Infiltration of seawater is mainly common among the items in **Table 2.15.2**. The excess values compared to the Reuse Standard are presumed to be caused by seawater infiltration from the Dead Sea.

Table 2.15.1 Water Quality Result of Existing Wells for Agricultural Use

Items		Standard Quality A	Well-1 (No.10) Majed Al Tarifi					Well-2 (No.12) Iamael A'daaq				
			Survey-1	Survey-2	Survey-3	Survey-4	Survey-5	Survey-1	Survey-2	Survey-3	Survey-4	Survey-5
		Sampling Date	Jun 22-13	Sept26-13	Dec21-13	Mar 1-14	Jun 17-14	Jun 22-13	Sept26-13		Mar 1-14	Jun 17-14
Biochemical Oxygen Demand (BOD)	mg/L	20	ND	5	ND	ND	ND	ND	4.2	-	-	ND
Total Suspended Solids (TSS)	mg/L	30	1.5	8.7	8	3	7.25	1	ND	-	-	10.75
Fecal coliform bacteris	colony/100mL	200	0	6	3	0	0	0	0	-	-	5
Chemical Oxygen Demand (COD)	mg/L	50	ND	16.9	2.3	ND	ND	ND	-	-	ND	ND
Dissolved Oxygen (DO)	mg/L	<1	3.6	6.26	3.55	2.8	-	3.95	6.53	-	-	-
Total Dissolved Solids (TDS)	mg/L	1,200	2,413	2,410	2,247	1,947	2,510	2,860	2,685	-	-	2,933
Potential of Hydrogen (pH)		6 - 9	7.98	8.094	7.65	7.372	7.797	7.7	8	-	-	7.361
Fat, Oil and Grease	mg/L	5	ND	9.85	23.6	ND	ND	ND	19.3	-	-	ND
Phenol	mg/L	0.002	0.00267	ND	-	0.033	-	0.00418	ND	-	0.037	-
Detergents (MBAS)	mg/L	15	ND	ND	ND	ND	ND	ND	ND	-	-	ND
Nitrate Nitrogen (NO3-N)	mg/L	20	0.97	ND	ND	ND	0.79	8.39	-	-	9.2	6.89
Ammonium Nitrogen (NH4-N)	mg/L	5	ND	ND	0.07	ND	ND	ND	ND	-	-	ND
Total Nitrogen (T-N)	mg/L	30	0.97	17.3	17.2	8.52	10.86	8.38	27.53	-	-	14.34
Chloride (Cl)	mg/L	400	1024.6	947.3	844	803.7	838.7	1007.9	869.82	-	-	1003.3
Sulfate (SO4)	mg/L	300	157.5	158.97	137.1	95.5	135.3	305.2	370.83	-	-	375.1
Sodium (Na)	mg/L	200	491	349.6	558	579.7	645	343	428.5	-	-	487
Magnesium (Mg)	mg/L	60	96.3	-	-	-	-	162	-	-	-	-
Calcium (Ca)	mg/L	300	54.4	-	-	-	-	130	-	-	-	-
Sodium Adsorption Ratio (SAR)	mg/L	5.83	9.26	-	-	-	-	4.74	-	-	-	-
Phosphate Phosphorus (PO4-P)	mg/L	20	20.3	-	-	-	-	ND	-	-	-	-
Aluminum (Al)	mg/L	5	0.239	-	-	-	-	0.212	-	-	-	-
Arsenic (As)	mg/L	0.1	ND	-	-	-	-	ND	-	-	-	-
Copper (Cu)	mg/L	0.2	ND	-	-	-	-	ND	-	-	-	-
Iron (Fe)	mg/L	5	0.087	-	-	-	-	0.4	-	-	-	-
Manganese (Mn)	mg/L	0.2	0.011	-	-	-	-	ND	-	-	-	-
Nickel (Ni)	mg/L	0.2	ND	-	-	-	-	ND	-	-	-	-
Lead (Pb)	mg/L	0.2	ND	-	-	-	-	ND	-	-	-	-
Selenium (Se)	mg/L	0.02	ND	-	-	-	-	ND	-	-	-	-
Cadmium (Cd)	mg/L	0.01	ND	-	-	-	-	ND	-	-	-	-
Zinc (Zn)	mg/L	2	0.029	-	-	-	-	0.042	-	-	-	-
Cyanide (CN)	mg/L	0.05	ND	-	-	-	-	ND	-	-	-	-
Chrome (Cr)	mg/L	0.1	ND	-	-	-	-	ND	-	-	-	-
Mercury (Hg)	mg/L	0.001	ND	-	-	-	-	ND	-	-	-	-
Cobalt (Co)	mg/L	0.05	ND	-	-	-	-	ND	-	-	-	-
Boron (B)	mg/L	0.7	2.75	-	-	-	-	2.16	-	-	-	-
Bacteria E. Coli	(colony/100mL)	100	0	-	-	-	0	0	-	-	-	5
Nematodes	(Eggs/L)	<1	ND	-	-	-	-	ND	-	-	-	-
Maximum temperature		35	-	-	-	-	-	-	-	-	-	-
Turbidity	NTU	10	-	-	-	-	-	-	-	-	-	-

ND: Not detected -: Not sampling

Table 2.15.2 Cause and Health Influence

Item	Cause and Health Influence
Total Dissolved Solid (TDS)	Main contents of calcium, magnesium, potassium, silicic acid and chloride. Drinking water quality: 500 mg/L. Little influence to human health with exceed the standard value. Influence to water taste
Phenol	Discharge source: coke oven gas, chemical industry and dyes industry. Drinking water quality standard 0.005 mg/L. LD_{50} (Media Lethal Dose) 300 mg/kg (mouse ingestion), 530 mg/L (rat ingestion). Toxicity to the central nerve
Chloride	Caused by infiltration of seawater and airborne salt (seawater: 19,000 mg/L, Dead Sea: 206,000 mg/L). As human factor: domestic sewage, industrial and agricultural discharge. LD_{50} (rat ingestion) Calcium chloride: 1000 mg/kg, Sodium chloride: 3000 mg/kg. Salty taste with 200 – 300 mg/L.
Sulfate	Caused by infiltration of seawater, fertilizer and industrial discharge. WHO Standard: 250 mg/L. Distasteful with 200 – 500 mg/L. Influence to a human: diarrhea
Sodium	Caused by infiltration of seawater and airborne salt, Cosmetics and dyeing industrial discharge. Drinking water standard: 200 mg/L. No acute toxicity
Manganese	From nature of a soil. Drinking water standard: 0.05 mg/L. Influence to human: insomnia, emotional disease, shaking and slurred language.
Boron	Caused by infiltration of seawater and metal-surface treatment. Drinking water standard: 1.0 mg/L. TDI (Tolerable Daily Intake) 0.096 mg/kg/day. Influence to human: emesis and diarrhea, erythralgia

Source: Water Quality Dictionary for Drinking Water (Japan Water Works Newspaper Company)

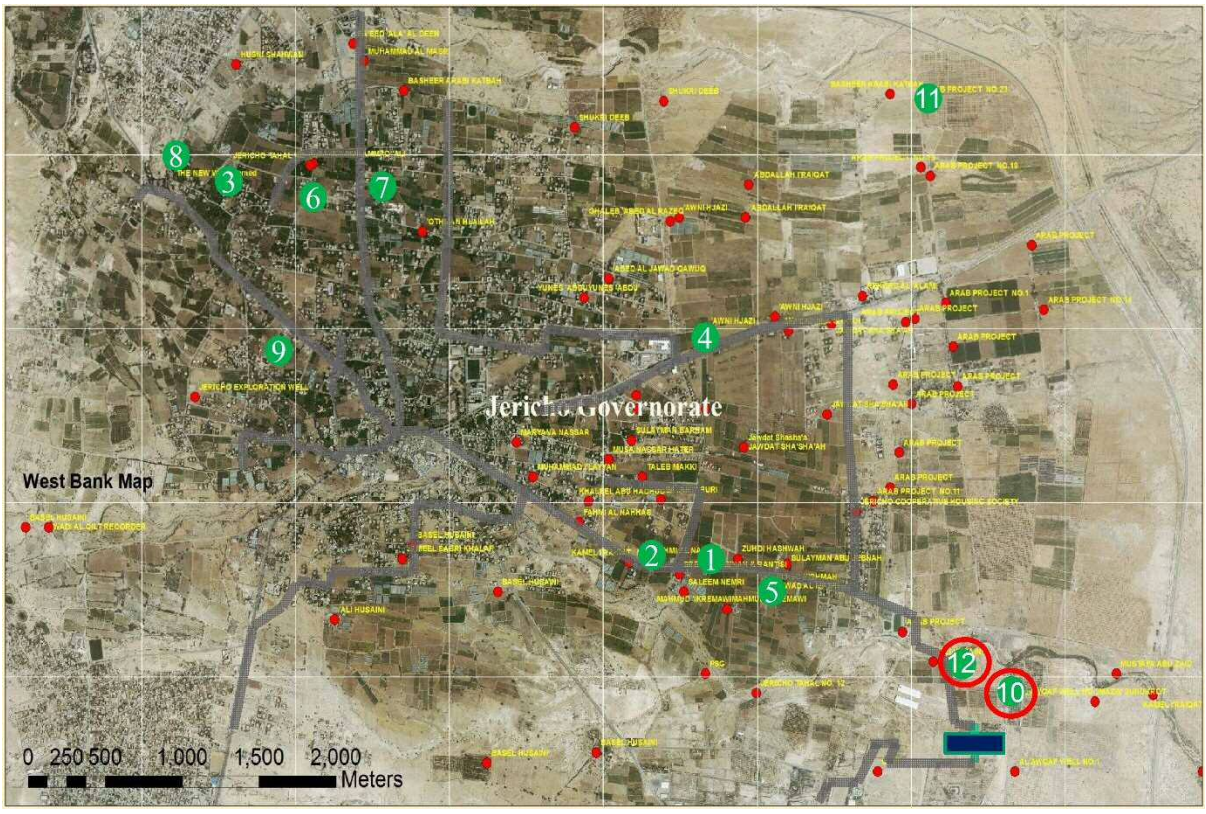


Figure 2.15.1 Groundwater Monitoring Point (No.10, No.12)

2.15.2 Water Quality Test Result of Treated Wastewater and Two Wells

Sampling and testing of the treated wastewater and two wells were conducted in December 2014, May

and November 2015, June 2016 and the water quality test results show in **Table 2.15.3**. The values highlighted with yellow color in above table mean the water quality parameter exceeded the level (Quality A) required by the Palestine Reuse Standard.

The treated wastewater test result in December 2014 shows that four items including Fecal coliform bacteria, Fat, Oil and Grease, Phenol and Selenium are above that the required standard level. While, in groundwater at the two wells, eight items including Total Dissolved Solid (TDS), Phenol, Chloride, Sulfate, Sodium, Manganese, Sodium Adsorption Ratio (SAR) and Boron exceeded the standard level.

The treated wastewater test result in November 2015 shows that four parameters including BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), Fat, Oil and Grease and T-N (Total Nitrogen) exceed the required standard level (Quality A). These 4 parameters will be retested.

The treated wastewater test result in June 2016 shows that three parameters including Fecal coliform bacteria, Fat, Oil and Grease and Escherichia coli exceed the required standard level (Quality A).

Water quality such as Fecal coliform bacteria and Escherichia coli can be controlled by chlorination. The proper operation of chlorination is instructed to the C/Ps. When the chlorination is operated properly, the treated wastewater is suitable and useful for agricultural use.

Table 2.15.3 Water Quality Test Result of Treated Wastewater and Existing Wells

Items		Standard Quality A	Treated Wastewater			Well-1 (No.10)					Well-2 (No.12)			
						Survey-1	Survey-2	Survey-3	Survey-4	Survey-5	Survey-1	Survey-2	Survey-4	Survey-5
		Sampling Date	1-Dec-14	20-May-15	11-Nov-15	Jun 22-13	Sept26-13	Dec21-13	Mar 1-14	Jun 17-14	Jun 22-13	Sept26-13	Mar 1-14	Jun 17-14
Biochemical Oxygen Demand (BOD)	mg/L	20	<5	<5	24	ND	5	ND	ND	ND	ND	4.2	-	ND
Total Suspended Solids (TSS)	mg/L	30	1	6.7	7	1.5	8.7	8	3	7.25	1	ND	-	10.75
Fecal coliform bacteris	colony/100mL	200	600-800	192	22	0	6	3	0	0	0	0	-	5
Chemical Oxygen Demand (COD)	mg/L	50	<10	<10	54	ND	16.9	2.3	ND	ND	ND	-	ND	ND
Dissolved Oxygen (DO)	mg/L	1<	2.1	3	2.6	3.6	6.26	3.55	2.8	-	3.95	6.53	-	-
Total Dissolved Solids (TDS)	mg/L	1,200	867	885	910	2,413	2,410	2,247	1,947	2,510	2,860	2,685	-	2,933
Potential of Hydrogen (pH)		6 - 9	7.85	7.68	7.58	7.98	8.094	7.65	7.372	7.797	7.7	8	-	7.361
Fat, Oil and Grease	mg/L	5	10.2	<1	18.4	ND	9.85	23.6	ND	ND	ND	19.3	-	ND
Phenol	mg/L	0.002	0.00581	0.018	<0.001	0.00267	ND	-	0.033	-	0.00418	ND	0.037	-
Detergents (MBAS)	mg/L	15	<0.01	<0.01	<0.01	ND	ND	ND	ND	ND	ND	ND	-	ND
Nitrate Nitrogen (NO3-N)	mg/L	20	1.23	0.35	0.42	0.97	ND	ND	ND	0.79	8.39	-	9.2	6.89
Ammonium Nitrogen (NH4-N)	mg/L	5	<0.05	<0.05	0.36	ND	ND	0.07	ND	ND	ND	ND	-	ND
Total Nitrogen (T-N)	mg/L	30	22.3	10.7	35.62	0.97	17.3	17.2	8.52	10.86	8.38	27.53	-	14.34
Chloride (Cl)	mg/L	400	237.9	232.9	223.36	1024.6	947.3	844	803.7	838.7	1007.9	869.82	-	1003.3
Sulfate (SO4)	mg/L	300	85.7	73.5	58.84	157.5	158.97	137.1	95.5	135.3	305.2	370.83	-	375.1
Sodium (Na)	mg/L	200	145	107.1	153.3	491	349.6	558	579.7	645	343	428.5	-	487
Magnesium (Mg)	mg/L	60	30.4	34.67	37.24	96.3	-	-	-	-	162	-	-	-
Calcium (Ca)	mg/L	300	86.6	83.59	94.84	54.4	-	-	-	-	130	-	-	-
Sodium Adsorption Ratio (SAR)	mg/L	5.83	ND	2.47	1.36	9.26	-	-	-	-	4.74	-	-	-
Phosphate Phosphorus (PO4-P)	mg/L	20	13.2	24.5	3.69	20.3	-	-	-	-	ND	-	-	-
Aluminum (Al)	mg/L	5	0.04	0.224	0.008	0.239	-	-	-	-	0.212	-	-	-
Arsenic (As)	mg/L	0.1	ND	ND	ND	ND	-	-	-	-	ND	-	-	-
Copper (Cu)	mg/L	0.2	0.035	0.011	0.015	ND	-	-	-	-	ND	-	-	-
Iron (Fe)	mg/L	5	0.07	0.143	0.041	0.087	-	-	-	-	0.4	-	-	-
Manganese (Mn)	mg/L	0.2	ND	0.041	0.04	0.011	-	-	-	-	ND	-	-	-
Nickel (Ni)	mg/L	0.2	ND	ND	ND	ND	-	-	-	-	ND	-	-	-
Lead (Pb)	mg/L	0.2	ND	ND	0.026	ND	-	-	-	-	ND	-	-	-
Selenium (Se)	mg/L	0.02	0.04	ND	ND	ND	-	-	-	-	ND	-	-	-
Cadmium (Cd)	mg/L	0.01	ND	ND	ND	ND	-	-	-	-	ND	-	-	-
Zinc (Zn)	mg/L	2	0.1	0.046	0.073	0.029	-	-	-	-	0.042	-	-	-
Cyanide (CN)	mg/L	0.05	<0.03	<0.03	<0.03	ND	-	-	-	-	ND	-	-	-
Chrome (Cr)	mg/L	0.1	ND	ND	ND	ND	-	-	-	-	ND	-	-	-
Mercury (Hg)	mg/L	0.001	ND	0.00015	0.000564	ND	-	-	-	-	ND	-	-	-
Cobalt (Co)	mg/L	0.05	ND	ND	ND	ND	-	-	-	-	ND	-	-	-
Boron (B)	mg/L	0.7	0.4	ND	0.11	2.75	-	-	-	-	2.16	-	-	-
Bacteria E. Coli	(colony/100mL)	100	TMTC	187	22	0	-	-	-	0	0	-	-	5
Nematodes	(Eggs/L)	<1	ND	ND	ND	ND	-	-	-	-	ND	-	-	-

Maximum limits for chemical and biological properties (mg/L) ND: Not detected -: Not sampling

2.15.3 Soil Test on Sewage Sludge and Soil for the Pilot Plant

In the early stage of the Pilot Plant, the sewage dry sludge and soil were tested and comparatively analyzed by the Sludge Standard for use in agriculture which was approved by Palestine Authority in November 2015. Sewage dry sludge tests were conducted twice in December 2014 and November

2015. The result shows in **Table 2.15.4**. Both sewage sludge and soil meet the Standard (heavy metal concentrations in sludge for agricultural use).

