

### Appendix List

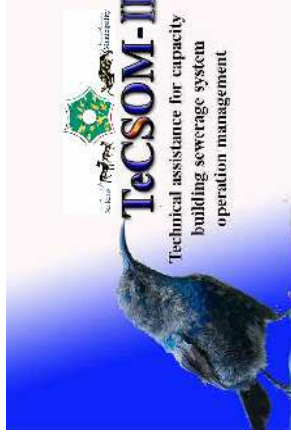
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## **Appendix 2.1.1**

### **Key Performance Indicator**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### Key Performance Indicators (KPIs)



June 28, 2022  
Head of Water & Wastewater Dept.  
Mohammad Fityani

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## 1. Analysis of Sewerage Management

1. Quantitative Analysis
2. Analysis of internal measurable elements of Jericho Sewerage System
3. Use 9 Key Performance Indicators (KPIs) for sewerage service provider
4. Easily and objectively understand how Jericho Sewerage performs/improves in comparison with previous year.
5. Data used for KPIs are readily available and official.
6. The data to be adopted will differ depending on the objective. Different data will provide different results for the same objective.

For example, even with the Sewerage coverage ratio, the total length of Sewer is used to indicate the amount of development. The number of connections is used to indicate the number of users.

7. Comparison with previous year or other municipalities

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## 2. Key Performance Indicators (KPIs)

- (1) Sewer Network Coverage Ratio
- (2) House Connection Coverage Ratio
- (3) Wastewater Quality Compliance
- (4) Sewage Sludge Quality Compliance
- (5) Facility Operating Ratio
- (6) Reuse Ratio of Treated Wastewater
- (7) Unit Treatment Cost
- (8) Operation Ratio
- (9) Collection Ratio

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## (1) Sewer Network Coverage Ratio

**Constructed Sewer Length**  
**Target Sewer Length**

- Ratio of sewer of the Jericho sewerage in the service area;
- “Constructed sewer length” is accessible to sewerage services.
- “Target sewer length” is planned sewer network in the sewerage service area.
- There is a need to update the sewer length when the municipality constructed sewers. The sewer length is needed with GIS database.

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## (1) Sewer Network Coverage Ratio

[Calculation]

Constructed sewer length : 59 km in 2021

Target sewer length : 124 km

$$\frac{59}{124} \times 100 = 47.6\%$$

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## (2) House Connection Coverage Ratio

**Total Number of sewerage customers**  
**Total Number of water customers**

- Ratio of population who benefited from Jericho sewerage in the service area;
- “Connected household number with access to sewerage service” is the **total number of sewerage customers**.
- “Total household number within service area” is the **total number of water customers**.
- There is a need to estimate the registered sewerage/water customer number. Refer to “Jericho municipality Regulation of Water and Wastewater Services Providers Data Variables”.

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## (2) Sewerage Coverage Ratio

[Calculation]

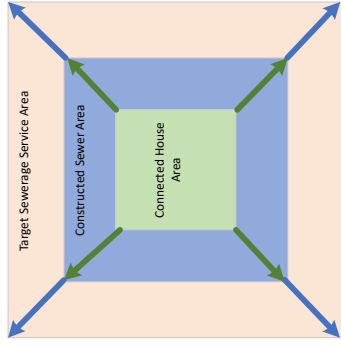
Total number of sewerage customers : 1,191 in 2021

Total number of water customers: 7,119 in 2021

$$\frac{1,191}{7,119} \times 100 = 16.7\%$$

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## (2) Interpretation of Coverage Gap



- “Connected House Area” can promote connections up to “Constructed Sewer Area”
- “Constructed Sewer Area” can construct sewer to “Target Sewerage Service Area” .

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## (2) Wastewater Quality Compliance

$$\frac{\text{Total number of samples passed}}{\text{Total number of samples tested}}$$

- Ratio of samples which passed treated wastewater quality tests according to “Technical Regulations for the Reuse of Treated Wastewater in Agricultural Irrigation”.
- The number of parameters stipulated is 37 in total.
- Samples as tested at laboratories. The results of test will be used to calculate KPI.

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## (2) Wastewater Quality Compliance

[Calculation]

Total number of samples passed : 37 parameters in 2021

Total number of samples tested : 37 parameters in 2021

$$\frac{37}{37} \times 100 = 100.0\%$$

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### (3) Sewage Sludge Quality Compliance

$$\frac{\text{Total number of samples passed}}{\text{Total number of samples tested}}$$

- Ratio of samples which passed treated sewage sludge quality (heavy metal contents) tests according to "The Use of Sewage Sludge in Agriculture".
- The number of parameters stipulated is 7 in total.
- Samples as tested at laboratories. The results of test will be used to calculate KPI.

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### (3) Sewage Sludge Quality Compliance

[Calculation]

Total number of samples passed : 7 in 2021

Total number of samples tested : 7 in 2021

$$\frac{7}{7} \times 100 = 100.0\%$$

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### (5) Facility Operating Ratio

$$\frac{\text{Daily Average Inflow}}{\text{Design Daily Average Inflow}}$$

- Daily average inflow is actual wastewater inflow amount at the Jericho Wastewater Treatment Plant (JWWTP).
- Design daily average inflow is planned daily inflow amount, it is 6,600 m<sup>3</sup>/day.
- This Ratio shows a capacity of acceptable sewage amount or surplus capacity of the JWWTP.

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### (5) Facility Operating Ratio

[Calculation]

Daily average inflow : 2,165 m<sup>3</sup>/day in May 2022

Design daily average inflow : 6,600 m<sup>3</sup>/day

$$\frac{2,165}{6,600} \times 100 = 32.8 \%$$

Surplus Capacity Ratio: (100 % - 32.8 %) = 67.2 %

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## (6) Reuse Ratio of Treated Wastewater

$$\frac{\text{Amount of Supplied Treated Wastewater to Farmers}}{\text{Amount of Treated Wastewater}}$$

- Amount of Supplied treated wastewater is actual pumped water amount which is installed at the irrigation tank at the Jericho Wastewater Treatment Plant (JWWTP).
- Amount of treated wastewater is outflow amount of JWWTP.
- This Ratio shows reuse of treated wastewater for agricultural use.

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## (6) Reuse Ratio of Treated Wastewater

[Calculation]

Sold /pumped treated wastewater amount : 1,216 m<sup>3</sup>/day in May 2022  
Daily average outflow : 2,111 m<sup>3</sup>/day in May 2022

$$\frac{1,216}{2,111} \times 100 = 57.6 \%$$

Unused Ratio: (100 % - 57.6 %) = 42.4 %

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## (6) Reuse Ratio of Treated Wastewater during High Demand Period

$$\frac{\text{Amount of Supplied Treated Wastewater from May to July}}{\text{Amount of Treated Wastewater from May to July}}$$

- Amount of Supplied treated wastewater is actual pumped water amount which is installed at the irrigation tank at the Jericho Wastewater Treatment Plant (JWWTP).
- Amount of treated wastewater is outflow amount of JWWTP.
- High water demand period for date palms is generally from May to July.
- This Ratio shows reuse of treated wastewater for agricultural use in High demand season.

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## (6) Reuse Ratio of Treated Wastewater during High Demand Period

[Calculation]

	May	June	July	Total
Treated Wastewater	47,190	49,710	56,100	153,000
Reuse Amount	49,215	55,037	61,345	165,597

Unit: m<sup>3</sup>/month

$$\frac{153,000}{165,597} \times 100 = 108 \Rightarrow 100 \%$$

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## (7) Unit Treatment Cost

$$\frac{\text{Operating Expense in a year}}{\text{Amount of Inflow Wastewater per year}}$$

- Unit cost to treat wastewater of 1 m<sup>3</sup> at the Jericho Wastewater Treatment Plant (JWWTP).
- "Operating Expense" is an item specified in "Jericho municipality Regulation of Water and Wastewater Services Providers Data Variables", Non-Operating Expense should be excluded from calculation.
- Amount of wastewater is inflow amount of the JWWTP.
- Unit Treatment Cost is usually used as the basis to determine sewerage tariff (cost recovery principles).

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## (7) Unit Treatment Cost

[Calculation]

According to the Income Statement, the total expense of Sewerage Service was 684,533 NIS (2021) with the following breakdown.

Item	(NIS)	Item	(NIS)
Personnel	366,366	Office Equipment & Consumable	
Electricity	209,492	Transport & Communication	
Repair	74,096	Service Charges	
Chemical	0	Other Non-Operating Expense	
Other Operating Expense	34,579		
Total	684,533		

$$\frac{684,533 \text{ NIS (in 2021)}}{663,490 \text{ m}^3 \text{ (in 2021)}} = 1.03 \text{ NIS/m}^3$$

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## (8) Operation Ratio

$$\frac{\text{Operating Expense in a year}}{\text{Operating Income from Sewerage Tariff in a year}}$$

- Proportion of operating expense and income from sewerage tariff
- Both "Operating Expense" and "Operating Income from Sewerage Tariff" are obtained from Income Statement;
- Operating Ratio is used to evaluate whether sewerage tariff covers the operation cost.
- If Operating Ratio > 1.0, operating expense is more than sewerage tariff. Need to consider either reduction of operating expense or increase of sewerage tariff.

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## (8) Operation Ratio

[Calculation]

The operating expense was 684,352 NIS in 2021.

According to the Income Statement, the sewerage tariff was 162,352 NIS (2021) with the following breakdown.

Item	(NIS)	Item	(NIS)
Sewerage tariff	162,352	Bank interest	
Connection fees	1,697,971	Other income	
Treated Wastewater	247,806		
Other charges	6,873		
Total Sewerage Revenue	2,115,002		

$$\frac{684,533 \text{ NIS}}{162,352 \text{ NIS}} = 4.22$$

Operating Ratio > 1.0, operating expense is more than sewerage tariff.

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## (9) Collection Ratio

$$\frac{\text{Income from Sewerage Tariff in a year}}{\text{Billed amount of Sewerage Tariff in a year}}$$

- Proportion of collected tariff among the billed amount
- Billed amount of sewerage tariff is divided into:
  - 1) "Billed and paid": Income from Sewerage Tariff
  - 2) "Billed but unpaid": Account Receivable

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## (9) Collection Ratio

[Calculation]

Income from Sewerage Tariff : 162,352 NIS in 2021  
Billed amount of Sewerage Tariff : 355,835 NIS in 2021

$$\frac{162,352}{355,835} \times 100 = 45.6 \%$$

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## 3. KPIs

KPI	Unit	2015	2016	2017	2018	2019	2020	2021
1 Sewer Network Coverage Ratio	%							47.6
2 House Connection Coverage Ratio	%							16.7
3 Wastewater Quality Compliance	%	89	92					100
4 Sewage Sludge Quality Compliance	%	100						100
5 Facility Operating Ratio	%	3.8	7.5	11.9	16.2	17.2	20.1	28.9
6 Reuse Ratio of Treated Wastewater	%	0	0	84	73	79	86	75.0
7 Unit Treatment Cost	NIS/m <sup>3</sup>	1.14	1.03	1.05	1.04	1.06	1.06	1.05
8 Operation Ratio		24.57	11.74	13.98	4.45	11.35	3.25	4.22
9 Collection Ratio	%	22.5	52.9	30.9	65.5	30.6	62.4	45.6

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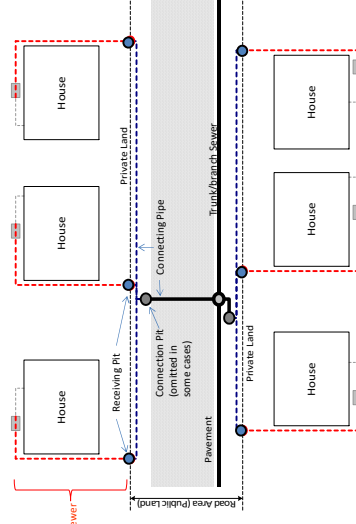
## Construction & Maintenance of House Connections

JM's Obligations

- 1) Maintenance of downstream from Receiving Pits
- 2) Construction of Receiving Pits

### Connection Fee Structure in Jericho

- ✓ Land or building owners are responsible for private sewer pits inside the owner's premises excluding receiving pits.
- ✓ Jericho Municipality is responsible for branch sewer, connection pit, connecting pipe and receiving pit.
- ✓ The connection fee is designed to cover all or a part of the construction cost of connection pit, connecting pipe and receiving pit.



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### (i) Staff Workload Ratio

$$\frac{\text{Number of Maintained Receiving Pits}}{\text{Number of workers}}$$

- Number of sewer connections per **Number of Subscriber Services Section workers**
- Indicates the amount of work and burden per person to maintain and manage House Connections.
- After construction of house, JM needs to maintain sewers from downstream of receiving pits such as check/clean inside pits and pipes.
- Number of receiving pits must be **accumulated number**.
- Staff Workload Ratio is used to evaluate the adequacy of human resources of the Subscriber Services Section.
- In case Staff Workload Ratio is too low, the section may be understaffed.

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### (i) Staff Workload Ratio

[Calculation]

Total number of registered receiving pits : 1,191 (in 2022)  
Total number of workers : 3 persons in Subscriber Services Section

$$\frac{1,191}{3} = 397 \text{ nos. per person in Total}$$

One worker has 397 receiving pits for maintenance. It means worker' workload per person.

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### (ii) Staff Productivity Ratio

$$\frac{\text{Number of new constructed connections per year}}{\text{Number of workers}}$$

- Number of sewer connections per **Number of Subscriber Services Section workers**
- Indicates the efficient work/construction of house connections per year.
- **Staff productivity ratio is evaluated as one worker's contribution in one year.**
- Staff Productivity Ratio is used to evaluate the efficiency of human resources of the Subscriber Services Section.
- In case Staff Productivity Ratio is too low, the section may be understaffed.

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## (ii) Staff Productivity Ratio

[Calculation]

Total number of new constructed connections in the year : 55 (in 2022)

Total number of workers : 3 persons in Subscriber Services Section

$$\frac{55}{3} = 18.3 \text{ nos. per person in the year}$$

One worker was involved in the construction of 18 units in one year.

Indicates work efficiency and contribution compared to the previous year.

## **Appendix 2.1.2**

# **Study on the Current Status and Future Projection of Sewage Volume at Jericho WWTP**

# Study on the Current Status and Future Projection of Sewage Volume at Jericho WWTP

## 1. Objective

The forecast of the sewage volume into a wastewater treatment plant is useful not only for the operation and maintenance of the facilities, but also for the forecast of electricity and reagent (disinfection) consumption for the operation and for the planning of sewerage management. In Jericho, treated wastewater is sold to farmers for agricultural use, and trends in the volume of treated wastewater also affect revenues from the sale of reclaimed water.

Sewage inflows are calculated based on projected population (e.g. resident population, tourist population), water supply demand and land use plans (development of surrounding areas, i.e. JAIP, Jericho Gate and refugee camp sewage reception).

Figure 1.1 shows the procedure for formulating planned sewage flow.

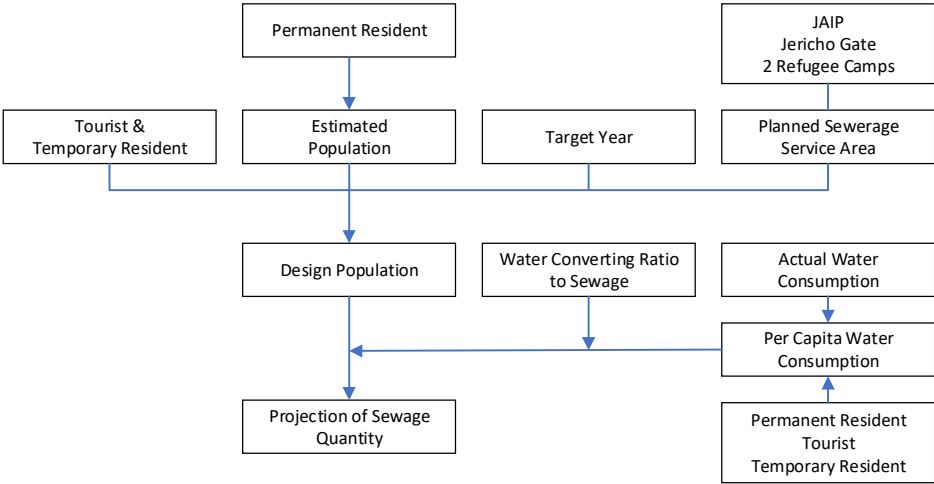


Figure 1.1 Procedure for Formulating Planned Sewage Flow

## 2. Design Population

### 2.1 Projection of Resident Population

The Jericho population is classified into two categories: resident and non-resident populations. The resident population is defined as inhabitants who have established a residence and live in Jericho City. The non-resident population of Jericho comprises overnight-stay tourists, one-day stay tourists and university students. As these populations use different amounts of water depending on their living arrangements, the amount of sewage generated by each of the resident and non-resident populations is calculated in the sewage volume projection.

The future population of Jericho Municipality, which will be used to forecast the design sewage flow, will be based on the official data of the Palestine Central Bureau of Statistics. The statistics forecasts the population until 2026. The forecast value of the population in the sewerage service area is covered in

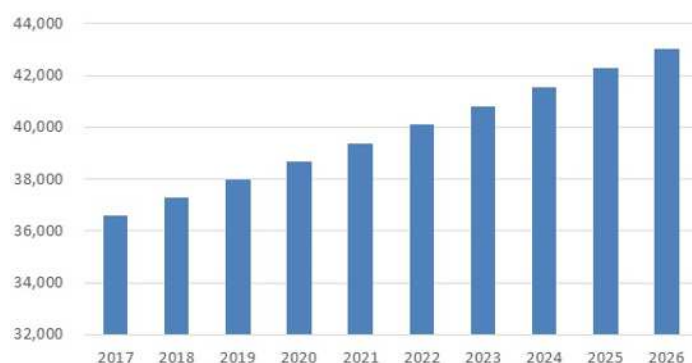
yellow in Table 2-1, which shows the resident population only and does not include the non-resident population such as overnight- and one-day stay tourists.

**Table 2-1 Population Projection**

Locality Name	Locality Code	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
		Actual	Forecasting								
Jericho & Al-Aghwar Gov.		49,568	50,481	51,410	52,355	53,317	54,289	55,268	56,256	57,248	58,243
Marj Na'ja	351045	821	836	851	867	883	899	915	932	948	964
Az Zubeidat	351110	1,664	1,695	1,726	1,758	1,790	1,823	1,856	1,889	1,922	1,956
Marj al Ghazal	351116	241	245	250	254	259	264	269	273	278	283
Al Jiftlik	351140	3,073	3,130	3,187	3,246	3,306	3,366	3,426	3,488	3,549	3,611
Fasayil	351510	1,623	1,653	1,683	1,714	1,746	1,777	1,809	1,842	1,874	1,907
Al A'uja	351690	5,179	5,274	5,371	5,470	5,570	5,672	5,774	5,877	5,981	6,085
An Nuwei'ma	351840	1,778	1,811	1,845	1,878	1,913	1,948	1,983	2,018	2,054	2,090
'Ein ad Duyuk al Fauqa	351845	877	893	910	927	944	961	978	996	1,013	1,031
'Ein as Sultan Camp	351865	4,346	4,426	4,507	4,590	4,675	4,760	4,846	4,932	5,019	5,107
Jericho (Ariha)	351920	20,726	21,107	21,496	21,891	22,293	22,699	23,109	23,522	23,937	24,353
Aqbat Jaber Camp	351975	8,882	9,046	9,212	9,382	9,554	9,728	9,904	10,081	10,258	10,437
An Nabi Musa	352075	340	346	353	359	366	372	379	386	393	400
Other Localities		18	18	19	19	19	20	20	20	21	21
<b>Total Population in Jericho Sewerage Service Area</b>		<b>36,609</b>	<b>37,283</b>	<b>37,970</b>	<b>38,668</b>	<b>39,379</b>	<b>40,096</b>	<b>40,820</b>	<b>41,549</b>	<b>42,281</b>	<b>43,018</b>
<b>Increasing Rate of Jericho Sewerage Area</b>		<b>100.0</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.8</b>	<b>101.7</b>

Source : Palestine Central Bureau of Statistics, Published Date : 30-05-2021

: Jericho Sewerage Service Area



**Figure 2-1 Population Projection in Jericho Sewerage Service Areas**

## 2.2 Assumption of Commuting Population

The Jericho city receives approximately 1.2 million overnight-stay tourists annually (2019, Table 2-2), and the volume of sewage derived from tourism is significant. Tourists are categorized into overnight-stay and one-day stay tourists. Other temporary inhabitants include university students.

The commuting population visiting from the outside of Jericho comprises two categories as shown below.

- ◆ Tourists (Overnight- and One-day stays)
- ◆ Trainees and staff of Al-Istiqlal University for the security training

## 2.2.1 Number of Tourists

Tourists are categorized by lengths of stay, i.e. overnight- and one-day stays, in Table 2-2. According to the Table, the number of tourists in 2020 decreased due to the COVID-19 and was slightly recovered in 2021.

**Table 2-2 Number of Tourists Visiting Jericho**

Category/Year		Foreigner			Local			Total		
		2019	2020	2021	2019	2020	2021	2019	2020	2021
Overnight Staying	Number of Visitors (person/year)	75,054	51,788	102,137	23,273	8,817	14,260	98,327	60,605	116,397
	Daily Average (person/day)	206	142	280	64	24	39	269	166	319
One day Staying	Number of Visitors (person/year)	773,381	391,838	425,722	390,918	179,817	210,660	1,164,299	571,655	636,382
	Daily Average (person/day)	2,119	1,074	1,166	1,071	493	577	3,190	1,566	1,744

Source: Ministry of Tourism

A maximum number of one-day stay tourists has been observed for three years based on the above Table 2-2.

With regard to hotels used by overnight-stay tourists, the Oasis Hotel has no plans to connect to the sewers because it has its own wastewater treatment plant. In addition, hotels that are not currently connected to sewers are identified and the number of rooms is counted. Therefore, the percentage of tourists staying in Jericho who use the sewerage system is calculated from the number of hotel rooms. The total number of rooms is 469, and total number of rooms without connection to sewers is 235. The percentage of future connections is approximately 50% ( $= (469-235)/469 \times 100$ ).

**Table 2-3 Room Numbers in Jericho City**

Hotel List in Jericho	Room Nos.	Sewer
1 Jericho Resort Village	139	Connected
2 Syraan Hotel	48	Connected
3 Oasis Hotel	179	Not Connected
4 Bab Al Shams	14	Connected
5 Al Baiara	33	Connected
6 Auberg-Inn Hotel	10	Not Connected
7 Waleed Hotel	10	Not Connected
8 Maghtas Hotel	16	Not Connected
9 Dolphin Hotel	20	Not Connected
Total	469	

Status as of October 31, 2022

Assuming that 50% of overnight tourists stay in hotels located in the sewerage planning area, the expected number of overnight tourists is 160 per day ( $= 319 \times 0.50$ ).

Since no data is available on the number of one-day tourists staying within the planned sewerage area, it is assumed that approximately 90% of the tourists will use the area. The assumed number of one-day stay tourists would be 2,880 ( $= 3,190 \times 0.9$ ) per day.

Overnight-Stay Tourists: 160 inhabitants/day

One-day Stay Tourists: 2,880 inhabitants/day

### 2.2.2 Al-Istiqlal University

The Al-Istiqlal University is located in the sewage service area, and most students have come from outside of Jericho. According to an interview with Jericho Municipality, a reasonable maximum number of students will be 1,500 inhabitants/day.

### 2.3 Future Projection of Design Population

The design population in the Jericho sewage service area until 2026 is shown in Table 2-4, and it will reach 48,038 inhabitants by the year 2026.

**Table 2-4 Future Projection of Design Population**

Category/Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Jericho Municipality	20,726	21,107	21,496	21,891	22,293	22,699	23,109	23,522	23,937	24,353
Surrounding Areas	2,655	2,704	2,755	2,805	2,857	2,909	2,961	3,014	3,067	3,121
Aqbat Jaber Camp	8,882	9,046	9,212	9,382	9,554	9,728	9,904	10,081	10,258	10,437
Ein Sultan Camp	4,346	4,426	4,507	4,590	4,675	4,760	4,846	4,932	5,019	5,107
Residents Sub-total	36,609	37,283	37,970	38,668	39,379	40,096	40,820	41,549	42,281	43,018
Tourist	Overnight Staying	160								
	One day Staying	2,880								
Al-Istiqlal University	1,500									
<b>Total Population</b>	<b>41,149</b>	<b>41,823</b>	<b>42,510</b>	<b>43,208</b>	<b>43,919</b>	<b>44,636</b>	<b>45,360</b>	<b>46,089</b>	<b>46,821</b>	<b>47,558</b>

### 3. Study on the Unit Water Consumption

#### (1) Target Wastewater Discharge

Table 3-1 shows water consumption for Domestic, Commercial, Industrial and Touristic users.

**Table 3-1 Water Consumption and Ratio**

Category	m <sup>3</sup> /year	Ratio
Quantity of billed water "Domestic class"	1,963,891	79.3%
Quantity of billed water "Commercial class"	144,291	5.8%
Quantity of billed water "Industrial class"	0	0.0%
Quantity of billed water "Touristic class"	368,774	14.9%
Total Quantity of billed water	2,476,956	100.0%

Source: Survey Variable List 2021, Jericho municipality



Sewage generated includes domestic, commercial, touristic, factory sewage and groundwater intrusion. According to the actual water supply in Jericho City (2021), no water is distributed to factories, as shown in Table 3-1.

The groundwater level in Jericho city is approximately Ground Level (GL) -25m. Since the deepest depth of the existing sewer is approximately GL-5m, the groundwater intrusion into the sewer is not considered.

The sewage collection in Jericho is based on a separate sewer system and the annual rainfall is relatively low (162 mm), so the volume of rainwater infiltration is not considered.

Therefore, the sewage generated in Jericho City is considered to be domestic, commercial and touristic sewage. From Table 3-1, touristic water accounts for 14.9% of the total, and therefore the volume of touristic wastewater is estimated separately.

While the commercial distribution of water supply is approximately 5.8% of the total, which is numerically small, it is therefore estimated together with domestic wastewater.

### **3.1 Actual Water Demand and Consumption**

Table 3-1 presents the actual water consumption by the measured bulk water meters of each area and these figures are listed by the water ledger in Jericho Municipality. The water consumption in Table 3-3 covers the population of the Jericho (Ariha) area in Table 2-1. However, water consumption by water tankers is not included in Table 2-1. Water consumption by water tankers is not considered due to its insignificant volume (approximately 1.5% of the total). Meanwhile, it does not include the other two refugee camps and the surrounding areas of the Jericho Sewerage Service Area.

**Table 3-3 Water Consumption by Area in 2019, 2020 and 2021**

No. of Area	Area	2019			2020			2021		
		No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)	No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)	No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)
1	Religious places	28	19,964	54.7	28	12,831	35.2	28	13,355	36.6
2	Al. Bayader	79	10,225	28.0	79	22,221	60.9	79	17,698	48.5
3	Gardens	54	57,137	156.5	54	64,660	177.2	54	48,077	131.7
4	City Center	204	33,341	91.3	204	33,759	92.5	204	32,405	88.8
5	Sheikh sabbah	372	120,073	329.0	372	118,633	325.0	372	105,512	289.1
6	Sheikh sbeih	356	114,313	313.2	356	108,119	296.2	356	104,639	286.7
7	Dahiya	68	31,987	87.6	68	35,408	97.0	68	27,971	76.6
8	Om Al.twabecen	70	19,817	54.3	70	19,901	54.5	70	19,147	52.5
9	Security depts.	59	170,961	468.4	59	206,918	566.9	59	212,286	581.6
10	Governmental dept.	51	41,479	113.6	51	37,634	103.1	51	37,358	102.4
11	Al.rasheed St.	35	7,066	19.4	35	8,797	24.1	35	9,255	25.4
12	Al.Quds St.	397	115,519	316.5	397	105,922	290.2	397	122,150	334.7
13	Al.Ma'moun St.	161	55,873	153.1	161	48,291	132.3	161	52,122	142.8
14	Al.maghtas St.	296	112,253	307.5	296	106,106	290.7	296	103,483	283.5
15	Amman St.	598	181,832	498.2	598	181,193	496.4	598	193,792	530.9
16	Falasteen St.	825	240,278	658.3	825	256,827	703.6	825	249,316	683.1
17	Yafa St.	50	17,945	49.2	50	19,189	52.6	50	15,850	43.4
18	Sabiha	339	74,252	203.4	339	120,574	330.3	339	97,094	266.0
19	Ein Assultan	462	134,277	367.9	462	151,857	416.0	462	135,561	371.4
20	Hisham Palace	423	136,198	373.1	423	126,251	345.9	423	153,735	421.2
21	Kitf Al.wad	483	182,576	500.2	483	158,884	435.3	483	115,316	315.9
22	Institutions and associations	84	123,661	338.8	84	69,126	189.4	84	168,176	460.8
23	Ein Assultan Camp	0	0	0.0	0	20	0.1	0	20	0.1
24	Municipal Facilities	22	78,433	214.9	22	103,575	283.8	22	71,053	194.7
25	Mosque (Aljame)	86	12,863	35.2	86	1,009	2.8	86	12,956	35.5
26	Aqbat Jaber Camp	0	0	0.0	0	0	0.0	0	0	0.0
27	Aldyouk	257	74,200	203.3	257	96,649	264.8	257	82,578	226.2
28	Al Sih	179	55,341	151.6	179	65,873	180.5	179	60,664	166.2
29	Al Thanya	202	77,225	211.6	202	74,654	204.5	202	64,634	177.1
30	Al Jericho	265	74,606	204.4	265	83,172	227.9	265	75,189	206.0
31	Al Qasab	215	68,566	187.9	215	57,307	157.0	215	75,564	207.0
Total		6,720	2,442,261	6,691	6,720	2,495,360	6,837	6,720	2,476,956	6,786

Source : Water and Sewerage Department , Jericho Municipality

Table 3-4 indicates the water consumption volume excluding Touristic water from Table 3-3.

**Table 3-4 Water Consumption by Area Excluding Touristic water**

No. of Area	Area	2019			2020			2021		
		No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)	No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)	No. of Active Meters	Consumption (m <sup>3</sup> /year)	Consumption (m <sup>3</sup> /day)
Total		6,720	2,078,652	5,695	6,720	2,123,846	5,803	6,720	2,108,182	5,776

### 3.2 Unit Water Consumption for Residents

Table 3-5 shows the unit water consumption except touristic water usage. The per capita (unit water consumption) is calculated based on the resident population in 2019, 2020 and 2021 in the Jericho water service area and water consumption shown in Table 3-4 included in commercial water.

**Table 3-5 Per Capita Water Consumption of Resident Population**

Year	Population	Water Consumption		
		m <sup>3</sup> /year	m <sup>3</sup> /day	l/capt./day
2019	21,496	2,078,652	5,695	265
2020	21,891	2,123,846	5,803	265
2021	22,293	2,108,182	5,776	259

Since the unit water consumption for the past three years was in the range of 259 to 265, that will set to **265 litres per capita per day (LPCD)**.

### 3.3 Unit Water Consumption of Other Usage

#### 3.3.1 Surrounding Areas of Jericho Municipality

The unit water consumption for residents in the sewage service areas around Jericho Municipality is **265 LPCD**, assuming the same lifestyle as the residents in the Municipality.

#### 3.3.2 Tourists

Since there is no actual data on the amount of per capita water consumption by the tourists, the following unit consumption, 50 LPCD for the One-Day Stay tourist proposed in the “Water Master Plan for Jericho City, page 108” will be adopted. On the other hand, the Overnight-Stay Tourist is assumed to be **45%** of domestic usage, which is the same value as the water converting ratio in Section 4.1.

- ◆ One-Day Stay: **50 LPCD**
- ◆ Overnight Stay: **265 \* 45% = 119 LPCD**

#### 3.3.3 Al-Istiqlal University

It is assumed that the unit consumption of water at the Al-Istiqlal University is about the same as that of the overnight-stay tourist.

- ◆ Al-Istiqlal University: **119 LPCD**

### 3.3.4 Refugee Camps

According to the “Aqbat Jaber Camp Sewerage System Preparing of Feasibility Study and Detailed Design with Tender Document, Final Report, page-23, October 2014”, the unit water consumption in this refugee camp is set to **170 LPCD**, and the same value will be adopted in this Study.

As for the Ein Al-Sultan Camp, **170 LPCD** is adopted because it has the same refugee camp area and lifestyles.

## 4. Water Converting Ratio to Sewage

### 4.1 Water Converting Ratio to Sewage for Domestic Users

According to the “Water Master Plan for Jericho City”, the percentage of domestic usage accounts for about 43.1% in total. Domestic water usage may change in the future, but the lifestyles are likely to be maintained. Therefore, it is assumed that **45%**, which is expected to have a margin in the actual percentage, is discharged to the sewer as domestic wastewater.

**Table 4-1 Water Converting Ratio to Sewage for Domestic Users**

Item	Gardening	Wet Cooling System	Swimming Pool	Domestic Use	Total Consumption
Unit Consumption (l/cap./day)	75.0	41.7	0.8	89.1	206.6
Percentage (%)	36.3	20.2	0.4	43.1	100.0

Source: "Water Master Plan for Jericho City, March 2011, Page 102" conducted by MAIRIE DE PARIS

### 4.2 Water Converting Ratio to Sewage for Refugee Camp

Based on the report of “Aqbat Jaber Camp Sewerage System Preparing of Feasibility Study and Detailed Design with Tender Documents, October 2014, Page 23”, the water converting ratio to sewage for refugee camp states that **75%** of water consumption is drained as sewage.

## 5. Design Sewage Flow

### 5.1 Unit Sewage Quantity

As mentioned above, assuming that 45% of the water consumption used by the resident population, and the drainage is discharged to the sewer, the basic unit of sewage amount is set as follows.

**Table 5-1 Unit Sewage Quantity for Design Sewage Flow**

Category		Water Consumption per Capita	Water Converting to Sewage Ratio	Unit Sewage Quantity
Domestic (including surround area)		265	45	119
Tourist	One Day Staying	50	-	50
	Overnight Staying	265	45	119
Al-Istiqlal University		265	45	119
Aqbat Jaber & Ein Sultan Camp		170	75	128

## 5.2 Connection to Sewer and Service Coverage Ratios for Domestic Users

The connection rate means the ratio of the population in use against the population with sewerage available. This is due to financial and/or topographical issues in areas where sewerage is available. The exact connection and sewage coverage ratio will be estimated based on the GIS data, but it is currently under preparation and is unknown.

