A 2-14-1: Draft Water Quality Standard for Agricultural Use

The documents of the fifteenth meeting for characterization committee of environment

Agenda

Document (2)

The final draft for the special specification
Treated wastewater-Treated Wastewater Effluent for agriculture purposes

1- Aspect

This specification specializes of the requirements and standard that must be provided in treated wastewater and emerging from the purification plants for wastewater.

2- Complementary References

2-1 Standards methods for the examination of water and wastewater edition 20, APHA, AWWA and WEP-2000 (and its modification)

3- Definitions

3-1 Wastewater: water which polluted by physical, chemical, biological and radiological materials. Produced and emerged from using water in domestic, industrial, commercial or agricultural purposes where become dangerous when re-using or discharging in contrary with the relevant regulations.

3-2 Treated wastewater: the wastewater which can discharge of some or all plankton, sediments and solutes in natural, mechanical, chemical or biological ways whether individually or collectively and which doesn't exceed the maximum levels that mentioned in this specification.

3-3 Treatment: any operation conducted on the crop after harvest.

3-4 Mechanical Processing Systems: systems that use automated methods for water treatment as an activated sludge system and the system of rotating biological tablets and biological filters.

3-5 Natural Treatment Systems: systems that treat the water naturally through aerobic and anaerobic pools optional ventilation or ripening pools or other.

4- General Conditions

4-1 Treated wastewater must match the features that have been described in table (1) and according to the planned final using.

4-2 Pipes must be used in transferring the treated wastewater in areas that may effect on the ground water or the surface water that used for drinking.

4-3 Treatment plants have not the permission to ease the treated wastewater by mixing with pure water in order to achieve the requirements in this specification.

4-4 Irrigation must be stopped before a month of the date of harvest crops that are eaten fresh and three weeks for the crops which need special treatment after harvest to dispose of the fallen fruits and contact to the land.

4-5 Treated wastewater is prevented to irrigate all kinds of vegetables.

5- Standard Requirements

Treated wastewater should have standard requirements contained in table (10 according to its own instructions and guidance.

Classification of the treated wastewater according to its quality is shown in table (1)

Maximum limits for chemical and biological properties (mg/L) unless otherwise stated	Quality of Treated Water			
	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Biochemical Oxygen Demand BOD5	20	20	40	60
Total Suspended Solids TSS	30	30	50	90
Fecal coliform bacteria (colony/100 mL)	200	1000	1000	1000
Chemical Oxygen Demand COD	50	50	100	150
Dissolved Oxygen DO	1<	1<	1<	1<
Total Dissolved Solids TDS	1200	1500	1500	1500
Potential of Hydrogen PH	9 _6	9_6	9_6	9_6
Fat , Oil and Grease	5	5	5	5
Phenol	0.002	0.002	0.002	0.002
Detergents MBAS	15	15	15	25
Nitrate Nitrogen NO3-N	20	20	30	40
Ammonium Nitrogen NH4-N	5	5	10	15
Total Nitrogen T-N	30	30	45	60
Chloride Cl	400	400	400	400
Sulfate SO4	300	300	300	300
Sodium Na	200	200	200	200
Magnesium Mg	60	60	60	60
Calcium Ca	300	300	300	300
Sodium adsorption ratio SAR	5.83	5.83	5.83	5.83
Phosphate Phosphorus PO4-P	15-20	15-20	15-20	15-20
Aluminum Al	5	5	5	5
Arsenic As	0.1	0.1	0.1	0.1
Copper Cu	0.2	0.2	0.2	0.2
Iron Fe	5	5	5	5
Manganese Mn	0.2	0.2	0.2	0.2
Nickel Ni	0.2	0.2	0.2	0.2
Lead Pb	0.2	0.2	0.2	0.2
Selenium Se	0.02	0.02	0.02	0.02
Cadmium Cd	0.01	0.01	0.01	0.01
Zinc Zn	2	2	2	2
Cyanide CN	0.05	0.05	0.05	0.05
Chrome Cr	0.1	0.1	0.1	0.1
Mercury Hg	0.001	0.001	0.001	0.001
Cobalt Co	0.05	0.05	0.05	0.05
Boron B	0.7	0.7	0.7	0.7
Bacteria E. coli (Colony/100 mL)	100	1000	1000	1000
Nematodes (Eggs/L)	less than or equal 1	less than or equal 1	less than or equal 1	less than or equal 1
Maximum temperature	35	35	35	35
The degree of turbidity	5-10	5-10	5-10	5-10
A: Nivelo meter				

5. Quality Control

Quality control is as follows:

5-1 The samples should be presented, compound and collected throughout the day by every two hours for (24 hour) except the properties which its analysis needs individual samples and the number of samples and the time period for sampling as shown in table (2) as a minimum.

5-2 For the purposes of evaluation the quality of treated water described in table (1) Described time period depends on table (2).v

5-3 In case of exceeded in any of the properties of treated wastewater used in agriculture, additional confirmatory sample of the treated wastewater to be taken; if the laboratory results show the exceed in samples, the concerned body is notified of the need to rectify the situation as soon as possible and follow-up taken procedures and the concerned body should show the corrective procedures.

5-4 In case of exceeded in any of the properties of treated wastewater used in agriculture, additional confirmatory sample of the treated wastewater to be taken ; if the laboratory results show exceed in samples, the concerned body is notified of the need to rectify the situation. If exceed continues for a period determined by the control body; treated wastewater to be stopped for using until a stability of water quality.

5-5 Samples are taken and analyzed according to Palestinian standard and in case of not available, international specifications for treated wastewater is taken.

5-6 The owner of the project of wastewater treatment plant has to ensure that the quality of reclaimed water match with the approved specifications shown in table (1) and they conduct the necessary lab tests with the need to open the official records for documenting the lab results and show it to the government regulators upon request.

5-7 The control bodies have to take all the necessary procedures of control to ensure the plant commitment to the standards that shown in table (1).

5-8 The frequency of samples collecting for the regulators and operators as contained in table (2)

Table (4) Quality Monitoring

Treatment system	Sampling frequency		Evaluation period
The type	Operators	Regulators	
Mechanical	Periodic tests: 8 samples per month (compound sample) Chemical and physical properties: 3 samples per day(individually) Biological tests 1- (Egg/L): 4 samples per month (compound sample) 2- E.coli: 8 samples per month (individually) 3-FC 8 samples per month (individually)	Periodic tests: 2 samples per month Chemical and physical properties: 2 samples per month Biological tests: 1- (Egg/L): 2 samples per month 2- E.coli: 2 samples per month 3- FC 1 sample per month	3 months A
Natural	periodic tests: 4 samples per month (compound sample) Chemical and physical properties: 3 samples per day (individually) Biological tests: 1- (Egg/L): 2 samples per month (compound sample) 2- E.coli: 4 samples per month (individually) 3- FC 4 samples per month (individually)	periodic tests: 1 sample per month Chemical and physical properties: 1 sample per month Biological tests: 1- (Egg/L): 1 sample per month 2- E.coli: 1 sample per month 3- FC 1 sample per month	6 months B
(A) according to seasons (December -February) , (March-May) , (June-August), (September-January) (B) In Summer and in Winter (Summer from the beginning of May-October, Winter from beginning of November-April). Remark: the chemical and biological tests: T-N, TSS, COD, BOD5, NO3, Turbidity, DO, PH, and Temperature.			

5-8 For the mechanical treatment plants that contain polishing pools and natural treatment plants, chemical oxygen demand is calculated after conducting the filtering process.

5-9 Geometric average is used to calculate the results of heat-resistant colon bacillus or the E.Coli during the evaluating the quality of treated wastewater.

5-10 The content of reclaimed wastewater from Total nitrogen is evaluated by calculating the average, so that the number of covered samples in the account not less than five samples.

5-11 The results of the examination of the heat-resistant colon bacillus are considered a substituted for the results of the results of examination of E.Coli when the technical equipment that necessary for the test is not available.

5-12 In case of the need to determine new standards that not included in this Palestinian standard, they refer to the institution of specifications and standards to take the necessary action.

5-13 In epidemiological cases, the control and operational parties should conduct investigating on the pathogens intestinal flora that may occur in the water.

6- Reuse of Treated Water

Reuse of treatment water in agriculture is as follows:

6-1 restricted cultivations without barriers.

6-1-1 Forest trees

6-1-2 Pastoral trees, during the period of protection. Ministry of Agriculture determine the period of protection.

6-1-3 Wooded reclaimed lands during the first year in condition there is no inter plantings

6-1-4 Industrial crops such as cotton and fiber and brooms.

6-1-5 Crops to be planted to produce seeds of agriculture and watermelons for seed production.

6-1-6 Woody crops and forestry that have no contact with the public.

6-1-7 Production of herbs that is used in landscaping for sale without public access to the site of production.

6-1-8 Planter forest and fruit-bearing nurseries.

6-1-9 Ornamentals

6-2 Restricted cultivations with barriers.

Table (3) shows the number and type of the required barriers

Table (3)

Plastic ground cover	Distance from drippers/irrigation system	Treatment water purification	Sand filter or long retention or 10% of treated water 1 of 3	crop	Low quality D	Medium quality C	Good quality B	High quality A	High quality
					Number of required barriers				
		+		Gardens, playgrounds and parks	Prohibited	Prohibited	Prohibited	1	Zero
				Crops of seeds production	Zero	Zero	Zero	Zero	Zero
				Artichoke	Prohibited	Prohibited	3	Zero	zero
+	++	+	+	Corn to eat	Prohibited	3	3	Zero	Zero
		++	++	Green feed	Prohibited	2	1	Zero	Zero
		++	+	Dry feed	3	zero	zero	Zero	Zero
	++	+	+	Citrus irrigated by dripping	3	2	2	Zero	Zero
	++	+	+	Citrus irrigated by non-dripping	4	3	3	Zero	zero
	++	+	+	Fruits that its crust not eaten like nut, dry almond, pomegranate, pistachio, fruitful pine and etc..	3	2	2	Zero	Zero
	++	+	+	Deciduous trees: apple, pears, peaches, apricot, jujube and cherry	Prohibited	2	zero	Zero	Zero
+	+	+	+	Tropical drops(mango, avocado)	4	2	zero	Zero	Zero
	++	+	+	Grapes with high trellis	Prohibited	2	2	Zero	zero
+	+	+	+	Grapes with ordinary trellis	Prohibited	2	2	Zero	
+	++	+	+	Cactus plants	2	2	zero	Zero	Zero
+	+++	+	+	Dates and palm	3	2	zero	Zero	Zero
+	++	+	+	Olives	3	2	2	Zero	Zero
+	+	+	+	Flowers	3	2	zero	Zero	Zero
				Irrigation the forest trees and forests that are not used as parks	Zero	Zero	Zero	Zero	Zero
				Industrial crops and grain	zero	zero	zero	Zero	zero

7- The Used Dividers

One of these methods enables the farmer of using the treated water according to the table (3):

7-1 In a distance that not less than 50 cm on the ground between the drippers and the crops or the fruits is considered two dividers.

7-2 In a distance that not less than 25 cm on the ground between drippers and the crops or the fruits is considered one divider.

7-3 In a distance that not less than 50 cm between the level of the sprinklers irrigation and the crops or the fruits is considered one divider.

7-4 Plastic ground cover that's between the treated water and the crops or the fruits is considered on divider.

7-5 Drip irrigation underground is considered on divider

7-6 Other dividers

7-6-1 Crops or fruits that its crust not eaten is considered one divider

7-6-2 Crops or fruits that are not eaten unless cooked is one divider

7-6-3 Sand filter is considered one divider

7-6-4 Wastewater detention for a period not less than (15 day) is considered one divider

7-6-5 The pools of water collection which do not have more than (10%) of treated water is considered one divider

7-6-6 Purify the treated wastewater using the chlorine which the remaining chlorine not less than (0.5 mg/L) and a contact time which not less than half an hour or any other purification method is considered one divider

8- Irrigating by Sprinklers

When using the treated wastewater in irrigation sprinklers, there should be insulating area between the end of the wet area and the public streets or the residential areas or whereabouts of residents (waiting area) for example. The distance depends on the quality of the treated wastewater.

Table (4) Shows the these distances:

Table (4) the quality of treated wastewater and the distance of irrigation using sprinklers

Water quality	High quality (A)	Good quality (B)	Medium quality(C)	Low quality(D)
Distance/m	50	80	120	150

10- General Warnings

Regarding to the warnings and general safety conditions, takes into consideration the instructions that issued by relevant authorities

11- References

Obligatory Technical Instructions 34-2012 treated wastewater for irrigation (23/1/2012).
Jordanian Standard 893-2006 water-reclaimed domestic wastewater.
WHO guide lines for the safe use of wastewater, excreta and grey water.

A 2-14-2: Plan of the Pilot Plant

The Draft Reuse Plan of Treated Wastewater and Sewage Sludge

August 15, 2014

1. Objective

A reuse of treated wastewater, sludge and final disposal are studied in Technical Assistance and Capacity Building Project for the Jericho Sanitation Project (TeCSOM).

2 Reuse of Treated Wastewater

2.1 Reuse Options

Factors that need to be considered in projecting treated wastewater use in agricultural and nonagricultural applications are addressed as follows:

(1) Landscape Irrigation

Landscape irrigation is the user of treated wastewater and is being used increasingly for various locations in public parks, community parks, roadside plantings, landscaping of other public open space and recreation areas. Treated wastewater has to meet high water quality levels for microbial concentrations because public contact with the applied water is a potential health hazard. Controlling chlorine residuals to maintain proper disinfection must be considered in landscape irrigation use. Treated wastewater can be used as agricultural water. However, depending on the available access by the public to the landscape irrigation, the degree of required treated wastewater quality will vary.

(2) Agricultural Irrigation

Treated wastewater can be used for agricultural irrigation. Depending on the use of the crop for eating, raw or not raw, the degree of the required treated wastewater quality will vary. Higher levels of treated wastewater quality are mandatory for application to raw eaten food crops by the draft Palestine Reuse Standards (Mya 22, 2014). The effect of water quality on the end crop, especially salt content, total dissolved solids and metals in treated wastewater must be considered for all soils and crops to prevent poor harvests.

(3) Flushing Sewer

It was recognized that sewers needed flushing, especially where certain reaches of sewer had an unfavorable combination of low slope and low tributary sewage flow. Sewers systems are affected by deposition of solids and sediments generating nuisances and operational difficulties. Methods of use treated wastewater for flushing sewers shall be used to solve/mitigate this problem.

(4) Amenity Use

Recreational and environmental uses include fountains, waterways in parks, creation of recreational lakes and ponds for amenity purposes. These uses may have roles which include landscape improvement, creation of waterfront space, recreation for the public and nature reserves for wildlife. The level of treatment of reclaimed water in most cases depends on the type of water body to which reclaimed water is released, and the degree of public contact and the health hazard. High quality and well disinfected reclaimed water must be maintained to ensure public health protection.

(5) Cooling Water for Industry

Industrial uses of reclaimed water are mainly power plants and manufacturing facilities where it is required for cooling purposes. Water quality, especially total dissolved solids and chlorides, is of concern because of the potential for scaling or corrosion in piping systems and heat

exchange units. Residual organic matter may also contribute to biological growth in cooling towers.

(6) Toilet Flush

Treated wastewater can be used as flush toilet water. Office buildings and apartments can have dual distribution systems, one system for potable water and the other for reclaimed water. Principal concerns with dual distribution systems are higher cost of infrastructure and the prevention of cross connection between the two water systems.

(7) Groundwater Recharge

Groundwater recharge is used to reduce, stop or reverse the decline of groundwater levels, and to protect underground freshwater in coastal aquifers against saltwater intrusion. Water quality requirements may include nitrogen removal or reduction of specific organic and inorganic contaminations. Water quality and flow of groundwater should be monitored sufficiently and continuously.

In Jericho City, above mentioned landscape irrigation, agricultural irrigation, flushing sewers and amenity use options are applicable.

2.2 Potential Risks and Measures on Reuse

A flexible approach to treated wastewater (or TE: Treated Effluent) usage in the future must be taken in light of potential constraints/risks in quantity and quality in providing treated wastewater. The measures to be taken to reduce the potential risks are considered as follows:

(1) From the view point of the public health, treated wastewater pipelines have to be identified with tapes in order to avoid accidental cross-connections between potable water and treated wastewater supplies.

(2) For avoiding human contact during public utility time, irrigation late at night and during early morning hours in public spaces is recommended to minimize the exposure of treated wastewater to the public.

(3) Warning signs at the irrigation sites should be provided to public users, indicating that “it is non potable water for irrigation only".

(4) The peak irrigation demand can be alleviated by scheduling irrigation for each site at different times.

(5) It is important to notify users immediately at the time of the deterioration of treated wastewater quality and to stop treated wastewater deliveries in case of accidents/emergencies.

2.3 Irrigation in the Garden and Amenity in the WWTP (Wastewater Treatment Plant)

There are the garden and amenity spaces (approximately 0.36 ha) in the Wastewater Treatment Plant (WWTP). The potential demand is approximately 27 m^3/day (garden) and 126 m^3/day (ponds, amenity). Sprinkling time is 20-30 minutes per day (twice a day) by manual.

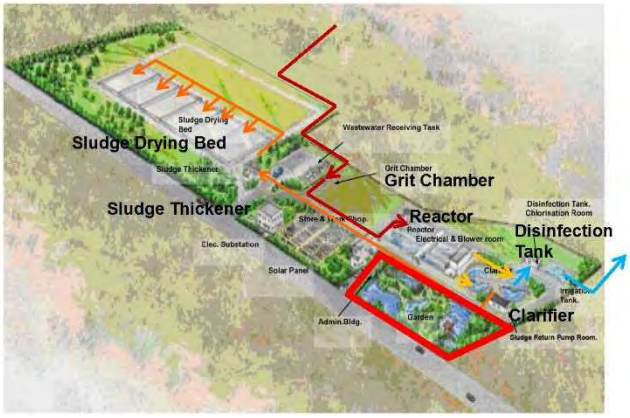


Photo 1 Sprinkling TE to Lawns

Photo 2 Dropping TE to Trees

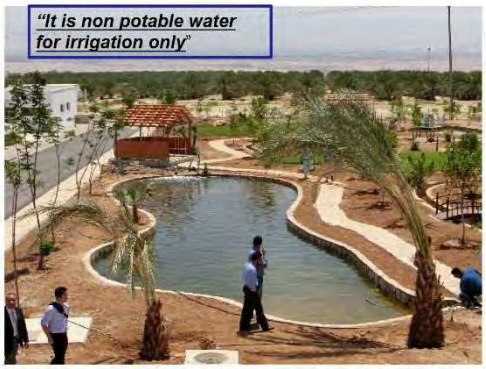


Photo 3 Amenity Pond

2.4 Flushing Sewers

A cesspit tanker frequently comes to the WWTP to put as a sludge into the wastewater receiving tank. After discharging the sludge, the emptied tanker goes to the irrigation tank, and then fills up the tank by TE. The tanker goes to the upper of a sewer and discharge TE from a manhole for flushing once a month. The control factors of flushing sewers that need to be considered in reusing TE are addressed.

- Control a manhole key no to discharge untreated wastewater/cesspit sludge into a manhole
- Monitoring illegal discharge in cooperation with the police
- Jericho municipality staff shall get on a tanker together

3. Pilot Plant Plan of Reuse Treated Wastewater

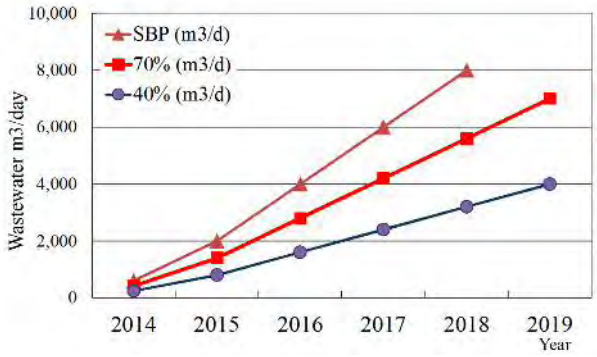
3.1 Precaution of the Pilot Plant

1) Estimation of wastewater generation and possible TE volume
2) Estimation of potential TE demand at the Pilot Plant
3) Selection of plants and products for the Pilot Plant
4) Measured water parameters (periodical water quality test)
5) Information disclosure of the test results

Before providing and/or selling the treated wastewater to users, 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.

3.2 Wastewater Generation at the WWTP

Wastewater generation (inflow of wastewater amount annually) was calculated in the Strategic Business Plan (SBP) for Managing Jericho Sewerage System. The following figure shows the wastewater inflow. It is assumed simultaneously that 70% and 40% of inflow amount.

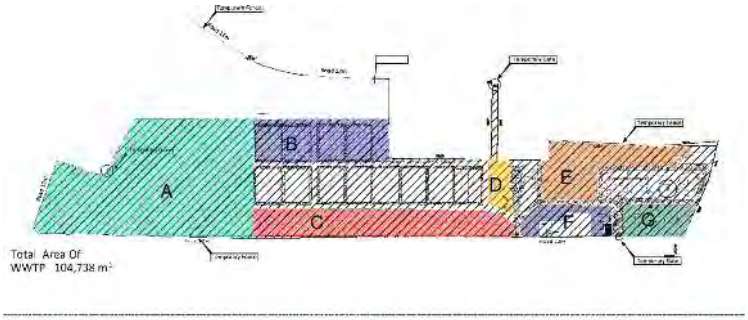


3.3 Location of the Pilot Plant

The location will be next the sludge drying beds in the northwest of the WWTP.

3.5 Potential TE Demand in the WWTP

Potential TE demand is shown in following Figure.



	A	B	C	D	E	F	G	Pond	Empty	Total
Area (ha)	3.39	1.02	1.19	0.18	0.81	0.29	0.33	0.03	0.06	7.30
Ratio	47%	14%	16%	2%	11%	4%	5%	0%	1%	100%
Water Demand (m^3/d)	237	65	60	20	49	24	27	126	0	610

3.6 The Draft Implementation Schedule of the Pilot Plant

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 wastewater. The commencement timing of an experimental farm outside of the WWTP will depend on the wastewater amount.

3.7 Methodology of the Pilot Plant

The experimental farm called the Pilot Plant will be set up inside the WWTP. The farm planted popular fruit trees in Jericho such as date palm, lemon (*citrus limon*), orange and so on may have approximately 1,800 m^2. The experiment of reusing treated wastewater and sludge fertilizer will be carried out mainly by the C/P, but the data of result will be shared with the JICA Expert Team.

From the viewpoint of demand, providing treated wastewater for palm dates shall be highly feasible reuse option since there are many palm date plantations near by the WWTP. If any cooperative farmer(s) around the WWTP provide(s) an experimental palm date farm, the experiment of reuse of treated

wastewater and sludge fertilizer will be carried out outside the WWTP. Since equipment such as distribution pipes and pumps may become essential depending on the location of such experimental farm, production equipment should be arranged. In addition, since the volume of distributed treated wastewater depends on the inflow wastewater, also the Pilot Plant in the WWTP is of the first priority, the timing of commencement of the outside experimental farm shall be studied.

Before providing the treated wastewater to farmers outside of the WWTP, the JICA 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.

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 approximately estimated water demand of the irrigation/pounds and the Pilot Plant is lower than 100m^3/day. On the other hand, as of the end of June 2014, the current influent amount reaches approximately 120 – 260 m^3/day (while effluent amount is between 80 - 200 m^3/day, lower than the influent amount.). Currently, a small amount of treated wastewater can be sold to users but neither the water quantity nor quality can be guaranteed. 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 shows the Pilot Plant area.

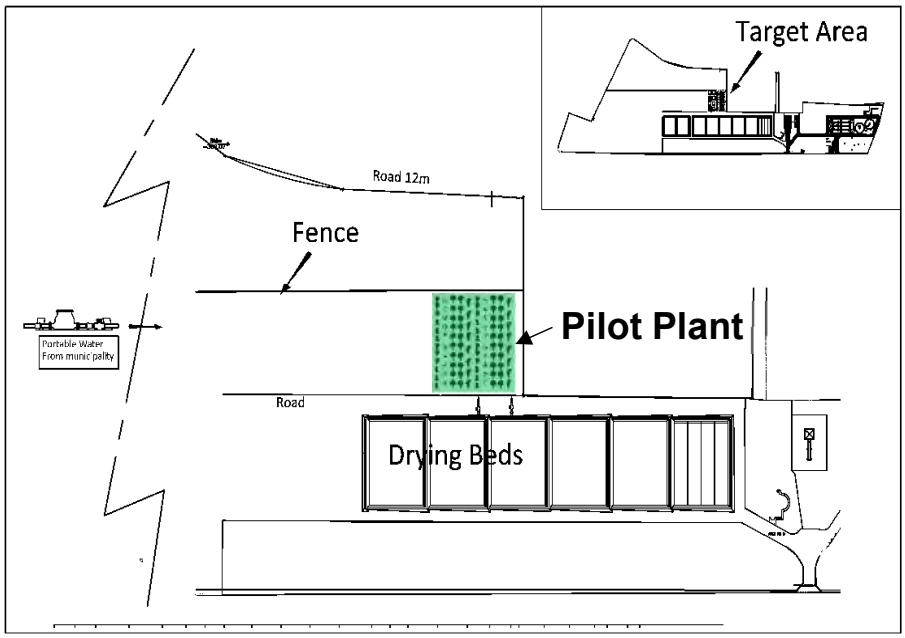
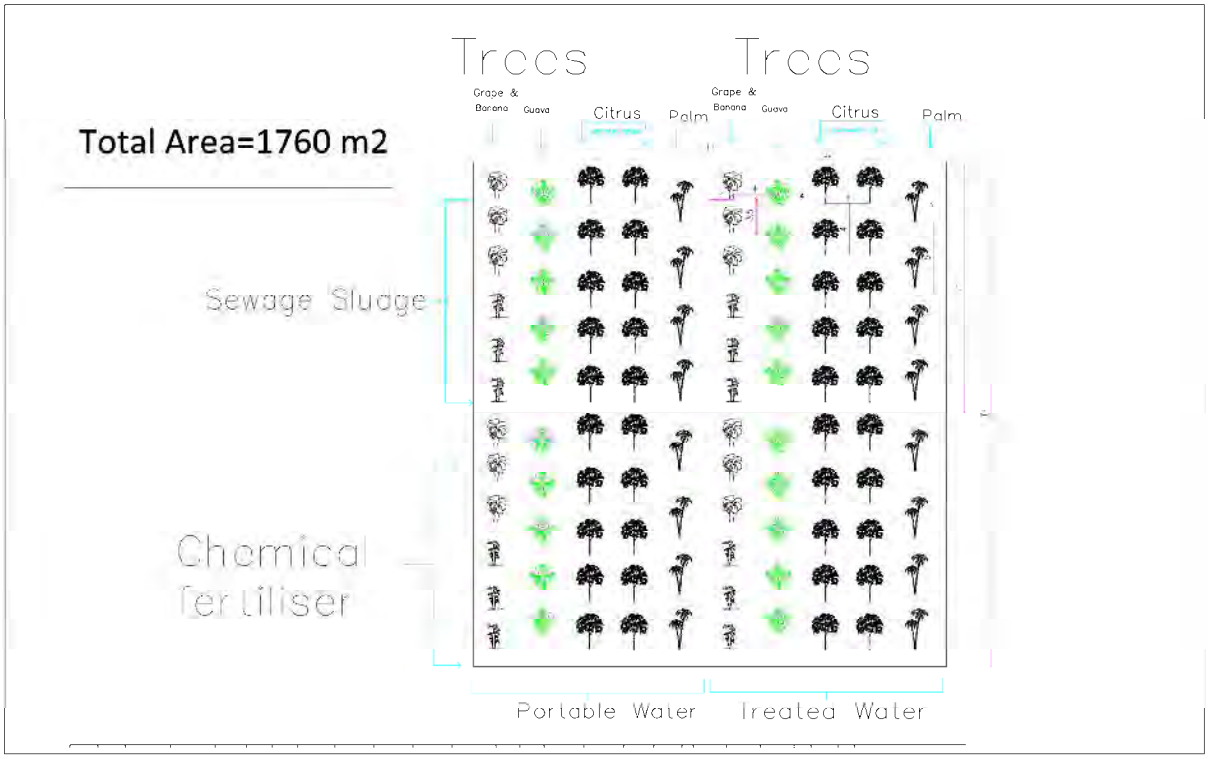
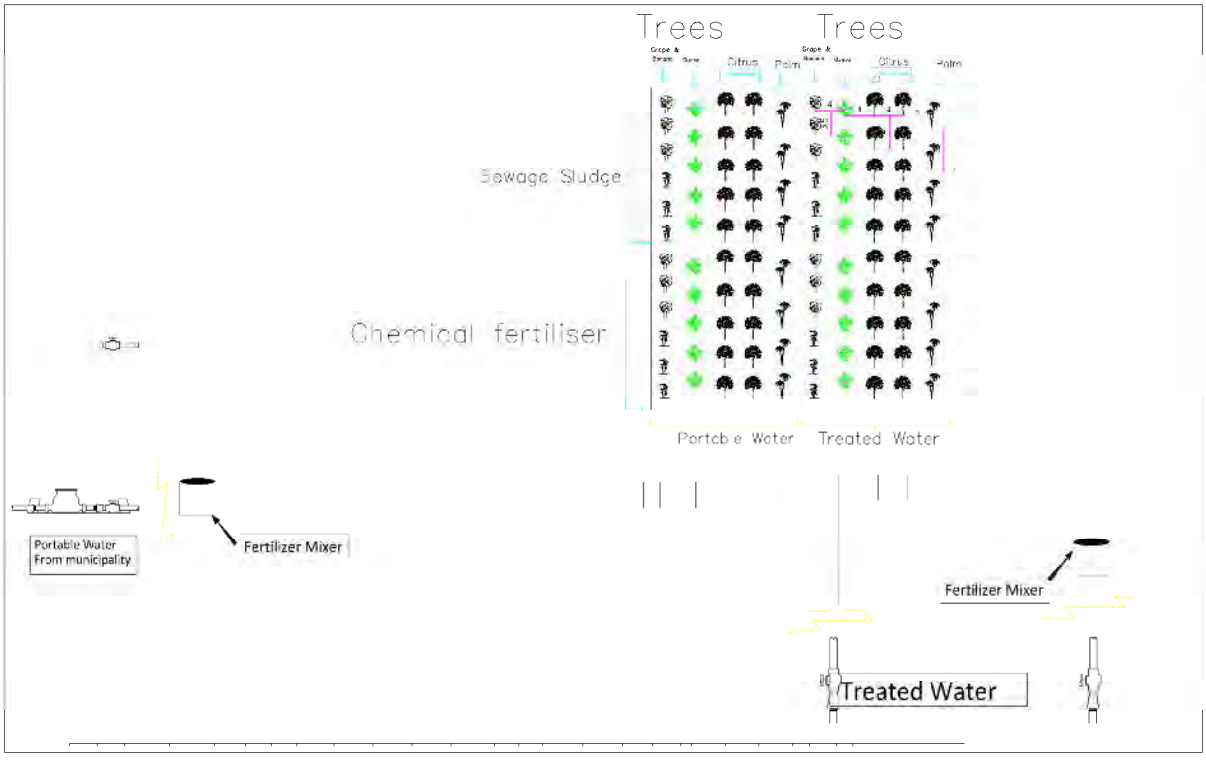
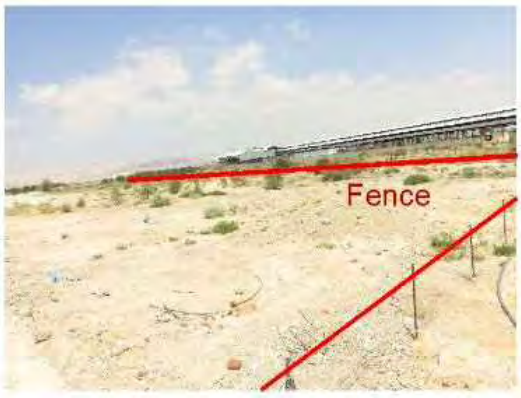


Figure Pilot Plant


Trees
Trees
Grape &
Banana
Guava
Citrus
Palm
Grape &
Banana
Guava
Citrus
Palm
Total Area=1760 m2
Sewage Sludge
Chemical
fertiliser
Portable Water
Treated Water


Trees
Trees
Sewage Sludge
Chemical fertiliser
Portable Water
Treated Water
Portable Water
From municipality
Fertilizer Mixer
Fertilizer Mixer
Treated Water

The Pilot Plant site shows below.



Need site clearance and soil replacement

Irrigation tapping point for cleaning drying bed

3.8 The Pilot Plant Area Preparation (Draft)

1) Surface Leveling and cleaning

All earth works on Site shall be completed before any fill is deposited. The pilot plant area should be clean from all rubbish, debris and any dirt .Sub-grade should be leveled before filling with any material.

2) Soil Improvement:

The soil and the work of the laboratory tests shall be studied to ensure suitability for the cultivation of tree species mentioned. And if it turns out that the soil contains a high percentage of salinity the soil for at least half a meter of good soil suitable for agriculture must be improved.

3) Soil Tilling and Mincing:

The target area for planting by mechanical tilling and mincing shall be prepared to mix in organic matter, or to reduce the amount of weeds in the area. Tillage is often classified into two types, primary and secondary. There is no strict boundary between them so much as a loose distinction between tillage that is deeper and more thorough (primary) and tillage that is shallower and sometimes more selective of location (secondary).

4) Chemical and natural fertilizers:

Organic material to the soils through tilling shall be added to improve the soil's texture and workability, while increasing its nutrient content. Chemical and natural fertilizers should be added in scientific ways and amounts taking into account the divisions shown in the accompanying drawings.

5) Irrigation system:

Suitable irrigation system for each type of trees should be made, and all the necessary dripping tubes, water taps and necessary meters should be prepared

Treated wastewater is getting from the treatment plant and in coordination with the engineers and the technicians of the plant.

For the source of potable irrigation water, all of the costs to get to the source of potable irrigation water

by the municipality must be coordinated with the municipality and pay.
Irrigation system must cover the whole target area of the study with the possibility of expansion to other areas as directed by the supervisor engineer.
The times and amounts of water suitable for irrigation scientifically thoughtful which commensurate with the nature of the soil and the type of trees and climatic conditions must be taken into account.

6) Palm Trees:
Palm is one of the most important crops, which the farmers in the Jericho and the Jordan Valley take care of. Palm produce fruits in a period ranging from two to three years from the date of Agriculture, so to achieve the purpose of this study; palm should not be less than the age of 3-4 years, and also must be healthy and free of disease and with good productivity, also with strong roots, making the rate of damage almost non-existent. When you move a palm tree to its new place; it must be done by specialists of planting the palms and to prepare the soil and all that is required before the transfer process.

3.9 Palestine Reuse Standard for Agriculture

The latest reuse standard for agriculture was prepared on May 22, 2014, but it is still a draft. MoA explained that the draft standard will be finalized as soon as possible.
The draft Reuse Standard shows below.

Classification of the Treated Wastewater according to Quality

Maximum limits for chemical and biological properties (mg/L) unless otherwise stated	Quality of Treated Wastewater			
	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Biochemical Oxygen Demand BOD5	20	20	40	60
Total Suspended Solids TSS	30	30	50	90
Fecal coliform bacteria (colony/100 mL)	200	1000	1000	1000
Chemical Oxygen Demand COD	50	50	100	150
Dissolved Oxygen DO	1<	1<	1<	1<
Total Dissolved Solids TDS	1200	1500	1500	1500
Potential of Hydrogen PH	9 _6	9_6	9_6	9_6
Fat , Oil and Grease	5	5	5	5
Phenol	0.002	0.002	0.002	0.002
Detergents MBAS	15	15	15	25
Nitrate Nitrogen NO3-N	20	20	30	40
Ammonium Nitrogen NH4-N	5	5	10	15
Total Nitrogen T-N	30	30	45	60
Chloride Cl	400	400	400	400
Sulfate SO4	300	300	300	300
Sodium Na	200	200	200	200
Magnesium Mg	60	60	60	60
Calcium Ca	300	300	300	300
Sodium adsorption ratio SAR	5.83	5.83	5.83	5.83
Phosphate Phosphorus PO4-P	15-20	15-20	15-20	15-20
Aluminum Al	5	5	5	5
Arsenic As	0.1	0.1	0.1	0.1
Copper Cu	0.2	0.2	0.2	0.2
Iron Fe	5	5	5	5
Manganese Mn	0.2	0.2	0.2	0.2
Nickel Ni	0.2	0.2	0.2	0.2
Lead Pb	0.2	0.2	0.2	0.2
Selenium Se	0.02	0.02	0.02	0.02
Cadmium Cd	0.01	0.01	0.01	0.01
Zinc Zn	2	2	2	2
Cyanide CN	0.05	0.05	0.05	0.05
Chrome Cr	0.1	0.1	0.1	0.1
Mercury Hg	0.001	0.001	0.001	0.001
Cobalt Co	0.05	0.05	0.05	0.05
Boron B	0.7	0.7	0.7	0.7
Bacteria E. coli (Colony/100 mL)	100	1000	1000	1000
Nematodes (Eggs/L)	less than or equal 1	less than or equal 1	less than or equal 1	less than or equal 1
Maximum temperature	35	35	35	35
The degree of turbidity	5-10	5-10	5-10	5-10
A: Nivelo meter				

Source: Palestine Ruse Standard (draft)

Comparison of Reuse Standard (Reference)

Maximum limits for chemical and biological properties (mg/L)

Items		MOA	Israel		Jordan	Oman	WHO	WHO
		High (A)	Irrigation	Trace Stream	A	A-1	Moderate	Element
Biochemical Oxygen Demand (BOD)	mg/L	20	10	10	30	15		
Total Suspended Solids (TSS)	mg/L	30	10	10	50	15	100	
Fecal coliform bacteris	colony/100mL	200	10	200		200		1000
Chemical Oxygen Demand (COD)	mg/L	50	100	70	100	150		
Dissolved Oxygen (DO)	mg/L	1<	0.5<	3<	2<			
Total Dissolved Solids (TDS)	mg/L	1200			1500	1500	2000	
Potential of Hydrogen (pH)		6 - 9	6.5 - 8.5	7 - 8.5	6 - 9	6 - 9	6.5 - 8	
Fat, Oil and Grease	mg/L	5		1	8	0.5		
Phenol	mg/L	0.002			0.002	0.001		
Detergents (MBAS)	mg/L	15			100			
Nitrate Nitrogen (NO3-N)	mg/L	20			30	50		
Ammonium Nitrogen (NH4-N)	mg/L	5				5		
Total Nitrogen (T-N)	mg/L	30	25	10	45			
Chloride (Cl)	mg/L	400	250	400	400	650		
Sulfate (SO4)	mg/L	300			500	400		
Sodium (Na)	mg/L	200	150	200	230	200		
Magnesium (Mg)	mg/L	60			100	150		
Calcium (Ca)	mg/L	300			230			
Sodium Adsorption Ratio (SAR)	mg/L	5.83	0.5	5	9	10		
Phosphate Phosphorus (PO4-P)	mg/L	20			30			
Aluminum (Al)	mg/L	5			5	5		5
Arsenic (As)	mg/L	0.1	0.1	0.1	0.1	0.1		0.1
Copper (Cu)	mg/L	0.2			0.2	0.5		0.2
Iron (Fe)	mg/L	5	2		5	1	1.5	5
Manganese (Mn)	mg/L	0.2			0.2	0.1	1.5	0.2
Nickel (Ni)	mg/L	0.2	0.2	0.05	0.2	0.1		0.2
Lead (Pb)	mg/L	0.2	0.1	0.008	5	0.1		5
Selenium (Se)	mg/L	0.02	0.02		0.05	0.02		0.02
Cadmium (Cd)	mg/L	0.01	0.01	0.005	0.01	0.01		0.01
Zinc (Zn)	mg/L	2	2	0.2	5	5		2
Cyanide (Cn)	mg/L	0.05				0.05		
Chrome (Cr)	mg/L	0.1	0.1	0.05	0.1	0.05		0.1
Mercury (Hg)	mg/L	0.001	0.002	0.0005	0.002	0.001		
Cobalt (Co)	mg/L	0.05						0.05
Boron (B)	mg/L	0.7	0.4		1	0.5	3	
Bacteria E. Coli	(colony/100mL)	100			100			
Nematodes	(Eggs/L)	<1			<1	<1	<1	
Redual Chlorine	mg/L		1	0.01				
Ammonia	mg/L		20	1.5				
Total Phosphorus (T-P)	mg/L		5	0.2		30		
Electrical Conductivity	dS/m		1.4			2000 μ /m	3000 μ /cm	
Fluoride	mg/L		2					
Barium (Ba)	mg/L			50		1		
Turbidity	NTU	10			10			
Fluoride (F)	mg/L				1.5	1		1
Beryllium (Be)	mg/L					0.1		0.1
Lithium (Li)	mg/L					0.07		2.5
Molybdenum (Mo)	mg/L					0.01		0.01
Nitrogen: Organic (kjeldahl)	mg/L					5		
Nitrate-N	mg/L					11.3		
Silver (Ag)	mg/L					0.01		
Sulphide (S)	mg/L					0.1		
Vanadium (V)	mg/L					0.1		0.1
Maximum temperature	degree	35						

Sampling schedule is shown below.

Parameter	Sampling Frequency (Time)		
	Daily	Weekly	Yearly
Biochemical Oxygen Demand BOD5	3		
Total Suspended Solids TSS	3		
Chemical Oxygen Demand COD	3		
Dissolved Oxygen DO	3		
Total Dissolved Solids TDS	3		
Potential of Hydrogen PH	3		
Nitrate Nitrogen NO3-N	3		
Ammonium Nitrogen NH4-N	3		
Total Nitrogen T-N	3		
Maximum temperature	3		
The degree of turbidity	3		
Fecal coliform bacteria (colony/100 mL)		2	
Nematodes (Eggs/L)		1	
Bacteria E. coli (Colony/100 mL)		2	
Fat , Oil and Grease			4
Phenol			4
Detergents MBAS			4
Chloride Cl			4
Sulfate SO4			4
Sodium Na			4
Magnesium Mg			4
Calcium Ca			4
Sodium adsorption ratio SAR			4
Phosphate Phosphorus PO4-P			4
Aluminum Al			4
Arsenic As			4
Copper Cu			4
Iron Fe			4
Manganese Mn			4
Nickel Ni			4
Lead Pb			4
Selenium Se			4
Cadmium Cd			4
Zinc Zn			4
Cyanide CN			4
Chrome Cr			4
Mercury Hg			4
Cobalt Co			4
Boron B			4

3.10 Groundwater Quality (2013 – 2014)

The water quality data of two wells located near the WWTP will be compared with the treated wastewater quality. Adaptation to agricultural use of treated wastewater will be verified based on the 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 locations of the target two wells are shown in following Figure.

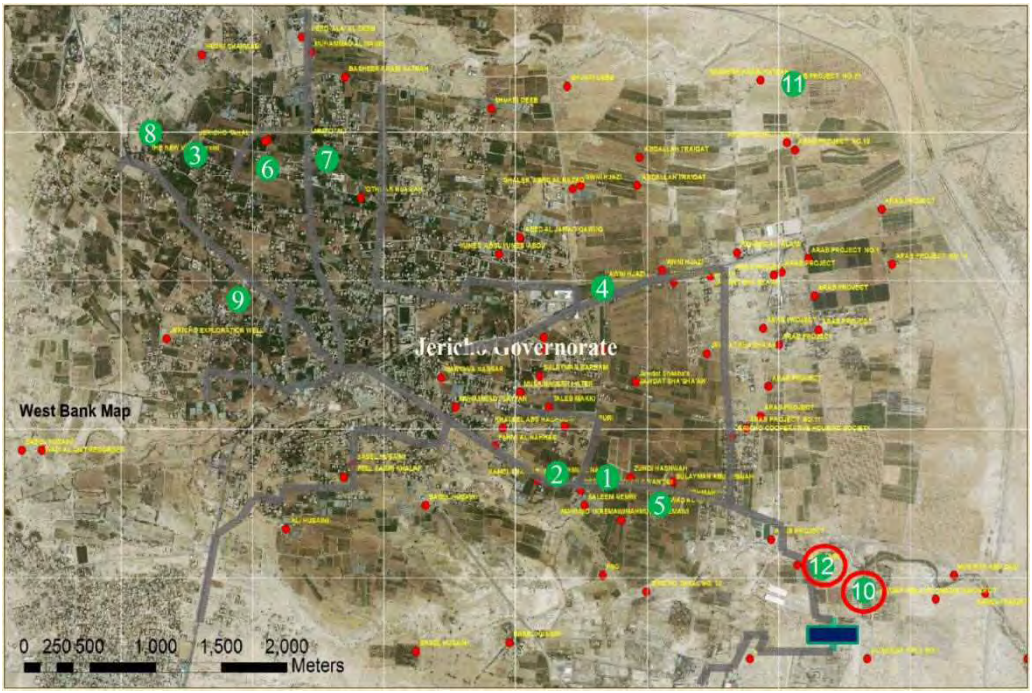


Table shows the water quality results.