Table 2.15.4 Test Result on Heavy Metal Concentrations in Sludge at the Pilot Plant

Parameter	Standard		Sewage Sludge		Soil (Dec. 2014)
	Palestine[1)]	Japanese[2)]	Dec. 2014	Nov. 2015	
Cadmium	20	5	3.2	1.94	ND
Copper	1,000	-	279.5	153.3	33.6
Nickel	300	300	30.2	31.9	39.5
Lead	750	100	29.7	15.7	ND
Zinc	2,500	-	1,258	1,029.2	100.4
Mercury	16	2	2,969	1.67	0.0133
Chromium	400	500	44.0	43.45	42.4
Arsenic	-	50	ND	ND	24.4

Unit: mg/kg of dry matter
1) Ministry of Agriculture, the Standard, 2015
2) Ministry of Agriculture, Forestry and Fisheries

2.15.4 Soil Analysis in the Pilot Farm

The Pilot Farm as an experimental farm (the reuse of treated wastewater outside of the WWTP) has been implementing since June 2015 (for 1 year). The 2 kind of soil tests were conducted in May 2016, one is a normal soil without treated wastewater, and the other is soil with treated wastewater called "Test soil". The results are shown in **Table 2.15.5**.

Table 2.15.5 Soil Test Results in the Pilot Farm (Unit: ppm)

Parameter	Normal[1)]	Treated Wastewater[2)]	Japanese Standard[3)]	Palestine Standard[4)]
Boron (B)	0.012	0.004	1.0	-
Fluorine (F)	0	0	0.8	-
Chromium (Cr)	0.004	0.005	0.05	400
Nickel (Ni)	0.002	0.003	-	300
Copper (Cu)	0.001	0.002	125	1,000

(Note)
1) Soil without watering treated wastewater in the Pilot Farm
2) Soil with treated wastewater in the Pilot Farm
3) Ministry of Environment, Environmental Quality Standards for Soil
4) Ministry of Agriculture, the Standard, 2015

The results between the test soil and normal soil are not much different and both samples meet the Palestine Sludge Standard and Japanese soil standard (reference). Therefore, harmful to the soil is not recognized. The result of experimental farm for only one year cannot guarantee soil safety under using treated wastewater, and a long term observation of soil contents in fields is necessary. However, the regular observation of treated wastewater quality can avoid a harmful influence to soil. In other words, when the heavy metals exceeding the Reuse Standard are detected from treated wastewater, it is necessary to conduct immediately a soil test.

2.15.5 Orange Component Analysis in the Pilot Plant

Orange component analysis, orange by potable water and orange by treated wastewater (TE) was conducted in June 2015 (refer to **Table 2.15.6**). The results between the potable water and TE are not much different and both samples meet the Water quality of Palestine Standard Institution (PSI) as a reference.

Table 2.15.6 Orange Component Analysis Results (June 2015)

Parameter		Potable Water (ppm)	TE (ppm)	PSI 41Water quality (ppm)
Silver	Ag	0.0002	0.0003	0.01
Aluminum	Al	0.0996	0.0385	0.2
Calcium	Ca	9.8061	16.5407	100
Cadmium	Cd	0.0018	0.0004	0.005
Chrome	Cr	0.0031	0.0046	0.05
Copper	Cu	0.0133	0.0407	1.0
Iron	Fe	0.3132	0.4583	0.3
Potassium	K	44.2475	53.2399	10
Magnesium	Mg	5.6671	11.8305	100
Manganese	Mn	0.0220	0.0312	0.1
Sodium	Na	1.5372	1.2493	200
Nickel	Ni	0.0031	0.0060	0.05
Lead	Pb	0.0004	0.0003	0.01
Zinc	Zn	0.0147	0.0134	5

2.16 Training on Water Quality Analysis

There is a water quality laboratory at the Jericho WWTP in the administration building. A professor of the An-Najah National University conducted the training and lectures (total eleven times) for water quality analysis to the C/P in December 2014, May-June and November-December 2015 in the second year of the Project. This cooperation with the local university can supplement the C/P's capacity in using local human resource which in turn can also lead to sustainability of C/P's capacity development. The training for water quality will be continued. Main training and lecture contents are shown as below.

- Water quality analysis (BOD, COD, T-N, pH)
- Calibration of water quality analysis equipment
- Water quality management (lecture)

Figure 2.16.1 Training at the WWTP Laboratory

2.17 Training on Two Lines Operation of WWTP

(1) Objective for training

Waste water treatment system is operated by No.1 train only until now, but the remaining No2 train will be started-up to operate accordingly due expansion of sewer networks and increase of house connection ratio. Then, training for start-up for 2nd train was conducted by the request from counterpart with the JICA expert.

Practically, treated water was available for this training, and guide line for the purpose of smooth start-up was prepared by C/P under some assumptions.

(2) Guild line for start-up

Outlines are as follows;

1) Calculate necessary waste sludge volume for start-up and keep a certain volume in the current operated No.1 final sedimentation tank. But, sludge turbulence and treated water quality should be cared.
2) Drain and be clean in No.2 reactor, final No.2 final sedimentation tank, return sludge pipes for start-up.
3) Check condition of membrane diffusers, reactor mixers, a clarifier, blowers, a DO meter, and related facilities. In particular, facilities which are located in the submersible area and bubbling test for membrane diffusers with riser pipes of key technologies should be cared in accordance with an instruction of the vender manual, and no any leakages can be found.
4) No.2 final sedimentation basin is full filled by treated water and No.2 reactor is also filled by treated water up to the center level of a propeller of the reactor mixer (total volume approx. 1,500m^3).
5) Waste sludge is transferred by one return sludge pump No.M03-02-01 for No.2 from No.1 final sedimentation basin to the dedicated No.2 reactor, and reactor mixers are operated continuously and oxygen is supplied in the reactor by intermediate operation of a blower.
6) 100 m^3/day of inlet sewage is encountered in the reactor during first several days by arrangement of opening degree of No.2 inlet weir gate, and MLSS will be kept around 500 mg/l. Daily measurement of MLSS and SVI for monitor is required carefully. Calculate BOD-SS load and monitor color of activated sludge to be light blown.
7) Inlet sewage flow will increase day by day after reach of stable condition, and MLSS will also increase through two weeks, and over flow to No.2 final sedimentation basin.
8) Finally, inlet flow and MLSS will be arranged to be equal with No.1 train.
   Detailed guide line which was finalized by treatment manager is shown in **Appendix A 2-17-1**.

(3) Conclusion

Start-up for 2nd train will be started preparation when inlet sewage flow reaches 2,000 m^3/ day. Then, action will be taken when it reaches 2,500 m^3/day (approx. 75 % out of full design capacity 3,300 m^3/

day at No.1 train). C/P has recognized that it is not difficult for 2nd train to start-up since activated sludge of No.1 final sedimentation basin in operation as well as facilities such as pumps and pipes can be available. Then, treatment manager and operator have completely agreed the above method.

【OUTPUT-3】

2.18 Training for Basic Knowledge of Sewer Plan and Implementation of Workshop

2.18.1 Objective

Shown in the results of the individual capacity assessment of the C/P individuals, the average of basic technical knowledge of sewerage was poor. A Japanese training course in November 2013 was conducted to systematically acquire basic knowledge, but to supply the lack of time and lateness of the stage, beforehand trainings and workshops were planned for basic knowledge acquisition.

2.18.2 Training Period and Contents

(1) First Workshop

A Workshop was carried out in following schedule and held as the elementary workshop. In the workshop, due to the time limitation to invite the relevant persons who belong to the central government, Al-Bielh, Nabulus and other municipalities; engineers, financial and institutional staff and others in Jericho municipality were participated.

- Date: June 20, 2013
- Venue: Jericho Training Center
- Program: Basic knowledge of sewerage planning and sewer design

  *Refer to **Appendix A 2-18-1** for attendance list and training materials

(2) Second Workshop

For the participants, it was necessary to first understand service area, population, wastewater unit per capita and quality of the inflow and targeted treated wastewater. To achieve this, the below training on wastewater system planning was carried out and after that, pipeline planning was explained. The used materials are shown in **Appendix (A 2-18-2)**. The contents of the training are shown below.

- Date: November 3-5, 2013 (3 days)
- Venue: Jericho City Office (the C/P's office on the 2nd floor)
- Participants: 3 civil engineers (Mr. Fetyani, Mr. Isayed, Mr. Ghazi)

<Day 1: November 3, 2013>

Lecture on the calculation method for plan specifications of the "Preparatory Survey for the Jericho City Water Environment Improvement Utilization Plan (2011)". Exercises in calculation of wastewater flow amount and quality using an example wastewater plan specifications (area, population, wastewater unit and wastewater load unit).

<Day 2: November 4, 2013>

Check the calculation and answers from the day before. Exercises in wastewater amount calculation (amount per each pipeline) using said answers and a sample plan.

<Day 3: November 5, 2013>

Check the results of the exercises of the day before. Lecture on wastewater pipeline cross-section selecting concerning the relation between wastewater amount and pipeline pitch (the Manning Formula), and explanation of pipe diameter calculation methods based on each pipeline's flow amount.

(3) Third Workshop

Through the trainings carried out in last year, C/Ps had knowledge of the basic pipe diameter calculation. But it is insufficient with only one training occasion.

Exercises for calculation of wastewater flow amount and quality using changed examples of wastewater plan specifications were provided again. And also, exercises in pipe profile calculation using calculated pipe diameter and slope were also done. The used materials are shown in **Appendix (A 2-18-3)**. The contents of the training are shown below.

- Date: May 5, 7 and 25, 2014 (3 days)
- Venue: Jericho Training Center on the 1st basement floor
- Participants: 4 civil engineers(Mr. Fetyani, Mr. Isayed, Mr. Ghouj and another staff)

＜Day 1: May 5, 2014＞

As a review of the last training, exercises in calculation of wastewater flow amount and quality using a different example wastewater plan specifications (population, wastewater unit and wastewater load unit). Confirm the understanding level of C/Ps by having trainees explain the calculation methods and results. Exercises about pipe diameter calculation using the pipe plan and each pipeline's flow amount.

＜Day 2: May 7, 2014＞

Check the results of the exercises of Day 1. Especially, explain the importance of pipe allowance calculated by full flow amount and planned flow amount. Lecture on pipe profile calculation (earth cover depth and invert level etc.) and exercises pipe profile on the drawing.

＜Day 3: May 25, 2014＞

Pipe profile calculation carried out on Day 2 was a basic case not considering underground facilities such as water / gas pipes. In Day 3, exercises about pipe profile calculation in consideration of underground facilities were done. Explain the importance of clearance from underground facilities to sewers.

2.18.3 Training Results

(1) First Workshop

All attendees took an examination at the end of the training for the following issues.

- Method of calculation for planned amount of wastewater flow and quality

- Method of calculation for sewer diameter

The result was not satisfactory. It showed that more training/workshop should be carried out regularly, and it is necessary to have a system, such as scheduled examination, to check knowledge of the person in charge.

(2) Second Workshop

The C/Ps had knowledge of the Manning Formula, therefore basic pipe diameter calculation methods were acquired.

(3) Third Workshop

The C/Ps gained elemental understanding about the calculation method of wastewater plan specifications such as wastewater flow amount and inflow water quality. But more exercises about each pipeline's flow amount and pipe profile calculation are necessary because this training was the first time it was carried out.

(4) Conducting a Technical Assessment Test related to Sewers

Technical tests were conducted with the aim of confirming the acquisition status of basic knowledge on C / P about sewers by the above training and on-site OJT. Technical tests were conducted with two kinds of test concerning the maintenance and management of sewers. The contents of test are shown in **Appendix A 2-18-4** and the outline of the test is shown below.

Test Time: November 2015
Number of examinees: 5 C/Ps
Results: Examine-A; Passed 5 C/Ps, Rejected 0 C/Ps (Power point Examine)
Examine-B; Passed 3 C/Ps, Rejected 2 C/Ps

In the case of PDM, the number of passed applicants was 4 or more, while additional lecture was given to 2 rejected C/Ps in Examination B. In the re-examination, 2 C/Ps passed, so all 5 C/Ps passed.

2.18.4 Suggestion for Future Works

The C/Ps that participated in the training / workshop, the goal of acquiring basic knowledge on sewer is considered to have been achieved. The C/Ps that participated the workshop has the possibility of moving to another section/department or changing to the private firm, and it is necessary for C/Ps to transfer technology to the third party of the basic knowledge. At the same time, technology transfer and information exchange to sewage engineers in other municipalities in the West Bank are carried out when the Jericho WWTP is visited by many engineers after the start of operation, and it is very important to continue in the future.

2.19 Maintenance of Sewer Network

2.19.1 Training on Maintenance of Sewer Network

(1) First Workshop

The C/Ps inspected the sewer cleaning and O&M site during the training in Yokohama, Japan, in November 2013 and understood its necessity in Jericho for the future. In Jericho, C/Ps recognized that sewerage works are making progress by grant assistance, and that the sediments in sewers and blockage of sewers by illegal dumping of wastewater and garbage from households are issues.

Under these conditions, trainings regarding the necessity of sewer cleaning, methods, equipment, safety control and sewer cleaning plan were carried out for C/Ps. The used materials are shown in **Appendix A 2-18-3**. The contents of the training are shown below.

- Date: May 28, 2014
- Venue: Jericho Training Center on the 1st basement floor
- Participants: 4 civil engineers(Mr. Fetyani, Mr. Isayed, Mr. Ghouj and another staff)
- Contents:
  - Objective and necessity of sewer cleaning
  - Development method of sewer cleaning plan
  - Priority decision method of sewer cleaning
  - Sewer cleaning method
  - Safety control

(2) Second Workshop

Currently inflow volume to sewers is small and then activities of maintenance for sewers have almost not been carried out. Since illegal connections and clogging by cloth discharged in sewers at the mouth of drop pipe of drop manhole were found in the Defect Liability Inspection, the necessity of inspection and cleaning was recognized.

As the maintenance of sewer system, some workshops were held instructing and discussing to the staff of sewage section of the municipality for importance of maintenance, checking points for cleaning and actual maintenance activities on 3rd June.

A jet washing vehicle with jet-washing system, vacuum system, washing water tank and vacuum tank plans to be donated to the municipality by USAUD (at beginning of October it was not provided) and the municipality can clean the sewer network using it (refer to **Figure 2.19.1**). Therefore, cleaning methods using the jet-washing vehicle was instructed by a seminar showing photos of actual examples in September.

In the seminar, since management of sewage section ask to the JICA Expert to formulate an example of comprehensive cleaning plan for sewers, the JICA Expert formulated and explained a plan (refer to **Appendix A 2-19-1**) emphasizing the importance of survey plan of actual conditions. The major contents of the plan are shown below;

Figure2.19.1 Sewer Cleaning Vehicle donated by USAID

1. Purpose
   1) To keep necessary function: to discharge necessary volume of wastewater
   2) To allocate proper budget with the staff
2. Regular Inspection Plan
2-1 Purpose
   1) To observe the condition of inside sewers and to find the timing of emergency and/or regular cleanings
   2) To monitor condition of facilities of sewers, such as connection pit, manhole covers and damages by nearby constructions
   3) To survey illegal connections along the network
2-2 Target of the Sewers
   1) Installed by Japanese Grant
   2) Installed by USAID
   3) Installed by JICA Pilot Project
2-3 Actual inspection activities
   1) Regular patrol for surface of sewers
   2) Based on decided priorities, to check inner pipes opening of manholes
   3) Under the information of consumers, to check sewers opening of manholes irregularly
3. Implementation of cleaning
3-1 Irregular cleanings
   Based on checking by patrols and information by consumers, cleaning shall be done if necessary
3-2 Regular cleaning
   Base on the plan, regular cleaning will be done considering priority

Above draft plan has been explained and distributed to staff in charge of maintenance of sewers, and the C/Ps will start the regular inspection immediately.

2.19.2 Daily Work of Sewer Cleaning of Sewer Network

Procured jet washing vehicle by USAID was delivered to Jericho Municipality on 31st January 2016 and next day, a trial operation by municipality staff was done utilizing the vehicle. Below cleaning activity was done in order based on the recommendation of our expert.

1) Removal and discharge sand and small gravel accumulated in inflow chamber of WWTP
2) Withdraw of sludge at the bottom of manhole pump pit, but there is almost no accumulation of sludge
3) Cleaning of drop manhole along Trunk 1 sewer

After above actions, the maintenance of sewer network has been carried out according to "Maintenance Manual for Sewer Network", and the outline is shown as followings.

1) Target of actions
   - Sewers and facilities installed by Japanese grant project
   - Sewers installed by USAID
   - Sewers, connection pipes and facilities installed Pilot Project done by JICA
2) Patrol activity
   - Regular patrol along sewer pipeline
   - Checking of sewer inside with manhole cover opening based on stipulated priority
   - With reporting of citizens, checking sewers by necessary method
3) Implementation of cleaning
   a) Irregular cleaning
      As the result of checking by patrol and citizen's report, a cleaning is done if necessary.
   b) Regular Cleaning
      Decided frequency of cleaning under the priorities will be done as the result of patrol activity. Currently, the inflow chamber of WWTP, drop manholes and the pump pit of manhole pump stations have been cleaned every 3- 6 months.