As a result of a visit to each house in 2015 after completion of the PP (Pilot Project)-1 and PP-2 projects, the connection rate was about 13%. After that, PP-3 to PP-5 were implemented with the support of Jericho Municipality, PWA and ROJ (Representative Office of Japan to Palestine) to promote house connections. The number of house connections at the end of 2021 was 1,374 as shown in Table 5-2.

**Table 5-2 Number of House Connections Constructed**

Item / Year		2014	2015	2016	2017	2018	2019	2020	2021	Total
PP-1	JICA	89								89
PP-2	JICA			295						295
PP-3	JM				185					185
PP-4	PWA								150	150
PP-5	ROJ							270		270
Jericho Municipality (JM)			40	110	67	52	34	30	52	385
Total		89	40	405	252	52	34	300	202	1,374

Source: Department of Water and Wastewater, Jericho Municipality

On the other hand, the person per household is 4.67 as shown in Table 5-3, based on the Palestine Central Bureau of Statistics in 2017.

**Table 5-3 Actual Person per Household in Sewerage Area**

Locality Name	2017		persons by household
	Population	Household	
An Nuwei'ma	1,778	372	4.78
'Ein ad Duyuk al Fauqa	877	191	4.59
'Ein as Sultan Camp	4,346	930	4.67
Jericho (Ariha)	20,726	4,582	4.52
Aqbat Jaber Camp	8,882	1,762	5.04
Total in Jericho Sewerage Area	36,609	7,837	4.67

Source : Palestine Central Bureau of Statistics, Published Date : 30-05-2021

Four (4) PPs (Pilot Projects) were implemented during this period (2015 to 2021) to promote connections to the sewers. The next Pilot Project in Jericho has not been planned at present and will rely on residents to apply for sewer connections. The average annual performance from 2015 to 2021 is 81 (=570 connections/7 years) connections (including PP3). Assuming that the number of sewer connections continues at this pace, the increase in coverage will be approximately 1.7% per year (=379/22,293 x100).

Table 5-4 shows the increase in coverage ratio.

**Table 5-4 Increase in Coverage Ratio**

Average Connection nos.	Family size (person)	Annual increase person	Population in 2021	Increase Coverage Ratio
81	4.67	379	22,293	1.7%

### 5.3 Sewage Flow for Domestic Users

The sewage network in the Jericho surrounding areas is currently underdeveloped, and it is expected that it will continue to be underdeveloped in the medium term.

Table 5-5 shows the projection of domestic sewage flow up to 2026 based on the above-mentioned conditions.

**Table 5-5 Sewage Flow Projection for Domestic Users**

Item/Year	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	
Population	Jericho Municipality	20,726	21,107	21,496	21,891	22,293	22,699	23,109	23,522	23,937	24,353
	Surrounding Areas	0	0	0	0	0	0	0	0	0	0
	Sub-total	20,726	21,107	21,496	21,891	22,293	22,699	23,109	23,522	23,937	24,353
Sewage Connection Ratio (%)	18	21	23	26	29	30.7	32.4	34.1	35.8	37.5	
Unit Sewage Flow (L/capt. /day)	119										
Design Sewage Flow in Domestic Use (m <sup>3</sup> /day)	444	527	588	677	769	829	891	955	1,020	1,087	

### 5.4 Sewage Flow for Commuting Persons

Table 5-5 shows the future projection of the sewage flow generated by commuting persons such as overnight-stay & one-day stay tourists and students of the Al-Istiqlal University.

**Table 5-5 Sewage Flow for Commuting Persons**

Item/Year		2017~2026
Tourist (persons)	Overnight Staying	160
	One day Staying	2,880
	Al-Istiqlal University	1,500
Sewage Connection Ratio (%)		100
Unit Sewage Flow (L/capt. /day)	Overnight	119
	One day	50
	University	119
Design Sewage Flow in Commuting Use (m <sup>3</sup> /day)	Overnight	19
	One day	144
	University	179
Total (m <sup>3</sup> /day)		342

### 5.5 Sewage Influent from Jericho Gate

A large-scale development named “Jericho Gate (for-sale housing, commercial facilities, etc.)” is underway on the south of Jericho municipality, and the sewage generated from this area is expected to connect to the Jericho sewerage system in the future.

**Table 5-6 Sewage Flow from Jericho Gate**

Item / Development Stage	2020	2021	2022	2023	2024	2025	2026
Number of Houses (unit)	261	119	171	0	210	187	218
Accumulated Number (unit)	261	380	551	551	761	948	1,166
Water Consumption (m <sup>3</sup> /day)	821	137	175	981	215	191	223
Accumulated Consumption (m <sup>3</sup> /day)	821	958	1,133	2,114	2,329	2,520	2,743

Source: Jericho Gate Development Plan

However, as a result of a field survey in June 2022, some housing construction has been underway, and the development is behind schedule.

A comparison of actual and planned water consumption at Jericho Gate is shown in Table 5-7.

**Table 5-7 Water Consumption Ratio**

Item / Development Stage		2021	2022
Planned Water Consumption (m <sup>3</sup> /day)	①	958	1,133
Actual water consumption (m <sup>3</sup> /day) <sup>1)</sup>	②	224	276
Actual water consumption Ratio	②/①	23%	24%

1) Jericho municipality, Collection Management Section: Bill data

The ratio of actual to planned values is approximately 23% in 2021 and 24% in 2022, accounting for an increase of 1%. Assuming that Jericho Gate will continue to be developed for housing, the ratio between

planned and actual values will decrease by 1% each year after 2023 (i.e. the actual value increases by 1% each year relative to the planned value). Considering the same living styles as in Jericho city, it is assumed that 45% of the water consumption flows into the sewers.

Therefore, the projected sewage volume that the Jericho Municipality will receive from the Jericho Gate is shown in Table 5-8.

**Table 5-8 Sewage Flow from Jericho Gate**

Item / Development Stage	2020	2021	2022	2023	2024	2025	2026
Water Consumption (m <sup>3</sup> /day)	821	958	1,133	2,114	2,329	2,520	2,743
Development Progress (Assumption)	5%	23%	24%	25%	26%	27%	28%
Water Converting to Sewage Ratio	45%						
Design Sewage Flow (m <sup>3</sup> /day)	18	99	122	238	272	306	346

## 5.6 Sewage Influent from Refugee Camps

### (1) Aqbat Jaber Camp

In Aqbat Jaber Camp, sewers were constructed out of UNRWA using UNDP funds. The construction of sewers covered general roads and house connections. According to the Camp Committee, 800-900 out of the 1,400 houses in the camp were connected to the sewers. Here, it is assumed that 850 houses are connected. The Committee explains that the remaining 550 houses cannot be connected to the sewers without donor support. Therefore, a connection rate of 61% (= 850/1,400 x 100) is retained.

### (2) Ein Al-Sultan Camp

The sewers in the Ein Al-Sultan Camp are under construction, which will be completed in May 2023. The Ein Sultan Camp will connect/discharge to the sewer in Jericho Municipality from 2024. There are two phases of sewer construction in total, with construction in 2022 being Phase 1. The target population for Phase 1 is 1,520, which is approximately 31.7% (=1,520/4,791 x 100) of the target population. Sewerage coverage in the camps is assumed to be 32%, since the implementation of Phase 2 is not scheduled until 2026. The assumption of connection rates for the camps is presented below in this Study.

**Table 5-9 Assumption of Connection Rate in Camps**

Category/Year		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Connection Ratio (%)	Aqbat Jaber Camp <sup>1)</sup>	20	30	40	50	61	61	61	61	61	61
	Ein Sultan Camp <sup>2)</sup>	0	0	0	0	0	0	0	32	32	32

1) Camp Committee interview survey: Total house connections are 1,400. Connected houses are approx. 850. Therefore, 850/1,400 x 100= 61%

2) Ein Asulutan Project Sewer Design Reprt: Total population is 4,791, Population in Phase-1 is 1,520. Therefore, 1,520/4,791 x 100= 31.7%

### (3) Sewage from Two Camps

The projected sewage volume that the Jericho Municipality will receive from the Aqbat Jaber and Ein Sultan camps is shown in Table 5-10.



**Table 5-10 Sewage Flow from Refugee Camps**

Category/Year		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Population	Aqbat Jaber Camp	8,882	9,046	9,212	9,382	9,554	9,728	9,904	10,081	10,258	10,437
	Ein Sultan Camp	4,346	4,426	4,507	4,590	4,675	4,760	4,846	4,932	5,019	5,107
Unit Sewage Quantity (L/capt./day)		128									
Connection Rate (%)	Aqbat Jaber Camp	20	30	40	50	61	61	61	61	61	61
	Ein Sultan Camp	0	0	0	0	0	0	0	32	32	32
Sewage Flow (m <sup>3</sup> /day)	<b>Aqbat Jaber Camp</b>	227	347	472	600	746	760	773	787	801	815
	<b>Ein Sultan Camp</b>	0	0	0	0	0	0	0	202	206	209
	<b>Camp Total Flow</b>	227	347	472	600	746	760	773	989	1,007	1,024

### 5.7 JAIP Wastewater

Wastewater from JAIP, which complies with the Sewerage By-Law for the Jericho Municipality, will be connected to the Jericho sewerage system. Since the type of business and water consumption of the factory within JAIP are unknown, 400 m<sup>3</sup>/day of wastewater which is described in the report of “JAIP Wastewater Treatment – Detailed Design Report, page 35, 15, February 2021” will be adopted as the final target.

According to the “JAIP, Water quantities used by each tenant at JAIP for the past three months, 2021”, the flow of JAIP wastewater was measured at 47.8 m<sup>3</sup>/day as actual data. Since there is no tenant location plan (water supply plan) for the JAIP, it is assumed that wastewater discharge will gradually increase in the future. The timing for accepting wastewater from JAIP is assumed to be from January 2023, since this will coincide with the operation of the pre-treatment plant. The wastewater forecast is shown in Table 5-11 on the assumption that there is a gradual attraction of factories to JAIP.

**Table 5-11 Generated Wastewater in JAIP**

Year	Flow Assumption (m <sup>3</sup> /day)	Remarks
2021	48	Actual Flow
2022	41	Actual Flow
2023	50	Connected
2024	60	
2025	70	
2026	80	
2027	90	
2028	100	
2029	110	
2030	120	

Pre-Treatment capacity: 400 m<sup>3</sup>/day

## 5.8 Projection of Sewage Quantity

Table 5-12 shows the projection of the sewage quantity of the Jericho Wastewater Treatment Plant (WWTP) by 2026 with reference to the population forecast of the Palestine Central Bureau of Statistics up to 2026.

**Table 5-12 Projection of Sewage Quantity (Daily Average) of Jericho WWTP**

Category / Year		2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Sewage Flow (m <sup>3</sup> /day)	Domestic	444	527	588	677	769	829	891	955	1,020	1,087
	Commuting Person	342									
	Jericho Gate	-	-	-	18	99	122	238	272	306	346
	Aqbat Jabel Camp	227	347	472	600	746	760	773	787	801	815
	Ein Sultan Camp	0	0	0	0	0	0	0	202	206	209
	JALP	-	-	-	-	-	-	50	60	70	80
	Total	1,013	1,217	1,402	1,620	1,857	2,053	2,294	2,618	2,744	2,878

## 5.9 Actual Wastewater Treatment Plant Inflows

The actual inflows to the Jericho WWTP are shown in Table 5-13. The planned and actual values deviate from each other due to various factors. However, the sewerage plan is revised accordingly on each occasion.

**Table 5-13 Actual Inflow at Jericho WWTP**

WWTP	Year	2017	2018	2019	2020	2021	2022
Daily Average Inflow (m <sup>3</sup> /day)		788	1,070	1,137	1,321	1,908	2,208

Source: Jericho municipality Water and Wastewater Department, SCADA data

## 5.10 2<sup>nd</sup> Reactor at Jericho WWTP

Identifying the maximum planned daily sewage flow is useful for forecasting when the 2nd reactor will be in operation. The capacity of one reactor is 4,900 m<sup>3</sup>/day (9,800 m<sup>3</sup>/day overall). When the volume of inflow sewage exceeds this capacity, the second reactor has to be operated. The ratio of average daily inflow to maximum daily sewage from January 2021 to October 2022 is identified as follows.

Daily Maximum Inflow	2,890 m <sup>3</sup> /day
Daily Average Inflow	2,205 m <sup>3</sup> /day
Maximum/Average	1.31

\*Daily maximum inflow was recorded on 22 August 2022, from the Jericho WWTP SCADA data.

The planned daily sewage flows shown in Table 5-12 multiplied by a peak factor of 1.31 are shown in Table 5-14. It can be forecast that the 2nd reactor will be operational from 2024.

**Table 5-14 Planned Daily Maximum Inflow and 2<sup>nd</sup> Reactor Operation**

Year	2022	2023	2024	2025	2026
Planned Daily Average Inflow (m <sup>3</sup> /day)	2,053	2,294	2,618	2,744	2,878
Planned Daily Maximum Inflow (m <sup>3</sup> /day)	2,690	3,005	3,430	3,595	3,771
Reactor No.1	On	On	On	On	On
Reactor No.2	-	-	On	On	On

The increase in the volume of inflow sewage is strongly affected by the implementation of PPs, i.e. the number of sewer connections. In the future, it is important for Jericho Municipality to efficiently process applications from citizens to connect to sewers and increase the number of sewer connections.

### **5.11 Procedure for Formulating Sewage Volume Forecast**

The formulation procedure for forecasting the sewage volume is shown in Figure 5-1.

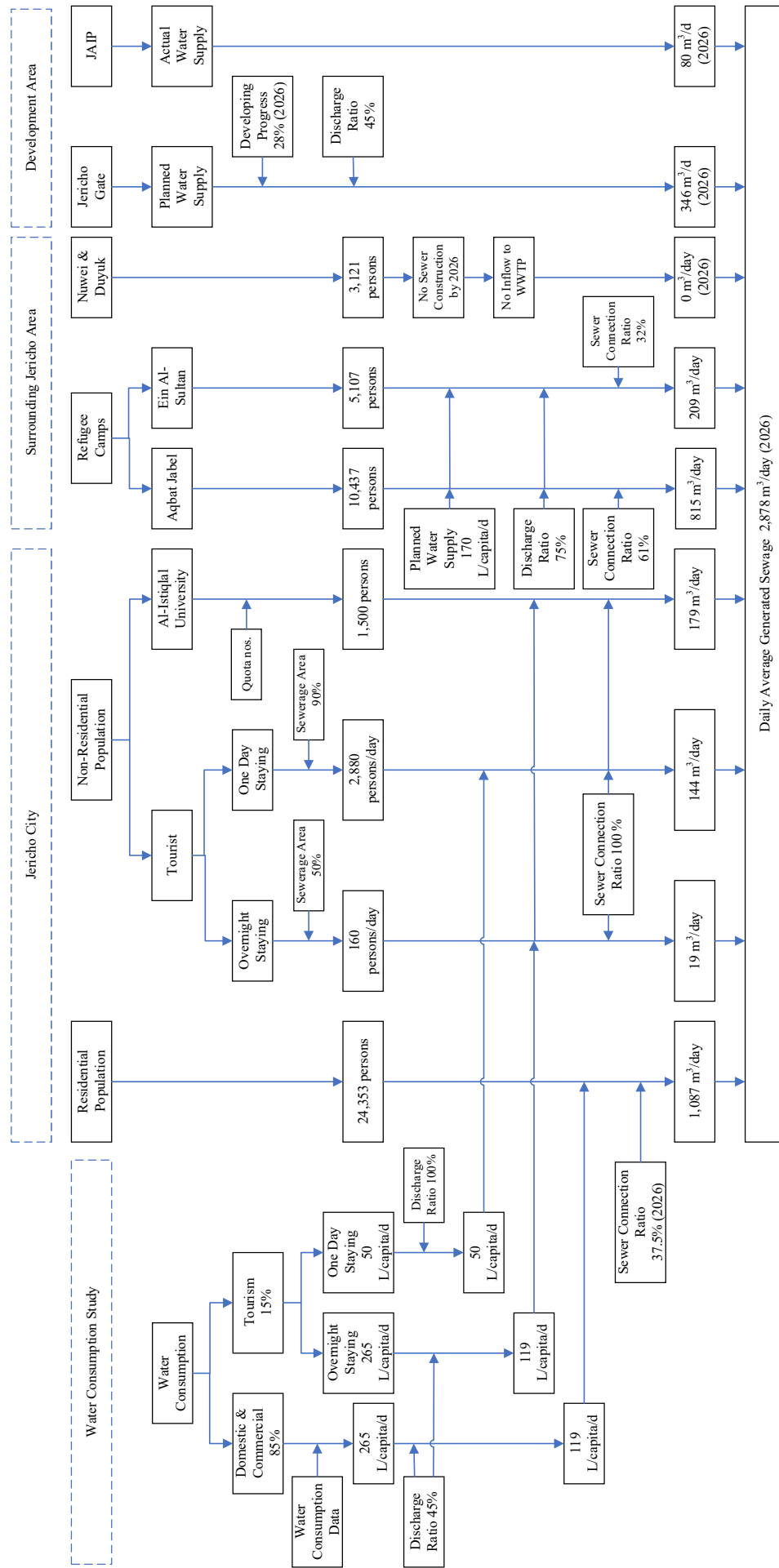
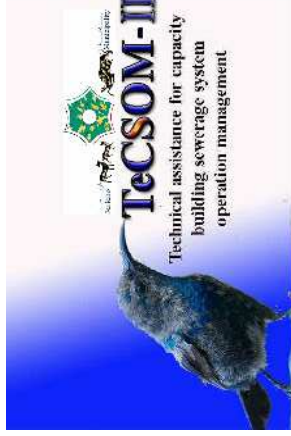


Figure 5-1 Procedure for Formulating Sewage Volume Forecast

## **Appendix 2.1.3**

# **Jericho Hills Village Sewer Connection Study**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Jericho Hills Village Sewer Connection Study



September 18, 2022  
Water and Wastewater Dept.  
Director Mohammad Fityani

1

### 1. Study Purpose

1. Sewer connection from the Jericho Hills Village to Trunk sewer
2. The developer and delegate requests JM to connect to Jericho sewer network on September 11, 2022.
3. The village has own cesspit tank but the village will abandon the cesspit due to high maintenance cost (tanker sludge cost).

2

### 2. Case Study Condition

- 45 houses in the Hills village
- Seasonal residents: 200 people
- Permanent residents: 50 people
- Building area: 160 m<sup>2</sup>/house
- Distance to existing sewer: 640 m
- Village covered construction cost: maximum 50%
- Water consumption: 160 L/capita/day
- To sewer inflow ratio: 45%
- Annual reuse ratio: 75%
- Evaluation period: 50 years as sewer lifetime
- Assessed over the lifetime of the sewer pipe, because the lifetime of a sewage pipe is generally 50 years.

3

### 3. Location Map



1. Gravity system available
2. Comparatively deeper earth cover depth approx. 5m depth
3. Trunk sewer has sufficient capacity to receive swage from the village

4

#### 4. Evaluation Factors

Jericho Municipality	Hills Village
1) Sewer construction cost	1) Covered construction cost (in case of 50%)
2) Selling Treated Wastewater	2) Sewerage fee
	3) Connection fee
	4) Cesspit maintenance cost

5

#### 5. Case Study Result

	JM	Village
[Expenditure]		
Sewer construction	416,000	-
Sewerage fee for 50 years	-	396,286
Covered construction cost	-	208,000
Cesspit maintenance cost**	-	-1,250,000
Connection fee**	-	-93,600
Sub total A	416,000	-739,314
[Revenue]		
Sewerage fee for 50 years	396,286	-
Sold Treated WW for 50 years	66,873	-
Construction cost by Village	208,000	-
Sub total B	671,159	-
[Benefit] (B-A)		
For 50 years	255,159	739,314
Per year	5,103	14,786

\*Unit: NIS

\*\* Costs that should be paid, but are exempt

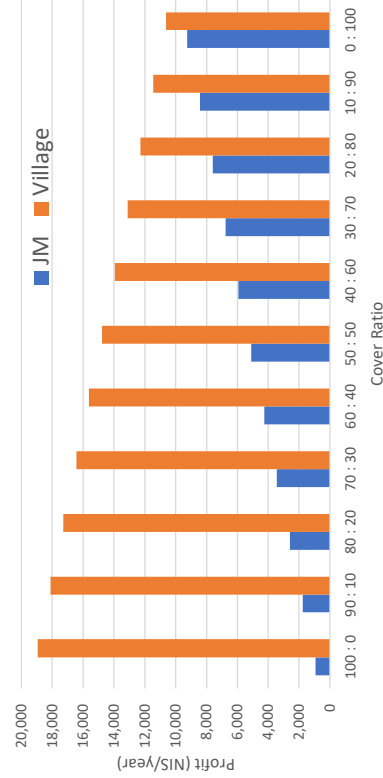
6

#### 6. Study Evaluation

JM	Village
[Advantage]	[Advantage]
<ul style="list-style-type: none"> <li>Revenue increase</li> <li>Inflow increase (KPIs improvement)</li> </ul>	<ul style="list-style-type: none"> <li>Cesspit maintenance free</li> <li>Living environment improvement</li> <li>Economically advantageous</li> </ul>
[Consideration]	[Consideration]
<ul style="list-style-type: none"> <li>Connected sewer maintenance</li> <li>Sewerage bill issue</li> </ul>	<ul style="list-style-type: none"> <li>Need understanding of residents due to sewerage fee payment</li> </ul>

7

#### 7. Case Study on Profit



8

## 8. Consideration

- Jericho municipality (JM) is not a commercial enterprise. It is a public service provider.
- Both parties benefit even if they bear different shares of the construction costs.
- JM can build up good relationship with the Village.
- If the donor pays all construction costs, then the JM may pay the full cost. However, the cooperation of the Village is also necessary to attract donors.

## ANNEX: Calculations

1	Construction								
2	Price of Part	400000000	500000000						
3	Price of Part	400000000	500000000						
4	Price of Part	400000000	500000000						
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81	Price of Part	400000000	500000000						
82	Price of Part	400000000	500000000						
83	Price of Part	400000000	500000000						
84	Price of Part	400000000	500000000						
85	Price of Part	400000000	500000000						



## **Appendix 2.1.4**

### **PWA Presentation Material**

## Sustainable Wastewater Management of Jericho Municipality

### Creation of Resource-Recycling Society



September 8, 2022

1

## 1. SDGs in Jericho Sewerage Project



- 1) Solar power generation  
Covers about 1/3 of the power consumption of WWTP



- 2) Reuse of Treated Wastewater  
First sale of Treated Wastewater in Palestine  
Important source of income

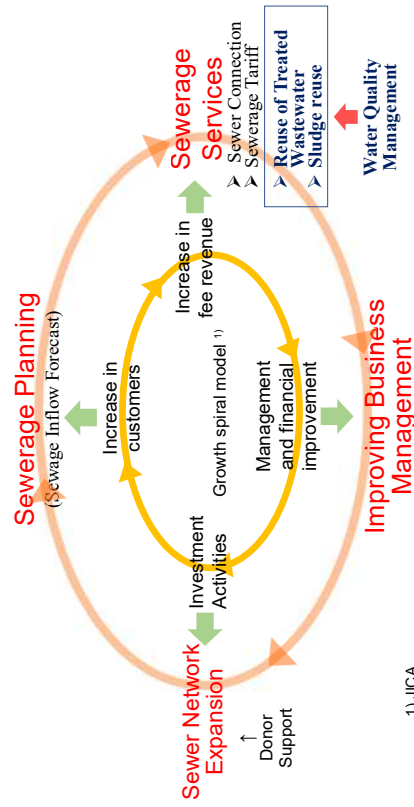


- 3) Reuse of sewage sludge  
Reuse as fertilizer



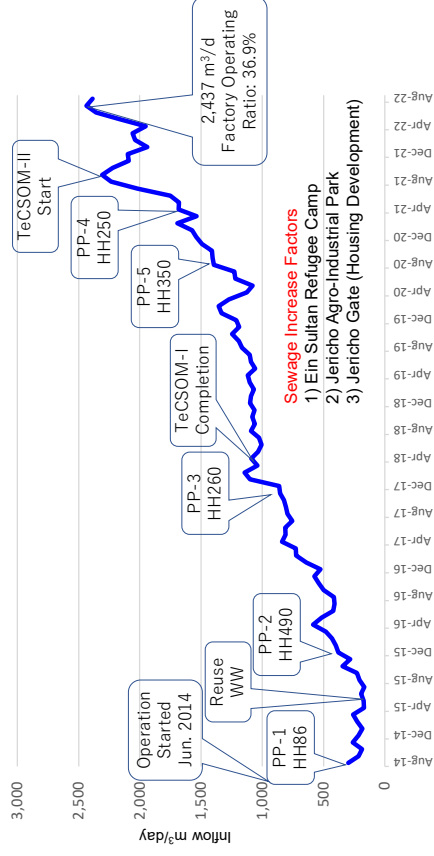
2

## 2. Growth Spiral Model in Jericho Sewerage



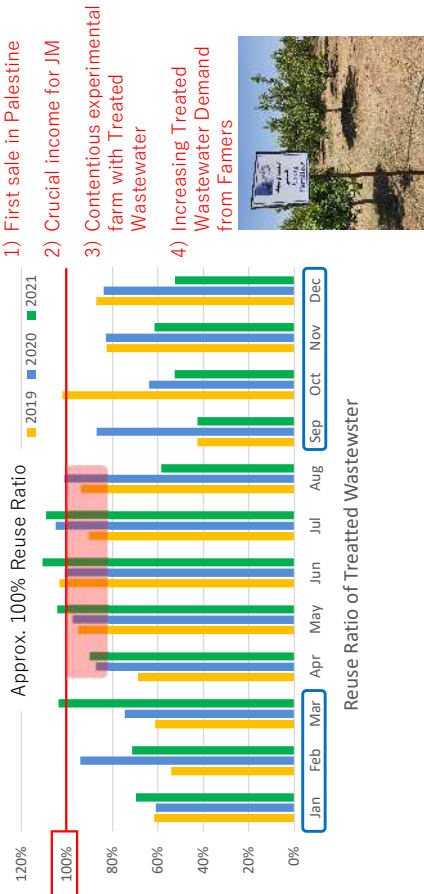
3

## 3. Inflow to WWTP and Pilot Projects



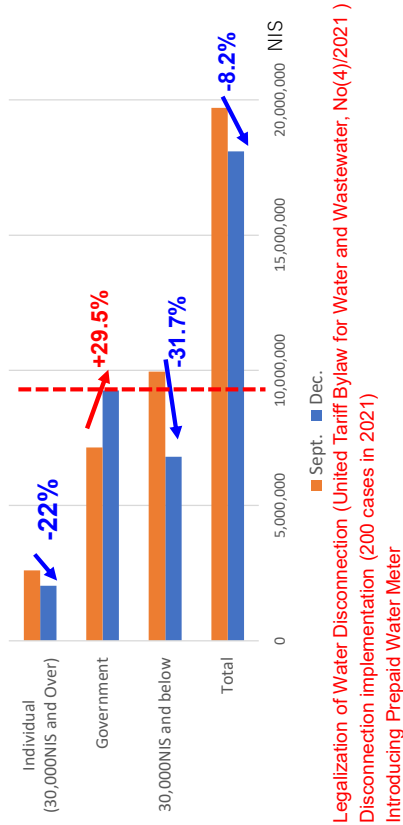
4

#### 4. Reuse Ratio of Treated Wastewater



5

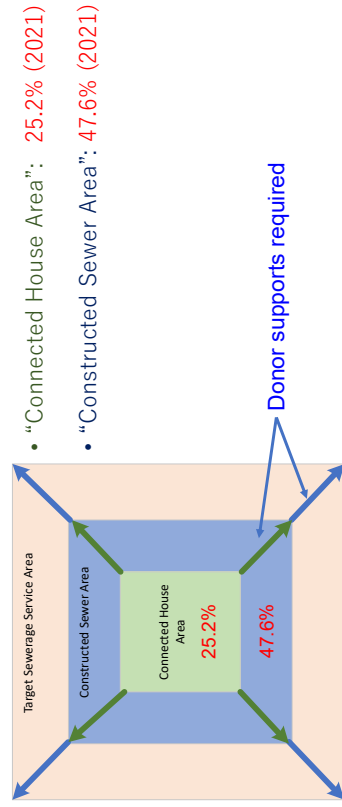
#### 5. Water Fee Debts in 2021



- 1) Legalization of Water Disconnection (United Tariff Bylaw for Water and Wastewater, No(4/2021 )
- 2) Disconnection implementation (200 cases in 2021)
- 3) Introducing Prepaid Water Meter
- 4) Jericho Mayor's letter and visit to Ministry of Finance for payment from Government institutions

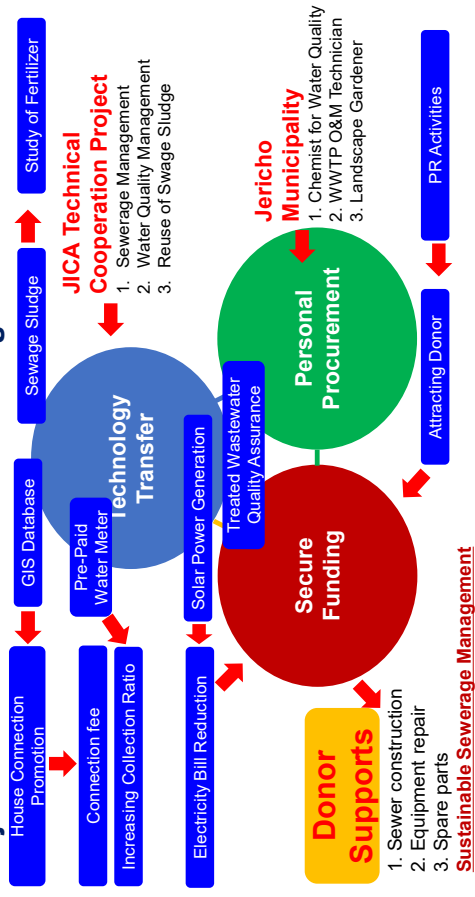
6

#### 6. Sewer Development



7

#### 8. Major Elements of Sustainable Management

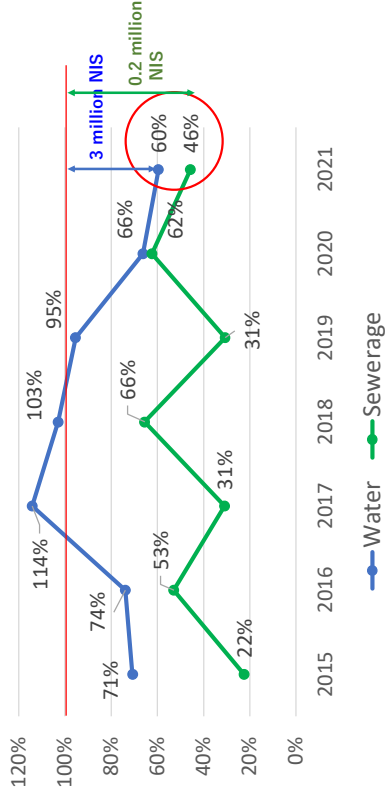


8

# Thank you very much for your Attention



## 5. Collection Rate

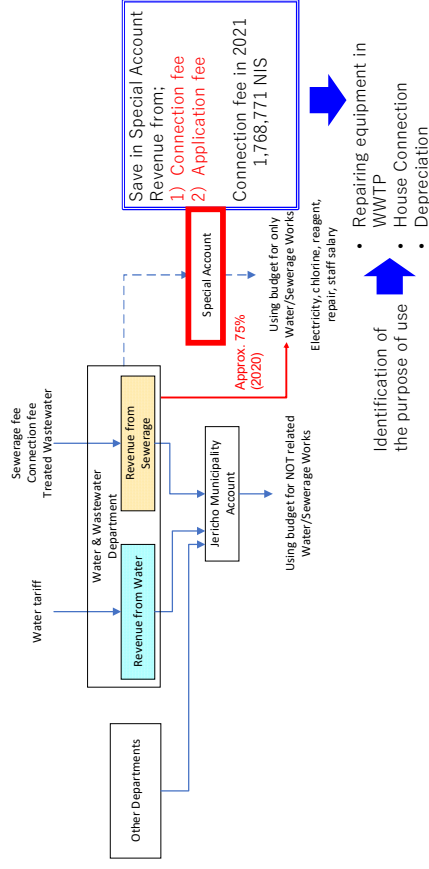


Source: Jericho Municipality Financial Data

## 2. JM's efforts and achievements

1. **Number of sewer connections**
  - 1,260 connection as of June 2022, Approximately 1,700 including PP4&5
  - JM constructed sewer: approximately 300 m length, and house connections: 186 (in PP3)
  - **Integration of sewer data using GIS**
    - a. Efficiency of decisions on sewer connections (Faster application acceptance)
    - b. Identification of effective sewer construction zones (Zones requiring sewer construction)
2. **Demand for Treated Wastewater**
  - Number of users/farmers
  - Pilot Plant (experimental farm) at the JWWTTP
  - KPIs
    - a. Reuse Ratio of Treated Wastewater (%)
    - b. Water Quality Compliance (%)
3. **Sewerage Fee Collection**
  - Amount/Ratio
  - Total Debts (Individual, Governments)

## 1. Establishment of Special Account in WWD



## **Appendix 2.1.5**

### **MoFA Presentation Material**

## Sustainable Wastewater Management of Jericho Municipality

### Creation of Resource-Recycling Society



March 7, 2023  
 Water & Wastewater Department  
 Mohammad Fityani

## 1. SDGs in Jericho Sewerage Project



- 1) Solar power generation  
 Covers about 1/5 of the power consumption of WWTP



- 2) Reuse of Treated Wastewater  
 First sale of Treated Wastewater in Palestine  
 Important source of income