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

The values highlighted with yellow color in above Table means an excess of the water quality a level in the Reuse Standard. 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 below Table.

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)

3.11 Relative Salt/Boron Tolerance of Agricultural Crops

Among the important agronomic factors, resistance to salt is the primary plant characteristic considered followed by boron tolerance, when selecting crops. Salt tolerance is the mechanism that allow plants to tolerate high salt stress. The relative salt tolerance of agricultural crops is show below Table.

The relative salt tolerance of agricultural crops

No.	Crops	Sensitivity			
		Tolerant	Moderately Tolerant	Moderately Sensitive	Sensitive
1	Bean				✓
2	Corn			✓	
3	Cabbage			✓	
4	Cucumber			✓	
5	Tomato			✓	
6	Date palm	✓			
7	Grape				✓
8	Banana, Citrus, Pepper, Eggplant, Cauliflower, Marrow				

Source: Water Reuse, Metcalf & Eddy, Aecom

The relative boron tolerance of agricultural crops is show below table.

No.	Crops	Sensitivity			
		Tolerant	Moderately Tolerant	Moderately Sensitive	Sensitive
1	Bean		✓		
2	Corn		✓		
3	Cabbage		✓		
4	Cucumber			✓	
5	Tomato	✓			
6	Date palm	✓			
7	Grape				✓

Source: Water Reuse, Metcalf & Eddy, Aecom

4. Reuse of Sewage Sludge

4.1 Reuse Options

1) Greenbelt and Agriculture Use

Fertilizer, soil conditioner, gardening soil, compost

2) Construction Materials Use

Cement material, roadbed material, tile, brick, back filling material, etc.

3) Heating Use

City gas, heating-cooling, fuel, etc.

4.2 Applicable Reuse of Sewage Sludge

a) Fertilizer

b) Cement material

c) Covering up seeds with soil at the dumping site

4.3 Soil Test Parameters

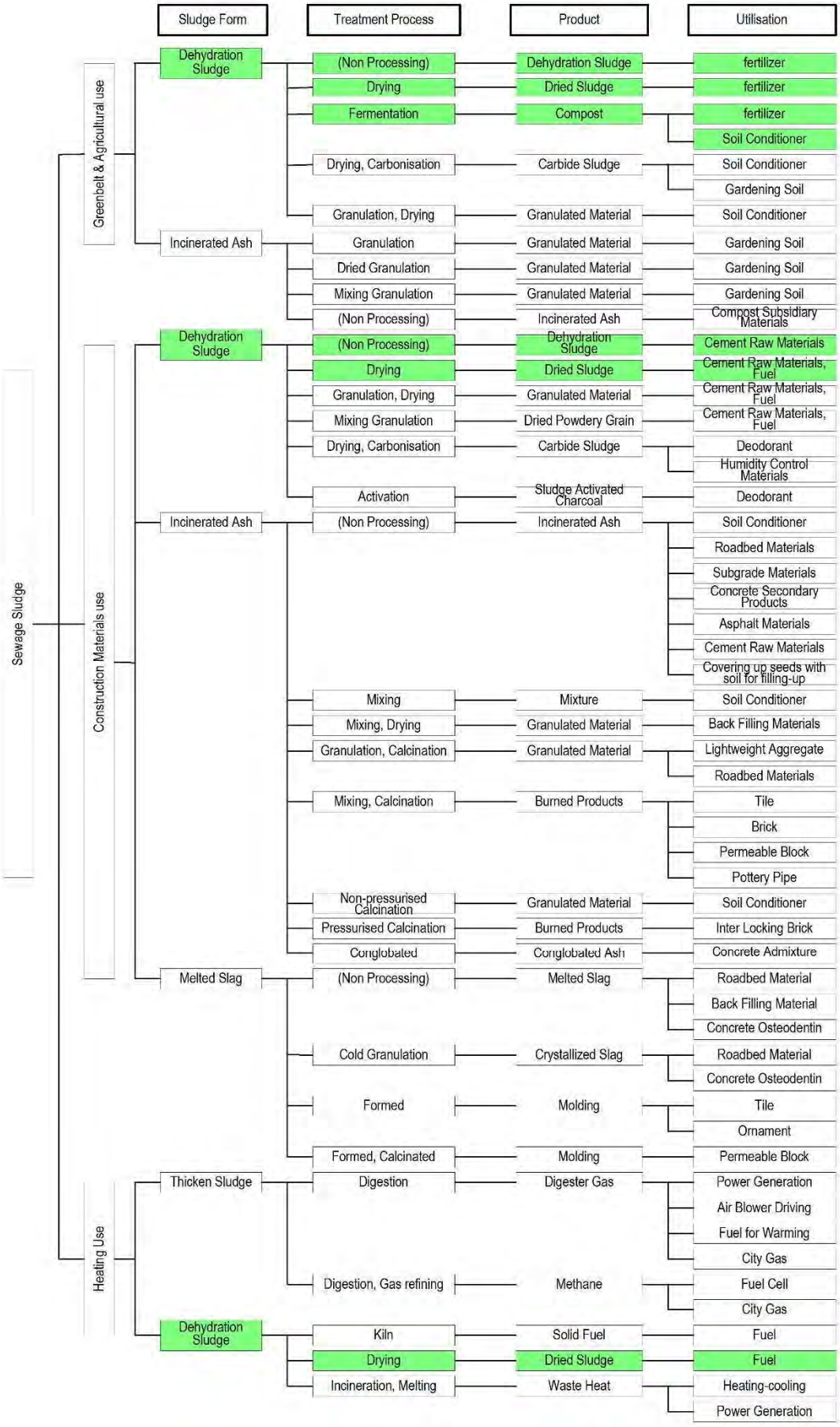
Limit values for heavy metal concentrations in sludge for use in agriculture are shown below.

Parameters	Palestine[1)]	Japanese[2)]
Cadmium	20 – 40	5
Copper	1,000 - 1,750	-
Nickel	300 – 400	300
Lead	750 – 1,200	100
Zinc	2,500 – 4,000	-
Mercury	16 – 25	2
Chromium	-	500
Arsenic	-	50

Unit: mg/kg of dry matter

1) Ministry of Agriculture, draft standard, 2013
2) Ministry of Agriculture, Forestry and Fisheries

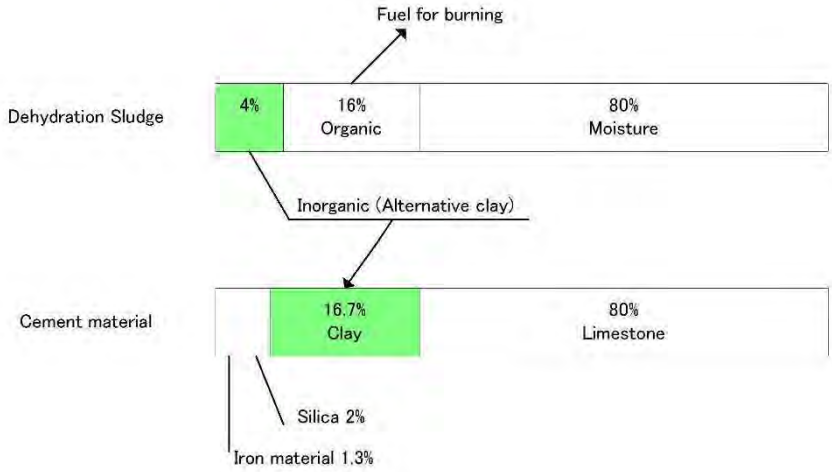
Reuse options of sewage sludge



4.4 Feasibility Study for Reusing Sewage Sludge

1) Cement Raw Material

A component of a cement raw material is shown below.



Estimation of potential demand in Israel

Potential Demand (Dst/y)
= Clinker capacity / (2/3) x Clay Ratio(16.7%) x 5%
= (2+4+0.65)million ton /(2/3) x 0.167 x 0.05
= 83,291 Dry ton/year
Water content: 50%
→83,291Dst/(1-0.5) = 166,582 wet-t/year

Jericho WWTP Mass Balance (Ultimate);
1.64Dst/year (3.28wet-t/year)

b) Covering up seeds with soil at the dumping site

Merits;

- Containment of offensive odor
- Landscape improvement

Demerit/Discussion;

- Reducing capacity of dumping site by soil covering
- Consensus by the Association (Joint Council Services, Planning and Development for Solid Waste Management In Jericho and Jordan Rift Valley(JCspd))

TeCSOM

Utilization of Treated Wastewater

Reuse Options;

- Landscape Irrigation → Applicable
- Agricultural Irrigation → Applicable
- Flushing Sewers → Applicable
- Amenity Use in the Garden in the Jericho WWTP
- Cooling Water for Industry
- Toilet Flush
- Groundwater Recharge

TeCSOM

Potential Risks and Measures on Reuse

- Treated Effluent pipelines have to be identified in order to avoid accidental cross-connections.
- Irrigation late at night and during early morning hours to minimize the exposure of Treated Effluent.
- Warning signs at the irrigation sites.
  "It is non potable water for irrigation only"
- Notify users and stop TE deliveries in case of accident/ emergencies.

TeCSOM

Irrigation in Garden & Amenity in WWTP

TeCSOM

Irrigation in Garden in WWTP

Sprinkling TE to lawns

Irrigation: twice a day
1 time: 10 – 15 min
By manual

Dropping TE to lawns

TeCSOM

Amenity Use

TeCSOM

Flushing Sewers

"Do not discharge into Manholes"

- JM staff going together
- Manhole Key control
- Monitoring illegal Discharge

TeCSOM

Pilot Plan of Reuse Treated Wastewater

1. Estimation of Wastewater generation and possible TE (Treated Effluent) volume
2. TE standard comparison with other countries
3. TE Demand at the WWTP
4. Selection of plants and products as a Pilot Plant
5. Measured parameters and Information disclosure to Users

TeCSOM

Pilot Plan at WWTP

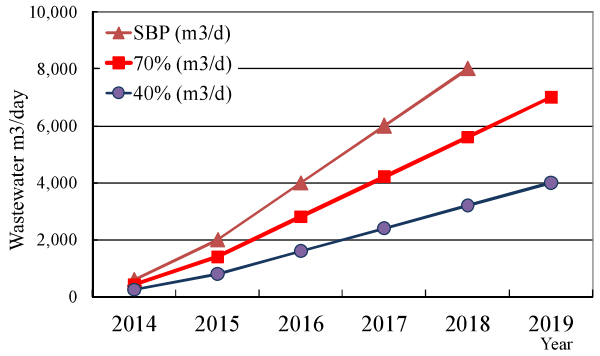
TeCSOM

Implementation Schedule of the Pilot Plan at the WWTP

1. TE Water Quality Test → Assignment of chemist
2. Record the WQ of TE and check to the Palestine Standard
3. Set the Pilot Plant at the WWTP *(planning)*
4. Questionnaire Survey to Farmers in Jericho with WQ results
5. Information Disclosure of TE Quality
6. Joint Workshop with PWA, MoA, JICA, etc.
7. Cooperation with a neighbor farm as experimentation outside of the WWTP
8. Providing TE to the farm → Selling TE for reuse

TeCSOM

Wastewater Generation at the WWTP



TeCSOM

Jericho WWTP Obligations

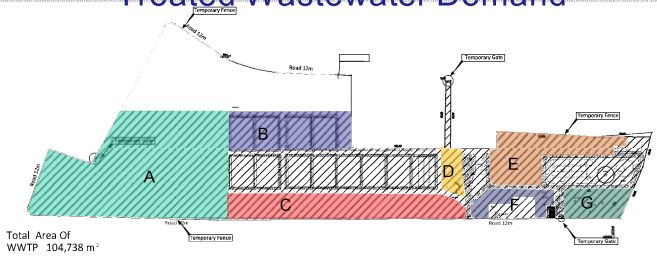
- Treated wastewater quality test
- Sewage sludge (soil) test
- Information disclosure on above test results

For guarantee of the quality to sell TE and Sludge

For avoiding conflicts between JM and customers regarding problems such as reduction/deterioration of products and/or plant withering,

TeCSOM

Treated Wastewater Demand



	A	B	C	D	E	F	G	Pond	Empty	Total
Area (ha)	3.39	1.02	1.19	0.18	0.81	0.29	0.33	0.03	0.06	7.30
Ratio	47%	14%	16%	2%	11%	4%	5%	0%	1%	100%
Water Demand (m^3/d)	237	65	60	20	49	24	27	126	0	610

TeCSOM

5. Standard of Treated Water for Agricultural Irrigation

Maximum limits (mg/L)	Quality of treated water: High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Biochemical Oxygen Demand BOD	20	20	40	60
Total Suspended Solids TSS	30	30	50	90
Fecal coliform bacteria (colony/100 ml)	200	1000	1000	1000
Chemical Oxygen Demand COD	50	50	100	150
Dissolved Oxygen DO	1<	1<	1<	1<
Total Dissolved Solids TDS	1200	1500	1500	1500
Potential of Hydrogen pH	6 - 9	6 - 9	6 - 9	6 - 9
Fat, Oil and Grease	5	5	5	5
Phenol	0.002	0.002	0.002	0.002
Detergents MBAS	15	15	15	25
Nitrate Nitrogen NO3-N	30	30	45	60
Ammonium Nitrogen NH4-N	5	5	10	15
Total nitrogen T-N	30	30	45	60
Chloride Cl	400	400	400	400
Sulphate SO4	300	300	300	300
Sodium Na	200	200	200	200
Magnesium Mg	60	60	60	60

(mg/L) unless otherwise stated	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Calcium Ca	300	300	300	300
Sodium adsorption ratio SAR	5.83	5.83	5.83	5.83
Phosphate Phosphorus PO4-P	15-20	15-20	15-20	15-20
Aluminum Al	5	5	5	5
Arsenic As	0.1	0.1	0.1	0.1
Copper Cu	0.2	0.2	0.2	0.2
Iron Fe	5	5	5	5
Manganese Mn	0.2	0.2	0.2	0.2
Nickel Ni	0.2	0.2	0.2	0.2
Lead Pb	0.2	0.2	0.2	0.2
Selenium Se	0.02	0.02	0.02	0.02
Cadmium Cd	0.01	0.01	0.01	0.01
Zinc Zn	2	2	2	2
Cyanide CN	0.05	0.05	0.05	0.05
Chrome Cr	0.1	0.1	0.1	0.1
Mercury Hg	0.001	0.001	0.001	0.001
Cobalt Co	0.05	0.05	0.05	0.05
Boron B	0.7	0.7	0.7	0.7
Bacteria E. coli (Colony/100 ml)	100	1000	1000	1000
Eggs of intestinal warms Nematodes (Eggs/L)	≤ 1	≤ 1	≤ 1	≤ 1

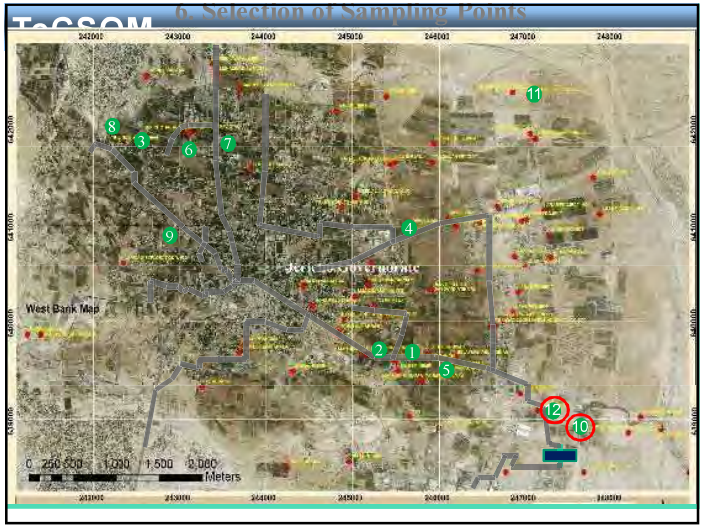
TeCSOM

Sampling Schedule

Parameter	Sampling Frequency (Time): Daily	Week	Month	Year
Biochemical Oxygen Demand BOD5	1			
Total Suspended Solids TSS	1			
Fecal coliform bacteria (colony/100 ml)	1			
Dissolved Oxygen DO	1			
Total Dissolved Solids TDS	1			
Potential of Hydrogen PH	1			
Nitrate Nitrogen NO3-N	1			
Ammonium Nitrogen NH4-N	1			
Total nitrogen T-N	1			
Maximum temperature	1			
The degree of turbidity	1			
Nematodes (Eggs/L)		1		
Fecal coliform bacteria (colony/100 mL)		2		
Bacteria E.coli (Colony/100 mL)		2		
Fat, Oil and Grease				1
Phenol				1
Detergents MBAS				1
Chloride Cl				1
Sulfate SO4				1
Sodium Na				1
Magnesium Mg				1
Calcium Ca				1
Sodium Adsorption Ratio SAR				1
Phosphate Phosphorus PO4-P				1
Aluminum Al				1
Arsenic As				1
Copper Cu				1
Iron Fe				1
Manganese Mn				1
Nickel Ni				1
Lead Pb				1
Selenium Se				1
Cadmium Cd				1
Zinc Zn				1
Cyanide CN				1
Chrome Cr				1
Mercury Hg				1
Cobalt Co				1
Boron B				1

TeCSOM

6. Selection of Sampling Points



TeCSOM 7. Well Information for Sampling

No	Point-Name	WELL DEPTH (m)	WATER USE
1	Sbeeru Hanhan &Rantisi	57	Agricultural
2	Fahmi al nahhas	126	Agricultural
3	Samed	120	Agricultural
4	Awni HJazi	100	Agricultural
5	Jawad Almasri & Mahmoud	137	Agricultural
6	Kaled Dabes		Agricultural
7	Dwedar	120	Agricultural
8	A'aen Al Soultan	Surface	Domestic/Agricultural
9	Kalel Fehmi Ghanem	217	Domestic
10	Majed Al Tarifi	55	Agricultural
11	Arab Project No.23	100	Agricultural
12	Ismael A'daaq		Agricultural

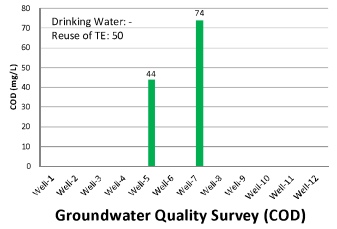
TeCSOM Groundwater Quality (2013-2014)

Items			Well 1 (No.10) Majed Al Tarifi				Well 2 (No.12) Ismael A'daaq				
			Survey-1	Survey-2	Survey-3	Survey-4	Survey-1	Survey-2	Survey-3	Survey-4	Detection
		Standard	Jun 25-13	Sept26-13	Dec 21-13		Jun 22-13	Sept26-13		Mar 1-14	Limit
Biochemical Oxygen Demand (BOD)	mg/L	20	ND	5	ND	ND	ND	4.2	-	-	1
Total Suspended Solids (TSS)	mg/L	30	1.5	8.7	8	3	1	ND	-	-	0.2
Fecal coliform bacteria	colony/100mL	200	0	6	3	0	0	0	-	-	
Chemical Oxygen Demand (COD)	mg/L	50	ND	16.9	2.3	ND	ND	-	-	ND	20
Dissolved Oxygen (DO)	mg/L	>1	4.6	6.26	3.55	2.8	3.95	6.55	-	-	
Total Dissolved Solids (TDS)	mg/L	1200	2,413	2,410	2,247	1,947	2,865	2,685	-	-	
Potential of Hydrogen (pH)		6 -8	7.98	8.094	7.65	7.372	7.7	-	-	-	
Fat, Oil and Grease	mg/L	5	ND	9.85	23.6	ND	ND	19.5	-	-	0.01
Phenol	mg/L	0.002	0.00267	ND	-	0.033	0.00418	ND	-	0.037	0.005
Detergents (MBAS)	mg/L	15	ND	ND	ND	ND	ND	ND	-	-	0.01
Nitrate Nitrogen (NO3-N)	mg/L	20	0.97	ND	ND	ND	8.39	-	-	9.2	0.05
Ammonium Nitrogen (NH4-N)	mg/L	5	ND	ND	0.07	ND	ND	ND	-	-	0.1
Total Nitrogen (T-N)	mg/L	30	0.05	17.4	17.2	8.52	8.39	27.53	-	-	
Chloride (Cl)	mg/L	400	1024.6	947.5	844	803.7	1007.9	869.82	-	-	
Sulfate (SO4)	mg/L	300	157.5	158.97	137.1	95.5	305.2	370.83	-	-	
Sodium (Na)	mg/L	200	491	349.6	558	579.7	343	428.5	-	-	
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	30	20.5	-	-	-	ND	-	-	-	0.05
Aluminum (Al)	mg/L	5	0.286	-	-	-	0.215	-	-	-	
Arsenic (As)	mg/L	0.1	ND	-	-	-	ND	-	-	-	0.05
Copper (Cu)	mg/L	0.2	ND	-	-	-	ND	-	-	-	0.006
Iron (Fe)	mg/L	5	0.067	-	-	-	0.4	-	-	-	
Manganese (Mn)	mg/L	0.2	0.011	-	-	-	ND	-	-	-	0.002
Nickel (Ni)	mg/L	0.2	ND	-	-	-	ND	-	-	-	0.015
Lead (Pb)	mg/L	0.2	ND	-	-	-	ND	-	-	-	0.04
Selenium (Se)	mg/L	0.02	ND	-	-	-	ND	-	-	-	0.075
Cadmium (Cd)	mg/L	0.01	ND	-	-	-	ND	-	-	-	0.004
Zinc (Zn)	mg/L	3	0.028	-	-	-	0.042	-	-	-	
Cyanide (CN)	mg/L	0.05	ND	-	-	-	ND	-	-	-	0.03
Chrome (Cr)	mg/L	0.1	ND	-	-	-	ND	-	-	-	0.007
Mercury (Hg)	mg/L	0.001	ND	-	-	-	ND	-	-	-	0.00005
Cobalt (Co)	mg/L	0.05	ND	-	-	-	ND	-	-	-	0.007
Boron (B)	mg/L	0.7	2.75	-	-	-	2.16	-	-	-	
Bacteria E. Coli	(colony/100mL)	10	0	-	-	-	0	-	-	-	
Nematodes	(Eggs/L)	<1	ND	-	-	-	ND	-	-	-	

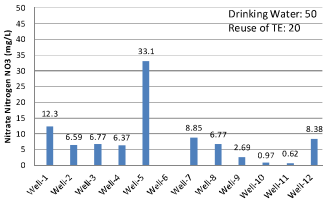
TeCSOM Water Quality Parameters

Parameter	Cause and Affect
TDS	Contents of calcium, magnesium, potassium, silicic acid and chloride Affect to taste of water
Phenol	LD50 (Media lethal dose) 530 mg/kg in a rat, 0.005 mg/L as portable water standard, toxicity to the central nerve
Chloride (Cl)	Seawater: 19,000mg/L, Dead Sea water: 206,000mg/L, Caused by infiltration of seawater, as a human factor sewage, domestic sewage, industrial and agricultural drainage, salty taste with rang 200-300 mg/L
Sulfate (SO4)	Caused by seawater and fertilizer, distasteful with range 200-500 mg/L, affect to a human: diarrhea
Sodium (Na)	Cased by infiltration of seawater and/or a nature of a soil
Magnesium (Mg)	Caused by a nature of a soil, contained a tenth of Fe, affect to a human: insomnia, emotional disease, shaking and slurred language
Boron (B)	Caused by infiltration of seawater, TDI (Tolerable Daily Intake): 0.096 mg/kg/day, affect to a human: emesis and diarrhea

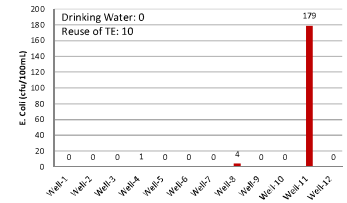
TeCSOM Groundwater Quality



Groundwater Quality Survey (COD)



Groundwater Quality Survey (NO3)



Groundwater Quality Survey (E. coli)

TeCSOM

Relative Salt Tolerance of Agricultural Crops

No.	Crops	Sensitivity			
		Tolerant	Moderately Tolerant	Moderately Sensitive	Sensitive
1	Bean				✓
2	Corn			✓	
3	Cabbage			✓	
4	Cucumber			✓	
5	Tomato			✓	
6	Date palm	✓			
7	Grape				✓
8	Banana, Citrus, Pepper, Eggplant, Cauliflower, Marrow				

Source: Water Reuse, Metcalf & Eddy, Aecom

TeCSOM

Relative Boron Tolerance of Agricultural Crops

No.	Crops	Sensitivity			
		Tolerant	Moderately Tolerant	Moderately Sensitive	Sensitive
1	Bean		✓		
2	Corn		✓		
3	Cabbage		✓		
4	Cucumber			✓	
5	Tomato	✓			
6	Date palm	✓			
7	Grape				✓

Source: Water Reuse, Metcalf & Eddy, Aecom

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Reuse Sewage Sludge Options

1. Greenbelt and Agricultural Use

   Fertilizer, soil conditioner, gardening soil, compost

2. Construction Materials Use

   Cement material, roadbed material, tile, brick, back filling material, etc.

3. Heating Use

   City gas, heating-cooling, fuel, etc.

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Reuse Sewage Sludge

- Applicable Reuse Options in Jericho:

  a) Fertilizer

  b) Covering up seeds with soil at the dumping site

  c) Cement material

  →Feasibility Study

- Soil Test Parameters

  Cadmium, Copper, Nickel, Lead, Zinc, Mercury, Chromium, Arsenic

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Covering up seeds at Dumping Site

Merits;
- Containment of Offensive Odor
- Landscape Improvement

Demerits/Discussion
- Reducing capacity by soil covering
- Consensus by the Association (Joint Council Services, Planning and Development for Solid Waste Management In Jericho and Jordan Rift Valley(JCspd))

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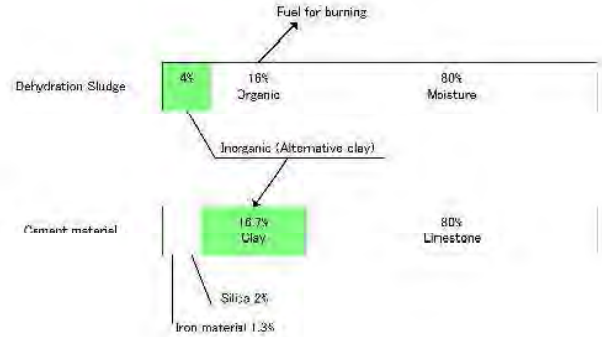
Cement Raw Material



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Estimation of Potential Demand

Potential Demand (Dst/y)

= Clinker capacity / (2/3) x Clay Ratio(16.7%) x 5%

= (2+4+0.65)million ton /(2/3) x 0.167 x 0.05

= 83,291 Dry ton/year

Water content: 50%

→83,291Dst/(1-0.5) = 166,582 wet-t/year

Jericho WWTP Mass Balance (Ultimate);

1.64Dst/year (3.28wet-t/year)

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Limit Values for Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine[1)]	Japanese[2)]
Cadmium	20 – 40	5
Copper	1,000 - 1,750	-
Nickel	300 – 400	300
Lead	750 – 1,200	100
Zinc	2,500 – 4,000	-
Mercury	16 – 25	2
Chromium	-	500
Arsenic	-	50

Unit: mg/kg of dry matter

1) Ministry of Agriculture, draft standard, 2013
2) Ministry of Agriculture, Forestry and Fisheries

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Nutrition for Soil

- Nitrogen (N)
- Phosphate (P_2O_5)
- Lime
- Kalium K_2O

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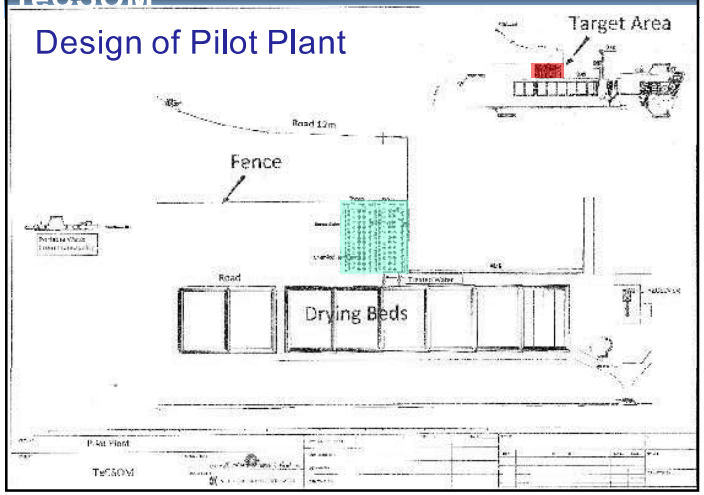
Design of Pilot Plant



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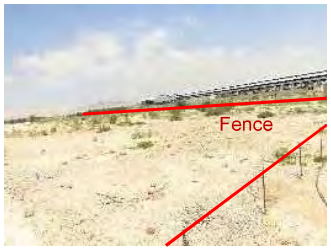
Pilot Plant Site



Need site clearance and soil replacement

Irrigation tapping point for cleaning drying bed

A 2-14-3: Operation of the Pilot Plant

Photo 1 11/11/2014

Groundbreaking Ceremony of the Pilot Plant as an experimental farm at the Jericho Wastewater Treatment Plant (WWTP)

Photo 2 18/11/2014

Before starting the ground leveling
An excavator machine prepares the soil for planting.

Photo 3 19/11/2014

Soil improvement transferred from in Jericho (outside WWTP)
The soil for citrus and alfalfa
Normal soil for palm dates is conveyed from inside the WWTP
Ground level is raised up approximately 0.5r

Photo 4 19/11/2014

The soil is conveyed by a truck (20 times)

Photo 5 22/11/2014

Ground leveling completed
Dark brown color is good soil for citrus
Light brown color is normal soil for palm da

Photo 6 22/11/2014

The buffer zone from the fence is 5m since a new fence will be built by Palestine side.

Photo 7 25/11/2014

Holes for planting

Photo 8 29/11/2014

Treated wastewater tapping point at the drying bed

Photo 9 29/11/2014

Irrigation system for planting

Photo 10 30/11/2014

Irrigation system for planting

Photo 11 30/11/2014

Signboard of the Pilot Plant

"Pilot Plant Project Reuse of Treated Wastewater & Sludge"

Photo 12 30/11/2014

Warning board
"It is Not portable water, for irrigation only"

Photo 13 1/12/2014

Water Meter for irrigation to measure treated wastewater volume

Photo 14 1/12/2014

Portable water tank: $7m^3$
Water is provided by a small pump from the tank

Photo 15 3/12/2014

Providing treated wastewater field
The Right plants are orange trees, The Left plants are lemon trees.

Photo 16 3/12/2014

Portable water storage tank

Photo 17 3/12/2014

Compost (animal fertilizer)

Photo 18 3/12/2014

Feeding/suction pump from the storage tank

Photo 19 4/12/2014

Providing treated wastewater field

Photo 20 4/12/2014

Planting lemon trees

Photo 21 6/12/2014

Planting palm dates

Photo 22 7/12/2014

Planting lemon and orange trees

Photo 23 7/12/2014

Dry sewage sludge for fertilizer

Photo 24 9/12/2014

Before plantation of Alfalfa and cone trees

Photo 25 9/12/2014

Irrigation: dropping system

Photo 26 10/12/2014

Arranging decorative trees in front of the Pilot Plant

Photo 28 11/12/2014

Planting decorative trees in front of the Pilot Plant

Photo 29 11/12/2014

Seeding Alfalfa and cone trees

Photo 30 13/12/2014

The pump cover for antitheft

Photo 31 13/12/2014

Camels intruded in the WWTP and ate the plants for the Pilot Plant.

Photo 32 13/12/2014

Eaten leaves by camels, and leaving few leaves

Photo 33 15/12/2014

Alfalfa growing up

Photo 34 15/12/2014

Panorama of the Pilot Plant

Photo 35 17/12/2014

Weeding out the Pilot Plant

Photo 36 17/12/2014

Alfalfa and Corn growing up

Photo 37 20/12/2014

Fence for preventing animals from outside

Photo 38 20/12/2014

Portable Water Storage Tank (7m3)
Pump for feeding to the plants
Water meter to measure water volume

Photo 39 20/12/2014

Water meter to measure treated wastewater volume
Chemical fertilizer mixer

Photo 40 20/12/2014

Panorama of the Pilot Plant
The Pilot Plant operation has started on 20th December, 2014

A 2-14-4: Handout Slides of the First Participatory Meeting

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Reuse of Treated Wastewater and Sewage Sludge

The Pilot Plant

December 21, 2014

NJS Consultants Co., Ltd.
Satoru Oniki

TeCSOM

Utilization of Treated Wastewater

Reuse Options;

- Landscape Irrigation → Applicable
- Agricultural Irrigation → Applicable
- Flushing Sewers → Applicable
- Amenity Use → in the Garden in the Jericho WWTP
- Cooling Water for Industry
- Toilet Flush
- Groundwater Recharge

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Potential Risks and Measures on Reuse

- Treated Effluent pipelines have to be identified in order to avoid accidental cross-connections.
- Irrigation late at night and during early morning hours to minimize the exposure of Treated Effluent.
- Warning signs at the irrigation sites.
  "It is non potable water for irrigation only"
- Notify users and stop TE deliveries in case of accident/ emergencies.

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Irrigation in Garden & Amenity in WWTP

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Irrigation in Garden in WWTP

Sprinkling TE to lawns

Irrigation: twice a day
1 time: 10 – 15 min
By manual

Dropping TE to lawns

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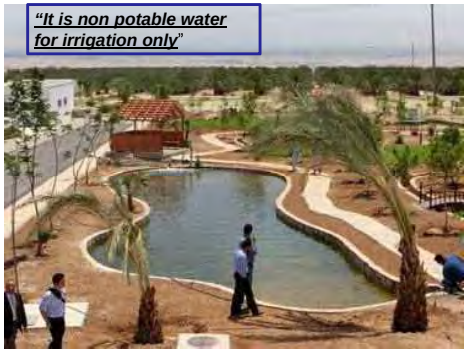
Amenity Use



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Implementation Schedule of the Pilot Plan at the WWTP

1. TE Water Quality Test
2. Record the WQ of TE and check to the Palestine Standard
3. Set the Pilot Plant at the WWTP
4. Questionnaire Survey
5. Information Disclosure of TE Quality
6. Joint Workshop
7. Cooperation with a neighbor farm as experimentation outside of the WWTP
8. Providing TE to the farm → Selling TE for reuse

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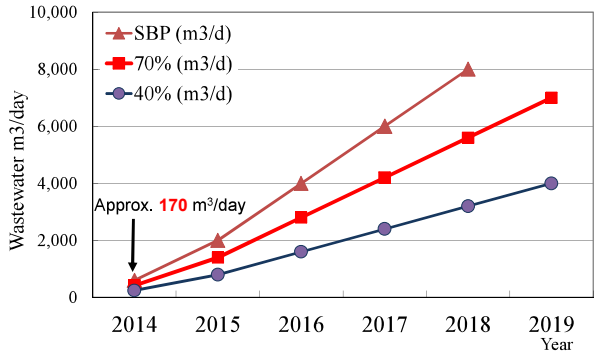
Wastewater Generation at the WWTP



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Jericho WWTP Obligations

- Treated wastewater quality test
- Sewage sludge (soil) test
- Information disclosure on above test results

I. For guarantee of the quality to sell TE and Sludge

II. For avoiding conflicts between JM and customers regarding problems such as reduction/deterioration of products and/or plant withering,

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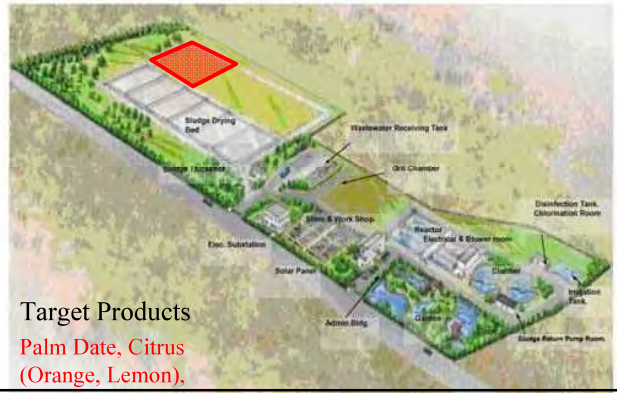
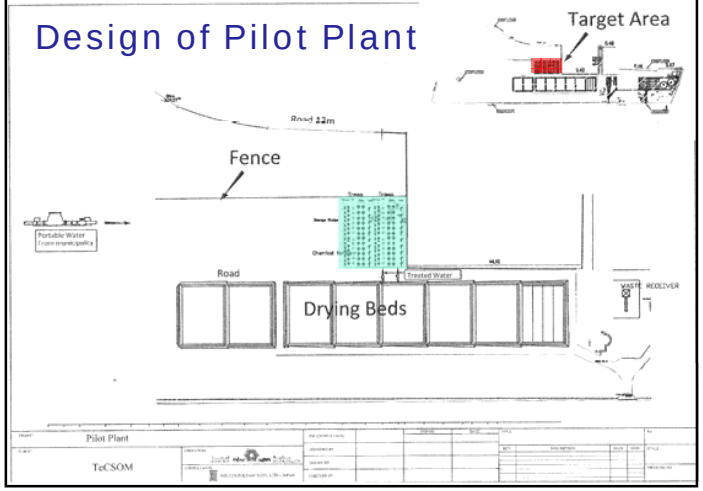
Pilot Plan at WWTP



TeCSOM

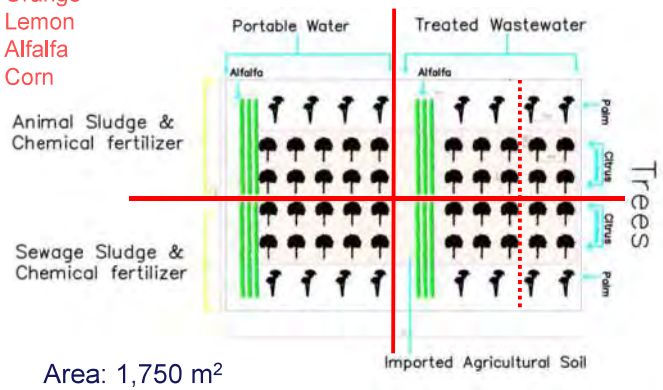
Design of Pilot Plant



TeCSOM

Pilot Plant Layout

Palm Date
Orange
Lemon
Alfalfa
Corn



Area: 1,750 m^2

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Pilot Plant

TeCSOM

Relative Salt Tolerance of Agricultural Crops

(Popular Products in Jericho)

No.	Crops	Sensitivity			
		Tolerant	Moderately Tolerant	Moderately Sensitive	Sensitive
1	Date palm	✓			
2	Orange				✓
3	Alfalfa	✓			
4	Corn			✓	
5	Tomato			✓	
6	Cucumber			✓	
7	Grape				✓
8	Bean				✓
9	Cabbage			✓	

Source: Water Reuse, Metcalf & Eddy, Aecom

TeCSOM

Relative Boron Tolerance of Agricultural Crops

(Popular Products in Jericho)

No.	Crops	Sensitivity			
		Tolerant >4.0 mg/L	Moderately Tolerant 2.0-4.0 mg/L	Moderately Sensitive 1.0-2.0mg/L	Sensitive <0.5-1.0mg/L
1	Orange				✓
2	Corn		✓		
3	Alfalfa	✓			
4	Cucumber			✓	
5	Tomato	✓			
6	Cabbage		✓		
7	Grape				✓
8	Bean		✓		

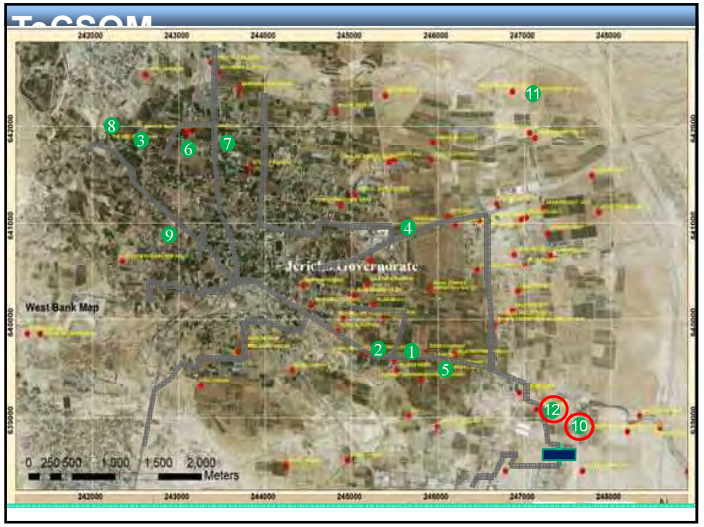
Source: Water Reuse, Metcalf & Eddy, Aecom

TeCSOM

Standard of Treated Water for Agricultural Irrigation

Maximum limits (mg/L)	Quality of treated water			
	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Biochemical Oxygen Demand BOD	20	20	40	60
Total Suspended Solids TSS	30	30	50	90
Fecal coliform bacteria (colony/100 ml)	200	1000	1000	1000
Chemical Oxygen Demand COD	50	50	100	150
Dissolved Oxygen DO	1<	1<	1<	1<
Total Dissolved Solids TDS	1200	1500	1500	1500
Potential of Hydrogen pH	6 - 9	6 - 9	6 - 9	6 - 9
Fat, Oil and Grease	5	5	5	5
Phenol	0.002	0.002	0.002	0.002
Detergents MBAS	15	15	15	25
Nitrate Nitrogen NO3-N	30	30	45	60
Ammonium Nitrogen NH4-N	5	5	10	15
Total nitrogen T-N	30	30	45	60
Chloride Cl	400	400	400	400
Sulphate SO4	300	300	300	300
Sodium Na	200	200	200	200
Magnesium Mg	60	60	60	60

(mg/L) unless otherwise stated	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
Calcium Ca	300	300	300	300
Sodium adsorption ratio SAR	5.83	5.83	5.83	5.83
Phosphate Phosphorus PO4-P	15-20	15-20	15-20	15-20
Aluminum Al	5	5	5	5
Arsenic As	0.1	0.1	0.1	0.1
Copper Cu	0.2	0.2	0.2	0.2
Iron Fe	5	5	5	5
Manganese Mn	0.2	0.2	0.2	0.2
Nickel Ni	0.2	0.2	0.2	0.2
Lead Pb	0.2	0.2	0.2	0.2
Selenium Se	0.02	0.02	0.02	0.02
Cadmium Cd	0.01	0.01	0.01	0.01
Zinc Zn	2	2	2	2
Cyanide CN	0.05	0.05	0.05	0.05
Chrome Cr	0.1	0.1	0.1	0.1
Mercury Hg	0.001	0.001	0.001	0.001
Cobalt Co	0.05	0.05	0.05	0.05
Boron B	0.7	0.7	0.7	0.7
Bacteria E. coli (Colony/100 ml)	100	1000	1000	1000
Eggs of intestinal warms Nematodes (Eggs/L)	≤ 1	≤ 1	≤ 1	≤ 1



TeCSOM Groundwater Quality (2013-2014)

Maximum limits for chemical and biological properties (mg/L)

Items	Standard Quality A Sampling Date	Wastewater Dec 1-14	Well-1 (No.10) Survey-1 Jun 22-13	Survey-2 Sep26-13	Survey-3 Dec21-13	Survey-4 Mar 1-14	Survey-5 Jun 17-14	Well-2 (No.12) Survey-1 Jun 22-13	Survey-2 Sep26-13	Survey-3	Survey-4 Mar 1-14	Survey-5 Jun 17-14
Biochemical Oxygen Demand (BOD)	mg/L 20	ND	0.01	3	ND	ND	ND	1.2	–	–	–	ND
Total Suspended Solids (TSS)	mg/L 30	1	15	8.7	8	3	7.25	1	ND	–	–	10.75
Fecal coliform bacteria	colony/100ml 200	TMTC	0	0	3	0	0	0	0	–	–	3
Chemical Oxygen Demand (COD)	mg/L 50	ND	ND	10.9	2.5	ND	ND	ND	–	–	ND	ND
Dissolved Oxygen (DO)	mg/L >5	2.1	3.6	6.29	3.95	2.8	–	3.95	6.55	–	–	–
Total Dissolved Solids (TDS)	mg/L 1,200	967	2,413	2,410	2,345	1,947	2,510	2,860	2,685	–	–	2,933
Potential of Hydrogen (pH)	6 – 9	7.85	7.98	8.094	7.65	7.372	7.797	7.7	8	–	–	7.365
Fat, Oil and Grease	mg/L 5	10.2	ND	9.85	23.6	ND	ND	ND	19.2	–	–	ND
Phenol	mg/L 0.002	0.00581	0.002627	ND	–	0.033	–	0.00418	ND	–	0.037	–
Detergents (MBAS)	mg/L 15	ND	ND	ND	ND	ND	ND	ND	ND	–	–	ND
Nitrate Nitrogen (NO3-N)	mg/L 20	1.23	0.97	ND	ND	ND	0.79	8.39	–	–	9.2	6.89
Ammonium Nitrogen (NH4-N)	mg/L 5	ND	ND	ND	0.07	ND	ND	ND	ND	–	–	ND
Total Nitrogen (T-N)	mg/L 30	22.3	0.97	17.3	15.2	8.52	10.46	8.38	27.53	–	–	14.34
Chloride (Cl)	mg/L 400	237.9	1024.6	947.3	844	861.7	638.7	1007.9	869.82	–	–	1003.3
Sulfate (SO4)	mg/L 300	65.7	157.5	158.97	137.1	95.5	135.3	305.2	370.83	–	–	375.1
Sodium (Na)	mg/L 200	145	491	549.6	558	570.7	645	583	428.5	–	–	487
Magnesium (Mg)	mg/L 60	30.4	96.3	–	–	–	–	162	–	–	–	–
Calcium (Ca)	mg/L 300	86.6	54.4	–	–	–	–	130	–	–	–	–
Sodium Adsorption Ratio (SAR)	mg/L 5.83	ND	9.26	–	–	–	–	4.74	–	–	–	–
Phosphate Phosphorus (PO4-P)	mg/L 20	15.2	20.3	–	–	–	–	ND	–	–	–	–
Aluminum (Al)	mg/L 5	0.04	0.259	–	–	–	–	0.212	–	–	–	–
Arsenic (As)	mg/L 0.1	ND	ND	–	–	–	–	ND	–	–	–	–
Copper (Cu)	mg/L 0.2	0.035	ND	–	–	–	–	ND	–	–	–	–
Iron (Fe)	mg/L 5	0.07	0.087	–	–	–	–	0.4	–	–	–	–
Manganese (Mn)	mg/L 0.2	ND	0.011	–	–	–	–	ND	–	–	–	–
Nickel (Ni)	mg/L 0.2	ND	ND	–	–	–	–	ND	–	–	–	–
Lead (Pb)	mg/L 0.2	ND	ND	–	–	–	–	ND	–	–	–	–
Selenium (Se)	mg/L 0.02	0.04	ND	–	–	–	–	ND	–	–	–	–
Cadmium (Cd)	mg/L 0.01	ND	ND	–	–	–	–	ND	–	–	–	–
Zinc (Zn)	mg/L 2	0.1	0.029	–	–	–	–	0.042	–	–	–	–
Cyanide (CN)	mg/L 0.05	ND	ND	–	–	–	–	ND	–	–	–	–
Chrome (Cr)	mg/L 0.1	ND	ND	–	–	–	–	ND	–	–	–	–
Mercury (Hg)	mg/L 0.001	ND	ND	–	–	–	–	ND	–	–	–	–
Cobalt (Co)	mg/L 0.05	ND	ND	–	–	–	–	ND	–	–	–	–
Boron (B)	mg/L 0.7	0.4	2.72	–	–	–	–	2.56	–	–	–	–
Bacteria E. Coli	cc/dmy/100ml 100	–	0	–	–	–	0	0	–	–	–	–
Nematodes	/Eggs/L1 <1	ND	ND	–	–	–	–	ND	–	–	–	–

ND: Not detected – Not sampling TMTC: Too Many To Count

TeCSOM Water Quality Parameters

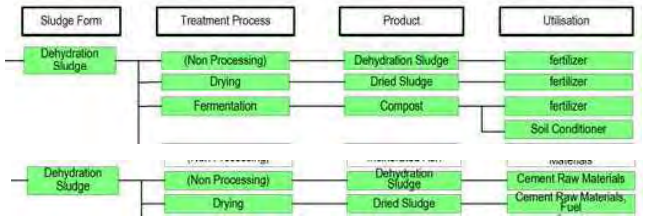
Parameter	Cause and Affect
TDS	Contents of calcium, magnesium, potassium, silicic acid and chloride Affect to taste of water
Phenol	LD50 (Media lethal dose) 530 mg/kg in a rat, 0.005 mg/L as portable water standard, toxicity to the central nerve
Chloride (Cl)	Seawater: 19,000mg/L, Dead Sea water: 206,000mg/L, Caused by infiltration of seawater, as a human factor sewage, domestic sewage, industrial and agricultural drainage, salty taste with rang 200-300 mg/L
Sulfate (SO4)	Caused by seawater and fertilizer, distasteful with range 200-500 mg/L, affect to a human: diarrhea
Sodium (Na)	Cased by infiltration of seawater and/or a nature of a soil
Magnesium (Mg)	Caused by a nature of a soil, contained a tenth of Fe, affect to a human: insomnia, emotional disease, shaking and slurred language
Boron (B)	Caused by infiltration of seawater, TDI (Tolerable Daily Intake): 0.096 mg/kg/day, affect to a human: emesis and diarrhea

TeCSOM

Reuse Sewage Sludge Options

TeCSOM

Reuse Sewage Sludge Options in Jericho



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Reuse Sewage Sludge Options

1. Greenbelt and Agricultural Use

   Fertilizer, soil conditioner, gardening soil, compost

2. Construction Materials Use

   Cement material, roadbed material, tile, brick, back filling material, etc.