2.20 Assistance of House Connection to Sewers (Pilot Project)

2.20.1 Objective

For a stable management of the sewerage works, an early boosting of the tariff income by progressing connection from private sewers to public sewers is essential. It is important to secure the inflow sewage quantity operate the WWTP which is constructed by the grant aid project stably. This will be possible by promoting house connections.

Municipality of Jericho selected several priority areas where connections to the public sewer are necessary as soon as possible, due to the generation of wastewater and the environmental conditions. In this Project, technical transfer to C/Ps will be implemented by various types of house connection, which is regarded as the Pilot project (PP). The PP will be divided into two phases (1st phase and 2nd

phase) to be carried out.

2.20.2 Connection Work by Palestinian Side Budget

The Ministry of Finance will place a disbursement as the counterpart fund to the grant aid project. This budget will be used for the Palestine side construction, and in addition, includes the cost for branch and connection sewers with receiving pit installations. The connection works within each premise are not included in the scope of works, and the works will be implemented by house owners.

The connections to buildings along the trunk and branch sewers constructed by the grant aid project are the first priority, and the connections in concentrated housing areas where branch and connection sewers will be extended, are the second priority.

The Experts and Municipality staff surveyed over 1,000 of the targeted buildings to confirm the current condition for connection. In this survey, the Experts and C/Ps interviewed the residents and owners of the buildings about the used number of apartment flats and location/ number of sharing buildings of cesspits as much as possible. Based on the survey, the possibility of connection to each building was discussed with C/Ps considering the difference ground level to the connection pits installed by the grant project and the priority of branch and connection sewers.

2.20.3 Target Area of PP

The target areas of PP were selected as below following various discussions considering C/P's requirements.

- To realize an early sewerage tariff income
- To expect securing wastewater inflow as much as possible in the WWTP
- To accumulate experiences of connections on various technical conditions (standardization of connection methods/procedures)

The range of connection for the PP is from the discharge points of the consumers to the connection pits installed by the grant aid project. Pipe Connection Planning Map is shown in **Figure 2.20.1**. The areas circled by blue lines are the PP areas, and areas circled by red lines shows the 1st phase areas. However connection works for some areas will not be implemented due to budget limitation.

2.20.4 Estimation of Connection Number of Users

The number of estimated connections for the PP is shown in **Figure 2.20.1**. This number is based on field surveys and information of the Google Map (2013), and **Table 2.20.1** shows the estimated connection number. The numbers of restaurants, shops, apartment flats and offices are accommodated in the buildings. The connection number of each building is counted as one and schools and other entities, which are composed by several buildings, are also counted as one. The number of buildings in the target areas of the 1st phase of the PP has been confirmed by a detailed site survey.

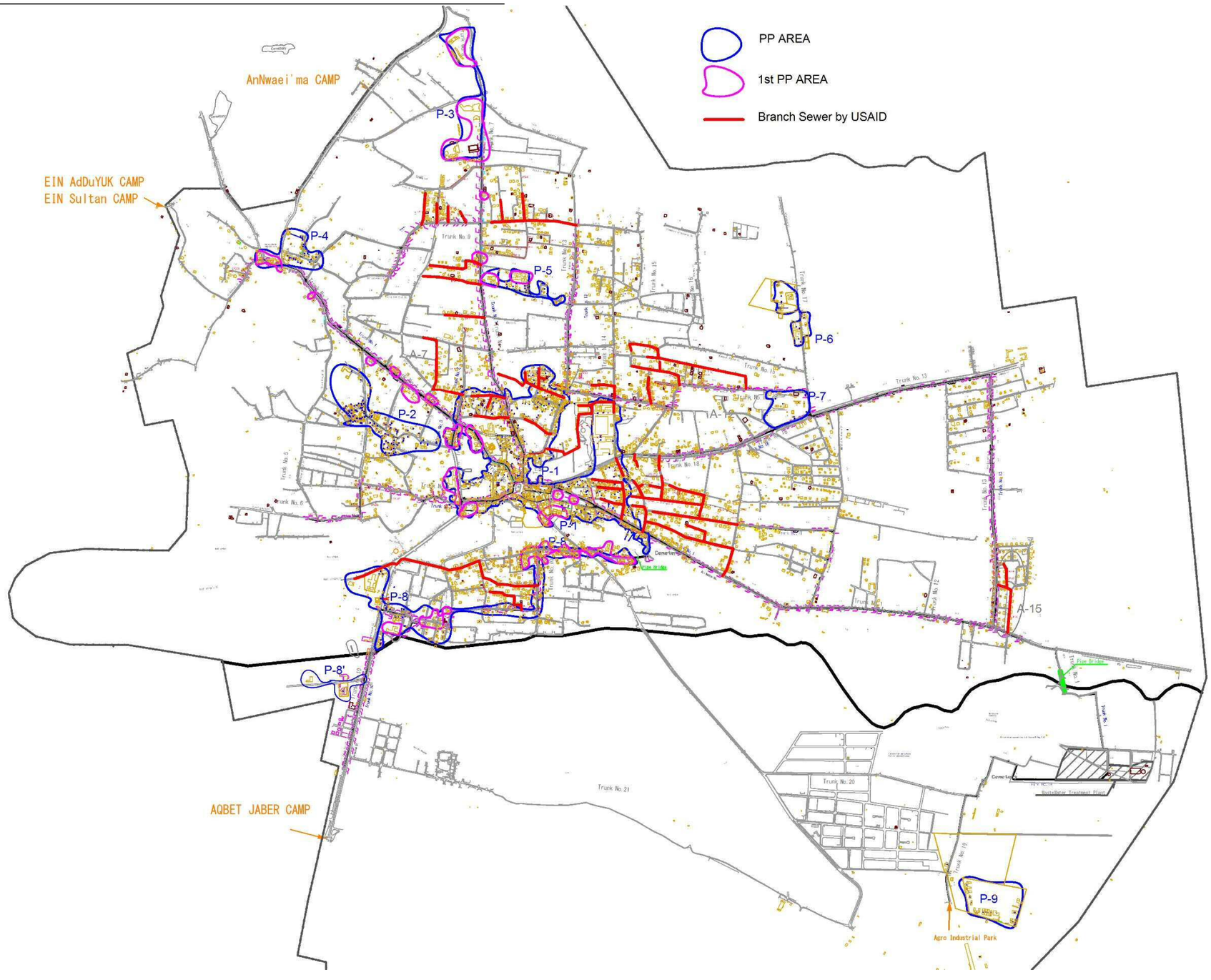


Figure 2.20.1 Designated Area of PP

Table 2.20.1 Estimation of Connection Number

Items /Category		Detached house	Commercial/Ap. Buildings					Schools	Factories	Instution	Hotel
			Buildings	Restaulan	Shop	Ap. Flats	Offices				
		①	②	③	④	⑤	⑥	⑧	⑨	⑩	⑪
PP Area	a)City center	80	246	15	490	100	50	7	0	10	2
	b)Other PP Area	160	45	1	60	80	10	6	0	18	1
	c)Total PP Area	240	291	16	550	180	60	13	0	28	3
	d)Ist PP Area	43	33	10	87	91	5	10	0	21	1
e)Other Area		833	138	6	43	360	5	2	3	8	3
f)Total		1,356	753	48	1,230	811	130	38	3	85	10
PP Area Connection		575	c)①＋②+⑧～⑪								
Other Area		987	e)①＋②+⑧～⑪								
Connetction Total		1,562									
PP Area Consumers		845	c) ①＋③～⑥+⑧～⑪Note:Half of shops in City Center are consumers								
Other Area		1,263	e) ①＋③～⑥+⑧～⑪								
Total Consumers		2,108	Note:Half of shops in City Center are consumers								
Ist PP Connections		94	d)①＋②+⑧～⑪								
Ist PP Consumers		268	d)①＋②+⑧～⑪								

As shown in above Table, 575 buildings and 845 users are to be connected by the PP, and in which half of shops in the City Center are not included in the user number because many of them are very small-scaled without water connection. The 1st phase of the PP targets 94 connections and 268 users. It includes many large scale buildings such as schools, a hotel, and public properties. By such large scale connections, the discharge amount for the WWTP operation is expected to be secured.

2.20.5 Implementation of the PP

As the 1st Phase PP, the public meeting was held for local residents of City Center supported by Jericho City on October 12 and 30, 2013. The house connection design including preparation of tender documents in the 1st Phase PP was completed in early December 2013, and the tender announcement with the scope of works and selection criteria of contractor were advertised in newspapers. Several companies purchased the tender documents, and submitted their offering prices. The JICA Experts and C/Ps selected one successful company after evaluation of the prices, company performance and construction ability. The final selection was done at the end of January 2014.

(1) Selection of Contractor of 1st Phase PP Construction

The specifications, which were prepared last year for the 1st phase PP construction, were announced in the newspapers with the cooperation of the municipality. The contents of the works were explained to the four contractors whom applied, and distributed the required PQ documents and sealed price to be submitted on a specified day. Upon evaluation of the PQ documents it was confirmed that each company satisfied the required conditions, therefore the bids were unsealed. Al Ferdaws for Engineering Contracting Co. Ltd, whose head office is located in Hebron, was selected due to the lowest price. The total 93 target buildings are shown in the below **Table 2.20.2**.

Table 2.20.2 Target Buildings for Original Contract

Category	Common Houses	Commercial /Apartment Buildings	Schools	Institutions including Mosque and Church	Hotel & Large Buildings	Total
Connection No.	34	38	11	5	5	93

(2) Commencement and Progress of 1st PP Connection Work

The Contract with Al Ferdaws Co., Ltd was concluded on February 23, 2014, and the survey work started from the topography survey in the beginning of March. There were suspicions regarding the quality of the actual construction work and management for Al Ferdaws Co., Ltd due to the remarkably low budget. However no serious problems for the management of progress/work and the quality of work have been observed. All things considered, Al Ferdaws Co., Ltd is a reliable and reasonable Palestinian constructor.

Discrepancy between contents of the contract and the actual work occurred along with the progress of the construction, an amendment of the contract was made to increase the contract price and extend the construction completion time from the original end of June to the end of July. The major reasons for the amendment were as follows;

a) For the connection work for large scale entities such as schools and public buildings, the extensions of pipe laying length were required due to the detection of numerous discharge points, and/or the extensions of laying pipes under the pavement were inevitable because these pipes could not be avoided from the route of pavement area.
b) The connection work for several large scale buildings which were planned to be included in 2nd Phase PP were included in the contract, with meditation of the municipality, since said facilities were scheduled to be reconstructed.

The amended target buildings are shown in the **Table 2.20.3** below, and the total number is 89.

Table 2.20.3 Amended Target Buildings

Category	Common Houses	Commercial /Apartment Buildings	Schools	Institutions including Mosque and Church	Hotel & Large Buildings	Total
Connection No.	35	28	9	12	5	89

In response to the municipality's strong require to assign a contact engineer, the Team hired two local engineers. Currently, smooth communication with the municipality is realized through the engineer. In addition, the other engineer was hired to supervise the performance and the progress of the work.

(3) Relation of the Connection Work to Commissioning of WWTP

For the commissioning of WWTP, wastewater is necessary as the nutrient for the activated sludge. To provide wastewater to the WWTP, the 1st phase PP was started in March 2014. In the municipality, there are four (4) tanker trucks owned by private companies to discharge wastewater from the cesspits attached to the buildings, and these were fully used to discharge wastewater to WWTP during the

early periods of the commissioning stage from May 14, 2014 to June 13, 2014. After partial completion of the sewers, wastewater discharge through sewer pipes from the area of 1st phase PP began. The total volume of wastewater has been gradually increasing and the inflow amount reached 300 m^3/day, including 100m^3/day of tanker-charged wastewater. The target amount, 300m^3/day, is expected to be fulfilled by only the wastewater discharged from the area upon the completion of the 1st PP.

(4) Precedence Design of Connections for Improvement of City Center Avenue

A project for the improvement of 1.2km of City Center Avenue donated by Russian Government was determined, it plans to refurbish the avenue and the alongside buildings. For the implementation, sewer pipes and pits for 200 shops and offices along the avenue needed to be installed before the replacement work of the pavement. When the above installation is carried out, connection pits to sewers for all shops and offices, including the small-scaled majorities, will undergo constructions for sanitary drainage facility installation. Since the avenue improvement works had been originally contracted to start at the end of April 2014, the layout plan for pipes and pits have been made based on research of all target shops and offices, without topography surveys, and the tender documents were prepared by the middle of April.

However the tender aided by Russian Government had not been carried out by the end of June, and since the contract with the consultant company for the 2nd Phase PP was concluded, the tender documents, including survey results, were submitted to the municipality.

(5) Preparation of the Design of 2nd Phase PP

The insufficient research of target buildings and discharge points proved to be an issue for the design of 1st phase PP, an exploration survey by entering the premises of each building with the staff of municipality was carried out. Based on this research, rough connection drawings were prepared and used as base maps for the 2nd phase PP. The approximate costs for the 2nd PP was estimated based on the material calculations by the drawings.

The design for 16km of branch sewers, which was originally planned to be installed by the counterpart funds, reached the final stage at the end of June, and the installation is to be carried out by USAID, according to the latest information. The installation by USAID is said to commence in September 2014. The branch sewers are shown in **Figure 2.20.1** with the 1st and 2nd phase PP areas. As shown in the figure, the branch sewers by USAID and the 2nd phase PP areas are partly overlapping, the PP will connect the users to the sewers after the installation by USAID.

(6) Ordering Design Work for 2nd Phase PP

For ordering the design work for 2nd phase PP, similar procedures with the 1st phase construction work was taken. The contents of the design and required qualifications were advertised in the newspapers,

and after holding a meeting for explanation of the work with the applicant companies, the confidential submission for PQs and quotation was required. The PQ and companies were evaluated, and only the bids by the qualified companies were opened.

Only one company out of the total four was qualified by the evaluation of PQ and since the quotation was lower than the budget, this company ORAL for Engineering Consultation was selected.

(7) Management of Design Works of 2nd Phase PP

The contact with ORAL was concluded on April 21 2014, and the topography survey was carried out. The survey for previous mentioned City Center area of the avenue improvement was done first and the design for the connections with the tender documents were finished. The survey continued on for the PP1 area, which is the surrounding area of the City Center and transited to other areas. Along with survey data collection, the layout for connection pipes and pits was determined with the calculation of the profiles. The survey was basically carried out for the points determined by the JICA Experts as pits and surveyed not only the level but also the coordination.

The design for areas where the users will be connected to the branch sewers installed by USAID is separated from other areas. The latter (design for other areas) is already completed.

For the 2nd PP, the Expert and C/Ps discussed the design contents and implementation schedule, periodically. This helped share at information and transfer technology to C/Ps.

(8) Management of Tender Process of 2nd Phase PP

The package 1 of the 2nd Phase Pilot Project (2nd PP) construction tender was carried out with cooperation of Jericho municipality in November 2014. The target areas for the 2nd PP are P1, P2, P4, P5, P6, P7, P8 and P9 as shown in **Figure 2.20.2**, and the package 1 areas, P1, P2, and P4 are the most important areas for the municipality. For the design of the 2nd PP, if a surplus budget remains after the tender of package 1, the budget will be applied for package 2.