- 3) Reuse of sewage sludge  
 Reuse as soil conditioner



## 2. Jericho Sanitation Circumstances (1)

### [Before Grant Aid Project]

- None of Sewerage Facility
- Cesspits and dispose sludge to a dumping site

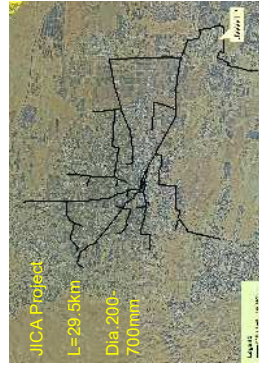


Sludge Tanker

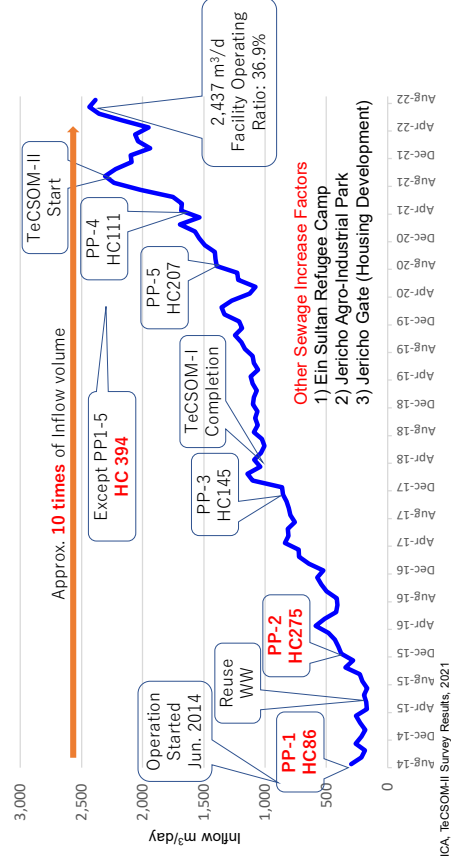
## 2. Jericho Sanitation Circumstances (2)

### [Just After the Project]

- Insufficient knowledge and understanding on sewerage system for residents.
- “Suffering to get consensus of a sewer connection and fee collection”
- Low sewage inflow and low revenue



### 3. Inflow to WWTP and Pilot Projects



### 4. JM Efforts on Sewerage Management (1)

#### 1. Public Awareness (Early Stage)

- 1) Door to Door for explaining/persuading connection to sewers
- 2) Public meetings held by JM (Mayor, Director, Section Chiefs, etc.)
- 3) Lectures at elementary schools by JM staff
- 4) Receiving visitors from schools at the Jericho WWTP
- 5) PR Activities: Leaflets, Homepage, SNS, Mayor message by radio

#### 2. Financial Aspect (Early Stage)

- 1) Discount campaign: Official sewerage fee 1.0NIS/m<sup>3</sup> ⇒ Temporary 0.5NIS/m<sup>3</sup>
- 2) Building permission: Building owner needs to pay a sewer connection fee (13NIS/m<sup>2</sup>)
- 3) Selling a treated wastewater for agricultural irrigation (0.5NIS/m<sup>3</sup>)

## Current JM Achievements (Phase II since 2021)

### 5. JM Efforts on Sewerage Management (2)

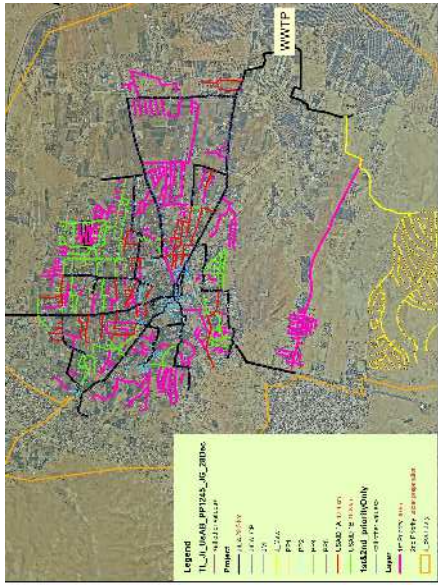
#### 3. Institutionalized Aspect

- 1) Establishment of the **Special Account** in the Water & Wastewater Dept.
- 2) Integrated collection of water and sewerage fees:  
Unpaid sewerage fee ratio 30% (2021)⇒0% (2022) by **encouragements**
- 3) Introduction of **penalty rules**: Suspension of water supply, Prevention of illegal dumping of cesspit sludge into manholes

#### 4. Sewer Connection Promotion

- 1) **Sewer database developed with GIS** to existing sewers & houses, connected/unconnected
- 2) Identification of **priorities** for sewerage development areas /routes
- 3) Efficiency of sewer connection **application process**
- 4) Sewer **maintenance**

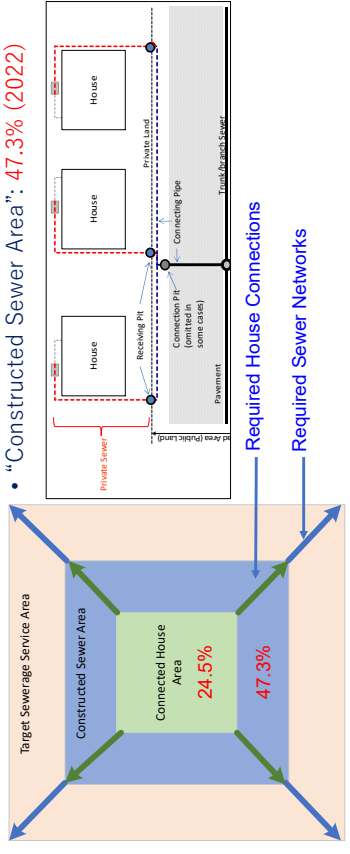
## 6. Priorities for Sewerage Development Areas /Routes



- 1) Identification of high densely residential areas and large water users
  - 2) Selection of efficient routes
  - 3) Planning of sewer construction
- ➔
- 1) The First priority routes: approximately 32 km and the project cost estimated
  - 2) Number of Beneficiaries/Buildings
- ➔
- 1) Quick responses to a donor's inquiries
  - 2) Ease to adjust the scope of works

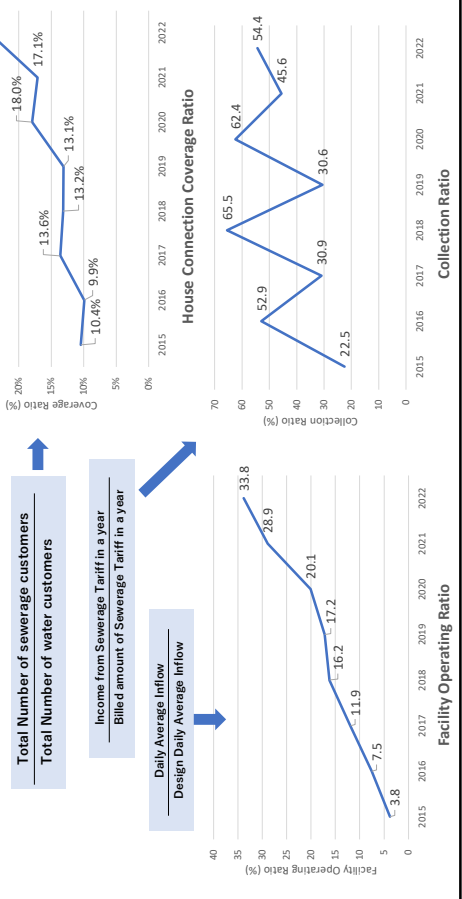
## 7. Sewer Development Required

- "Connected House Area": 24.5% (2022)
- "Constructed Sewer Area": 47.3% (2022)

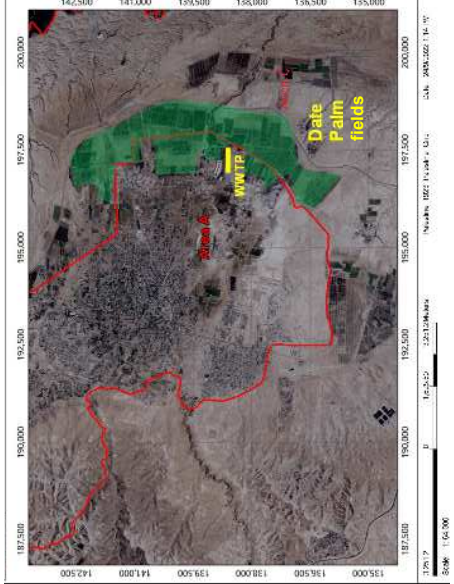


Required House Connections  
Required Sewer Networks

## 8. Key Performance Indicators



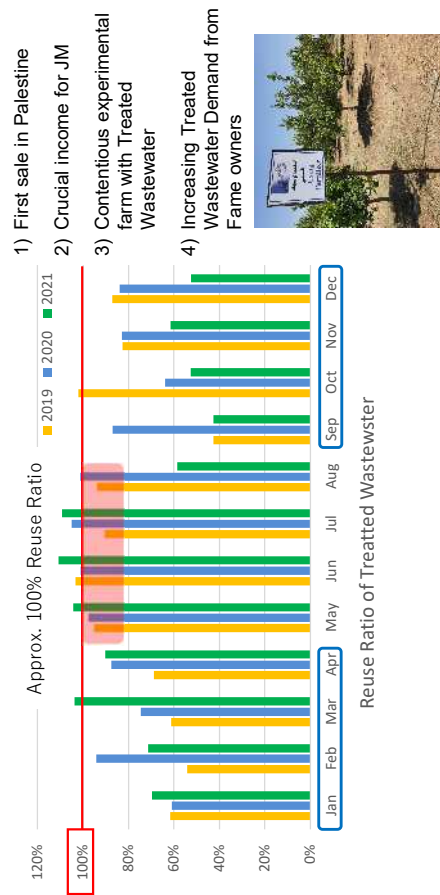
## 9. Area Category in Jericho



- 1) New well construction requires a permission from the "Israel and Palestinian Joint Water Committee".
- 2) Well construction in Area C is more scrutinized than in Areas A & B, and permits take more time to obtain.
- 3) There are many date palm fields around the WWTP, most of which are located in Area C.
- 4) The demand for water is very high.
- 5) Groundwater contains higher salinity rather than treated wastewater.



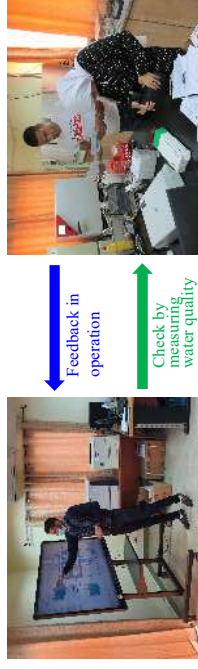
## 10. Reuse Ratio of Treated Wastewater



13

## 11. Water Quality Management

- (1) Water Quality Tests in the Laboratory in the Jericho WWTP
  - OJT with revised SOPs conducted by Japanese Experts
- (2) Periodic water quality monitoring
  - Data accumulation
  - Data analysis (the reuse standards, operation factors, etc.)
- (3) Linkage to the WWTP operation and maintenance
- (4) **Treated wastewater quality assurance**



14

## 12. Pilot Plant at JWWTP

- Start in December 2014
- Palm Date, Oranges, Lemon, Alfalfa, Corn
- Area: 1,750 m<sup>2</sup>
- Potable Water vs Treated Wastewater
- Chemical Fertilizer vs Sewage Sludge
- Evaluation: Appearance, Fruit ingredients



## 13. Appearance, Fruit ingredients (Lemon)



Date	Sample Type
Nov. 2015	Potable & Animal Sludge
Dec. 2022	Treated Wastewater & Sewage Sludge

Source: JICA, TeCSOM Project Completion Report, 2018

15

16

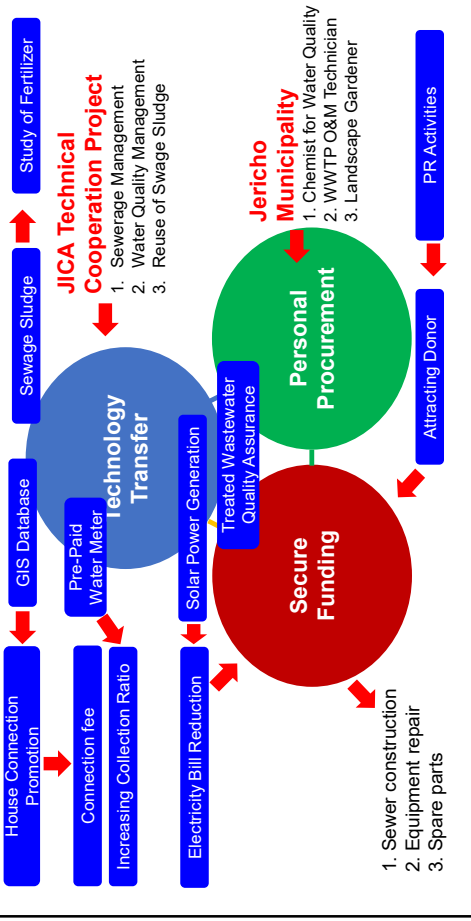
## 14. Jericho Website

Wastewater Treatment Plant

Put Wastewater Service Activities Information/Reports

The screenshot shows the Jericho Municipality website. The navigation menu includes Home, About Us, Services, and Contact Us. A featured article titled "Jericho-Palestine: Introduction and Challenges of Sewerage Projects in the City of Jericho" is highlighted with a red box. Below the article, there is a photo of a wastewater treatment plant and a group of people. A red arrow points from the article title to the photo.

## 15. Major Elements of Sustainable Management



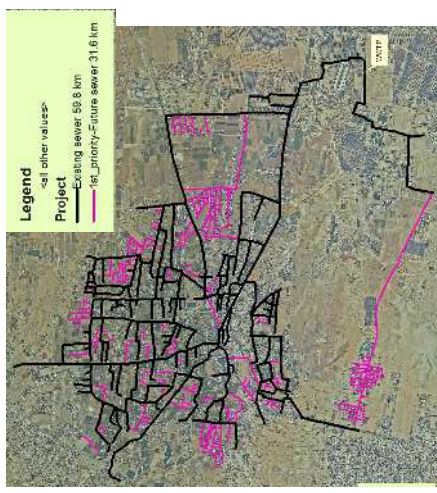
## 16. Toward Success of Donor Supports

- 1) Candidate Donors  
EU, USAID
- 2) New donor since 2018 (USAID supports)



JM has been achieving the valuable city of invests.

- SDGs
- Self-assessment with KPIs
- Information disclosure, etc.



Thank you very much for your Attention



## **Appendix 2.2.1**

# **Water Quality Monitoring Plan**





## **Appendix 2.2.2**

### **Jericho WWTP Water Quality Results and Sludge & Soil Results**



## Report # 3 (Final Report) – Results of the sampling Campaigns in November 2021, November 2022, and April 2023.

*Date: April 28, 2023*

### *Changes to Context*

No changes in the context since the second sampling campaign in November 2022.

The second sampling campaign was planned on the 28<sup>th</sup> September 2022, but due to political instability in the West Bank and several incursions of the Israeli forces to cities, including a siege on Nablus, the sampling campaign was postponed to November 2022.

The second and third sampling campaign was supposed to include sampling from of effluent of Jericho Agro-Industrial Park (JAIP), but since the pretreatment unit of JAIP's is not ready, all samples taken from the influent of Jericho's wastewater treatment plant are considered from domestic sources.

A new agreement between ANNU (An-Najah National University) and NJS CO. was made in September 2022 to add the sampling and analysis of soil samples from a pilot farm in Jericho.

From the 1<sup>st</sup> October 2022, the ANNU has made a restructuring for its scientific centers were several centers and institutes were merged to newly established centers. The water and environmental studies institute was dissolved and its units were merged with others centers under the newly established center; Energy, Water and Food Security Research Center. Dr. Anan Jayousi was appointed as the manger of the center and so he will be contact person for the NJS contract.

### *Summary*

Three sampling campaigns were conducted to monitor the performance Jericho's Wastewater Treatment Plant (WWTP) on 23/11/2021, 02/11/2022, and on 03/04/2023. Each time three samples were collected mainly from:

- Influent stream to the WWTP
- Effluent stream from the WWTP
- Accumulated sludge onsite

In addition to soil samples taken from a pilot farm (Samed Land) on 16/11/2022, and 03/04/2023. Photos of the sampling event in November 2022 and April 2023 are given in the annex.



Samples were analyzed at the laboratories of Energy, Water and Food Security Research Center, An-Najah National University (ANNU), Nablus, and according to standard procedures as outlined in the reports. Official laboratory reports of analyses' results were issued on:

- 28/12/2021 for the first campaign;
- 28/11/2022 of the second campaign;
- And on 19/04/2023 for the third campaign.

Data was analyzed and report was drafted by Dr. Abdel Fattah Hasan.

### Discussion of Results

Direct results of the analysis are in **bold** and underlined.

#### - Jericho WWTP performance

Jericho WWTP is utilizing an extended aeration technology and aimed for removal of solids and organic content of wastewater with biological nutrient removal, mainly for nitrogen. So, the following parameters are usually used to describe the efficiency of similar plants; Biochemical Oxygen Demand (BOD<sub>5</sub>), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Nitrogen (TN) and Phosphorous as phosphate (PO<sub>4</sub>-P). Based on analysis reports, the following efficiencies were achieved by WWTP (Table 1).

Table 1. Performance of Jericho WWTP.

No.	Parameter (mg/L)	Results of November 2021			Results of November 2022			Results of April 2023		
		Influent	Effluent	Efficiency	Influent	Effluent	Efficiency	Influent	Effluent	Efficiency
1	BOD <sub>5</sub>	675	21	97%	647	22	97%	485	14	97%
2	COD	1050	39	96%	1002	56	94%	878	22	97%
3	TSS	585	9.5	98%	595	13.6	98%	450	22	95%
4	TN	101	8.9	91%	118	10	92%	107	10	91%
5	PO <sub>4</sub> -P	39.1	9.3	76%	37.5	8.3	78%	33	5.1	85%

**Based on the achieved efficiencies during 2021, 2022, and 2023, Jericho WWTP's performance is high, and the plant is continued to be well operated.**

#### - Jericho WWTP Influent

By comparing the influent characteristics of the collected samples in November of 2021 and 2022 to the requirements of the Palestinian regulations on connection of premises to public sewers #16-2013 (Table 2), the influent is described as of mostly domestic origin, and can be received by the WWTP without any additional pretreatment. All values of the influent results are well below the requirements, except for Fat, Oil and Grease (FOG) which can be easily removed from the treated wastewater in the grit chamber. FOG is mostly of domestic (residential houses) and commercial (restaurants and hotels) origins.





In case of no use of grease traps in restaurant and hotels, and providing that Jericho is touristic city especially for winter times, such values of FOG (144, 137.5, and 118 mg/l) are expected to be found in raw wastewater.

Table 2. Jericho WWTP Influent Characteristics.

No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Limits according to 16/2013
1	Total Suspended Solids (TSS)	mg/L	585	595	450	600
2	Chemical oxygen Demand (COD)	mg/L	1,050	1002	878	2,000
3	Fat, Oil and Grease	mg/L	144	137.5	118	100
4	Phenol	mg/L	0.08	0.07	.07	10
5	Detergents (MBAS)	mg/L	6.5	6.0	4.0	40
6	Chloride (Cl <sup>-</sup> )	mg/L	375	325	395	500
7	Sulphate (SO <sub>4</sub> )	mg/L	50	76.4	91.1	1,000
8	Sodium (Na)	mg/L	205.5	192	213	500
9	Aluminum (Al)	µg/L	2858.5	1198.7	333.9	10,000
10	Arsenic (As)	µg/L	2.46	2.8	6.7	5,000
11	Copper (Cu)	µg/L	74.8	66.6	24.2	4,500
12	Iron (Fe)	µg/L	3650.1	1348.9	903.1	50,000
13	Manganese (Mn)	µg/L	84.8	58.6	44.4	10,000
14	Nickel (Ni)	µg/L	16.4	8.4	8.4	4,000
15	Selenium (Se)	µg/L	3.94	10.7	31.9	50
16	Cadmium (Cd)	µg/L	0.53	0.3	0.1	1,000
17	Zinc (Zn)	µg/L	344.6	141.8	90.6	15,000
18	Cobalt (Co)	µg/L	1.64	0.8	0.7	50
19	Chrome (Cr)	µg/L	21.6	11.5	13.1	5,000
20	Boron (B)	µg/L	213.3	139.2	144.5	5,000
21	Cyanide (CN)	µg/L	0.0	0.0	0.0	2,000
22	Mercury (Hg)	µg/L	0.0	0.0	0.0	500
23	Tin (Sn)	µg/L	0.0	0.0	0.0	10,000
24	Beryllium (Be)	µg/L	0.13	0.04	0.06	5,000
25	Barium (Ba)	µg/L	85.0	70.0	47.5	10,000
26	Silver (Ag)	µg/L	0.1	0.3	0.2	1,000
27	Lithium (Li)	µg/L	1.3	12.9	18.3	5,000
28	Vanadium (V)	µg/L	16.54	9.2	16.3	100
29	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	675	647	485	---
30	Dissolved Oxygen (DO)	mg/L	0.0	0.0	0.0	---



No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Limits according to 16/2013
31	Total Soluble materials(TDS)	mg/L	1272	1218	1260	---
32	pH	---	7.9	7.8	7.28	---
33	Nitrate Nitrogen(NO <sub>3</sub> -N)	mg/L	0.0	0.0	0.0	---
34	Ammonium Nitrogen(NH <sub>4</sub> -N)	mg/L	70	92	82	---
35	Total Nitrogen	mg/L	101	118	107	---
36	Magnesium(Mg)	mg/L	4.7	58.99	29.2	---
37	Calcium(Ca)	mg/L	162.5	93.5	168	---
38	Sodium Adsorption(SAR)	mg/L	4.3	3.8	3.98	---
39	Phosphate Adsorption(PO <sub>4</sub> -P)	mg/L	39.1	37.5	33	---
40	Lead(Pb)	µg/L	8.9	5.3	2.2	---
41	Eggs of intestinal worms Nematodes	Egg/50ml	Detected	Detected	Detected	---
42	Fluoride(F)	µg/L	5.28	5.1	4.8	---
43	Fecal Coliform bacteria	CFU/100ml	9*10 <sup>6</sup>	7*10 <sup>6</sup>	TMTC	---
44	Bacteria <i>E.coli</i>	CFU/100ml	5*10 <sup>6</sup>	4*10 <sup>6</sup>	TMTC	---

#### - Jericho WWTP Effluent

Same for the effluent from the Jericho WWTP, and by comparing results of the collected samples in 2021, 2022, and 2023 with the PS 742-2015, the effluent is almost Type A after disinfection (Table 3).



Table 3. Jericho WWTP Effluent Characteristics

No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Quality Criteria based on PS 742-2015			
						Type A	Type B	Type C	Type D
1	Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	21	22	14	20	20	40	60
2	Total Suspended Solids (TSS)	mg/L	9.5	13.6	22	30	30	50	90
3	Fecal coliform bacteria (Before Chlorination)	CFU/100ml	7.0*10 <sup>4</sup>	3.6*10 <sup>4</sup>	3*10 <sup>3</sup>	200	1000	1000	1000
	Fecal coliform bacteria (After Chlorination)	CFU/100ml	60	22	7	200	1000	1000	1000
4	Chemical oxygen Demand (COD)	mg/L	39	56	22	50	50	100	150
5	Dissolved Oxygen (DO)	mg/L	2.3	2.2	2.5	>1	>1	>1	>1
6	Total Soluble materials (TDS)	mg/L	1129	1135	1140	1200	1500	1500	1500
7	pH	----	7.6	7.5	7.4	6-9	6-9	6-9	6-9
8	Fat, Oil and Grease	mg/L	< 5	<5	<5	5	5	5	5
9	Phenol	mg/L	0.002	<0.002	<0.002	0.002	0.002	0.002	0.002
10	Detergents (MBAS)	mg/L	0.1	0.1	0.1	15	15	15	25
11	Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	5.6	8.7	10.3	20	20	30	40
12	Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/L	0.0	<1.0	0.0	5	5	10	15
13	Total Nitrogen (T-N)	mg/L	8.9	<10	<10	30	30	45	60
14	Chloride (Cl <sup>-</sup> )	mg/L	350	355	310	400	400	400	400
15	Sulphate (SO <sub>4</sub> )	mg/L	135	123.9	138.3	300	300	300	300
16	Sodium (Na)	mg/L	196	199	190	200	200	200	200
17	Magnesium (Mg)	mg/L	4.9	57.7	19.4	60	60	60	60
18	Calcium (Ca)	mg/L	126.5	80.8	160	300	300	300	300



No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Quality Criteria based on PS 742-2015			
						Type A	Type B	Type C	Type D
19	Sodium Adsorption Ratio (SAR)	-	4.7	4.13	3.77	5.83	5.83	5.83	5.83
20	Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	9.3	8.3	5.1	15-20	15-20	15-20	15-20
21	Aluminum (Al)	µg/L	13.82	10.9	18.8	5000	5000	5000	5000
22	Arsenic (As)	µg/L	1.28	3.0	4.6	100	100	100	100
23	Copper (Cu)	µg/L	3.25	4.2	3.8	200	200	200	200
24	Iron (Fe)	µg/L	182.2	240.4	304.1	5000	5000	5000	5000
25	Manganese (Mn)	µg/L	11.7	11.9	27.2	200	200	200	200
26	Nickel (Ni)	µg/L	4.7	4.1	5.1	200	200	200	200
27	Lead (Pb)	µg/L	0.20	0.20	0.3	200	200	200	200
28	Selenium (Se)	µg/L	5.09	11.9	12.7	20	20	20	20
29	Cadmium (Cd)	µg/L	0.0	0.0	0.0	10	10	10	10
30	Zinc (Zn)	µg/L	12.5	21.6	25.4	2000	2000	2000	2000
31	Cobalt (Co)	µg/L	0.33	0.4	0.4	50	50	50	50
32	Chrome (Cr)	µg/L	1.13	3.5	5.9	100	100	100	100
33	Boron (B)	µg/L	111.0	144.5	121.4	700	700	700	700
34	Cyanide (CN)	µg/L	0.0	0.0	0.0	50	50	50	50
35	Mercury (Hg)	µg/L	0.0	0.0	0.0	1	1	1	1
36	Bacteria <i>E.coli</i> (Before Chlorination)	CFU/100ml	3.0*10 <sup>4</sup>	6.0*10 <sup>2</sup>	5.0*10 <sup>2</sup>	1000	1000	1000	100
	Bacteria <i>E.coli</i> (After Chlorination)	CFU/100ml	20	8	6	1000	1000	1000	100
37	Eggs of intestinal worms Nematodes	Egg/500ml	Not Detected	Not Detected	Not Detected	<1	<1	<1	<1
38	Fluoride(F)	µg/L	0.47	0.45	0.4	---	---	---	---
39	Tin(Sn)	µg/L	0.0	0.0	0.0	---	---	---	---
40	Beryllium(Be)	µg/L	0.0	0.0	0.0	---	---	---	---
41	Barium(Ba)	µg/L	17.1	31.5	38.5	---	---	---	---
42	Silver(Ag)	µg/L	0.2	0.0	0.2	---	---	---	---
43	Lithium(Li)	µg/L	14.8	14.0	9.3	---	---	---	---
44	Vanadium(V)	µg/L	3.5	6.2	9.9	---	---	---	---



The Palestinian Technical Obligatory Regulations for treated wastewater (TWW) reuse, 34-2012 and the Palestinian TWW Specification, PS 742-2015 provide the bases for reuse of TWW in irrigation. The cropping pattern to be adopted is usually based on the assessment of the main parameters in comparison with the specification limits, to determine the water quality grade, then the non-differentiating other quality parameters to determine the group of potential crops or /and the required mitigation measures to minimize the crop reduction i.e. leaching fraction, which is water infiltrating down in the ground and become not available to the plant.

In general, the Palestinian standards PS 742-2003 follow both Jordanian and Israeli regulations. The standards follow the same approach in defining TWW quality classes based on physical, chemical, parasitological, and heavy metal parameters as the case of the Jordanian standards and at the same time it adopted the Israeli approach of barriers which are additional measures allows to irrigate the same crop with the different quality grades but with different required barriers. Based on such classification, four classes (A, B, C and D) are identified, being A is the highest quality and so on. Each quality has a specific maximum value allowed for the treated wastewater content of BOD, COD, TN, PO<sub>4</sub>-P, TSS, TDS, Fecal Coliforms and heavy metals.

Although the Palestinian specification classifies the treated effluent to 4 classes, many crops can be irrigated with more than a water class but with additional measures termed "barriers" to compensate for the lower effluent quality as shown in Table 3. This approach is adopted from the Israeli approach,

Barriers which in addition to water quality determine the types of crops to be irrigated with TWW are:

- i. A distance not less than 50 cm between drippers and the fruit is considered 2 barriers
- ii. A distance not less than 25 cm between drippers and the fruit is considered 1 barrier
- iii. A distance not less than 50 cm between the sprinkler nozzle and the lower fruit branch level fruit is considered 1 barrier, this barrier is adopted from the Israeli standards, in which the sprinkler nozzles refer to the micro-sprinklers used in greenhouses, pointing downwards, away from the fruit. This barrier could be implemented for tree crops by lowering the sprinkler nozzles below the lower fruit branches and/ or raising the fruiting branches above the nozzles as clarified by ministry of agriculture.
- iv. Plastic Soil mulch between the TWW and the fruit is considered 1 barrier
- v. Subsurface drip irrigation is considered 2 barriers
- vi. Other barriers:
  - a. A fruit with shell or an edible cover is considered 1 barrier



- b. A crop that is only cooked eaten is considered 1 barrier: this barrier is not relevant as the specification does not allow irrigating any type of vegetables given the fact that all other permissible crops do not need cooking.
- vii. Filtering, retention and disinfection:
- Sand filter is considered as 1 barrier
  - The retention of TWW not less than 15 days is considered as 1 barrier
  - A storage /collecting pool containing no more than 10 % TWW is considered 1 barrier
  - The disinfection of TWW with Chlorine, and the residual chlorine not less 0.5 mg/l and contact time not less than half an hour or any other disinfection method is considered 1 barrier
- viii. Crops that do not need barriers:
- Industrial crops like cotton
  - Crops for seed, seedling
  - Timber trees and forestry with no public contact
  - The production of turfs and lawns to be sold without public contact with the production sites
  - Nurseries
  - Ornamental and decorative plants

Given that the Palestinian specifications and regulation prevents irrigating vegetables, it can therefore be considered internationally competitive regulations on TWW for agricultural reuse. Most parameters are strictly regulated which reflects its close approach to the Israeli standard. In addition to the strict exclusion of all vegetables, the regulation conditioned that each TWW reuse scheme should obtain a specific reuse permit from ministry of agriculture, that is renewed periodically and is given for specific grower, crops, areas and duration.

**Based on Table 3, and above discussion. Jericho WWTP's effluent from 2021 to 2023 can be used for all purposes mentioned in Table 4 for Type A. In case quality was deformed to Type B or less, then the uses are listed also each type in Table 4, according to the Technical Obligatory Regulations, 34-2012.**

Table 4. Permitted Use of Treated Wastewater for the Different Effluent Quality Grades\* (adapted from the Palestinian Technical Obligatory Regulations, 34-2012)

Class	Parameter	Concentration	Allowable use and required barriers
Grade A	BOD	20 mg/l	<ul style="list-style-type: none"> <li>unrestricted irrigation of all crops, except vegetables</li> <li>no barriers needed under any type of irrigation systems</li> <li>under sprinkler systems 50m from public areas is conditioned as public protection measure</li> </ul>
	TSS	30 mg/l	
	F. coli	<200 CPU/100ml	
	Total -N	30mg/l	
	TDS	1200 mg/l	
Grade B	BOD	20 mg/l	<ul style="list-style-type: none"> <li>unrestricted irrigation of dry and green fodder without barriers under any irrigation system</li> <li>tree crops require 2 barriers</li> </ul>
	TSS	30 mg/l	



Class	Parameter	Concentration	Allowable use and required barriers
	F. coli	<1000 CPU/100ml	<ul style="list-style-type: none"> <li>under sprinkler systems 80m from public areas is conditioned as public protection measure</li> </ul>
	Total -N	30 mg/l	
	TDS	1500 mg/l	
Grade C	BOD	40 mg/l	<ul style="list-style-type: none"> <li>unrestricted irrigation of dry and green fodder without barriers</li> <li>under any irrigation system</li> <li>tree crops require 2 barriers</li> <li>under sprinkler systems 120m from public areas is conditioned as public protection measure</li> </ul>
	TSS	50 mg/l	
	F. coli	<1000 CPU/100ml	
	Total -N	45 mg/l	
	TDS	1500 mg/l	
Grade D	BOD	60 mg/l	<ul style="list-style-type: none"> <li>unrestricted irrigation of dry fodder without barriers under any irrigation system</li> <li>irrigation of green fodder is prohibited</li> <li>tree crops require 3 barriers</li> <li>under sprinkler systems 150m from public areas is conditioned as public protection measure</li> </ul>
	TSS	90 mg/l	
	F. coli	<1000 CPU/100ml	
	Total -N	60 mg/l	
	TDS	1500 mg/l	

\* Major parameters which are related to treatment level and technology are shown in this table but the grade of the effluent is determined by the complete set of parameters as in the first table

**Furthermore the effluent sodicity (SAR) and salinity of the treated effluent are critical parameters to screen the potential crops and the required leaching fraction of them, Table 5 below shows the FAO guidelines of water quality interpretation in irrigation. Hereby, Jericho WWTP's effluent require slight to moderate degree of restriction on reuse based on TDS values 1129-1135 mg/L, and slight to moderate leaching by infiltrating fresh water based on SAR values as 4.13-4.7.**

Table 5. Guidelines for Interpretations of Water Quality for Irrigation Quoted from FAO "Water Quality for Irrigation"

Potential Irrigation Problem		Units	Degree of Restriction on Use			
			None	Slight to Moderate	Severe	
Salinity						
	EC <sub>w</sub>	dS/m	< 0.7	0.7 – 3.0	> 3.0	
	(or)					
	TDS	mg/l	< 450	450 – 2000	> 2000	
Infiltration						
SAR	= 0 – 3	and EC <sub>w</sub>	dS/m	> 0.7	0.7 – 0.2	< 0.2
	= 3 – 6			> 1.2	1.2 – 0.3	< 0.3
	= 6 – 12			> 1.9	1.9 – 0.5	< 0.5



Potential Irrigation Problem	Units	Degree of Restriction on Use		
		None	Slight to Moderate	Severe
= 12 – 20		> 2.9	2.9 – 1.3	< 1.3
= 20 – 40		> 5.0	5.0 – 2.9	< 2.9

**- Jericho WWTP Sludge**

Sludge results for Jericho WWTP’s sludge samples of November 2021 and 2022, and April 2023 are discussed here against the Palestinian Standard PS 609-2014 for organic fertilizers and soil conditioners, and the Palestinian mandatory technical instructions #59-2015 for treated sludge uses for agricultural purposes.