3. Heating Use

   City gas, heating-cooling, fuel, etc.

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Reuse Sewage Sludge

- Applicable Reuse Options in Jericho:

  a) Fertilizer

  b) Covering up seeds with soil at the dumping site

  c) Cement material

- Soil Test Parameters

  Cadmium, Copper, Nickel, Lead, Zinc, Mercury, Chromium, Arsenic

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Limit Values for Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine[1)]	Japanese[2)]
Cadmium	20 – 40	5
Copper	1,000 - 1,750	-
Nickel	300 – 400	300
Lead	750 – 1,200	100
Zinc	2,500 – 4,000	-
Mercury	16 – 25	2
Chromium	-	500
Arsenic	-	50

Unit: mg/kg of dry matter

1) Ministry of Agriculture, draft standard, 2013
2) Ministry of Agriculture, Forestry and Fisheries

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Soil Test Result 1

(December 1st 2014)

Parameters	Palestine	Soil	Sludge
Cadmium	20 – 40	ND	3.2
Copper	1,000 - 1,750	33.6	279.5
Nickel	300 – 400	39.5	30.2
Lead	750 – 1,200	ND	29.7
Zinc	2,500 – 4,000	100.4	1,258
Mercury	16 – 25	0.0133	2.969
Chromium	(500)	42.4	44.0
Arsenic	(50)	24.4	ND

Unit: mg/kg of dry matter
( ): Japanese standard

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Nutrition for Soil

- Nitrogen (N)
- Phosphate (P_2O_5)
- Lime
- Kalium K_2O

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Soil Test Result 2

(December 1st 2014)

Parameters	Soil	Sludge
Total Nitrogen	838	32,531
Phosphate (P_2O_5)	4,140	23,740
Lime	262,200	115,620
Kalium (K_2O)	6,400	2,430

Unit: mg/kg of dry matter

TeCSOM

Monitoring Item at the Pilot Plant

- Monitor and verify the yields and growth such as product color, taste and size
- Irrigation volume (m^3/week)
- Tree size (thickness of tree body: mm)

Challenge

- Implementation of a Pilot Farm (outside experimental farm)

TeCSOM

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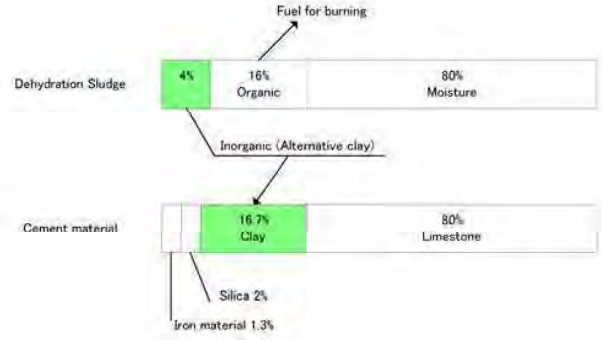
Covering up seeds at Dumping Site

Demerits/Discussion;
- ➢ Reducing capacity by soil covering
- ➢ Consensus by the Association (Joint Council Services, Planning and Development for Solid Waste Management In Jericho and Jordan Rift Valley(JCspd))

TeCSOM

Cement Raw Material



TeCSOM

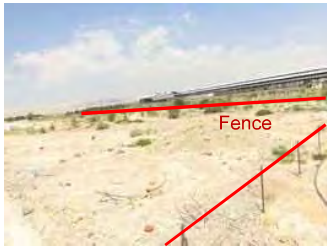
Estimation of Potential Demand

Potential Demand (Dst/y)
= Clinker capacity / (2/3) x Clay Ratio(16.7%) x 5%
= (2+4+0.65)million ton /(2/3) x 0.167 x 0.05
= 83,291 Dry ton/year
Water content: 50%
→83,291Dst/(1-0.5) = 166,582 wet-t/year

Jericho WWTP Mass Balance (Ultimate);
1,640Dst/year (3,280wet-t/year)

TeCSOM

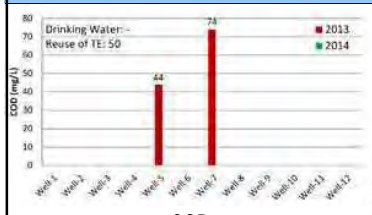
Pilot Plant Site



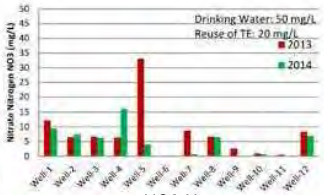
Need site clearance and soil replacement

Irrigation tapping point for cleaning drying bed

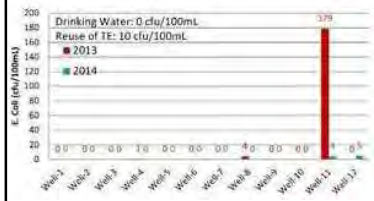
TeCSOM Groundwater Quality



COD



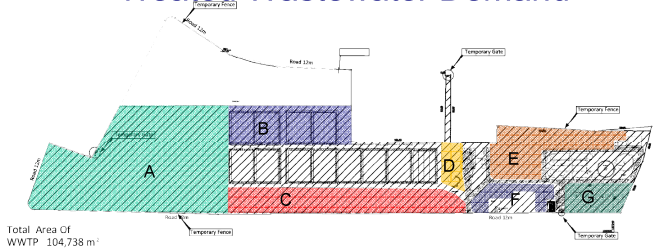
NO3-N



E. Coli

TeCSOM

Treated Wastewater Demand



	A	B	C	D	E	F	G	Pond	Empty	Total
Area (ha)	3.39	1.02	1.19	0.18	0.81	0.29	0.33	0.03	0.06	7.30
Ratio	47%	14%	16%	2%	11%	4%	5%	0%	1%	100%
Water Demand (m^3/d)	237	65	60	20	49	24	27	126	0	610

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Flushing Sewers

"Do not discharge into Manholes"

- JM staff going together
- Manhole Key control
- Monitoring illegal Discharge

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7. Well Information for Sampling

No	Point-Name	WELL DEPTH (m)	WATER USE
1	Sbeeru Hanhan &Rantisi	57	Agricultural
2	Fahmi al nahhas	126	Agricultural
3	Samed	120	Agricultural
4	Awni HJazi	100	Agricultural
5	Jawad Almasri & Mahmoud	137	Agricultural
6	Kaled Dabes		Agricultural
7	Dwedar	120	Agricultural
8	A'aen Al Soultan	Surface	Domestic/Agricultural
9	Kalel Fehmi Ghanem	217	Domestic
10	Majed Al Tarifi	55	Agricultural
11	Arab Project No.23	100	Agricultural
12	Ismael A'daaq		Agricultural

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Sampling Schedule

Parameter	Sampling Frequency (Time)			
	Daily	Week	Month	Year
Biochemical Oxygen Demand BOD5	3			
Total Suspended Solids TSS	3			
Chemically absorbed Oxygen COD	3			
Dissolved Oxygen DO	3			
Total Dissolved Solids TDS	3			
Potential of Hydrogen PH	3			
Nitrate Nitrogen NO3-N	3			
Ammonium Nitrogen NH4-N	3			
Total nitrogen T-N	3			
Maximum temperature	3			
The degree of turbidity	3			
Nematodes (Egg/L)		1		
Fecal coliform bacteria (colony/100 mL)		2		
Bacteria E. coli (Colony/100 mL)		2		
Fat, Oil and Grease				4
Phenol				4
Detergents MBAS				4
Chloride Cl				4
Sulfate SO4				4
Sodium Na				4
Magnesium Mg				4
Calcium Ca				4
Sodium Adsorption Ratio SAR				4
Phosphate Phosphorus PO4-P				4
Aluminum Al				4
Arsenic As				4
Copper Cu				4
Iron Fe				4
Manganese Mn				4
Nickel Ni				4
Lead Pb				4
Selenium Se				4
Cadmium Cd				4
Zinc Zn				4
Cyanide CN				4
Chrome Cr				4
Mercury Hg				4
Cobalt Co				4
Boron B				4

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Pilot Plan of Reuse Treated Wastewater

1. Estimation of Wastewater generation and possible TE (Treated Effluent) volume
2. TE standard
3. TE Demand at the WWTP
4. Selection of plants and products as an experimental farm
5. Measured parameters (water quality) and Information disclosure to Users

A 2-14-5: Questionnaire Results at the First Participatory Meeting

Technical Assistance and Capacity Building Project for Jericho Sanitation Project (TeCSOM)

Questionnaire
on
Reuse of Treated Wastewater and Sewage Sludge

December 21st 2014

2. Perception of Wastewater Treatment Plant

2-1	Wastewater Treatment Plant (WWTP) and Sewer networks were constricted in Jericho. Do you realize the importance/ necessity of the WWTP in Jericho?	☐ Yes **11 (7)** ☐ No, I do not recognize any importance of the Wastewater Treatment Plant (WWTP) in Jericho **0 (0)**
2-2	If you answered "Yes" on Q2-1, why do you think Wastewater Treatment Plant (WWTP) is important for Jericho? *(Multiple answers allowed)*	☐ Because it reduces pollution of water resources (groundwater) **11 (7)** ☐ Because it reduces insects and animals **9(4)** ☐ Because it reduces oral/contagion disease **8(5)** ☐ Because it reduces bad smell from stagnant wastewater **10(6)** ☐ Because it contributes to save land space by backfilling abandoned cesspit (discharge tank) **11(7)** ☐ Because it eliminates maintenance of cesspit (discharge tank) **8(5)** ☐ Because treated wastewater can be reused for irrigation and save portable water **11(7)** ☐ Other ( )

( ): stakeholder's answer except Jericho municipality staff

Please look at the page back

3. Perception of Treated Wastewater Reuse

3-1	As an experimental farm, reuse of wastewater for agriculture is already started in the Jericho Wastewater Treatment Plant. From a viewpoint of effective utilization of water resources, do you think that reuse of wastewater is something useful?	(1) Yes, I think re-use of wastewater is useful….go to Q3-2 **10(6)** (2) No, I don't think….go to Q3-3 **0(0)** (3) No idea……...go to Q3-4 **0(0)**
3-2	In case you choose (1) on Q3-1: What kind of reuse is acceptable in the Jericho City? *(Multiple answers allowed)*	☐Agricultural Irrigation such as palm dates **9(6)** ☐Landscape Irrigation such as watering of parks, roadside plantings and greenbelts **8(6)** ☐Reclaimed water for amenity such as fountains, waterways and pounds **3(2)** ☐Other ( )
3-3	In case you choose (2) on Q3-1: *(Multiple answers allowed)*	☐Because I do not know whether treated wastewater quality meets the standard for agriculture use **0(0)** ☐Because it may not be safety for human health. **0(0)** ☐Because I feel it is dirty and/or lack of hygienic care **0(0)** ☐Because I feel I dislike it **0(0)** ☐Because it is against my religious belief. **0(0)** ☐Other ( )
3-4	If treated wastewater quality is disclosed periodically and the tested water quality meets the reuse standard, Do you think that treated wastewater is usable?	☐ Yes, I want to use it **6(3)** ☐ No, I do not want to use it **0(0)** ☐ Other ( )
3-5	When the Jericho Municipality sells treated wastewater, Do you want to buy/use it?	☐ Yes, I want to buy/use it **8(5)** ☐ No, I do not want to buy/use it **1(1)** ☐ No idea, it depends on price (tariff) **2(1)**

( ): stakeholder's answer except Jericho municipality staff

4. Perception of Treated Sewage Sludge Reuse

4-1	Do you know that dry sludge generated from Wastewater Treatment Plant (WWTP) can be used for fertilizer of agricultural products and/or plant?	☐ Yes **10(6)** ☐ No **1(0)**
4-2	Do you agree with reuse of dry sludge from Wastewater Treatment Plant (WWTP)?	☐ Yes **9(6)** ☐ No **2(1)**
4-3	In case you choose "No" on Q4-2: Why do you feel rejection for reuse of dry sludge for agriculture? *(Multiple answers allowed)*	☐Because I do not know whether contents of dry sludge such as heavy metals meet the standard for agriculture use **1(1)** ☐Because I feel it is dirty and/or lack of hygienic care **2(1)** ☐Because I feel I dislike it **0(0)** ☐Because I feel it smells bad **0(0)** ☐Because it may not be safety for human health **1(1)** ☐Because it is against my religious belief. **0(0)** ☐Other ( )
4-4	If dry sludge meets the Reuse Standard for agriculture purpose, Do you yourself use the dry sludge as fertilizer?	(1) Yes, I want to use it **9(5)** (2) No, I do not want to use it **1(1)** →Reasons ( )
4-5	When the Jericho Municipality sells dry sludge, Do you want to buy/use it?	☐ Yes, I want to buy/use it **6(3)** ☐ No, I do not want to buy/use it **4(3)** ☐ Other ( )

( ): stakeholder's answer except Jericho municipality staff

5. Next Workshop

5	JICA Expert Team and Jericho Municipality will have the 2nd workshop on the Reuse in May 2015. We will report the progress of the Pilot Plant. Would you like to attend the workshop again?	☐ Yes, I want to attend it and to know the progress **11(7)** ☐ No, I do not recognize any importance of the reuse of treated wastewater and sludge. **0(0)** ☐ No idea **0(0)**

( ): stakeholder's answer except Jericho municipality staff

== The end of question ==

A 2-14-6: Power Point Slides of the Workshop

TeCSOM

Reuse of Treated Wastewater and Sewage Sludge

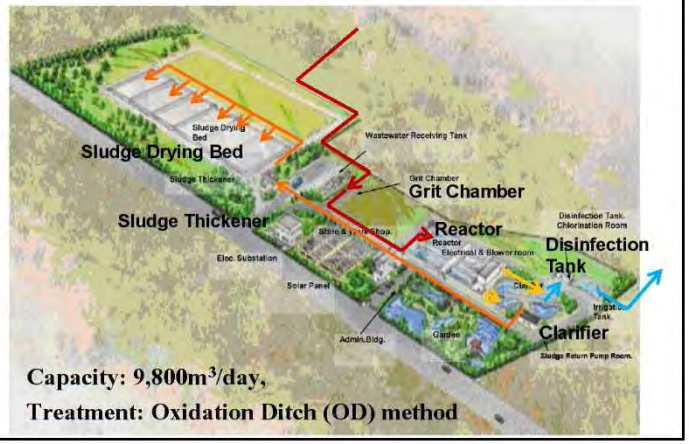
The 3rd Workshop

February 7, 2016

NJS Consultants Co., Ltd.
Satoru Oniki

TeCSOM

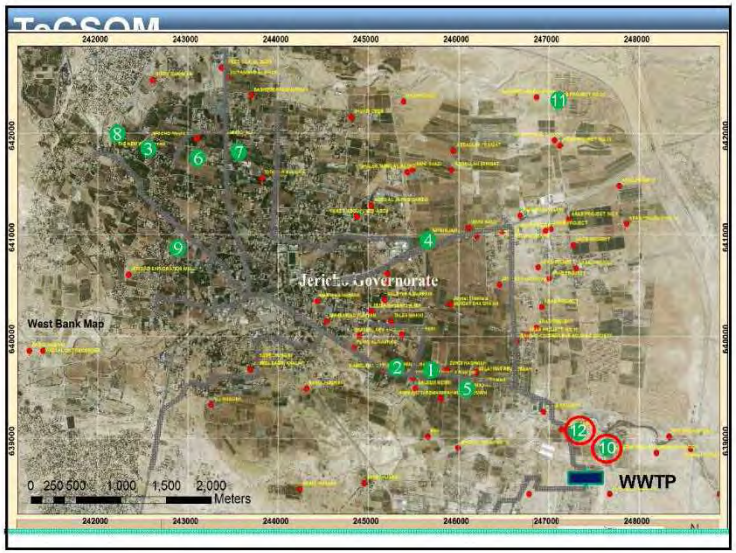
Jericho Wastewater Treatment Plant



TeCSOM

Treated Wastewater Quality

- Meet the Palestine Reuse Standard?
- Groundwater Quality?
- Heavy Metals?
- Safe Products?



TeCSOM Treated Wastewater Quality (2014-2015)

Items		Standard Quality A Sampling Date	Treated Wastewater 2014/12/1	2015/5/20	2015/11/11	2015/11/29	Well-10 2013/6/22	Well-12 2013/6/22
Biochemical Oxygen Demand (BOD)	mg/L	20	<5	<5	24	11	<5	<5
Total Suspended Solids (TSS)	mg/L	30	1	6.7	7		1.5	1
Fecal coliform bacteris	colony/100mL	200	600-800	192	22		0	0
Chemical Oxygen Demand (COD)	mg/L	50	<10	<10	54	40	<10	<10
Dissolved Oxygen (DO)	mg/L	1<	2.1	3	2.6		3.6	3.95
Total Dissolved Solids (TDS)	mg/L	1,200	867	885	910		2,413	2,860
Potential of Hydrogen (pH)		6 - 9	7.85	7.68	7.58		7.98	7.7
Fat, Oil and Grease	mg/L	5	10.2	<1	18.4	<1	<1	<1
Phenol	mg/L	0.002	0.00581	0.018	<0.001		0.00267	0.00418
Detergents (MBAS)	mg/L	15	<0.01	<0.01	<0.01		<0.01	<0.01
Nitrate Nitrogen (NO3-N)	mg/L	20	1.23	0.35	0.42		0.97	8.39
Ammonium Nitrogen (NH4-N)	mg/L	5	<0.05	<0.05	0.36		<0.05	<0.05
Total Nitrogen (T-N)	mg/L	30	22.3	10.7	35.62		0.97	8.38
Chloride (Cl)	mg/L	400	237.9	232.9	223.36		1024.6	1007.9
Sulfate (SO4)	mg/L	300	85.7	73.5	58.84		157.5	305.2
Sodium (Na)	mg/L	200	145	107.1	153.3		491	343
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

ND: Not detected

TeCSOM Treated Wastewater Quality (2014-2015)

Items		Standard Quality A Sampling Date	Treated Wastewater 1-Dec-14	20-May-15	2015/11/11	Well-10 Survey-1 Jun 22-13	Well-12 Survey-1 Jun 22-13
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	<0.03	<0.03
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
Nematodes	(Eggs/L)	<1	ND	ND	ND	ND	ND

ND: Not detected

TeCSOM

Irrigation in Garden in WWTP

Sprinkling TE to lawns

Irrigation: twice a day
1 time: 10 – 15 min
By manual

Dropping TE to trees

TeCSOM

Amenity Use

Tilapia fish: 170

- ✓ African freshwater cichlid fish
- ✓ Introduced to many areas for food

Amenity use and detection of toxic substances in water

TeCSOM

Pilot Plan at WWTP

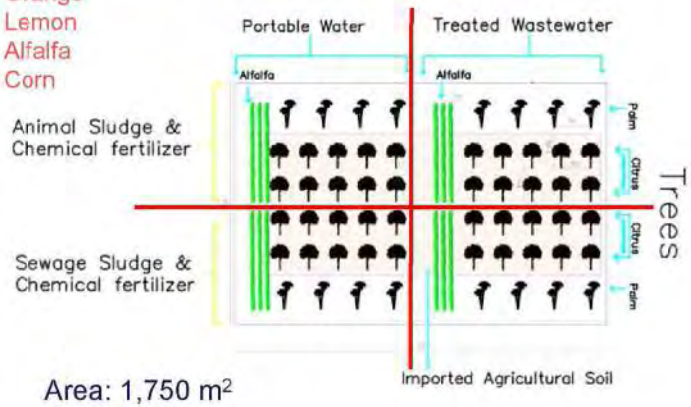
Target Products

Palm Date, Citrus (Orange, Lemon), Alfalfa, Corn

TeCSOM

Pilot Plant Layout

Palm Date
Orange
Lemon
Alfalfa
Corn



Area: 1,750 m^2

TeCSOM **Construction of the Pilot Plant**

TeCSOM

Pilot Plant in December 2014

Potable Water | Treated Wastewater

TeCSOM

Pilot Plant in May 2015

Potable Water | Treated Wastewater

TeCSOM

Pilot Plant in November 2015

Potable Water | Treated Wastewater

TeCSOM

Pilot Plant in February 2016

Potable Water | Treated Wastewater

TeCSOM

Pilot Farm (External Experimental Farm)

- ✓ Palm date
- ✓ Approx. 200 Trees
- ✓ Private farm land
- ✓ Providing Treated Wastewater
- ✓ No Sewage Sludge
- ✓ Commencement: Early June 2015

TeCSOM

Irrigation Tank

Irrigation Tank (1000 m^3) at WWTP

Irrigation Pump (Private)

TeCSOM

Pilot Farm (External Experimental Farm)

TeCSOM

Treated Wastewater Quality

- Meet the Palestine Reuse Standard?
- Groundwater Quality?
- **Heavy Metals?**
- **Safe Products?**

TeCSOM

Products Analysis (Orange)

		Potable Water	TE
Citric acid in Juice	mg/100mL	653	1,866
Brix of Juice	%	9.2	8.0
Ascorbic acid in Juice	mg/100mL	69.36	71.67
% of Juice		13.6	5.9
Total coliform count	CFU/g	Nil	Nil
Fecal coliform count	CFU/g	Nil	Nil
Enterococci	CFU/g	Nil	Nil

TeCSOM

Products Analysis (Lemon)

Parameter		Potable Water (ppm)	TE (ppm)	TE/PW	PSI 41 Water quality (ppm)
Silver	Ag	0.0002	0.0003	2.16	0.01
Aluminum	Al	0.0996	0.0385	0.39	0.2
Calcium	Ca	9.8061	16.5407	1.69	100
Cadmium	Cd	0.0018	0.0004	0.20	0.005
Chrome	Cr	0.0031	0.0046	1.49	0.05
Copper	Cu	0.0133	0.0407	3.07	1.0
Iron	Fe	0.3132	0.4583	1.46	0.3
Potassium	K	44.2475	53.2399	1.20	10
Magnesium	Mg	5.6671	11.8305	2.09	100
Manganese	Mn	0.0220	0.0312	1.42	0.1
Sodium	Na	1.5372	1.2493	0.81	200
Nickel	Ni	0.0031	0.0060	1.92	0.05
Lead	Pb	0.0004	0.0003	0.75	0.01
Zinc	Zn	0.0147	0.0134	0.91	5

TeCSOM

Sludge Reuse at WWTP

TeCSOM

Limit Values for Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine[1)]	Soil (Dec. 2014)	Sludge (Dec. 2014)	Sludge (Nov. 2015)
Cadmium	20	ND	3.2	1.94
Copper	1,000	33.6	279.5	153.3
Nickel	300	39.5	30.2	31.9
Lead	750	ND	29.7	15.7
Zinc	2,500	100.4	1,258	1,029
Mercury	16	0.0133	2.969	1.67
Chromium	400	42.4	ND[2)]	43.45

Unit: mg/kg of dry matter

1) Ministry of Agriculture, Sludge Reuse Standard, 2015
2) ND: Not Detected

TeCSOM

Nutrition for Soil Test Result

Parameters	Soil (Dec. 2014)	Sludge (Dec. 2014)	Sludge (Nov. 2015)
Total Nitrogen	838	32,531	40,900 (4.1%)
Phosphate (P_2O_5)	4,140	23,740	23,050 (2.3%)
Lime	262,200	115,620	70,550 (7.1%)
Kalium (K_2O)	6,400	2,430	3,480 (0.3%)

Unit: mg/kg of dry matter

TeCSOM

Reuse Sludge in Samed Land

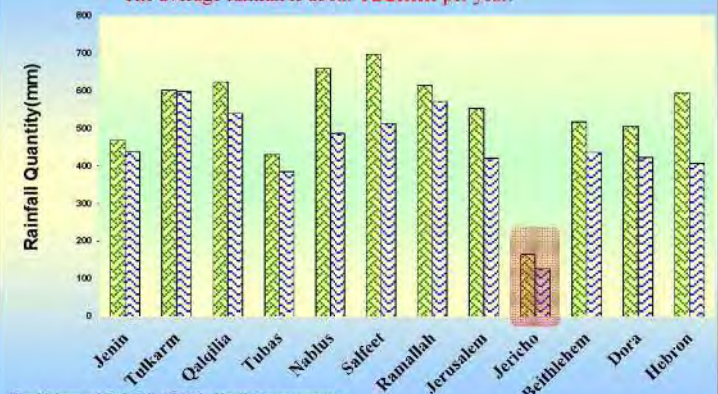
Lemon, Orange, Olive (15 donum)

TeCSOM

Thank you very much for your attention

TeCSOM **Jericho Climate**

- The average maximum temperature is about **45° C** in summer.
- The average rainfall is about **150mm** per year.



The Values of Rainfall 2010 in North Governorates comparing with the Historical average.

TeCSOM

Reuse Options of Treated Wastewater

Agricultural Irrigation	Landscape Irrigation
Amenity Use	Flushing Sewers
Cooling Water for Industry	Toilet Flush
Groundwater Recharge	

A 2-14-7: Agreement on the External Experimental Farm

AGREEMENT
ON
IMPLEMENTATION OF EXPERIMENTAL FARM
(PILOT FARM)

FOR

TECHNICAL ASSISTANCE AND CAPACITY BUILDING PROJECT
FOR
THE JERICHO SANITATION PROJECT (2ND YEAR)

BETWEEN

MUNICIPALITY OF JERICHO

AND

NJS CONSULTANTS CO., LTD.

AND

VALLEY TRADING COMPANY

DECEMBER 27TH, 2014

AGREEMENT ON
IMPLEMENTATION OF EXPERIMENTAL FARM
(PILOT FARM)
FOR
TECHNICAL ASSISTANCE AND CAPACITY BUILDING PROJECT FOR THE JERICHO SANITATION PROJECT (2ND YEAR)

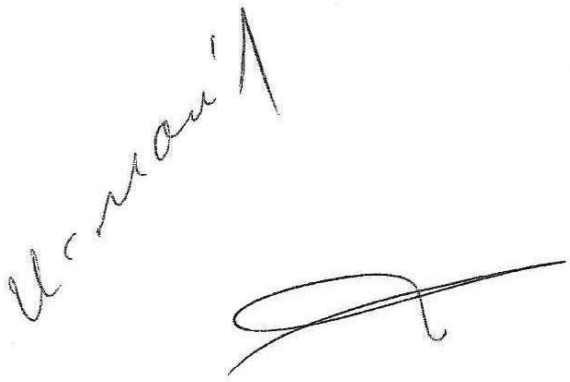
THIS AGREEMENT (hereinafter, together with the Conditions of Agreement, Specifications and Price Schedule, referred to as "the Agreement") made and entered into 27th of December 2014 by and between the NJS Consultants Co., Ltd. (hereinafter referred to as "NJS Consultants" which shall include its legal successors and assigns), having its temporary project office at Jericho Training Center, Al.Maghtas Street, Jericho and Municipality of Jericho Department of Water and Sewerage (hereinafter referred to as "the Jericho Municipality" which shall include its legal successors and assigns), having its principal office at Center of City, Jericho, Palestine and Valley Trading Company (hereinafter referred to as "the Farm Owner" which shall include its legal successors and assigns), having its principal office at Jericho, Palestine.

WITNESS that the parties concerned, promise, and agree with each other as follows:

(1) The Farm Owner agrees to implement the experimental farm specified in this Agreement (hereinafter referred to as "the Pilot Farm") in accordance with the terms, conditions and requirements of the Agreement.

It is agreed that terms, conditions and requirements of the Agreement shall prevail except to the extent that they are expressly modified or altered by the Agreement.

IN WITNESS WHEREOF, each of the parties hereto has caused the Agreement to be executed in duplicate as of the above date first above written by its duly authorized representative.



FOR AND ON BEHALF OF:

Municipality of Jericho

Mr. Mohammad Jalaytah
Mayor

FOR AND ON BEHALF OF:

Valley Trading Company

Ismail Daiq
Agricultural Consultant &
(Farm Owner)

FOR AND ON BEHALF OF:

NJS Consultants Co., Ltd.

Satoru Oniki
JICA Expert, Deputy Chief Advisor
Technical Assistance and Capacity Building
Project for the Jericho Sanitation Project

SECTION 1

CONDITIONS OF AGREEMENT

1.1 DEFINITIONS

The following words and expressions shall have the meaning assigned to them except where the context otherwise requires:

(a) "NJS Consultants" shall mean the NJS Consultants Co., Ltd. having its temporary project office at Jericho Training Center, Al.Maghtas Street, Jericho, and shall include its legal successors and assigns.

(b) "Jericho Municipality" shall mean Municipality of Jericho Department of Water Supply and Sewerage, and shall include the NJS Consultant's counterpart in the TeCSOM Project, and shall include its legal successors and assigns.

(c) The "Farm Owner" shall mean Valley Trading Company which shall provide an experimental farm outside the Jericho Wastewater Treatment Plant, and shall include legal personal representative, successors and assigns.

(d) The "Agreement" shall mean the Agreement among NJS Consultants, Jericho Municipality and the Farm Owner, Conditions of Agreement and Specifications attached hereto or to be provided or approved by with respect to the Agreement.

(e) The "Pilot Farm" shall mean the experimental farm to be carried out by the Farm Owner.

(f) The "Contract Price" shall mean the sum named in the Agreement as the contract price.

(g) The "Specifications" shall mean the specifications annexed or issued under the Agreement.

(h) The "Project" shall mean the project Technical Assistance and Capacity Building Project for the Jericho Sanitation Project.

(i) The "TeCSOM" shall mean the nickname of the project Technical Assistance and Capacity Building Project for the Jericho Sanitation Project.

(j) The "Site" shall mean the areas in the Jericho as stipulated in the Specifications.

(k) "Day, Week, Month, and Year" shall mean calendar day, calendar week, calendar month and calendar year, respectively.

(l) "Approval" or "Approved" shall mean approval or approved in writing by NJS Consultants, Jericho Municipality and/or the Farm Owner.

(m) "Writing" shall mean any manuscript, typewritten or printed statement under seal or hand.

Word importing the singular only will also include the plural and vice versa where the context requires. The Agreement shall not affect their meaning.

1.2 FARM OWNER TO INFORM HIMSELF FULLY

The Farm Owner shall be deemed to have satisfied himself as to all the conditions and circumstances.

1.3 EFFECTIVE DATE OF AGREEMENT AND COMMENCEMENT OF THE WORK

The Agreement shall be effective on the date specified in the Agreement.

The Farm Owner shall commence the operation of the Pilot Farm (the experimental farm) upon receipt of "Notice to Proceed" which will be issued by NJS Consultants after completion of connecting a pipe from the irrigation tank at the Jericho Wastewater Treatment Plant (hereinafter referred to as "the WWTP").

1.4 MANNER OF EXECUTION

All the Pilot Farm to be done under the Agreement shall be executed by the Farm Owner.

1.5 INFORMATION AND OFFICIAL PERMISSION

(1) The NJS Consultants and Jericho Municipality shall make available to the Farm Owner for the purpose of performing the Pilot Farm, all necessary information such as treated wastewater quality and lists of the Specifications contained herein.

(2) Official permission from the authorities concerned for the execution of the Pilot Farm at the Site shall be arranged by the Farm Owner at his own expense.

(3) The Farm Owner shall arrange so that the Farm Owner may have free access to the land required to perform the Pilot Farm, and shall assume liability for damage to lands and associated properties due to such access, unless damage caused by negligence or fault of NJS Consultants and/or Jericho Municipality. In the case of damages caused by negligence or fault of NJS Consultants and/or Jericho Municipality, the Farm Owner shall be indemnified by NJS Consultants and/or Jericho Municipality.

1.6 FARM OWNER'S REPRESENTATIVE AND PERSONS

(1) The Farm Owner shall make his own arrangements for the engagement of all the engineers, technicians, pump operators and laborers necessary for the execution of the Pilot Farm. The Farm Owner shall submit to Jericho Municipality for his approval, a complete list of principal staff showing names, functions, personal photos when the Farm Owner's staff operates irrigation pump at the irrigation tank of the WWTP.

(2) The Farm Owner shall appoint one or more competent representatives from among the Farm Owner's engineers or surveyors assigned to the Pilot Farm, to operate and maintain the irrigation pump which shall be provided by the Farm Owner for the Pilot Farm on the Site.

1.7 FARM, CROPS, MATERIALS, EQUIPMENT AND FACILITIES TO BE PROVIDED BY THE FARM OWNER AND THE FARM OWNER'S OBLIGATIONS

(1) The Farm Owner shall, at his own expense, supply and provide all the equipment, farms for the Pilot Farm, existing pipes for irrigation, a pump for irrigation, materials, laborer

(operator), and any other items required for the execution of the Pilot Farm without compensation outside the WWTP.

(2) The Farm Owner shall, at his own expense, maintain and operate a pump and irrigation networks of the Pilot Farm.

(3) The Farm Owner shall not irrigate treated wastewater exceed 140 m^3/week in the Pilot Farm.

(4) The Farm Owner shall take on visitors as a field trip at the Pilot Farm when Jericho Municipality and/or NJS Consultants request accepting visitors to the Farm Owner.

(5) The Farm Owner shall not demand compensation for Jericho Municipality and/or NJS Consultants in case that the Farm Owner's crops are deteriorated or the products are reduced at the Pilot Farm.

1.8 FARM, CROPS, MATERIALS, EQUIPMENT AND FACILITIES TO BE PROVIDED BY NJS CONSULTANTS

(1) NJS Consultants shall, at his own expense, supply and provide all the equipment, materials, laborer (operator), pipe installation work, a pump installation work, electric supply work and any other items required in order to connect a pipe from the irrigation tank to an existing pipe (6 inches) that is close to the irrigation tank.

(2) NJS Consultants shall, at his own expense, conduct a treated wastewater quality tests for total 4 times in a half year based on the draft Reuse Standard for Agriculture, and provide Jericho Municipality and the Farm Owner with these test results.

(3) NJS Consultants shall issue Identification Cards to the Farm Owner's staff approved by Jericho Municipality in order to enter the WWTP for the pump operation and maintenance.

1.9 MATERIALS, EQUIPMENT, INSTALLATION WORK, ID AND FACILITIES TO BE PROVIDED BY JERICHO MUNICIPALITY

(1) Jericho Municipality shall, at his own expense, supply and provide treated wastewater set the maximum amount 140 m^3/week, land for installed pipe and electricity for an irrigation pump, electric bills for a pump and any other items required for the execution of the Pilot Farm inside the WWTP.

(2) Jericho Municipality shall, at his own expense, supply and provide the Farm Owner with treated wastewater quality information in case that the Farm Owner requests it.

(3) In case of treated wastewater deteriorated or under any water pollution, Jericho Municipality shall inform the Farm Owner and NJS Consultants of the situation immediately.

(4) In case of high possible treated wastewater shortage supplied, Jericho Municipality shall inform the Farm Owner and NJS Consultants of the situation immediately.

1.11 INSURANCE

(1) The Farm Owner shall, at his own expense, effect accident and injury insurance for engineers, surveyors, technicians and laborers employed by the Farm Owner for the execution of the Pilot Farm, and shall keep NJS Consultants and Jericho Municipality free from any claims for compensation for any such accident and injury.

(2) The Farm Owner shall, at his own expense, insure the equipment, materials and facilities to be provided by the Farm Owner and keep each part thereof insured for its full value against loss, damage or fire outside the WWTP.

1.12 FORCE MAJEURE

(1) If either party is temporarily unable by reason of force majeure or the laws or regulations of Palestine Interim Self-Government Authority to meet any of its obligation under the Agreement, and such party gives to the other party written notice of the event within fourteen (14) days after its occurrence, such obligations of the party as it is unable to perform by reason of the event shall be suspended as long as the inability continues.

(2) Neither party shall be liable to other parties for loss or damage sustained by such other parties arising from any event referred to in Clause 1.12 (1) or delays arising from such event.

(3) The term "Force Majeure" as employed herein shall mean acts of God, strikes, lock-outs or other industrial disturbances, acts of the public enemy, wars, blockades, earthquakes, storm, lightning, floods, washouts, civil disturbances, explosions, and any other similar events beyond the control of either party and which by the exercise of due diligence neither party is able to prevent.

1.13 TIME FOR IMPLEMENTATION

The whole of the Pilot Farm shall be carried out within the time fixed in the Agreement.

1.14 SUSPENSION AMD/OR AMENDMENT OF THE PILOT FARM

Jericho Municipality, NJS Consultants and/or the Farm Owner shall suspend and/or amend the progress of the Pilot Farm.

1) The Farm Owner and/or Jericho Municipality shall inform these parties to terminate the Agreement before 30 days when the party suspends the Pilot Farm.

2) The Farm Owner and/or Jericho Municipality shall inform these parties to amend the Agreement before suitable time when the party change the following conditions of the Pilot Farm.

    a) Change supplied treated wastewater volume (m^3/day)

1.15 NOTICE AND CORRESPONDENCE

Any notice given to the Farm Owner shall be served by sending by post to or by delivery at the Farm Owner's principal place of business, or to the address of his representatives at the Site. Any notice given to NJS Consultants shall be served by post to or delivery at NJS Consultant's address as stated in the Agreement. Any notice given to Jericho Municipality shall be served by post to or delivery at Jericho Municipality's address as stated in the Agreement.

1.16 DOCUMENTS

All the correspondences, figures, drawings and other documents shall be written in the English language.

SECTION 2

SPECIFICATIONS

(The Pilot Farm Implementation)

2.1 Purpose of the Pilot Farm

From the viewpoint of demand, providing treated wastewater for palm dates shall be highly feasible reuse option since there are many palm date plantations near by the WWTP. When cooperative farmer around the WWTP provides an experimental palm date farm, the experiment of reuse of treated wastewater will be carried out outside the WWTP. The purpose of the Pilot Farm shall be conducted to be analyzed palm dates irrigated by treated wastewater.

2.2 Location of the Pilot Farm

The Pilot Farm locations will be indicated by the Farm Owner.

2.3 Representatives and Supervisor

NJS nominates following person in charge of overall management for the Work. The Farm Owner shall access to the Representative/ Supervisor for reporting, approval, discussion, requirement and any consultation.

Representative of NJS

Satoru Oniki:	Deputy Chief Advisor of TeCSOM
Office Address:	NJS Headquarter (Tokyo)
Contact Number:	Office Tel: +81-3-5919-7453 (Japan)
	e-mail Address: njs-oniki@mbp.nifty.com

Supervisor of Jericho Municipality

Eng. Ghazi A.Al-Naji: Director of Water and Wastewater Department

Office Address:	Center of City, Jericho, Palestine
Contact Number:	Office Tel: 059-920-1351
	e-mail Address: ghaziNaji@yahoo.com

Mohammed Awajneh: Mechanical Engineer

Office Address:	Center of City, Jericho, Palestine
Contact Number:	Office Tel: 059-952-0575
	e-mail Address: cbr.khalaf@hotmail.com

The Farm Owner nominates the following person in charge of performing the Pilot Farm.