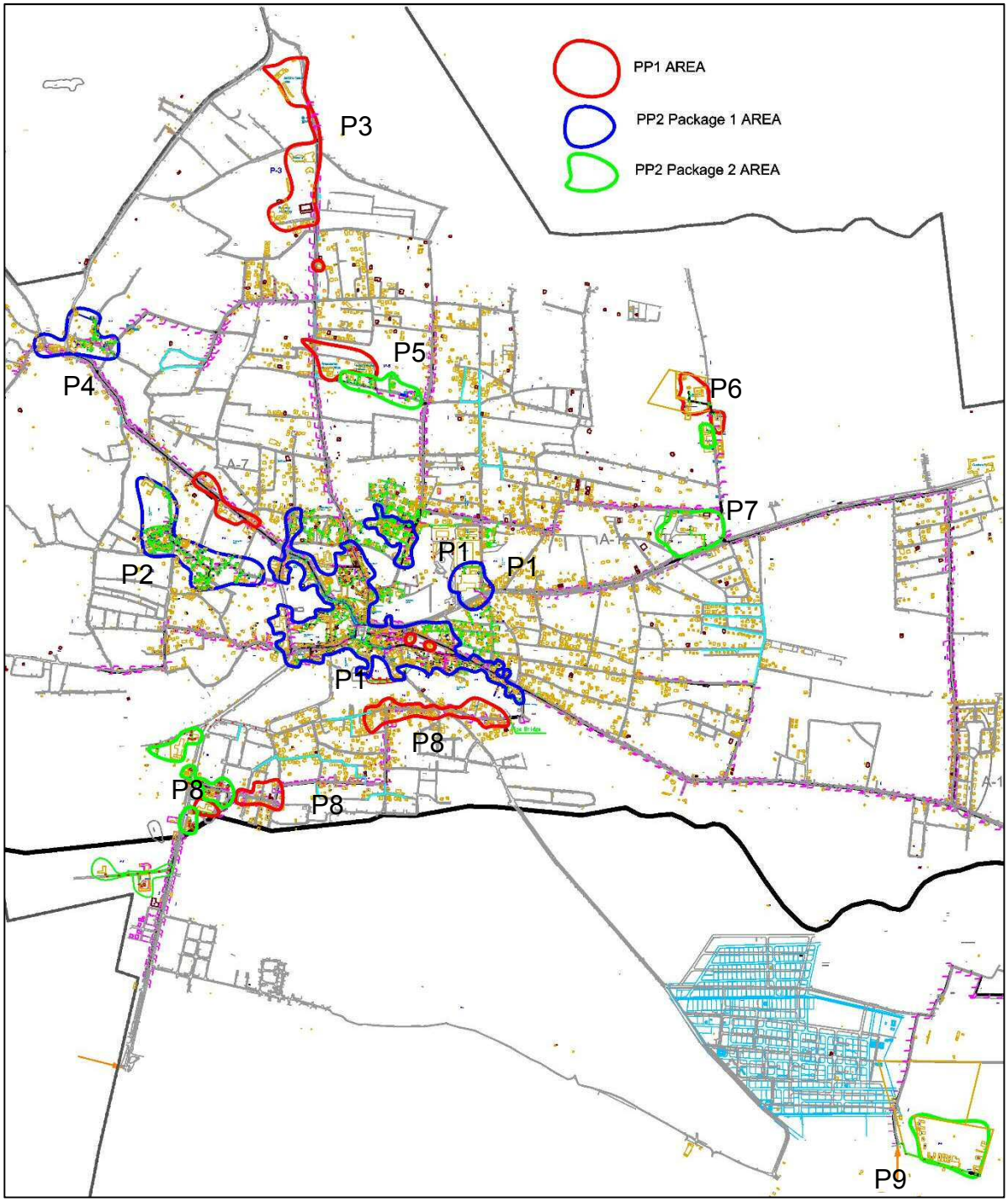


Figure 2.20.2 Areas of Pilot Project

As the result of tender, the JICA Expert Team contracted with Dar Al-Bina for Trading and General Contracting Company (Dar Al-Bina Com.) which offered the lowest price within the four (4) companies participated and satisfied the required qualifications of the tender.

The municipality evaluated Dar Al-Bina Com. as a good contractor by judging the company's numerous construction works. The construction was contracted on November 23, 2014, the actual installation

was started in January 2015, and the end of construction was stipulated at the end of July 2015 in the contract.

(9) Management of Construction of 2nd Phase PP

The construction has already started in areas P2 and P4, and approximately 100 housings out of a total 430 target housings were connected including area P1by the beginning of April. The JICA Expert Team hired and assigned two (2) engineers who also worked in the 1st PP for construction supervision, while one of them has been working together with part-time municipality staffs. The two JICA Expert Team's engineers and two municipality's staff in charge of house connection have been working to gain client cooperation and conduct construction supervision under the negotiation of clients, ordering site survey and actual designing to the contractor. The staff has been assigned since the 1st PP and their current skills of managing construction are sufficient for these works. The roles of the JICA Expert Team are to advise the engineer if necessary, to check the sites and drawings, and to manage the works to not violate necessary principals.

The range of the road improvement project donated by the Russian Government is shown in **Figure 2.20.3**. It focuses on improvement of the avenue, including pavement or replacement of pavements in major sidewalks and main roads. In this area, the design of sewer connection works were made based on the precondition of the completion of the road construction, and it will be contracted out to the contractor of road works.

This project had originally been planned to commence in May 2014, but this timing was in doubt at the beginning of April 2014. However Jericho municipality cannot wait long for the commencement of the project and desires an early construction of the connection work. On the other hand, a part of sewage pipes in this area is downstream of the planned pipes currently included in the 2nd PP construction, the installation of said pipes are required to be started by the middle of May. The contract negotiations and inspection comp1etion must be finished within the working schedule of the JICA Expert Team.

The work plan for this area has been determined after discussions with the municipality as follows;

1) If the construction of road improvement area starts by mid-May, the JICA Expert Team will contract out the connection work according to the original plan.
2) If it is certain that the contract of road improvement work will be executed by the end of 2015, by mid-May, the JICA Expert Team will contract with Dar Al-Bina Com. for the necessary work and will negotiate with the contractor for remaining road improvement works.
3) If the time and/or execution of the road improvement work are unknown by mid-May, all works for the pipe installation in the area will be contracted to Dar Al-Bina Com.

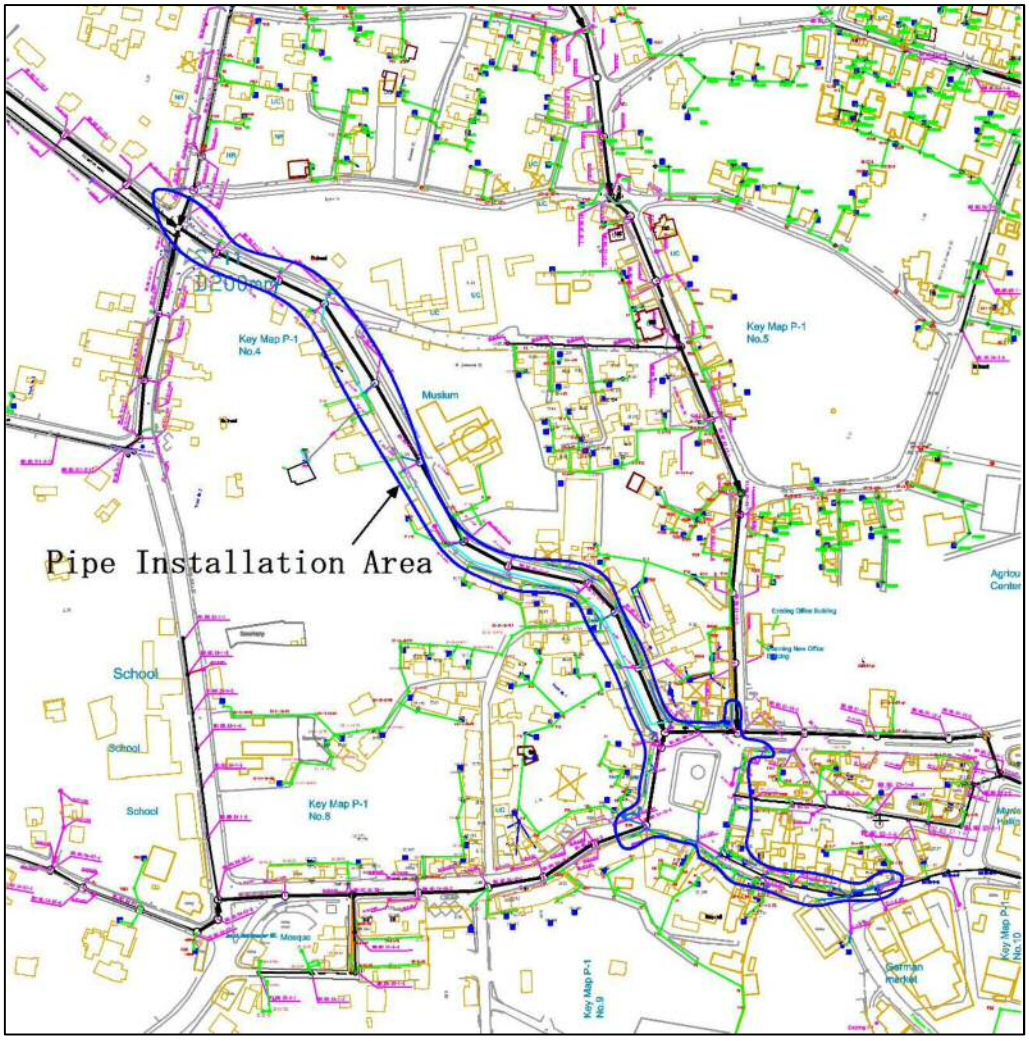


Figure 2.20.3 Areas of Road Improvement in Municipality Center

Because the time of commencement of the road improvement plan (the area circled by green line shown in **Figure 2.20.3**) donated by Russian Government was not unknown at the end of May, a design change so that Dar Al-Bina Co. would execute the work to conduct connection work at the area was done. With the change of contract, the construction term was also extant to be the end of September, but actual completion was postponed to be the end of December.

For house connections, there are cooperative and uncooperative house owners, and around 15-20 % of owners finally rejected to connect. In addition, even though they accepted to connect to their house, they reject to use the connection pipe, which is necessary to use for neighbors connection by the topography condition.

Although the piece of constructed amount was supervised applying contract unit prices with Dar Al-Bina Co. referring their submitted pieces, they suddenly offered that the amount of arranged work would exceed the contract price and stopped work before completion. The JICA Expert discussed on this matter with them including the municipality and concluded that they could remain 64 connections, of

which the municipality will complete the connections with their budget. The necessary budget for the connections was around 20,000 USD, and the JICA Expert issue a letter to the mayor of municipality to request completion of connections. The average cost per housings was very small compared to the average and effective because connection pipes were extent near by the target houses.

The connection number of housing/buildings and that of consumers were shown in **Table 2.20.4**.

Table 2.20.4 Connection number by PP2

Category	Detached Houses	Schools	Institutions/ Mosque/ Church	Hotel	City Center Connection	Restaulant	Apartment/ Domitory	Shop	Offices	Total
No.of Private Sewers	201	3	11	1	90	14	255	287	71	**933**
No.of Connections	201	5	11	1	74	29		150		**471**

2.20.6 Assistance of House Connection by Other Projects

At the end of May 2016, 76 of connections without pilot project had been completed, and other around 50 citizens were offered and progressed to connect sewers. USAID-1A had done 12km of branch sewer extension as 1st phase project, and other plans contributing house connection are progressing as followings.

(1) USAID 2nd Phase (1B) Branch Extension Plan

The design for 24km of branch sewer, of which the municipality offered to install, has been completed and the plan is mostly expected to realize. For realization of this plan, because progressing of house connection for 1st phase project area is essential to be chosen by USAID, the municipality decided to conduct later-mentioned project by their budget.

(2) House Connection Project by Municipal Budget

The municipality decided to carry out a project with one million NIS budget for house connection mainly along branch sewers installed by USAID, which aims progress the connections as much as possible within the budget. The JICA Expert cooperated the project to visit target housings, confirm the willing of connection, to design actual connection and make calculations of the cost. As the resulted in the activities, the plan was formulated with the cost of 1.06 million NIS for around 250 buildings living 600 families including 55 buildings, of which connections were not completed by Phase 2 Pilot Project due to lack of the budget. A tender was done with above contents and a local contractor contracted with the budget of 860,000NIS. The construction work started at beginning of May 2016 and it was planned to complete at the end of 2016.

(3) Sewer Installation Project for Acbat Jabar Camp by UNRWA

A sewer installation project with two (2) million USD was realized by UNRWA and the actual preparation work was started on May 2016. The design was done by PWA under a financial aid by a French Local Government and the design includes sewer and manhole without house connection. The

JICA Expert explained the condition of Jericho Sewage System to the staff of UNRWA as the designer and supervisor of grant project and emphasized the importance of including house connection to the project.

(4) Connection project by Palestine Government

Connection project by Palestine government with budget of a million USD, which was promised as local side budget of the Jericho grant aid project, is tackling as important theme to realize. For realization, the municipality issued a request latter to PWA on April. When this project is realized, the possibility one million budget of Japanese aid as a counter fund for house connection work will be high.

2.20.7 Technology Transfer through the PP Projects

Through the PP project as mentioned before, the technology transfer to C/Ps were carried out.

- Method of various household connections and cost comparison for each condition
- Concept of connection under the conditions on the structure of the building or topography
- Concept and formulation method of technical standards when the municipality permits connection
- Concept of preparation of appropriate development plan to accelerate house connection
- Upon development of the branch sewers, the technical view of the prioritized area and sewers to be requested for other donors

A considerable number of defect works of benching of invert at connection works were found. The reason was assumed to be lack of understanding of invert function based on the inspection, for example i) inside of pipe cannot watch through from manhole and it means we cannot check the condition of inner sewer, because inflow and out flow pipe was very near, ii) the benching is too high even though the height shall be less than 50% of pipe diameter. When the height of benching is over 50% of pipe diameter, the edge will be easily broken and the maintenance become difficult.

On these points, the expert instructed to our hired supervisors by standard drawings issued by a Sewerage Works in Japan. The expert went together the supervising/inspection as much as possible and instructed to local supervisors to correct methods at the site. After these actions, the works were improved considerably.

Finishing of benching tends to be not considered important because the rate to total costs is very small. However since it affects seriously the maintenance, the staff of municipality should understand the importance. In the workshop aforementioned, the expert pointed out the issues and tried to promote the understanding to the municipality staff.

2.20.8 Creating GIS-based Map and Database for House Connection Survey

From mid-February 2017, the JICA Expert has assisted C/P in making GIS-based database for a Jericho's

on-going field survey data. The field survey-coordinated and conducted by Jericho Municipality- has been collecting GPS points of house line connection joints. Attributes such as connection pit, fitting, private sewer, and main manhole are also recorded for each GPSed joint point. The connection lines (created by connecting the surveyed GPSed points for each house) have also their own attribute data such as owner`s name, pipe line diameter, building type, and the house's water meter number. All the above data has been recorder in GIS in parallel with the survey progress.

The GIS shapefiles include two separate layers: the connection point shapefile and the connection lines shapefile with the related attribute tables. This is still an on-going work and will continue until all house connection lines are surveyed and mapped in GIS. As of April 13, house connection lines have been mapped in GIS for a total of 75 buildings.

2.21 Data Collection and Verification of Benefits from Sewer Construction

2.21.1 Purpose of the Study

The Project requires to conduct by the local contractor on the groundwater quality survey to be analyzed by comparing the data before/after sewer construction to verify the effect of sewer construction (the reduction of untreated wastewater exudation amount from cesspit to underground).

2.21.2 Groundwater Quality Survey

The JICA Expert Team and C/Ps collected data concerning the quality of groundwater before constructing the sewers (before starting operation of the WWTP), to be analyzed by comparing the data before/after sewer construction to verify the effect of sewer construction.

Escherichia coli (E. coli) is used as an indicator of sanitary condition while Chemical Oxygen Demand (COD) and Nitrate-nitrogen (NO_3-N) are used as indicators of groundwater pollution by untreated wastewater. The sampling points and frequencies of measurement are shown in **Table 2.21.1**. Data collection, comparison and analysis are conducted intermittently as a monitoring practice of groundwater quality. Sampling and measurement were conducted by a local consultant four times in June 2013, June 2014, May 2015 and February 2016.

Table 2.21.1 Sanitary Environment and Items of Groundwater Monitoring

Items	Sampling Location	Check Interval	Remarks
COD	11 Locations of tube well, and 1 location of surface water Total 12 locations	Once in a year	Sampling timing should be under the high temperature except rainy season
Nitrate-nitrogen			
Number of E. coli.			

The sampling points were selected based on the well information of Municipality of Jericho. 11 points are located near the trunk sewers, and the remaining 1 point (No.11) is outside of the sewerage service area. C/Ps with knowledge on groundwater pumping visited the well locations with the JICA Experts, and decided the points after confirming the well conditions. **Figure 2.21.1** shows the twelve sampling points. The No.10 and No.12 wells are the same as the points of the Baseline survey (water quality for agriculture). The well information is shown in **Table 2.21.2**.