**It is important to note that the PS 609-2014 is about processing, storing, transporting, packaging, and applying organic fertilizers and soil conditioners, and is discussed in this report in concern to the reuse of Jericho WWTP’s sludge.**

Results and limits for all uses as fertilizers, soil conditioners and agricultural purposes are listed in table 6.

The PS 609-2014 defines organic materials as carbon materials of animal or vegetable origin or a mixture of them. Also, defines the organic soil additives as:

- Organic soil conditioners: They are organic materials that are added to the soil in order to improve its physical and biological properties. Organic soil conditioners are not classified as fertilizers because they contain a small percentage of the three main nutrients, namely nitrogen, phosphorous and potassium, which are usually less than 2% of the mass of the product. These organic materials should have been subjected to fermentation processes, which include sterilization by high temperature for a sufficient period of time, to ensure that they are free from insect eggs, remnants of viable weeds, and microorganisms such as fungi and bacteria, .....etc.
- Organic fertilizer: It is the fertilizer resulting from the addition of the main nutrients and any other nutrients sourced from the process of biological decomposition of organic materials to the organic soil conditioner with a percentage exceeding 2% of the mass of the product and not more than 20%. **Sludge produced from WWTPs is not allowed to be used as fertilizer in any form.**

Table 6. Characteristics for sludge accumulated in Jericho WWTP and the Palestinian requirements for the use as fertilizer or soil conditioners.

No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Limits as soil fertilizer based on PS609-2014	Limits as soil conditioner based on PS609-2014	Sludge quality based on TI 59-2015	Soil quality receiving sludge based on TI 59-2015
1	Nitrogen (N)	mg/Kg	28550	40000	44100		>1500		





No.	Parameter	Unit	Results Nov. 21	Results Nov. 22	Results Apr. 23	Limits as soil fertilizer based on PS609- 2014	Limits as Soil conditione r based on PS609- 2014	Sludge quality based on TI 59-2015	Soil quality receiving sludge based on TI 59- 2015
2	Lime (as CaCO <sub>3</sub> )	mg/Kg	41,795	27,097	26,895				
3	Magnesium (Mg)	mg/Kg	2,430	6,640	6,860				
4	Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/Kg	219.2	215.0	205				
5	Kalium (K <sub>2</sub> O)	mg/Kg	323.2	326	320				
6	Arsenic (As)	mg/Kg	0.00	0.02	1.79	15	15		
7	Copper (Cu)	mg/Kg	0.179	1.81	230.73			1000	50
8	Nickel (Ni)	mg/Kg	0.026	0.15	24.82	50	50	300	30
9	Lead (Pb)	mg/Kg	0.018	0.15	22.99	120	120	750	50
10	Cadmium (Cd)	mg/Kg	0.00	0.00	1.2	3	3	20	1
11	Zinc (Zn)	mg/Kg	0.55	3.59	518.89			2500	150
12	Chromium (Cr)	mg/Kg	0.039	0.28	31.36	100	100	400	20
13	Mercury (Hg)	mg/Kg	0.0	0.0	0.0	1.5	1.5	16	1
14	Eggs of Intestinal Nematodes	Egg/100 gm	Detected	Detected	Detected				
15	pH	----	6.8	6.9	6.85	<7.5	<7.5		
16	EC	ms/cm	7.7	7.5	8.7		<15		
17	Moisture Content	%	9.9	8.9	14.4	<15%	<20%		
18	Total Fecal Coliform	CFU/100 ml	Nil	Nil	Nil				
19	Total Organic Matter	%	62.83	63.76	59.9	>45%	>50%		
20	Bulk Density	g/L	525	545	625				
21	Powdered Sludge Density	g/L	839	770	859				
22	C:N		11:1	8:1	13:1	<15:1			
23	Added nutrients		Nil	Nil	Nil	<20%			

In addition to the following classifications of organic additives:



Formed as granules, cylindrical pellets, or tablets.

Unformed (loose or packed).

The PS 609-2014 also requires the following conditions for storage and transportation:

- The organic fertilizer and soil conditioner shall be stored in dry stores that are not exposed to moisture, sunlight and pollution. They are also stored in special packages so that they can bear the loading and unloading.
- When shipping and transporting, care should be taken to preserve the integrity of the packages and their contents.
- In the case of bulk shipment of fertilizers and organic soil conditioner (without packages), this must be done in closed special trucks, taking all necessary precautions to ensure that they are not exposed to contamination.
- The separation between (organic fertilizers and organic soil conditioners), pesticides and any other materials.

Finally, the following general requirements must be met for organic soil conditioner and compost:

- The product should be of animal and/or vegetable origin and the use of sludge from sewage stations is not allowed, same for solid waste origin. **This point was discussed and confirmed with MoA (Eng. Imad Ghonmeh, Soil Department), where Mr. Ghonmeh stated that for Jericho's WWTP, sludge can be considered as treated (thickened and sun dried), and so can be used for producing compost and can be applied according to the Technical Instructions # 59-2015 (discussed below)**
- The compost must be free of any substances harmful to the soil and plants
- It shall be free from weed seeds, weeds, and viable plant parts.
- It shall be free from pathogens and harmful insects.
- The compost must not contain any foreign material visible to the eye.
- The compost must be homogeneous in texture and free of lumps that could impede its regular distribution in the soil.
- The granular fertilizer should flow easily.
- It shall be dry and without an unpleasant smell.
- The ratio of nitrogen, phosphorous and potassium must match the percentage specified on the label.

**Based on the results in Table 6 and the above requirements, sludge of Jericho's WWTP even though meets the requirements of the PS 609-2014 can't be used as fertilizer, but can be used as soil conditioner and can be used for preparation of compost. Moreover, based on the Palestinian mandatory technical instructions #59-2015, Jericho WWTP's sludge can be used for agricultural purposes according the below definitions and providing the required conditions.**

**For the results of April 2023, some changes in the quality of the sludge were detected for some heavy metals (Cu, Ni, Pb, Cd, Zn, and Cr) were concentrations found in relevance**



**to the 2021 and 2022 results. All still within the limits except for Cd (1.2 mg/kg) exceeded the TI 59-2015. The reason for such an elevation in concentrations of these heavy metals might be attributed to some industrial discharges. Time of accumulating the sampled sludge can't be determined for sure, but this can be checked by reviewing the plant's records of COD. A verification sampling and analysis of new sludge samples is scheduled to check for such variation.**

The objective PS 59-2015 is to regulate the production and use of treated sewage sludge in agriculture in a way that limits Environmental damages and prevents harmful environmental effects on soil, vegetation, animals and humans, thus encouraging Correct use of this sludge.

Sludge: Solids of wet or dry consistency remaining in:

- 1) sewage plants that treat domestic, urban or related wastewater Similar composition to it.
- 2) sedimentation ponds and other similar facilities for sewage treatment.
- 3) Sewage stations other than those mentioned in points (1) and (2).

Treated sludge: sludge that has undergone biological (biological), chemical or thermal treatment, or storage over a long period of time or any other suitable process to significantly reduce its fermentability and health hazards and the environment resulting from its agricultural use.

- Agriculture: Cultivation of all types of crops (food, commercial and industrial) and any other uses related to Agricultural production, such as agricultural reclamation and seedling production.
- Use of sludge: Adding treated sludge to the soil or any other addition to it. For saturated paste extract (EC)
- Saline soil: Soil in which the electrical conductivity level is (dS/L) > 2.5 dS/L. (Saturated paste extract)
- Producer: The entity that produces the treated sludge locally or imports it from abroad under a license issued on the authority of the competent authority.
- The Competent Entity: The entity or entities specified by the Council of Ministers to implement the provisions of these Instructions in accordance with the Article (23) of the Standards and Metrology Law and other relevant applicable laws.



Sludge must be treated, and the approval of the competent authority must be obtained before it is used in agriculture in accordance with this instructions. The concentration of heavy metals in the soil to which the treated sludge is added should not exceed the limits The maximum limit given in Table 6.

The concentration of heavy metals in the treated sludge should not exceed the maximum limits mentioned in Table 6. It should not exceed the annual maximum quantities of these heavy metals that can be submitted to the prepared soil). For planting beyond the maximum limits set out in Table 6. The competent authority shall prevent the use of treated sludge if the analysis shows that one or more concentrations of Heavy metals in soils exceed the maximum limits set out in Table 6 and take the necessary steps to ensure that these limits are not exceeded as a result of sludge use.

The competent authority should regulate the use of treated sludge in a way that does not lead to the accumulation of heavy metals in the soil).

To achieve this, one must be applied - when analyzed to exceed the maximum limits mentioned and the following actions are needed (a) The competent authority shall set the maximum limits for the quantities of treated sludge, expressed in units (tons) of dry matter that can be added to the soil per unit area (dunums) per year with Attention to the maximum concentrations of heavy metals in treated sludge given in Annex (2) of the instructions.

The competent authority must ensure that the quantities of heavy metals that have been added to the food supply are not exceeded Soil per unit area (dunam) annually to the maximum limits specified in Annex (3) of the instructions.

The competent authority shall regulate the use of treated sludge in saline soils. Producers of treated sewage sludge shall provide the information contained in the Appendix (4) of the instructions.

The competent authority shall prevent the use of treated sludge or provide it for use in:

- a) Grassland or forage crops if the grassland is to be grazing or the crops are harvested Feed before the expiration of a certain period of use. The competent authority must determine this period, taking into account geographic and climatic factors, provided that it should not be less than 3 weeks in any case.
- b) Soil planted with fruit and vegetable crops, excluding fruit trees.
- c) The land prepared for cultivation with crops of fruits and vegetables, which are usually in direct contact with the soil. It is eaten raw, for 10 months prior to harvesting the crops and during the harvest itself.



## Jericho Soil

### MoA Samples (2020)

Results of soil analysis for three samples collected and analyzed by the MoA (National Agricultural Research Center (NARC)), were received through NJS (Table 7).

*Table 7. Jericho's Soil Analysis for three samples collected in 2020 by MoA.*

No.	Parameter	Unit	Sample 1	Sample 2	Sample 3
1	pH	mg/l	8.11	7.94	7.96
2	EC	dS/m	4.8	8.3	6.2
3	Cl	ppm	1524	2304	3403
4	Na	ppm	100	90	180
5	K	ppm	80	90	180
6	Ca	meq/L	6	15	52.5
7	Mg	meq/L	24	50	41.1
8	CO <sub>3</sub> <sup>-2</sup>	ppm	48	6	6
9	HCO <sub>3</sub> <sup>-</sup>	ppm	63.4	103.7	103.7
10	P <sub>2</sub> O <sub>5</sub>	ppm	0.596	1.772	3.403
11	NO <sub>3</sub> <sup>-</sup>	ppm	1.5	1.5	1.5
12	Total Organic Matter (TOM)	%	1.51	2.13	2.47

Received results of Jericho's soil analysis show that the soil is highly saline and is not suitable for growing sensitive plant varieties. The reason for the increase in salinity is the high concentration of chloride in the soil. From the data in the table, EC is mostly reflected by the Chloride concentration, so based Brown et al. (1954) (Annex 2) for the classification of soil salinity based on EC, The Jericho's soil is saline to strongly saline.

The most important techniques that can be used to deal with such soils are to:

- Cultivate it with medium-resistant crops or salt-resistant crops
- Use of drip irrigation systems to reduce the risk of salinity
- Add an organic substance to improve its chemical and physical properties

Below table shows crop types and their classification in terms of salinity



Table 8. Crops types and their tolerance to salinity.

Salinity rating group	Threshold salinity (dS/m)	Yield salinity (dS/m)
sensitive	1.4	8.0
moderately sensitive	3.0	16.0
moderately tolerant	6.0	24.0
tolerant	10.0	32.0

### - pH

The results of the analysis show that the soil has an alkaline effect (pH: 7.94-8.11), but it is not considered highly alkaline. In general, the best pH is neutral to slightly acidic, i.e. between 6.5 - 7.5. To improve the pH condition in the soil, the following measures must be taken:

- To add an organic substance that improves pH
- To add acidic fertilizers during the agricultural season

### - Chloride

The results of the analyzes show that the chloride in the soil is very high (1524-3403 mg/L) and causes toxicity to plants sensitive to chloride. In general, fruit trees are more sensitive to chloride and boron than vegetables and fodder crops. Using a sprinklers in irrigation system is to be avoided to prevent the leaves from burning.

### - Phosphorous and nitrogen

The results of the analysis show that phosphorous (0.596-3.403 mg/kg as  $P_2O_5$ ) and nitrogen are low (1.5 as  $NO_3^-$  for the three samples) in the soil and the addition of chemical and organic fertilizers is required to improve the fertility condition in this soil.

### - Organic matter:

The results of the analysis show that the percentage of organic matter is acceptable to good in the soil (1.51-2.47 %), as the concentration of organic matter in mineral soil in general ranges between 3-6% and depends mainly on humidity and temperature in the soil. Adding organic matter in the form of biological or plant residues or compost is necessary to improve fertility and increase the percentage of organic matter in this soil.

### - Ca +Mg

The results of the analysis show that the concentration of these elements is good (30-93.6 meq/L) and there is no harm to the plant from these elements.



- **SAR**

For classification purposes, a soil is considered sodic if **Sodium Adsorption Ratio (SAR)** levels are 13 or more, however, these values are just general guidelines and don't imply that the lower numbers will not result in detrimental effects related to soil sodicity, especially for shrinking and expanding clays. If soil results for SAR are more than 5 and the Electrical Conductivity (EC) is less than 2 dS/cm, movement of soil water may be restricted due to swelling, dispersion or both

Received results were used to calculate SAR for Jericho's soil (Table 9) and based on equation 1.

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}} \dots\dots(1)$$

Where all concentrations are in meq/L.

Table 9. SAR results for Jericho's soil analysis results of 2020 as conducted by MoA.

Sample No.	Na (meq/L)	Ca + Mg (meq/L)	SAR
1	4.3	6	1.12
2	3.9	15	0.69
3	7.8	52.5	1.14

**Results show that the soil as moderately sodic (SAR <13), and since SAR is >5 and EC >2, movement of soil water mostly will not restricted by swelling or dispersion, and irrigation by treated wastewater fro Jerich's WWTP will be possible and will not increase the soil sodicity (expressed as SAR) for years.**

**In addition, sludge produced from Jericho's WWTP can be applied to amend the soil nitrogen and phosphorous content and can contribute to increase the organic content of the soil, allover will increase the soil fertility.**

Important not: Application of treated effluent and sludges for agricultural purposes need to take into consideration the quality monitoring requirements as stated in the Palestinian Standards, and technical regulations regarding the number of samples, their frequencies and used equipment for sampling.

WWS Sample (November 2022) and April 2023

For the second and third sampling campaigns, soil samples were collected from a polit farm (Samed Land). The farm is owned by Jericho Municipality and planted 15 citrus and 2 palm trees Photo 1. Samples were taken from the vicinity between the trees, around 1.2 kg soil each and from the subsurface with a starting depth of 15 cm. Results of soil samples are presented in Table 10.



Photo 1. Potential Farm (Samed) in Jericho for Pilot Reuse Project.

Table 10. Results of Soil from Samed Farm, November 2022, and April 2023.

No.	Parameter	Unit	Results Nov. 2022	Results Apr. 2023
1	Nitrogen (N)	mg/Kg	850	8600
2	P as P <sub>2</sub> O <sub>5</sub>	mg/Kg	22.6	22.5
3	K as K <sub>2</sub> O	mg/Kg	32.5	19.6
4	pH	-	7.26	7.2
5	EC	dS/m	1.32	1.065
6	Moisture content	%	9.4	16.5
7	Total Fecal Coliform	CFU/100 ml	Nil	Nil
8	Total Organic Matter (TOM)	%	8.43	13.56
9	C/N	-	99.2	15.86

In Table 10, it can be seen that sludge was applied to the soil where both organic contents and moisture almost doubled (+/-), N increased by 10-folds and so C/N ratio decreased. While for P and K levels didn't significantly change between 2022 (before application the sludge) and in 2023 (after), since both were not abundant in the sludge (see table 6), and so didn't vary in the soil.





## General Conclusion

The results of the WWTP's influent, effluent and sludge from November 2021 to November 2022 didn't change and almost at the same level and the previous conclusions from the first report are valid to this second report.

Results showed that the soil is with at a good level for organic matter content (Table 10; 8.5-14%), dry and with low salinity. N and P content are suitable for cultivation. The soil can be enhanced for irrigated agriculture by using treated wastewater and applying treated sludge, but the N, P and metals contents need to be monitored over a period of time.

End.

## Annex 1.

Photos of the sampling event of November 2022 from Jericho's WWTP influent, effluent, sludge.



# جامعة النجاح الوطنية An-Najah National University

المراكز العلمية |  
Water Research Unit



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# جامعة النجاح الوطنية An-Najah National University

المراكز العلمية | مركز أبحاث الطاقة والماء والأمن الغذائي ووحدة أبحاث المياه  
Water Research Unit

Photos of the sampling event of April 2023 from Jericho's WWTP influent, effluent, sludge



Report of Sample Analysis

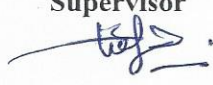
Sample No. 2021110884M		Source Sample No: Influent	
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	24/11/2021
Batch No.	-----	Receiving Time	8:00
Manufacturing Date	-----	Analysis Date	24/11/2021
Exp. Date	-----	Results Issued Date	27/12/2021
Storage Condition	-----	Report Date	28/12/2021
Sample description: One Bottle of 1 liter & one bottle of 2L .			

Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	675		Instruction Manual Method of Velp Scientific
Total Suspended Solids (TSS)	mg/L	585		SMWW 2540D 2017
Fecal coliform bacteria	CFU/100ml	9.0*10 <sup>6</sup>		SMWW 9222- D (2017)
Chemical oxygen Demand (COD)	mg/L	1050		Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	0.0		Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1272		SMWW 2540- C (2017)
pH	----	7.9		SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	144		SMWW 5520 (2017)
Phenol	mg/L	0.080		SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	6.5		P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	0.0		Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/l	70		Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	101		Instruction manual method of HI 83214
Chloride (Cl)	mg/L	375		P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	50		SMWW 4500 S (2017)
Sodium (Na)	mg/L	205.5		SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	4.7		SMWW 4500C (2017)
Calcium (Ca)	mg/L	162.5		SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	4.3		By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	39.1		P (2017) SMWW 4500
Aluminum (Al)	µg/L	2858.5		SMWW 3125
Arsenic (As)	µg/L	2.46		SMWW 3125
Copper (Cu)	µg/L	74.8		SMWW 3125
Iron (Fe)	µg/L	3650.1		SMWW 3125


Tests Results			
Manganese (Mn)	µg/L	84.8	SMWW 3125
Nickel (Ni)	µg/L	16.4	SMWW 3125
Lead (Pb)	µg/L	8.9	SMWW 3125
Selenium (Se)	µg/L	3.94	SMWW 3125
Cadmium (Cd)	µg/L	0.53	SMWW 3125
Zinc (Zn)	µg/L	344.6	SMWW 3125
Cobalt (Co)	µg/L	1.64	SMWW 3125
Chrome (Cr)	µg/L	21.6	SMWW 3125
Boron (B)	µg/L	213.3	SMWW 3125
Cyanide (CN)	µg/L	0.0	SMWW 3125
Mercury (Hg)	µg/L	0.0	SMWW 3125
<i>E. coli</i>	CFU/100ml	5.0*10 <sup>6</sup>	SMWW 9222H-2017
Eggs of intestinal warms Nematodes	Egg/500ml	Detected	Home Method
Fluoride (F)	µg/L	5.28	Instruction Manual method
Tin ( Sn )	µg/L	0.0	SMWW 3125
Beryllium (Be)	µg/L	0.13	SMWW 3125
Barium (Ba)	µg/L	85.0	SMWW 3125
Silver (Ag)	µg/L	0.1	SMWW 3125
Lithium (Li)	µg/L	1.3	SMWW 3125
Vanadium (V)	µg/L	16.54	SMWW 3125

**Notes:**

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Supervisor  
  
Zahran Ashqar



Manager  
  
Dr. Abdel Fattah Mallah

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Report of Sample Analysis

Sample No. 2021110885M	Source Sample No: Effluent		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	24/11/2021
Batch No.	-----	Receiving Time	8:00
Manufacturing Date	-----	Analysis Date	24/11/2021
Exp. Date	-----	Results Issued Date	27/12/2021
Storage Condition	-----	Report Date	28/12/2021
Sample description: One glass bottle of 1L & two glass bottles of 0.5 L .			


Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	21		Instruction Manual Method of VELP Scientific
Total Suspended Solids (TSS)	mg/L	9.5		SMWW 2540D 2017
Fecal coliform bacteria (Before Chlorination )	CFU/100ml	7.0*10 <sup>4</sup>		SMWW 9222- D (2017)
Fecal coliform bacteria (After Chlorination )	CFU/100ml	60		SMWW 9222- D (2017)
Chemical oxygen Demand (COD)	mg/L	39		Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	2.3		Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1129		SMWW 2540- C (2017)
pH	----	7.6		SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	< 5		SMWW 5520 (2017)
Phenol	mg/L	<0.002		SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	0.1		P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	5.6		Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/L	0.0		)Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	8.9		Instruction manual method of HI 83214
Chloride (Cl)	mg/L	350		P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	135		SMWW 4500 S (2017)
Sodium (Na)	mg/L	196		SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	4.9		SMWW 4500C (2017)
Calcium (Ca)	mg/L	126.5		SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	4.7		By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	9.3		P (2017) SMWW 4500
Aluminum (Al)	µg/L	13.82		SMWW 3125
Arsenic (As)	µg/L	1.28		SMWW 3125
Copper (Cu)	µg/L	3.25		SMWW 3125

Tests Results			
Iron (Fe)	µg/L	182.2	SMWW 3125
Manganese (Mn)	µg/L	11.7	SMWW 3125
Nickel (Ni)	µg/L	4.7	SMWW 3125
Lead (Pb)	µg/L	0.20	SMWW 3125
Selenium (Se)	µg/L	5.09	SMWW 3125
Cadmium (Cd)	µg/L	0.0	SMWW 3125
Zinc (Zn)	µg/L	12.5	SMWW 3125
Cobalt (Co)	µg/L	0.33	SMWW 3125
Chrome (Cr)	µg/L	1.13	SMWW 3125
Boron (B)	µg/L	111.0	SMWW 3125
Cyanide (CN)	µg/L	0.0	SMWW 3125
Mercury (Hg)	µg/L	0.0	SMWW 3125
<i>E. coli</i> (Before Chlorination )	CFU/100ml	3.0*10 <sup>4</sup>	SMWW 9222H-2017
<i>E. coli</i> (After Chlorination )	CFU/100ml	20	SMWW 9222H-2017
Eggs of intestinal worms Nematodes	Egg/500ml	Not Detected	Home Method
Fluoride (F)	µg/L	0.47	Instruction Manual method
Tin (Sn)	µg/L	0.0	SMWW 3125
Beryllium (Be)	µg/L	0.0	SMWW 3125
Barium (Ba)	µg/L	17.1	SMWW 3125
Silver (Ag)	µg/L	0.2	SMWW 3125
Lithium (Li)	µg/L	14.8	SMWW 3125
Vanadium (V)	µg/L	3.5	SMWW 3125

**Notes:**

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Supervisor

  
Zahran Ashqar



Manager

  
Dr. Abdel Fattah Mallah


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Report of Sample Analysis

Sample No. 2021110886M	Source Sample No: <b>Sludge</b>		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Dry Sewage Sludge	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	24/11/2021
Batch No.	-----	Receiving Time	8:00
Manufacturing Date	-----	Analysis Date	24/11/2021
Exp. Date	-----	Results Issued Date	27/12/2021
Storage Condition	-----	Report Date	28/12/2021
Sample description : 3-Plastic Bags contain about 1.2 Kg of sludge .			

Tests Results				
Test	Units	Results	Limits	Reference
Nitrogen (N)	%	2.855		Instruction manual method of HI 83214
Lime ( as CaCO <sub>3</sub> )	mg/Kg	41795		SMWW 3500-Ca (2017)
Magnesium ( Mg)	mg/Kg	2430		SMWW 3500-Mg (2017)
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/Kg	219.2		AOAC 960.03
Kalium ( K <sub>2</sub> O)	mg/Kg	323.2		Flame photometer manual
Arsenic (As)	mg/Kg	0.00		SMWW3125
Copper (Cu)	mg/Kg	0.179		SMWW3125
Nickel (Ni)	mg/Kg	0.026		SMWW3125
Lead (Pb)	mg/Kg	0.018		SMWW3125
Cadmium (Cd)	mg/Kg	0.00		SMWW3125
Zinc (Zn)	mg/Kg	0.55		SMWW3125
Chromium (Cr)	mg/Kg	0.039		SMWW3125
Mercury (Hg)	mg/Kg	zero		SMWW3125
Eggs of Intestinal Nematodes	Egg/100gm	Detected		Home Method
pH	----	6.8		SMWW-4500H-2017
EC	ms/cm	7.7		Instruction Manual Method of HACH (HQ14d)
Moisture Content	%	9.9		AOAC 934.01(2016)
Total Fecal Coliform	CFU/100ml	Nil		SMWW 9221E
Total Organic Matter	%	62.83		ICARDA 5.5
Bulk Density	g/L	525		ICARDA 4.6
Powdered Sludge Density	g/L	83.9		ICARDA 4.6

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Supervisor  
  
Zahran Ashqar



Manager

  
Dr. Abdel Fattah Mallah

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قسم التحاليل

Report of Sample Analysis

Sample No. 2022110372M	Source Sample No: Influent		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	2/11/2022
Batch No.	-----	Receiving Time	14:30
Manufacturing Date	-----	Analysis Date	2/11/2022
Exp. Date	-----	Results Issued Date	28/11/2022
Storage Condition	-----	Report Date	28/11/2022
Sample description: One Bottle of 2 liter waste water .			

Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	647		Instruction Manual Method of Velp Scientific
Total Suspended Solids (TSS)	mg/L	595		SMWW 2540D 2017
Fecal coliform bacteria	CFU/100ml	7*10 <sup>6</sup>		SMWW 9222- D (2017)
Chemical oxygen Demand (COD)	mg/L	1002		Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	0.0		Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1218		SMWW 2540- C (2017)
pH	----	7.8		SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	137.5		SMWW 5520 (2017)
Phenol	mg/L	0.07		SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	6.0		P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	0.0		Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/l	92		Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	118		Instruction manual method of HI 83214.
Chloride (Cl <sup>-</sup> )	mg/L	325		P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	76.4		SMWW 4500 S (2017)
Sodium (Na)	mg/L	192		SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	58.99		SMWW 4500C (2017)
Calcium (Ca)	mg/L	93.5		SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	3.8		By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	37.5		P (2017) SMWW 4500
Aluminum (Al)	µg/L	1198.7		SMWW 3125
Arsenic (As)	µg/L	2.8		SMWW 3125



قسم التحاليل

Tests Results				
Cooper ( Cu )	µg/L	66.6		SMWW 3125
Iron (Fe)	µg/L	1348.9		SMWW 3125
Manganese (Mn)	µg/L	58.6		SMWW 3125
Nickel (Ni)	µg/L	8.4		SMWW 3125
Lead (Pb)	µg/L	5.3		SMWW 3125
Selenium (Se)	µg/L	10.7		SMWW 3125
Cadmium (Cd)	µg/L	0.3		SMWW 3125
Zinc (Zn)	µg/L	141.8		SMWW 3125
Cobalt (Co)	µg/L	0.8		SMWW 3125
Chrome (Cr)	µg/L	11.5		SMWW 3125
Boron (B)	µg/L	139.2		SMWW 3125
Cyanide (CN)	µg/L	0.0		SMWW 3125
Mercury (Hg)	µg/L	0.0		SMWW 3125
<i>E. coli</i>	CFU/100ml	4*10 <sup>6</sup>		SMWW 9222H-2017
Eggs of intestinal worms Nematodes	Egg/500ml	Detected		Home Method
Fluoride (F)	µg/L	5.1		Instruction Manual method
Tin ( Sn )	µg/L	0.0		SMWW 3125
Beryllium (Be)	µg/L	0.04		SMWW 3125
Barium (Ba)	µg/L	70.0		SMWW 3125
Silver (Ag)	µg/L	0.3		SMWW 3125
Lithium (Li)	µg/L	12.9		SMWW 3125
Vanadium (V)	µg/L	9.2		SMWW 3125
<sup>2</sup> NO <sub>2</sub>	µg/L	0.0		HI 97707

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Analyst

B. I. al-Shayb



Supervisor

Zahran Ashqar



## قسم التحاليل

## Report of Sample Analysis

Sample No. 2022110373M	Source Sample No: Effluent		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	2/11/2022
Batch No.	-----	Receiving Time	14:30
Manufacturing Date	-----	Analysis Date	2/11/2022
Exp. Date	-----	Results Issued Date	28/11/2022
Storage Condition	-----	Report Date	28/11/2022
Sample description: One glass bottle of 1L & two glass bottles of 0.5 L .			

Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	22		Instruction Manual Method of VELP Scientific
Total Suspended Solids (TSS)	mg/L	13.6		SMWW 2540D 2017
Fecal coliform bacteria (Before Chlorination)	CFU/100ml	3.6*10 <sup>4</sup>		SMWW 9222- D (2017)
Fecal coliform bacteria (After Chlorination)	CFU/100ml	22		SMWW 9222- D (2017)
Chemical oxygen Demand (COD)	mg/L	56		Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	2.2		Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1135		SMWW 2540- C (2017)
pH	----	7.5		SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	< 5		SMWW 5520 (2017)
Phenol	mg/L	<0.002		SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	0.1		P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	8.7		Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/L	< 1.0		)Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	< 10		Instruction manual method of HI 83214
Chloride (Cl)	mg/L	355		P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	123.9		SMWW 4500 S (2017)
Sodium (Na)	mg/L	199		SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	57.7		SMWW 4500C (2017)
Calcium (Ca)	mg/L	80.8		SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	4.13		By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	8.3		P (2017) SMWW 4500



قسم التحاليل

Tests Results				
Aluminum (Al)	µg/L	10.9		SMWW 3125
Arsenic (As)	µg/L	3.0		SMWW 3125
Copper (Cu)	µg/L	4.2		SMWW 3125
Iron (Fe)	µg/L	240.4		SMWW 3125
Manganese (Mn)	µg/L	11.9		SMWW 3125
Nickel (Ni)	µg/L	4.1		SMWW 3125
Lead (Pb)	µg/L	0.2		SMWW 3125
Selenium (Se)	µg/L	11.9		SMWW 3125
Cadmium (Cd)	µg/L	0.0		SMWW 3125
Zinc (Zn)	µg/L	21.6		SMWW 3125
Cobalt (Co)	µg/L	0.4		SMWW 3125
Chrome (Cr)	µg/L	3.5		SMWW 3125
Boron (B)	µg/L	144.5		SMWW 3125
Cyanide (CN)	µg/L	0.0		SMWW 3125
Mercury (Hg)	µg/L	0.0		SMWW 3125
<i>E. coli</i> (Before Chlorination )	CFU/100ml	6*10 <sup>2</sup>		SMWW 9222H-2017
<i>E. coli</i> (After Chlorination )	CFU/100ml	8		SMWW 9222H-2017
Eggs of intestinal worms Nematodes	Egg/500ml	Not Detected		Home Method
Fluoride (F)	µg/L	0.45		Instruction Manual method
Tin (Sn)	µg/L	0.0		SMWW 3125
Beryllium (Be)	µg/L	0.0		SMWW 3125
Barium (Ba)	µg/L	31.5		SMWW 3125
Silver (Ag)	µg/L	0.0		SMWW 3125
Lithium (Li)	µg/L	14.0		SMWW 3125
Vanadium (V)	µg/L	6.2		SMWW 3125

Notes:

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Analyst

Bilal Shajk



Supervisor

Zahran Ashaqa

Zahran Ashaqa

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قسم التحاليل

Report of Sample Analysis

Sample No. 2022110374M	Source Sample No: Sludge		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Sludge	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	2/11/2022
Batch No.	-----	Receiving Time	14:30
Manufacturing Date	-----	Analysis Date	2/11/2022
Exp. Date	-----	Results Issued Date	28/11/2022
Storage Condition	-----	Report Date	28/11/2022
Sample description: Plastic Bag contain about 3 Kg of sludge.			

Tests Results				
Test	Units	Results	Limits	Reference
Nitrogen (N)	%	4.0		Instruction manual method of HI 83214
Lime ( as CaCO <sub>3</sub> )	mg/Kg	27097		SMWW 3500-Ca (2017)
Magnesium ( Mg)	mg/Kg	6940		SMWW 3500-Mg (2017)
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/Kg	215.0		AOAC 960.03
Kalium ( K <sub>2</sub> O)	mg/Kg	326		Flame photometer manual
Arsenic (As)	mg/Kg	0.02		SMWW3125
Copper (Cu)	mg/Kg	1.81		SMWW3125
Nickel (Ni)	mg/Kg	0.15		SMWW3125
Lead (Pb)	mg/Kg	0.15		SMWW3125
Cadmium (Cd)	mg/Kg	0.00		SMWW3125
Zinc (Zn)	mg/Kg	3.59		SMWW3125
Chromium (Cr)	mg/Kg	0.28		SMWW3125
Mercury (Hg)	mg/Kg	0.0		SMWW3125
Eggs of Intestinal Nematodes	Egg/100gm	Detected		IHome Method
pH	----	6.9		SMWW-4500H-2017
EC	ms/cm	7.5		Instruction Manual Method of HACH (HQ14d)
Moisture Content	%	8.9		AOAC 934.01(2016)
Total Fecal Coliform	CFU/100ml	Nil		SMWW 9221E
Total Organic Matter	%	63.76		ICARDA 5.5
Bulk Density	g/L	545		ICARDA 4.6
Powdered Sludge Density	g/L	770		ICARDA 4.6

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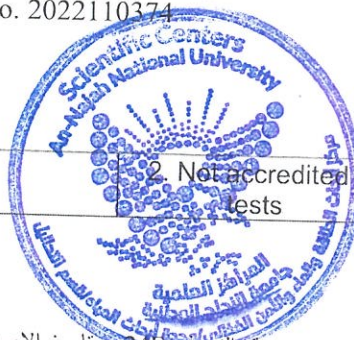
Analyst

Bilal shayb

Supervisor

Zahran Ashqar

*(Signature)*



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قسم التحاليل

Report of Sample Analysis

Sample No. 2022110375M	Source Sample No: Soil		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Soil	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	2/11/2022
Batch No.	-----	Receiving Time	14:30
Manufacturing Date	-----	Analysis Date	2/11/2022
Exp. Date	-----	Results Issued Date	28/11/2022
Storage Condition	-----	Report Date	28/11/2022
Sample description: 3-Plastic Bags contain about 1.2 Kg of sludge.			