Representative of Valley Trading Company

Dr. Ismail Daiq	Agricultural Consultant
Main Office	Jericho, Palestine
Contact Number:	Office Tel: 059-704-4440
	e-mail Address: Daiq.Ismail@gmail.com

2.5 The Pilot Farm Implementing Period

The Pilot Farm shall be started from the agreement date by the 1st of May, 2016. If In case that Jericho Municipality would like to extend the period of the Pilot Farm, Jericho Municipality and Farm Owner should discuss and decide the extended period.

A 2-14-8: License Procedure Application Form for Agricultural Reuse

Appendix A 14-8 Information of the Farm, License Procedure, Application and License

1. Reuse of Treated Wastewater and Sewage Sludge

1.1 Farm Owner Information

	Item	Information	Remarks
1	Farm Owner's Name	Mr. Ayman Taweel	Jericho resident
2	Purpose	Irrigation for palm trees	
3	Area	150 donum (15 ha)	
4	No. of Trees	2,180 trees	Palm date 4-7 years old
5	Distance from the WWTP	Approx. 600m	
6	Existing Tube Well Capacity	15 m^3/hr, 107 m depth	1 well, 24hrs operation
7	Farm Situation	Refer to Photos	
8	Required Water	350m^3/day (everyday) →150 m^3/day	Dr. Ismai:150m^3/day Mr. Salem: 150m^3/day

Photo-1 Palm Date Trees

Photo-2 Storage Pound (with fishes)

Photo-3 Irrigation Pump

Photo-4 Bulk Meter for Irrigation

1.2 Issuing the License Procedure in Ministry of Agriculture

Administration: Public Administration for Agriculture Water. Department: wastewater Use	Standard procedure No.	AW1-01-v1.0
	Review the standard No.	
	Implementation date:	
Number of pages: 3	Last date of modification:	
Reference: Head of Wastewater Use Dept.	Approval:	

Manual of Permission Procedures of Using the treated wastewater for irrigation

Introduction

This document includes instructions and guidance on standard procedures of the MOA about the procedures of organizing the process of re-using the treated water for irrigation which is including work results, tasks and period of time.

The scale of applying the procedure

This procedure is to organize irrigation the agricultural crops by treated wastewater coming from the WWTP in all the cities by giving the license to farmers in order to use the treated water in cooperation with wastewater treatment plants. It is taken in consideration the type of products and the standard of treated wastewater generating from WWTP for agriculture.

Requirements/ pre-conditions

Entry criteria:

- The applicant should be registered in the Directorate of Agriculture Farms in the same area that need to be replanted.
- The treatment plant that they want to take the water from it should have a licensed.

Input:

- Permit request form for the use of the treated water number (temp. A-AWI -01-v1.0)
- Permit form for the use of the treated water number (temp.A-AWI-01-v1.0)

Output:

- The use of agricultural irrigation water treatment permits
- Archived documents and updated data
- Report for a field visit

Responsibilities

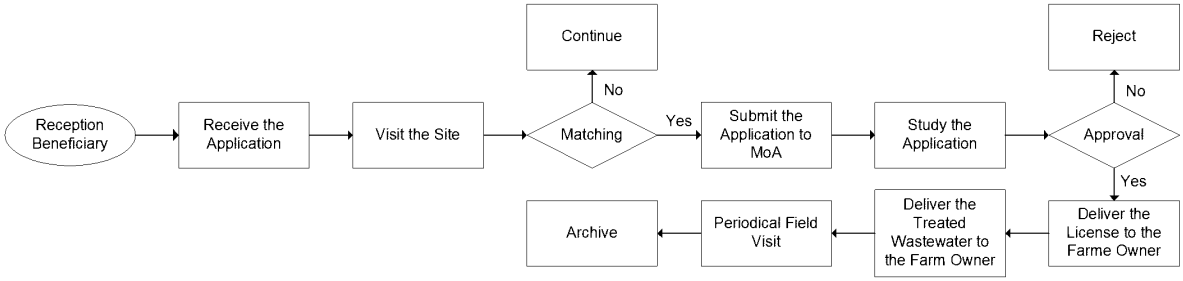
- Director of the Directorate of Agriculture
- Director of the Department uses of the Marginal water use
- Head of the Department of Water and Irrigation - Technical Department - Department of Agriculture
- the Secretary
- Department of Archives and Documentation - Support Services Department - the Department of Agriculture

Procedure:

The procedure listed:

- Should give the beneficiary the application form for the use of the treated wastewater, Explain the requirements needed and the time required to issue a statement and annexes.
- Make sure to fill in the form correctly and attached all the required documents with the application.
- The head of the water department make a preliminary study of the file statement and examine the possibility of using treated wastewater for the crops that need to be planted that mentioned in the request of the beneficiary.
- In case there was initial consent they should conduct a field survey for the site to verify what was stated in the application, then submit the application to the ministry, if there are any missing in the application, the applicant should complete it and adjustment the files.
- Submit the file to the Marginal water department according to the administrative sequence containing the request of the beneficiary, report for the field visit, the recommendations from the Technical Department Director, and they will respond to the application for either approval or rejection with the reason.
- Make a compulsory recommendation for using treated wastewater in proportion with the same category according to the Palestinian Reus Standard and instruction Technical regulation, provide adjustment condition to use permission in accordance with the treated wastewater form. Submit the recommendation to the Director General of Agricultural Water and Irrigation, and send the file to the Directorate concerned.
- Submit the beneficiary the use permission which is dependent on the cultivation product was mentioned in the statement.
- Make sure that the validity and the health of the permission issued by the Ministry of Agriculture, in coordination with the wastewater treatment plant, then they deliver the wastewater to the beneficiary.
- Ensure compliance with the instructions issued by the ministry and recommendations contained in the permission through field visits patrol site.

- If there is any residue, it should make recommendations to the Department of Agriculture to take measures against crisis.
- Save a copy of the permission to use file for the Directorate and a copy for the ministry



Step	Responsibility	Description step	Time Zone
Reception Beneficiary	Head of Water and Irrigation Department	-Should give the beneficiary the application form for the use of the treated wastewater. - Explain the requirements needed and the time required to issue a statement and annexes.	30 min
Receipt of the request for the use of wastewater	Head of Water and Irrigation Department	Make sure to fill in the form correctly and attached all the required documents with the requirement	1 hour
Visiting site	Head of Water and Irrigation Department	-The head of the water department make a preliminary study of the file statement and examine the possibility of using treated wastewater for the crops that need to be planted that mentioned in the request of the beneficiary - In case there was initial consent they should make a field visit for the site to verify what was stated in the application, then submit the demand to the ministry, if there are any missing in the application, the applicant should complete it and adjustment the files.	2 days
Send the application to the Ministry	Head of Water and Irrigation Department Technical Department	Submit the file to the Marginal water department according to the administrative sequence containing the request of the beneficiary, report for the field visit, the recommendations from the Technical Department Director, it is based to respond to	1 day

		the demand for either approval or rejection with the reason.	
Study the application	Director of the Department of marginal water use	-Study the application and make sure that the treated wastewater fits the plant and respond for either approval or rejection -Make a compulsory recommendation for using water in proportion with the same category according to the Palestinian Reuse Standard and instruction Technical regulation, provide adjustment condition to use permit in accordance with the treated wastewater form - write the reason if they reject the application -submit a recommendation to the head of water and irrigation department - send the file to the Directorate concerned	1 day
Submit the farm owner use permit	Head of Water and Irrigation Department	Communicate with the beneficiary and inform him about issuing the license	1 day
Deliver the water to the farm owner	A committee of the Technical Department	Deliver the beneficiary the water after insuring the accuracy of the licenses from MOA and with corporation with WWTP.	
Field visits periodically	Head of Water and Irrigation Department	- If there is any residue it should make recommendation to the Department of Agriculture to take measures against crisis - Ensure compliance with the instructions issued by the ministry and recommendations contained in the permission through field visits patrol site	
Archiving	The Secretary Documentation Archives	Save a copy of the use permit file for the Directorate and a copy for the ministry	1 day

1.3 License Procedure on Treated Wastewater Reuse

Jericho municipality (JM)	Farm Owners (FO)	Ministry of Agriculture (MoA)
1. Information discloser of Treated Effluent (TE) amount and TE Quality 2. Setting/deciding TE unit price (NIS/m^3)		
	1. Application of product type (Usage of TE for agricultural use) and required TE amount →	1. Receive
3. Instruction to FO (JM and FO responsibilities) →	2. Submission of an application[1)] to MoA	
	1) Refer to Appendix-1 →	2. Receive the application 3. Study[2)] it by the Local Committee (the Jericho branch office staff) in MoA (for one week) 4. Approval and issue the License
	3. Getting the License ←	
4. Received the License Copy from FO ←	4. Submission of the License Copy to JM	2) Refer to Appendix-2
5. Permit to supply/provide the FO with TE 6. Exchange the Agreement between JM and FO	5. Exchange the Agreement	
7. Start to provide TE →	6. Start to irrigate their trees	
	←	5. Monitoring and advising
Responsibilities		
1. Secure the TE Quantity 2. Testing TE Quality periodically and informing FO, and the first time only to MoA. 3. Monitor TE quality inside the WWTP 4. Informing the accidental information when TE deteriorated quality and/or shortage of amount. In case of the accident and stop providing TE, JM never compensate FO's products. 5. JM's responsible area is the boundary of the Wastewater Treatment Plant (WWTP) 6. JM installs a water meter for TE and manage it. 7. Providing the electricity for FO's pump 8. Supervision of installation of the pump	1. Quantity of their products 2. Quality of their products 3. Providing a pump and TE distribution pipeline and managing the pipeline 4. FO has a responsibility to secure/maintain the pipeline from the WWTP boundary to their farm. 5. FO also has a responsibility of any damage of the pipeline such as thieving and/or misuse. 6. To pay TE tariff 7. To pay electricity cost	1. Monitoring and advising the TE quality 2. Issuing the License to FO

1.4 Reuse Application for MoA

State of Palestine

Ministry of Agriculture

Administration: General Administration of agricultural water and irrigation **Department:** Department of the treated waste water	The sample code	
	Related to conducting work No.	
	Related to conducting work Name.	

License Application to use the treated wastewater for irrigation

G01	The Date	G02	Agriculture Department
G03	File No.	G04	Governorate Code.

Part One: Details about the land piece

W01	Full name for The applicant		
W02	ID No.	W03	Address
W04	Phone No.	W05	The proposed site
W06	The coordinates of the site	W07	Segment ¥ Voucher
W08	Block	W09	Site area

Part Two: Information about the agriculture way and Crops

A01	**Crops that will be planted**	**Irrigation method** Spirt , filtration, filtration underneath the soil	**Planted area** Donum	**Season** Date of Agriculture
1				
2				
3				
4				
A02				

Part Three: Information about the Water quality

C01	COD	C02	BOD
C03	TSS	C04	FECAL COLIFROM
C05	TOTAL COLIFROM	C06	Water salinity
C07	Treated waste water source	C08	Treated water type

Part Four:

1. Land Ownership Certificate	
2. The beneficiary blocks area map	
3. Leasing contract/ or any Related documents	
4. Check water quality	

Part Five: The Committee's recommendation

Signature required seals

Full Name	**Date**	**Signature/ Stamp**
Applicant's name		
The employee receives the request		

Commission local visit	**Date of visit**	

Approval to use the treated water for irrigation

Director of the Department of the treated waste water		
Director General of the Directorate		

Reuse License issued by MoA

17-02-'16 11:10 FROM- T-815 P0001/0001 F-026

State of Palestine **دولة فلسطين**

Ministry of Agriculture وزارة الزراعة

Temp.B-AWI-01-v1.0	رمز النموذج:	الإدارة: الإدارة العامة للمياه الزراعية والري
AWI-01-v1.0	تابع لإجراء عمل معياري رقم:	الدائرة: دائرة استخدامات المياه الهامشية
دليل إجراءات تصريح استخدام مياه هامشية للري	تابع لإجراء عمل معياري اسم:	

تصريح استخدام مياه معالجة للري

مديرية الزراعة: أريحا والأغوار	G02	التاريخ: 20160217	G01
رمز المديرية:	G04	رقم الملف: 201601	G03
تاريخ انتهاء التصريح:	G06	رقم التصريح: 2016/1	G05

عنوانه	رقم الهوية	W02	الاسم الرباعي لطالب الرخصة	W01
	978495299	W04	أيمن محمد عبد الله الطويل	W03
العنوان: أريحا / السبع		W06	هاتف 0596611168	W05

القطعة\القسيمة: ٢٥ / حوض ٢ / مزارعه ٢١	A02	إحداثيات الموقع: —	A01
مساحة الموقع: 150 دونم	A04	الحوض: \	A03
نوع شبكة الري المستخدمة: ري بالتنقيط	A06	المحاصيل المنوي زراعتها: نخيل	A05
الأكسجين الممتص حيوياً BOD: 13	A08	الأكسجين الممتص كيميائياً COD: 21	A07
~~الميكروبات البرازية FECAL COLIFORM:~~ —	~~A10~~	~~المواد العالقة TSS:~~	~~A09~~
ملوحة المياه: 1 ميلي سيمنز	A12	الميكروبات الكلية TOTAL COLIFORM: —	A11
نوع المياه المعالجة: نوع A	A14	مصدر المياه العادمة المعالجة: محطة بلدية أريحا لمعالجة المياه	A13

- بناءً على طلب الترخيص وعلى المعلومات المذكورة أعلاه يسمح لطالب التصريح باستخدام مياه الصرف الصحي المعالجة لري أنواع المحاصيل المذكورة أعلاه فقط لا غير، حتى تاريخ انتهاء التصريح.
- يجب إيقاف الري للمزروعات قبل شهر من تاريخ القطاف للأشجار المثمرة التي تؤكل ثمارها نيئة (بدون طبخ) وثلاث أسابيع للمحاصيل التي بحاجة لمعاملات خاصة بعد الحصاد والتخلص من الثمار الساقطة والملامسة للأرض.
- ملاحظة: يمنع استخدام المياه العادمة المعالجة في أي مكان آخر أو لري غير المحاصيل المذكورة أعلاه.

التوقيع/الختم	التاريخ	الاسم الرباعي
[signature]	20160217	عماد كامل مصطفى الحلبي

STATE OF PALESTINE Ministry of Agriculture Cabinet of the Minister of Agriculture

STATE OF PALESTINE Ministry of agriculture		
Management: Overall management for agricultural and irrigation water Department : Marginal Water Use	Form No.	Temp. B-AWI-01-v10
	Date of conduct the Standard Procedure No.:	AWI-01-v10
	Date of conduct the Standard Procedure Name.:	

Permission to use the treated water for irrigation			
G01	Date: 17/02/2016	G02	MOA branch office: Jericho
G03	File No. 01/2016	G04	Directorate Code:
G05	Permit No.: 1/2016	G06	Permit expiration date

W01	Applicant Full Name:	G02	ID No.	Address
W03	Ayman Mohammad Abdalah Altawel	G04	974952999	
W05	Tel: 0599661168	G06	Address: Jericho/ Assieh	

A01	Site coordinates: -	A02	Land: 35/part of 30/ part of 31
A03	Block: 1	A04	site area : 150 Donm
A05	Products to be planted: Palms	A06	type of irrigation system : Drip irrigation
A07	COD: 21	A08	BOD: 13
A11	Total Coliform: -	A12	Water salinity:
A13	Treated water source: WWTP	A14	Type of treated water: A

* Up on the license application and the information mentioned above, the applicant may use the treated waste water to irrigate the crops mentioned above only and just, until the end of the license.

*You must stop the irrigation of crops month before the date of harvesting fruit trees that are eaten without cooking ,and three weeks for crops that need special transactions after the harvest and get rid of the fallen fruits and in contact with the ground

* Note : its not Allowed to use the treated wastewater anywhere else or to irrigate any other crops mentioned above

Full name	Date	Signature/stamp
Emad Hamad Khlief Khlief	17/02/2016	

A 2-14-9: Minutes of Meeting between Jericho Municipality and MoA

Appendix A 2-14-9 Minute of Meeting between Jericho Municipality and MoA on Sludge Reuse

MINTUES OF MEETING

Day: Sunday date 15/5/2016 place Jericho Municipality (JM) time: 10:00

Attendance

Jafar salahat – MOA in Jericho

Hazem Yassen MOA

Emad Khlief MOA

Bahaa Alsalibi NJS

Mohammad Fetiani JM

Ibrahim Abu Seba JM

-discussion was made on item number 11 in the contract of providing treated water , which is related to tests of the treated water in which the municipality will conduct. And the modification on this item was as follow:

1- The First team committed to do the tests on regular bases, according to the technical specification which is mentioned on the license application form and the permission issued by MOA and up on request of the second team.

2- For the subject of pilot plant for using the sludge for agriculture purpose, it was agreed to conduct the pilot plant inside of WWTP by using a part of NARC land, and a meeting will be held with NARC to determine the area of land to be used and type of the crops to be planted for research purposes Within cooperation between JM and MOA.

الرقم: _____ Ref.:

التاريخ: _____ Date:

محضر اجتماع

وزارة الزراعة ودائرة المياه والصرف الصحي

اليوم: الأحد التاريخ 2016/5/15 المكان مكتب مدير دائرة المياه الزمان :(10:00)

الحضور :

- جعفر صلاحات – وزارة الزراعة / أريحا
- حازم ياسين – دائرة الأسمدة / وزارة الزراعة
- عماد خليف –وزارة الزراعة
- بهاء الصليبي – NJS
- م. محمد الفتياني – بلدية أريحا
- م. إبراهيم أبو صبيعة – بلدية أريحا

- تم البحث والتشاور في بند (11) في نموذج اتفاقية توريد مياه معالجة والمتعلق بالفحوصات التي ستقوم البلدية بتنفيذها والتعديل على هذا البند على النحو التالي:

1. يلتزم (الفريق الأول) بعمل الفحوصات بشكل دوري وذلك حسب التعليمات الفنية الإلزامية والمذكور عناصرها في طلب الترخيص والرخصة الصادرة من وزارة الزراعة وذلك حسب طلب (الفريق الثاني).
2. بالنسبة لموضوع المشروع التجريبي لاستخدام الحماه لأغراض الزراعة تم الاتفاق على ان يكون المشروع داخل المحطة واستغلال جزء من الأرض المقتطعة للمركز الوطني للبحوث الزراعية وسيتم تحديد اجتماع مع المركز لتحديد مساحة القطعة ونوع المزروعات التي سيتم زراعتها لأغراض البحث ضمن التعاون ما بين بلدية أريحا ووزارة الزراعة.

التوقيع:

جعفر صلاحات	حازم ياسين	عماد خليف	بهاء صليبي	م. محمد الفتياني	م. ابراهيم أبو صبيعه
وزارة الزراعة	دائرة الأسمدة	وزارة الزراعة	NJS	بلدية أريحا	بلدية أريحا

Private Mandatory Technical Instructions
The Use of Sewage Sludge in Agriculture
Second Draft (8/4/2013)

Sludge means: solid materials with wet and dry texture resulting from:

Article (2)

2-5 Member state: state(s) that determined by the Council of Ministers to implement the provisions of these regulations according to the article (23) of the specifications and standards law and other relevant applicable law.

Article (18)

Member state should put a plan to apply all the provisions of these regulations so as to ensure the application stages and the required resources for its implementation that does not exceed the duration of this plan of the validity of these instructions.

Article (19)

These instructions apply after from the date of this issuance and announced.

Article (20)

In case of any dispute in the interpretation of one of the provisions of these mandatory technical instructions, so the interpretation of the mandatory technical instructions must be adopted.

Article (21)

To modify all that contradictory of these instructions

The Use of Sewage Sludge in Agriculture (20.04.2009)
(2013/4/8)

Article 1

The purpose of this Directive is to regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil, vegetation, animals and man, thereby encouraging the correct use of such sewage sludge.

Article 2

For the purpose of this Directive:

(a) "Sludge" means:

i. Residual sludge from sewage plant treating domestic or urban wastewaters and from other sewage plants treating wastewaters of a composition similar to domestic and urban wastewaters.

ii. Residual sludge from septic tanks and other similar installations for the treatment of sewage.

iii. Residual sludge from sewage plants other than those referred to in (i) and (ii).

(b) "Treated sludge" means: sludge which has undergone biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use.

(c) "Agriculture" means: the growing of all types of commercial food crops, including for stock-rearing purposes.

(d) "Use" means: the spreading of sludge on the soil or any other application of sludge on and in the soil.

Article 3

1. The sludge referred to in Article 2 (a) (i) may be used in agriculture in accordance with this Directive.

Article 4

Values for concentrations of heavy metals in soil to which sludge is applied concentrations of heavy metals in sludge and the maximum annual quantities of such heavy metals which may be introduced into soil intended for agriculture are given Annexes 1A, 1B and 1C.

Article 5

Without prejudice to Article 12:

1. Member States shall prohibit the use of sludge where the concentration of one or more heavy metals in the soil exceeds the limit values which they lay down in accordance with Annex 1A and shall take

the necessary steps to ensure that those limit values are not exceeded as a result of the use of sludge.

2. Member States shall regulate the use of sludge in such a way that the accumulation of heavy metals in the soil does not lead to the limit values referred to in paragraph 1 being exceeded. To achieve this, they shall apply one or other of the procedures provided for in (a) and (b) below.

(a) Member States shall lay down the maximum quantities of sludge expressed in tonnes of dry matter which may be applied to the soil per unit of time as set out in Annex 1C.

(b) Member States shall ensure observance of the limit values for the quantities of metals introduced into the soil per unit of area and unit of time as set out in Annex 1C.

Article 6

Without prejudice to Article 7:

(a) Sludge shall be treated before being used in agriculture. Member States may nevertheless authorize under conditions to be laid down by them. The use of untreated sludge if it is injected or worked into the soil.

(b) Sewage sludge producers shall regularly provide users with all the information referred to in Annex 2A.

Article 7

Member States shall prohibit the use of sludge or the supply of sludge for use on.

(a) Grassland or forage crops if the grassland is to be grazed or the forage crops to be harvested before a certain period has elapsed.

This period, which shall be set by the Member States taking particular account of their geographical and climatic situation, shall under no circumstances be less than three weeks.

(b) Soil in which fruit and vegetable crops are growing with the exception of fruit trees.

(c) Ground intended for the cultivation of fruit and vegetable crops which are normally in direct contact with the soil and normally eaten raw, for a period of 10 months preceding the harvest of the crops and during the harvest itself.

Article 8

The following rules shall be observed when using sludge:

The sludge shall be used in such a way that account is taken of the nutrient needs of the plants and that the quality of the soil and of the surface and groundwater is not impaired.

Where sludge is used on soil of which the pH is below 6. Member States shall take into account the increased mobility and availability to the crop of heavy metals and shall, if necessary, reduce the limit values they have laid down in accordance with Annex 1A.

Article 9

Sludge and soil on which it is used shall be analyzed as outlined in Annexes 2A and 2B.

The reference methods for sampling and analysis are indicated in Annex 2C.

Article 10

1. Member States shall ensure that up-to-date records are kept which register:

(a) The quantities of sludge produced and the quantities supplied for use in agriculture.

(b) The composition and properties of the sludge in relation to the parameters referred to in Annex 2A.

(c) The type of treatment carried out, as defined in Article 2 (b).

(d) The names and addresses of the recipients of the sludge and the place where the sludge is to be used.

2. The records shall be available to the competent authorities and shall provide a basis for the consolidated report referred to in Article 17.

3. Information on the methods of treatment and the results of the analysis shall be released upon request to the competent authorities.

ANNEX 1A

Limit Values for Concentrations of Heavy Metals in Soil

(mg/kg of dry matter in a representative sample, as defined in Annex 2C, of soil with a pH of 6 to 7)

Parameters	Limit Values
Cadmium	1 – 3
Copper	50 – 140
Nickel	30 – 70
Lead	50 – 300
Zinc	150 – 300
Mercury	1 – 1.5
Chromium	–

(2) Member states may permit the limit values they fix to be exceeded in respect of these parameters on soil with a pH consistently higher than 7. The maximum authorized concentrations of these heavy metals must in no case exceed those values by more than 50%. Member States must also seek to ensure that there is no resulting hazard to human health or the environment and in particular to groundwater.

ANNEX 1B

Limit Values for Heavy Metal Concentrations in Sludge for Use in Agriculture

(mg/kg of dry matter)

Parameters	Limit Values
Cadmium	20 – 40
Copper	1000 – 1750
Nickel	300 – 400
Lead	750 – 1200
Zinc	2500 – 4000
Mercury	16 – 25
Chromium	–

ANNEX 1C

Limit Values for Amounts of Heavy Metals which may be added annually to Agricultural Land, based on a 10- year Average

(kg/ha/year)

Parameters	Limit Values
Cadmium	0.015
Copper	1.2
Nickel	0.3
Lead	1.5
Zinc	3
Mercury	0.01
Chromium	–

A 2-14-10: Selling Price of Treated Wastewater and Handover Letter to Jericho Municipality

Appendix A 2-14-10 Letter of the Mayor on Unit Price and Handover of the Pilot Plant

1.1 Unit Price of the Treated Wastewater

Decision No (2) session (05)
Date: 2/2/2016

Municipal Council has been decided in the session No. (05) the tariff of treated wastewater resulting from the WWTP for irrigation at the price of (1/2) Nis/m^3 for one year till 31/12/2016 from the date of decision. After one year, the municipal council has the right to reconsider the tariff of the cubic meter by raising or lowering it. Agreements and commitment which has been signed with the water user should be organized under the conditions that are mentioned in the agreement and the commitment. The legal unit prepares the agreement duly based on the decision purposes and submit it to the municipal council for announcing.

Mayor: Mohammed Jalaytah

الرقم: Ref.:

التاريخ: Date:

قرار رقم (2) جلسة (05)
بتاريخ 2016/02/02

قرر المجلس البلدي بجلسة رقم (05) بوضع تسعيرة المياه المعالجة الناتجة من محطة معالجة المياه العادمه التابعة لبلدية أريحا وذلك لري المزروعات بسعر (1/2) شيكل ونصف للكوب الواحد لمدة عام واحد وذلك من تاريخه ولغاية 2016/12/31م. عند انتهاء المدة المذكورة يحق للمجلس البلدي إعادة النظر في تسعير التسعيرة للكوب الواحد وله الحق في رفع أو تخفيض قيمة الكوب الواحد. على أن يتم تنظيم الاتفاقيات وملحق بها التعهد الخاص الموقع مع مستخدم المياه ضمن الشروط التي تنظم وتذكر في الاتفاقية والتعهد الخاص لملحق الاتفاقية وتكلف الوحدة القانونية بإعداد الاتفاقية حسب الأصول وتتفق مع غايات القرار وعرضها على المجلس البلدي لغايات إفرازها.

والله ولي التوفيق

رئيس البلدية
محمد جلايطة

نسخة: مدير المالية.
مدير العلاقات العامة والثقافة.
مسؤول شعبة الاعلام.
مدير دائرة المياه والصرف الصحي.
رئيس قسم الصرف الصحي
مدير وحدة تقنية المعلومات.
مدير وحدة الجودة.
مدير وحدة خدمات الجمهور.
رئيس قسم المحكمة.
رئيس وحدة الرقابة الداخلية.
مدير البلدية

1.2 The Pilot Plant Handover

January 27, 2016

Mr. Mohammed Jalaitah
Mayor
Jericho Municipality

Hand Over of the Pilot Plant and Japanese Garden
in the Jericho Wastewater Treatment Plant

The Project for Technical Assistance and Capacity Building Project
for the Jericho Sanitation Project

Dear Sir.

Japan International Cooperation Agency on Japanese technical cooperation on the Project for Technical Assistance and Capacity Building Project for the Jericho Sanitation Project, the TeCSOM Team hands over following items to Environment and Health Department, Jericho Municipality (hereinafter referred to as "the Department"). After handover, the Department shall be responsible for the Pilot Plant and Japanese Garden in the Jericho Wastewater Treatment Plant (WWTP) and for using and maintaining those plants appropriately. The Department irrigates and put fertilizer on these plants. TeCSOM Team will support the Pilot Plant till the end of May 2016.

The Pilot Plant	1 Lot (Refer to Appendix-1)
The Japanese Garden	1 Lot
Other Trees in the WWTP	1 Lot

Sincerely yours,

Satoru Oniki
Deputy Chief Advisor
JICA Expert Team
TeCSOM Team member

Mohammed Jalaitah
Mayor
Jericho Municipality

CC: Basel A. Hijazi, Director of Engineering Department, Jericho Municipality, TeCSOM Counterpart Team Leader

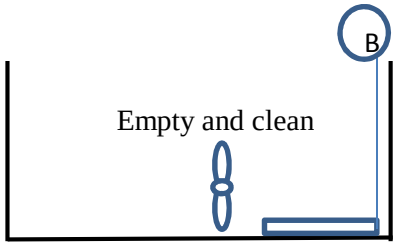
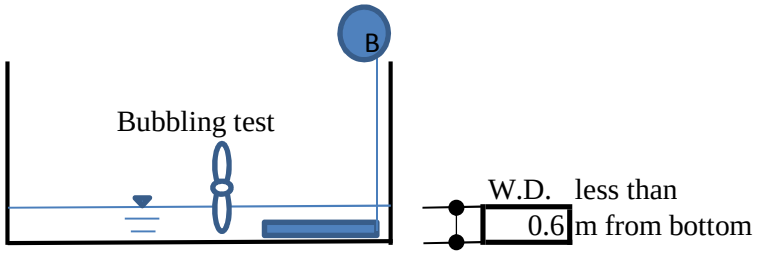
Mohammed Al-amleh, Director of Environment and Health Department, Jericho Municipality

A 2-17-1: Guideline on Two Lines Operation of WWTP

Appendix A 2-17-1

Guilde line for start-up of 2nd train

Municipality should inform farmers of limitation of treated water during start-up.

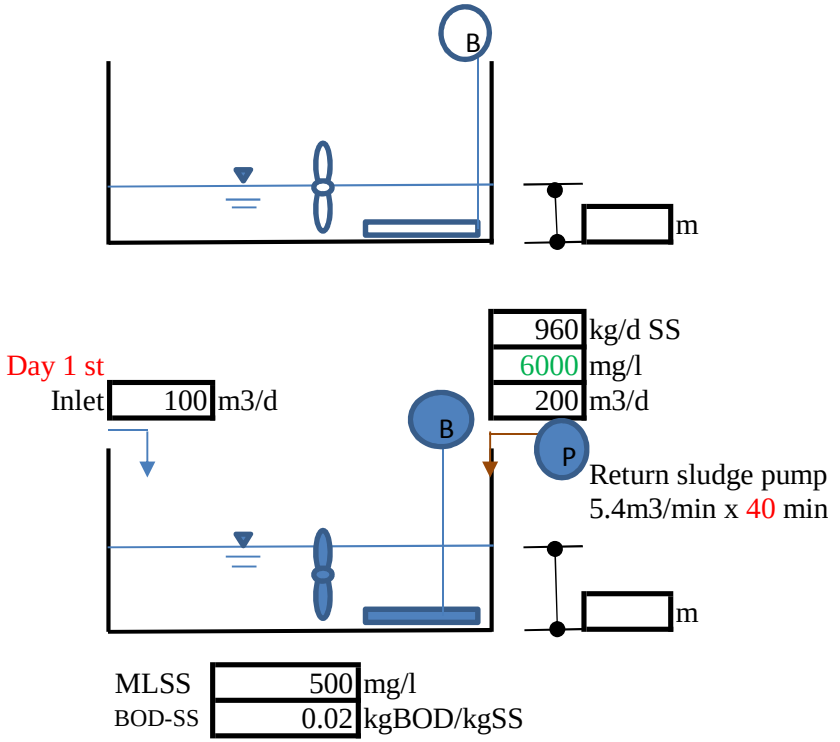
Procedure	Monitoring and key action	
Calculate necessary waste sludge volume for start-up and keep a certain volume in the current operated No.1 final sedimentation tank. And keep high MLSS over 4,000 mg/l in the No.1 reactor.	Sludge turbulence and treated water quality in the final sedimentation tank should be	
Drain and be clean in No.2 reactor, final No.2 final sedimentation tank, return sludge pipes for start-up.	Any stones, debris should be removed out of the reactor and clarifier, to protect membranes	
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** should be cared in accordance with an instruction of the vender manual, and **no any leakages can be found.**	After completion of visual and performance chek of facilities, treated water should be filled within 100 mm to Maximum 300 mm from above the membrane	

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. 1,500m3).

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.

100 m3/d 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.

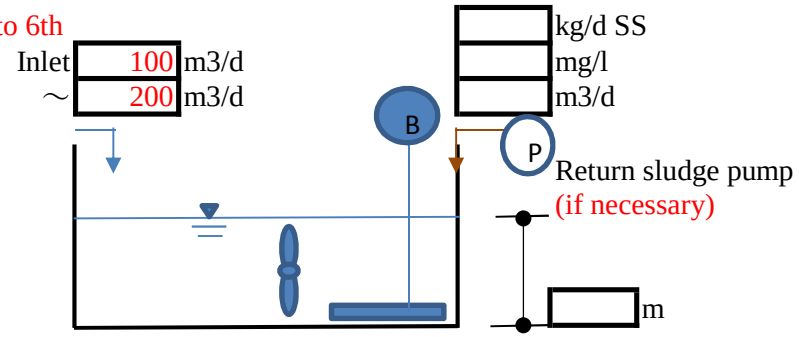
SVI, MLSS, color of activated sludge should be measured. Blower is operated intermediately by manual.



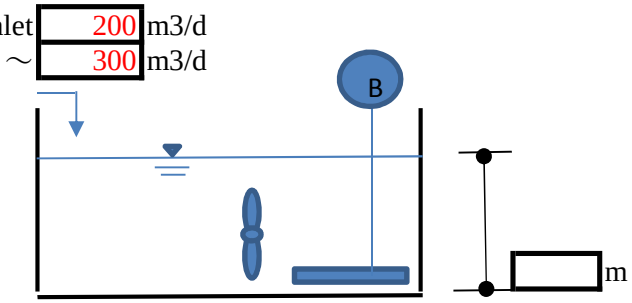
Inlet sewage flow will increase day by day after reach of stable condition, and MLSS will also increase through two weeks, prior to overflow. If necessary, MLSS can be increased by return sludge pump No.M03-02-01.

SVI, MLSS, color of activated sludge should be measured.

Day 2nd to 6th



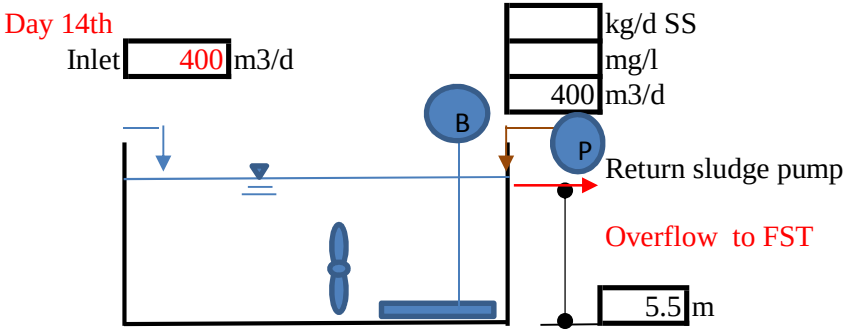
Day 7th to 13th



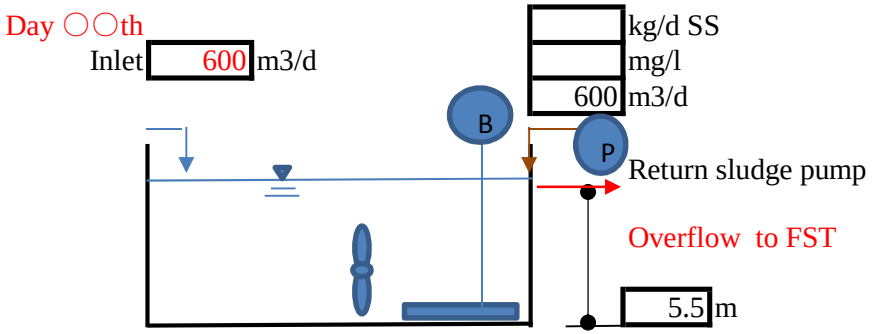
Start over flow to No.2 final sedimentation basin. Suction header valve at sedimentation basin No.1 is open and return sludge pump should operate intermediately.

SVI, MLSS, color of activated sludge should be measured. Calculate BOD-SS load and monitor color of activated sludge to be light blown. Blower is operated automatically by DO control. Scada setting should change. Treated water can start to

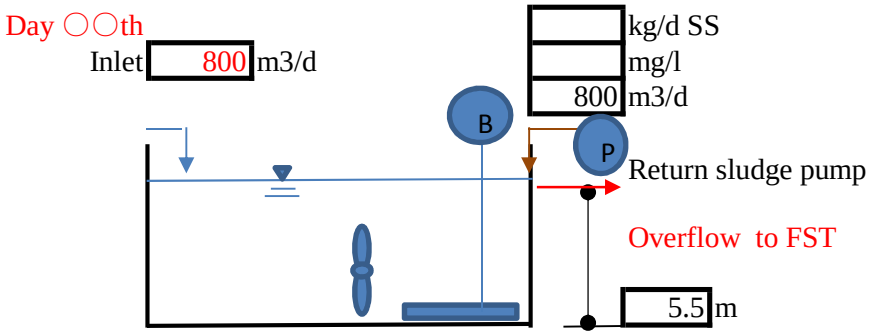
Day 14th

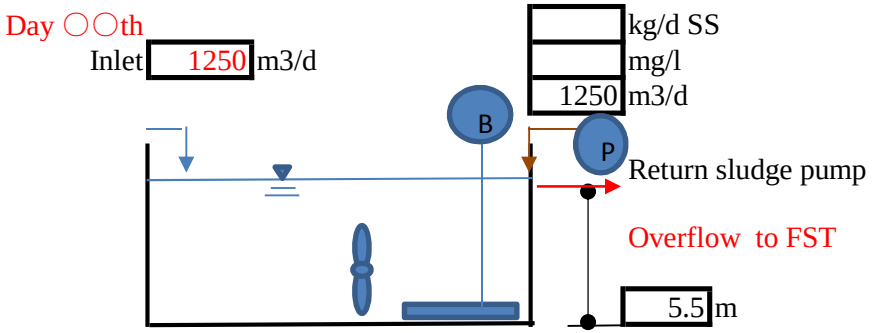


Finally, inlet flow and MLSS will be increased day by day to be equal with No.1 train. 1250 m3/d/each train.
Return sludge pump should operate intermediately.



SVI, MLSS, color of activated sludge should be measured. Calculate BOD-SS load and monitor color of activated





Completed

Note: Above procedure can be arranged due to an operated condition of train 1 before start-up.
BOD-SS load should be less than 0.2 kgBOD/SS.

<Outputs-3>

A 2-18-1: First Workshop (Slides on the Sewerage Planning)

TECHNICAL ASSISTANCE AND CAPACITY BUILBING PROJECT
FOR
THE JERICHO SANITATION PROJECT

1st WORKSHOP

June 20, 2013

SECTION 1
SEWERAGE PLANNING

CONTENTS OF THIS SECTION

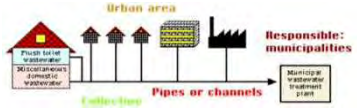
1. Types of Sanitation System
2. Wastewater Collection System
3. Procedure on Implementation of Sewerage Project
4. Design Conditions

1. Types of Sanitation System

(1) Sewerage System
- **Centralized Sewerage System**
- **Decentralized Sewerage System**

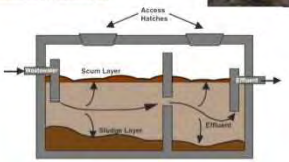
(2) On-site Treatment System
- **Pit Latrine**
- **Septic Tank**
- **Advanced Household Treatment System**

(1) Sewerage System



(2) On-site Treatment System

On-site Treatment System
(Septic Tank)

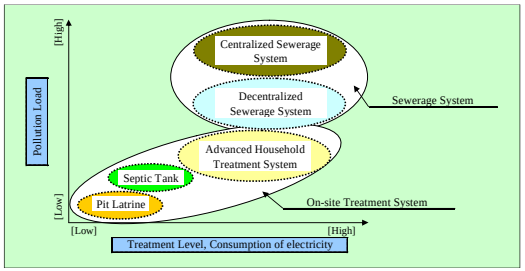


On-site Treatment System

(Advanced Household Treatment System)

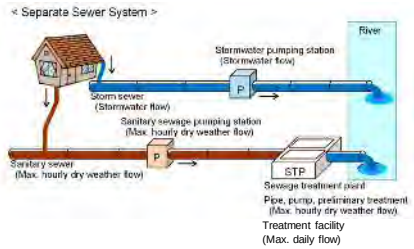
An example of small-scale johkasou

Applicable Sanitation System

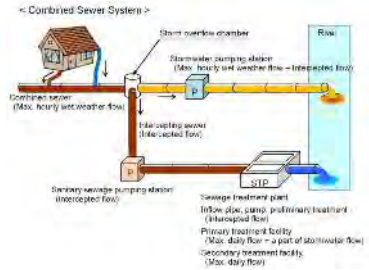


2. Wastewater Collection System in Sewerage System

(1) Separate Sewer System

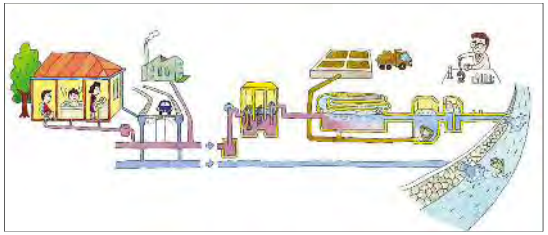


(2) Combined Sewer System

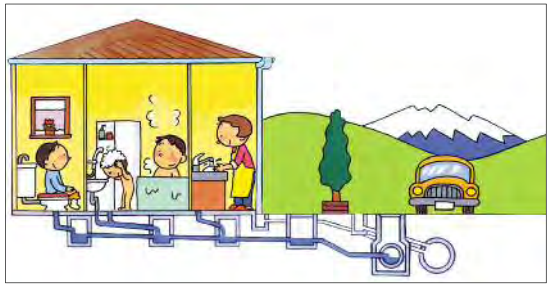


Sewerage System in Jericho

(Separate System)



Household Discharging System



3. Procedure on Implementation of Sewerage Project

(1) Preliminary Survey for Planning

↓

(2) Master Plan

↓ (Selection of F/S Project Area)

(3) Feasibility Study (F/S)

↓ (Selection of 1st Implementation Area)

(4) Basic Design and Detail Design

↓ (Bidding)

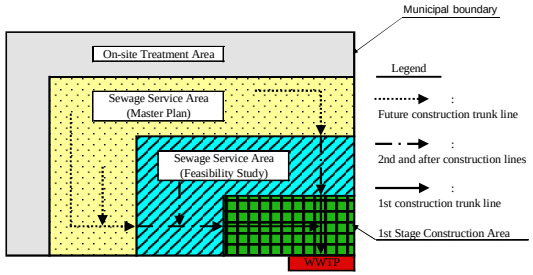
(5) Construction

↓

(6) Operation and maintenance

(7) Reuse of treated water and sludge

Types of Sewage Catchment Area



(1) Preliminary Survey for Planning

- H.W.L of river water at discharging point of treated water from WWTP
- Regulations (water quality, Noise, odor, etc.)
- Sewage by-law
- Regional Development plan
- Environmental Impact Assessment (EIA) for WWTP
- Underground facilities (water supply, gas, power cable, etc.)