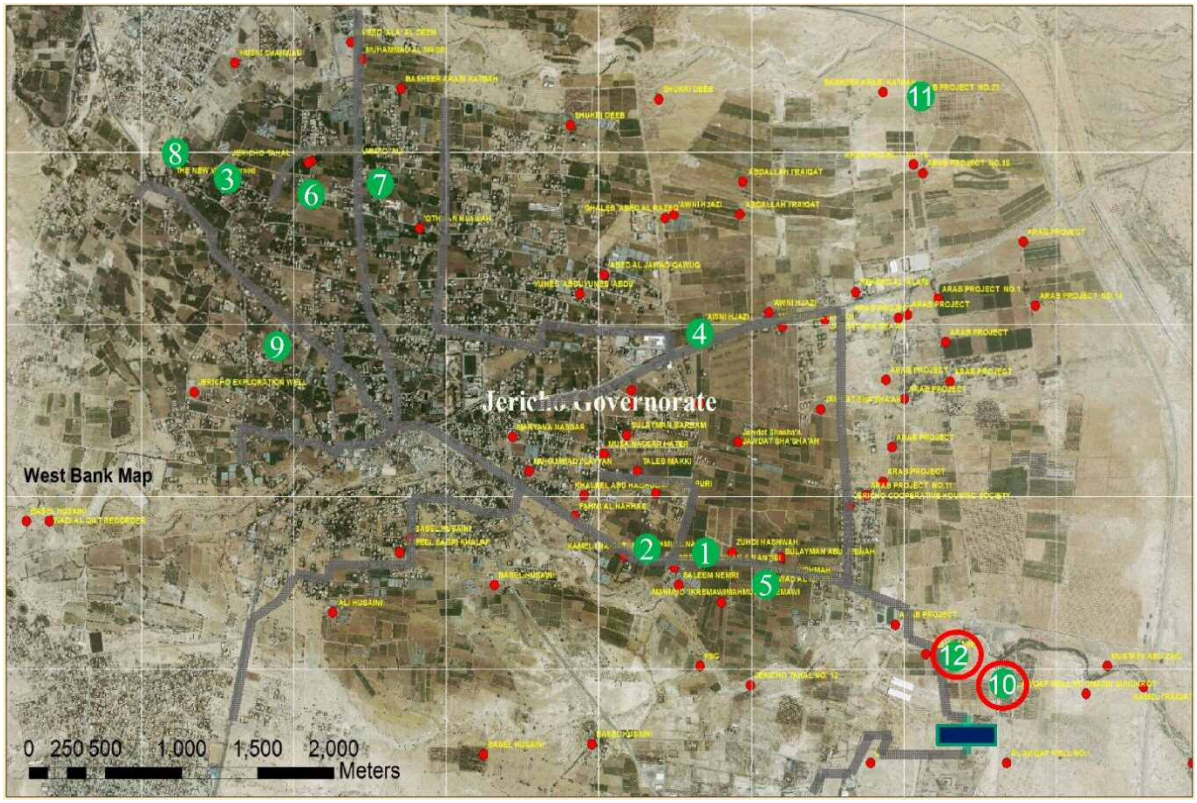


Figure 2.21.1 Groundwater Monitoring Point

Table 2.21.2 Information of Monitoring Well

No.	Point-Name	Well Depth (m)	Water Use	Well ID
1	Sbeeru Hanhan &Rantisi	57	Agricultural	19-13/006
2	Fahmi al nahhas	126	Agricultural	19-13/048
3	Samed	120	Agricultural	19-14/026A
4	Awni HJazi	100	Agricultural	19-14/037
5	Jawad Almasri & Mahmoud	137	Agricultural	19-13/015A
6	Kaled Dabes	No data	Agricultural	
7	Dwedar	120	Agricultural	
8	A'aen Al Soultan	Surface	Domestic/Agriculture	
9	Kalel Fehmi Ghanem	217	Domestic	
10	Majed Al Tarifi	55	Agricultural	
11	Arab Project No.23	100	Agricultural	19-14/081
12	Ismael A'daaq	No data	Agricultural	

The JICA Expert and C/Ps visited the wells of No.5, 7, and 11 where water quality of COD and E.coli are high comparatively, and conducted an interview survey to farmers about harvests. The responses are shown as below.

No.5 Well: Usage of chemical fertilizer, product: cucumber, decreasing harvest

No.7 Well: Usage of chemical fertilizer, main product: cabbage, smaller product size

No.11 Well: Usage of compost, product: palm date, constant harvest

The results of water quality test (2013~2016) are shown in Figure **2.21.2** to **2.21.4**.

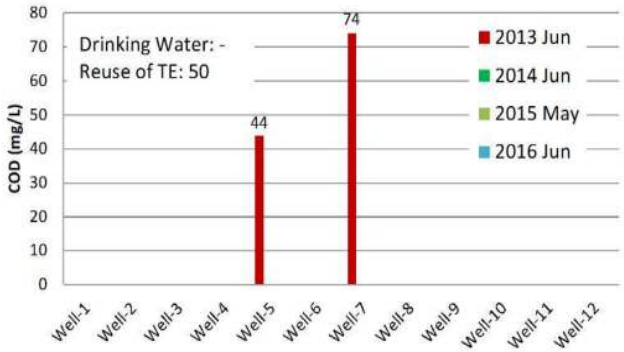


Figure 2.21.2 COD

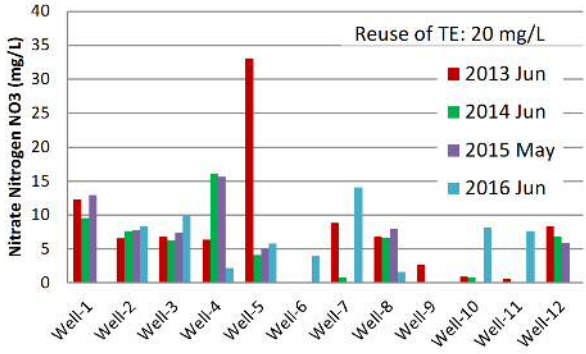


Figure 2.21.3 NO_3-N

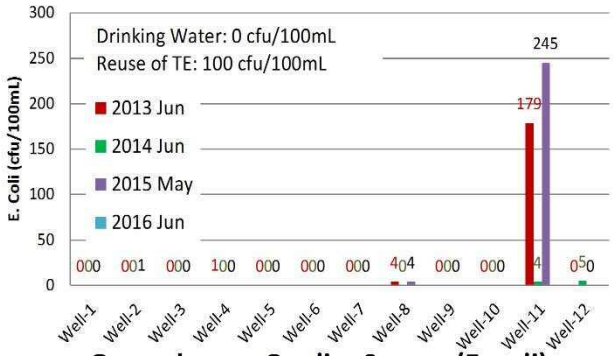


Figure 2.21.4 E.coli.

2.21.3 Verification of Benefits from Sewer Construction

Although the result of COD in No. 5 and No.11 Well in 2013 is higher than the Palestine Reuse Standard, the results in 2014 and 2015 are below detectable limits (below 10 mg/L). The result of E. Coli, the well No. 11 exceeds the Standard value. However, the values of NO_3-N differ among wells and it cannot be clearly started that the water quality has improved from 2013 to 2016. Since the values of NO_3-N except well No.5 in 2013 is lower than the Standard, the groundwater as agriculture use is applicable due to within the Reuse Standard value.

The 2nd survey was conducted right after the WWTP operation has started and number of house connection to the public sewer were only 35 as of the end of June 2014. The number of house connection is 640 and connection ratio is only 10.5% (=640/6070) as of the end of June 2016. Therefore it cannot be judged to be correctly showing the effects of sewer construction.

2.22 Supporting the Sewage Development for Refugee Camp around Jericho Municipality

The sewage development plan for the refugee camps located near Jericho municipality, Aqbat Jaber Camp (AJ Camp) and Ein Al-Sultan Camp, were planned by Busanson Municipality in October 2014. According to the development plan, the area was divided four (4) packages as sown in **Table 2.22.1** and **Figure 2.22.1**.

Table 2.22.1 Outline of AJ Camp

Package No.	Sewer Length (m)	Population Served (%)	Served Population	Estimated Cost (USD)
1	10,166	40	3,451	1,769,735
2	8,567	30	2,711	1,488,305
3	7,960	20	1,770	1,343,590
4	2,787	10	918	578,180
Total	29,480	100	8,850	5,179,810

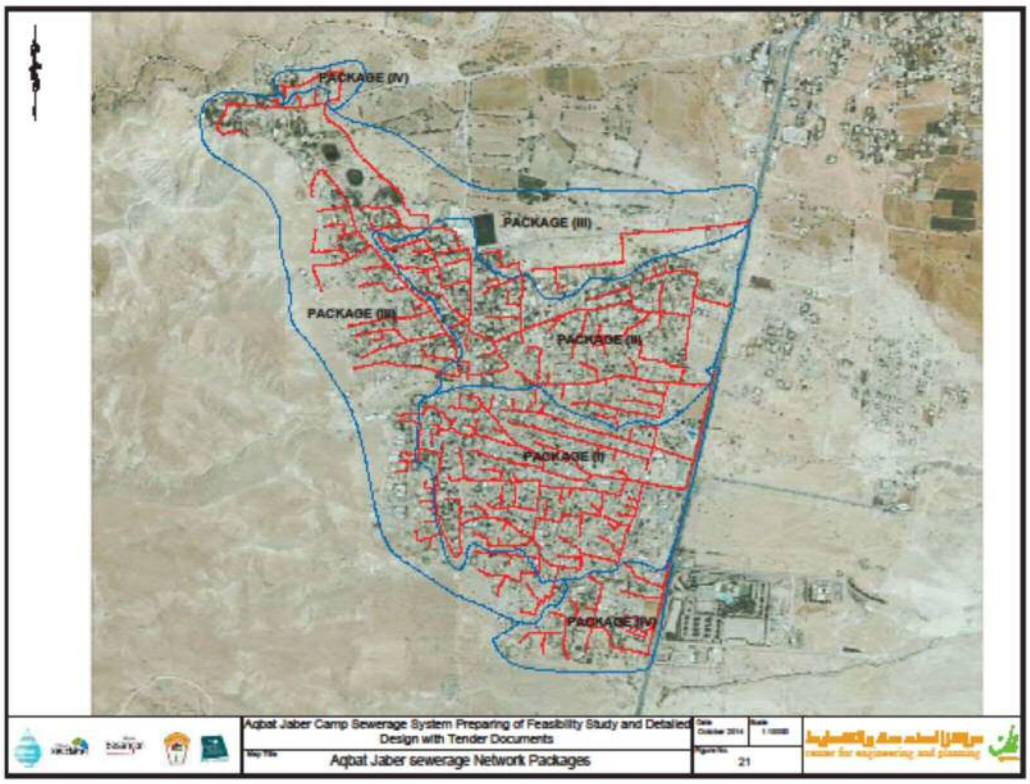


Figure 2.22.1 General Sewerage Plan of AJ Camp

2.22.1 Package-1 Project of AJ Camp

The sewerage project under the above-mentioned plan was implemented by the United Nations Relief and Works Agency for Palestine Refugees in the Near East (UNRWA). This project shall be funded by Japan (2 million USD) and the construction was planned to be completed by the end of 2017 (refer to **Figure 2.22.2**).

The target for this project was only Package-1 of the refugee camp. The target was only the pipe connection to the existing No.10 trunk main of Jericho Sewage System and the sewage branches under the road and house connection was not included, therefore discussions were being held between UNRWA and JICA Palestine Office regarding the possibility of house connection construction and finally it was included in the Project.


Figure 2.22.2 Sewer Construction in AJ Camp

Regarding to the drawings, the households within the target area is 557. Assuming that several houses may be using the same connection pit, the number of connections is calculated as below.

557×0.7 (considering the results of the PP area and city style of AJC) = 400 connections

Also, there are two schools within the target area.

Before discharging sewage to the existing trunk sewer of Jericho municipality, UNRWA and Jericho municipality were discussed to install the screen facility and prepare the Agreement which were including the sewerage tariff and responsibility of sewer maintenance.

2.22.2 Project for Other Areas in AJ Camp

The sewage development including the house connection for the areas of Package -2 to Package -4 is planned for UNRWA development under Japanese funds as well as Package-1, which was adopted as a budget application in Japan. In the AJ camp, houses are densely populated, it is possible to conduct projects with high investment effect, and it is expected to contribute to securing a large amount of sewage.

【OUTPUT-4】

2.23 Training for Basic Knowledge of Sewerage Management and Implementation of Workshop

2.23.1 Objective

In order for Jericho municipality to maintain stable sewerage facilities continuously, it is essential to acquire basic knowledge not only on technical aspects but also on financial aspects. As mentioned in "**2.5 Capacity Assessment**", by the results of individual capacity assessment of C/Ps, the average of basic knowledge of financial was poor. It will be necessary for C/Ps to gain basic knowledge for financial and management aspects.

2.23.2 Training and Workshop

As the training and workshop concerning management of sewerage facilities, the following activities were carried out in the Project. The subjects of the training and workshop on finance and management were basically members who added technician representatives, mainly in financial and management staff in Jericho municipality. Jointly working with the JICA experts to transfer technology to C/P, and also conducted technology transfer by consulting with related organizations (PWA, JAIP jurisdiction PIEFZA etc.).

(1) Wastewater Tariff and Connection Fee

It is necessary to newly set wastewater tariff and connection fee collected from sewage users before the start of service of sewerage facilities, and at the various meetings shown in **Table 2.24.1**, the JICA Expert had some lectures to C/Ps and related agencies.

(2) Sewerage Management Plan (Strategic Business Plan)

The strategic business plan has close relation with financial plan and sewerage tariff system. As described in "**2.9 Assistance in Preparation Sewerage Management Plan**", by setting up the study team in 2014 and implementing the training, consultation and workshop shown in **Table 2.9.1** emphatically, technology transfer was provided by the JICA Expert.. In addition, a participatory meeting on the sewerage management plan was held on July 13, 2016 with the intention of exchanging information and discussing cases of implementation in Jericho municipality and other related organizations.

2.24 Assistance of Developing Wastewater Tariff

The draft of the wastewater tariff and connection fee for the sewerage system in Jericho was developed and finalized based on the discussions with C/Ps. Preliminary meetings with PWA (the approving authority) were held and the proposed tariff and fee scheme was basically agreed.

2.24.1 Verification of Current Water Tariff

The following three points are the characteristics of the current water tariff in the Jericho municipality: (a) categorization of customers into the domestic and industrial; (b) fixed tariff for industrial customers and (c) progressive volumetric tariff. A discussion session was held with the C/P prior to the development of wastewater tariff scheme, based on the paper prepared by the JICA Expert Team verifying the appropriateness of the above characteristics. The JICA Expert Team emphasized the following points at the discussion that:

- Introduction of fixed charge was recommended;
- Commercial users does not need to be categorized;
- Uniform linear (volumetric) charge is recommended.

The C/Ps expressed their opinions that (a) the measuring method of discharged wastewater should be developed and (b) the uniform volumetric charge should be introduced to make sure the fairness among customers. Because around 40 percent of supplied drinking water was used for the purpose of air-conditioning and gardening, which would not be discharged to sewerage system.

2.24.2 Development of Draft Wastewater Tariff

The annual cost of operation and maintenance was calculated for the FY 2015 based on the conditions set in the Basic Design Study for the Grant Aid Project, because no specific data was available at that time necessary to develop the detailed financial plan. The cost was divided into the fixed cost and variable cost, and the draft wastewater tariff scheme comprising fixed charge and volumetric charge was developed as shown below and discussed with the C/P.

- Fixed tariff: 13.0NIS per 2 months
- Volumetric tariff: 1.1NIS/m^3 (the unit price of the present water tariff is in the range of 1.0 to 5.0NIS/m^3)

2.24.3 Development of Connection Fee Scheme

The draft of connection fee scheme was proposed to the C/P based on the current one of the municipality of Al-Bireh. But the municipality of Jericho is spread in the plain area and the average property area seems to be larger than that in the municipality of Al-Bireh. Hence the data of property area and buildings was collected to analyze the distribution status and to verify the “unit price” scheme of the present draft.

2.24.4 Meetings with C/Ps and Relevant Organizations

The tariff working team was established consisting of 6 C/Ps and the Experts. 5 meetings were held for developing the wastewater tariff and connection fee scheme, also for ensuring the C/Ps data sharing for calculation and the technical transfer on the calculation methodology. In the meanwhile the

meetings with relevant organizations were held, i.e. with JAIP (Jericho Agricultural Industrial Park) and PWA; the former (JAIP) will discharge the largest portion of the wastewater to be treated at the Jericho WWTP especially at the early stage of its operation; the latter (PWA) is the approving authority of wastewater tariff and gave basic consent to the proposed wastewater tariff scheme at the meeting. The meeting schedule and agenda is shown in **Table 2.24.1**.

Table 2.24.1 Meetings with Working Team and Relevant Organizations

Type	Date	Participants (Except Expert Team)	Agenda
Working Team Meeting	29 Aug 2013	Working Team members	Lecture on methodology of calculating connection fee; Discussion on basic topics to be determined; Data collection request to C/Ps
	9 Sep 2013		Lecture on methodology of calculating wastewater tariff; Discussion on basic topics to be determined; Data collection request to C/Ps
	19 Sep 2013		Draft for connection fee scheme
	26 Sep 2013		Draft for wastewater tariff scheme
	6 Oct 2013		Hands-on lecture on detailed calculation procedure of wastewater tariff
Meeting with JAIP	2 Sep 2013	1 from PIEFZA, 1 from PRICo, 1 from JICA Palestine Office and 5 from Jericho Municipality	Data request for estimated volume and quality of wastewater to be discharged from JAIP; Discussion on planning /construction status and cost allocation principles of sewer pipeline within JAIP, pumping station and pressure main to connect to Jericho Trunk Sewer
Meeting with PWA	5 Sep 2013	2 from PWA and 5 from Jericho Municipality	Questions on tariff setting principles in "Water Tariff Regulation 2013"; Discussion on process and schedule until the enactment of Sewerage By-Law of Jericho Municipality
	9 Oct 2013	1 from PWA and 4 from Jericho Municipality	Discussion on draft for wastewater tariff scheme of Jericho Municipality

2.24.5 Tariff and Fee Scheme

(1) Wastewater Tariff

The wastewater tariff was developed based on the following principles. The draft scheme is shown in **Table 2.24.2** and Calculation procedure explanation materials prepared for detail lectures to C / Ps are shown in the **Appendix A 2-24-1**.

- The tariff is designed to be applied from 2014 to 2018, for 5 years
- The tariff revenue will cover 100 % of the O&M cost and a part of the depreciation cost (i.e. only the portion of investment funded by Jericho Municipality)
- Customers are divided into 2 categories, residential and commercial, as practiced in the current water tariff.
- Costs are classified as fixed and variable, and allocated to each customer category; the fixed charge is designed to cover the basic cost and the volumetric charge is designed to cover variable costs; after this, the unit charges to be modified considering the balance with the current water tariff.