Tests Results				
Test	Units	Results	Limits	Reference
Nitrogen (N)	%	0.085		Instruction manual method of HI 83214
<sup>2</sup> Phosphorus as P <sub>2</sub> O <sub>5</sub>	mg/kg	22.6		5.10 ICARDA *
<sup>2</sup> K As K <sub>2</sub> O	mg/kg	32.5		ICARDA 5.11*
pH	----	7.26		SMWW-4500H-2017
EC	µs/cm <sup>2</sup>	1320		Instruction Manual Method of HACH (HQ14d)
Moisture Content	%	9.4		AOAC 934.01(2016)
Total Fecal Coliform	CFU/100ml	Nil		SMWW 922IE
Total Organic Matter	%	8.43		ICARDA 5.5
C/N	----	99.2		Home Method

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Analyst

Bilalshayb



Supervisor

Zahran Ashqar

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قسم التحاليل

Report of Sample Analysis

Sample No. : 2023040133	Source Sample No: Influent		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	-----	Sample Receiving Date	3/4/2023
Batch No.	-----	Receiving Time	12:15
Manufacturing Date	-----	Analysis Date	3/4/2023
Exp. Date	-----	Results issued Date	19/4/2023
Storage Condition	-----	Report Date	19/4/2023
Sample description: One Bottle of 2 liter waste water.			

Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand BOD <sub>5</sub> (	mg/L	485	----	Instruction Manual Method of VELP Scientific
Total Suspended Solids (TSS)	mg/L	450	----	SMWW 2540D 2017
Chemical oxygen Demand (COD)	mg/L	878	----	Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	0.0	----	Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1260	----	SMWW 2540- C (2017)
pH	----	7.28	----	SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	118	----	SMWW 5520 (2017)
Phenol	mg/L	0.07	----	SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	4.0	----	P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	0.0	----	Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/L	82	----	)Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	107	----	Instruction manual method of HI 83214
Chloride (Cl)	mg/L	395	----	P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	91.1	----	SMWW 4500 S (2017)
Sodium (Na)	mg/L	213	----	SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	29.2	----	SMWW 4500C (2017)
Calcium (Ca)	mg/L	168	----	SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	3.98	----	By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	33	----	SMWW 4500 P (2017)
Aluminum (Al)	µg/L	333.9	----	SMWW 3125
Arsenic (As)	µg/L	6.7	----	SMWW 3125
Copper (Cu)	µg/L	24.2	----	SMWW 3125



قسم التحاليل

Tests Results				
Iron (Fe)	µg/L	903.1	----	SMWW 3125
Manganese (Mn)	µg/L	44.4	----	SMWW 3125
Nickel (Ni)	µg/L	8.4	----	SMWW 3125
Lead (Pb)	µg/L	2.2	----	SMWW 3125
Selenium (Se)	µg/L	31.9	----	SMWW 3125
Cadmium (Cd)	µg/L	0.1	----	SMWW 3125
Zinc (Zn)	µg/L	90.6	----	SMWW 3125
Cobalt (Co)	µg/L	0.7	----	SMWW 3125
Chrome (Cr)	µg/L	13.1	----	SMWW 3125
Boron (B)	µg/L	144.5	----	SMWW 3125
Cyanide (CN)	µg/L	0.0	----	SMWW 3125
Mercury (Hg)	µg/L	0.0	----	SMWW 3125
Eggs of intestinal worms Nematodes	Egg/500ml	Detected	----	Home Method
Fluoride (F)	µg/L	4.8	----	Instruction Manual method
Tin (Sn)	µg/L	0.0	----	SMWW 3125
Beryllium (Be)	µg/L	0.06	----	SMWW 3125
Barium (Ba)	µg/L	47.5	----	SMWW 3125
Silver (Ag)	µg/L	0.2	----	SMWW 3125
Lithium (Li)	µg/L	18.3	----	SMWW 3125
Vanadium (V)	µg/L	16.3	----	SMWW 3125

Notes:

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- \* Standard Methods for Examination of Water and Wastewater.



Analyst

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*Bilal Shayeb*

Supervisor

Eng. Majd Quqa

*Majd Quqa*

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قسم التحاليل

Report of Sample Analysis

Sample No. : 2023040134	Source Sample No: effluent		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Waste Water	Sample Receiving Place	Lab.
Trade Mark	----	Sample Receiving Date	3/4/2023
Batch No.	----	Receiving Time	12:15
Manufacturing Date	----	Analysis Date	3/4/2023
Exp. Date	----	Results Issued Date	19/4/2023
Storage Condition	----	Report Date	19/4/2023
Sample description: One Bottle of 2 liter waste water.			

Tests Results				
Test	Units	Results	Limits	Reference
Biochemical Oxygen Demand (BOD <sub>5</sub> )	mg/L	14.0	----	Instruction Manual Method of Velp Scientific
Total Suspended Solids (TSS)	mg/L	22	----	SMWW 2540D 2017
Fecal coliform bacteria (Before Chlorination)	CFU/100ml	3 * 10 <sup>3</sup>	----	SMWW 9222- D (2017)
Fecal coliform bacteria (After Chlorination)	CFU/100ml	7.0	----	SMWW 9222- D (2017)
Chemical oxygen Demand (COD)	mg/L	22	----	Instruction Manual Method HI 83214 (2002)
Dissolved Oxygen (DO)	mg/L	2.5	----	Instruction manual method of DO meter
Total Soluble materials (TDS)	mg/L	1140	----	SMWW 2540- C (2017)
pH	----	7.4	----	SMWW 4500- H (2017)
Fat , Oil and Grease	mg/L	< 5	----	SMWW 5520 (2017)
Phenol	mg/L	< 0.002	----	SMWW 5530 D (2017)
Detergents (MBAS)	mg/L	0.1	----	P.S – 41 - 2005
Nitrate Nitrogen (NO <sub>3</sub> -N)	mg/L	10.3	----	Instruction manual method of HI 83214
Ammonium Nitrogen (NH <sub>4</sub> -N)	mg/L	0.0	----	Instruction manual method of HI 83214
Total Nitrogen (T-N)	mg/L	< 10	----	Instruction manual method of HI 83214
Chloride (Cl)	mg/L	310	----	P.S – 41 - 2005
Sulphate (SO <sub>4</sub> )	mg/L	138.3	----	SMWW 4500 S (2017)
Sodium (Na)	mg/L	190	----	SMWW 3500-Na (2017)
Magnesium (Mg)	mg/L	19.4	----	SMWW 4500C (2017)
Calcium (Ca)	mg/L	160	----	SMWW 4500C (2017)
Sodium Adsorption Ratio (SAR)	mg/L	3.77	----	By Calculation
Phosphate Phosphorous (PO <sub>4</sub> -P)	mg/L	5.1	----	P (2017) SMWW 4500



قسم التحاليل

Tests Results				
Aluminum (Al)	µg/L	18.8	----	SMWW 3125
Arsenic (As)	µg/L	4.6	----	SMWW 3125
Cooper ( Cu )	µg/L	3.8	----	SMWW 3125
Iron (Fe)	µg/L	304.1	----	SMWW 3125
Manganese (Mn)	µg/L	27.2	----	SMWW 3125
Nickel (Ni)	µg/L	5.1	----	SMWW 3125
Lead (Pb)	µg/L	0.3	----	SMWW 3125
Selenium (Se)	µg/L	12.7	----	SMWW 3125
Cadmium (Cd)	µg/L	0.0	----	SMWW 3125
Zinc (Zn)	µg/L	25.4	----	SMWW 3125
Cobalt (Co)	µg/L	0.4	----	SMWW 3125
Chrome (Cr)	µg/L	5.9	----	SMWW 3125
Boron (B)	µg/L	121.4	----	SMWW 3125
Cyanide (CN)	µg/L	0.0	----	SMWW 3125
Mercury (Hg)	µg/L	0.0	----	SMWW 3125
<i>E. coli</i> (Before Chlorination )	CFU/100ml	5 * 10 <sup>2</sup>	----	SMWW 9222H-2017
<i>E. coli</i> (After Chlorination )	CFU/100ml	6.0	----	SMWW 9222H-2017
Eggs of intestinal warms Nematodes	Egg/500ml	ND	----	Home Method
Fluoride (F)	µg/L	0.4	----	Instruction Manual method
Tin ( Sn )	µg/L	0.0	----	SMWW 3125
Beryllium (Be)	µg/L	0.0	----	SMWW 3125
Barium (Ba)	µg/L	38.5	----	SMWW 3125
Silver (Ag)	µg/L	0.2	----	SMWW 3125
Lithium (Li)	µg/L	9.3	----	SMWW 3125
Vanadium (V)	µg/L	9.9	----	SMWW 3125
<sup>2</sup> NO <sub>2</sub>	µg/L	0.0	----	HI 97707

Notes:

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Majd Quqa

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قسم التحاليل

Report of Sample Analysis

Sample No. : 2023040135	Source Sample No: Sludge		
Tests Required By:	NJS CO.,LTD		
Address	----	Tel. No.	
Sample Type	Sludge	Sample Receiving Place	Lab.
Trade Mark	----	Sample Receiving Date	3/4/2023
Batch No.	----	Receiving Time	12:15
Manufacturing Date	----	Analysis Date	3/4/2023
Exp. Date	----	Results Issued Date	19/4/2023
Storage Condition	----	Report Date	19/4/2023
Sample description: Plastic Bag contain about 3 Kg of sludge.			

Tests Results				
Test	Units	Results	Limits	Reference
Nitrogen (N)	%	4.41	----	Instruction manual method of HI 83214
Lime ( as CaCO <sub>3</sub> )	mg/Kg	26 895	----	SMWW 3500-Ca (2017)
Magnesium ( Mg)	mg/Kg	6 860	----	SMWW 3500-Mg (2017)
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/Kg	205	----	AOAC 960.03
Kalium ( K <sub>2</sub> O)	mg/Kg	320	----	Flame photometer manual
Arsenic (As)	mg/Kg	1.79	----	SMWW3125
Copper (Cu)	mg/Kg	230.73	----	SMWW3125
Nickel (Ni)	mg/Kg	24.82	----	SMWW3125
Lead (Pb)	mg/Kg	22.99	----	SMWW3125
Cadmium (Cd)	mg/Kg	1.2	----	SMWW3125
Zinc (Zn)	mg/Kg	518.89	----	SMWW3125
Chromium (Cr)	mg/Kg	31.36	----	SMWW3125
Mercury (Hg)	mg/Kg	0.0	----	SMWW3125
Eggs of Intestinal Nematodes	Egg/100gm	Detected	----	Home Method
pH	----	6.85	----	SMWW-4500H-2017
EC	ms/cm <sup>2</sup>	8.7	----	Instruction Manual Method of HACH (HQ14d)
Moisture Content	%	14.4	----	AOAC 934.01(2016)
Total Fecal Coliform	CFU/100ml	Nil	----	SMWW 9221E
Total Organic Matter	%	59.5	----	ICARDA 5.5
Bulk Density	g/L	625	----	ICARDA 4.6
Powdered Sludge Density	g/L	859	----	ICARDA 4.6

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Supervisor

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Majd Quqa

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قسم التحاليل

Report of Sample Analysis

Sample No. : 2023040136	Source Sample No: Soil		
Tests Required By:	NJS CO.,LTD		
Address	-----	Tel. No.	
Sample Type	Soil	Sample Receiving Place	Lab.
Trade Mark	----	Sample Receiving Date	3/4/2023
Batch No.	----	Receiving Time	12:15
Manufacturing Date	----	Analysis Date	3/4/2023
Exp. Date	----	Results Issued Date	19/4/2023
Storage Condition	----	Report Date	19/4/2023
Sample description: 3-Plastic Bags contain about 1.2 Kg of sludge.			

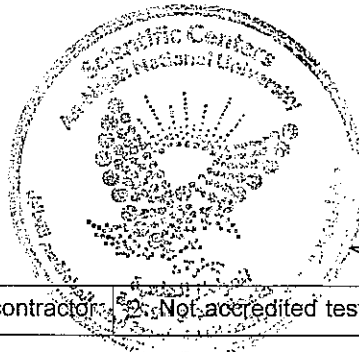
Tests Results				
Test	Units	Results	Limits	Reference
Nitrogen (N)	%	0.86	----	Instruction manual method of HI 83214
<sup>2</sup> Phosphorus as P <sub>2</sub> O <sub>5</sub>	mg/kg	22.5	----	ICARDA5.10*
<sup>2</sup> K As K <sub>2</sub> O	mg/kg	19.6	----	ICARDA 5.11*
pH	----	7.2	----	SMWW-4500H-2017
EC	ms/cm <sup>2</sup>	1 065	----	Instruction Manual Method of HACH (HQ14d)
Moisture Content	%	16.5	----	AOAC 934.01(2016)
Total Fecal Coliform	CFU/100ml	Nil	----	SMWW 9221E
Total Organic Matter	%	13.56	----	ICARDA 5.5
C/N	----	15.86	----	Home Method

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## **Appendix 2.2.3**

# **Standard Operation Procedures (SOPs)**

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>pH, EC, TDS</b>	Effective Date: Revised No.

## 1. Scope and Objectives

This SOPs provides standard operating procedures for determining pH, EC and TDS

## 2. Meaning of pH, EC and TDS

### pH

pH refers to the measure of hydrogen ion concentration in a solution. The value of pH is defined between 0 to 14, and pH less than 7 is defined as acidic and pH above 7 is defined as basic. Generally, acceptable pH for irrigation water is between 5.5 and 7.5.

Alkaline water (pH >7) may contain high concentrations of bicarbonate or carbonates. These causes calcium and magnesium precipitation in the soil and can affect plant growth.

Acidic water (pH <7) can also have a detrimental effect on plant growth, particularly causing nutritional problems. In addition, water with pH less than 6 shows corrosiveness, which can lead to damage to metal pipes, tanks and fittings. Moreover, more acidic water (below pH 4) can cause the soil acidification.

### Electrical Conductivity (EC)

EC is a measurement of water's ability to conduct electricity. EC is related to water temperature and the total concentration, mobility, valence and relative concentration of ions.

In general, higher EC means more electrolytes in the water. Since most salts can be ionized, EC can also represent the amount of total dissolved solids (TDS).

Water with high EC is unsuitable for irrigation. Thus, EC is an important criterion for irrigation water quality.


### Total dissolved Solids (TDS)

Total dissolved solids (TDS) is a dissolved content of inorganic and organic substances present in a water in molecular, ionized, or micro-granular (colloidal sol) suspended form.

Primary sources for TDS in water body is agricultural and domestic runoff, clay-rich mountain waters, leaching of soil contamination, and point source water pollution discharge from industrial or sewage treatment plants.

The most common chemical constituents are calcium, phosphates, nitrates, sodium, potassium, and chloride.

**Note:** TDS is defined as the increased amount of weight after evaporated and dried of filtered water (see: US Standard methods 2540C). However, in this HI9811-5, TDS is determined as a conversion value from EC (EC 1  $\mu$ S/cm = TDS 0.5 mg/L).

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>pH, EC, TDS</b>	Effective Date:  Revised No.

### 3. Equipment and Materials


- HANNA HI9811-5 pH/EC/TDS/Temperature meter
- Small beaker

### 4. Reagents

- Distilled water
- Calibration Standard
  - pH 7.01 buffer: HANNA HI7007 or HI70007
  - EC 1,413  $\mu\text{S}/\text{cm}$  solution: HANNA HI7031 or HI70031

### 5. Sampling and Preservation

- Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.
- Measurement pH and EC / TDS on the day the sample is taken.

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>pH, EC, TDS</b>	Effective Date: Revised No.

## 6. Calibration

- **Calibration should be done at least once a month.**

### (1) pH calibration

- Take a small amount of pH 7.01 buffer in a clean beaker (about 4 cm of the tip of the electrode should be in the solution).
- Press **pH** key to display pH measurement.
- Remove the protective cap from the electrode, rinse and immerse the electrode tip in the buffer and stir gently. Wait a couple of minutes for the reading to stabilize.
- Take the temperature of buffer solution: Select “°C” mode and read temperature.
- Adjust the **pH calibration knob** until the display shows the pH value at the above temperature (see below pH – Temperature chart).

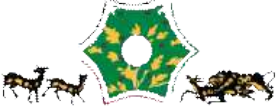
Temp (°C)	pH Value (7.01 buffer)
15	7.04
20	7.03
25	7.01
30	7.00
35	6.99
40	6.98
45	6.98

### (2) EC calibration

- Take a small amount of EC 1,413  $\mu\text{S}/\text{cm}$  solution in a clean beaker (about 4 cm of the tip of the electrode should be in the solution).
- Immerse the electrode tip in the solution and wait for a couple of minutes for thermal equilibrium to be reached.
- Make sure no air bubbles trapped inside the probe by shaking probe in the solution.
- Press  **$\mu\text{S}/\text{cm}$**  key.
- Adjust the **EC/TDS calibration knob** until the display shows the decided EC value (1,413 $\mu\text{S}/\text{cm}$  at 25°C).

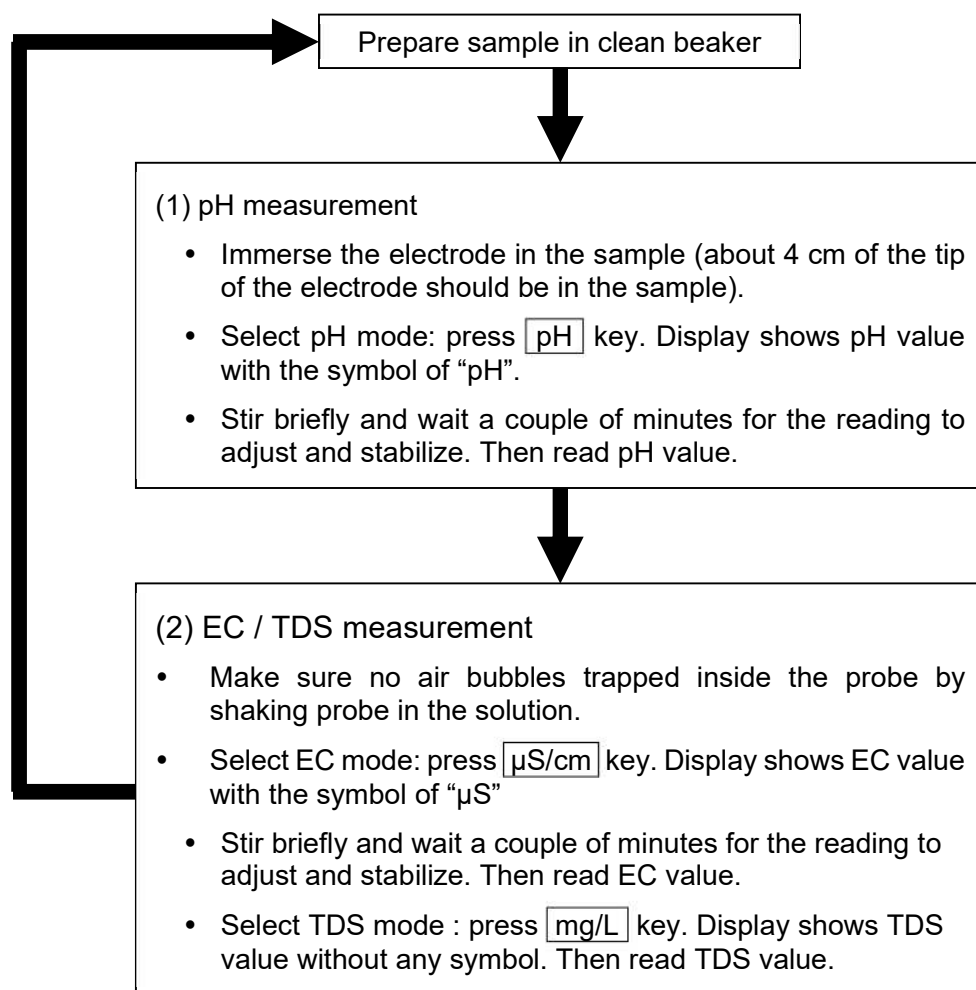
**Note:** Since the TDS measurements of HI9811-5 are converted from EC, calibration regarding TDS is not performed.




 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>pH, EC, TDS</b>	Effective Date:  Revised No.

## 7. Sample measurement

- Before pH, EC / TDS measurement, separate small quantities of sample into clean beaker.
- Never dip the electrode directly into sampling bottle.
- Repeat below cycle at least twice to **obtain at least two sets of data for pH, EC, and TDS.**




 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>pH, EC, TDS</b>	Effective Date:  Revised No.

## References

- HANNA HI9811 & 9811-5 Instruction Manual

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Turbidity</b>	Effective Date: Revised No.

### 1. Scope and Objectives

To provide standard operating procedures for determining turbidity in Wastewater treatment plant (WWTP) influent sewage and treated water.

### 2. Principle

Turbidity can be measured by its effect on the scattering light, which is termed as Nephelometry. Higher the intensity of scattered lights higher the turbidity. Results from nephelometric measurements are expressed as nephelometric turbidity units (NTU).

### 3. Equipment and Materials

- HACH 2100Q Turbidimeter
- Sample cell
- Tissue paper

### 4. Reagents

- Distilled water
- StabCal calibration Standard (20, 100 and 800NTU)

### 5. Sampling and Preservation

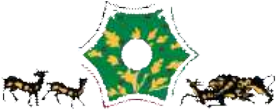
Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine turbidity on the day the sample is taken. If storage is unavoidable, store the samples in dark for up to 24 hr.

### 6. Measurement procedure

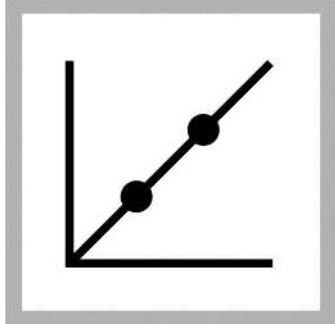

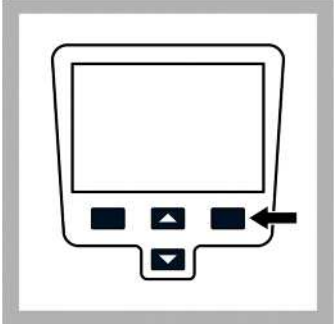
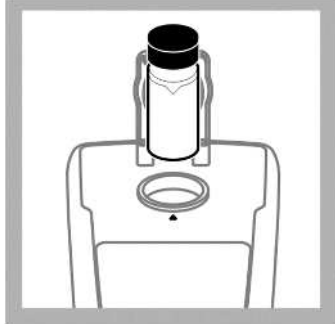
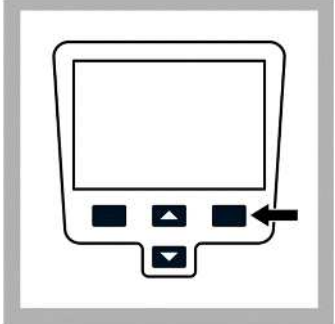
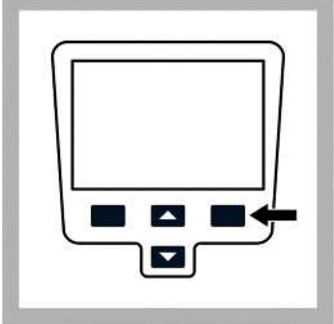
Turbidity measurement procedure includes following 2 steps.

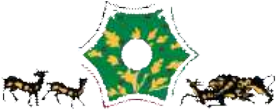
- (1) Calibration before measurement (at the beginning of daily work)
- (2) Sample measurement

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	<b>STANDARD OPERATING PROCEDURES</b> <b>Turbidity</b>	Effective Date:  Revised No.

### 6.1 Calibration

- Calibrate the turbidimeter HACH 2100Q at the start of the workday according to the following procedure.

 <p>1. Push the <b>CALIBRATION</b> key to enter the Calibration mode. Follow the instructions on the display.</p> <p><b>Note:</b> Gently invert each standard before inserting the standard.</p>	 <p>2. Insert the 20 NTU StabCal Standard and close the lid.</p> <p><b>Note:</b> The standard to be inserted is bordered.</p>	 <p>3. Push <b>Read</b>. The display shows Stabilizing and then shows the result.</p>
 <p>4. Repeat Step 2 and 3 with the 100 NTU and 800 NTU StabCal Standard.</p> <p><b>Note:</b> Push <b>Done</b> to complete a 2-point calibration.</p>	 <p>5. Push <b>Done</b> to review the calibration details.</p>	 <p>6. Push <b>Store</b> to save the results.</p> <p>After a calibration is complete, the meter automatically goes into the Verify Cal mode.</p>

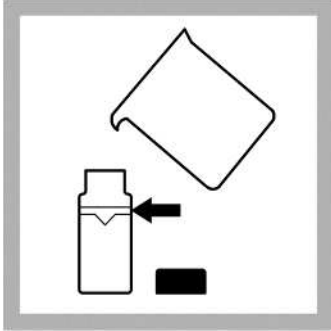

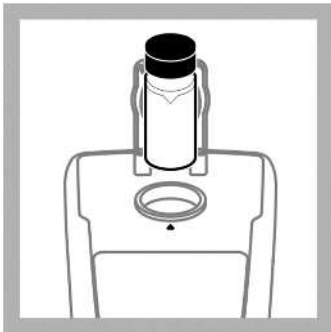
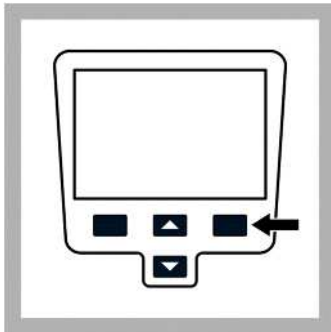
 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Turbidity</b>	Effective Date: Revised No.


## 6.2 Sample measurement

### (1) Sample preparation

- Remove large, suspended solids (SS) before measurement.
- Stir sample well before measurement to ensure the homogeneity of sample.
- Be careful not to create air bubbles in the sample.

### (2) Preparation of sample cell and measurement


	
<p>1: Rinse sample cell with sample</p> <p>Fill a sample cell to the line (about 15 mL).</p> <p>Take care to handle the sample cell by the top. Cap the cell.</p>	<p>2. Wipe the cell with a soft tissue paper to remove water spots and fingerprints.</p>
	
<p>3. Gently invert and then insert the sample cell in the instrument cell compartment so the diamond or orientation mark aligns with the raised orientation mark in front of the cell compartment.</p> <p>Close the lid.</p>	<p>4. Push <b>Read</b>. The display shows Stabilizing then the turbidity in NTU.</p> <p><b>Repeat steps 1 to 4 at least twice for each sample.</b></p> <p><b>Note:</b> At least two measurements should be done on one sample.</p>

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	<b>STANDARD OPERATING PROCEDURES</b> <b>Turbidity</b>	Effective Date:  Revised No.

## References

- HACH 2100Q and 2100Qis User manual, 08/2021, Edition 6

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<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>BOD<sub>5</sub></b>	Effective Date: Revised No.

## 1. Scope and Objectives

This document provides the Standard Operating Procedures (SOPs) for determining 5days Biological Oxidation Demand (BOD<sub>5</sub>) in wastewater treatment plant (WWTP) influent sewage and treated water.

## 2. Principle

This document describes a method for measuring BOD by measuring pressure differences.

When organic matter present in water is consumed by microbial activity, dissolved oxygen (DO) is consumed. BOD is an indicator that measures the amount of organic matter in the water based on the degree of consumption of DO. BOD utilizes the activity of microorganisms in aerobic conditions. In this time, microorganisms consume DO and generate CO<sub>2</sub> (aerobic respiration).

Aerobic respiration consumes oxygen and produces carbon dioxide (CO<sub>2</sub>). When this reaction takes place in a sealed bottle, the oxygen in the bottle is replaced by CO<sub>2</sub>.

When this CO<sub>2</sub> is adsorbed and removed, the pressure inside the bottle is reduced. By measuring this pressure reduction, the amount of DO consumption can be indirectly measured.


This is the BOD measurement principle described in this SOPs.

## 3. Equipment and Materials

- WTW OxiTop measuring system
- Magnetic stirrer and stirrer rod
- Incubator (20°C ± 1°C)
- Glass ware for measurement (measurement cylinder or overflow measurement flask)
- Sample bottle (Brown)
- Rubber sleeve

## 4. Reagents

- Sodium hydroxide (NaOH)
- Nitrification inhibitor solution (N-Allylthio Urea): NTH600

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## 5. Sampling and Preservation

- Homogenize wastewater sample on a magnetic stirrer until all deposited suspended matter is distributed every throughout the liquid.


## 6. Measurement procedure

- Determine the appropriate sample volume according to the BOD measurement ranges shown below.
- Add the number of drops in the below table of the nitrification inhibitor solution to the sample bottle.

Measuring range in mg/L BOD	Sample volume in mL	Factor for BOD calculation	Nitrification inhibitor solution drops
0 to 40	432	1	9
0 to 80	365	2	7
0 to 200	250	5	5
0 to 400	164	10	3
0 to 800	97	20	2
0 to 2000	43.5	50	1

- Insert a magnetic stirring rod into sample bottle.
- Fit the bottle necks with the rubber sleeve that have been filled beforehand with NaOH tablets.
- Tightly screw the pressure measuring heads onto the bottles.
- Place the sample bottle in the incubator at 20°C ± 1°C.
- Read the measurement value at day 5.



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	<b>STANDARD OPERATING PROCEDURES</b> <b>BOD<sub>5</sub></b>	Effective Date: Revised No.

### Remarks


- In accordance with Palestinian water quality standards for wastewater and agricultural reuse water, BOD<sub>5</sub> measurements at the WWTP shall be made only for treated water.
- In the technical requirement of the treated wastewater quality for agricultural purpose, category of BOD<sub>5</sub> is decided as below.

Maximum limits	Category of treated water (BOD <sub>5</sub> )			
	High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
BOD <sub>5</sub> (mg/L)	20	20	40	60

### References

- WTW Operation of the Single Measuring System OxiTop
- Application report, Respirometric BOD<sub>5</sub> determination of domestic waste water
- Palestine Standard PS742-2015, Treated Wastewater – Treated Wastewater Effluent for Agricultural Purpose

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 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>General notification for the use of pHotoFlex –</b> <b>STD spectrometer</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

This SOP describes the general notification for the use of pHotoFlex - STDspectrometer.

The analytical equipment covered in this SOP is a xylene (WTW) spectrometer, model pHotoFlex-STD.

## 2. General notes

When carrying out measurements with the pHotoFlex- STD, always use genuine reagents and perform the measurement operation according to the SOP for the relevant measurement item.

## 3. Equipment and Materials

- Xylen (WTW) pHotoFlex-STD spectrometer
- Sample cell

## 4. Reagents

- Distilled water
- Genuine reagents for the relevant measurement item

## 5. Precautions in experimental operation

### Reagent blank values

Generally, the evaluation of the photometric measurement refers to the comparison value of a blank value which sample without the substance to be determined (reagent blank value).

The reagent blank value is measured using the same amount of deionized water instead of sample water.


More accurate measurements can be obtained by subtracting the reagent blank value from the obtained measurements.

The reagent blank should be measured for each measurement item at least one (1) time / month.

### Sample dilution

Dilution of the sample can be required for the following reasons:

- The expected concentration of the substance to be determined is near or above the upper measuring range limit.
- Other substances in the sample cause the measured values to be change due to matrix interferences.

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For dilution operation, use deionized water and common laboratory measuring equipment with sufficient accuracy (volumetric flasks, pipettes etc.).

The error in dilution can increase with an increasing dilution factor. Therefore, before dilution operation, check whether a different test or method with a suitable measuring range can be adopted.

## 6. Minimizing interfering effects by sample pretreatment

The following factors can affect photometric measurement and cause incorrect measurement results:

- Unsuitable pH value of the sample
- Turbidity
- Adverse temperature
- Improper, especially not representative, sampling
- Change of the sample due to long storing period or unsuitable storing conditions (under sun light, high temperature)

The following section provide a detailed description of important influencing factors and practical instructions on remedial actions.

### Influence of pH value

pH value can affect the course of chemical reactions in a photo spectrometric analysis.


For some tests the pH value of a solution has to be in a certain range. With these tests, the SOP provides the necessity to check the pH value, and if necessary, adjust the pH value.

Observe the following points when adjusting the pH range:

- Use the specified pH adjuster described in SOPs.
- In the pH adjustment operation, the volume of the sample should not increase (is not diluted) too much. The volume increase by the drops is negligible if the resulting dilution is less than 2 %.
- With a greater dilution, the measurement result should be converted according to the increase of sample volume.

### Influence of turbidity

In the photometrical measurement, measurement value of the sample with a visibly

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turbidity is interfered by the turbidity ingredients (small particles, etc.).


Depending on the type of sample or measurement target, the interference of turbidity can be compensated.

When the target of measurement is determined as dissolved ingredient, filtration before measurement can be adopted for pretreatment method. For filtrating, grass fiber filter or membrane filters (recommended pore size 0.45  $\mu\text{m}$ ) can be used.

When the considerable of the target of measurement is bound on the solid matter (particle), the target of measurement has to be brought into an analyzable form before measurement.

This pre-treatment process is done in a chemical digestion procedure. Procedure is described in SOP if necessary.


However, in some measurement procedures, the solid substance is digested in the measurement process (e. g. COD measurement). In this case, the suspended solid matter in water is representative part of sample. Thus, for the exact measurement, homogenizing of sample (and solid matter) is important.

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	<p><b>STANDARD OPERATING PROCEDURES</b> <b>General notification for the use of pHotoFlex –</b> <b>STD spectrometer</b></p>	<p>Effective Date:</p> <p>Revised No.</p>

## References

- Photometry analysis manual, pHotoFlex Series, Practical part and analysis specifications, Prog. V 1.30 W

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 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (LR): 0.02 – 2.5mg/L as NH<sub>4</sub>-N</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.02 – 2.5mg/L as NH<sub>4</sub>-N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If the pH is outside the appropriate range.
- iii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 2.0 mL liquid transfer

## 4. Reagents

- WTW model No. NH4-2 TC reagent set

## 5. Sampling and Preservation


Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Ammonium (LR) measurement for each test package.