(2) Master Plan

- **Target year : 15～30years**
- **Set the basic condition**
  - **Sewage collection system**
  - **Design service Area**
  - **Design service population**
  - **Design sewage flow**
  - **Design sewage quality (raw sewage and treated water)**
- **Facility planning**
  - **Flow capacity and required diameter of sewers**
  - **Study on treatment method and location of WWTP**
  - **Facility planning of WWTP**

(3) Feasibility Study

- **Target year : 5～10years**
- **Set the basic condition for F/S**
  - Design service population
  - Design sewage flow
- **Facility planning**
  - Facility planning of WWTP (staged plan)

(4) Basic Design and Detail Design

- **Facility design of sewers and WWTP**
  - Conducting detail topo. survey and geological survey
  - Facility design on the target area
- **Cost estimations**
  - Bill of quantities (BOQ)
  - Cost estimations
- **Tender Documents in D/D Stage**

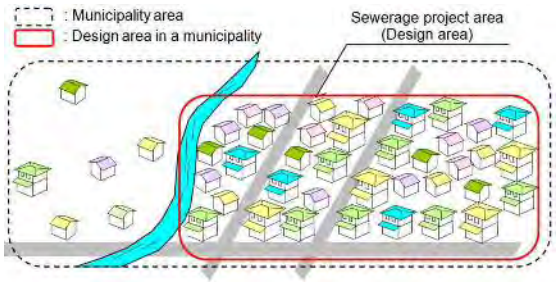
(5) Construction

(6) Operation and Maintenance

(7) Reuse of Treated Water and Sludge

4. Design Conditions

(1) Design Service Area



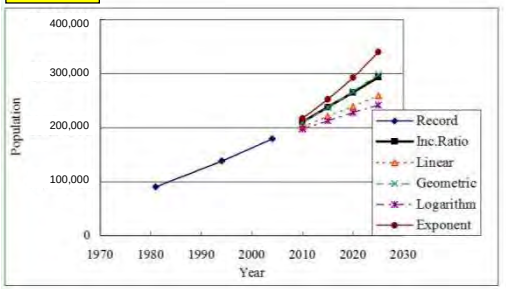
(2) Design Population Projection

Formula for Population Projection

(1) Growth rate	: Y=b(1+a)^X
(2) Linear	: Y=aX+b
(3) Geometric	: Y=a*X^b
(4) Logarithm	: Y=a+b*Ln*X
(5) Exponent	: Y=a*e^bx

Population Projection

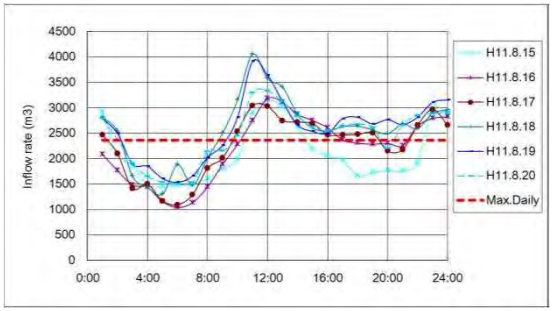
Sample



(3) Components of Sewage Flow

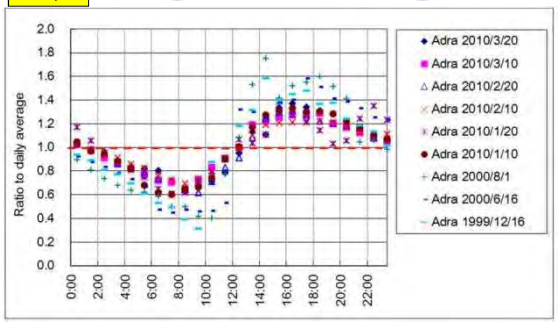
(4) Daily Flow Fluctuation

Daily Flow Fluctuation in Japan



Daily Flow Fluctuation

Sample



Daily Flow Fluctuation in Jericho

- **Daily average flow (DAF) : Annual average**
- **Daily maximum flow (DMF) : DAF x 1.50**
- **Hourly maximum flow (HMF) : DAF x 2.90**

Source; The Preparatory Survey Report on the Jericho Wastewater Collection, Treatment system and Reuse Project, August 2011, P-24

(5) Calculation of Design Flow

How to calculate design flow in Jericho (residents)

Service population in 2020	**: 25,076 persons**
Per capita water consumption	**: 250 (l/cap/day)**
Discharge to sewage ratio	**: 70 %**
Connection to sewage ratio	**: 80 %**

Source; The Preparatory Survey Report on the Jericho Wastewater Collection, Treatment system and Reuse Project, August 2011, P-22

Design Flow (DAF)=25,076 x 0.25 x 0.70 x 0.80 = 3,511 m^3/day

Design Flow (DMF)=3,511 x 1.50 = 5,267 m^3/day

Design Flow (HMF)=3,511 x 2.90 = 10,182 m3/day

Design Flow in Jericho

Item	Target Year		Fluctuation ratio
	2020	Ultimate	
Daily average	6,600	9,900	1.0
Daily Maximum	9,800	14,400	1.5
Hourly Maximum	19,100	29,000	2.9

Source; The Preparatory Survey Report on the Jericho Wastewater Collection, Treatment system and Reuse Project, August 2011, P-24

(6) Design Swage Quality

Pollution load by per person

Item	Unit Pollution Load (g/cap/day)	
	Jericho	Japan
BOD	60 x 80% = 48	58
TSS	70 x 80% = 56	45
T-N	12 x 80% = 9.6	11

Source; The Preparatory Survey Report on the Jericho Wastewater Collection, Treatment system and Reuse Project, August 2011, P-22

How to calculate total pollution load in Jericho (residents)

(1) BOD
Service population in 2020 : 25,076 persons
Per capita pollution load : 48 g/cap/day
Pollution load : 25,076 x 48 = 1,204 kg/day

(2) TSS
Service population in 2020 : 25,076 persons
Per capita pollution load : 56 g/cap/day
Pollution load : 25,076 x 56 = 1,404 kg/day

(3) T-N
Service population in 2020 : 25,076 persons
Per capita pollution load : 9.6 g/cap/day
Pollution load : 25,076 x 9.6 = 241 kg/day

Design Sewage Quality in Jericho

Item	Design Flow (m^3/day)	Pollution load (kg/day)	Design sewage quality	
			Calculation (mg/l)	Adoption (mg/l)
-	(a)	(b)	(c)	-
BOD	9,889	4,036	408	500
TSS		4,611	466	500
T-N		748	76	75

Source; The Preparatory Survey Report on the Jericho Wastewater Collection, Treatment system and Reuse Project, August 2011, P-26

(c) = (b) x 10^3 / (a)

A 2-18-2: Second Workshop (Slides on the Sewer Design and Exercise)

SECTION 2
SEWER DESIGN

CONTENTS OF THIS SECTION

1. Design sewage flow
2. Flow velocity and slope
3. Min. and Max. velocity
4. Flow calculation
5. Flow Allowance
6. Pipe material
7. Minimum pipe diameter
8. Minimum earth cover depth
9. Pipe foundation
10. Siphon
11. Manhole
12. Connection pipe and pit

1. Design Sewage Flow

Design Sewage flow for design of sewers

Hourly Maximum Flow in ultimate stage

2. Flow Velocity and Slope

(1) Gravity pipe=Manning Formula

$V=1/n \times R^{2/3} \times I^{1/2}$

(2) Pressure pipe=Hazen-Williams Formula

$V=0.84935 \times C \times R^{0.63} \times I^{0.54}$

Where:

V	: Velocity in full pipe (m/sec)
n	: Roughness coefficient
R	: Pipe radius (m) (= A / P)
A	: Cross-section area of pipe (m2)
P	: Wetted perimeter (m)
I	: Pipe slope (=1/1,000)
C	: Velocity coefficient

(3) Roughness coefficient (=n)

Concrete pipe	: n=0.013
PVC pipe	: n=0.010

(4) Velocity coefficient (=C)

Ductile iron pipe : C=110

3. Min. and Max. Velocity

(1) Why is the Min. velocity need to be set?

- To avoid the sedimentations such as sand, waste, etc.
- To acquire the velocity for self-cleaning force

(2) Why is the Max. velocity need to be set?

- To avoid structures suffer from damage

Adopted Min. and Max. Velocity

Item	Russia	Egypt	US	Japan	Jericho
Minimum (m/sec)	V=0.7 (150<D<250mm) V=0.8 (300<D<400mm) V=0.9 (450<D<500mm) V=1.0 (600<D<800mm)	V=0.75 (D<700mm) V=1.0 (D>700mm)	V=0.6	V=0.6	V=0.6
Maximum (m/sec)	V=4.0 (non-metal pipe) V=8.0 (metal pipe)	V=2.0 (gentle slope) V=3.0 (steep slope)	V=2.5-3.0	V=3.0	V=3.0

4. Flow Calculation

$Q = A \times V$

Where:

Q : Flow in full pipe (m3/sec)

A : Cross-section area in full pipe (m2)

V : Velocity in full pipe (m/sec)

5. Flow Allowance

Flow Allowance

Country	Diameter	Allowance
Japan	D<700 mm	100%
	700 <D<1,650 mm	33~50 %
	Pressure pipe	No allowance
Egypt	D<700 mm	33%
	D>700 mm	25%
Jericho	150<D<600 mm	100%
	700<D<1,500 mm	50~100%
	Pressure pipe	No allowance

6. Pipe Material

Material		Strength	Corrosion	Cost	Installation	n=
Concrete		○	△	○	△ (Heavy)	0.013
PVC		△	○	○	○	0.010
Ductile Iron		○	○	△	△ (Heavy)	0.010 ~ 0.013

7. Minimum Pipe Diameter

Item	Russia	Germany	US	Japan	Jericho
House connection	-	-	D=150mm	D=100mm (Population<10,000) D=150mm (Standard)	D=200mm
Sanitary sewer	D=150mm (Residential, Industrial area) D=200mm (Street passing)	D=250mm	D=200mm	D=150mm (Population<10,000) D=200mm (Standard)	D=250mm

8. Minimum Earth Cover Depth

(1) Why is the Min. earth cover need to be set?

- To avoid structural damage to pipe

(2) Minimum earth cover depth

Japan	Jericho
D<300mm H=0.6m (road), H=0.5m (walkway) D>300mm H=1.0m	D>150mm H=0.9m

9. Pipe Foundation

Poor pipe foundation

What kind of problems are happened ?

(1) Unequal setting of pipe

(2) Broken pipe

Problems by Improper Foundation

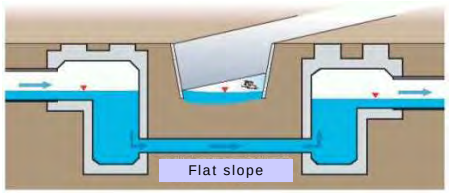
Road Caving

Road Caving

Type of Pipe Foundation

Item	PVC pipe	Concrete pipe
Sand Bedding	○	△
Gravel Bedding	X	○
Concrete Bedding	△	○

10. Siphon



11. Manhole

Maximum Interval

Longer interval ⇨ Lower construction cost

Shorter interval ⇨ Easy maintenance

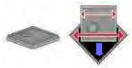
Interval	Applicable Conditions
Longer interval	Wide road Big diameter
Shorter interval	Narrow road Small diameter

Maximum Manhole Interval

Diameter	Russia	US	Japan	Jericho
150	35	100	75	75
200 450	50			
500 600	70			

Manhole Cover

Why the cover is circular shape ?

Artistic cover in Japan



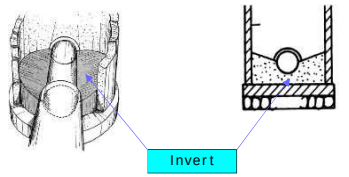
Precast Manhole



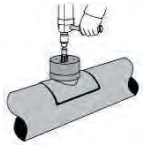
Invert on Manhole Bottom

Why is invert need to be set?

- Odor (H_2S generation)
- Concrete corrosion (H2S generation)
- Hydraulic risk (head loss)

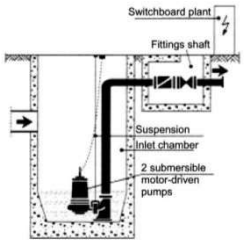


12. Connection Pipe and Pit

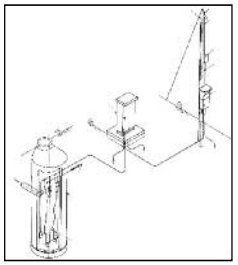

Small Manhole

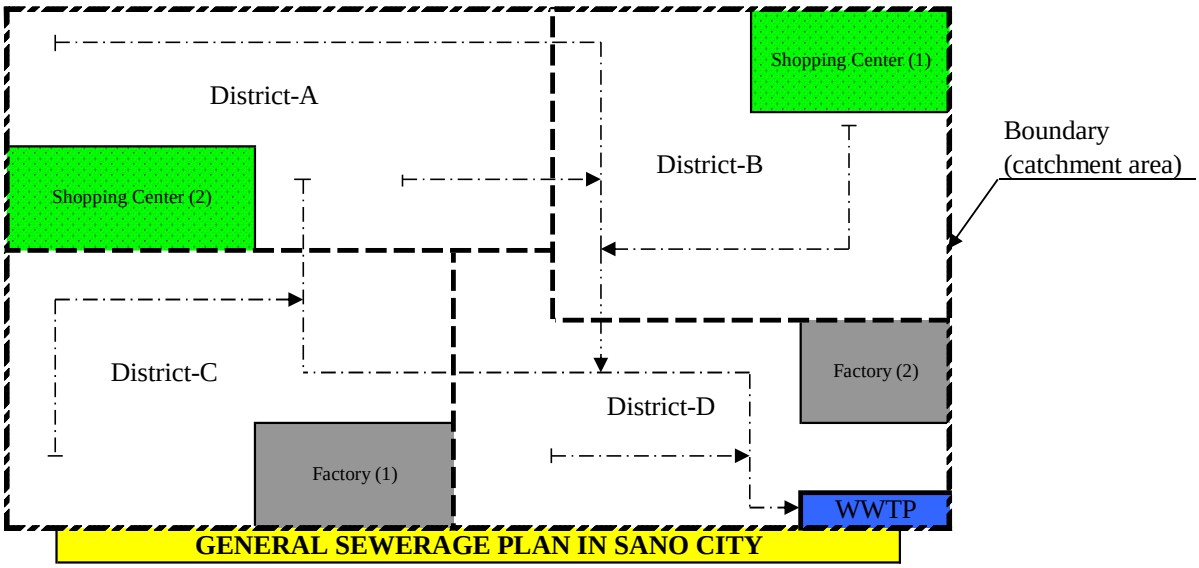
Appendix (Manhole Pump Station)



Submersible pump

Power Supply and Control System for MH Pump Station



1. Design Conditions

1-1 Target Year

2020 (1st phase)	2030 (Ultimate)

1-2 Sewage Catchment Area (ha)

District	Year 2020	Year 2030
District-A	250	270
District-B	220	250
District-C	230	280
District-D	280	300
Total	980	1,100

1-3 Design Population

District	Year 2020	Year 2030
District-A	2,500	3,000
District-B	5,500	7,000
District-C	8,000	11,000
District-D	14,000	21,000
Total	30,000	42,000

1-4 Per capita water consumption (l/cap/day)

District	Year 2020	Year 2030
District-A	300	320
District-B	260	280
District-C	220	250
District-D	180	220

1-5 Discharge to sewage ratio in domestic sewage

70%

1-6 Connection to sewer ratio in domestic sewage

Item	Year 2020	Year 2030
Connection ratio	70%	85%

1-7 Commercial wastewater (m^3/day)

Item	Year 2020	Year 2030
Shopping center (1)	300	330
Shopping center (2)	200	230

1-8 Industrial wastewater (m^3/day)

Item	Year 2020	Year 2030
Shopping center (1)	180	200
Shopping center (2)	250	260

1-9 Flow fluctuation ratio

Daily average flow **(DAF)**	1.0
Daily maximum flow **(DMF)**	1.5
Hourly maximum flow **(HMF)**	2.5

1-10 Unit Pollution Load per Person

Parameter	Unit pollution load (g/cap./day)
BOD	60
TSS	65
T-N	12

2. Estimation of Sewage Flow in Year 2020 and 2030

2-1 Domestic Flow in Year 2020 (Daily average flow)

District	Population (person)	Water consumption (l/cap/day)	Discharge ratio (%)	Connection ratio (%)	Domestic flow (m^3/day)
District-A	2,500	300	70%	70%	367.5
District-B					
District-C					
District-D					

2-2 Domestic Flow in Year 2030 (Daily average flow)

District	Population (person)	Water consumption (l/cap/day)	Discharge ratio (%)	Connection ratio (%)	Domestic flow (m^3/day)
District-A	3,000	320	70%	85%	571.2
District-B					
District-C					
District-D					

2-3 Domestic Flow in 2020

District	Daily average flow (m^3/day)	Flow fluctuation ratio	Daily maximum flow (m^3/day)	Flow fluctuation ratio	Hourly maximum flow (m^3/day)
District-A	367.5	1.5	551.3	2.5	918.8
District-B					
District-C					
District-D					

2-4 Domestic Flow in 2030

District	Daily average flow (m^3/day)	Flow fluctuation ratio	Daily maximum flow (m^3/day)	Flow fluctuation ratio	Hourly maximum flow (m^3/day)
District-A	571.2	1.5	856.8	2.5	1,428.0
District-B					
District-C					
District-D					

2-5 Total Flow in 2020

District	Domestic flow			Commercial wastewater flow	Industrial wastewater flow	Total flow		
	Daily average flow	Daily maximum flow	Hourly maximum flow			Daily average flow	Daily maximum flow	Hourly maximum flow
	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)
District-A	367.5	551.3	918.8	200	0	567.5	751.3	1,118.8
District-B								
District-C								
District-D								
Total								

2-6 Total Flow in 2030

District	Domestic flow			Commercial wastewater flow	Industrial wastewater flow	Total flow		
	Daily average flow	Daily maximum flow	Hourly maximum flow			Daily average flow	Daily maximum flow	Hourly maximum flow
	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)	(m^3/day)
District-A	571.2	856.8	1,428.0	230	0	801.2	1,086.8	1,658.0
District-B								
District-C								
District-D								
Total								

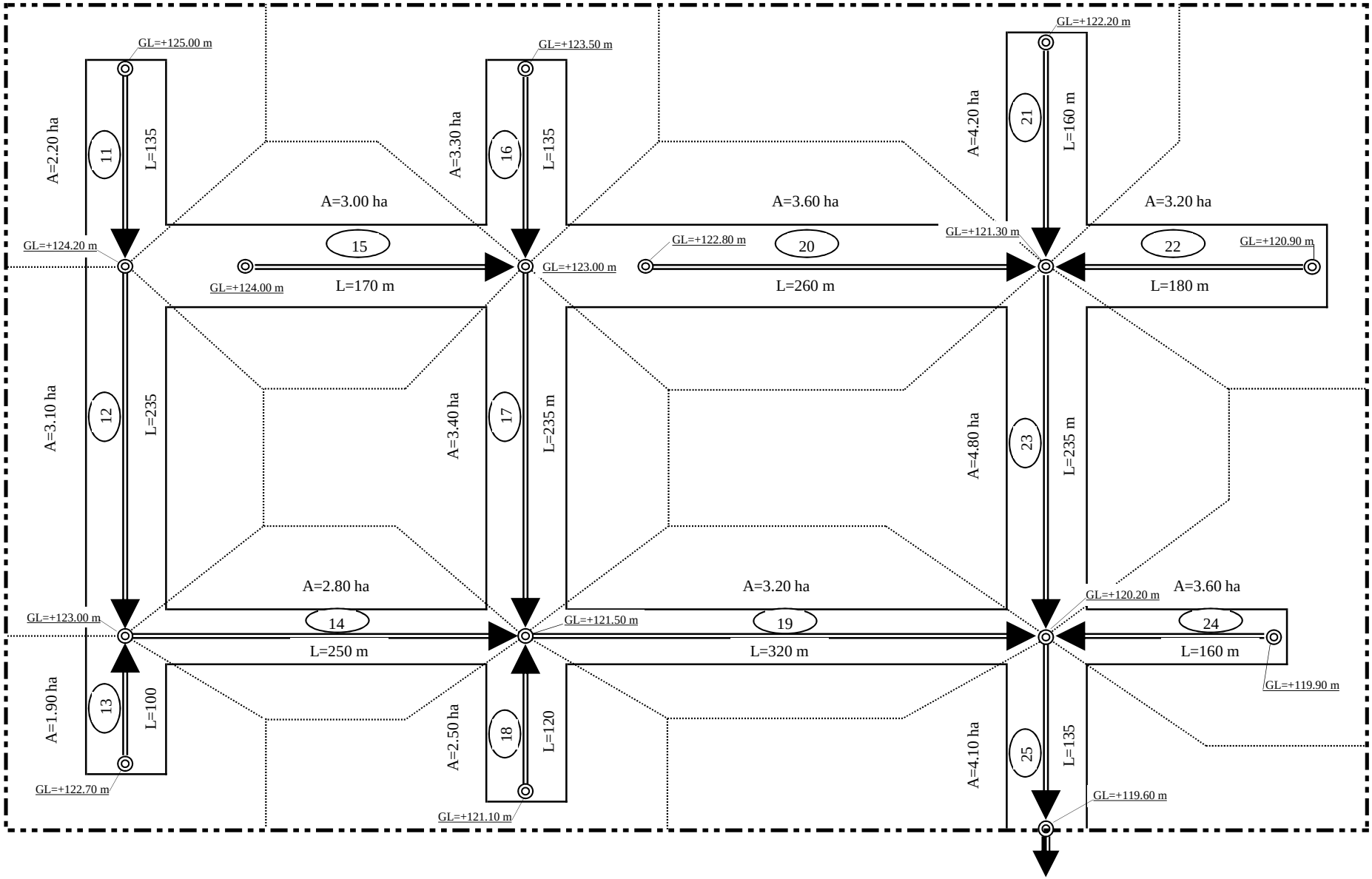
2-7 Sewage flow by unit area in 2030 for calculation of flow by sewer section

District	Total sewage flow (HMF)	Catchment area	Sewage flow by unit area	
	(m^3/day)	(ha)	(m^3/day/ha)	(m^3/sec/ha)
District-A	1,658.0	270	6.141	0.000071
District-B				
District-C				
District-D				

3. Estimation of Raw Sewage Quality in Year 2030

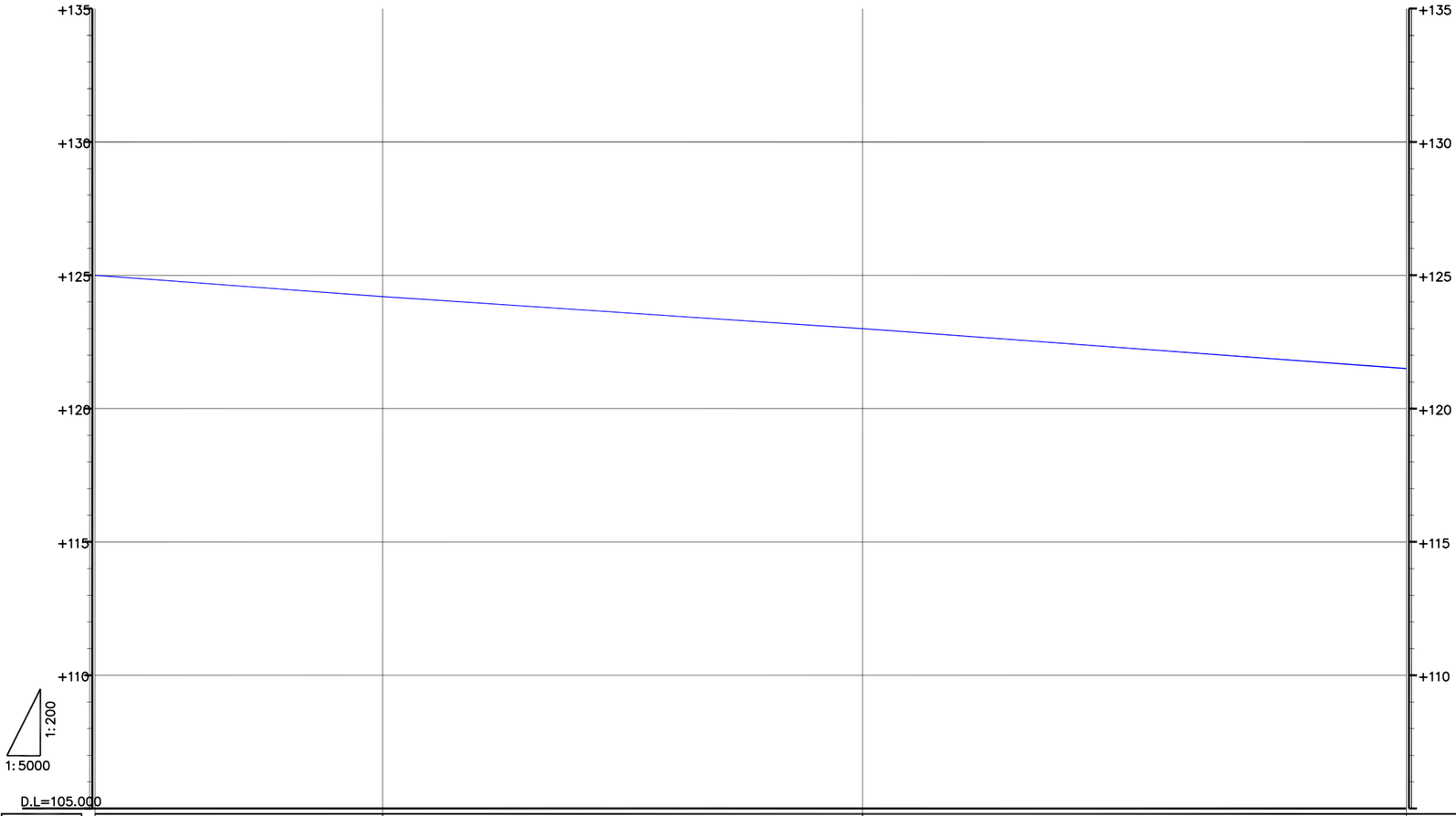
Parameter	Design population	Unit pollution load	Connection ratio	Pollution load	Design flow (DAF)	Raw sewage quality
	(person)	(g/cap./day)	(%)	(kg/day)	(m^3/day)	(mg/l)
BOD	42,000	60.0	85%	51.0		
TSS						
T-N						

PART OF DISTRICT-A AREA



Flow Capacity Calculation Sheet

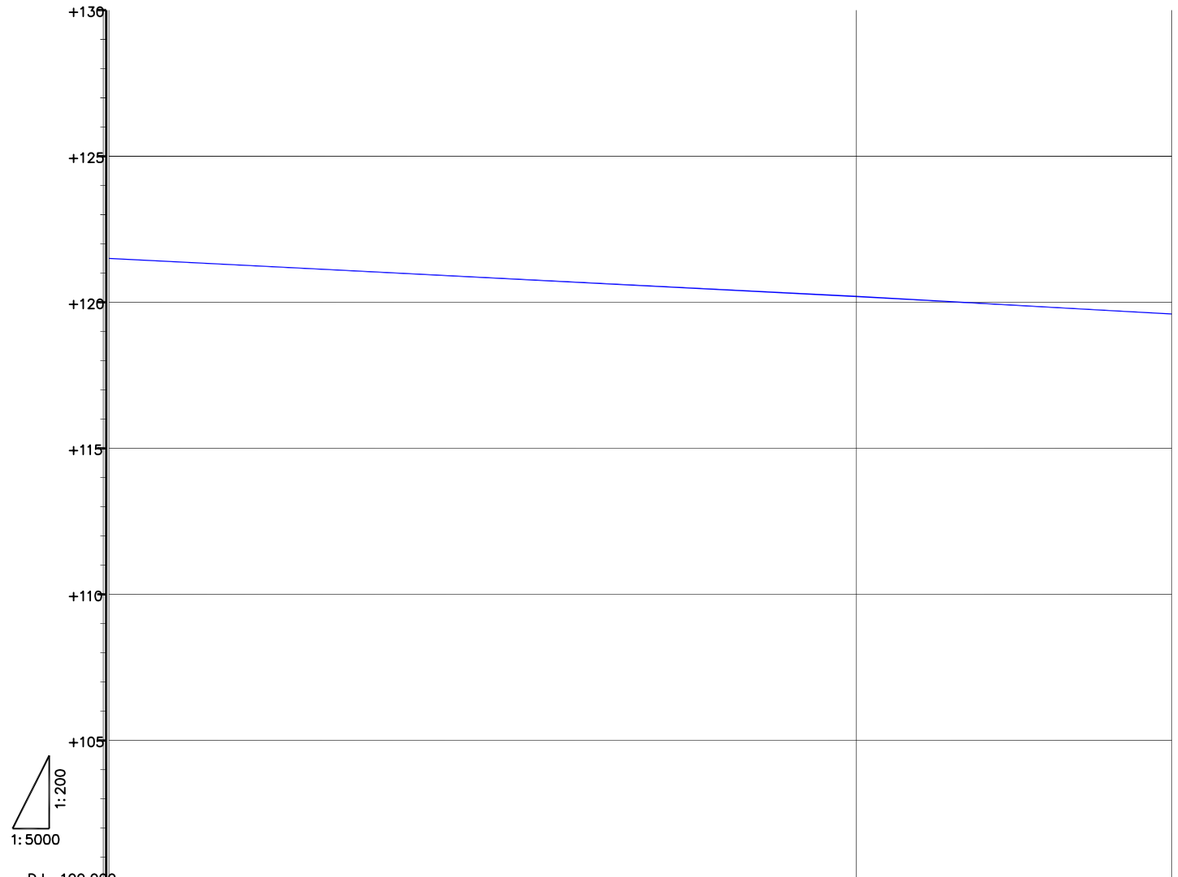
Section NO.	Downstream section NO.	Covered area	Accumulated area	Flow by unit area	Sewage flow	Section length	Ground level	Pipe Diameter	Slope	Full pipe velocity	Full pipe flow	Flow allowance
		(ha)	(ha)	(m^3/sec/ha)	(m^3/day)	(m)	(m)	(mm)	(1/1000)	(m/sec)	(m3/sec)	(%)
11	12											
12	14											
13	14											
14	19											
15	17											
16	17											
17	19											
18	19											
19	25											
20	23											
21	23											
22	23											
23	25											
24	25											
25	-											

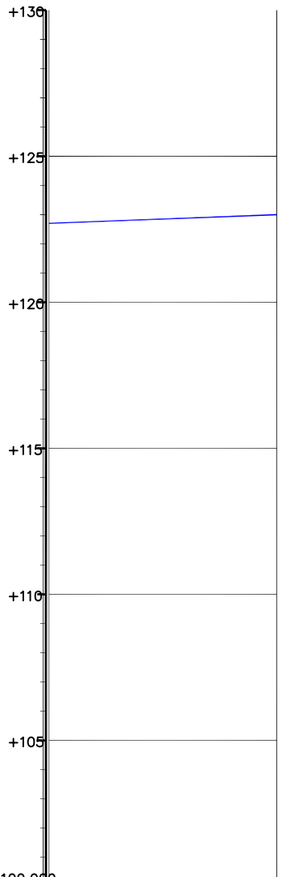


Sewer No.	11	12	14
Diameter			
Slope			
Length			
Ground Level	125.00	124.20	123.00	121.50
Earth Cover				
Invert Level				
Excavation Depth				
Accumulated Length	0.0	270.0	720.0	1230.0
Single Length	0.0	270.0	450.0	510.0

Pipe Number

11	12	14		





Sewer No.	19	25		13
Diameter				
Slope				
Length				
Ground Level	121.50	120.20	119.60	122.70	123.00
Earth Cover				
Invert Level				
Excavation Depth				
Accumulated Length	1230.0	1870.0	2140.0	0.0	195.0
Single Length	0.0	640.0	270.0	0.0	195.0

Pipe Number

19	25	13		

A 2-18-3: Third Workshop (Slides on the Sewer Cleaning)

1. Purposes of Sewer Cleaning

1. Purposes of Sewer Cleaning

- Sewer system is required to regularly clean up since soil and sand mixed in wastewater are apt to sediment.
- At rainfall time in combined sewer, soil and sand on the road, footpath, and from private land, flow in sewer pipes with rain water.
- Wastewater contains oils and fats from restaurants and household flows in, adhere, and sediment in sewer.
- Moreover, illegal dumping of domestic rubbish by citizens and ready-mixed concrete from construction site often cause clogging of sewer

1. Purposes of Sewer Cleaning

- These sedimentation makes flow disturbance, generation of bad odor, and overflow at the rainfall time results in submersion of manholes under water.
- Therefore、it is necessary to monitor sewer portions with poor discharge and accumulations of soil and sand by regular manhole survey or using camera to establish sewer cleaning plans and to conduct cleaning services.

2. Preparation & Arrangement of Sewerage Inventory

2. Preparation & Arrangement of Sewerage Inventory

1. To properly maintain sewer systems, it is necessary to grasp the locations, sizes, and shapes of facilities that are recorded in sewerage inventory.
2. Records for sewerage inventory are necessary to be created for all of the sewerage systems such as sewer, pump stations, and treatment systems.

Component of Sewerage Inventory (for Sewer)

(1) Sewer Record of Basic Data
(2) Sewer Network Plan & Profile
(3) Complain Record

(1) Sewer Record of Basic Data

Necessary Items for Sewer Record

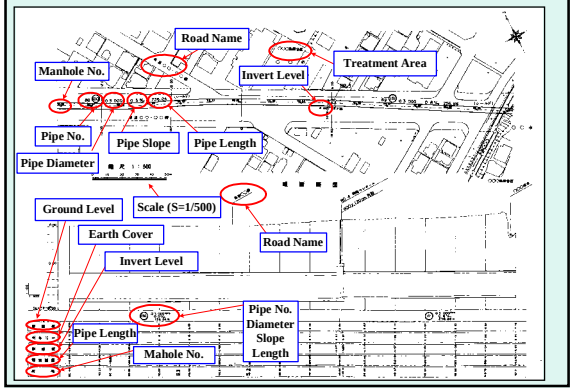
① Pipe No.
② Diameter (mm, inch)
③ Pipe Length (m)
④ Pipe Material
⑤ Road Name
⑥ Construction Year
⑦ District Name
⑧ Effluent Pump Station
⑨ Sewer Cleaning Date
⑩ Sewer Cleaning Condition

Sample of Sewer Record

District Name: Colombo 1

Pipe No.	Diameter (mm, inch)	Pipe length (m)	Material	Road Name	Construction Year	District Name	Effluent Pump Station	Sewer Cleanig Record	
								Date	Condition
SI-001	12"	108.63	Clay	De Zoysa St	1920	Fort	Sala Island PS	14/01/2006	Sand 30%

(2) Sample of Sewer Network Plan & Profile



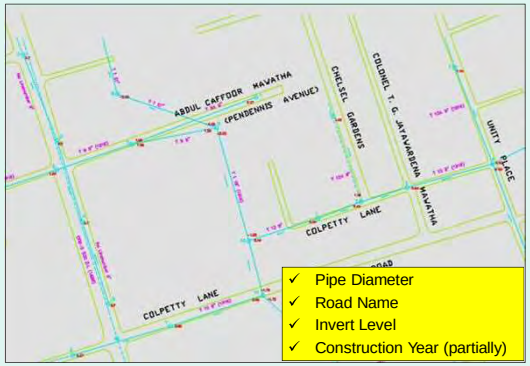
(3) Complaint Record

Complaint from residents shall be recorded for following Items

① Overflow Points of Wastewater on Roads
② Number of Complaint by Residents
③ Sewer Areas with Repeated Overflows
④ Sewer Cleaning Record
⑤ Contents of Sedimentation
- ➢ Sand/Sludge
- ➢ Rubbish
- ➢ Oil/Fat
- ➢ Wood Roof
- ➢ Mortar

Existing Sewer Drawing of the Target City (Auto CAD Data)

Details of Existing Sewer Drawing



- ✓ Pipe Diameter
- ✓ Road Name
- ✓ Invert Level
- ✓ Construction Year (partially)

Necessary Data for Drawings

(1) Pipe No. → ×
(2) Pipe Diameter → ○
(3) Pipe Length → ×
(4) Pipe Material → ×
(5) Road Name → ○
(6) Construction Year → partially

Sewer Network Plan & Profile will be drawn by **SEWER CAD** with these Data

3. Subdivision of Sewer Cleaning Area

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3. Subdivision of Sewer Cleaning Area

- Sewer cleaning works are conducted by area unit, after establishing sewer cleaning areas based on the cleaning plan.
- Sewer cleaning areas are established by area unit with catchment area of each pump station or more small areas.

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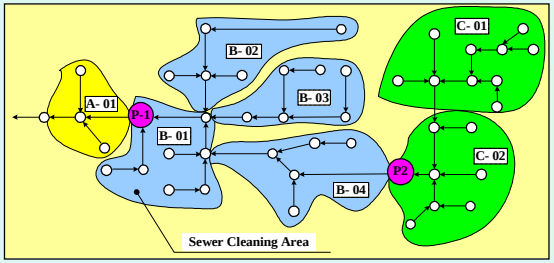
General Idea of Sewer Cleaning Area



A- 01, B- 01, B- 02, B- 03, B- 04, C- 01 shows Sewer Cleaning Area

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4. Inspection and Investigation

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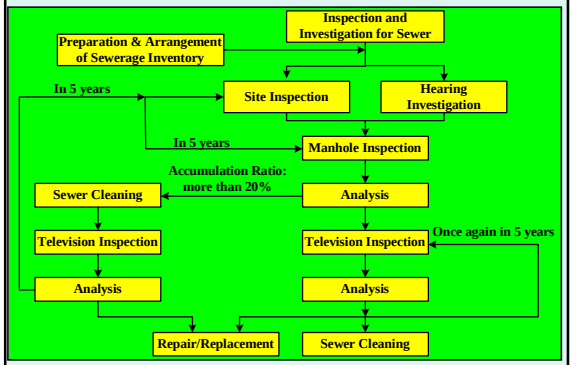
4. Inspection and Investigation

- To discharge in sewer by day and night and to permanently keep good conditions at construction time, inspection and investigation works is necessary.
- To keep a long life of sewer system by inspection and investigation works is an objective of maintenance works.
- Sewer cleaning works can reduce overflow, bad odour, caving, other damages and accidents by inspection and investigation works.

Flow Chart on Inspection and Investigation



Site Inspection - 1

To properly grasp sewer conditions at any time and keep normal functions; inspection and investigation works such as the monitoring of sewer, discharge conditions in sewer, damage happened by other construction works, the visual observations for caving protection and systematic maintenance shall be carried out.

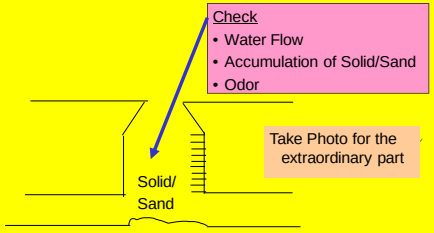
Inspection members: 3 inspectors + security guards (as required)
Daily inspection length: approx. 3 km/day

Site Inspection - 2

Inspection method:

Inspectors carry out the monitoring by traveling along and on sewer routes.

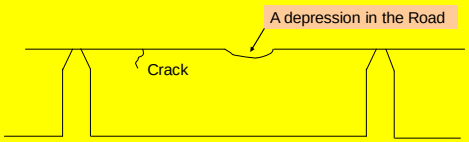
a) Check of discharge conditions of wastewater in sewer



Site Inspection - 3

b) Check of route above ground (installation route of sewer)

- Check of irregularities parts on ground
- Check of conditions of paved roads
- Check of loose and damage of manhole covers
- Check of waterhole and depression on road



Site Inspection - 4

Large Crack

Site Inspection - 5

Necessity of Emergency Practice

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Hearing Investigation - 1

Complains from citizens
- Overflow of wastewater from manhole
- Bad odor

↓

Information arrangement with factors of frequency, areas, and causes

↓

Identifications of sewer areas that tend to take place the clogging of sewers

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Manhole Inspection

- Visual method that inspectors enter manholes and directly check flows of wastewater and inside situation of manhole.
- Inspection sewer: more than 800mm in diameter
- Inspection shall be carried out after safety check on concentrations of oxygen and hydrogen sulfide because inspectors directly enter manholes.

Inspection members：3 inspectors + security guards （as required）
Numbers of daily inspection sites：approx.60 manholes/day

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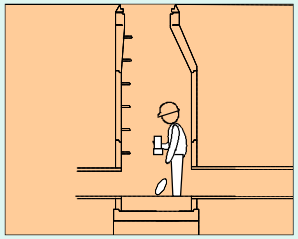
Manhole Inspection

Inspection method：
Inspectors enter in manhole and check sewer conditions by mirror and/or video camera.



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Manhole Inspection

Characteristics：
- Inspection accuracy is high, since inspectors directly check extraordinary conditions.
- Inspection cost is cheaper than that of TV inspection.
- Inspection records contribute to operation and maintenance as basic records for scheduling sewer maintenance.
- Matching inspection results with sewerage inventory

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Television Inspection - 1

- Inspection survey that inserts TV camera into existing pipes and checks inside conditions.
- Inspection survey that reflects extraordinary parts on monitored TV on ground and continuously records in video tapes.
- Records are utilized as maintenance information for sewer by arranging and storing photographs of extraordinary parts.

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Television Inspection - 2

Application ranges of pipe diameter :

150 mm to less than 800 mm

Inspection members :

Inspectors (5 persons),

Security guards (as required)

Characteristics :

- Inspection works shall be possible only by opening and acquiring a running route of self moving TV camera in sewer.
- Inspection works continuously can conduct till maximum cable length of 100 m to 200 m.

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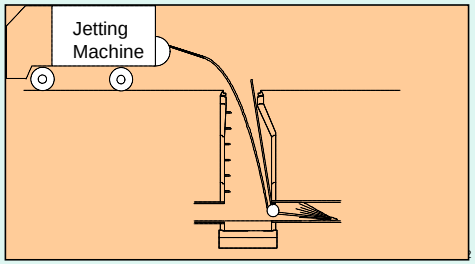
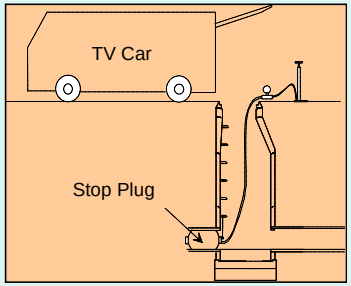
Television Inspection - 3

(1) Sewer Cleaning



Television Inspection - 4

(2) Parking of TV Car and Setting up of Stop Plug to Upstream of Flow



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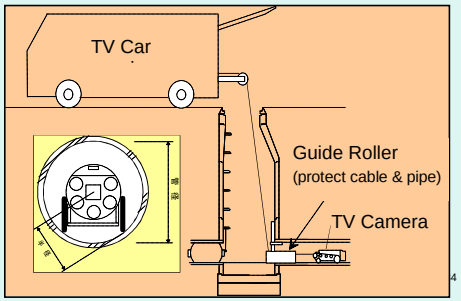
Television Inspection - 5

(3) Setting up of TV Camera



4

Television Inspection - 6

Setting up of TV Camera

35

Television Inspection - 7

Setting up of Guide Roller to protect manhole

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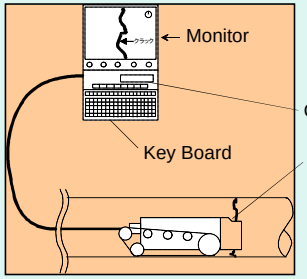
Television Inspection - 8

Setting up of Guide Roller to protect pipe

37

Television Inspection - 9

(4) Inspection of Sewer Inside



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Television Inspection - 10

Records :

The followings give suggested procedures for accurate recording of televised pipe conditions:

- Enters data view information, such as the date and job number, after the camera is placed in the manhole.
- Announces or notes why the pipe is being inspected and if tributary pipes are plugged or active, or flow should be being bypassed.
- Records pipe material, pipe joint intervals, and pipe diameter.

Television Inspection - 11

- Record all structural defects as they are encountered.
- Record all extraneous flow sources and assign leakage rate.
- Identify all service connections and note whether they are active, capped, or abandoned.
- Identify maintenance problems such as roots, grease, sediments, or dips.
- Note whether the entire line was inspected, or note the reason for in-complete inspection.

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5. Analysis

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5. Analysis

Based on inspection results, pipe conditions are classified into the ranks of A to C that are evaluated.

Rank A :

- Requires emergency practices.
- Requires immediate cleaning works and/or repairing.

Rank B :

- Conducts cleaning works and repairing within 5 years by scheduling it in yearly programs.

Rank C :

- No requires cleaning works and repairing in the immediate future but at any point in time.