Table 2.24.2 Draft Scheme of Wastewater Tariff

Proposed Wastewater Tariff (Residential)

Category		Supplied Water Volume	Proposed	
			Fixed Charge (/cycle)	Volumetric Charge
Residential	1	0-10m^3	5 NIS	0.5 NIS/m^3
	2	11-20m^3	5 NIS	0.5 NIS/m^3
	3	21-30m^3	5 NIS	0.8 NIS/m^3
	4	31-50m^3	5 NIS	1.0 NIS/m^3
	5	51-100m^3	5 NIS	1.5 NIS/m^3
	6	101-150m^3	5 NIS	1.5 NIS/m^3
	7	151-250m^3	5 NIS	1.5 NIS/m^3
	8	251m^3-	5 NIS	2.0 NIS/m^3

Proposed Wastewater Tariff (Commercial)

Category		Supplied Water Volume	Proposed	
			Fixed Charge (/cycle)	Volumetric Charge
Commercial	1	0-10m^3	10 NIS	1.0 NIS/m^3
	2	11-20m^3	10 NIS	1.0 NIS/m^3
	3	21-30m^3	10 NIS	1.2 NIS/m^3
	4	31-50m^3	10 NIS	1.4 NIS/m^3
	5	51-100m^3	10 NIS	1.6 NIS/m^3
	6	101-150m^3	10 NIS	1.8 NIS/m^3
	7	151-250m^3	10 NIS	2.0 NIS/m^3
	8	251m^3-	10 NIS	2.0 NIS/m^3

Tariff at a glance (NIS/2months)

Bi-month water use	Wastewater Tariff		Water Tariff	
	Residential	Commercial	Residential	Commercial
5	7.5	15.0	35.0	35.0
10	10.0	20.0	40.0	40.0
15	12.5	25.0	45.0	45.0
20	15.0	30.0	50.0	50.0
25	19.0	36.0	55.0	60.0
30	23.0	42.0	60.0	70.0
40	33.0	56.0	70.0	90.0
50	43.0	70.0	80.0	110.0
100	118.0	150.0	130.0	310.0
200	268.0	340.0	430.0	810.0
500	843.0	940.0	1,880.0	2,310.0

(2) Connection Fee

The connection fee was set up based on the following principles. The draft scheme is shown in **Table 2.24.3**.

- The connection fee is designed to cover all of the construction cost for connection pit, connecting pipe and receiving pit, of which Municipality of Jericho has the responsibility to construct (refer to **Figure 2.24.3**).
- The construction cost stated above is estimated using the results of the preliminary survey of the pilot project which was contracted out to the local consultant; the estimated cost is 3,173 NIS per connection.
- The connection fee is imposed on the building floor area and is calculated by "the number of all connections of water supply service in Jericho Municipality" multiplied by "the unit construction cost 3,173 NIS/connection" stated above and divided by "The sum of building floor area in Jericho Municipality".

- The unit connection fee was calculated as 16.6 NIS/m^2, but was adjusted to 15 NIS/m^2 referring to the current price applied in Al-Bireh Municipality i.e. 3 JD (=15 NIS) per square meter of building.

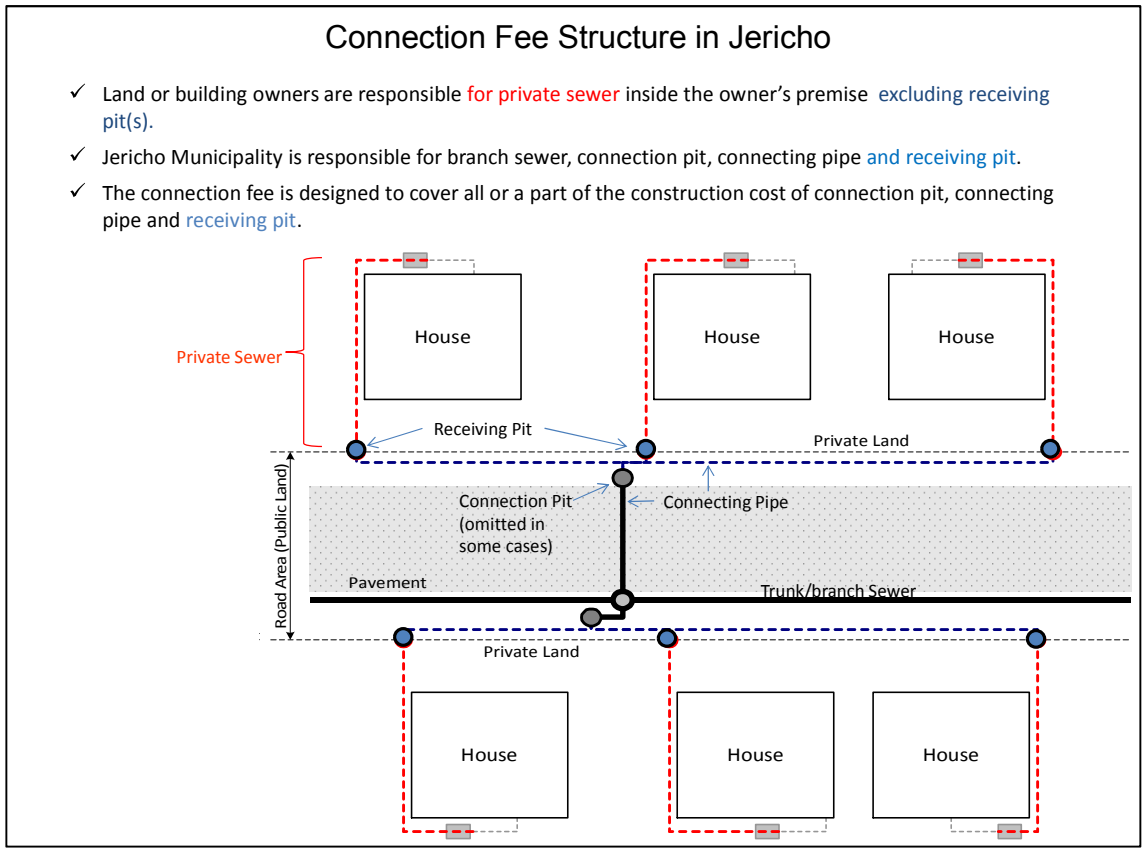


Figure 2.24.1 Conceptual Diagram of Connection to Sewer and the Construction Cost to be Recovered by Connection Fee

Table 2.24.3 Draft Scheme of Connection Fee

Category	Fee
For every square meter of building	15 NIS/m^2

(3) Wastewater Tariff and Fee Scheme

The proposed draft of wastewater tariff and connection fee was rejected at the Municipality Council in December 2013, hence the financial plan and tariff scheme were redeveloped with C/Ps, based on a series of discussions with PWA (the approval authority), the Mayor of Jericho Municipality, the opposing group in the Municipality Council, etc. The final scheme approved by the Municipality Council is shown in **Table 2.24.4**.

Table 2.24.4 Approved Wastewater Tariff and Connection Fee

Category	Unit Fee	Notes
Sewerage Fee	1.0 NIS/m^3	For every cubic meter of water consumption
Connection Fee	13 NIS/m^2	For every square meter of building

(4) Commencement of Tariff and Fee Collection

The collection of said fees was expected to start immediately after the sewerage service had started, but the situation as February 2015 is as follows.

- Wastewater tariff; has been charged but not collected
- Connection fee; is not charged
- In-house connection; is not charged
- Tanker sludge; discussions to collect the charge per disposal to WWTP have begun

To follow up the situation, the JICA Expert Team held discussions with Jericho municipality and the C/P and conducted activities to promote charge collection. As the result, the situations have been improved as shown below as of end of March 2015.

1) Wastewater tariff

149 bills have been sent and 9 have been collected.

2) Connection fee and in-house fee

21 bills (total amount: 125,000NIS) had been paid. The payers were owners of newly-constructed building located along the sewage pipelines. Fees have not yet been collected from the PP target area.

3) Tanker sludge disposal charge

The owners of the tanks have been informed that the charge collection will begin in March 2015, but since then no trucks have been seen to dispose sludge to the WWTP. It is assumed that the sludge is being directly disposed to Wadi. The mayor made cooperation requests to the police to enhance the monitoring for illegal disposal, and as a result, 2 trucks had then transferred sludge to the WWTP by the end of March.

(5) Support for Promoting Collection of Wastewater Tariff

Since the development of wastewater tariff scheme is one of the components of sewerage management plan, the activity for the captioned topic is the same as is described in "**2.9 Assistance in Preparation Sewerage Management Plan**". The collection rate of wastewater tariff has been much lower than the expected level, the JICA Experts thus provided the C/Ps with a series of consultation and the C/Ps proposed and got approval by the Municipality Council and PWA in August 2015 to halve both the wastewater tariff and connection fee i.e. 0.5 NIS/m^3 for wastewater tariff and 7 NIS/m^2 for connection fee with the time limit up to the end of December 2016 and to the end of December 2017 respectively. The collection ratio of wastewater tariff has been still much lower than the expected level, though it was doubled in the period of November-December 2015 as shown in **Table 2.24.5**, which is thought to be due to the temporary reduction of wastewater tariff to be applied from September 2016 up to the end of 2017.

Table 2.24.5 Collection Ratio of Wastewater Tariff on Accrual Basis (Unit: NIS)

			Sep-Oct 2015	Nov-Dec 2015	Jan-Feb 2016	Mar-Apr 2016	May-Jun 2016	Total
Billed Amount	NIS	A	15,433	11,077	13,026	13,266	17,572	70,374
Billed Connections		B	184	172	211	380	366	1,313
Paid Amount	NIS	C	1,269	1,979	1,121	1,438	2,380	8,187
Collection Ratio		D=C/A	8.2%	17.9%	8.6%	10.8%	13.5%	11.6%

(6) Present Status of Wastewater Tariff Collection (as of the end of 2017)

1) Sewerage Tariff

Measures of making sewerage tariff half the price (1.0 → 0.5 NIS/m3) were originally planned to be carried out until the end of December 2016, but were extended until the end of 2017 in order to promote the collection rate, and it has returned to 1.0 NIS/m3 from 2018. **Table 2.24.6** shows the collection rate for the accumulative collected amount every half year from 2015 and the collection rate of water supply tariff.

Table 2.24.6 Collection Rates of Sewerage and Water Tariff (until the end of 2017)

Duration	Item	Invoiced Amount (NIS)	Collected Amount (NIS)	Collection Rate (%)
2015/1/1~2015/6/30	Water Tariff	3,076,417	2,058,304	67
	Sewerage Tariff	151,197	617	0.4
2015/1/1~2015/12/31	Water Tariff	7,464,850	5,142,902	69
	Sewerage Tariff	194,904	18,074	9
2015/1/1~2016/6/30	Water Tariff	10,755,027	7,527,070	70
	Sewerage Tariff	248,263	48,704	20
2015/1/1~2016/12/31	Water Tariff	15,175,642	11,234,013	74
	Sewerage Tariff	332,660	85,261	26
2015/1/1~2017/6/30	Water Tariff	17,928,412	12,883,441	72
	Sewerage Tariff	400,403	103,418	26
2015/1/1~2017/12/31	Water Tariff	21,895,219	15,617,075	71
	Sewerage Tariff	**498,372**	**122,606**	**24**

2) Connection Fee

As for the connection fee for connecting household to sewer network, as in the above-mentioned sewerage tariff, a half-price (7 NIS/m2) discount was scheduled until the end of 2017 in order to promote tariff collection, but it was extended until the end of 2018. The status of fee collection at the end of 2017 for the PP-1 and PP-2 areas is shown below.

Total amount of invoice : 957,094 NIS
Collected total amount : 166,958 NIS（17%）

3) Selling Charge of Treated Wastewater

The number of farmers has increased becoming the amount of treated wastewater increases in WWTP, and five farmers has reused at the end of 2017. The followings are presented the present status.

Treated wastewater tariff	: 0.5 NIS/m3 (until the end of 2017)
	: 1.0 NIS/m3 (from 2018)
Payment procedure	: Farmers pay an annual fee in advance based on the annual usage assumed at the beginning of the year and adjusting at the end of the year
Collection rate of tariff	: 100%
Total selling amount in 2017	: 70,340 NIS

(7) Countermeasures for Promoting Collection of Wastewater Tariff

1) Enhancement of Organization on Billing Staff

The low level of the collection ratio is basically due to the prevailing unwillingness to pay of the customer side, and this can be improved by the following countermeasures:

- To extend the public relations activity for enhancing the payment;
- To strengthen the intervention against the non-payment by the Municipality side.

Regarding the latter means, the responsible sections /sub-sections of the Municipality in charge of meter reading and bill delivery/ collection are the following three:

- Water and Sewerage Department/ Potable Water Section/ Meter Reading Sub-Section
- Water and Sewerage Department/ Potable Water Section/ Billing Sub-Section
- Financial Department/ Revenue Collection Section

The former two sub-sections of the Potable Water Section should be in charge of reading meters, entering data, taking notes and issuing, delivering and collecting bills according to the current job descriptions, but reportedly they are not doing the jobs of bill delivery and collection. Besides, there are five collectors in charge of collecting water and sewerage tariff in Revenue Collection Section, but one collector is taking sick-leave and the remaining four collectors are forced to deliver and collect the bills of around 1,500 connections/2 months, which is thought to be too much work load.

Thus the JICA Experts started a series of consultation to improve the currently practiced workflow and the organization structure, including the integration of the two sub-sections stated above into the Revenue Collection Section.

2) Introduction of Prepaid Water Meter (PPWM)

As one of measures to improve the current low tariff collection rate, the JICA Expert began consultation with Jericho municipality on the feasibility of PPWM introduction of water and wastewater tariff

collectively. In Jericho municipality, for the introduction of PPWM, Jericho municipality secured 15,000 € (equivalent to about 150 pieces) as a budget for 2016 and examined it for installation. In that case, there are plans to consider incentives for the user (keeping the discount fee, securing a long supply time compared to the user of the normal meter, etc.).

Furthermore, with the aim of supporting the promotion of the installation of PPWM, the JICA Expert are planning to set up 450 units by the Japanese side fund (scheduled for follow-up project). **Table 2.24.7** shows the PPWM maintenance plan prepared for the budget request to the Japanese side.

Table 2.24.7 PPWM Maintenance Plan

Type	2017	2018	2019	2020	2021	2022	2023	Remarks
1 Bulk water and apartment	←							Devices need to be devised such as installing it vertically at multiple installation locations of apartment
2 New building	←	—	—	—	—	—	→	
3 Heavy debt user	←	—	→					Work on the new team in the water supply and sewerage and finance department
4 Fault meter		←	—	→				
5 Others		←	—	—	—	—	→	
Total (connection number)	800	800	800	800	800	800	800	Total 5,600

The estimated maintenance cost of PPWM is presented as below.

Investment budget:

O&M cost = 87,480 NIS (10 years)

PPWM renewal = 291,600 NIS (450 units)

Other equipment of PPWM = 27,360 NIS Total 406,440 NIS

Income:

Total income = 555,950 NIS (10 years)

3) Establishment of Penalties Clause for Unconnected and Unpaid Wastewater Tariff

As there are no penalties for unconnected to the sewer network and unpaid tariffs from each house in the current sewerage by-law, the JICA Expert have carried out activities to enact new regulations.

November 2016: Start a survey work by hiring a legal expert

December 2016: After meeting with JICA Experts and C/P, prepare the draft penalties clause

March 2017: Meeting with lawyer of Jericho, C/P, legal experts and JICA experts, finalizing the draft

March 2017: Submit draft version to MoLG

After finalizing and submitting the draft of penalties clause, the JICA Expert and C/P discussed with the

PWA and MoLG to obtain an inquiry from them and waited for the reply as of the end of 2017. The draft of the penalty clause is attached in **Appendix A 2-24-2**.

(8) Collection on Construction Cost of Internal House Connection in PP-1 and PP-2

According to the Sewerage By-Law enacted in Jericho municipality, the sewerage beneficiaries have obligation to pay the sewerage related tariff such as sewerage tariff and connection fee, and the construction cost of the internal connection pipe and Jericho municipality have to collect their expenses. At the end of January 2018, as for the construction cost of the internal house connection in the PP-1 and PP-2 areas that were installed by TeCSOM, funds recovery by Jericho municipality has not been done. Reason for not collecting the construction cost of the internal house connection pipe is that if the municipality request to the customers to pay three types of fee (sewerage tariff, connection fee and construction cost of the internal house connection pipe) at once, it is highly likely that the burden on the residents will be great and a quarrel with the customers will be highly happen. Jericho municipality is considering the following strategic actions for the fee collection.

First Stage : Prioritize customizing payments of sewerage fee and connection fee
Second Stage : Start collecting the replacement portion of the internal house connection pipe after the collection by the first stage got on track

The staffs of Jericho municipality recognizes the necessity of construction cost recovery as mentioned in "Activity Plan on Financial Aspect" of Chapter 6 "6.3 Future Activities Plans of Jericho for the TeCSOM Recommendation", and a new team is expected to be organized and started collection immediately.