If residual chlorine is present (especially, treated water), Sodium thiosulfate (Na<sub>2</sub>SO<sub>3</sub>) solution have to be added to eliminate residual chlorine. Add 1 drop of 0.1mol/L Na<sub>2</sub>SO<sub>3</sub> solution per 0.3mg/L residual chlorine to 1 L sample.

If iron is present, measurement of ammonium is disturbed (Measurements are bulked).

- i) Prepare a standard solution of iron to match the concentration of iron in the sample.
- ii) Use this iron standard solution to determine the reagent blank value for an ammonium measurement.

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	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (LR): 0.02 – 2.5mg/L as NH<sub>4</sub>-N</b>	Effective Date:  Revised No.

## 6. Measurement procedure

### 6.1 General

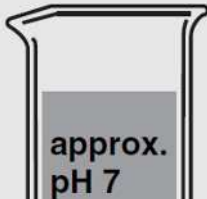



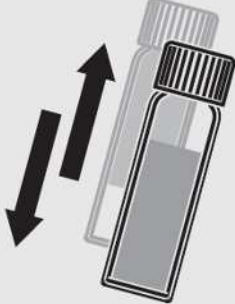

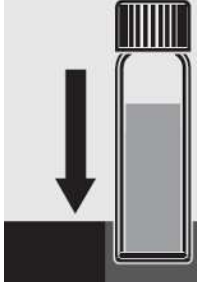
When measuring samples, the following measurement operations should be performed at least twice on one collection sample.


Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.

If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

### 6.2 Procedure of measurement

1	2	3	4
			
Adjust pH value <b>Approx. 7.0</b>	Add 2.0mL of sample into a reaction cell	Add the contents of a <b>VARIO AMMONIA</b> <b>Salicylate F5</b> reagent	Add the contents of a <b>VARIO AMMONIA</b> <b>Cyanurate F5</b> reagent
5	6	7	
			
Shake the cell vigorously.	React for <b>20 minutes</b>	Insert the cell in the photometer and measurement	


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	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (LR): 0.02 – 2.5mg/L as NH<sub>4</sub>-N</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Ammonium, Program No. 312

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 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (HR) : 0.4 – 50mg/L as NH<sub>4</sub>-N</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.4 – 50mg/L as NH<sub>4</sub>-N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If the pH is outside the appropriate range.
- iii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 0.1 mL liquid transfer

## 4. Reagents

- WTW model No. NH4-3 TC reagent set

## 5. Sampling and Preservation


Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Ammonium (LR) measurement for each test package.

If residual chlorine is present (especially, treated water), Sodium thiosulfate (Na<sub>2</sub>SO<sub>3</sub>) solution have to be added to eliminate residual chlorine. Add 1 drop of 0.1mol/L Na<sub>2</sub>SO<sub>3</sub> solution per 0.3mg/L residual chlorine to 1 L sample.

If iron is present, measurement of ammonium is disturbed (Measurements are bulked).

- i) Prepare a standard solution of iron to match the concentration of iron in the sample.
- ii) Use this iron standard solution to determine the reagent blank value for an ammonium measurement.

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	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (HR) : 0.4 – 50mg/L as NH<sub>4</sub>-N</b>	Effective Date:  Revised No.

## 6. Measurement procedure

### 6.1 General

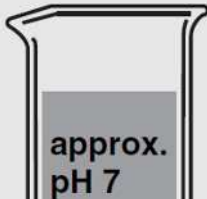



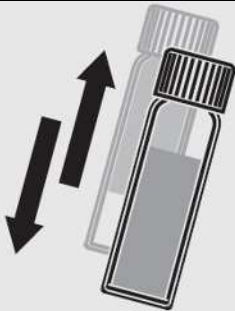

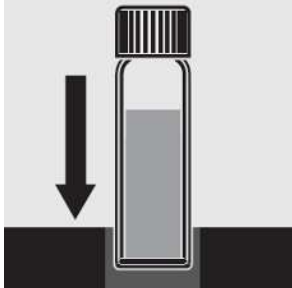
When measuring samples, the following measurement operations should be performed at least twice on one collection sample.


Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.

If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

### 6.2 Procedure of measurement


1	2	3	4
			
Adjust pH value <b>Approx. 7.0</b>	Add 1mL of sample into a reaction cell	Add the contents of a <b>VARIO AMMONIA</b> <b>Salicylate F5</b> reagent	Add the contents of a <b>VARIO AMMONIA</b> <b>Cyanurate F5</b> reagent
5	6	7	
			
Shake the cell vigorously.	React for <b>20 minutes</b>	Insert the cell in the photometer and measurement	

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Ammonium (HR) : 0.4 – 50mg/L as NH<sub>4</sub>-N</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Ammonium, Program No. 313

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 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (LR): 0.1 – 2.7mg/L as NO<sub>3</sub>-N</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.1 – 2.7mg/L as NO<sub>3</sub>-N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 2.0 mL liquid transfer
- Micro spoon (Blue colored, WTW genuine)
- **Protective googles and gloves.**

## 4. Reagents

- WTW model No.14556 reagent set

## 5. Sampling and Preservation


Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Nitrate (LR) measurement for each test package started.

## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

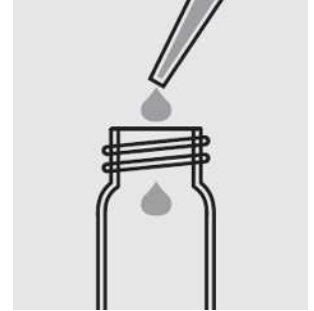

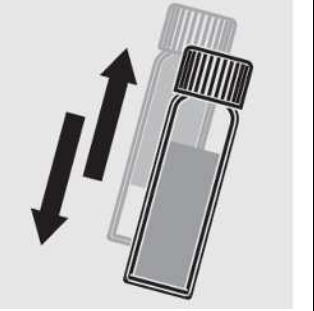

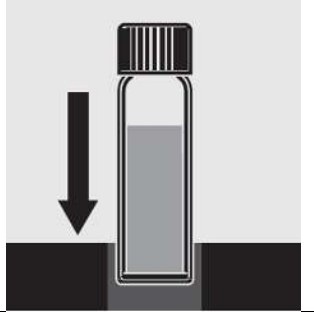
 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (LR): 0.1 – 2.7mg/L as NO<sub>3</sub>-N</b>	Effective Date:  Revised No.


Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.

If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

## 6.2 Procedure of measurement


<b>1</b>	<b>2</b>	<b>3</b>
		
Add <b>2 mL of sample</b> into the reaction cell Do not mix the contents	Add <b>1 level blue micro spoon</b> of <b>NO<sub>3</sub>-1K reagent</b> . Caution: The contents will foam. Use <b>protective goggles and gloves</b> .	Shake the cell <b>vigorously for 5 seconds</b> .
<b>4</b>	<b>5</b>	
		
React for <b>30 minutes</b>	Insert the cell in photometer and measurement	

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (LR): 0.1 – 2.7mg/L as NO<sub>3</sub>-N</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Nitrate, Program No. 61

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 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (HR) : 0.2 – 30mg/L as NO<sub>3</sub>-N</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.2 – 30mg/L as NO<sub>3</sub>-N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 1.0 mL liquid transfer

## 4. Reagents

- WTW model No. NO3-1 TC reagent set

## 5. Sampling and Preservation

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Nitrate (HR) measurement for each test package started.


## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

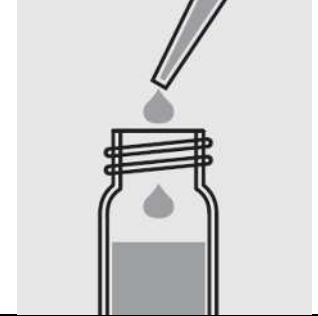
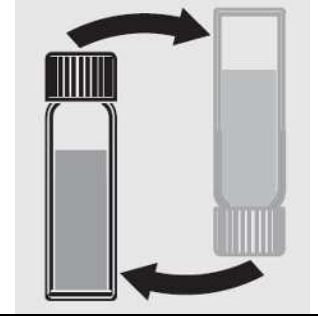
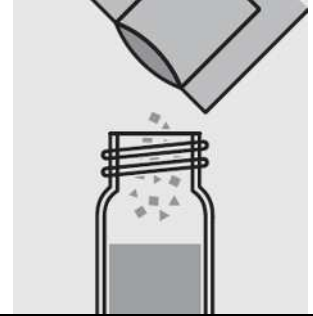
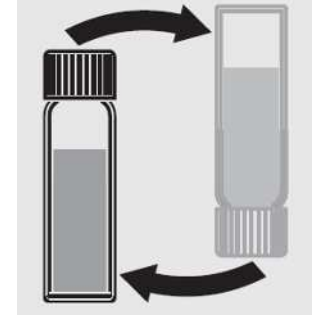

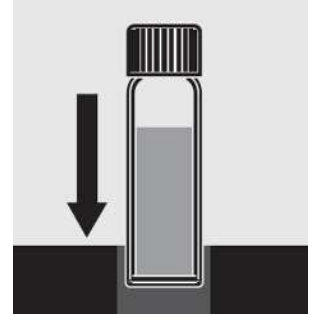
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.

If the range of variation of the data is large, a third (3rd) measurement shall be taken.


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (HR) : 0.2 – 30mg/L as NO<sub>3</sub>-N</b>	Effective Date:  Revised No.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

## 6.2 Procedure of measurement

1	2	3
		
<b>Add 1.0mL of sample</b> into a reaction cell	<b>Mix the contents</b> by carefully swaying the cell (10 times)	Add <b>VARIO NITRATE Chromotropic reagent</b>
4	5	6
		
<b>Mix the contents</b> by carefully swaying the cell (10 times)	<b>React 5 minutes</b>	Insert the cell in the photometer and measure




 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Nitrate (HR) : 0.2 – 30mg/L as NO<sub>3</sub>-N</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Nitrate, Program No. 314

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen (LR) : 0.5 – 25mg/L as N</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Total Nitrogen measurement.

Measurement range: 0.5 – 25mg/L as N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 2.0 mL liquid transfer
- Powder funnel for WTW reagent

## 4. Reagents

- WTW model No.: Ntot 1 TC (LR) reagent set

## 5. Sampling and Preservation

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.


Determine the reagent blank value for Total Nitrogen (LR) measurement once a month.

## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

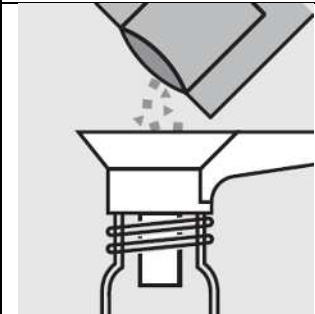

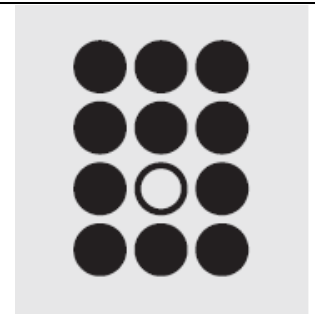
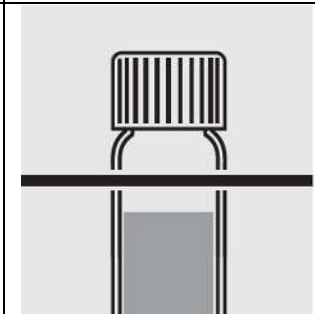
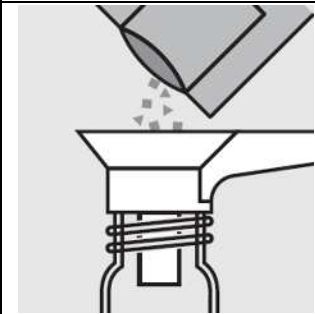
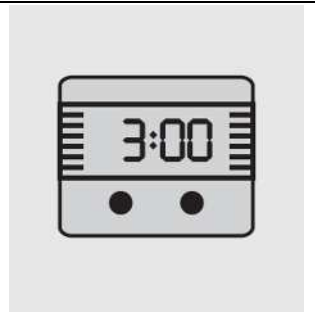
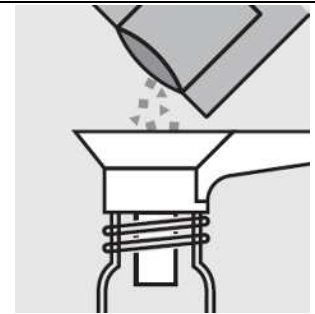
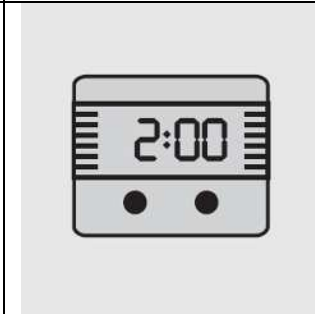
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen (LR) : 0.5 – 25mg/L as N</b>	Effective Date:  Revised No.

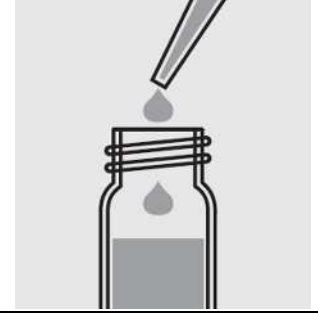
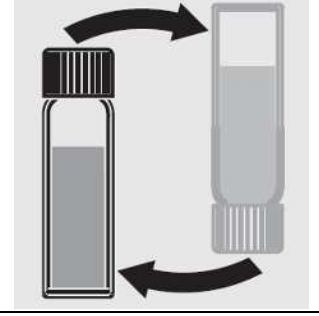
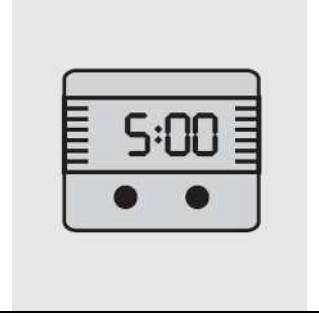
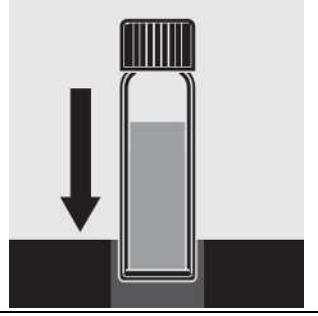
If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

### 6.2 Procedure of measurement

1	2	3	4
			
Add <b>VARIO TN Persulfate reagent</b> into <b>TN Hydroxide LR cell</b>	Add <b>sample (2.0 mL)</b> Then <b>mix vigorously at least 30 seconds.</b>	Heat the cell using thermo reactor at <b>120 deg.C for 30 minutes</b>	Remove the cell from the thermo reactor and cool down in a cell rack.
5	6	7	8
			
Add <b>VARIO TN Reagent A</b> Then close cell cap and <b>mix for at least 15 seconds.</b>	React <b>3 minutes</b>	Add <b>VARIO TN Reagent B</b> Then close cell cap and <b>mix for at least 15 seconds.</b>	React <b>2 minutes</b>
9	10	11	12


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen (LR) : 0.5 – 25mg/L as N</b>	Effective Date: Revised No.

			
<b>Transfer 2.0mL</b> of prepared sample into <b>TN Acid LR/HR (Reagent C)</b> reaction cell.	Mix carefully swaying the cell ( <b>10 times Approx. 30 seconds altogether</b> ) <b>Caution: Cell becomes warm</b>	React <b>5 minutes</b>	Insert the cell in the photometer and measure

## References

- Photometry Analysis Manual, pHotoFlex Series, Nitrogen, Total LR, Program No. 319

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen(HR) : 10 – 150mg/L as N</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Total Nitrogen measurement.

Measurement range: 10 – 150mg/L as N.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 0.5mL liquid transfer
- Powder funnel for WTW reagent

## 4. Reagents

- WTW model No.: Ntot 2 TC (HR) reagent set

## 5. Sampling and Preservation

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Total Nitrogen (HR) measurement once a month.


## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

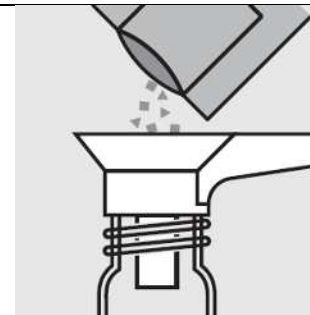
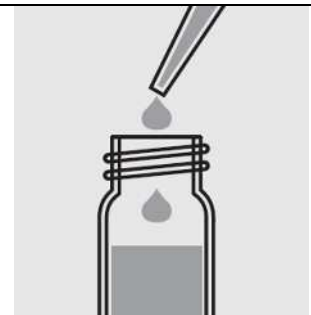
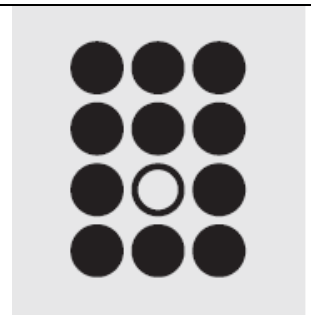

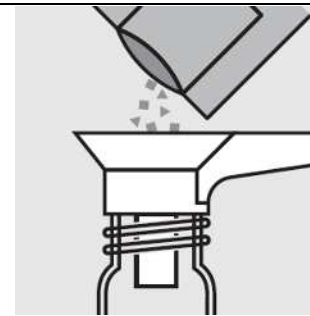
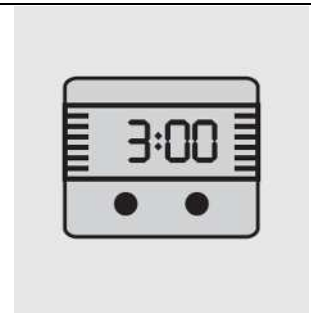
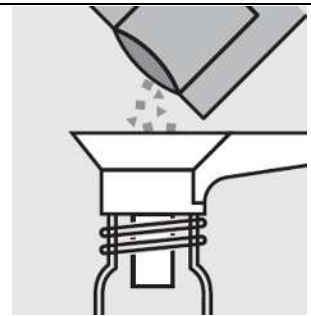
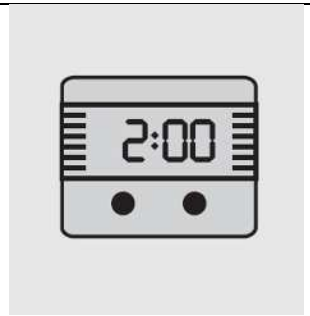
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.


If the range of variation of the data is large, a third (3rd) measurement shall be taken.

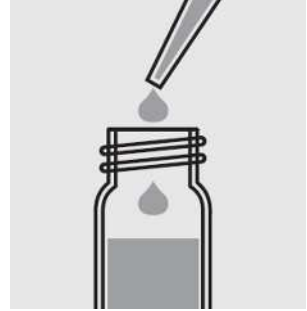
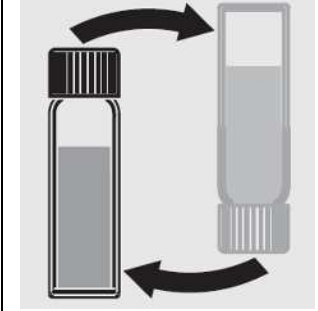
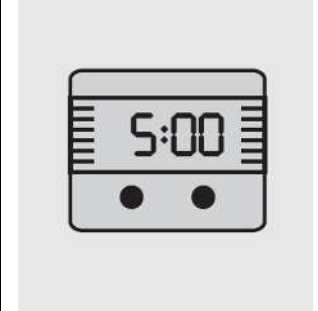
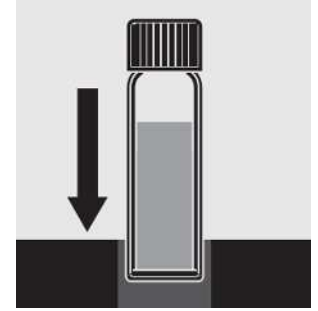
 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen(HR) : 10 – 150mg/L as N</b>	Effective Date:  Revised No.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

## 6.2 Procedure of measurement

<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
			
Add <b>VARIO TN Persulfate reagent</b> into <b>TN Hydroxide HR cell</b>	Add <b>sample (0.5mL)</b> Then <b>mix vigorously at least 30 seconds.</b>	Heat the cell using thermo reactor at <b>120 deg.C for 30 minutes</b>	Remove the cell from the thermo reactor and cool down in a cell rack.
<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>
			
Add <b>VARIO TN Reagent A</b> Then close cell cap and <b>mix for at least 15 seconds.</b>	React <b>3 minutes</b>	Add <b>VARIO TN Reagent B</b> Then close cell cap and <b>mix for at least 15 seconds.</b>	React <b>2 minutes</b>
<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Nitrogen(HR) : 10 – 150mg/L as N</b>	Effective Date:  Revised No.

			
<b>Transfer 2.0mL</b> of prepared sample into <b>TN Acid LR/HR (Reagent C)</b> reaction cell.	Mix carefully swaying the cell ( <b>10 times Approx. 30 seconds altogether</b> ) <b>Caution: Cell becomes warm</b>	React <b>5 minutes</b>	Insert the cell in the photometer and measure

## References

- Photometry Analysis Manual, pHotoFlex Series, Nitrogen, Total HR, Program No. 320

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (LR): 10 – 150mg/L</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining COD measurement.

Measurement range: 10 – 150mg/L.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 2.0 mL liquid transfer

## 4. Reagents

- WTW model No. 09772 COD (Hg free) reagent set

## 5. Sampling and Preservation

Determine the reagent blank value for COD (LR) measurement for each test package started.

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

To implement the measurement **after homogenizing the suspension solids** in the sample.

## 6. Measurement procedure

### 6.1 General


When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.



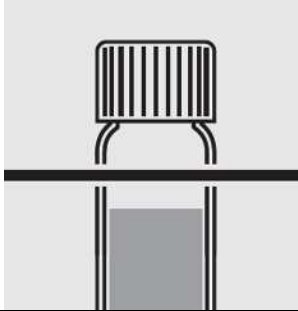
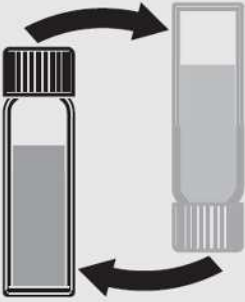
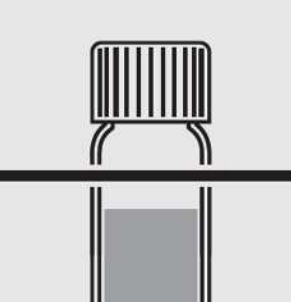
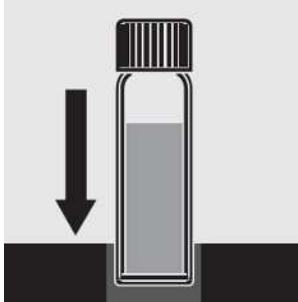
If the range of variation of the data is large, a third (3rd) measurement shall be taken.


The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.



 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (LR): 10 – 150mg/L</b>	Effective Date:  Revised No.

## 6.2 Procedure of measurement


1	2	3
		
<p><b>Add 2.0mL of sample</b> into a reaction cell  <b>Mix vigorously.</b></p> <p><b>Caution: cell become very hot</b></p>	<p>Heat the cell in the thermos reactor for <b>2 hours at 148 deg. C.</b></p>	<p>Remove the cell from the thermos reactor and let it cool down in a cell rack.</p>
4	5	6
		
<p><b>After approx.. 10 minutes cooling time, sway the cell.</b></p>	<p>Place the cell in the cell rack again, and let it cool down to room temperature.</p>	<p>Insert the cell in the photometer and measure</p>

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (LR): 10 – 150mg/L</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, COD, Program No. 58

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (HR) : 100 – 1,500mg/L</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining COD measurement.

Measurement range: 100 – 1,500mg/L.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 2.0 mL liquid transfer

## 4. Reagents

- WTW model No. 09773 COD (Hg free) reagent set

## 5. Sampling and Preservation

Determine the reagent blank value for COD (HR) measurement for each test package started.

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

To implement the measurement **after homogenizing the suspension solids** in the sample.

## 6. Measurement procedure


### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.


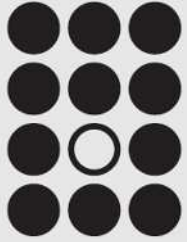

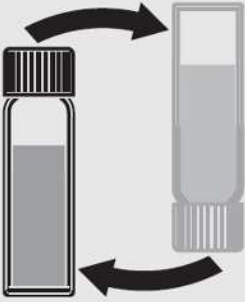

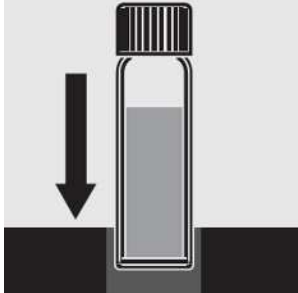
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.


If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (HR) : 100 – 1,500mg/L</b>	Effective Date:  Revised No.

## 6.2 Procedure of measurement


1	2	3
		
<p><b>Add 2.0mL of sample</b> into a reaction cell  <b>Mix vigorously.</b></p> <p><b>Caution: cell become very hot</b></p>	<p>Heat the cell in the thermos reactor for <b>2 hours at 148 deg. C.</b></p>	<p>Remove the cell from the thermos reactor and let it cool down in a cell rack.</p>
4	5	6
		
<p><b>After approx.. 10 minutes cooling time, sway the cell.</b></p>	<p>Place the cell in the cell rack again, and let it cool down to room temperature.</p>	<p>Insert the cell in the photometer and measure</p>

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>COD (HR) : 100 – 1,500mg/L</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, COD, Program No. 59

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (LR): 0.007 – 0.8mg/L as PO<sub>4</sub>-P</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.007 – 0.8mg/L as PO<sub>4</sub>-P.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 10.0 mL liquid transfer

## 4. Reagents

- WTW model No.PO4-1 TP reagent set

## 5. Sampling and Preservation

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.


Determine the reagent blank value for Phosphate (LR) measurement for each test package started.

## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.

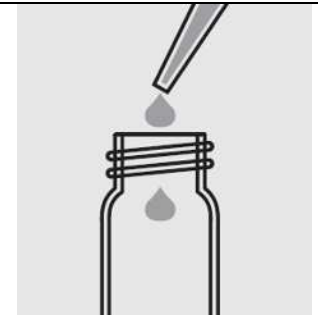

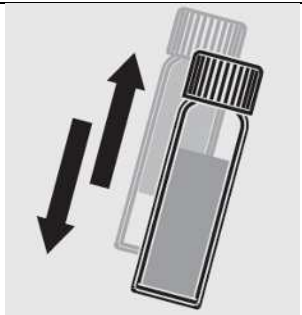
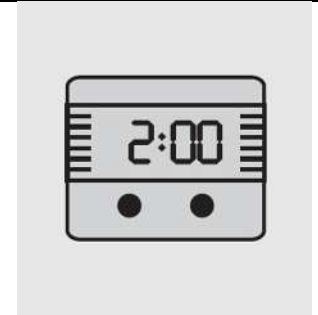
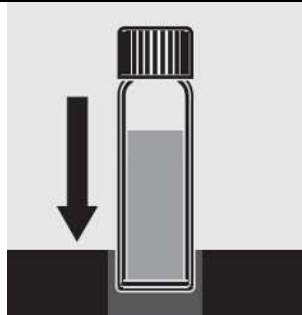
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (LR): 0.007 – 0.8mg/L as PO<sub>4</sub>-P</b>	Effective Date:  Revised No.

If the range of variation of the data is large, a third (3rd) measurement shall be taken.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

### 6.2 Procedure of measurement

<b>1</b>	<b>2</b>	<b>3</b>
		
Add <b>10 mL of sample</b> into the empty cell	Add the contents of a <b>VARIO Phos3 F10</b> reagent	Shake the cell for <b>10 to 15 seconds</b> .
<b>4</b>	<b>5</b>	
		
React for <b>2 minutes</b>	Insert the cell in photometer and measurement	


 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (LR): 0.007 – 0.8mg/L as PO<sub>4</sub>-P</b>	Effective Date:  Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Phosphate, Program No. 306

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	



 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (HR): 0.02 – 1.63mg/L as PO<sub>4</sub>-P</b>	Effective Date:  Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Nitrate measurement.

Measurement range: 0.02 – 1.63mg/L as PO<sub>4</sub>-P.

## 2. General notes

The method of measurement described here uses the pHotoFlex-STD measuring device manufactured by Xylem (WTW) and its genuine reagents.

Pretreat the sample in accordance with SOP 'General precautions for measurements with the pHotoFlex-STD' if the sample is in the following conditions.

- i) If the concentration of the substance to be measured is determined to be outside the determination range.
- ii) If it contains a large amount of turbidity.

## 3. Equipment and Materials

- Xylem (WTW) pHotoFlex-STD spectrometer
- Pipette: Appropriate for 5.0 mL liquid transfer

## 4. Reagents

- WTW model No.PO4-2 TC reagent set

## 5. Sampling and Preservation

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

Determine the reagent blank value for Phosphate (HR) measurement for each test package started.


## 6. Measurement procedure

### 6.1 General

When measuring samples, the following measurement operations should be performed at least twice on one collection sample.



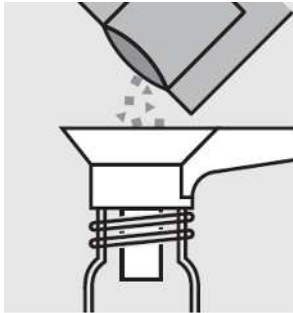
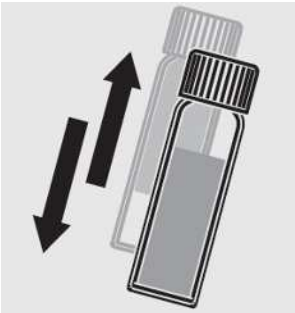

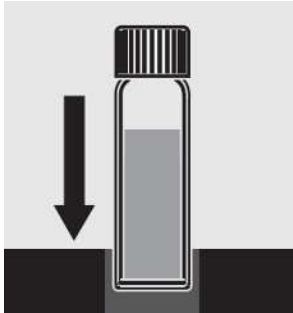
Two (2) sets of data should be obtained for one collection sample, and if the variation in the data is reasonable, the average of the two (2) sets of data should be used as the reported value.


If the range of variation of the data is large, a third (3rd) measurement shall be taken.

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (HR): 0.02 – 1.63mg/L as PO<sub>4</sub>-P</b>	Effective Date:  Revised No.

The determination of the validity of the data variation shall be in accordance with SOP: Data collection and accuracy control.

## 6.2 Procedure of measurement


1	2	3
		
Add <b>5.0 mL of sample</b> into the empty cell	Add the contents of a <b>VARIO Phos3 F10</b> reagent	Add the contents of a <b>VARIO Phos3 F10</b> reagent and close screw cap
4	5	6
		
Shake the cell <b>approx. 10 to 15 seconds.</b>	React for <b>2 minutes</b>	Insert the cell in photometer and measurement

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.  Effective Date:
	<b>STANDARD OPERATING PROCEDURES</b> <b>Phosphate (HR): 0.02 – 1.63mg/L as PO<sub>4</sub>-P</b>	Revised No.

## References

- Photometry Analysis Manual, pHotoFlex Series, Phosphate, Program No. 315

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Suspended Solid (TSS)</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for determining Total Suspended Solid.

## 2. General notes

**Principle:** A well-mixed sample is filtered through a weighted standard glass-fiber filter and the residue retained on the filter is dried to a constant weight at 103 to 105 °C. The increase in weight of the filter represents the total suspended solids.

**Interferences:** Exclude large floating particles or submerged agglomerates of nonhomogeneous materials from the sample if it is determined that their inclusion is not representative.

## 3. Equipment

- Glass-fiber filter
- Filter holder and funnel
- Vacuum filtration system
- Porcelain dish
- Drier (103 to 105 °C)
- Desiccator (with silica gel)
- Electronic balances (capable of measuring less than 0.1 mg)

## 4. Preparation

### Preparation of glass-fiber filter

Insert filter disk in filter holder. Apply vacuum and wash filter disk with three successive 20 mL portions of distilled water.

Washed filter is transferred into drier and dried at 103 to 105 °C for 1 hour.

Dried filter is stored in desiccator until use, and weight before use.

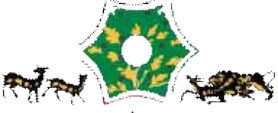
### Selection of sample size (volume)

Choose sample volume to yield between **2.5 and 200mg dried residue**.

If complete filtration takes **more than 10 min**, increase filter diameter, or decrease sample volume.

## 5. Sampling

Sample collection will be done according to the water quality monitoring plan and SOPs for sample collection.

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Suspended Solid (TSS)</b>	Effective Date:  Revised No.

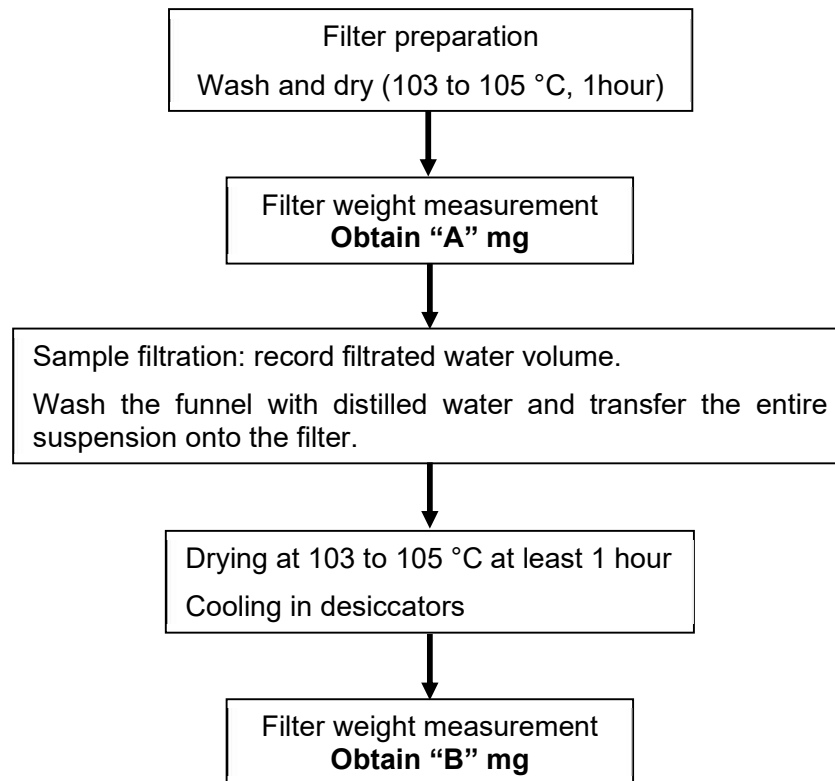
Homogenize the sample before filtration.