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Sedimentation of Soil/Sand -1

Rank A : Accumulation of soil/sand by ratio of 40% in Pipe Diameter and Requirement of Emergency practice

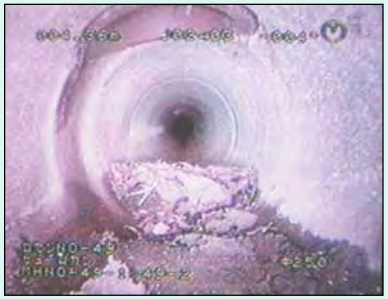
Sedimentation of Soil/Sand - 2

Rank A : Accumulation of soil/sand by ratio of 40% in Pipe Diameter and Requirement of Emergency practice

Sedimentation of Soil/Sand - 3

Rank A : Accumulation of soil/sand by full in Pipe Diameter and Requirement of Emergency practice

Accumulation of Soil/Sand - 4



Rank B : Accumulation of Soil/Sand by ratio of 20 % in Pipe Diameter

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Accumulation of Soil/Sand - 5

Rank C : Sedimentation but No Influence for Discharging of Wastewater

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Adherence of Oils and Fats -1

Rank A : Requirement of Emergency Practice

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Adherence of Oils and Fats-2

Rank B：less than of 30% in Pipe Diameter

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Adherence of Oils and Fats -1

Rank C：Sedimentation but No Influence for Discharging of Wastewater

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Clogging by Wood Roots-1

Rank A：More Than 30% in Pipe Diameter

51

Clogging by Wood Roots -2

Rank B：More Than 10% in Pipe Diameter

52

Clogging by Wood Roots -3

Rank C：Less Than 10 % in Pipe Diameter

53

Clogging by Mortar -1

Rank A：More Than 30 % in Pipe Diameter

54

Clogging by Mortar-2

Rank B : More Than 10 % in Pipe Diameter

55

Clogging by Mortar-3

Rank B : Less Than 10 % in Pipe Diameter

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6. Determination of Priority Order of Sewer Areas for Implementation of Cleaning Works

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6. Determination of Priority Order of Sewer Areas for Implementation of Cleaning Works

After setting up of cleaning sewer areas, establishes 5 years' cleaning programs including priority order for implementation of cleaning works considering the following factors.

(1) Overflow points of wastewater on roads
(2) Sewer areas with much complains by residents
(3) Sewer areas with repeated overflows and much complains
(4) Urbanized area with high population density
(5) Sewer area along main road
(6) Implementation of cleaning works from upper streams
(7) Sewer areas with smooth slopes of pipe line and with tendency of sedimentation of soil and sand

7. Sewer Cleaning Method

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7. Sewer Cleaning Method

(1) Sewer Cleaning Works by combination of High Pressure Jetting Machine and High Power Sludge Suction Machine

(2) Sewer Cleaning Works with High Power Sludge Suction Machine

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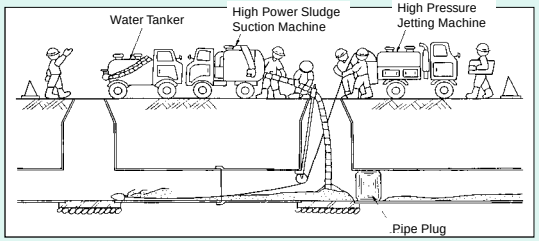
Sewer Cleaning Works by combination of High Pressure Jetting Machine & High Power Sludge Suction Machine

Sewer cleaning works to carry away soil and sand in sewer by combination of high pressure jetting machine and high power sludge suction machine.



Sewer Cleaning Works by combination of High Pressure Jetting Machine & High Power Sludge Suction Machine

Overview of Cleaning Works Site

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Sewer Cleaning Works by combination of High Pressure Jetting Machine & High Power Sludge Suction Machine

Overview of Cleaning Works Sites

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Sewer Cleaning Works by combination of High Pressure Jetting Machine & High Power Sludge Suction Machine

Night Work

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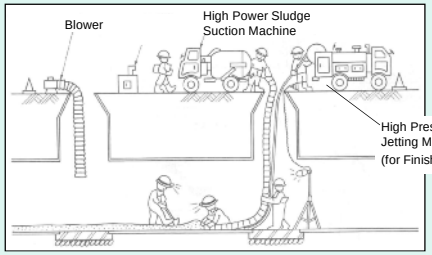
Sewer Cleaning Works by combination of High Pressure Jetting Machine & High Power Sludge Suction Machine

- Applicable Pipe Diameter: less than 800mm
- Equipment and Materials Used for Cleaning Works: High pressure jetting machine, High power sludge suction machine, Water tanker, Security guard equipment and materials one unit, Other materials (Shovel, rope, sand pile, etc.)
- Workforce: 5 workers
- Characteristics:
  - High speed operation works due to good performance and high capacity of cleaning machines
  - Safety operation for sewer
  - High performance (Cleaning of pipe wall by high pressure water jetting)

Sewer Cleaning Works with High Power Sludge Suction Machine

General and popular cleaning works that workers enters in manholes: soil and sand are directly sucked by high power sludge suction machine.



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Sewer Cleaning Works with High Power Sludge Suction Machine

- Application pipe diameter:
  more than 800mm
- Equipment and Materials Used for Cleaning Works:
  High power sludge suction machine, Water tanker, Sludge submersible pump, Generator, Safety guard materials one unit, Other materials（shovels etc.）
- Workforce:
  5 members

Sewer Cleaning Works with High Power Sludge Suction Machine

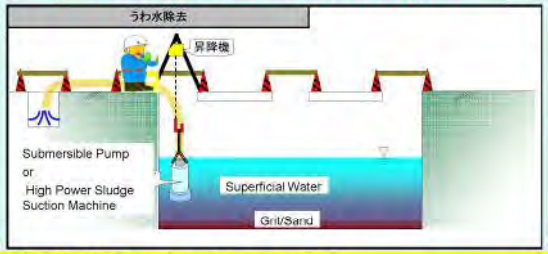
- Characteristics：
  - Less damage of sewer systems than other cleaning methods because workers directly handle a suction horse and suck soil and sand in sewer by using high power sludge suction machine.
  - General and popular cleaning methods with the highest efficiency for carrying away soil and sand from sewer.
  - It has high performance in case of low discharge of wastewater. It is recommended to use other methods (use of bucket machine) in case of high discharge of flow.

8. Grit/Sand Removal from Pump Station

8. Grit/Sand Removal from Pump Station

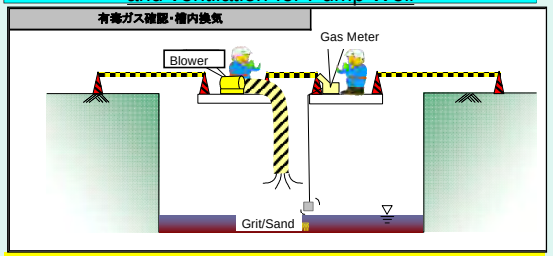
- Pump chamber that workers can enter in is manually cleaned.
- Cleaning works are carried out by using a sludge suction machine and a high pressure jetting machine, and by addition of a dump truck to get good efficiency, if a lot of sludge is planned to carry away.

STEP-1 Removal of Superficial Water



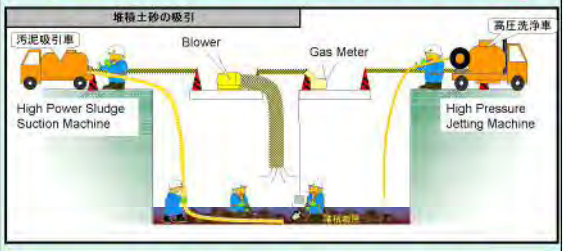
① Setting of lift machine on an open hole
② Discharge of superficial water by use of Submersible Pump or High Power Sludge Suction Machine
③ Necessity of Careful work to avoid the breakdown of the pump that may be caused by suction of grit/sand

STEP-2 Confirmation of with or without of toxic gases and ventilation for Pump Well



① As carrying away of grit/sand from a pump well is conducted by entering of workers in a pump well, confirmation of with or without of toxic gas and ventilation have to be conducted
② Ventilation for a pump well and detection for toxic gas have to continuously conduct during cleaning works in a well

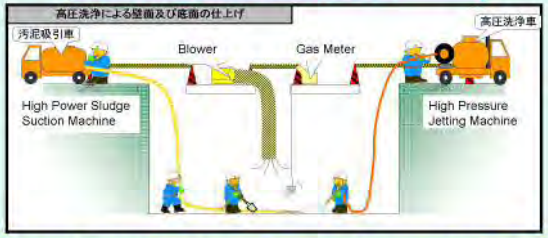
STEP-3 Suction & Carrying away of Sludge



① Workers enter in a pump well and carry out suction works of grit/sand

② Cleaning work can be performed by combination of three workers: one operator for sludge suction horse and two workers for sludge collection near a suction horse using shovels

STEP-4 Water jetting works to walls and floors by using high pressure jetting machine



① In case that grit/sand is consolidated and is impossible to pick away and remove by shovels, it shall be sucked by High Power Sludge Suction Machine after softening by jetting water with high pressure.

② After carrying away grit/sand, cleaning works shall be completed by high pressure water washing on walls and floors

A 2-18-4: Technical Test on Sewer

Appendix A 2-18-4

Mini Test for Pipe Cleaning

Please select proper mark

Sewer pipe can be clogged various materials discharged by (1), and it will cause flooding of wastewater from manholes. Therefore since prevention of discharging such materials is the most important, public campaign and (2) for customers are essential.

In order to realization of above, function/system of sewerage, proper manners for use sewage and (3) of clogging by such discharge should be (advertized) through TV, radio, bulletin and leaflet.

However because the effects of these campaign cannot be perfect, (4) for sewer pipe shall be carried out by a management organization of sewerage system which is Jericho Municipality in this case.

For an efficient cleaning, proper information arrangement of the ewer system is essential. In Jericho Municipality, currently around (5) km of trunk/branch sewers donated by Japanese Government and 12km of branch sewers donated by (6) was installed. In addition, some connection systems for around 350 buildings are installed by Phase 1 and 2 Pilot Project carried out by JICA.

There are some range of sewers along which should be carefully observed, such as (7), drop manholes and small slope ranges. This information was already classified and grouped with the location map.

In addition, the information how to actually clog and/or sediment accumulation shall be grasped by (8) researches.

Accordingly periodic research activity shall be done for beginning several years, and then regular cleaning plan can be formulated. Of course, cleanings for (9) and found points by above mentioned periodic researches shall be done.

After several years from the start of operation of sewerage system, (10) cleaning of which interval shall be determined based on the research previously mentioned will be done. In addition, public campaign of awareness for proper usage of sewage shall be continuously done.

(1) a. the contractor, b. foreigners, c. customers, d. the client
(2) a. warning , b. education, c. announcement, d. information
(3) a. bad effects, b. realization, c. emergency, d. good influences
(4) a. cleaning, b. installation, c. maintenance, d. repair work
(5) a. 15km b. 20km, c. 29km, d. 45km
(6) a. GTZ, b. JICA, c. PWA, d. USAID
(7) a. steep pipes, b. bend pipes, c. siphons, d. small pipes
(8) a. emergency b. intermittent, c. periodical, d. continuous
(9) a. regular base, b. specific points, c. emergency, d. irregular
(10) a. emergency, b. irregular, c. continuous, d. regular

Original Contents

Sewer pipe can be clogged various materials discharged by customers, and it will cause flooding of wastewater from manholes. Therefore since prevention of discharging such materials is the most important, public campaign and education for customers are essential.

In order to realization of above, function/system of sewerage, proper manners for use sewage and bad effects of clogging by such discharge should be advertized through TV, radio, bulletin and leaflet.

However because the effects of these campaign cannot be perfect, cleanings for sewer pipe shall be carried out by a management organization of sewerage system which is Jericho Municipality in this case.

For an efficient cleaning, proper information arrangement of the sewer system is essential. In Jericho Municipality, currently around 29km of trunk/branch sewers donated by Japanese Government and 12km of branch sewers donated by USAID was installed. In addition, some connection systems for around 350 buildings are installed by Phase 1 and 2 Pilot Project carried out by JICA.

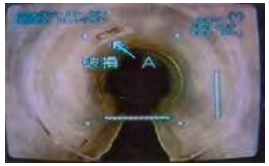
There are some range of sewers along which should be carefully observed, such as siphons, drop manholes and small slope ranges. This information was already classified and grouped with the location map.

In addition, the information how to actually clog and/or sediment accumulation shall be grasped by periodic researches.

Accordingly periodic research activity shall be done for beginning several years, and then regular cleaning plan can be formulated. Of course, cleanings for emergency and found points by above mentioned periodic researches shall be done.

After several years from the start of operation of sewerage system, regular cleaning of which interval shall be determined based on the research previously mentioned will be done. In addition, public campaign of awareness for proper usage of sewage shall be continuously done.

What appears in this swear line wall?
1) Concrete corrosion.
2) Rust.
3)Pipe color.
4) Bacteria.



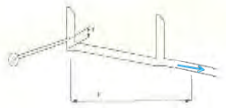
What appears in this swear line wall?
1) Insect.
2) Manufacture fault.
3)Pipe color.
4) Damage.

Why is this pipe Broken?
1) Manufacture Fault.
2) Rust.
3)Crushed by upper load.
4) Concrete Corrosion.

What does this photo shows?
1)No Asphalt.
2) Manhole projection.
3) Extra weight of the manhole.
4)manhole depression.

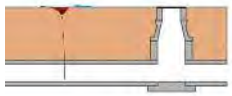
Please fill the blank table with the exact H2S Concentration that match the effect?
1) 5 ppm.
2) 20 ppm.
3)350 ppm.
4) 1000-2000 ppm.

Concentration (ppm)	Symptom/Effects
( )	Offensive odor
( )	Nearly instant death
( )	Bronchitis, pneumonia, pulmonary edema
( )	Danger to life

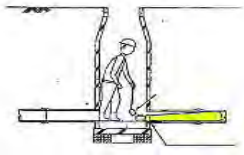


What does thisarrow shows?
1)Direction of the pipe.
2)Pipe Diameter.
3)Direction of flow.
4)Pressure direction.

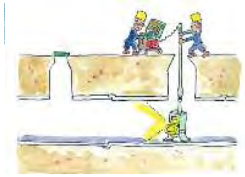
What's the result If sediment were abandoned without cleaning and consolidated in the pipes?
1) The more sediment accumulates.
2) The slower velocity of flow becomes.
3) The flow will be affected.
4)All above.



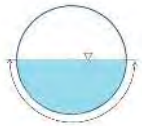
What are the main things to Inspect in the Manholes and for swear?
1)Appearance.
2)Surface abrasion.
3)Pavement damage.
4)All above.



What is this labor doing?
1)Cleaning the manholes .
2) Checking the line alignment.
3)Checking swear and manhole for abnormalities.
4) All above.



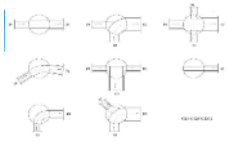
What is this labor doing?
1)Cleaning the manholes .
2) Drilling the ground.
3) TV inspection for manholes.
4) Cleaning the Pipe.



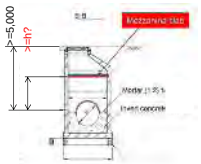
What is the formula used to calculate the Flow velocity for gravity pipes?
1) Bernoulli's formula.
2) Theis's Formula.
3) Mathias's Formula.
4) Manning Formula.

What is the useful life for PVC pipe?
1)30 years.
2)40 years
3)50 years.
4) 60 years.

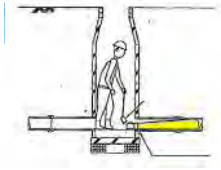
What is the cleaning frequency for a pipe Age more than 30 years?
1) Every 4 years.
2)Every 5years
3)Every 6 years.
4) Every 2 years.



What is this Photo showing?
1)Manhole bench .
2) Manhole Base.
3) Manhole Invert .
4)Manhole Diameter.



At what high should the Manhole mezzanine slab be constructed.
1) 3 meter.
2) 2 meter.
3) 4 meter.
4) 1 meter.



What is the max H2S concentration inside the manhole before getting inside the manhole for inspection?
1) H2S < 30 ppm.
2) H2S< 10ppm.
3) H2S< 100ppm.
4) H2S< 1000ppm.

O2

What is the minimum oxygen percentage to Be inside the manhole before getting in for inspection?

1) 23%
2) 37%
3) 20%
4) 18%

One of the following is NOT a methodology of pipe cleaning inside of sewers:
1) Cleaning with water Jet sear cleaner .
2) Cleaning with sludge suction machine.
3) Cleaning with hand reel winch machine.
4) Cleaning with air jetting.

What is the useful life of manhole concrete barrel?
1) 30 years.
2) 50 years.
3) 15 years.
4) 20 years.

Why Manhole cover take this shape embossment?

1) To show the brand name.
2) Non slip.
3) To take a asphalt shape.
4) To be easily opened.

A 2-19-1: Draft Plan for Management of Sewer Network

添付資料-XX1

Draft Plan for Management of Sewer Network

28th September 2015

NJS Consultant Co., Ltd

1. Purpose

1) To keep necessary function: to discharge necessary volume of wastewater

2) To allocate proper budget with the staff

2. Procedure

1) Regular Inspection Plan

2) Emergency Cleaning Plan

3) Regular Cleaning Plan

3. Regular Inspection Plan

3-1 Purpose

1) To observe the condition of inside sewers and to find the timing of cleanings, emergency and/or regular

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

3-2 Target of the Sewers

The layout plan for target sewers is shown in attached figure.

i) Japanese Grant

Target sewers are summarized in Table -1.

ii) USAID

Target sewers are summarized in Table -2

iii) Connections by JICA PP

Target sewers are summarized in Table -3

iv) Connections by Municipality/Private

3-3 Inspection category

1) Patrol for monitoring of sewer conditions

Reporting sheet is shown in Attachment -1.

a) Procedure: Patrol along sewer network for surface inspection by two staff using car

b) Range: All target shown 3-2 except for house connections

c) Frequency: monthly

d) Major target: shown 3-1, 2) and 3)

2) Inspection for check of sewer conditions

Reporting sheet is shown in Attachment -2.

i) Priority of the targets

High priority targets are shown in Table -2.

- High priority sewers; major trunk and sample trunk
- Drop Manholes; drop mouse is easily clogged
- Siphons; Settling of sand and organic materials
- Small slope sewers; easily clogged compared to large slope pipes

ii) Actual procedures

Because basically, major sedimentation/rubbish was basically accumulated at manhole, the condition to settle and can be checked at manhole.

a) To open manhole and check

Tool: Manhole opener, Hammer, light, camera

b) To record the conditions observed from outside

c) Enter to manhole if outstanding sedimentation/rubbish was found and record the conditions.

iii) Frequency of check

a) Drop manhole of major sewer (Number. 6) and siphon(2 place) : every 3month
b) Manhole of major sewer and small slope (number 14): every half year
c) Manhole of major sewer (Number 135): every year
d) Drop manhole without major sewer (Number 11): every half year
e) Manhole of small slope sewer (Number 94): every year
f) Manhole of other trunk and branch sewer including USAID: every two years
g) Manhole of utilizing connection pit : every two years

4. Emergency Cleaning Plan

The procedures are concentrated to cleaning procedures utilizing the jet/vacuum truck provided by USAID

4-1 Required incident

1) To be informed overflow from manholes/pits by people

In this case, inspection to grasp actual conditions by staff is necessary.

2) To find outstanding sediment/accumulated rubbish in manhole and/pr pipe by patrol and/or regular inspection

4.2 Formulation of System

1) To assign a person in charge to receive information from people

2) To formulate a team to work to cleaning work with the communication system

3) To prepare necessary tool for cleaning, such as light, exhaust fun, O_2/H_2S meter, red cone and etc.

4) To allocate necessary budget

5) To train actual actions

5. Regular Cleaning Plan

Regular cleaning plan will be determined based on regular inspection results.

The priority of the cleaning shall be same as regular inspection and the frequency may be as below:

1) Drop manhole along major sewer: every 3 month-6 month
2) Siphon: every half – 1 year
3) Small slope along major sewer: 1- 3 years
4) Small slope and major sewer: 3 years
5) Other trunk and branch sewer: 5 years

Table -1 Data of Sewer Network by Japanese Grant

Sewer	Start MH	Dia(mm)	Length(m)	No.of MH	No. of CP	Major(m)	Drop MH	Siphon	L(m)<0.3%
	MH1-1-1	250	332	10	15				
	MH1-5-1	315	1,514	32	50		01-08-01		
							01-09-01		
							01-09-02		
	MH1-11-1	355	556	11	14	556	01-11-1		
T1	MH1-12-1	400	929	19	48	929	01-12-1		
							01-13-1		
	MH1-18-1	600	2,262	37	95	2,262	01-21-1		
	MH1-24-1	700	405	23	14	405	01-24-1		
							01-27-1		
T2	MH2-1-1	200	252	4	11				252
T3	MH3-1-1	200	164	4	10				164
	MH4-1-1	200	504	9	13				226
	MH4-4-1	250	805	20	29		04-04-02		
T4							04-06-01		
							04-06-02		
	MH4-9-1	315	303	27	20	303			303
	MH7-1-1	200	453	8	3				
T7	MH7-4-1	250	747	11	19				
	MH7-7-1	315	1,289	18	17				1,289
	MH7-12-1	315		8	13	420			
T9	MH9-1-1	200	756	17	41				238
	MH10-1-1	400	3,163	52	103		10-05-11	10-01-8	
T10	MH10-11-1	400		10	15	542		10-01-12	
	MH10-109-1	200	224	5	13				75
T-11	MH11-1-1	200	1,150	18	31		11-03-1		270
	MH13-1-1	200	1,694	29	55		13-09-01		674
	MH13-10-1	250	992	17	56				
T13	MH13-14-1	315	1,195	19	41				
	MH13-19-1	355	794	17	36		13-09-01		
	MH13-28-1	400	952	14	26				952
	MH13-30-1	400		4	11	267			
T18	MH18-1-1	200	994	18	51				
T19	MH19-1-1	315	673	14	0				673
	MH19-4-1	400	1,236	23	0		19-7-3		
	CS-1	200	263	5					
	S-1	200	491	15	13				
	S-2	200	213	8	5				59
	S-3	200	131	5					
	S-4	200	196	6	1				
	S-5	200	134	4					134
	S-6	200	302	6					103
Add	S-7	200	159	3					
	S-8	200	272	4	4				
	S-9	200	154	3					
	S-10	200	728	13					
	S-11	200	700	20					
	S-12	200	345	5					
		315	128	2					128
	S-13	200	176	3					

Table -2 Data of Sewer Network by USAID

Trunk	Dia.(mm)	Length(m)	MH no.	CP no.	Drop MH
T1	200	2,248	85	112	
T2	200	601	23	25	
T7	200	2,297	90	109	
T9	200	301	14	17	
T10	200	1,247	46	54	
T11	200	2,535	93	125	11A-001
T13	200	3,086	117	140	
Total		12,315	468	582	

Table -3 Data of Sewer Network by JICA PP

Sewer	Dia(mm)	Length(m)	MH no.	Note
T1	200	400	21	
	160	368	46	
T4	200	213	16	
	160	72	6	
T7	200	143	6	
T10	200	60	3	
	160	110	6	
	80	50	0	Pressure
S1	200	739	37	
	160	739	26	
	100	180	0	Pressure
S2	160	143	20	
S5	160	90	4	
S6	200	135	8	
S7	200	135	7	
S9	200	50	2	
S10	200	154	11	
	160	107	14	
	80	126	0	Pressure
S11	200	451	21	
	160	605	41	
S12	200	195	6	
CS1	200	404	13	
Total		5,669	314	

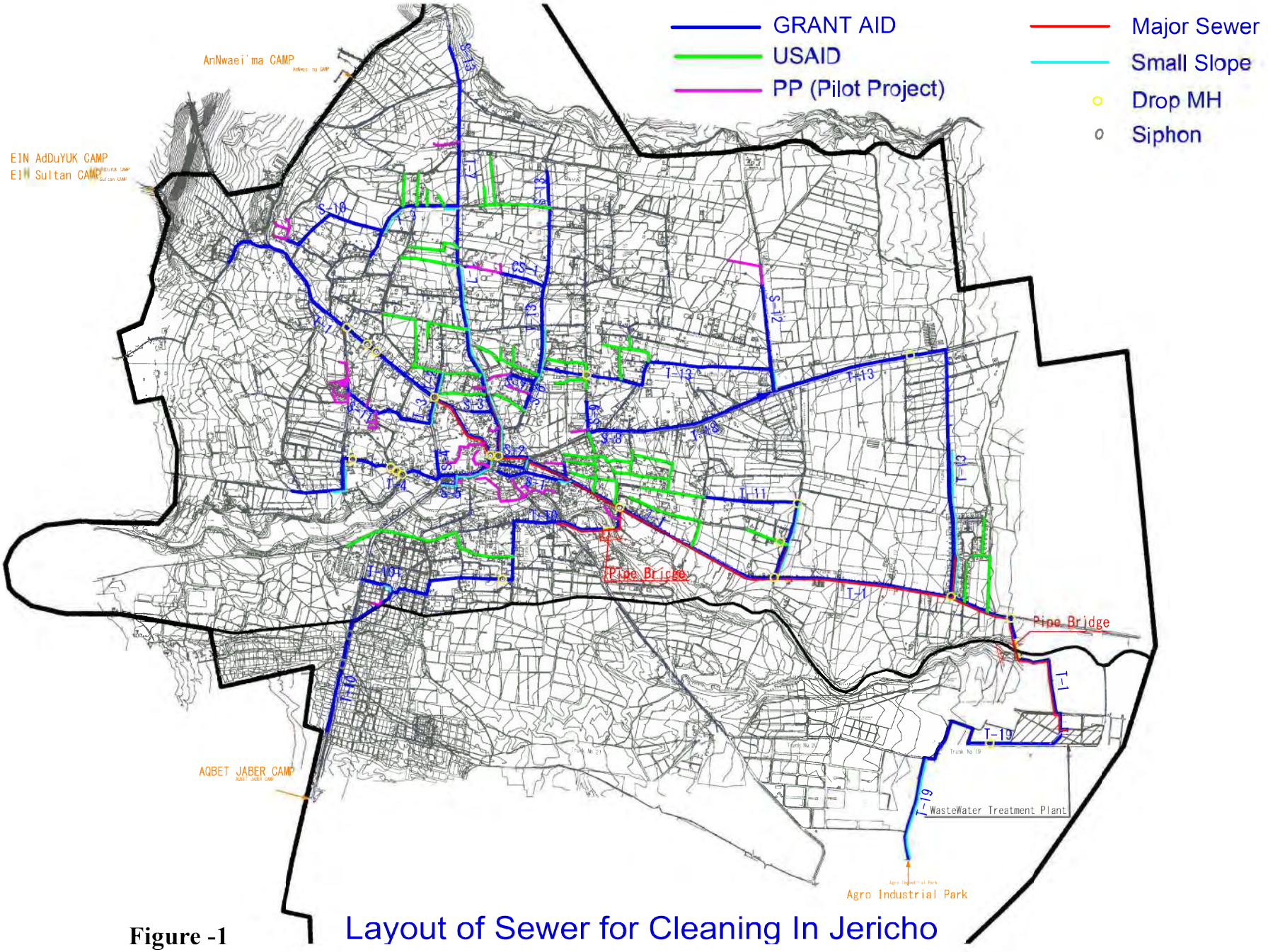


Figure -1 Layout of Sewer for Cleaning In Jericho

Attachment-1 Patrol Sheet

Patrol Sheet			
		Date	
		Signature	
Time		Member	
Target	Found Results		
Drop Manhole			
Siphon			
Major Pipes			
Pipes with small slope			
Other Trunk			
CS1, S1-S13			
USAID			
PP Area			
CP			
Action			
Note			
USAID			
PP Area			
Action			
Note			

Attachment -2 Inspection Sheet

Inspection Sheet

		Date	
		Signature	
Time		Member	

Target	Found Results
Drop Manhole	
Siphon	
Major Pipes	
Pipes with small slope	
Other Trunk	
CS1, S1-S13	
USAID	
PP Area	
CP	
Action	
Note	

<Outputs-4>

A 2-24-1: Calculation Procedure Explanation Materials for Wastewater Tariff

Appendix A 2-24-1

Memorandum on Calculation Sheet of Wastewater Tariff

1. Connections

(1) Household connections

- Potential number of household connections along trunk sewer is counted up and grouped into neighborhood, using satellite image and site investigation: total 1,553 connections of which 800 are assumed to be started construction in 2014 and the other 753 are constructed in 2015. **(refer to page 1)**
- All 5,195 water supply connections in 2012 start to be constructed by 2018. **(refer to page 1)**
- Of the connections of which construction start in a given year, 50% are assumed to be completed and discharged to sewer. **(refer to page 2)**

(2) Large users

- Large users are comprised of 26 (24), from "Arab Development Society" to "Border Crossings"; each location is identified and grouped into neighborhood. **(refer to page4)**

(3) Jericho Agro-Industrial Park (JAIP)

- Wastewater from JAIP is estimated by interpolation of 638 m^3/d in 2014 and 2,500 m^3/d in 2018; the former 638 m^3/d is from questionnaire survey for tenants of JAIP conducted by JAIP developer; the latter 2,500 m^3/d is from feasibility study of JAIP development. **(refer to page 5)**

2. Unit wastewater consumption

(1) Household connections

- Estimation is based on "unit supplied water per connection" according to 18 neighborhoods; this is from past water supply data (except large users) from 2008 to 2012. **(refer to pages 9 and10)**
- Estimation is made by using primary regression equation prepared for each neighborhood. **(refer to pages 8, 11 and 12)**
- Unit wastewater consumption is calculated from unit water consumption multiplied by 55%. **(refer to pages 6 and 7)**

(2) Large users

- Water supply volume of each large user is assumed to be increased by annual rate of 5.3 %, which is the average of past water supply (except large users) from 2008 to 2012. **(refer to page 4)**
- Unit wastewater consumption is calculated from unit water consumption multiplied by 55%. **(refer to page 4)**

3. Wastewater volume

- Wastewater from household is calculated by multiplying “discharged connections” by “unit wastewater volume” of each neighborhood. **(refer to pages 6 and 7)**
- Wastewater from large users is summed up using projected wastewater volume of each user; of which 50 % is assumed to be discharged in connected year and 100 % from the next year. **(refer to page 4)**
- Influent to WWTP is calculated by multiplying the sum of discharged wastewater by 1.1, of which 0.1 is the rainwater inflow due to misconnection of private sewer. **(refer to page 7)**

4. Cost calculation

(1) Operation and Maintenance Cost

- Personnel Cost **(refer to page 19)**
  - 14 personnel are assumed to be assigned from April 2014, of which 1 manager, 3 engineers and 10 technicians/workers.
  - 9 working months for 2014, and 12 working months after 2015
  - Unit personnel cost is 7,000 NIS /cap /month for manager, 5,500 NIS /cap /month for engineer and 3,700 NIS /cap /month for technicians /workers as of 2012 in Jericho Municipality; annually 5% increase
- Electricity Cost
  - Comprised of “fixed charge” and “metered charge”
  - “Fixed charge” is calculated by “maximum demand” multiplied by “unit fixed charge”; maximum demand is 225 kW when all equipment are in full operation; “unit fixed charge” is 6.4087 NIS/kW/day for low demand users (JDECO as of 2013); annually 5 % increase. **(refer to pages 14,17 and 18)**
  - “Metered charge” is calculated by “total load” multiplied by “unit metered charge”; “total load” is based on 3,655 kWh/day per treated wastewater 6,600 m^3/d considering operation hours; total load of a given year =3,655 kWh/day *Influent wastewater volume /6,600 m^3/day *1.1; “unit metered charge” is calculated by weighted average of Rate A, B and C and their seasonal settings of JDECO tariff; annually 5 % increase. **(refer to pages from 14 to 18)**
  - Solar generation is calculated by “100 kW *8 hours/day *0.7 (efficiency)”; reduction of electricity metered charge is calculated by “solar generation” *”unit metered charge”. **(refer to page 13)**
  - 9 working months for 2014, and 12 working months after 2015 **(refer to page 13)**
- Repair Cost **(refer to pages 20 and 21)**
  - Comprised of “spare parts replacement”, “shipping” and “supervisor” cost.

- Estimation by contractor (Hitachi)

➢ Chemicals Cost **(refer to page 22)**

- The cost of Hypo-chlorine solutions is calculated, to be dosed to effluent before discharging to Wadi.
- Unit dose rate is 0.18 m^3/d per treated wastewater 6,600 m^3/d =0.0000273 m^3/m^3.
- Unit cost of chemicals is 1.3 NIS/kg (as of 2013 in Jericho Municipality); annually 5% increase.

(2) Capital cost

Depreciation and other capital costs are not considered during this calculation cycle from 2014 -2018.

5. Annual cost and cost classification **(refer to pages 23 and 24)**

(1) Only fixed electricity charge is included in fixed cost; other costs are dealt with as variable cost.

(2) Fixed cost is recovered by fixed charge and variable cost is recovered by volumetric charge, in principle.

6. Cost allocation **(refer to pages 25 and 26)**

(1) General

➢ Discharged connections and wastewater are categorized into “residential” and “commercial” and into 8 volume categories (from 0-10m^3 to over 251 m^3); the figure of water supply service in 2012 is used for this categorization.

➢ There should be some deviation between the share of wastewater from 2014 to 2018 and the share of supplied water for all the municipality in 2012, because the former is for limited area of connections, whereas the latter is for all the municipality; the adoption of the latter is justified to avoid frequent and substantial revision of tariff structure.

➢ Annual average, minimum, maximum and variation from minimum to maximum are calculated based on the figure of water supply service in 2012.

(2) Allocation of fixed cost **(refer to page 26)**

➢ Fixed cost is allocated to “residential” and “commercial” by the share of “annual minimum wastewater”.

➢ Fixed cost thus allocated is further allocated to each volume category by the number of discharged connections.

(3) Allocation of variable cost **(refer to page 26)**

➢ Variable cost is allocated to “residential” and “commercial” by the share of “variataion from minimum level”.

➢ Variable cost thus allocated is further allocated to each volume category by the share of

"variation from minimum level", within each "residential" and "commercial" category.

- Unit volumetric charge calculated above is an "average", and should not be applied to specific volume band; i.e. 0.5 NIS/m^3 of residential for 31-50 m^3 is a weighted average of 0 -10 m^3, 11 -20 m^3, 21 -30 m^3 and 31 -50 m^3.

7. Revenue Estimate **(refer to pages 27 -30)**
   - Fixed charge is calculated by multiplying cumulative total of discharged connections (annual value multiplied by 4.5 in 2014 and by 6 in 2015 -2018).
   - Theoretical unit volumetric charge specific to each volume band should be calculated manually. **(refer to page 27)**

8. Adjusting fluctuation of unit tariff among 8 volume categories

The fluctuation of calculated unit tariff among 8 volume categories can be adjusted and made smooth, considering cost recovery, gap from water tariff and affordability for low-incomers. **(refer to page 31)**

9. Balance of revenue and expenditure **(refer to page 32)**

A 2-24-2: Draft of the Penalty Clause

Appendix A 2-24-2

Cabinet decision No. ( ) for the year 2017 for the amendment of the Connecting Houses and Facilities to the Public Sewer System No. (16) for the year 2013.

Based on the basics amendment law provisions of 2003, as amended, in particular Article (70) thereof,

And on the Water Law No. (3) for the Year 2002, particularly Article (42) thereof,

And on the local Authorities Law No. (1) for the year 1997,

And on the Law No. (7) of 1999 of the environment,

After revising the system of connecting houses and facilities to the public sewer network No. (16) for the year 2013, and upon the recommendation of the Minister of Local Government and head of the Water Authority and based on the requirements of the public interest and based on the powers vested in us by law, and based on what was approved by the Cabinet in its meeting held in Ramallah on / / , it has been issuing the following amendments: -

Article (1)

To amend article No. (5) of the system to be added to it as follows: -

3. After the deadline set by the service provider for the compulsory connection of the owner, all the determined fees of the owner or user are considered as public funds, whether the owner or the user or the service provider was connected to the public sewer network or not.

4. The amount due of the owner or the user who fails to pay the bill on time is as follows: - (a) the service provider sends a written notice to the owner or user, stating the amount owed to the service provider and its details and that this must be paid within fifteen days from the date of notification; (b) in the event of non-payment of the owner or user, the amount due is issued to the Execution Department and bills are considered as the official bonds that shall be collected under Execution Law No. (23) for the Year 2005 and not to be stopped unless the decision is issued from the court that has the lawsuit to stop it.

Article (2)

To amend the article No. (6) paragraph (2) to be as follows:

In case there is no ability to connect directly to public sewer, owners should allow installing pipes in their private lands for the neighboring lands within a setback and is located at a higher level than their land, according to the regulatory diagram approved by the local authority in accordance with the following procedures: -

a. Inform the land owner by a notice attached with a diagram which shows the track of the pipe to express the reason for objections within a period of 15 days.

b. Discuss the objections by a committee made for this purpose and consists of:

1. a representative of PWA;
2. a representative of MOLG;
3. a representative of service provider.

c. The committee studies the objections and within a period of 2 months makes a final decision.

d. In case of no objection submitted and/or the committee has issued a decision, the commission is entitled to enable the service provider to take an action directly on site without any objection so that the staffs/ employees of the service provider conduct inspection or connect to the public sewer for the necessary extension. Anyone objecting or making a problem to the staffs/ employees is regarded as committing an offense to the staff resistance contrary to the provisions of this system.

The owner of these pipes should commit by a written undertaking to maintain it on their expense and to change the track in case it blocked the freedom of the land owner, and also to remove it in case there is an ability to connect directly to the public sewer.

Article (3)

To amend article (21) to be:

Anyone who makes one of the following actions:

1. To damage the property of the water and sewer authority;

2. To connect his own sewer with the authority sewer or to cut it without a permission;

3. To cause any obstacle for the employee of service provider or to stop him for doing his duties or to refuse to let him enter his land to inspect public and private sewer;

4. To use public sewer without a license or illegally use sewer in a way different from what has been approved in the license;

5. To discharge rainwater to public sewer network;

6. To throw any of prohibited materials that are mentioned in annex No. ( ) of this system;

7. To discharge sewage outside of the exact location in the wastewater treatment plant or specified by the service provider within the border of competent authorities;

8. To discharge sewage of private cesspit without written approval from the service provider;

shall be punished by the imprisonment for a period of not less than 6 months and not more than one year or a fine of not less than 500 JD and not more than 5000 JD or what is met by equivalent currency, that affects the text does not any more severe penalty imposed under any other law.

Article (4)

To amend article No (21) from the system to be article No (22) and to amend article No (22) from the system to be article No (23).

Article (5)

All competent authorities must implement the provisions of this amendment after passing 30 days from the date of publication in an official gazette.

This issued in Ramallah in / / 2017

Prime Minister

Rami Alhamdullah

<<Chapter 3>>

A 3-1-1: Presentation Materials of Japan Training

برنامج بناء القدرات لادارة مشروع الصرف الصحي

1

مشروع الصرف الصحي في مدينة اريحا
البرنامج التدريبي في اليابان
2013/ 11/ 23-9

2

TeCSOM

تقوم الحكومه اليابانيه الى جانب تنفيذ مشروع الصرف الصحي بتنفيذ مشـــروع للدعم الفني وتطوير ادارة الصرف الصحي في مدينة اريحا مدته (44) شهر بقيمة (5) مليون دولار خلال الفتره من (كانون اول /2012– تموز / 2016)

3

الاهداف المرجوه من مشروع الدعم الفني لبلدية اريحا :

- وضع نظام للمستفيدين من خدمة الصرف الصحي
- عمل دورات تدريبيه وورشات عمل للمشرفين على المشروع
- وضع انظمة للمياه التي تخرج من محطة المعالجه والحمأه
- وضع آليات لاستخدام المياه المعالجه

4

الاهداف المرجوه من مشروع الدعم الفني لبلدية اريحا :

- تحضير الدليل الخاص بالتشغيل والصيانه لمحطة التنقيه والشبكه
- نشر التوعيه بين المواطنين ونقل الخبره بما يتعلق بمحطة التنقيه والشبكه
- وضع هيكليه للمستحقات المطلوبه من المستفيدين من خدمة الصرف الصحي
- وضع خطة ماليه للبلدية لادارة محطة وشبكة الصرف الصحي

5

المشاركون في الدورة :

- عشرة موظفين من البلدية وممثل عن سلطة المياه الفلسطينيه

6

برنامج الدوره التدريبيه

- وقد شملت هذه الدوره المتخصصه على جانب فني نظري ، بالاضافه الى الجانب العملي والزيارات الميدانيه لمواقع مختلفه وفي الجانب النظري كان هناك برنامج يومي للمحاضرات في المجالات التاليه :-

– نبذه عن خدمة المجاري في اليابان وخاصه مدينة يوكوهاما
–صيانة وادارة انابيب الصرف الصحي
–تصميم انابيب الصرف الصحي
–تصميم المرافق الصغيره الحجم لمعالجة مياه المجاري

7

وشملت الزيارات في اليابان

- **مدينة يوكوهاما**
  - زيارة بلدية يوكوهاما والاجتماع مع السيد واتانابيه مدير عام ادارة التخطيط والتنسيق لاعمال الصرف الصحي
  - المركز التثقيفي والاعلامي لخدمة الصرف الصحي
  - زيارة محطة كوؤهووكو للاطلاع على مرافق المحطه ومشاهدة عملية تنظيف انابيب المجاري
  - زيارة ملعب نيسان ومشاهدة أمثله عملية لاعادة استخدام المياه المعالجه في ذلك الموقع .

8




9

TeCSOM

مدينة تاكاماتسو

– زيارة محطة نيركاموؤبيه لمعالجة مياه المجاري
– الاطلاع على تجربة اعادة استخدام المياه المعالجه في بلدية تادوؤتسو

10

TeCSOM

مدينة كيوتو

– زيارة محطة كوؤبا للصرف الصحي
– زيارة محطة تسوتشي ياما للصرف الصحي

11

تصميم وصيانة شبكات الصرف الصحي

تم اكتساب المعارف الاساسية وتعزيزها حول محطات وشبكات الصرف الصحي بشكل عام من تصميم وادارة وتشغيل وصيانة للمحطة والشبكات, وهذه المعارف سوف تساعد كثيرا طاقم البلدية لادارة المحطة والشكبة وتشغيلها وتطويرها في المستقبل.

12

تصميم وصيانة شبكات الصرف الصحي

- الى جانب الاطلاع على مبادىء التصميم الذي يساعد مهندسي البلدية لتصميم بعض الخطوط والتأكد من سلامة التنفيذ والمساعدة في تصميم بعض الخطوط الفرعية وخاصة الربط المنزلي.

13

التشغيل والصيانة لنظام الصرف الصحي

- ركز هذا التدريب على كيفية الادارة المناسبة لصيانة وتشغيل مرافق الصرف الصحي.
- نظرة عامة لعمل وصيانة محطات معالجة الصرف الصحي
- نظرة عامة لتصميم وصيانة شبكات الصرف الصحي.

14

الجانب المالي :

- عادة ما يتم تمويل هذه المشاريع من الدولة لان التكلفه تكون مرتفعة جدا ولا تتحمل موازنة البلديات مثل هذه التكاليف .
- يتم التعامل مع شبكات ومحطات الصرف الصحي كاصول فيتم تصنيفها الى شبكات وابنية وعمرها 50 سنة , المضخات وعمرها 20 سنة واخيرا الاجهزة الكهربائية ويقدر عمرها ب 15 عاما. ومن الملفت للانتباه هو ضرورة الاعتماد على نوعية المنتج المستخدم في شبكات ومحطات التنقية عند تحديد عمر المنتج لاننا وجدنا ان هناك محطات وشبكات عمرها اكثر من العمر الافتراضي .

15

الجانب المالي :

لا يتم انشاء شبكات الصرف الصحي في سنة واحدة انما يتم توزيعه على عدة سنوات حتى لا يكون هناك عجز في الموازنة

16

الجانب الاداري

- وفي هذه المحطات تكون مؤسسة الصرف الصحي وموظفيها ملك للبلدية ويتغاير عدد الموظفين وفقاً لحجم محطة الصرف الصحي، مع وجود خصخصة لخدمة تنظيف وصيانة أنابيب الصرف الصحي كما الحال في أحدى محطات الصرف الصحي التابعة لبلدية يوكوهاما والتي قام فريق البلدية بزيارتها، حيث أن عملية غسيل وصيانة انابيب الصرف الصحي من خلال شركة خاصة وفق معايير محددة (يتم تنظيف الانبوب الواحد مرة كل خمس سنوات بحيث لا يسمح بتجاوز عملية تراكم الاوساخ في الأنبوب لأكثر من 15%.) في حين تقوم بلدية يوكوهاما بالإشراف على عملية التنظيف بحيث تقدم الشركة الخاصة تقرير عن عملية التظيف للبلدية.
- محطات أسستها المحافظة وتتم إدارتها من قبل القطاع الخاص.