2.25 Assistance of Developing Financial Plan

The financial plan is developed in line with the development of wastewater tariff and is included in the sewerage management plan. Hence the activity for the captioned topic is included in "**2.9 Assistance in Preparation Sewerage Management Plan**".

CHAPTER 3

C/P TRAINING IN JAPAN AND JORDAN

CHAPTER 3 C/P TRAINING IN JAPAN AND JORDAN

3.1 Implementation of the C/P Training in Japan

3.1.1 Training Period

November 11 to 23, 2013 (12 days)

Trainee members: 11 persons (refer to **Table 3.1.1**)

Table 3.1.1 Participant List

No.	Name	Position	Organization
1	Mr. Basel Hijazi	Head of Engineering Dept.	Jericho Municipality
2	Mr. Ghazi A. Al-Naji	Advisor to the Mayor for Water and Wastewater Dept.	Jericho Municipality
3	Mr. Iyad Hamdan	Chief of Quality Section	Jericho Municipality
4	Mr. Mohammed Fetyani	Head of Water and Wastewater Dept.	Jericho Municipality
5	Mr. Ibrahim Abu Seiba	Chief of Sewerage Section	Jericho Municipality
6	Mr. Mohammed Awajneh	Mechanical Technician	Jericho Municipality
7	Mr. Maher Al Swaidy	Electrical Technician	Jericho Municipality
8	Mr. Mohammed Isayed	Chief of Engineering Dept.	Jericho Municipality
9	Mr. Mohammed Azmuty	Sub-section Chief of Public Relation Dept.	Jericho Municipality
10	Mr. Mohammed Abu Muhsen	Head of Financial Planning Dept.	Jericho Municipality
11	Mr. Nael Ali Ahmad	Projects Manager	PWA

3.1.2 Training Concepts

(1) Training Goal

Participants are expected to acquire “practical” basic knowledge of sewerage system, including operation and maintenance of wastewater treatment plant, through lectures and site visits.

(2) Training Issues

Reasons for C/P Training Jericho municipality is absolutely short of human resources with sufficient knowledge and technology of operation and maintenance on sewerage system (plants and pipe network) as well as sewage works management. At the next stage, the municipality needs to expand pipe network which also requires knowledge and technology for planning and designing. Furthermore, skill of public relations and persuasion to residents should be also enhanced in regard to house connection, tariff collection and adequate use of sewerage system.

(3) Current level of participants

Each participant had a certain level of knowledge of their own field including architecture, water supply facility, roads, administration, finance and public relations. However, none of them had any practical basic experience related to sewerage system and needed to adjust not only their own skills to sewerage system but also learn about each other fields and roles in the system.

(4) Goals to be achieved

Since participants have different fields of work, the goals of this training were chosen as follows:

1) Participants enhance the basic knowledge of their own field
2) Participants acquire the basic knowledge outside their own field regarding sewage works management
3) Participants understand how to apply basic knowledge gained from Japan to Jericho

3.1.3 Training Schedule

date		time			subjects	lecturer / person in charge	organization in charge	venue	location	accommodation
10/11	Sun		-		arrival in Japan					Yokohama
11/11	Mon	AM			briefing		JICA Yokohama	JICA Yokohama	Yokohama	Yokohama
		13:15	-	13:45	courtesy visit	WATANABE Satoshi	Exective Director, City of Yokohama	Yokohama Municipality	Yokohama	
		15:15	-	15:45	program orientation	HAYASHISHITA Kozo	Yokohama Water Company	JICA Yokohama	Yokohama	
		16:00	-	17:30	free discussion with lecturers	HAYASHISHITA Kozo ISHIKAWA Makoto	Yokohama Water Company City of Yokohama	JICA Yokohama	Yokohama	
		18:00	-	19:00	welcome party		Yokohama Water Company	JICA Yokohama	Yokohama	
12/11	Tue	9:30	-	12:00	Sewage works in Japan	AKASAKA Shinji	Assistant Manager, City of Yokohama	JICA Yokohama	Yokohama	Yokohama
		13:30	-	16:00	Sewer pipe maintenance	ONODA Kenichi	Assistant Manager, City of Yokohama	JICA Yokohama	Yokohama	
13/11	Wed	9:30	-	12:00	Sewer pipe designing	OONAMI Wataru	Yokohama Water Company	JICA Yokohama	Yokohama	Yokohama
		13:30	-	16:00	Raising public awareness (1)		Kodaira City	Sewage Museum, Kodaira	Kodaira, Tokyo Met.	
14/11	Thu	9:30	-	12:00	Sewer pipe cleaning	ONODA Kenichi	Assistant Manager, City of Yokohama	Kohoku WTP	Yokohama	Yokohama
		13:30	-	16:00	WTP operation and maintenance (large 1)	WAKABAYASHI Tatsuya	City of Yokohama	Kohoku WTP	Yokohama	
15/11	Fri	9:30	-	12:00	Small-sized WTP designing	USUI Jiro	Japan Sewage Works Agency	JICA Yokohama	Yokohama	Yokohama
		13:30	-	16:00	Reuse of reclaimed water (1)	MORITA Naotaka	City of Yokohama	International Stadium Yokohama	Yokohama	
16/11	Sat				off					Yokohama
17/11	Sun				move to Takamatsu					Takamatsu
18/11	Mon	9:30	-	11:00	WTP operation and maintenance (small 1)	AMAKO Susumu	Manager, Kagawa Prefecture Sewerage Public Corporation	Kabe River WTP	Sanuki, Kagawa Pref.	Takamatsu
		13:30	-	16:00	Reuse of reclaimed water (2)	KAWATA Kazuaki	Manager, Tadotsu Town	Tadotsu Town	Tadotsu, Kagawa Pref.	
19/11	Tue				move to Kyoto					Kyoto
		13:00	-	15:00	WTP operation and maintenance (large 2)	KATAYAMA Kimihiro	Manager, City of Kyoto	Toba WTP	Kyoto	
20/11	Wed	9:30	-	11:00	WTP operation and maintenance (small 2)	KURODA Yoshiji	Assistant manager, Koka City	Eau du bourg, Tsuchiyama	Koka, Shiga Pref.	Kyoto
		13:30	-	15:30	Raising public awareness (2)	HAGA Hiroki	Reserecher, Lake Biwa Museum	Lake Biwa Museum	Kusatsu, Shiga Pref.	
21/11	Thu	9:00	-	10:30	Raising public awareness (3)		City of Kyoto	Canal Museum of Lake Biwa	Kyoto	Yokohama
					move to Yokohama					
22/11	Fri	AM			preparation for evaluation meeting			JICA Yokohama	Yokohama	Yokohama
		16:00	-	17:00	evaluation meeting	MIKAMI Kenta	JICA Yokohama	JICA Yokohama	Yokohama	
		17:00	-	17:30	closing ceremony	ADACHI Ichiro	Director, JICA Headquarter	JICA Yokohama	Yokohama	
		18:00	-	19:00	farewell party		NJS Consultants	JICA Yokohama	Yokohama	
23/11	Sat				leave Japan					

3.1.4 Remarks about Training

(1) Lectures

Lectures on "sewage works in Japan / Yokohama" and "sewer pipe maintenance" were delivered by assistant managers of Environmental Planning Bureau of Yokohama Municipal Government (hereinafter referred to as "YEPB"), the successor of the former Sewage Works Bureau. Yokohama commenced the modern sewage works provided with wastewater treatment plants in 1950, relatively later than other major cities. However it achieved almost 100% in 2002. YEPB has accumulated knowledge and technology as well as has faced a lot of challenges during the rapidly expanding period. Practical methods and recently incurred problems were discussed at the lectures.

The lecture on "sewer pipe designing" was delivered by an engineer of Yokohama Water Company (YWC) who has a high skill in pipe designing through the expansive work experience at the former Yokohama Sewage Works Bureau and Japan Sewage Works Association. The lecture followed by exercise deepened the understanding of participants.

In regard to "wastewater treatment plant designing", major municipalities, including Yokohama, have not generally introduced small-sized plant of OD-type, same as Jericho. The lecture was delivered by the official from Japan Sewage Works Agency (JS) which has supported small municipalities to install their sewerage system with OD-type treatment plants.

The contents of lectures were no more than the outline due to time constraints which made it difficult to cover all topics of sewage works. Nonetheless, the lectures on finance and personnel administration were desirable and the project team asked YEPB to deliver lectures on those issues. Those issues were finally included in "sewage works in Japan / Yokohama" session since YEPB contributed only two days due to their hectic schedule.

There were some comments on the lecture topics. Some participants, especially from finance section, commented that a finance-specified lecture should have been included. Other participants claimed more deepened lecturers in their own specialties.

There were several reasons that these comments could not be applied at this stage of training. If any of lectures had been deepened for specific persons, others might have been left behind or might have lost their interest. The way topics were included is considered to be optimum at this stage, considering that the most participants have little knowledge of sewerage system and their background and specialties were diverse.

(2) Lecture materials

Lecturers from YEPB and JS made use of the existing materials. YWC's lecturer produced original materials especially designed for Jericho participants. All the lecture materials and some of the brochures of visiting places were translated to Arabic.

(3) Motivation/Learning attitude

Participants actively addressed questions through the training since it was a precious occasion to learn about sewage system and management. The senior officer (would-be executive), especially, expressed strong awareness toward starting-up of the city's sewage works organization.

Mastery level, on the other hand, seems to be considerably inconstant taking into account the participants' diverse backgrounds, positions, specialties and educational qualifications.

3.1.5 Opinions from Participants at the Evaluation Meeting

Name	Good points	Need to be improved	Suggestion
Basel Hijazi	practical and theoretical comprehensive (from design to maintenance)	Lecture utilizing GIS system is in need.	Continue this training to make follow-up.
Ghazi Naji	satisfied	Training may have been divided into multiple groups.	Let staffers spend a day or two at WTP to experience the daily routine.
Iyad Hamdan	Got a clear image of raising public awareness and pipe cleaning.	Concrete way of management (organization, workforce) was not included.	Provide information on human resources. (what specialty for which work)
Mohammed Abu Musen	pipe cleaning using camera, reuse of reclaimed water (groundwater recharge)	office routine (billing, collecting), tariff system Certain part of lectures was explained in a rush.	
Mohammed Fetyani	site visit (different types of WWTP, sludge treatment, water reuse, museum)	more concrete issues (maintenance equipment and materials, organization reinforcement, farmer convincing regarding agricultural use of reclaimed water)	enhancing capability of technicians (mechanicians, electricians) outsourcing process
Mohammed Awajneh	Acquired accurate perception of wastewater treatment WTPs were neat and clean.	Specialty-classified program might be better.	
Maher Swaidy		Maintenance method of high-priced equipment should have been included.	
Mohammed Isayed	Acquired knowledge of wastewater treatment technology and maintenance.	more specified training in regard to electric and mechanic Lectures using video image may be more efficient.	Spending a day or two at WWTP and observing daily routine will be useful.
Mohammed Azmuty	Acquired knowledge for PR, observing WWTP and pipe in operation.	How to raise awareness of residents toward the importance of sewage system should be included.	Specialty-classified training was expected.
Ibrahim Seiba	comprehensive issues site visit	O/M and designing should have been more focused.	a project for identifying crops suitable for reclaimed water, support for procurement of vehicles and cameras
Nael Ahmad	good start of building capacity Components were comprehensive but impossible to cover all the fields.	Concentrate more for management to have sustainability.	Continue support and technical assistance even after completion of WWTP.

3.1.6 Results and Application

(1) Results

Almost all of the participants expressed their new understandings of sewerage system in general. They also expressed a desire to learn how to apply their specific skills to the project. Observing the actual scene of what had been merely vague knowledge until before, each of them came to recognize the task to be deepened.

(2) Aspects to be considered

Since the top priority to bring about comprehensive understanding of sewage works has been almost achieved, C/Ps need to enhance the skill of their own specialty through daily practice at the next stage. Those capacity building activities will be accompanied on the occasion of elaborating works, such as various manuals, ledger, raising public awareness or tariff collection, implementing the project.

Arousing concern is that some participants expressed discontent that specialty-specified programs were not included, although the aim of curriculum, "to get comprehensive knowledge", and one of the goals, "to acquire the basic knowledge outside their own field, regarding sewage works management", had been informed beforehand. But some of them didn't seem to be necessarily enthusiastic in the issues outside their specialty. The motivation to enhance the skill of one's own field is surely important. However, acquiring proper and comprehensive understanding of sewage works is indispensable because very limited number of personnel will be in charge. It should be carefully monitored that comprehensive knowledge is certainly instilled among staffers.

3.1.7 Report of Japan Training

The C/P, participants, had presentation of the training in Japan on 22nd December 2013. Participants were total 21included in Mayor. The presentation material is shown in **Appendix A 3-1-1.**

The C/P, participants recommendations are the following,

(1) Cleaning and maintenance of sewers with high pressure vehicle is required
(2) Utilization of water tanker for reuse of treated wastewater
(3) Implementation of multiple training on sewer design
(4) Implementation of training of cleaning and maintenance on small size sewers
(5) Implementation of O&M training of WWTP
(6) Technology transfer relation to treated wastewater reuse and implementation of training on financial management
(7) Collaboration between sewerage management and public relation (for example, tour of WWTP)

For (3) to (7) items above, the JICA Expert intends to continue training through the Project.


3.2 Field Training Tour for Wastewater and Sludge Reuse in Jordan

3.2.1 Field Training Tour for Wastewater Reuse

(1) Field Tour and Discussion at Amman

The field tour for wastewater reuse was conducted as shown below.

June 9 to 11, 2015 (3 days)

Trainee members: 6 persons (4 Jericho farmers, 1 WWTP engineer and 1 public relation staff)

To promote treated wastewater reuse in Jericho, C/P suggested a visit of few Jericho farmers to the Madaba WWTP in Amman, Jordon to learn how farmers utilize the treated wastewater for farming irrigation. The visiting farmers then were requested to speak at the farmer's workshops in Jericho in order to share their learning and encourage wastewater reuse in Jericho. **Appendix A 3-2-1** provides more details on the trip planning and farmers selection criteria.

The purpose of the study tour included:

- visit a Jordanian WWTP with focus on treated wastewater re-use
- visit farmers/farms currently using the treated wastewater
- share the learning with Jericho framers; first hand observations of re-use, crops, new potential crops for Jericho, methods, impacts, costs, water saving, etc
- contribute to the Project's educational workshops for wastewater re-use for framers in Jericho

According to the work report prepared by the Jericho's municipality's public relation section, the followings are listed as the main outputs of the trip:

- Learned about the Jordanian experience in irrigation using the treated wastewater in order to break the fear of the farmer of using the treated wastewater. The treated wastewater was sold freely at first and then the government increased the cost when there were many requests for using it.
- Observed and discussed the Jordanian farmers' experiences in the re-use and the possibility to apply this experience in Jericho. The visited Jordanian farmers agreed that it's economically beneficial to them and they need more amounts of it, this encourages the farmers to apply this

experience in Jericho.

- Identified types of crops that use treated wastewater (which are not found in Palestine) like the Dutch herb and can be introduced.

Pictures of Field Study in Jordan

(2) Workshop to Share Experience of Field Training Tour

A number of 32 farmers were invited on June 15th, 2015 to visit the WWTP with a focus of treated wastewater reuse. The purpose was to share experience of the selected farmers who visited Jordon for wastewater re-use. After an introductory presentation by the WWTP manager who also attended the Jordon tour, an open discussion was hold.

The selected farmers shared the following learning with their other fellow farmers:

- It is economically beneficial to them using the treated wastewater.
- Jordanian Government helps and assists farmers in reusing the treated wastewater by offering the treated water for free for the first few years. Now, the water is provided by some fees to farms especially those near the WWTP. The treated wastewater at Jericho WWTP has higher quality than the visited Jordanian WWTP so it will be better for irrigation.
- More connections in Jericho is needed in order to increase the wastewater which can in turn reduce the cost of treated wastewater.
- It is important to properly use the treated wastewater as that water should not touch the plant.

Pictures of Workshop for Jericho Farmers

3.2.2 Field Training Tour for Sludge Reuse

(1) Field Tour and Discussion at Aqaba Municipality

Almost all of the treated waste water at the WWTP is being used for irrigation but the sludge remains unused. Though the amount of the sludge is still low at the WWTP, C/P has limited knowledge of using sludge and setting up related regulations for future usages -when the amount of the produced sludge reaches high. Giving lack of experience of sludge use in the West Bank area, the neighboring country of Jordon was the best option for a training trip to learn more about PR activities on sludge use awareness and also some technical aspects.

After several planning meetings with C/P and the JICA Experts, a study tour was set up for April 8th to April 10th, 2017 to visit the Aqaba municipality Water Company, Aqaba Branch of the Jordon Ministry of Agriculture, and some Jordanian farmers who use the sludge. Three C/P members, three farmers from Jericho, and a member of the Palestine Ministry of Agriculture joined the study trip.

The purpose was:

A) To learn about techniques used in their sludge composting
B) To learn about legislation and standards for sludge use
C) To learn about the results of sludge use in agriculture
D) To learn about economic aspects of the sludge use
E) To meet with the farmers/farms currently using sludge
F) To share the learning with other Jericho framers
G) To contribute to educational workshops in Jericho on sludge use

Outline of the training tour is shown in **Table 3.2.1**.