## 6. Filtration and measurement

### 6.1 General

Two (2) sets of data should be obtained for one sample and average value of these two (2) sets of data should be used as the reported value.

### 6.2 Procedure of measurement




### Calculation

Total suspended solids (TSS) mg/L = (B mg – A mg) x 1,000 / Sample volume (mL)

B mg: Weight of filter + Dried residue (mg)


A mg: Weight of filter

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Total Suspended Solid (TSS)</b>	Effective Date:  Revised No.

## References

- US Standard methods 2540 Solids

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

 <p>بلدية أريحا Jericho Municipality</p>	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Sample collection</b>	Effective Date: Revised No.

## 1. Scope and Objectives

To provide standard operating procedures for sample collection.

## 2. Equipment

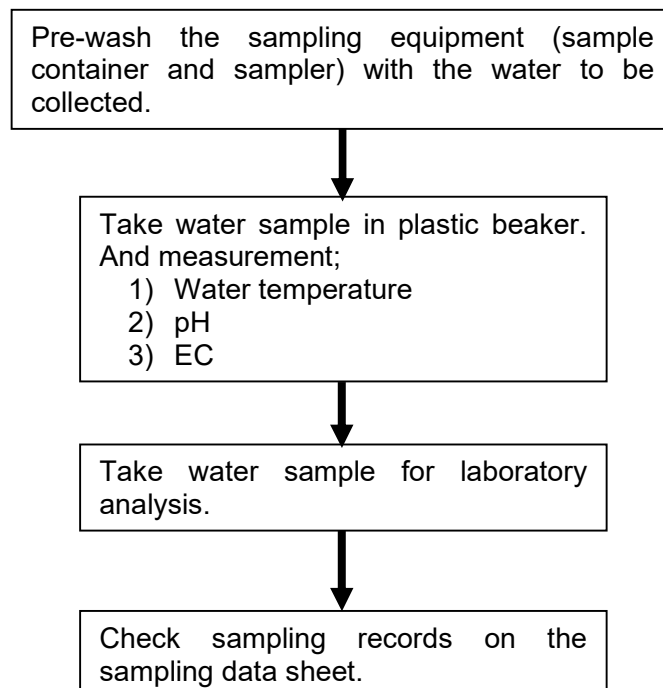
- Sample container (Glass vial, Plastic bottle)
- Sampler (Long-handled scoop, etc.)
- Plastic beaker (approx.. 1L)
- pH meter / EC meter
- Thermometer (for air temperature / for water temperature)
- Data sheet


## 4. Preparation

- Sample containers should be washed and dried beforehand.
- Attach data label on sample containers.

## 5. Sampling

Sampling is carried out in the following steps.



 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Sample collection</b>	Effective Date: Revised No.


Items to be filled in on the sampling data sheet.

- Sampling location
- Sampling date and time
- Air temperature
- Water temperature
- pH\*
- EC\*

**Note:** pH and EC are the minimum field measurement items. If necessary, turbidity is also measured in the field.

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	



 <p>بلدية أريحا Jericho Municipality</p>	<p><b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b></p>	<p>Registration No.</p>
	<p><b>STANDARD OPERATING PROCEDURES</b> <b>Data quality management</b></p>	<p>Effective Date:</p> <p>Revised No.</p>

### 1. Scope and Objectives

Provides a standard operating procedure for data quality management in water quality monitoring.

### 2. Principles of water quality analysis data acquisition

- To obtain water quality data for one sample, at least two measurements should be taken and two data should be obtained.
- Any two or more water quality data acquired must be evaluated for their variability using statistical methods and must fall within a reasonable range of variability.
- The average value is obtained from the data that falls within a reasonable range of variation, and this is the result of the measurement.

### 3. Calculation


This SOPs describes a simple evaluation method that can be performed using only the four basic calculations.

- Relative Percentage Difference (RPD)
  - RPD is a measure of Precision of two data and is given by following formula.
  - Acceptable PRD (%) is ( ± ) 30 – 50 % (**Tentative <40%**)

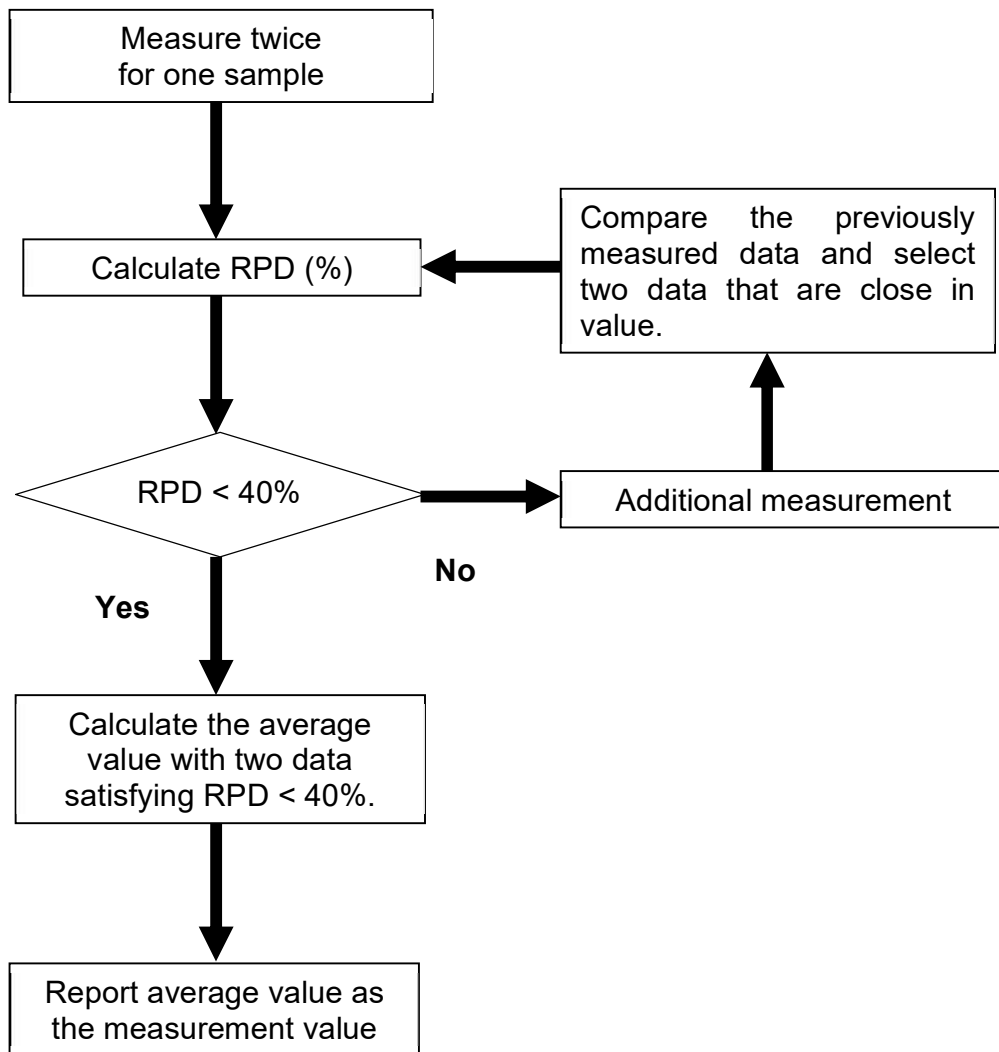
$$\text{RPD (\%)} = (\text{Data 1} - \text{Data 2}) / \text{Average value (Data1 and Data2)} \times 100$$


- Average value

$$\text{Average value} = (\text{Data1} + \text{Data2}) / 2$$

 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.
	<b>STANDARD OPERATING PROCEDURES</b> <b>Data quality management</b>	Effective Date: Revised No.

#### 4. Flow of data processing



 بلدية أريحا Jericho Municipality	<b>Jericho municipality</b> <b>WATER/WASTE WATER DIVISION</b>	Registration No.  Effective Date:
	<b>STANDARD OPERATING PROCEDURES</b> <b>Data quality management</b>	Revised No.

<b>Written By:</b>	Yasuhiko MORITA	JICA Expert
<b>Reviewed By:</b>	XXXX	
<b>Approved By:</b>	XXXX	

## **Appendix 2.2.4**

### **Orientation Material**

## Introduction of TeCSOM-II and Jericho WWTP labo

1

## Location of Waterworks laboratory and WWTP laboratory



2

## Overview of Jericho Municipal sewerage system

- ✓ The main sewer and WWTP (WasteWater Treatment Plant) of Jericho City was constructed by the Japanese grant aid.
- ✓ However, connections to the sewerage system are not widespread. Sewage inflow is **2,500 m<sup>3</sup>/day** compared to the WWTP's capacity of **9,800 m<sup>3</sup>/day**.

The challenge of Jericho Municipal Sewerage.



- 1) Solar power generation  
Covers about 1/3 of the power consumption of WWTP



- 2) Reuse of Treated Wastewater  
First sale of Treated Wastewater in Palestine  
Reuse for agricultural water



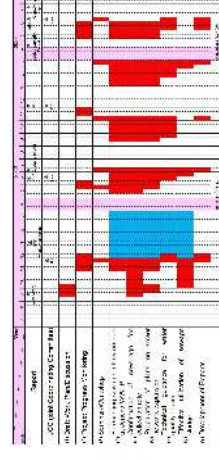
- 3) Reuse of Sewage sludge  
Reuse of dried sludge as fertilizer or soil conditioner

3

## Relationship of Jericho municipality and JICA experts.

Technical assistance for Capacity building Sewerage system Operation Management

- TeCSOM-I :2012 Dec- 2018 Mar.
- TeCSOM-II: 2021 Aug. – 2023 Jul.



Schedule of TeCSOM-II

4

## Relationship of Jericho municipality and JICA experts.

### Objectives of TeCSOM-II

**A Sustainable Wastewater Management System is established in Jericho Municipality.**

**Output-1 :** Based on the current status and future projections of wastewater treatment in Jericho, including the water balance, the **Capacity to plan for the expansion of the sewer network** to increase the inflow to the Jericho Wastewater Treatment Plant is strengthened.

**Output-2 :** Capacity for influent **water quality testing in the Jericho Wastewater Treatment Plant** is strengthened.

**Output-3 :** Potential for reuse of the sewage sludge from the Jericho Wastewater Treatment plant is studied.

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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality 2<sup>nd</sup> Joint Coordinating Committee Outline of the Water Quality Monitoring in the WWTP



June 21<sup>st</sup>, 2022

Sobhi Yaghi

Lab Technician of JWWTP

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## Contents in TeCSOM-II

The WWTP Lab technician conducted an assessment for the WWTP laboratory assisted by the TeCSOM-II Water quality Expert(Dr.Morita)

1. Assessment for the monitoring parameters , test procedures(SOP's) , devices calibration.
2. Assessment for the monitoring frequency
3. Assessment in the HR (Lab technician availability).
4. Comparison situation with other WWTP in Palestine(Nablus WWTP).

7

Issues improved in TeCSOM-II	
Item	TeCSOM-II (In practice)
Test Frequency SOP's	<ul style="list-style-type: none"> <li>• 3 times /week</li> <li>• Revision for the SOP's(BOD, Turbidity, pH/ EC/ TDS etc.)</li> <li>• SOPs for data quality management</li> </ul>
Calibration	<ul style="list-style-type: none"> <li>• Calibration is regular (prior every test)</li> </ul>
Human Resource	<ul style="list-style-type: none"> <li>• Additional Lab technician assignment is requested</li> <li>• Currently : <b>the Existing Lab technician availability in WWTP increased to 3 d/week, furthermore JM will announce for additional Lab technician</b></li> </ul>
Procurement Plan	<ul style="list-style-type: none"> <li>• No procurement plan for WWTP Lab(request items upon need)</li> <li>• Procurement plan is prepared after evaluating the Lab requirement ,investigating the local market (visiting potential suppliers) and monitoring frequency is set up.</li> </ul>

8

## Improvement in TeCSOM-II: SOPs

### SOPs prepared until June

pH/EC/TDS

Turbidity

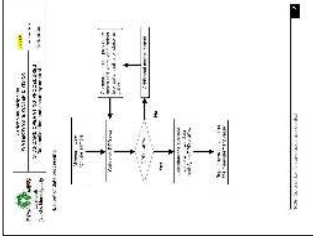
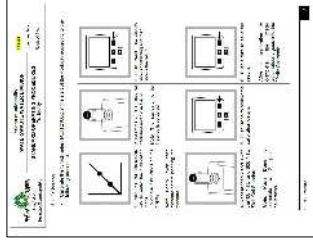
BOD<sub>5</sub>

Data collection and Accuracy control

### SOPs to be created in the next Expert's stay period

TSS, COD, T-N, NO<sub>2</sub>-N, NO<sub>3</sub>-N, NH<sub>4</sub>-N, T-P, PO<sub>4</sub>-P, SV<sub>30</sub>, (MLSS)

Prepare easy-to-understand SOPs with diagrams and flow chart



## Improvement in TeCSOM-II: Monitoring plan

	Water temperature	pH	EC (TDS)	Turbidity	Free residual chlorine	BOD <sub>5</sub>	COD	TSS	T-N	NO <sub>2</sub> -N	NH <sub>4</sub> -N	PO <sub>4</sub> -P	SV <sub>30</sub>	MLSS	SVI
Inflow water quality monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Water treatment process monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Treated water quality monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Sludge condition monitoring	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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## Improvement in TeCSOM-II: Work schedule

Monitoring Item	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Water temperature	✓	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓	✓
EC (TDS)	✓	✓	✓	✓	✓	✓	✓
Turbidity	✓	✓	✓	✓	✓	✓	✓
DO	✓	✓	✓	✓	✓	✓	✓
Free residual chlorine	✓	✓	✓	✓	✓	✓	✓
BOD <sub>5</sub>	✓	✓	✓	✓	✓	✓	✓
COD	✓	✓	✓	✓	✓	✓	✓
TSS	✓	✓	✓	✓	✓	✓	✓
T-N	✓	✓	✓	✓	✓	✓	✓
NO <sub>2</sub> -N	✓	✓	✓	✓	✓	✓	✓
NH <sub>4</sub> -N	✓	✓	✓	✓	✓	✓	✓
PO <sub>4</sub> -P	✓	✓	✓	✓	✓	✓	✓
SV <sub>30</sub> (MLSS)	✓	✓	✓	✓	✓	✓	✓

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## Issue in WWTP laboratory Limitation of capacity and equipment

- ✓ Can be monitoring in WWTP laboratory
  - BOD, COD, Turbidity, TSS, TDS, Nitrogen compounds, Phosphate phosphorus, Residual chlorine: 13 items
- ✓ Items for which **outsourced analysis** should be considered
  - Inorganic matter, heavy metals, and microorganisms: 34 items
  - Jericho WWTP Lab does not have the equipment for analyze these items.
  - Outsourcing: Considering cooperation with An-Najah Univ.

12



**Lesson learnt**

- ◆ Analyze the results after the measurement process.
- ◆ Compare and verify the accuracy of the measurements.

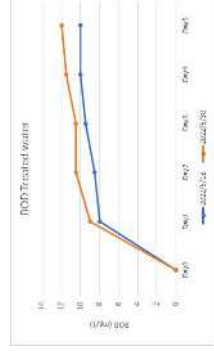
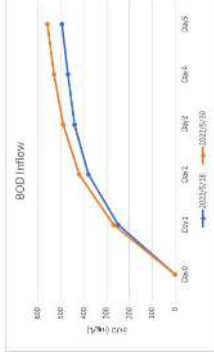


**Issues to develop**

- ◆ Develop a system to monitor water quality electronically by sensors linked electronically through special programs.

### Lessons learnt: Implementation of correct experimentation in accordance with SOPs.

- Example: BOD test, Inflow and Treated water BOD
- Experiments with high repeatability can now be conducted.



Visit to the water laboratory of Nablus Municipality WWTP



- Understood that the daily monitoring is required to ensure the quality of water.
- Yearly procurement plan is necessary

### Challenges in water Quality

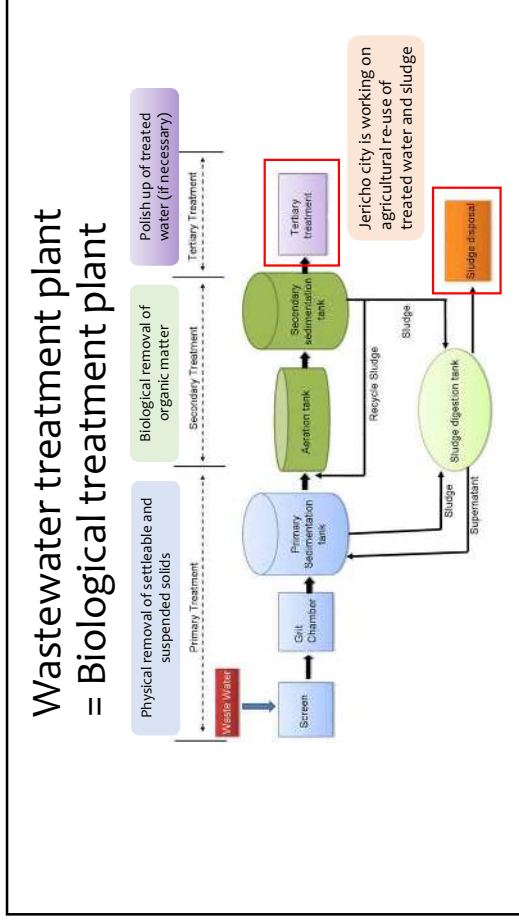
1. Increase laboratory staff: Assigning new Lab technician
2. Capacity enhancement of new staff:
3. Monitoring and supervision of JAIP effluents
4. Develop an annual budget for laboratory operations and a procurement plan
5. Visualization and more detailed analysis of water quality data using EXCEL (additional PCs in the sewage laboratory are desired).
6. Implementing national and international searches for academic information by improving the internet environment.



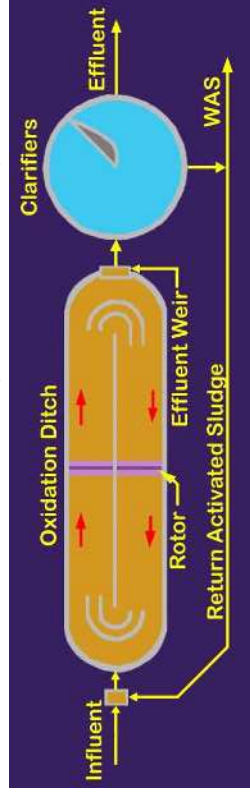
**THANK YOU**

# Introduction of Jericho WWTP

2022/08/30 Morita



## Various biological treatment methods Oxidation ditch (Jericho WWTP)



- Sewage is treated by micro-organisms while circling a race-track shaped tank (this is an "oxidation ditch").
- The long retention time of sewage (the time it remains in the tank) allows it to absorb sudden fluctuations in the quality of the incoming wastewater and to provide good sewage treatment.

## Facility in Jericho WWTP



Screen and Grid chamber

Solids such as sand, gravel and plastic are removed here.

## Facility in Jericho WWTP



Oxidation ditch

- This is the main part of WWTP.
- In this race-track reactor tank, sewage flows in a constant direction.
- Regular aeration (air supply) keeps the oxygen concentration in the water within a certain range.

5

## Facility in Jericho WWTP



Sedimentation tank (Clarifier)

- Supernatant of treated water is collected, and deposit (floc of activated sludge) is separated.
- Some of the separated activated sludge is returned to the oxidation ditch to maintain biological density (Mixed Liquor Suspended Solid: MLSS) in oxidation ditch, and the rest is sent to the drying bed as excess sludge.
- In this WWTP, this process is the last step of water treatment process.

6

## Facility in Jericho WWTP



Treated water tank (Irrigation water tank)

- Treated water is collected and stored in this tank.
- Treated water is used for agricultural purposes.
- From this tank, treated water is distributed to nearby farms (water distribution facilities are currently under construction).
- This treated water is a “**product**” for Jericho Municipality.

7

## Facility in Jericho WWTP



Sludge drying bed

- Excess activated sludge is sent to a drying bed for drying.
- The dried sludge is used as fertilizer on farmland.
- This dried sludge is also a “**product**” for Jericho Municipality.

8

## Sampling and monitoring work in WWTP



9

## The meaning of laboratory analysis work in Jericho WWTP

**Question:** What in the meaning of water quality monitoring in Jericho WWTP?

- It can be described as a **process for quality control and quality assurance** of the "product" (treated water).
- In order to maintain the quality of the product, it is important to control not only the quality of the product (treated water) but also the treatment process (manufacturing process).
- In future, composition of dried soil (ingredients of inorganic matter, heavy metal, etc.) will be analyzed.
- For more detailed chemical analysis, **joint implementation with university** is planned.

10

## **Appendix 2.2.5**

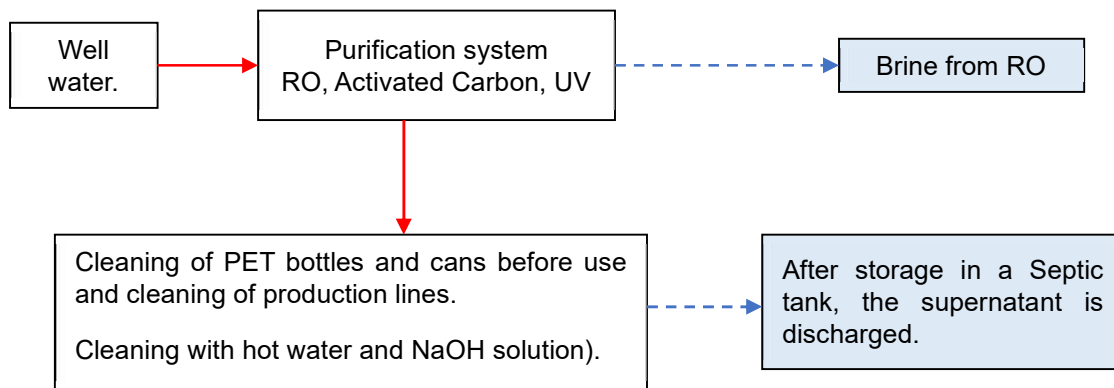
### **Drinking Factory Survey**

## Drinking Factory's wastewater quality survey

### Outline of Factory

- This plant adjusts raw material of soft drink to a predetermined composition and bottles them into PET bottles and cans.
- The only bottling plant in the West Bank, shipping products throughout the West Bank and parts of Israel.
- Production: 40,000 bottles/hour, 16-hour operation.
- Usually, Sat. - Thu. operation and Fri. off. In the summer period, operation Sat. - Fri. (without holiday).

### Water use flow diagram.



### Wastewater treatment method

- Before direction by Jericho Municipality: Brine mixed with septic tank effluent and discharged: the high TDS effluent observed in Trunk No. 19 is presumed to be due to the discharge of brine.
- After direction by Jericho Municipality: Brine is temporarily stored and taken outside by tanker truck for treatment (However, it is not known where it is taken and treated).

Photo: 2023/Mar. / 09 Water sampling and facility visit



Ro filtration unit (Nitto Denko Co.)



Activated carbon filter



On-line water quality monitor



Wastewater in septic tank



Discussion with manager



Sampling



Inside the Septic tank



Laboratory work



## **Appendix 2.2.6**

# **Reagent Procurement Plan**

WTW spectrometer reagent

Monitoring item	Price for 12 month (NIS)	Rmks
Total nitrogen	5,950	LR
	7,650	HR
NO3-N	6,800	LR
	1,350	HR
NH4-N	2,360	LR
	1,620	HR
PO4-P	2,760	LR
	4,410	HR
COD	9,660	LR
	12,420	HR
<b>Sub total</b>	<b>54,980</b>	

BOD reagent and GFC for TSS

Monitoring item	Price for 12 month (NIS)	Rmks
BOD	300	NaOH tab
	500	Nitrification inhibitor
TSS	1,740	Glass fiber filter
<b>Sub total</b>	<b>2,540</b>	

pH and EC buffer

Monitoring item	Price for 12 month (NIS)	Rmks
pH buffer 7.0	3,750	2022Nov. Bidding price
EC 1413µS/cm	3,240	diotto
<b>Sub total</b>	<b>6,990</b>	

Total yearly budget for reagent

**64,510** NIS

Spectrometer reagent Procurement Plan															
Item	Sample place	Reference Raw and Criteria	Sample/ month	Test/month (2 tests/sample)	Test / 6 month	Test/year (Month x 12)	Reagent	Packet / Package	Package/ Month	Package/ Year	Round up .Package / month	Package / 6 month	Package / year	Price/Package (NIS) as of 2023 Jan.	Price/Year (NIS)
Total Nitrogen	Effluent	Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	14	28	168	336	TN-LR								
	Influent	Jericho WWTP Design parameter	10	20	120	240	TN-HR								
	Trunk No.1	Jericho WWTP Design parameter	4	8	48	96	TN-HR								
	Trunk No.19	Jericho WWTP Design parameter	4	8	48	96	TN-HR								
		Nr. of test (2 tests / sample)	64	288	576										
Nitrate(NO <sub>3</sub> -N)	Reagent	TN-LR		28	168	336			50	0.56	6.72	1	4	7	850
		TN-HR		36	216	432			50	0.72	8.64	1	5	9	850
	Effluent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	8	16	96	192	Nitrate NO3								
	Influent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	6	12	72	144	NO3-ITC								
		Nr. of test (2 tests / sample)	28	168	336										
Ammonia Nitrogen (NH <sub>4</sub> -N)	Reagent	Nitrate NO3		16	96	192			25	0.64	7.68	1	4	8	850
		NO3-ITC		12	72	144			50	0.24	2.88	1	2	3	450
	Effluent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	8	16	96	192	NH4-2 TC								
	Influent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	6	12	72	144	NH4-3 TC								
		Nr. of test (2 tests / sample)	28	168	336										
Phosphate (PO <sub>4</sub> -P)	Reagent	NH4-2 TC		16	96	192			50	0.32	3.84	1	2	4	590
		NH4-3 TC		12	72	144			50	0.24	2.88	1	2	3	540
	Effluent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	14	28	168	336	PO4-1 TP								
	Influent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	10	20	120	240	PO4-2 TC								
		Nr. of test (2 tests / sample)	4	8	48	96	PO4-2 TC								
COD	Trunk No.1	Jericho WWTP Design parameter	4	8	48	96	PO4-2 TC								
	Trunk No.19	Jericho WWTP Design parameter	4	8	48	96	PO4-2 TC								
		Nr. of test (2 tests / sample)	64	288	576										
	Reagent	PO4-1 TC		28	168	336			100	0.28	3.36	1	2	4	690
	PO4-2 TC		36	216	432			50	0.72	8.64	1	5	9	490	
COD LR (Cat. No. 09772) should be change COD1-TC (Cat. No. 251990)	Effluent	Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (PS742:2015); High quality (A)	14	28	168	336	COD LR								
	Influent	Jericho WWTP Design parameter	10	20	120	240	COD HR								
	Trunk No.1	Cabinet resolution No.16:2013, House and Facilities' Connection System to the Public Sewage Network	4	8	48	96	COD HR								
	Trunk No.19	Cabinet resolution No.16:2013, House and Facilities' Connection System to the Public Sewage Network	4	8	48	96	COD HR								
		Nr. of test (2 tests / sample)	64	384	768										
Total (NIS)	Reagent	COD LR		28	168	336			25	1.12	13.44	2	7	14	9,660
		COD HR		36	216	432			25	1.44	17.28	2	9	18	12,420
														54,980	

BOD PS-742 (A: High quality) 20 mg/L

Reagent	Sample	Frequency	Test/month	Bottle/month
Sodium Hydroxide	Effluent	each 5 days	4	0.8
	Influent	each 5 days	4	0.8
	Trunk 1	1/month	0	0
	Trunk 19	1/month	0	0
	JALP	1/month	0	0
	Jerich Gate	1/month	0	0
			<b>Sub total</b>	<b>1.6</b>

Track record of use 2 bottles/ 10 tests = 0.2 Bottle / test

Reagent	Sample	Frequency	Test/month	mL / month
Nitrofication inhibitor	Effluent	each 5 days	4	0.8
	Influent	each 5 days	4	1.6
	Trunk 1	1/month	0	0
	Trunk 19	1/month	0	0
	JALP	1/month	0	0
	Jerich Gate	1/month	0	0
			<b>Sub total</b>	<b>2.4</b>

Track record of use Influent test 0.4 mL  
Effluent test 0.2 mL  
\*1 bottle 25 mL

TSS PS-742 (A: High quality) 1500 mg/L

Reagent	Sample	Frequency	Test/month	Measure / sample	Measure /month
GFC	Effluent	4 times / week	10	2	20
				1	10

	Bottle consumption	Round up (Bottle)	Price (NIS)
1 month	1.6	2	30
6 months	9.6	10	150
1 year = 12 months	19.2	20	300

Unit price (as of 2023 Jan)  
15 NIS

Consumption volume	mL	Bottle	Round up (Bottle)	Price (NIS)
1 month	2.4	1	1	250
6 months	14.4	1	1	250
1 year = 12 months	28.8	1	2	500

Unit price (as of 2023 Jan)  
250 NIS

Consumption volume	Filter (Piece)	Box	Round up (Box)	Price (NIS)
1 month	20	0.20	0	1,160
6 months	120	1.20	2	1,160
1 year = 12 months	240	2.40	3	1,740

Unit price (as of 2023 Jan)  
560 NIS  
100 filters/ box

Reagent	Package		3 calibration/week			Consumption		Consumption (Round)		Unit price (NIS)		Procurement price	
	mL	Pauch / Package	1 month	6 month	12 month	6 month	12 month	6 month	12 month	6 month	12 month	6 month	12 month
pH buffer 7.0	500		600	3,600	7,200	7	14	8	15	250		2,000	3,750
						pH buffer (bottle)		pH buffer (bottle)				pH buffer	
EC 1413µS/cm		20	12	72	144	4	7	4	8	405		1,620	3,240
			EC standard (pauch)			EC standard (Box)		EC standard (Box)				EC standard	
<b>Total</b>											<b>3,620</b>	<b>6,990</b>	

Note

pH buffer      Use 50mL/ calibration  
10 times calibration/ bottle

EC standard      Use 1 pauch / calibration  
20 times calibration /box

## **Appendix 2.2.7**

### **Survey of Suppliers of Chemical Analysis Equipment and Reagents**

## Visit survey of suppliers of chemical analysis equipment and reagents in Palestine

### (1) Object of visit survey

4 distributors Ramallah City and 1 distributor in Qalqili City were identified through a preliminary survey and visited each distributor.

Date of visit survey 25 May 2022, Ramallah City; 12 June 2022, Qalqili City.

### (2) Main survey item

- ✓ Manufacturers of measuring equipment which are dealing (HACH, HANNA, WTW, etc.,)
- ✓ Kind of reagents (genuine chemicals) and the grades reagent (analytical grade or not)
- ✓ Kind of laboratory equipment such as glassware (beaker, flask, measuring cylinder, etc.,) and the quality of the products.
- ✓ Availability of stock of reagents and laboratory equipment and possibility of support of import procedures

### (3) Survey results

The survey results are summarized in Table 1. In this survey, Bio Tech in Ramallah City and Labo Tech in Qalqili City were considered as a promising distributor.

Table 1 Result of visit survey

Distributor	Feature of distributor	Assessment
Ramallah City		
Bio Tech	<ul style="list-style-type: none"> <li>• Bio Tech has delivered water quality monitoring equipment to a water quality lab in Jericho, to a JAIP tenant, and to a lab at JAIP's water treatment facility.</li> <li>• They have also delivered to other water quality labs in Palestine.</li> <li>• HACH and HANNA are available. In addition, they are distributor of Shimadzu Corporation (Japan).</li> <li>• Bio Tech always has a certain amount of equipment and reagents in stock.</li> </ul>	Yes
Medical Supply Service	<ul style="list-style-type: none"> <li>• Specializes in medical equipment (used in hospitals, etc.) and pharmaceuticals and testing instruments</li> <li>• Not specialized in water quality analysis</li> </ul>	×
Allow company	<ul style="list-style-type: none"> <li>• Allow company has experience with leak detection equipment: delivered to a project in the Jenin city.</li> <li>• They delivered water quality analysis equipment</li> </ul>	×

	<p>(portable pH, EC, DO meters) for Jericho municipality ("Aquameter" in WWTP lab).</p> <ul style="list-style-type: none"> <li>• Only order taking, no stock of equipment.</li> <li>• Since they do not have stock, they cannot respond to urgent procurement.</li> <li>• Their knowledge of water quality analysis is low.</li> </ul>	
Bioline Medical Service	<ul style="list-style-type: none"> <li>• Specializing in pharmaceutical and medical equipment.</li> <li>• Dealing with laboratory glassware, but procuring only common glass wares (e.g., beakers and flasks).</li> <li>• The quality of the glass measurement equipment is not good (the glass was distorted, resulting in accuracy problems).</li> </ul>	<p>△ Procurement is limited to beakers, flasks and bottles, excluding measuring equipment.</p>
Qalqili City		
Lab Tech	<ul style="list-style-type: none"> <li>• They delivered equipment for universities in Palestine, Water quality laboratory in JAIP administration building and drinking water company's laboratory in Jericho city.</li> <li>• Distributor of WTW, HACH and Palintest.</li> <li>• <u>They delivered laboratory equipment for Jericho WWTP laboratory</u></li> <li>• Bio Tech always has a certain amount of equipment and reagents in stock.</li> </ul>	Yes

Photos of each distributor: Photos of Bio Tech and Lab Tech are shown in Photo 1.

Photo 1 Stock yard and Workshop of Bio Tech and Lab Tech

Bio Tech		
		
Stock yard	Stock yard	Workshop
Lab Tech		





(1) Conditions for the implementation of the procurement of analytical equipment and reagents

The following conditions were identified regarding the procurement of analytical equipment and reagents in Palestine and Jericho municipality.