17

الجانب الاداري

- الجزء الثاني من التدريب تم تنفيذه خلال الاسبوع الثاني من الدورة وكان عبارة عن زيارات ميدانية لمحطات معالجة المياه العادمة صغيرة الحجم وكبيرة الحجم، وكذلك لمتاحف يمكن للزوار تعلم طبيعته وتاريخ الصرف الصحي وتعلم كيفية رفع الوعي لدى المواطنين وخصوصا الاطفال وطلاب المدارس وصغار السن.

18

العلاقات العامة

- فيما يتعلق بجانب التوعية والعلاقات العامة لمشروع الصرف الصحي فقد ركزت الدورة على جوانب ضيقة ونظرية باستثناء زيارة وحيدة للمركز البيئي في يوكوهاما والاطلاع على محتوياته والتي تتضمن نماذج لادوات الصرف الصحي ومحطات المعالجة الى جانب قاعة لعرض الافلام التعريفية بالمشروع حيث تم عرض فيلم خاص عن الصرف الصحي في مدينة يوكاهاما، اما ما تم تداوله في المحاضرات فقد تناولت جوانب فنية استفدنا منها وشكلت معرفة جديدة في كيفية عمل شبكات الصرف الصحي.

19

التوصيات

•يجب أن تعمل البلدية على الحصول على معدات الصيانه اللازمه مثل سيارة الكاميرا وسيارة التنظيف حيث أن سيارة الكاميرا تقوم بالكشف عن طبيعة وأماكن التسكير في خطوط الصرف الصحي وسيارة التنظيف تحتوي على الخرطوم للتنظيف بضغط ماء عالي للقيام بصيانة أنابيب الصرف الصحي الدورية والطارئة

•البلدية بحاجة الى سيارة تنك مع مضخة وذلك للقيام باستخدام المياه المعالجة لعمليات الري للمناطق الخضراء المتوزعة في عدة اماكن من شوارع المدينة.

20

التوصيات

بالنسبة لموضوع التصميم محاضرة واحدة غير كافية وبالتالي يجب تخصيص حلقات دراسية اضافية وكذلك التدريب على برامج مستخدمة في التصميم.
بالنسبة لموضوع الصيانة ، تم التركيزعلى المواسير الاسمنتية وجزء كبير من الشبكة في اريحا مواسير بلاستيكية ، وبالتالي يلزم تعزيز طاقم البلدية بالخبرة الكافية لصيانة المواسير البلاستيكية والطرق المستخدمة لذلك

21

التوصيات

- بحاجة الى دورات عملية ومتخصصة في امور صيانة وتشغيل محطات معالجة الصرف الصحي.
- بحاجة الى دورات متخصصة في تصميم مرافق الصرف الصحي.
- بحاجة الى دعم فني ومالي لعمل دراسات حول اعادة استخدام المياه المعالجة في أغراض الري.

22

التوصيات

- إستكمال تطوير الأوصاف الوظيفية والإجراءات الخاصة بالخدمة في المدينة.
- إختيار الطاقم الخاص بتنفيذ مهام الصرف الصحي، مع ضرورة الإستفادة من إمكانية الدوام الجزئي في المحطة للتوفير في تكاليف الطاقم، على سبيل المثال دوام مسؤول المختبر، التشغيل، الحراسة والعمال....

23

التوصيات

- البدء بالتأسيس لنشاط تثقيفي مستمر حول خدمة الصرف الصحي يتم تنفيذه بالتعاون ما بين قسم الصرف الصحي وقسم العلاقات العامة في البلدية، بالإضافة إلى توفير قاعة تثقيفية في محطة المعالجة يتم من خلالها محاكات عمليات إدارة ومعالجة المياه العادمة في المدينة وذلك من أجل تسهيل تنفيذ مهمة التثقيف في هذا المجال.

24

التوصيات

- تحديد مسؤولية عملية تنظيف الأنابيب وصيانتها حيث هناك شروط حاسمة وهامة جداً في هذا المجال خصوصاً ما يتعلق بالجانب الصحي، حيث يشترط على طاقم التنظيف الحصول على شهادة تأهله للتعامل مع أنابيب الصرف الصحي ودخولها وتنظيفها، كما أن هناك معدات خاصة لعمليات التنظيف يجب العمل على توفيرها في حال تم الإعتماد على طاقم البلدية في عملية التنظيف.

التوصيات

- تحديد سياسة البلدية في ربط المنشآت والمساكن بشبكة الصرف الصحي وفق البندين التاليين:
- **الربط داخل حدود ملكية المواطن:**
- أن يتم من خلال المواطن دون إشراف البلدية.
- أو أن يتم من خلال المواطن تحت إشراف البلدية.
- **الربط ما بين حدود الملكية وأقرب منهل عام:**
- أن يتم ذلك من خلال مقاول خارجي.
- أو أن يتم ذلك من خلال طوقم البلدية.

شكرا لاستماعكم

A 3-2-1: Details of Field Training Tour in Jordan (Wastewater Reuse)

Appendix A 3-2-1

Farmers visit of Amman's WWTP/farms/farmers currently re-use treated wastewater.

The criteria for selection of four Jericho farmers included their type of crop production (mostly dates, but bananas and herbs), own different size of farms, geographical distribution of farms within the city (not just those close to the WWTP), residency in Jericho, both male and female farmers, age, and passport holders. The selection was conducted after discussing candidate farmers through joint meetings by the Jericho Municipality, Jericho Union of Farmers, and the NJS experts.

Designing and Iimplementation by:	Jericho Municipality							
Visiting sites:	Madaba WWTP in Amman							
	Visiting farmers/farms							
Advising and financial support:	NJS Consultants							
Date:	June 9th-11th, 2015							
Number of attendees:	6 people (4 Jericho farmers + 1 WWTP engineer + 1 public relation staff)							
Farmer selection committee:	Jericho Municipality, Jericho union of farmers, NJS							
Farmers selection criteria	Planted crops (dates/bananas/herbals/fruits), farm size, geographical distribution of farms, Jericho residency, gender, age, passport holders							
Purpose:	Tour of WWTP with focus on treated wastewater re-use Meet with farmers/farms currently using treated wastewater Share the learning with Jericho framers; re-use, crops, new potential crops for Jericho, methods, impacts, costs, water saving Contribute to educational workshops in Jericho							
Visiting schedule:	9/6/2015 5:00 pm arrival to Amman (Caravan Hotel) Al-Lowaibda 10/6/2015 10:00 am reception at Jordanian Water Authority. 10:30 am lecture about re-use of the treated water. 11:30-12:30 lunch. 1:00 meeting with farmers and visits to the farms that use the treated wastewater. 6:00 pm back to hotel. ※Eng. Tayseer Abu Khadra (WWTP's Director of Environment and Reuse Directorate) will join the delegation. 11/6/2015 10:00 am visit to WWTP, the farms that have used the treated wastewater to benefit from and to see the used Irrigation methods. 5:00 back to Jericho City.							
Covered travel expenses:	Crossing Tax							155 NIS
	Transportation from Jericho lounge to Israeli side							16 NIS
	Transportation from Israeli side to Jordanian side							16 NIS
	Jordanian boarders tax							55 NIS
	Transportation from Jordanian bridge to hotel							40 NIS
	Hotel rent							160*2=320 NIS
	Meals							150*3=300 NIS
	Internal transportation in Amman							150*2=300 NIS
	Transportation from hotel to Jordanian bridge							75 NIS
	Transportation from Jordanian bridge to Jericho lounge							32 NIS
	Travel insurance							55 NIS
	Total per person							1,364 NIS
	Total for 6 people:							8,184 NIS
Participants info:	Mr. Ibrahim AbuSeiba	Manager of Jericho WWTP						
	Mr. Mohamad Azmoty	Public awareness staff at Jericho Municipality						
	Mr. Sabry Edaik	Farmer	46 yr	Over 100 ha	Near WWTP	Male	Dates	Associate Degree
	Ms. Miyaser Dwedar	Farmer	59 yr	1.8 ha	Near city center	Female	Herbs	9th Grade Completion
	Mr. Ishac Shish	Farmer	47 yr	7 ha	E of Jericho	Male	Vegetable, Dates	Bachelor
	Mr. Hossam Dreat	Farmer	37 yr	10 ha	N of Jericho	Male	Bananas	High School Diploma

A 3-2-2: Details of Field Training Tour in Jordan (Sludge Reuse)

A Study Tour of Sludge Use in Aqaba, Jordan

Designing and Iimplementation by:	Jericho Municipality	
Visiting sites:	Aqaba City water company in Jordan	
	Visiting farmers/farms	
Advising and financial support:	NJS Consultants	
Date:	April 8th to 10th, 2017	
Number of attendees	7 people (3 Jericho farmers +1 WWTP engineer + 1 public relation staff+ head of water and sewer dept , agriculture ministry)	
Farmer selection committee	Jericho Municipality, NJS	
Farmers selection criteria	(dates/bananas/), farm size, geographical distribution of farms, Jericho residency, age, passport holders	
Purpose	Learning about techniques used in their sludge composting. Viewing legislation and standards for reuse of sludge. Look at the results (negative or positive) for the re-use of sludge in agriculture. Meet with farmers/farms currently using sludge. Share the learning with Jericho framers; re-use, crops, new potential crops for Jericho, methods, impacts, costs and water saving. Contribute to educational workshops in Jericho. Viewing the economic aspects of the reuse of sludge.	
Visiting schedule	08/4/20147 5:00 pm arrival to aqaba a7la tala Hotel) 2017/4/9 10:00 am reception at aqaba water com by Mohammad MAHAMID 10:30 am lecture about re-use of the SLUDGE 12:00-1:00 lunch. 2:00 meeting with farmers and visits to the farms that use the SLUDGE in Ma'an city . 6:00 pm back to hotel. ※Eng.MOHAMMAD MAHAMID (AQABA WATER COM will join the delegation. 2017/4/10 10:00 am visit to Aqaba branch of Jordanian MoA, regarding related regulations and licenses 5:00 back to Jericho City.	
Covered travel expenses (1JD=5.17NIS, 1USD=3.60NIS)	Crossing Tax	153*7 + 277*1 = 1348 NIS
	Transportation from Jericho lounge to Israeli side	23 * 7 = 161 NIS
	Jordanian boarders tax	55 * 7 = 385 NIS
	Transportation from Jordanian bridge to hotel	434 * 4 = 1736 NIS
	Hotel rent	281 *7 *2 = 3934 NIS
	Meals	1082 NIS
	Internal transportation in Amman, Aqaba and Ma'an	200 + 776 = 976 NIS
	Transportation from Jordanian bridge to Jericho lounge and Israeli side to Jericho	55 * 7 = 385 NIS
	Total	10,007

<<Chapter 4>>

A 4-2-1: Minutes of Meeting on the Terminal Evaluation Survey

MINUTES OF MEETING
BETWEEN
JAPAN INTERNATIONAL COOPERATION AGENCY
AND
AUTHORITIES CONCERED OF THE PALESTINE
ON
TECHNICAL ASSISTANCE AND CAPACITY BUILDING PROJECT FOR THE JERICHO SANITATION PROJECT

Jericho, December 2, 2015

Mr. Daisuke Iijima
Leader
Terminal Evaluation Team
Japan International Cooperation Agency

Mr. Mohammed Jalaitah
Mayor
Jericho Municipality

Ms. Yuko Mitsui
Chief Representative
JICA Palestine Office
Japan International Cooperation Agency

Mr. Nael Ali Ahamad
Manager, Project Management Unit
Palestinian Water Authority

The Terminal Evaluation Team, organized by the Japan International Cooperation Agency, was dispatched from November15 to December 2, 2015 to review the progress of the Japanese Technical Cooperation Project for "Technical Assistance and Capacity Building Project for the Jericho Sanitation Project."

The Terminal Evaluation Team visited Jericho municipality to exchange views and opinions on the project with project stakeholders and had a series of discussion with the Palestinian authorities concerned.

As a result of the discussions, both parties agreed on the matters referred to in the attached document hereto.

END

Attached document: Terminal Evaluation Report

TERMINAL EVALUATION REPORT
ON
TECHNICAL ASSISTANCE
AND
CAPACITY BUILDING PROJECT
FOR
THE JERICHO SANITATION PROJECT

Japan International Cooperation Agency

and

Authorities Concerned of the Palestine Authority

December2, 2015

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Abbreviations and Acronyms

C/P	Counterpart
JAIP	Jericho Agro-Industrial Park
JCC	Joint Coordinating Committee
JICA	Japan International Cooperation Agency
JSC	Joint Service Council
M/M	Minutes of Meeting
MoA	Ministry of Agriculture
MoLG	Ministry of Local Government
NIS	New Israel Shekel
O&M	Operation and Maintenance
OJT	On-the-Job Training
PA	Palestinian Authority
PDM	Project Design Matrix
PIEFZA	Palestinian Industrial Estates and Free Zones Authority
PO	Plan of Operation
PWA	Palestine Water Authority
R/D	Record of Discussion
SCADA	Supervisory Control And Data Acquisition
USAID	United States Agency for International Development
WWTP	Wastewater Treatment Plant

1. Introduction

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 has no other discharging points, thus, if remains within the valley. Since there is no proper wastewater treatment facilities available in this area, the contamination of the groundwater vein, which is the sole water source for the water supply system of the Jericho municipality, has been found in serious condition in January 2010.

From a viewpoint of effective use of the limited water source, treated wastewater is expected to be used as a new water source. Agricultural activities have been prospected in this area and construction of an "Agro-Industrial Park" is planned as a core project in the "Corridor for Peace and Prosperity" that is being promoted by the Government of Japan. Wastewater generated in the park is also planned to be treated and utilized.

Based on these circumstances, the Palestinian Authority requested Jericho Wastewater Collection, Treatment System and Reuse Project in Jericho municipality located in the Jordan River's West Bank Area in August 2008 under the Japanese Grant Aid Assistance. In response to the request, the Government of Japanese decided to conduct Preparatory Survey and JICA conducted survey to examine the target facility construction sites, wastewater treatment method and so forth. The Exchange of Note and Gran Agreement for the Grant Project were concluded on February 28, 2011.

The Palestinian Authority also requested technical cooperation for the Project and the Government of Japan accepted the request. JICA conducted Detailed Planning Survey from 20th November, 2011 to 20th December, 2011. Both sides agreed the outline of the Project.

1-2. Summary of the Project Design

<Overall Goal>
Sewerage facilities in Jericho municipality are operated and managed appropriately under sound financial condition.
<Project Purpose>
System for operation and management of sewerage works in Jericho municipality is established.
<Expected Outputs>
(1) Strategic Business Plan for sewerage works in Jericho municipality is developed. (2) Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant (WWTP) is developed. (3) Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed. (4) Capacity of Jericho municipality for financial management of sewerage works is

developed.
<Project Implementation Period>
From December 2012 to July 2016
<Implementing Agency>
Jericho Municipality
<Target Area>
Jericho municipality and its surrounding areas
<Beneficiaries>
Jericho municipality, Residents of Palestine

2. Outline of the Review

2-1. Background of the Review

Technical Assistance and Capacity Building Project for the Jericho sanitation Project (hereinafter referred to as "the Project") is a bilateral technical cooperation project between the Government of Japan through JICA and Authorities Concerned of Palestine. This four-year project was launched in December 2012 to improve the system for operation and management of sewerage works in Jericho municipality. As the Project has reached final stage of the whole project period, the Terminal Evaluation of the Project was conducted by the Terminal Evaluation Team (hereinafter referred to as "the Evaluation Team").

2-2. Objectives of the Review

The objectives of the Terminal Evaluation are listed as follows:

(1) To jointly review inputs, activities, and outputs of the Project to date and assess the likelihood of achieving the Project Purpose as well as the Overall Goal in due course;

(2) To jointly analyze the progress and achievements in reference to the Project Design Matrix (PDM) ver. 2(see Annex 2) and the five criteria for evaluation (relevance, effectiveness, efficiency, impact, and sustainability); and

(3) To discuss measures to be taken for the Project's further improvement and to prepare the Terminal Evaluation Report.

2-3. Members of the Evaluation Team

Japanese Side

Name	Title	Organization
Mr. Daisuke Iijima	Leader	Advisor, Environment Management Team 2, Environment Management Group, Global Environment Department, JICA Headquarter
Mr. Noriaki Yokouchi	Cooperation and Planning	Assistant Director, Environment Management Group, Global Environment Department, JICA Headquarter
Mr. Akihiro Mochizuki	Evaluation and Analysis	Senior Consultant, ICONS Inc.

2-4. Schedule of the Evaluation

The Terminal Evaluation was conducted from November15 to December 2, 2015(see Annex 1 for the detailed schedule of the Terminal Evaluation).

2-5. List of Interviewees

The Terminal Evaluation Team conducted interviews with project stakeholder, including JICA Experts.

Name	Position	Organization
Mr. Basel Hijazi	Head of Engineering Department	Jericho Municipality
Mr. Eyad Anabosi	Head of Quality Section	Jericho Municipality
Mr. Mohammed Abu Mohsen	Head of Financial Department	Jericho Municipality
Mr. Mohammed Fetyani	Head of Water and Sewerage Department	Jericho Municipality
Mr. Mohammed Awajneh	Water Networks Maintenance/ Sewerage Section, Water and Sewerage Department	Jericho Municipality
Mr. Maher Swaidy	Electrician, Sewerage Section, Water and Sewerage Department	Jericho Municipality
Mr. Mohammed Isayed	Civil Engineer, Strategic Planning and Economic Development Section	Jericho Municipality
Mr. Mohammed Azmouti	Public Relations Section, Public Relations Department	Jericho Municipality
Mr. Ibrahim Abu Sibaa	Head of Sewerage Section, Water and Sewerage	Jericho Municipality

	Department	
Mr. Omran Khlaf	Operator, Sewerage Section, Water and Sewerage Department	Jericho Municipality
Mr. Hazem Bali	Engineer, Project Planning Section, Engineering Department	Jericho Municipality
Mr. Abed Habad	Head of Revenue Collection Management Section, Financial Department	Jericho Municipality
Mr. Nael Ali Ahmad	Manager, Project Management Unit	PWA
Mr. Rami Abu Ktaish	Project Management Specialist	USAID
Mr. Karim K. Husari	Senior Projects Manager	Black & Veatch
Mr. Jamal Awwadat	Committee President	Aqbat Jaber Camp
Mr. Imad Abu Sombul	Manager Director	Aqbat Jaber Camp
Mr. Takeo Matsuzawa	Team Leader	PIEFZA
Mr. Kunitoshi Saito	Business Development Services Expert	PIEFZA
Mr. Hirofumi Sano	Chief Advisor	JICA Expert
Mr. Satoru Oniki	Deputy Chief Advisor	JICA Expert
Mr. Toshihiko Tamama	Financial Management	JICA Expert

3. Methodology of the Review

3.1.Review Method

In accordance with the New JICA Guidelines for Project Evaluation (the First Edition, 2010), the Terminal Evaluation Team evaluated the Project, taking the following steps:

Step 1. Prepare an evaluation grid that lists questions, data/information necessary for the review and information sources;

Step 2. Collect data and information necessary for the review;

Step 3. Assess the Project's achievements in reference to the PDM and the Plan of Operation (PO) (see Annex 3);

Step 4. Analyze the factors that promoted or inhibited the Project's achievements, including factors relating to the project design and the project implementation process;

Step 5. Analyze the Project from the viewpoints of the five evaluation criteria, defined in "3-2 Five Evaluation Criteria";

Step 6. Draw up recommendations from the analysis;

Step 7. Share the preliminary evaluation results with stakeholders and discuss the future direction of the Project; and

Step 8. Reach an agreement on the evaluation results between the Japanese and Palestinian sides.

3.2.Five Evaluation Criteria

Five evaluation criteria used in the Terminal Evaluation are defined as follows:

Relevance: Relevance is assessed in terms of the Project's validity in relation to the development policy of the Government of Palestine at the evaluation stage, Japan's Official Development Assistance (ODA) policy, and the needs of the Project beneficiaries, as well as the appropriateness of the project approach to address the needs.

Effectiveness: Effectiveness is assessed based on the prospect of achieving the Project Purpose by the end of the project period and whether this is due to the Project's Outputs.

Efficiency: Efficiency is assessed by focusing on the relationship between Outputs and Inputs in terms of timing, quality and quantity of Inputs. It measures to what extent Project Inputs have economically been converted into Outputs in consideration of the achievements of both Inputs and Outputs.

Impact: Impact is assessed based on the prospect of achieving the Overall Goal within three to five years of the project completion and the positive and negative changes that have been produced, directly or indirectly as a result of project implementation.

Sustainability: Sustainability is assessed in terms of institutional, organizational, financial and technical aspects, by examining the extent to which the achievements of the Project will be maintained or further expanded by Palestine side after the project period.

3.3.Data Collection Methods

The following sources of information and data were used in the Terminal Evaluation:

1) Interviews with and/or questionnaires' answers from Counterparts (C/Ps), collaborating organizations and the Japanese expert team.

2) Site visits
   - Wastewater Treatment Plant
   - Project Site of Pilot Project
   - Jericho Agro Industrial Part
   - Aqbat Jaber Refugee Camp

3) Documents agreed upon by both sides prior to and/or during the course of the Project implementation, including the Record of Discussions (R/D), Minutes of Meetings (MM), and PDM;

4) Records of inputs from both sides and activities of the Project, including the records on C/P nomination, JICA Experts' assignment, and actual expenses covered by both Palestinian and Japanese sides;

5) Documents that provide data and information indicating the degree of achievement of the Project Outputs, Project Purpose, and Overall Goal; and

6) Documents that show the project's relevance and sustainability (e.g. Japan's Country Assistance Policy for Palestine).

4. Project Performance to Date

4-1. Achievements of Inputs

(1) Japanese Side

1) Assignment of Experts

The Japanese side has assigned 12 experts to the Project. The assigned experts' fields of expertise are the following.

Table 1. Expertise of JICA Experts

No.	Position and/or Assigned Tasks	Name
1	Chief Advisor / Institutional Operation/ Legal System	Mr. Hirofumi Sano
2	Deputy Chief Advisor / Reuse of treated wastewater and sewage sludge	Mr. Satoru Oniki
3	Operation and Maintenance of Sewage Treatment Plant (Mechanical)-1	Mr. Yasuaki Konda
4	Operation and Maintenance of Sewage Treatment Plant (Mechanical)-2	Mr. Yoshikazu Nagano
5	Operation and Maintenance of Sewage Treatment Plant (Mechanical)-3	Mr. Masaru Kasahara
6	Operation and Maintenance of Sewage Treatment Plant (Electrical)	Mr. Akira Hasebe
7	Water Quality Management / Sewer Network Construction and Maintenance -1	Mr. Keiji Matsuoka
8	Sewer Network Construction and Maintenance -2	Mr. Kozo Hayashishita
9	Awareness Raising / Project Coordinator	Ms. YasumiTsutsui
10	Financial Management	Mr. Toshihiko Tamama
11	Sewer Network Construction Assistance /Project Coordinator	Mr. Yusuke Sakae
12	Awareness Raising	Ms. FatemehMasouteh

2) Provision of Machinery and Equipment

The Japanese side has provided various equipment related to sewerage system (e.g. Electric panel for pump, Distribution pipe for Treated Effluent, Oxygen & Hydrogen sulfide meter and others) and office equipment (Laptop computers and others) that are necessary for the project implementation (see Annex 4. List of Equipment provided by the Japanese Side).

3) Training

As it shown below in detail, since 2013, eleven counterpart members have attended the training in Japan.

No.	Name	Position / Organization
1	Mr. Basel Hijazi	Head/ Engineering Department/ Jericho Municipality (1995)
2	Mr. Ghazi Aki	Director of Waste Water Department/ Jericho Municipality (2013)
3	Mr. Eyad Anabosi	Head/ Quality Unit/ Jericho Municipality (2005)
4	Mr. Mohammed Abumohsen	Head/ Financial Planning and Analyzing Section / Jericho Municipality (2004)
5	Mr. Mohammed Fetyani	Head/ Projects Executing and Supervision Division / Engineering Department/ Jericho Municipality (2004)
6	Mr. Mohammed Awajneh	Water Pumps Maintenance/ Water and Sewerage Department, Water Quality and Maintenance Section/ Jericho Municipality (2006)
7	Mr. Maher Swady	Electrician/ Engineering Department, Maintenance Section / Jericho Municipality (1994)
8	Mr. Mohammed Isayed	Civil Engineer/ Execution and Supervision of Project Section/ Engineering Department / Jericho Municipality (2011)
9	Mr. Mohammed Azmouti	Head of Media Section/ Public Relations and Media/ Jericho Municipality (2013)
10	Mr. Ibrahim Abusibaa	Engineer/ Water and Sanitation Department/ Jericho Municipality (2009)
11	Mr. Nael Ali Ahmad	Manager/ Projects Management Unit/ PWA(2010)

4) Local Expenses

The Japanese side has covered USD 1,173,782 in total as local expenses as of 31st October, 2015

1) Operation cost in Palestine borne by Japan (Unit: US$)

	December 2012 - August 2014	October 2014 – October 2015	TOTAL
General local expenses	137,665	132,917	270,581
Equipment	6,251	3,459	9,710
Local consultant	312,879	571,574	884,453
Training in Japan	9,038	0	9,038
Total	465,833	707,950	1,173,782

(2) The Palestinian Side

1) Assignment of Counterparts (C/Ps)

The Palestinian side has assigned C/Ps from Jericho municipality and PWA for the implementation of project activities.

Corresponding task	Name	Title
Project Chief	Mr. Based Hijazi	Head of Engineering Department
Output 1 "Establishment of organization base for departments in charge of sewage works"	Mr. Ghazi A. Al-Naji	Director of Water & Wastewater Department
	Mr. IyadHamdan	Management
	Mr. Mohammed Fetyani	Civil Engineer
	Mr. Ibrahim Abu Seiba	Mechanical Engineer
Output 2 "Development of capacity Jericho municipality for O&M of the WWTP"	Mr. Ibrahim Abu Seiba	Mechanical Engineer
	Mr. Mohammed Awajneh	Technician
	Mr. Maher Al Swaidy	Technician(Electricity)
Output 3 "Development of capacity Jericho municipality for O&M of sewer network and promotion for connection to public sewers"	Mr. Mohammed Isayed	Civil Engineer
	Mr. Mohammed Fetyani	Civil Engineer
	Mr. Ibrahim Abu Seiba	Mechanical Engineer
Output 4 "Public awareness"	Mr. Mohammed Isayed	Civil Engineer
	Ms. WiamIreket	Public Relations
	Mr. Mohammed Azmuty	Public Relations
Output 4 "Financial management"	Mr. Mohammed Abu Muhsen	Finance Management
	Mr. Raja Baha Shareef	Finance Management

2) Facilities

The Palestine side has provide done office in Jericho municipality to be used as a project office, and also provided one meeting room.

3) Local Costs

The Palestine side has covered 242,041 NIS in total for management cost, operation-maintenance cost for wastewater treatment plant and others as of October 2015. In addition to the costs table above, the Palestinian side has covered salary of C/Ps in the Project's activities.

4-2. Achievements of Activities

As shown in the Plan of Operation (see Annex 3), project activities have been conducted as planned. However the activities corresponding to Output 3 and Output 4 are relatively delayed. Mid-term Review to the Project was not conducted, therefore, no recommendations were suggested to be implemented.

4-3. Achievements of Outputs

Output 1: Strategic Business Plan for sewerage works in Jericho municipality is developed.
Objectively Verifiable Indicator (hereinafter "indicator[s]"): Indicators: 1-1 Departments in charge of sewerage works is officially approved in Jericho municipality 1-2 The number of full-time staff for sewage works is more than 14 persons. 1-3 The by-laws for users of sewerage facilities is enforced. 1-4 Sewerage Strategic Business Plan is approved by city council.

The achievement level of Output 1 is deemed as relatively high.

Indicator 1-1: The indicator has been achieved. The letter has been submitted from Jericho municipality that Sewerage department was established officially in June, 2013.

Indicator 1-2: It is not achieved. Currently, there are 16 posts including the director of Water and Sewerage department. At the time of Terminal Evaluation, 9 full-time staffs have been assigned. The municipality is under recruiting five more staffs in 2016 to fulfill the indicator, Due to budget restriction for fiscal year of municipality, recruitment will be conducted in the beginning of 2016.

Indicator 1-3: It is achieved. It has been approved by Jericho municipality council, Ministry of Local Government and Palestine Water Authority in March, 2014

Indicator 1-4: It is achieved. Same as indicator 1-3, sewerage Strategic Business Plan was also approved with user charge modification by city council in March, 2014.

Output 2: Capacity of Jericho municipality for appropriate operation and maintenance of the wastewater treatment plant (WWTP) is developed
Indicators: 2-1 More than 6 staff pass a technical examination for O&M of the WWTP. 2-2 Hazardous materials exceeding the quality standard do not flow into sewerage facilities 2-3 70 % of treated wastewater and 10 % of sludge are utilized 2-4 More than 80 % of served population recognizes the need for the WWTP.

The achievement of Output 2 is considered relatively high at the time of Terminal Evaluation. In order to comply fully the indicator 2-3, more usage of sludge is required.

Indicator 2-1: It has been achieved. Eight staff passed the technical examination for O&M of the wastewater treatment plant at the time of Terminal Evaluation.

Indicator 2-2: It has been achieved. The quality test of treated wastewater and sludge was conducted three times in December 2014, May 2015 and November 2015. According to the result, both treated water and sludge contain less quantity of heavy metal which is permitted in the Water Quality Standard for Agriculture Use and Use of Sewage Sludge in Agriculture.

Indicator 2-3: The indictor is partially achieved. At the time of October 2015, the wastewater treatment plant has produced approximately 8,649 m^3/month treated wastewater and approximately 7,192 m^3/month of treated water which is equivalent to 83 percent of total production has been reused. This is the effluent flow data which obtained by SCADA data, thus the accuracy is confirming. Currently, considering of stable supply to clients, the Project has been supplying only one farmer who collaborates with the experiment of the Project. Meanwhile, the Project and Jericho municipality has an intention to establish the required procedure to conclude the contract for the supply/usage of treated wastewater in near future. Therefore, the percent of treated wastewater usage is expected to achieve 100% without notable obstacle. On the other hand, the sludge has been produced approximately 30,100kg, and is utilized approximately 488kg which is equivalent to1.6% of total quantity at the time of Terminal Evaluation. Due to environment issue and save a disposal cost, the Project has discussed with Ministry of Agriculture for the usage of sludge which generates from the WWTP. Prior to the discussion, Ministry of Agriculture has a policy to promote a sludge, because there are also WWTPs in other cities such as Al-Bireh, Nablus and Jenin. Since Ministry of Agriculture has authorized "The usage of Sewage Sludge in Agriculture" in November 2015. Jericho municipality has agreed to the regulation on behalf of contribution to environment protection.
Then, the Project and Jericho municipality are ready to promote the usage of sludge at first in the municipality's farm as an experiment during the rest of the Project period.

Indicator 2-4: The indicator has been achieved. The Project conducted questionnaire surveys the recognition the needs for the WWTP through questionnaire to the population who have

participated to workshops held by the Project in 2013, 2014 and 2015. The recognition of the served population has been increased as 64% among 100 participants in 2013, 86% among 111 participants in 2014 and 96% among 105 participants in 2015.

Output 3: Capacity of Jericho municipality for appropriate maintenance of sewer networks is developed.
Indicators: 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.

The achievement level of Output 3 is considered as medium. Because the indicator3-2 is not achieved.

Indicator 3-1: The indicator has been achieved. Currently, all five staffs passed both exams. There are two types of exam. Exam A is for sewer maintenance, exam B is for sewer cleaning.

Indicator 3-2: At the time of Terminal Evaluation, it is not achieved due to delay of house connection to sewer system. Therefore, the probability of achievement is considered as low at the time of the Project.

As of November 28th 2015, 1,222 households connected to the sewer system. Among the connected households, Pilot Project connected 1,179 households meanwhile Jericho municipality connected 43 households. It should be mentioned that high cost of internal connection causes hesitance for the connection. According to the cost quotation by the Project, internal connection cost is 7 to 10 times higher than connection fee.

On the other hand, the Project has implemented the customer satisfaction survey for 70 connected owners/households to sewer system in regard to satisfaction to new sewerage system in June 2015. The survey has implemented to 105 persons and 105 persons have answered to the questionnaire. Among the 105 person, 86 % of owners/residents have shown their satisfaction for the connection to public sewers due to disappearance of bad smell from cesspits, no insects or rats, more space due to the cesspit backfill, or cleaner environment in the city.

Output 4: Capacity of Jericho municipality for financial management of sewerage works is developed.
Indicators: 4-1 Collection rate of user charge for sewerage facilities exceed 60 % 4-2 A mid-term financial plan is approved by relevant organizations. 4-3 More than 60 % of served population recognizes the need for payment of user charge. 4-4 Income (subsidy, borrowing, charges, etc.) exceeds expenditure in the Strategic Business Plan

The achievement level of Output 4 is deemed as medium.

Indicator 4-1: The collection rate of user charge for sewerage facilities increase to 16 %[1] in billed amount base at September and October 2015. Currently, the user charge (tariff) collection rate of water is 37% for the average in September and October, 2015. Considering the circumstance, the probability of achievement of the indictor is considered as low at the end of the Project. There are two reasons the sewage tariff collection rate remains low in Jericho. The one is that even after the bill of sewage and water are integrated in the same bill in June 2015, some customers insist to pay only water tariff and refuse to pay sewerage tariff at the Customer Center. The staffs of the Customers Center accept those claims in order to collect the tariff of water, at least. The second reason is that even the water tariff collection rates remains 30 % approximately. Relaxed enforcement is a major cause hindering achievement.

However, it shows improving trend due to discount campaign for sewerage charge from 1.0 NIS/m^3 to 0.5 NIS/m^3 in order to increase user charge rate collection. The campaign has started from September 2015 and will be continued until December 2017. The tariff collection rate is increased but it is also included the bills which passed due date. Therefore, it is needed to be analyze the effect of campaign. In addition, the Project team has started visiting houses of potential clients to persuade and to encourage for payment of user charge. They have started visiting houses from November 2015. At the time of Terminal Evaluation, they have visited 16 houses and 5 of them have submitted application for the connection to sewer system.

Indicator 4-2: It has been achieved. Strategic Business Plan 2014-2018 for Managing Jericho Sewerage System has been elaborated in March 2014. However, the mid-term financial plan has been revised completely in all activities and plan of operation due to introducing discount campaign for improvement of collection rate. The revised version has been prepared in November 2015. Then the Project will explain to PWA and mayor for approval. .

Indicator 4-3: It has been achieved. According to the survey which was conducted to 105 served population in public meeting/workshop during 2015, 98% of served population have recognized for the need for payment of user charge according to questionnaire.

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1 Total amount of bill corresponding to usage in September and October, 2015 is 13,600 NIS. Meanwhile, 2,202 NIS has been paid until due date for the bill.

Indicator 4-4: The indicator has not been achieved at the time or Terminal Evaluation. And it seems difficult to be achieved at the end of the Project due to delay of following reasons such as "slow increase of connection number to sewer system", "slow improvement of user charge collection rate" and "no inflow from JAIP". According to the Strategic Business Plan 2014, it was estimated to achieve a 25,000 NIS in surplus. Currently, it is estimated to achieve a 3,000,000 NIS in accumulated deficit due to reasons described before. Therefore, the Project has revised and modified the Strategic Business Plan according to this sewerage connection trend and the coordination with donors.

4-4. Prospect for Achieving the Project Purpose

Project Purpose: System for operation and management of sewerage works in Jericho municipality is established.
Indicators: (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 Strategic Business Plan

Administrative and technical aspects have been achieved in terms of technical transfer. Meanwhile finance aspect has the challenge to be solved. The importance of financial aspect

Indicator (1): The indicator has been achieved. The Water Department has been changed to Water and Sewerage Department officially in June, 2013.

Indicator (2): The city council of Jericho municipality, the Ministry of Local Government and the Palestine Water Authority approved the by-law for users of sewerage facilities in March, 2014.

Indicator (3): It has been achieved. The manuals namely security control, operation & maintenance and troubleshooting for sewerage facility was prepared in 2014.The daily operation is being conducted according to the manuals. The Project will continue to improve the manuals for the rest of the Project period.

Indicator (4): It is in the process to revise Strategic Business Plan at the time of Terminal Evaluation. The Strategic Business Plan prepared in 2014 has been revised due to prevailing public reluctance in terms of payment of connection fee and internal connection cost to sewerage system as well as sewerage user charge. It is in the process for approval by PWA and the mayor of Jericho.

4-5. Prospect for Achieving the Overall Goal

Overall Goal: Sewerage facilities in Jericho municipality are operated and managed appropriately under sound financial condition.
Indicators: (1) Annual income exceeds annual expenditure. (2) Effluent from wastewater treatment plant become below effluent standard.

To achieve Overall goal, it is needed to make an effort achieving indicator (1) by Palestinian side. The indicator (1) could be achieved if Jericho municipality will increase both number of connection and collection rate. Meanwhile, indicator (2) is prospected to be achieved because of the results of analysis, treated wastewater and sludge have already satisfied with the standards of Ministry of Agriculture at the time of Terminal Evaluation. And the engineers who have improved their capacity by the Project continues to work in the WWTP

4-6. Implementation Process of the Project

As shown in the Plan of Operation, most of the Project activities have been conducted as planned, however some activities are delayed. The factors that have facilitated and hindered the project implementation are summarized below.

(1) Facilitating Factors of the Project Implementation

1) The Commitment and Ownership of Jericho Municipality and PWA

Jericho municipality and PWA have shown strong commitment to improve and extend sewerage system in Jericho. In the first, Jericho municipality has assigned 12 full time staffs so far as counterparts to the Project. In addition, the municipality has a plans to employ and to assign 2 staffs more. This is considered as the strong ownership to the Project. Jericho municipality has been conducting enthusiastically public awareness activities to change mindset of citizen in order to increase fee collection rate and recollect connection tariff in installments.

On the other hand, PWA has also been collaborating closely to the Project with participation to workshop and JCC. PWA has strongly supported explaining to member of city council in order to establish user charge plan based on Strategic Business Plan. In addition, PWA has been demanding PA for disbursement of the budget which is committed by PA at Preparatory Survey of Jericho Wastewater Collection, Treatment System and Reuse Project in July, 2011. Thanks to the effort, some part of the budget has been disbursed and it has been constructed fence, water supply pipeline and access & internal roads of the WWTP. Furthermore, it should be recognized that PWA has been paying the land rent of the WWTP to Ministry of WAQF and Religious Affairs. PWA provides advice for Jericho municipality in regard of coordination with donors. These ownership have been contributing to the Project.

2) Effective Communication between JICA Experts and C/Ps, and among C/Ps

The Project holds weekly meeting in order to share the progress among all the Project members. The effective communication and information sharing have been contributing to the implementation of the Project and for raising ownership to the Project. .

(2) Hindering Factors of the Project Implementation

1) High cost for the connection fee and internal connection to citizen

According to the work plan of the Project, Jericho municipality had committed to bear connecting 2,000 households to sewerage system as a Project. To connect sewerage system, the owners of household have to pay connection fee to the Jericho municipality. The internal connection cost varies with the length from current septic tank to connection pit, therefore, in some cases, the owner should pay expensive cost.

The cost issue is likely to become a negative factor to the owners of existing building. On the other hand, it is obliged to pay the connection fee to obtain construction permission, therefore, it is no difficulty to collect the connection fee for new building.

5. Result of the Review

5-1. Relevance

The Relevance of the Project is assessed as high since the improvement of sewerage service is in line with the needs of Jericho municipality and citizens, development policies of Palestine government, and the Japanese government's assistance policy to Palestine.

(1) Relevance with the Needs of Jericho municipality and citizen of Jericho

Currently, the public sewerage service system in Jericho municipality is not well developed. Therefore, most of the effluents from household cesspit seep directly into ground without any treatment. Due to the circumstances, the environment deterioration in urban area and the groundwater contamination are concerns. Besides the number of wells which are unsuitable for agricultural use is increasing due to the progression of contaminated groundwater. In this respect, the improvement of hygienic environment and the securement and preservation of water resource for agricultural use are urgent issues in Jericho municipality.

In order to improve the circumstances, the Government of Japan constructed sewerage facility in Jericho municipality through grant aid. Obviously, the facility shall be properly operated and maintained for fulfilling its functions. Meanwhile, Palestine has few experiences with regard to sewerage system operation. Accordingly, it is difficult for Jericho municipality to set up an adequate organization and to implement the training for capacity development by itself. Based on the background, Palestine requested a technical cooperation project to the Government of Japan to transfer the Japanese technologies and experiences in public sewerage service system to Jericho municipality. Therefore, the Project is in line with the needs of Jericho municipality and its citizens.

(2) Relevance with the Development Policy of the Palestinian government

The Project is consistent with the country development framework of National Sector Strategy for Water and Wastewater 2011-2013 and National Water Strategy for Palestine 2012-2032.

Based on the strategy, Palestine has been conducting the activities of sewerage facility system improvement which contributes to preserve the environmental hygiene and water preservation, to promote reuse of treated wastewater, to train the human resources, and to raise public awareness on sewerage system. These are considered as higher priority issues

(3) Relevance with the Japanese Assistance Policy to Palestine

In Country Assistance Policy for Palestine (2012), the Government of Japan sets basic policy to build peace through self-supporting promotion of economic and social based on the concept of "Corridor for Peace and Prosperity". In order to achieve the objective, the government of Japan has been supporting to establish and improve basic human needs areas such as water and sewerage in terms of human security. Moreover, the government of Japan has agreed to focus on seven prioritized sectors, namely, support for medium-small sized companies and trade promotion, agriculture, tourism, local autonomy, finance, water supply and sewerage system and health according to the National Development Plan of Palestine. Thus, the Project is consistent with the Japanese assistance policy to Palestine.

(4) Comparative Technical Advantages

Prior to the Project, Japan has provided assistance for sewerage facility construction "Jericho Wastewater Collection, Treatment System and Reuse Project" through grant aid. In addition, Japan also has been providing support for construction of Jericho Agro Industrial Park and conducting technical cooperation project in order to improve and consolidate of the function of sewerage facility of Jericho municipality. The Project would make a contribution to the improvement of living environment and agriculture development in the area.

Furthermore, Japan has implemented similar technical cooperation projects in Syria, India, Malaysia and other countries and obtained notable results. Due to these experiences, Japan has a comparative technical advantage to support the improvement of financial condition of Jericho municipality through the construction of sewerage facility and the activities related to sewerage pipe line maintenance.

5-2. Effectiveness

The Effectiveness of the Project is assessed as medium. It is observed a certain sign of improvement in "System for operation and management of sewerage works in Jericho municipality is established" (Project Purpose) at the Terminal Evaluation. However, according to the indicators of each Outputs, there is still much room to be improved regarding the number of house connections (Output3), the collection rate and the revenue (Output4).

(1) Prospect for Achieving the Project Purpose

Some important outputs are not achieved fully sufficient such as "Output-3 (Indicator 3-2)" and "Output-4 (Indicators 4-1)". Therefore, further efforts is required to the Project and Jericho municipality in order to achieve the Project Purpose at the end of the Project.

Meanwhile, the outcome achieved through the Project activities is shared and also highly evaluated by directors and staff of Jericho municipality. Furthermore, they recognize the importance of increasing the collection rate of sewerage user charge and also the number of household connection to the sewerage pipeline system. Accordingly, they have been taking specific actions to improve the situation, such as visiting potential clients connecting to sewerage system and providing the facility for payment of connection fee in installment payment.

(2) Causal Relationship between the Outputs and the Project Purpose

The Project has been designed from scratch in order to establish system for operation and management of sewerage works in Jericho municipality. There is a clear causal relationship among the four Outputs, Development Strategic Business Plan for sewerage works (Output 1), Capacity development of operation and maintenance of wastewater treatment plant (Output 2), Capacity development for maintenance of sewer networks (Output 3), Capacity development for financial management of sewerage works (Output 4) and Project Purpose (Establishment of operation and management of sewerage works).

(3) Fulfillment of the Important Assumption

There are two important assumptions for achieving the Project Purpose. One is "More than 80% of C/P continue working in the organization" and the other is "The number of farmers do not decrease drastically". At the time of the Terminal Evaluation, it has not been observed any sign of the change to related issues, therefore, both assumptions are likely to be fulfilled.

5-3. Efficiency

The Efficiency of the Project is assessed as relatively high. Most of the inputs required for implementing project activities have been allocated in sufficient quality/quantity and at the appropriate timing for the production of the planned Outputs. Positive collaboration effect with USAID is observed in enhancement of sewerage system.