Table 3.2.1 Training Tour of Aqaba Municipality

Date	Time	Visiting Place	Remarks
2017 4/9	-	Trip (Jericho to Aqaba)	
4/10	10:00-12:00	Visiting Aqaba Water Company	Photo 3.2.1
	12:30	Visiting WWTP in Maan municipality	Photo 3.2.2
	13:30	Visiting two farmers of sludge reusing	Photo3.2.3
4/11	10:00	Visiting the Aqaba office of the Ministry of Agriculture	Photo3.2.4
	-	Back to Jericho	

Note: Farmers mix the sludge with soil and get a good result and in the same time they used a treated water

Detailed planning schedule and the summary report with Photos are attached to **Appendix A 3-2-2**.

Photo 3.2.1 Visiting the Aqaba Water Company and Discussion

Photo 3.2.2 Visiting WWTP in Maan Municipality

Photo 3.2.3 Visiting Farmers Reusing Sludge

Photo 3.2.4 Visiting the Aqaba Office of the Ministry of Agriculture

CHAPTER 4

MIDTERM AND TERMONAL SURVEYS

CONDUCTED BY JICA

CHAPTER 4 MIDTERM AND TERMINAL SURVEYS CONDUCTED BY JICA

4.1 Midterm Management Survey

4.1.1 Objective

The objectives are to visit the sewage treatment plant, potential sewage large scale discharging sources (Jericho Agro-Industrial Park, Aqbat Jabel refugee camp, etc.) and consult with Jericho Municipality.

4.1.2 Outline of the Survey

<<Visiting Period>> : May 14th to 15th in 2014

<<Team Member>> :

Name	Title	Organization
Mr. Ken Okumura	Leader	Environment Management Team 2, Environment Management Group, Global Environment Department, JICA Headquarter

<<Survey Schedule>>

Day/Hour		Activities
May 14th	13:00~14:30	Visiting Jericho Sewage Treatment Plant
	15:00~15:40	Visiting Jericho Agro-Industrial Park, Aqbat Jabel Camp
	16:00~17:00	Meeting with JICA Expert Team about the contents for discussion with Jericho Municipality
May 15th	9:00~10:00	Meeting with JICA Expert Team about the progress of the Pilot Project
	10:00~12:00	Meeting with the Mayor and C/Ps of Jericho Municipality
	13:30~15:30	Visiting the site of Pilot Project

4.2 Terminal Evaluation Survey

The Terminal Evaluation carried out by JICA Headquarters (hereinafter referred to as "Evaluation") has been reported including recommendations and information gathered by questionnaires and interviews to Project related parties, site surveys, verification of Project activities and implementation process, and analysis following the 5 evaluation criteria. The Terminal Evaluation Report was presented at the before mentioned Chapter "**2.2 JCC and TC Meeting**", and the Minutes of Meeting (**Appendix A 4-2-1**) has been approved by Jericho Municipality, PWA and JICA.

4.2.1 Objective

1) Review the outputs (activities, inputs) of the Project to date and assess the implementation process
2) Review the progress and achievement status of the Project, analyze the contributing/ inhibiting

factors

3) Overall evaluation from the 5 criteria for evaluation (relevance, effectiveness, efficiency, impact, sustainability)
4) Discuss measures to be carried out by the end of the Project
5) Draw useful lessons for similar future project

4.2.2 Outline of the Survey

【Evaluation period】: November 16, 2015 – December 3, 2015

【Evaluation Team Members】:

Name	Title	Organization
Mr. Daisuke Iijima	Leader	Environment Management Team 2, Environment Management Group, Global Environment Department, JICA Headquarter
Mr. Noriaki Yokouchi	Cooperation and Planning	Environment Management Team 2, Environment Management Group, Global Environment Department, JICA Headquarter
Mr. Akihiro Mochizuki	Evaluation and Analysis	ICONS Inc.

4.2.3 Activities and Achievements

Output1: Strategic business plan for sewerage works in Jericho Municipality is developed
The achievement level of Output 1 is deemed as relatively high. The official approval of the Water and Sewerage Department, the enforcement of by-laws for users and the approval of sewerage strategic business plan have been achieved. However, against the plan to hire 14 full-time staffs for sewerage works, currently only 9 staffs have been assigned. Additional recruitment of full-time staffs are planned for 2016.

Output 2: Capacity of Jericho Municipality for appropriate operation and maintenance of the WWTP is developed
The achievement level of Output 2 is deemed as relatively high. All target staffs passed the technical examination for O&M of the WWTP. The quality test of treated wastewater and sludge showed results that the values of hazardous substances such as heavy metal are below the standard. And 96% of the served population has recognized the needs for the WWTP. On the other hand, regarding the reuse of treated wastewater and sludge, treated wastewater reuse has achieved the target but the sludge has not, and the possibility of its achievement by the end of the Project is considered to be low.

Output 3: Capacity of Jericho Municipality for appropriate maintenance of sewer networks is developed
The achievement level of Output 3 is deemed as medium. All target staffs passed the technical examination for sewer maintenance and house connection. Meanwhile, regarding the house connection to the sewer system, the completed connections at the time of the Evaluation was 1,222, against the target of 2,000. Within the 1,222 connections, 1,179 were completed by the pilot project, and 43 were completed by Jericho.

Output 4: Capacity of Jericho Municipality for financial management of sewerage works is developed.
The achievement level of Output 3 is deemed as medium. The following 2 of the 4 targets were achieved. The mid-term financial plan was approved in March, 2014, and 98% of the served population recognized the need for payment of user charge. However, the collection rate of user charge for sewerage facilities was 16% (billed amount base at September and October, 2015) against the target ratio 60%. For this reason, amendments were made for the mid-term financial plan which was approved in March 2014, since the original plan had recorded a surplus but according to the current situation, a large deficit is to be registered. The amended plan is waiting for approval by the Mayor and PWA.

Project Purpose: System for operation and management of sewerage works in Jericho Municipality is established
The Project Purpose has not been achieved at the time of the Evaluation. Improvement of O&M capacity required for WWTP operation has been achieved by Project activities, and technical transfer for foundation of implementation organization has been completed by the official approval of the Water and Sewerage Department. On the other hand, regarding the financial technical transfer, improvements have been made but continuous enforcement will be necessary.

Overall Goal: sewerage facilities in Jericho Municipality are operated and managed appropriately under sound financial conditions.
The achievement of the Overall Goal is deemed to be possible in taking into accounts of the commitment by Jericho Mayor had been implemented backed by a strong initiative, and the improvement of the financial situation by increasing the ratio for both house connection and user charge for sewerage facilities. The quality of treated wastewater has already satisfied with the standards of MOA at the time of the Evaluation.

4.2.4 Evaluation Results

Criteria	Result
Relevance	High
Effectiveness	Medium
Efficiency	Relatively high
Impact	Relatively high
Sustainability	Relatively high (except financial aspects)

4.2.5 Conclusion

To achieve the Project Purpose, it is required to make continuous efforts to increase the ratio of house connection and user charge for sewerage facilities, by activities such as door-to-door visits and promotions. During JCC, the Jericho Mayor declared that the Municipality will firmly implement measures to solve said issues, and it is expected that the strong leadership of the Mayor will enhance the proposed activities.

4.2.6 Terminal Evaluation Follow-up Activities

The following activities were planned to be completed by the end of the contract period (March 2018) as follow-up activities to the proposals made regarding the above mentions. The items proposed upon Evaluation are the below 9 points.

1. Enhancement of door-to-door visits to increase house connection
2. Promote user charge collection
3. Consideration of the effects of customer acquisition
4. Promote development of city sewage branch pipelines
5. Accurate implementation of the mid-term financial plan
6. Improvement of inner drainage pipe (construction cost)
7. Continue promotion activities
8. Collect the Pilot Project cost
9. Promote the reuse of treated wastewater and sludge

The follow-up activities for the above points are described below.

(1) Enhancement of door-to-door visits to increase house connection

Door-to-door visits by city workers had started in November 2015. A special team has been formed for the visits (formed by persons of PR, sewerage pipe and WWTP fields, and adding a member in charge of financial matters when possible), and the visits are made in the afternoons when the head of the family is expected to be at home. The Jericho Municipality is targeting 100 new house connections per month, and the visits are planned to continue. Upon the visits, the team delivers the PR material produced by the Project (calendars, leaflets, key holders, etc.).

To increase house connection, Jericho is also planning to support the following measures.

- Set a target price for in-house piping construction for houses inside the city, and provide the information upon door-to-door visiting.
- Prepare a list of pipe material providers and constructors.
- Prepare a general drawing of future sewer pipe development plan (prioritization).
- Prepare a general drawing of sewer pipe development progress (to show in the manager's office).

(2) Promote user charge collection

In addition to start to collect water and sewer charge together, a special team shall be formed to make door-to-door visits to increase charge collection. The measures listed below are also to be implemented to support the collecting.

- Collect the construction cost (considering fairness) for in-house piping and connection piping of the PP area.

- Sign an agreement between the Municipality and user before starting the house connection/in-house piping construction.
- Set a target amount and achievement period for user charge collection based on the Strategic Business Plan,

(3) Consideration of the effects of customer acquisition

In order to increase the house connection to public sewers and the user charge collection, Jericho is using methods such as door-to-door visits, PR activities, reuse of treated wastewater, etc. To consider the effects of the activity outcomes, supports to set the following sewerage management indicators shall be provided.

- Public sewage connection rate (number of house connection, population, development rate of sewage pipe mains and branches)
- User charge collection rate (amount based on sewage tariff and connection tariff)
- Reuse rate of treated wastewater and sludge
- Reduction ratio of pollution load

(4) Promote development of city sewage branch pipelines

To promote the development of sewage pipe branches inside the city, supports to implement the below methods shall be provided.

- Looking for possibilities of Japanese government aid (usage of returned capital) and confirmation of possible development areas.
- Confirmation of possibilities of additional support (Phase 2) by USIAD
- Confirmation of the plan to carry out PA's original budget (USD 1 million) and the details (branch pipes / house connection) and period of the construction using said budget.
- Confirmation of the plan to carry out Municipality's original budget (NIS 0.5 million) and the details and period of the construction using said budget
- Site inspection of the Jericho Hospital treatment facility and preparation of pipeline plan (planned to use returned capital)

(5) Accurate implementation of the mid-term financial plan

Prepare plans to fulfill future surplus business.

(6) Improvement of inner drainage pipe (construction cost)

Discuss the construction cost of in-house sewage pipe, taking into account the affordable prices of the city life, to provide as information to the residents upon door-to-door visits. This discussion shall be shared with the C/Ps to gain understandings from the residents for house connection.

(7) Continue promotion activities

Provide support to continue residential awareness activities to increase the number of the in-house sewage connection and the user charge collection.

- WWTP facility PR activities targeting women and children.
- Regular orientations for the residents.
- Discussion for promoting sewage user charge collection of general households (broadcasting the Mayor's message via radio, etc.).

(8) Collect the Pilot Project cost

The cost for house connection implemented by the PP has not been collected. Jericho Municipality is planning to collect fees from the users in the PP area, to maintain fairness with the residents outside the PP area. The amount to be collected is to be determined in the above (6), and supports to start the collection shall be provided.

(9) Promote the reuse of treated wastewater and sludge

To improve the mid-term financial plan, it is necessary to promote the reuse of treated wastewater and sludge to collect tariff. Supports to implement the below measures shall be provided.

- Gain approval from MOA to promote treated wastewater reuse.
- Prepare a model of a contract which can be used by the farmers and Municipality regarding treated wastewater reuse.
- Consider an accurate charge for treated wastewater reuse for agricultural use.
- Early agreements upon the operation of sludge tankers from WWTP, and accurate cost of tankers with the owners.

CHAPTER 5 DELIVERABLES

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5.1 Progress Report

Based on the contract with JICA, the progress report shown in **Table 5.1.1** was submitted at each stage of this work.

Table 5.1.1 Submitted Progress Reports

Phase	Progress Report	Submitted Time	Number of Report
1st Year	Progress Report -1	June 2013	Japanese 4sets, English 14sets, PDF
	Progress Report -2	December 2013	Japanese 4sets, English 14sets, PDF
	Progress Report -3	August 2014	Japanese 4sets, English 14sets, PDF
2nd Year	Progress Report -4	May 2015	Japanese 3sets, English 10sets, PDF
	Progress Report -5	December 2015	Japanese 3sets, English 10sets, PDF
	Progress Report -6	September 2016	Japanese 3sets, English 10sets, PDF

At the final stage of this work, the Draft Final Report was submitted in February 2018 and the Final Report was submitted in March 2018.

5.2 Deliverables of Capacity Development

Based on the contract with JICA, the following manual/troubleshooting was prepared and submitted with the aim of making it useful for the operation and management of continuous sewerage works in Jericho municipality.

1. Manual and troubleshooting on water quality management
2. Manual and troubleshooting on mechanical equipment operation
3. Manual and troubleshooting on electrical equipment operation
4. Manual on safety and hygienic work
5. Report for completion of Pilot Project
6. Manual and troubleshooting on house connection work
7. Manual on operation and maintenance of sewers
8. Manual on financial and business plan

5.3 Other Technical Report

As a result in the course of carrying out the TeCSOM project, the JICA Expert has produced and submitted the following deliverables.

- Phased construction plan on the sewerage facility for Jericho Municipality (refer to **Appendix A 5-3-1**)

CHAPTER 6

ENCOUNTERED ISSUES AND RECOMMENDATIONS

CHAPTER 6 ENCOUNTERED ISSUES AND RECOMMENDATIONS

6.1 Encountered Issues through the Project Implementation

Since December 2012 the JICA Expert have implemented this project with C / P at the site. In the future, it is necessary to overcome the following items as a task to properly operate and manage sewerage facilities in Jericho City under a sound financial conditions.

<Institutional Aspect>

- The liaison system between the departments in charge of sewerage works in the Jericho municipality is lacking
- It is expected that shortage of staff will occur when sewage volume increases in the future

<Financial Aspect>

- It is difficult to grasp the status of tariff collection related to sewerage by month, and the recognition of the collection rate of staff is low
- Bulk water users (especially government agencies) occupying a large proportion by monthly invoiced amount has not been collected
- Together with C / P, TeCSOM has carried out public awareness activities to gain understanding from residents about sewerage, and continuous activities are necessary to get further understanding
- Jericho municipality increased the number of staff for collecting water and sewerage tariff, but it is necessary to further increase in preparation for future increasing the number of target households
- The budget for water and sewerage in Jericho municipality is weak and it is necessary to secure necessary budget for the future

<Technical Aspect>

- Part of the collected cesspit sludge has not been discharged to WWTP
- Although there are few factories that have enormous impact on biological treatment, it is necessary to prepare for cases where unexpectedly high concentrations sewage flow into WWTP
- Although the amount of sludge generated at WWTP is small at present, it is necessary to study the disposal method
- Jericho municipality has agreed to accept sewage from JAIP, but no agreement has been concluded with Aqbat Jaber (AJ) camp
- After the completion of the TeCSOM project, sewage works in Jericho municipality needs to be appropriately operated and managed under a sound financial condition

6.2 Recommendations from the TeCSOM

In response to the above-mentioned problems faced by Jericho municipality, the JICA Expert recommends the following in order to properly operate and manage the sewerage facilities under a sound financial conditions in the future.

<Institutional Aspect>

- A communication system (regular meeting, circulating the weekly / monthly report for share information) should be established between departments
- Jericho municipality should consider the staff increasing and training them through OJT in order to operate sewerage facilities stably in the future

<Financial Aspect>

- Jericho municipality should prepare a report on the monthly financial situation to submit the mayor and share information at relevant departments
- To ensure sound financial condition, Jericho municipality should surely collect water and sewerage tariffs from bulk water users
- Jericho municipality should appoint a person in charge of public awareness raising and hold regular public meeting for residents
- Rebuilding and secure collection system of water and sewerage tariff
- Jericho municipality should consider to maintain budget for encouraging to expand of sewer network and house connection and renewal of future mechanical and electrical equipment of WWTP, furthermore, it is necessary to reliably collect the construction cost of the in-house connection pipe in the Pilot Project area installed by the TeCSOM Project
- Jericho municipality is expected to implement sewerage works based on the management plan up to 2020, and revise it reflecting the annual sewerage works

<Technical Aspect>

- From the viewpoint of improvement of living environment and ground water quality conservation, sludge tanker vehicles should be controlled strongly so that collected cesspit sludge is appropriately put into WWTP
- To protect WWTP, water quality monitoring team should be established to promptly analyze water quality and conducting on-site inspections regularly at factories
- Jericho municipality should consult with the Ministry of Agriculture and establish an agricultural utilization process of sludge
- Jericho municipality should conclude an agreement with AJ Camp as soon as possible regarding the sewerage tariff, the quality of receiving water, and the responsibility of maintaining the pipe
- After the completion of the technology transfer project of TeCSOM, the JICA Expert hope to

fully utilize the products (several manuals, technical information, know-how and management plan on sewerage works)

6.3 Future Activities Plans of Jericho Municipality for the TeCSOM Recommendations

In response to the recommendations made by the JICA experts, Jericho Municipality prepared the plans for future activities. An action plan is shown in **Appendix A 6-3-1**.