(1) Achievement of Outputs

Some of the outputs have not reached the targets of their indicators. However considering the quantity of inputs, the degree of the achievement seems to be acceptable level. On the other side, the employment of qualified local civil engineers has contributed to effective usage of limited resources. The equipment provided by the Project is appropriate for Jericho municipality in terms of quality and quantity. Meanwhile most of equipment is under usage in

the Project activities so that it is managed under the Project properly.

Training in Japan has contributed to improve the understanding of sewerage system in general. They have noticed the subjects that should be improved more specifically such as GIS system, user charge system, public awareness and others.

On the other hand, the number of household connection is not reached to the target level due to the unwillingness of owners for assuming the cost for connection. Although, the project has been conducting public awareness, it is still needed more to come out the effect.

(2) Synergy effects with other activity

JICA and USAID have been collaborating for the construction of sewer network in Jericho. JICA funded for the construction of trunk sewer. Meanwhile, branch sewer of 12.5km with flushing jet machine were funded by USAID, which was originally requested by PWA for 16km of branch sewers. In addition, Jericho Agro Industrial Park has an intention to connect to the Jericho sewerage system. The construction branch sewer assumed by USAID was finished and handed it over to Jericho municipality in the end of November, 2015. With this handover, the Project and Jericho municipality can enhance the public awareness and promotion activity for connecting to sewerage system. It is observed that positive synergy effect has been generated through the collaboration with USAID. On the other side, Jericho Agro Industrial Park estimates the volume of sewage would reach to more than 200m^3/day at the end of 2016 according to the list of companies which have already paid the rent by check in advance. Considering the circumstances, it is expected to generate more synergy effects with other activities in the near future.

(3) Implementation Timing of Training in Japan

The training in Japan to C/Ps was efficiently planned in terms of timing. Therefore, they could utilize immediately the technology obtained in Japan from the beginning of the WWTP operation start.

5-4. Impact

The Impact of the Project is assessed as relatively high. At the time of Terminal Evaluation, the probability for achieving the Overall Goal is not ensured. The probability would be increased if Jericho municipality improves the number of connections to sewerage system and increase the rate of collection sewerage user charge from users.

(1) Prospect for Achieving the Overall Goal

As it mentioned in "5.3 Efficiency (2)", the construction of branch sewer funded by USAID was finished and handed it over to Jericho municipality in 2015. Besides, from Jericho Agro Industrial Park the estimated sewage inflow would reach to more than 200m^3/day at the end

of 2016. Considering the circumstances, it is expected to generate synergy effect with other activities in the near future. On the other side, the indicator 2 "Effluent from wastewater treatment plant meets effluent standard" for Overall goal is achieved at the time of Terminal Evaluation.

In the conclusion, the prospect for achieving Overall goal would be increased, if Jericho municipality increases the number of connection and collection rate of sewerage fee.

(2) Public awareness increase

In order to improve the public awareness, the Project has held public meetings and workshops, visited household owners and carried out activities. Since the beginning of the Project, 13 public meetings were held with 1,007 participants in total. These activities have contributed to encourage the citizen to submit for the application for the connection because they have come to recognize the importance of sewerage in terms of hygiene and environment. According to the municipality, 359 applications for connection have been submitted and 43 house owners have already paid the connection fee. On the other side, the Project has encouraged to raise public awareness especially in elementary school. To date, approximately 300 school children from 5 schools have visited to the sewerage facility. These are considered as spill-over effect of the Project.

(3) Technology transfer to other Wastewater Treatment Plant

PWA is considering to apply the technology introduced in the wastewater treatment plants in Al-Bireh. Because PWA highly evaluates the aeration technology to the wastewater treatment plant of Jericho. This is considered as positive impact of the Project. Besides, PWA is also considering solar panels technology in Tubas-Tayasir WWTP as Jericho WWTP

5-5. Sustainability

The Sustainability of the Project is assessed as relatively high except financial aspect at Terminal Evaluation. The Sustainability has been evaluated by following four aspects; "Political aspect", "Organizational aspect", "Financial aspects" and "Technical aspect".

(1) Political aspect

As discussed in "5-1 Relevance," the Project is in line with the country's development policies, such as "Water Authority Strategy Plan 2016-2018 " and "National Water Strategy for Palestine 2012-2032". In this respect, it is quite obvious that Palestine will continue the policies towards improvement of sewerage system in Jericho. Therefore, sustainability in political aspect is considered as high.

(2) Organizational aspect

The organizational aspect is considered as high. Jericho municipality set Sewerage department in 2013 to improve the capacity for managing sewerage. Besides, the number of the departments has been increased according to conduct the task corresponding. Furthermore, the contract status of C/Ps is permanent and stable. These factors contribute to the sustainability on organizational aspect.

(3) Financial aspect

The financial aspect is considered relatively low because the number of connected households and user charge collection rate for sewerage have not been achieved the target set in the Strategic Business Plan in 2014. In order to increase the sustainability in financial aspect, the Project should increase the number of connected households and user charge collection rate. Besides, the Project needs to make an effort to utilize the treated wastewater and tanker sludge as resource of income. In the circumstances, the Project has organized the team to visit houses for the promotion of sewerage connection since November 2015. At the time of Terminal Evaluation, there have been conducted only three times, though they have good results. According to the results, the Project has planned to increase the team numbers in order to accelerate the activities. In addition the Project has started discount campaign in connection fee and sewerage charge and also shows positive results. It shows a sign of improvement in financial aspect through the attempts.

(4) Technical aspect

The technical sustainability of the Project is relatively high.

According to C/Ps interviewed by the Terminal Evaluation Team, C/Ps have gained theoretical knowledge adequately. However some of the C/Ps think that they need to develop skills through more practices in their operation by using the knowledge gained in the theoretical training. Accordingly, the Project needs to give more training opportunities during the rest of the project period.

6. Conclusion

To date of the Terminal Evaluation, most of the project activities have been implemented with strong ownership of Jericho municipality and PWA. In regard to achievement for Project Purpose, The indicators corresponding to administrative and technical issues have been achieved. Meanwhile, the indicator related to financial issue is to be improved with continuous effort by the Palestinian side. The Project and PWA should take action immediately to the recommendations of the Terminal Evaluation in order to improve the achievement of the Project by the end of the Project.

For further improvement of the Project, the Terminal Evaluation Team recommends the measures presented in "7. Recommendations."

7. Recommendations

Based on the above analysis of the Project, the Terminal Evaluation Team put forth the following recommendations for the improvement of the Project. The following recommendations should be conducted by the Project, Jericho municipality and PWA.

(1) Intensive "Door-to-Door Visit" to promote households connections

Increase the household connection is crucial for the Project. According to the current Strategic Management Plan shows the Jericho Municipality should connect households at the pace of 28 households per month.

On the other, the Municipality started "Door-to-Door Visit" to promote households connections since November 2015 and obtained instant effect confirming 5 requests of connections from the residents.

In order to promote the household connection, the Municipality should conduct intensive "Door-to-Door Visit" in the remaining period of the Project for target households as following. -Target: 755 households in total (around 100 households per month)

1) 585 households along with the branch sewer recently constructed funded by USAID
2) 170 households along with the trunk sewer constructed under the Grant Aid

(2) Both water and sewer charges should be collected completely and increase the tariff collectors to increase collection rate

Even after the bill integration with water user charge, the municipality still accepts the refusal of sewer charges payment despite both user charge are written in the same bill.

In order to increase collection rate, the Municipality to enforce the strict collection as following steps.

Step1: Both water and sewer charges should be collected completely at customer service.
Step2: Increase the number of tariff collectors and activate the tariff collectors to visit houses to promote collection of water and sewerage tariff.
The team also collects the repayment of the Pilot Project if it is the target households.

The progress on two actions, (1) and (2), mentioned above should be periodically reported to JICA Palestinian Office and the first reporting should be made at the end of January 2016. JICA will review the progress and may consider the further assistance on expanding sewer networks if there is notable progress with stronger initiatives and strict enforcement by the Municipality.

(3) Evaluation of encouragement scheme

Jericho municipality should evaluate the performance of two encouragement schemes which were introduced in 2014 and take a necessary action for further improvement. The method of evaluation should be established with the help of JICA Expert.

(4) Construction remaining branch sewer

In order to complete the sewerage network plan, PA should make an effort to find the fund to construct the remaining branch sewers by searching fund from donors and others to support

this Project. In addition, since PA committed to allocate 2 millions US$ at the early beginning of the project, PA used around one million US$ to implement the electricity, road, water, fencing with gates and guard room, etc. The remaining one million US$ which can be used to supply material like pipes (4" and 6" and small manholes) for the purpose of completing the house connection should be disbursed as soon as possible

For the actual implementation of branch sewers, the installation plan with priority need to be formulated with the help of JICA expert.

(5) Ensuring Implementation based on Revised Strategic Business Plan

Regarding financial issue, the Strategic Business Plan 2014-2018 ver.2.1 shows considerable amount of deficit. Since it is not healthy condition for the municipality to prolong this deficit situation subsidized by other resources, the management plan needs to be scrutinized towards healthy condition with the help of JICA Expert as soon as possible and the municipality ensures to implement the sewage works according to the revised management plan.

(6) Improvement of method to promote household connections

In order to promote the household connections, the Jericho Municipality needs to explain its necessity by showing the actual cost of household connection, with more affordable price using the local resources at the time of "Door-to-Door Visit".

(7) Continuous Public Awareness Activities

Public awareness activities are crucial for sewerage works and continuous and periodical PR are necessary. Those efforts will create a positive image of sewerage works and get more support from the citizen. Especially PR activities in school program and woman association are effective to foster the next generation. Besides, using local media such as radio stations and newspapers should is effective tool for public awareness.

(8) Repayment on the Pilot Project

The construction cost of households connection, which is connected under the Pilot Project, need to be collected from those owners to ensure fairness among the citizens, the collected fund should be kept separately and the fund should be utilized for the construction cost of the connection-fee part (from connection pit until receiving pit) in new area.

(9) Treated Water and Sludge

The Project should take necessary procedure to obtain a permission of Ministry of Agriculture as soon as possible and start the process of selling treated water.

Regarding the tanker sludge, continuous effort to enforce to collect the sludge to WWTP is

necessary by the Jericho Municipality.

8. Lessons Learnt

(1) Written Confirmation for Advance Payment

The Project faces difficulty in collecting the connection fee and domestic construction cost under the Pilot Project, which should be repaid to the Municipality because it was agreed verbally with the targeted resident in the explanatory meeting of the Pilot Project. The written confirmation should be obtained to ensure the agreement of repayment from the resident before constructions when the Municipality makes an advance payment for the resident.

(2) Setting periodical targets in case for achieving indicators

In the Project, numerical indicators such as sewerage collection rate and connection numbers was set at the beginning of the Project, but the Project realized and took actions for the delay of progress in the later of the Project period. In order to take countermeasures in appropriate timing, the periodical target should be set to take timely actions to tackle the delay of progress especially for the case of setting numerical target.

(3) Improving Effectiveness of starting Technical Cooperation Project before the end of infrastructure construction by Grant Aid

The Project has started before the end of WWTP and sewers construction. The timing has contributed to effectiveness in terms of preventive maintenance and proper operation. In the same context, training in Japan has been implemented before handover of the WWTP and sewers. It has also contributed to smooth and effective implementation of the Project.

9. Annex

Annex 1. Terminal Evaluation Schedule
Annex 2. Project Design Matrix
Annex 3. Plan of Operation
Annex 4. Schedule of JICA Expert Team
Annex 5. List of Equipment Provided by the Japanese Side
Annex 6. Organigram of Jericho municipality
Annex 7. Workflow on Output

Annex 1. Terminal Evaluation Schedule

Date			Mr.Iijima	Mr.Yokouchi	Mr.Mochizuki
Nov.	16	Mon			Arrival at Jericho Interveiw with Experts
	17	Tue			Interveiw with C/P
	18	Wed			Participate to weekly meeting of project Interveiw with C/P Visit WWTP
	19	Thu			Interveiw with C/P
	20	Fri			Document Preparation
	21	Sat			Interveiw with C/Ps etc.
	22	Sun			Interveiw with PWA, Jericho Agro Industrial Park
	23	Mon			Participate weekly meeting of project Interveiw with C/Ps etc.
	24	Tue			Interveiw with C/Ps etc.
	25	Wed			Interveiw with C/Ps etc.
	26	Thu	Arrival at Jericho		Interveiw with C/Ps etc.
	27	Fri	Document Preparation	Arrival at Jericho	Document Preparation
	28	Sat	Site Visit of Jericho WWTP, Acbat Jabel Camp, JAIP		
	29	Sun	Kick-off Meeting with Jericho Municipality & PWA		
	30	Mon	Discussion on M/M		
Dec.	1	Tue	Preparation for JCC		
	2	Wed	JCC		
	3	Thu	Departure from Jericho		

PDM (Project Design Matrix) ver.2

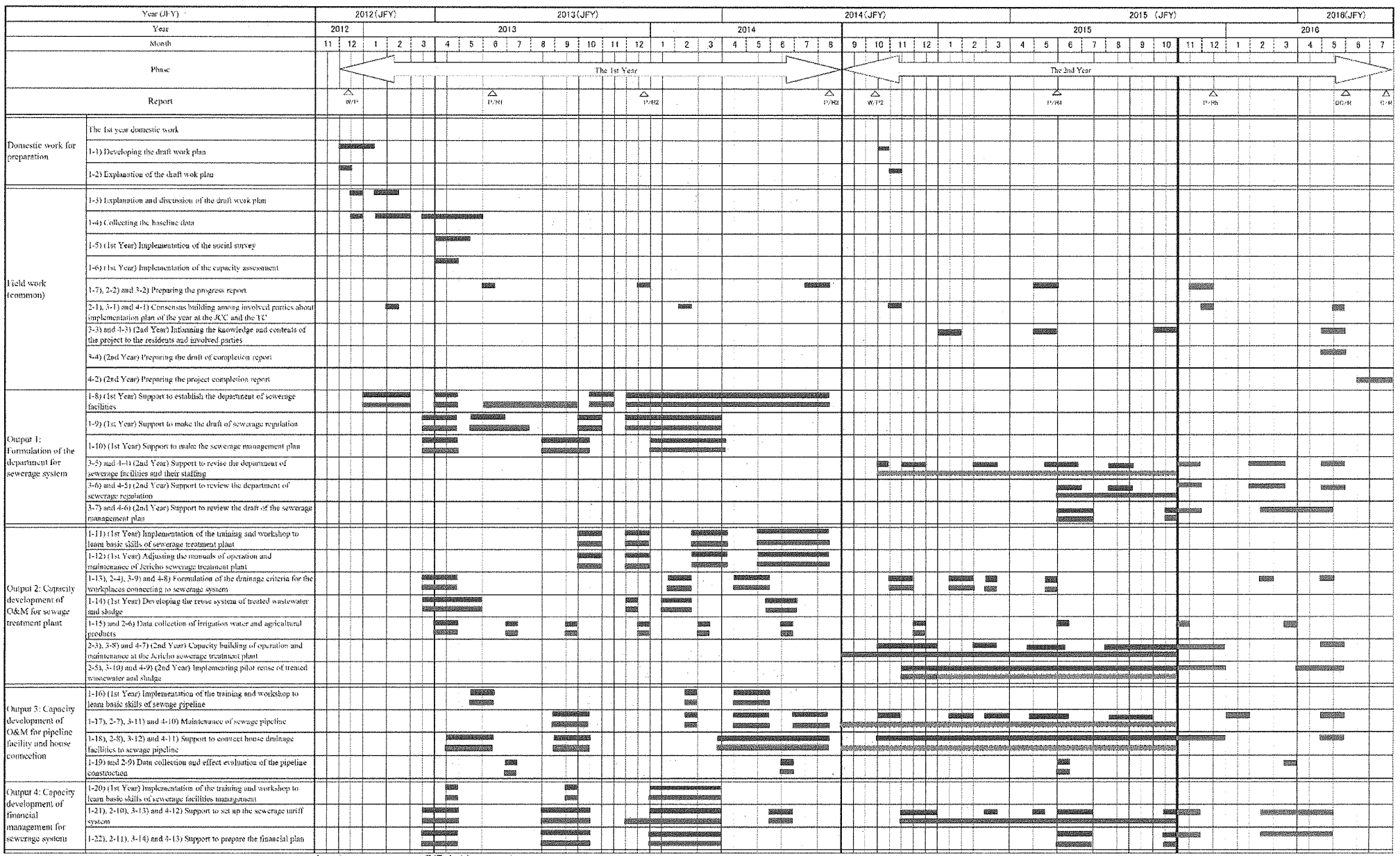
Project Name : Technical Assistance and Capacity Building Project for Jericho Sanitation Project
Target Area : Jericho municipality and its surrounding areas
Target Group : Department in charge of operation and maintenance of Jericho sanitation project
Project Duration : December 2012 - July 2016

Annex 2. Project Design Matrix

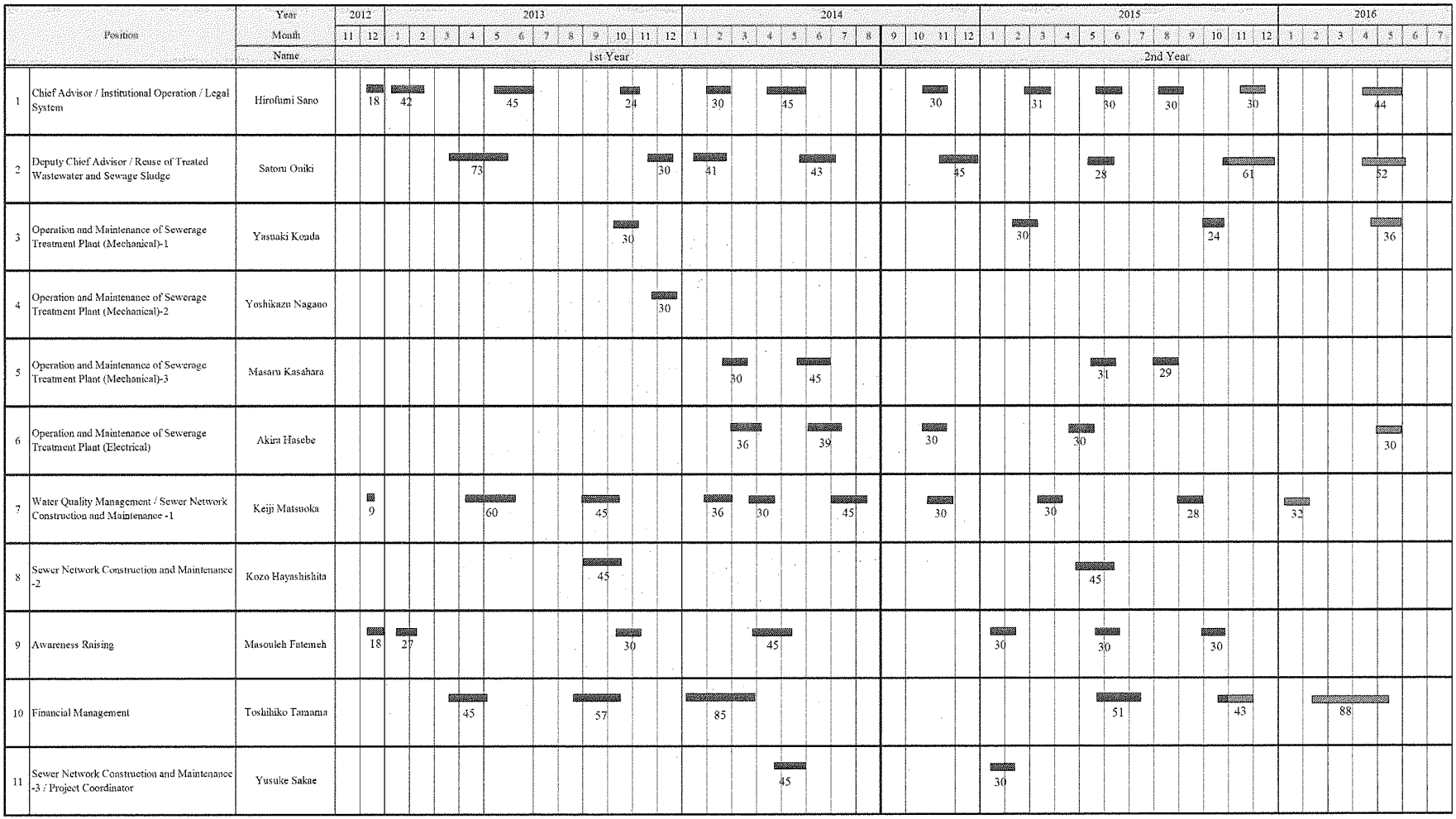
as of 19 February, 2014

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		1st year: Item / Verification; In and after 2nd year: Item / Verification	
(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	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: 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 **40 %** 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 In and after 2nd year: 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 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 In and after 2nd year: 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 In and after 2nd year: 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	**Inputs**		
	Palestinian side	Japanese side	
(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	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	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.

Annex 3. Plan of Operation



Annex 4. Schedule of JICA Expert Team

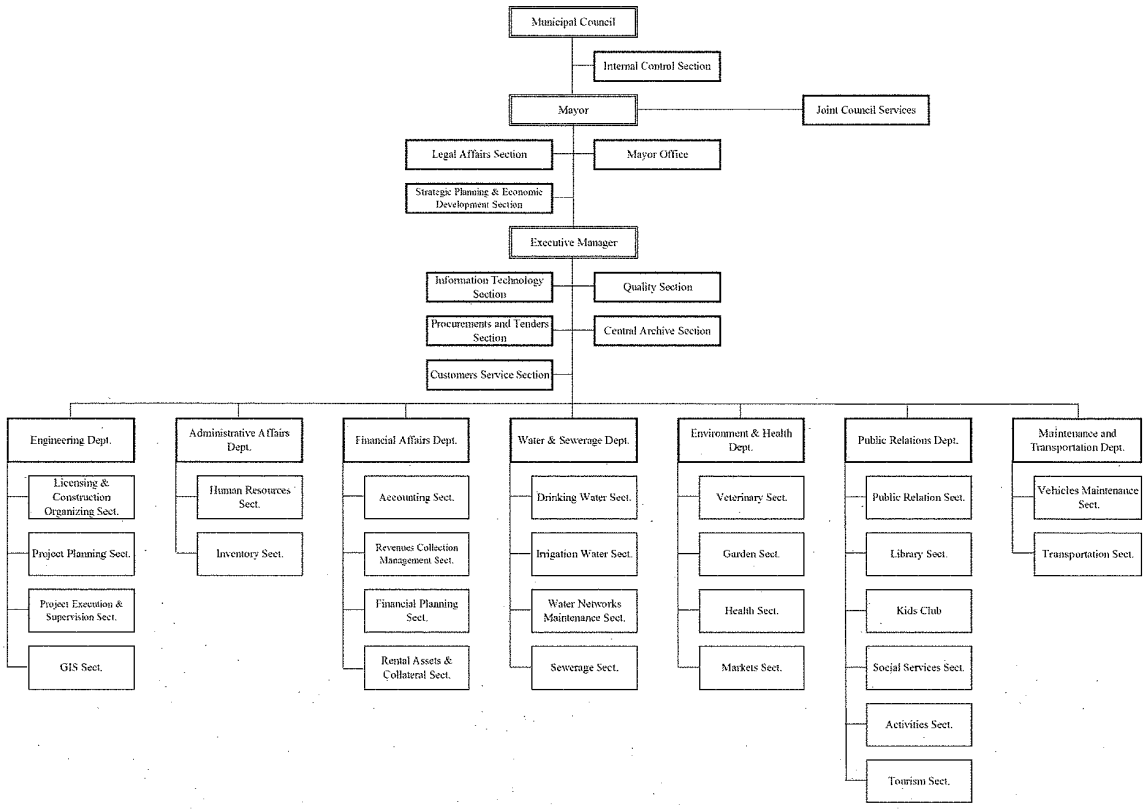


Annex 5. List of Equipment Provided by the Japanese Side

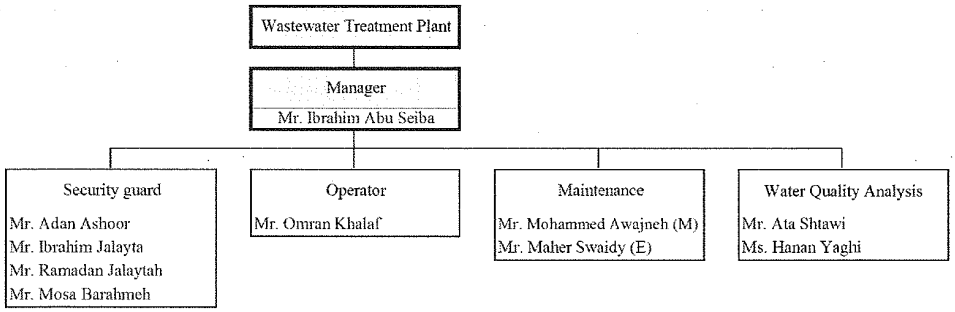
Equipment	Q'ty	Period	Place
Photocopy Machine	1	1st Year	Project Office
Laptop computer	2	1st Year	Project Office
Printer	2	1st Year	Project Office
Electric panel for pump	1	2nd Year	Jericho WWTP
Distribution pipe for Treated Effluent	1	2nd Year	Jericho WWTP
Oxygen & Hydrogen sulfide meter	1	2nd Year	Jericho WWTP
Electric conductivity & Total Dissolved Solids meter	1	2nd Year	Project Office

Annex 6. Organigram of Jericho municipality

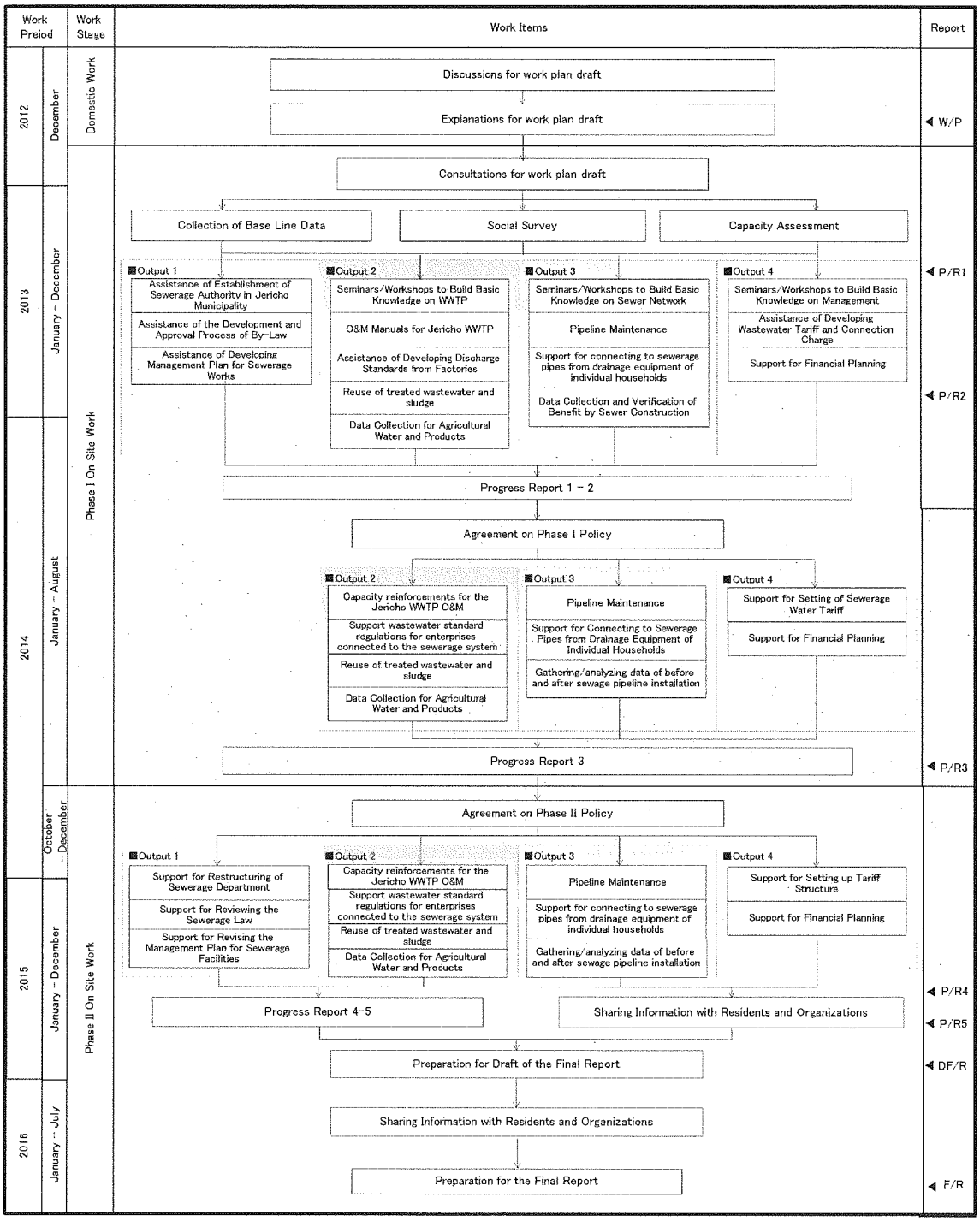
(1) Jericho municipality



(2) Jericho Wastewater Treatment Plant



Annex 7. Workflow on Outputs



<<Chapter 5>>

A 5-3-1: Phased Construction Plan for Jericho Sewer Network

Appendix A 5-3-1

Phased Construction Plan for Jericho Sewer Network

2018.3.10

1. Constructed Sewer Network and House Connections until the end of 2016

Sewer network (Trunk and Branch Sewers):

Item	Constructed sewer length (km)	Remarks
JICA Project	25.3+4.4+3.9=33.6	Grant Aid and TA Projects
USAID-1A Project	11.7	Branch sewers
Total	**45.3**	

Number of house connection (excluding commercial, school, factory, etc.):

246 (PP-1 in TA) + 645 (PP-2 in TA) = 891 households

Served population: 891 * 4.5 person/household = 4,010 persons

Actual inflow of WWTP: **526 m3/day**

Sewerage coverage ratio: 4,010 / 23,220 = 17.3 %

2. Constructed House Connections until the end of February 2017

Number of household constructed by the Jericho own budget (0.87million NIS): 500 households

Served population: 500 * 4.5 person/household = 2,250 persons

Additional sewage flow: 2,250*181 l/person/day*0.5 = 204 m3/day

Total inflow of WWTP: 526 + 204 = 730 m3/day

Sewerage coverage ratio: (4,010+2,250) * 100 / 23,220 = 27.0 %

Occupancy rate of WWTP: 730 / 6,600 = 11.1 %

3. Required Sewage Collection Facility

The proportion of the surrounding areas (An Nwaeima and Ein ADuyuk) of Jericho to the total flow is low (about 9% of total sewage volume) and the cost investment effect is also low, so it is not considered in this study.

3.1 Branch Sewer:

Item	Length (km)	Remarks
USAID-1B Project	**24.0**	Detail design was complete
Other required sewers	**55.3**	
Total	**79.3**	

3.2 House Connection

Total population of Jericho in 2020: 25,932 persons (estimated value)

Number of household in 2020: 25,932 / 4.5 person/household = 5,763 households

Potential number of household connection: (25,932 - (4,010 + 2,250) / 4.5 = **4,372 households**

3.3 Other Sewage Generating Facilities

- **Aqbat Jaber (AJ) and Ein Sultan (ES) Refugee Camps**
- **Jericho Agro-Industrial Park (JAIP)**
- **Jericho Hospital**
- **Tanker Sludge collected from Cesspit**

4. Scenario of Phased Construction of Jericho Sewer Network

Phase-2：End of 2017 (part area of AJ Camp implemented by UNRWA)
Phase-3：End of 2019 (branch sewers constructed by USAID-1B, counterpart and PA funds with 2.1 million USD, remaining areas of AJ Camp constructed by UNRWA)
Phase-4：After 2020

5. Phase-2 (End of 2017)

5.1 Scope of the Project

Branch sewer and house connection in the package-1 area for Aqbat Jabel Camp are constructed by UNRWA using Japanese budget.

5.2 Sewage Flow and Coverage Ration at the end of 2017

Total population of AJ Camp: 9,336 persons

Population of the package-1 area (covered 40%): 9,336*40% = 3,734 persons

Sewage flow of package-1 area: 3,734 * 90 l/cap./day * 80% * 100% = **269 m3/day**

Wastewater from JAIP (assumption): 6 factories * 15 m3/factory/day = 90 m3/day

Tanker sludge volume: 40 m3/day

Total flow at the end of 2017: 526+204+269+90+40 = 1,129 m3/day

Sewerage coverage ratio at the end of 2017: (4,010 + 2,250) * 100/23,870 = 26.2 %

Occupancy rate of WWTP: 1,129 / 6,600 = 17.1 %

6. Phase-3 (End of 2019)

6.1 USAID-1B Project

Target of sewer length: L = 24.0 km

Accumulated total length: 45.3 + 24.0 = 69.3 km

6.2 Project by the Counterpart and PA Funds

6.2.1 PP-4 project

Target number of house connection: 650 connection pits

Households per connection pit: 2.42 household/connection pit (source: PP-3)

Number of total household: 650 * 2.42 = 1,573 households

Additional population: 1,573 * 4.5 = 7,079 persons

Additional sewage flow: 7,079 * 181 l/cap./day * 0.5 = **641 m3/day**

Actual detail design cost: 7,400 USD

Calculated construction cost: 4.6 million NIS = 1.28 million USD

Total cost: 7,400 + 1,280,000 = 1,287,400 USD

6.2.2 PP-5 Project (House Connection in the Area of USAID-1B Project)

The indicators of number of connection pit and household per kilometer of sewer length for the study are assumed referring the actual data of the USAID-1A Project as shown below.

USAID 1A Project	
Length of constructed sewer	11.7 km
Number of connection pit	157 connection pits
Number of household	450 household
Connection pit per km	157 / 11.7 = 13.4 connection pit/km
Household per km	450 / 11.7 = 38.5 household/km

Sewer length of USAID-1B Project: 24 km

Number of connection pit: 24 * 13.4 = 322 connection pits

Number of household: 24 * 38.5 = 924 households

Additional population: 924 * 4.5 person/household = 4,158 persons

Additional sewage flow: 4,158 * 181 l/cap./day * 0.5 = **376 m3/day**

Sewerage coverage ratio at the end of 2019: (4,010+2,250+7,079+4,158) * 100 / 25,932 = 67.5 %

Unit construction cost of house connection per connection pit (PP-3 project): 1,600 USD/connection pit

Unit construction cost per sewer (PP-1 and PP-2 projects): 250,000 USD/km

Detail design fee is assumed 5% in the construction cost

Construction cost of house connection: 322 * 1,600 = 515,200 USD

Detail design fee of house connection: 515,200 * 5% = 25,760 USD

Total cost: 515,200 + 25,760 = 540,960 USD

6.3 Remaining Area of AJ Camp

Total population of AJ Camp in 2020: 10,142 persons

Population in the remaining area: 10,142 - 3,734 = 6,408 persons

Additional sewage flow of the remaining area: 6,408 * 90 l/cap./day * 80% * 100% = **461 m3/日**

6.4 Sewage Flow and Coverage Ration at the end of 2019 (Phase-3)

Additional sewage flow in PP-4 project: 641 m3/day

Additional sewage flow in PP-5 project: 376 m3/day

Additional sewage flow of remaining AJ Camp: 461 m3/day

Wastewater from JAIP (assumption): 20 factories * 15 m3/factory/day = 300 m3/day

Tanker sludge volume: 150 m3/day

Total flow at the end of 2019: **1,129+641+376+461+300+150 = 3,057 m3/day**

Occupancy rate of WWTP: 3,057 / 6,600 = 46.3 %

7. Phase-4 (after 2020)

【Conditions】

- Sewerage coverage ratio: 100 %
  Number of total household: 25,932 / 4.5 = 5,763 households
- Population coming from the outside of Jericho: 184 m3/day (100 %)
- Sewerage coverage ratio in AJ and ES Camps: 100 %
- JAIP: 400 m3/day
- Jericho Hospital: 150 m3/day
- Tanker sludge volume: 30 m3/day (collecting from Jericho suburbs un-sewerage area)

Required sewage collecting facility to achieve 100% of connection rate is studied as below.

Total household number in 2019 (Phase-3): 891+500+1,573+924 = 3,888 households

Required newly household connection: 5,763-3,888 = 1,875 households

Additional connection pit: 1,875 / 2.42 = 775 connection pits

Required construction cost for connection pit: 775 * 1,600 = 1,240,000 USD

Required detail design fee for connection pit: 1,240,000 * 5% = 62,000 USD

Total cost for house connection: 1,240,000 + 62,000 = 1,302,000 USD

Additional branch sewer: 79.3 - 24.0 = 55.3 km

Required construction cost for branch sewer: 55.3km * 250,000 USD/km = 13,825,000 USD

Required detail design cost for branch sewer: 13,825,000 * 5% = 691,250 USD

Total cost for branch sewer: 13,825,000 + 691,250 = 14,516,250 USD

【Sewage Flow Estimation】

Inhabitant sewage flow (100% connection): 25,932 * 181 l/cap./day * 0.5 = 2,349 m3/day

Sewage flow of coming population from outside of Jericho (100% connection): 184 m3/day
Sewage flow of AJ Camp (100% connection): 403 + 269 = 672 m3/day
Total population of ES Camp: 4,466 persons
Sewage flow of ES Camp (100%): 4,466 * 90 l/cap./day *80% * 100% = 322 m3/day
Sewage flow of JAIP (100%): 400 m3/day
Jericho Hospital: 150 m3/day
Tanker sludge volume: 30 m3/day (collecting from Jericho suburbs un-sewerage area)
Total sewage flow: 2,349 + 184 + 672 + 322 + 400 + 150 + 30 = 4,107 m3/day
Treatment capacity of WWTP: 6,600 m3/day (Daily average)
Occupancy rate of WWTP: 4,107 / 6,600 = 62.2 %

【Estimation of Construction Cost of sewer and House Connection in ES Camp】

Total population of ES Camp: 4,466 persons
Estimated number of household in ES Camp: 4,466 / 4.5 = 992 households
Estimated number of newly household connection: 992 / 2.42 = 410 connection pits
Additional branch sewer: 992 / 38.5 (household/km) = 25.8 km

Required construction cost for connection pit: 410 * 1,600 = 656,000 USD
Required detail design fee for connection pit: 656,000 * 5% = 32,800 USD
Total cost for house connection: 656,000 + 32,800 = 688,800 USD
Required construction cost for branch sewer: 25.8km * 250,000 USD/km = 6,450,000 USD
Required detail design cost for branch sewer: 6,450,000 * 5% = 322,500 USD
Total cost for branch sewer: 6,450,000 + 322,500 = 6,772,500 USD

<<Chapter 6>>

A 6-3-1: Future Action Plan for the TeCSOM Recommendations

Date :13/2/2018 التاريخ:

Ref. :Ec2/6/368 الرقم:

Date: February 13, 2018

Mr. Hirofumi SANO
Chief advisor, JICA Expert

Subject: Future Action Plan about the TeCSOM Recommendations

First of all, allow me to send you our deep thankfulness and appreciation for your generous support to Jericho Municipality and its residents. In reference to the above mentioned subject, the key personnel of the relevant departments in the Jericho Municipality have discussed after the JCC meeting and submit the future action plan for keeping appropriately operation and management under a sound financial condition.

Yours Sincerely

Mr. Salem Ali Ghrouf
Mayor
Jericho Municipality

2018

Recommendations

Jericho municipality should take action immediately and continuously to the following recommendations to improve the achievements of the Project after the Project termination.

(1) The liaison system between the departments in charge of sewerage works in the Jericho municipality is lacking.

A communication system (regular meeting, circulating the weekly / monthly report for share information) should be established between departments.

We have communication system, but need develop system to organize the relationship between department related to sewerage (service dep. , financial dep. , engineering dep.).

The quality dep. Prepare the draft of the system and hand to council member to take approval.

(2) It is expected that shortage of staff will occur when sewage volume increases in the future.

Jericho municipality should consider the staff increasing and training them through On the Job Training (OJT) in order to operate sewerage facilities stably.

The municipality has a plan to increase the team of sewage department with 2 additional employees (1 mechanical, 1 lab tech.).

(3) 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.

Jericho municipality should prepare a report on the monthly financial situation to submit the mayor and share information at relevant departments.

The financial dep. Started to submit a report each duration (2 months) from the beginning of this year 2018).

(4) Bulk water users (especially government agencies) occupying a large proportion by monthly invoiced amount has not been collected.

To ensure sound financial condition, Jericho municipality should surely collect water and sewerage tariffs from bulk water users.

The financial dep. Will prepare collection policy for the governmental associations, and they will finish at the end of march/2018.

(5) Together with Counterparts, TeCSOM (Technical Assistance for Capacity Building Sewerage System Operation Management) has carried out public awareness activities to gain understanding from residents about sewerage, and continuous activities are necessary to get further understanding.

Jericho municipality should appoint a person in charge of public awareness raising and hold regular public meeting for residents.

The PR appoints Mr. Ali khassan to follow public awareness for residents to increase both sewage tariff and house connection.

(6) 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.

Rebuilding and secure collection system of water and sewerage tariff.

The financial dep. finished the draft of new organization chart for the collection dep., and working on activating the SMS, pal pay system.

(7) The budget for water and sewerage in Jericho municipality is weak and it is necessary to secure necessary budget for the future.

1) 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.

- Separate account was established in the beginning of this year 2018, for the water and sewage dep. (all the revenue and expenditure).

- Separate the collection of PP1&PP2 cost was also established.

2) Jericho municipality is expected to implement sewerage works based on the management plan up to 2020, and revise it reflecting the annual sewerage works.

Jericho municipality expect to implement around 80 connections by our team, 650 connections by PA, more than 300 connections will be implemented by JICA.

3) To increase the tariff collection ratio, Jericho municipality should take action such as introduction the Pre-paid Water Meter, strengthening the Public Relations (PR) activity and the organization of the tariff collectors.

Jericho municipality will implement 2 projects of Pre-paid water meter through

JICA and Paris municipality (around 500 unit will installed); the target area is the rented houses and new building in the first stage.

We changed the strategy of collection in 2018, increase the no. of readers to 5 and their mission (read-print-collect), the collector's mission concentrated on the people who delay or refuse to pay.

(8) Part of the collected cesspit sludge has not been discharged to WWTP.

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.

- The sewage dep. With quality dep. Will prepare a form for the tankers to determine the source of waste water to decide if possible trough the waste water in WWTP or not.

- Follow the tanker owners through the police of the municipality to obligate the tankers discharge the waste water only in the WWTP.

-The municipality will work with donors to construct pretreatment unit for industrial waste water, tankers which exhale from the restaurants or stone factory ....etc.

(9) 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.

To protect WWTP, water quality monitoring team should be established to promptly analyze water quality and conducting on-site inspections regularly at factories.

We will work on establishing environmental control section and hire a lab tech. to make the tests and follow all biological, environmental issues.

(10) Although the amount of sludge generated at WWTP is small at present, it is necessary to study the disposal method.

Jericho municipality should consult with the Ministry of Agriculture and establish an agricultural utilization process of sludge.

The municipality cooperates with MOA to implement PP in the WWTP, but we need donor to cover the budget of external tests.

(11) Jericho municipality has agreed to accept sewage from JAIP, but no agreement has been concluded with Aqbat Jaber (AJ) camp.

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.

The governorate now follows the contract (agreement) between AJ camp Jericho municipalities. Eng. Mohammad Njoom from the governorate follows this subject.

(12) The current inlet flow of WWTP (capacity 6,600 m^3/day) which started operation in June 2014 is only about 900 m^3/day. For the future, it is necessary to promote the development of sewage network and house connection.

To increase the inlet flow and suppling treated wastewater to the farmers, Jericho municipality should intensively construct additional sewers and house connection using the collected tariff and another donor fund.

- PP3 funded by the municipality and covered 185 connections.

-PP4 will be funded by PA which covers 650 connections.

-The team of the municipality will implement around 80 connections according to the revised plan 2018-2020.

- 1M$ will be donated from JICA to cover additional house connections.

(13) After the completion of the TeCSOM project, sewage works in Jericho municipality needs to be appropriately operated and managed under a sound financial condition.

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).

We will put all the effort to keep and sustain this project, now the team is qualified to operate and manage both the WWTP and networks and we look to continue the networks, house connection to achieve the main goal of the project and solve all the problems related to sewage by covering all Jericho 100%

End