- a) Restrictions on importation of chemicals in Palestine and measures to address them.
- The import of general chemical reagents requires a special permission of Israel. For this reason, it takes at least two months from order to delivery at the earliest.
  - On the other hand, reagents sold as test kits, such as HACH test kit, are easily available. They are readily available from stock.

b) Rules for procurement of equipment in Jericho Municipality

Procurement up to USD 3,000: Procurement from designated vendor

- ✓ Procurement can be done in accordance with WWD requirements, but previous approval of Mayor is required. That is, the order can be placed to a specific vendor after obtaining the Mayor's approval for the list of items to be procured (name of item, unit price and number of items).
- ✓ Procurement can be done only after obtaining further mayoral approval for the quotation.

Procurement of USD 3,000 to USD 20,000: Price quotation competition

- ✓ WWD prepares a list of procurement items. The Purchase Unit of Jericho Municipality obtains quotations from 3 or 4 vendors (minimum 2 vendors).
- ✓ The vendor quotations are evaluated by the Tender Committee of Jericho Municipality to finalize the successful bidder.

Procurement over USD 20 000: Competitive tendering

- ✓ WWD prepares a list of procurement items according to the decided procurement plan.
- ✓ Competitive tendering is conducted after the tender information has been published

in the newspaper.

Due to restrictions and difficulty on the procurement of chemicals in Palestine, the implementation of water quality measurements in accordance with the official analytical methods established in Palestine (which refer to US EPA's Standard Methods) is considered difficult. Therefore, water quality analysis will continue to be conducted using test kits.

(2) Trial implementation of procurement of analytical equipment and reagents

After reviewing the results of the market survey with WWD, it was decided to procure reagents for 6 months using the additional budget request due at the end of June. Item and number of reagents to be procured was determined based on the water quality monitoring plan. The list of reagents to be procured is shown in Table 2.

After reviewing the provisional quotations obtained from distributors, it was decided that the procurement would be undertaken either by appointing a distributor or through a price quotation competition. It was confirmed with WWD that the procurement would be done by the time of the next expert trip (August 2022).

Table 2 Procurement item list

Measurement item	Name of reagent	Nos. (Package)
Calibration reagent		
pH	pH 7.0 Buffer 20mL x 20 sachets	1
EC (TDS)	1,413 $\mu$ S/cm Conductivity Solution, 20mL x 20 sachets	1
Turbidity	HACH 2100Q StableCal Standard	1
DO	Aquaread DO Zero calibration solution-150	2
BOD <sub>5</sub>	Sodium hydroxide	2
	NTH600	2
Analysis reagent		
COD (High concentration)	COD cell test 100-1500mg/L	4
COD (Low concentration)	COD cell test 10-150mg/L	2
T-N (High concentration)	Ntot 2-TC (10 - 150mg/L)	2
T-N (Low concentration)	Ntot 1-TC (0.5 - 25mg/L)	1
NO <sub>3</sub> -N (High concentration)	NO <sub>3</sub> -1 TC (0.2 - 30mg/L NO <sub>3</sub> -N)	2
NO <sub>3</sub> -N (Low concentration)	NO <sub>3</sub> -N(0.1-2.7mg/L) 14556	2
NH <sub>4</sub> -N (High concentration)	NH <sub>4</sub> -3TC (0.07 - 9.37 mg/L NH <sub>3</sub> )	2
NH <sub>4</sub> -N (Low concentration)	NH <sub>4</sub> -2TC (0.005 - 0.447 mg/L NH <sub>3</sub> )	1
PO <sub>4</sub> -P (High concentration)	PO <sub>4</sub> -2TC (0.02 - 1.63 mg/L PO <sub>4</sub> -P)	2
PO <sub>4</sub> -P (Low concentration)	PO <sub>4</sub> -1TC (0.007 - 0.8 mg/L PO <sub>4</sub> -P)	1
TSS	Glass fiber filter 100pks	2

## **Appendix 2.2.8**

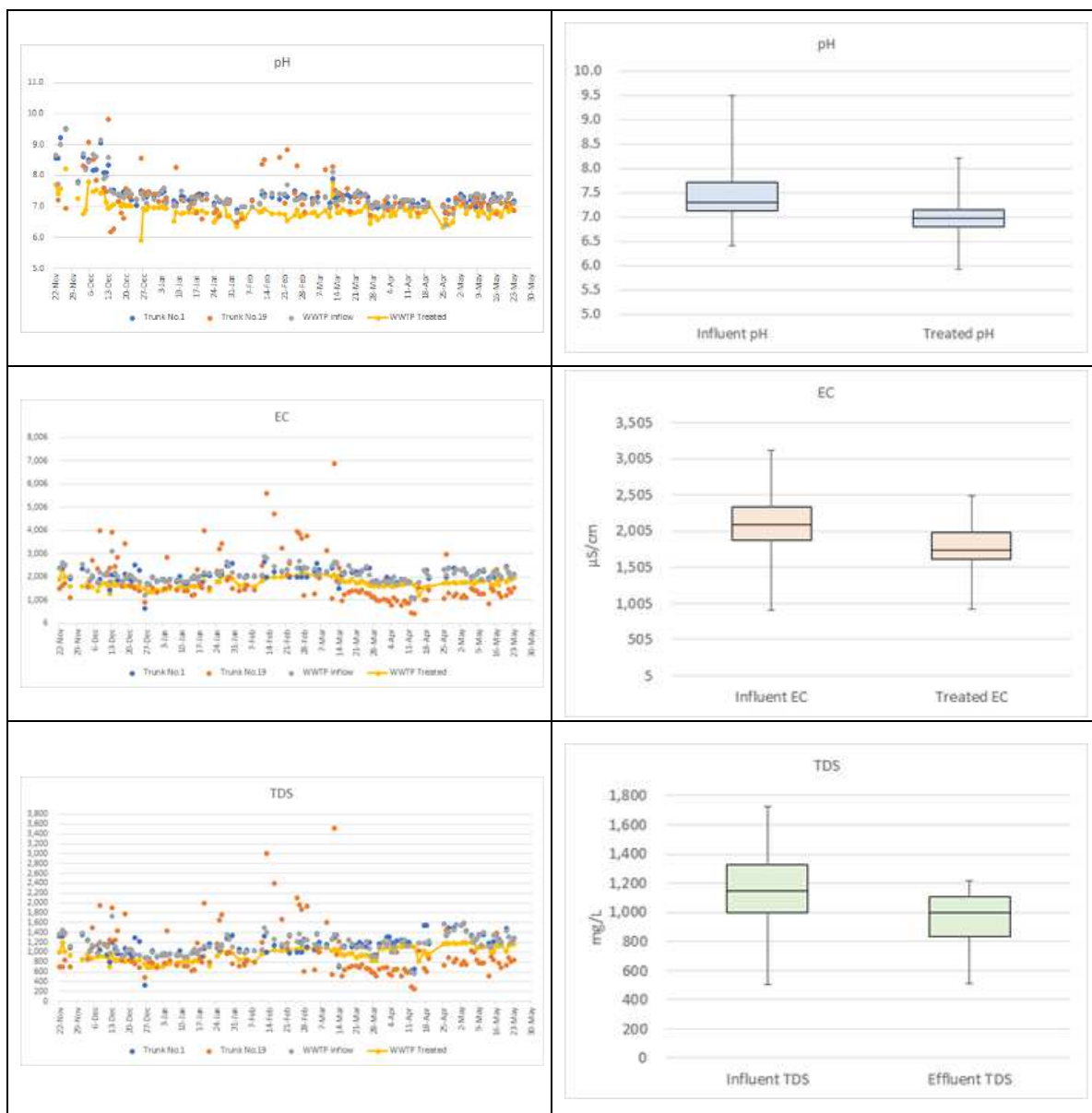
### **Data Analysis**

# 1. Data Analysis

## (1) Inflow sewer and treated water quality

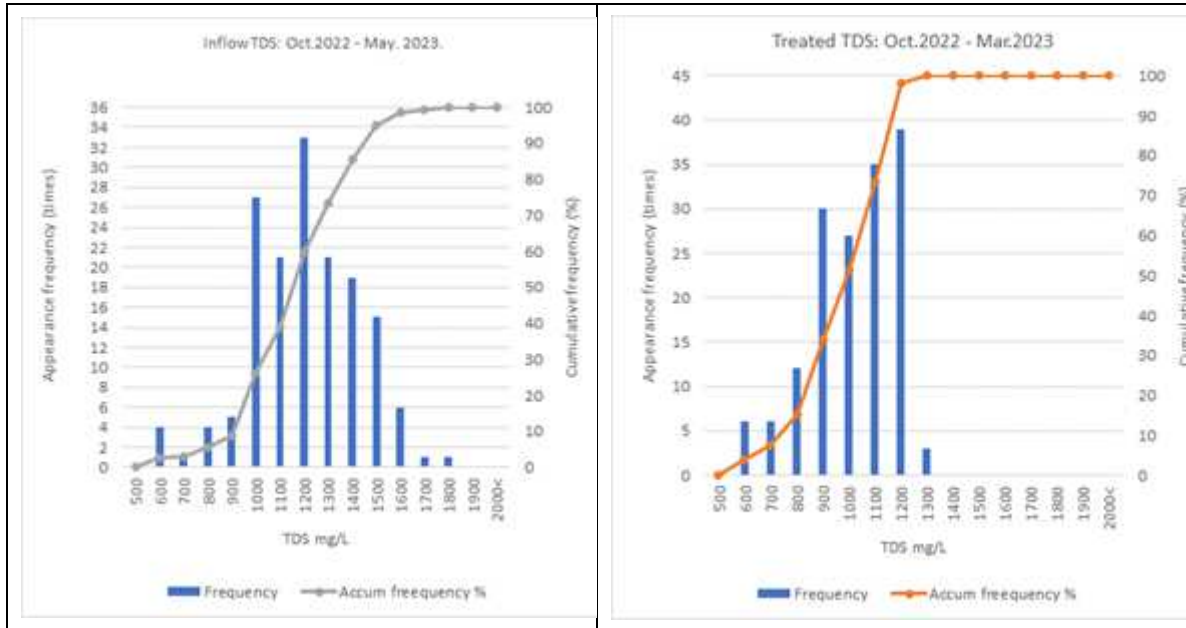
### pH, EC, TDS and Turbidity

- Daily variation of pH, EC and TDS (left side): Comparison among monitoring values of inflow sewage (trunk line 1, trunk line 19, WWTP influent pit) and treated water.
- Box-and-whisker diagram of monitoring data(right-side): Comparison between influent sewage (WWTP influent pit) and treated water.
- The fluctuations in pH, EC and TDS are smoothed by the biological treatment. It was also found that TDS decreased as a result of biological treatment.

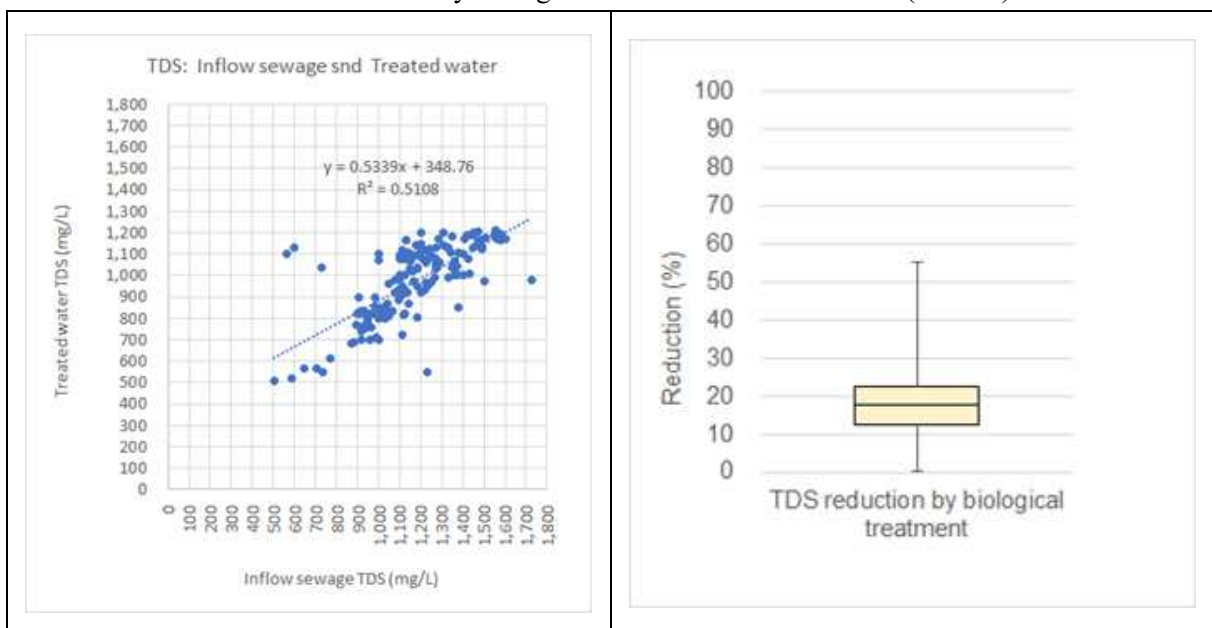


## TDS data analysis

- Distribution of TDS concentrations in influent sewage and treated water (Pareto chart analysis).
- TDS in influent sewage was observed in some inflows above 1200 mg/L, but after treatment it is almost 1200 mg/L.

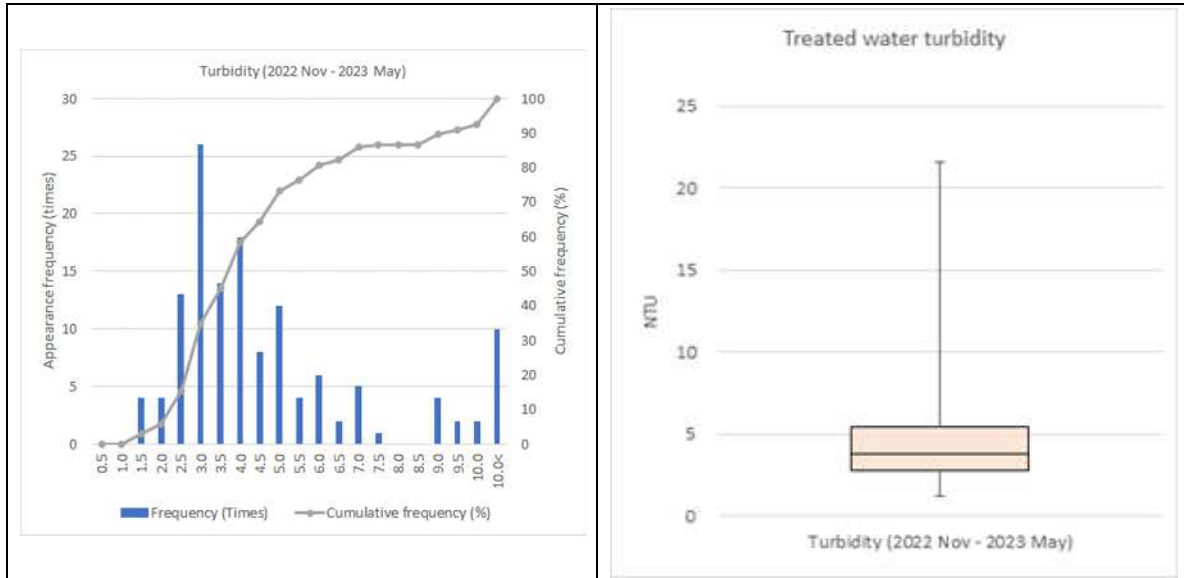


- The correlation chart of TDS of the influent and treated water (Left-side) shows that even if the influent TDS is around 1,600 mg/L, the TDS in treated water is decreased around 1,200 mg/L.
- The removal ratio of TDS by biological treatment was about 18% (median).

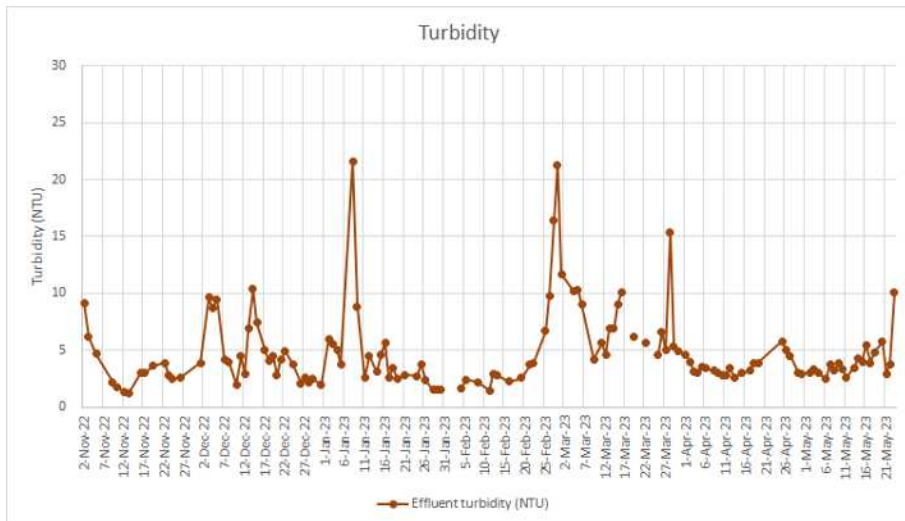


## Turbidity

- The median turbidity value was 3.8 NTU and the 75th percentile value was 5.5 NTU. However, sometimes exceed 10 NTU which is the standard value for agricultural reuse of WWTP treated water.

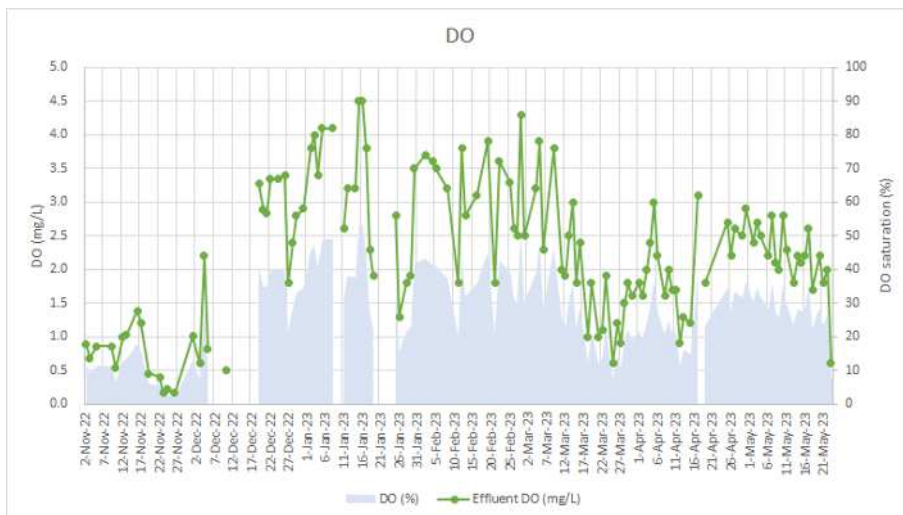
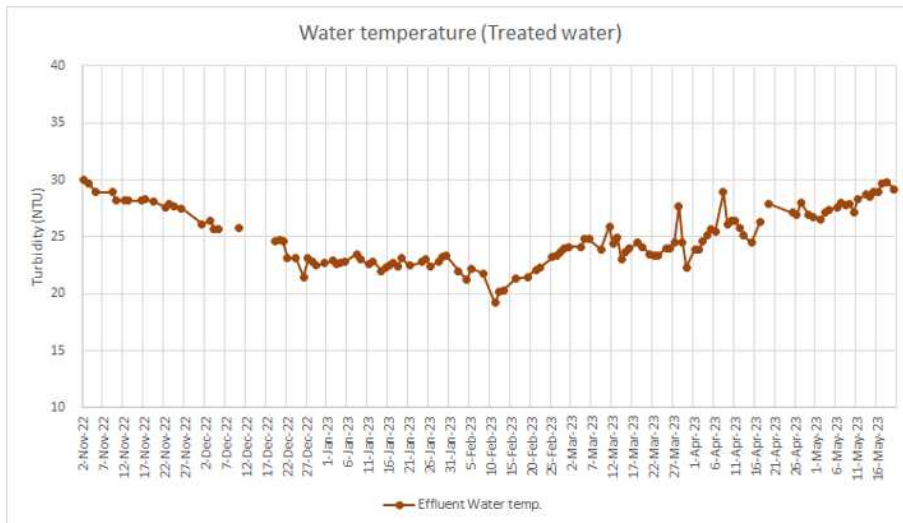


- Sudden increases in treated water turbidity occur suddenly (no seasonal changes were observed). Turbidity seems to be affected by the sludge withdrawal from the final sedimentation tank (Clarifier) is properly carried out or not.



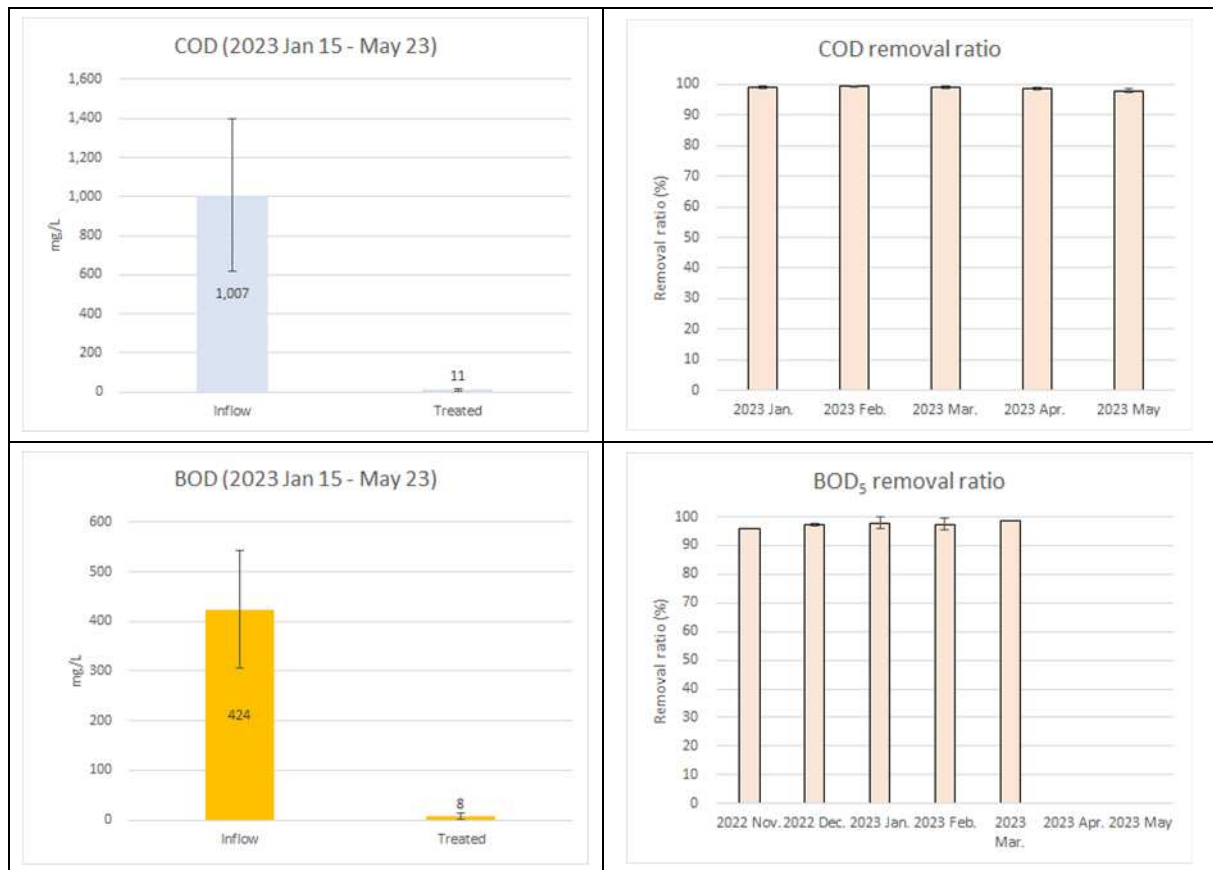
## Dissolved oxygen (DO), Water temperature

- Water temperature tend to decrease during the rainy season and increase during the dry season.
- The DO of the treated water also followed this trend, thus, increasing during the low-water temperature period (rainy season) and decreasing during the high-water temperature period (dry season).
- DO values as a percentage of dissolved oxygen saturation concentration averaged 27%, but varied between 2% and 52%. The percentage tended to increase during the rainy season.



### CODcr, BOD<sub>5</sub>

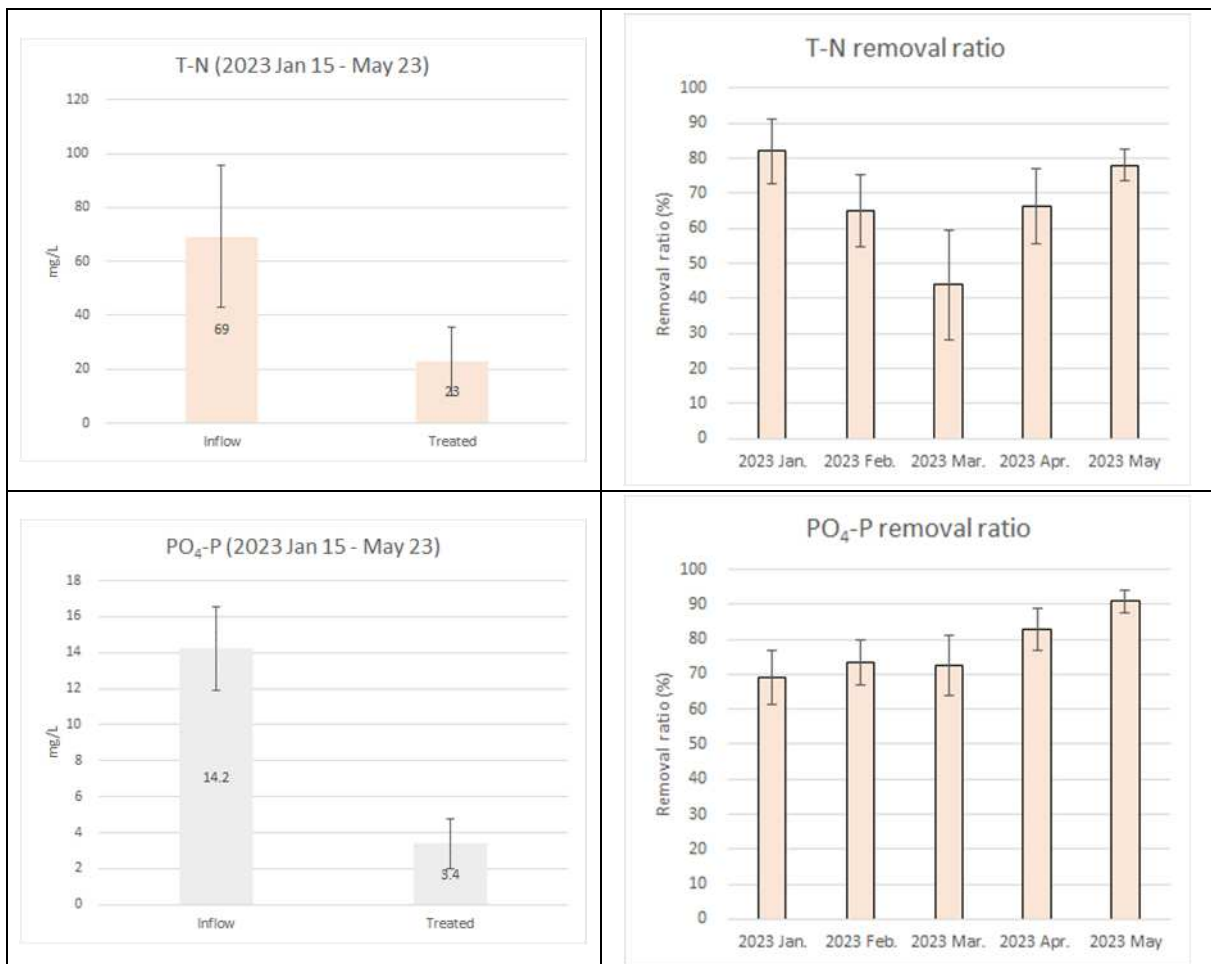
- The average COD and BOD of the influent sewage is 1007 mg/L and 424 g/L, respectively.
- While the average COD removal ratio was 99%, and BOD removal ratio was 98%.
- The removal ratios of COD and BOD were almost constant during January to May 2023.





## T-N, PO<sub>4</sub>-P

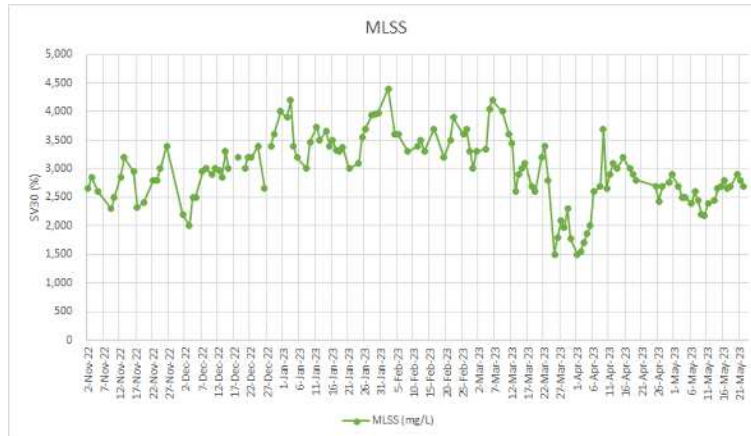
- Total nitrogen removal ratios have decreased in March 2023. This trend is similar to the change in DO during the same period, but no correlation was found between the two.
- In the biological treatment of nitrogen, nitrogen eventually diffuses into the atmosphere as a gas. However, for the agricultural re-use of treated water, the nitrogen component should be left in the treated water as much as possible (remaining Nitrogen compound in treated water is an added value because it becomes a fertilizers).
- In PS742-2003, the reference value for T-N is 30 mg/L. In contrast, the T-N of the treated water averaged 23 mg/L  $\pm$  13 mg/L (1 SD). It is generally a desirable T-N concentration.
- Phosphorus removal rates are gradually increasing. In the view of the principle of phosphorus removal in biological treatment, it is assumed that phosphorus is transferring to the sludge.



## (2) Treatment process

### MLSS, SV30, SVI

- Management indicators for activated sludge are monitored almost daily.
- These indicators are used to decide the sludge return rate and to determine the implementation of sludge withdrawal.



## 2. Water quality monitoring data

List of water quality monitoring data from Nov. 2022 to May 2023.  
(Blank: Observation missing)

### Inflow sewer

(1) Trunk No.1  
2022 Nov.

Monitoring item	22-Nov	23-Nov	24-Nov	26-Nov
pH	8.6	8.6	9.2	9.5
EC (µS/cm)	2,399	2,399	2,514	1,944
TDS (mg/L)	1,328	1,328	1,381	1,097

2022 Dec.

Monitoring item	1-Dec	3-Dec	4-Dec	5-Dec	7-Dec	8-Dec	10-Dec	11-Dec	12-Dec	14-Dec	15-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	24-Dec	26-Dec	27-Dec	28-Dec	29-Dec	31-Dec
pH	7.8	8.6	8.2	8.5	8.2	8.2	8.2	8.1	8.1	8.1	7.5	7.4	7.4	7.4	7.5	7.5	7.2	7.1	7.5	7.4	7.3	7.5	7.3
EC (µS/cm)	2,350	2,261	1,881	2,012	1,781	1,910	2,105	2,088	1,457	2,100	2,100	1,880	1,800	2,120	1,978	1,930	2,530	2,309	650	1,750	1,685	2,000	1,850
TDS (mg/L)	1,352	1,244	1,035	1,100	980	1,052	1,153	957	800	1,200	1,070	960	930	1,081	1,002	990	1,290	1,215	330	890	840	1,030	900

2023 Jan.

Monitoring item	2-Jan	3-Jan	4-Jan	5-Jan	8-Jan	9-Jan	11-Jan	12-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	21-Jan	24-Jan	25-Jan	26-Jan	28-Jan	29-Jan	30-Jan	
pH	7.4	7.4	7.4	7.5	7.2	7.2	7.1	7.3	7.3	7.2	7.1	7.2	7.4	7.4	7.4	7.1	6.9	7.2	7.1	7.1	7.2	7.2
EC (µS/cm)	1,900	1,881	1,814	1,910	1,820	2,030	1,740	1,750	1,940	1,960	1,891	2,044	1,788	2,111	2,070	2,150	2,060	2,130	2,509	2,565	2,600	2,600
TDS (mg/L)	940	960	943	970	928	1,030	900	900	990	995	967	1,042	912	1,079	1,165	1,097	1,050	1,140	1,280	1,305	1,340	1,340

2023 Feb.

Monitoring item	2-Feb	4-Feb	5-Feb	8-Feb	11-Feb	12-Feb	13-Feb	16-Feb	19-Feb	21-Feb	22-Feb	25-Feb	26-Feb	27-Feb	28-Feb
pH	6.9	7.0	7.0	7.2	7.1	7.4	7.4	7.4	7.3	7.2	7.4	7.3	7.5	7.3	7.4
EC (µS/cm)	2,080	1,490	2,060	2,045	2,060	2,650	2,000	2,230	2,220	2,340	1,999	2,000	2,400	1,989	2,400
TDS (mg/L)	1,060	770	1,050	1,030	1,050	1,330	1,000	1,140	1,130	1,190	989	1,000	1,200	1,000	1,260

2023 Apr.

Monitoring item	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	15-Apr	17-Apr	18-Apr	19-Apr	25-Apr	26-Apr	27-Apr	29-Apr	30-Apr	
pH	7.0	7.0	7.1	7.0	7.0	7.3	7.1	7.2	7.2	7.2	7.0	7.1	7.1	7.1	7.2	7.0	7.0	7.0	6.8	7.2	7.2	7.2
EC (µS/cm)	1,830	1,990	1,900	1,820	2,010	1,780	1,900	1,910	1,800	1,800	1,125	1,100	1,759	2,310	2,310	1,938	2,340	2,000	2,400	2,400	2,400	2,330
TDS (mg/L)	1,200	1,313	1,313	1,200	1,159	1,230	1,254	1,250	1,200	1,200	630	650	1,179	1,547	1,547	1,163	1,578	1,340	1,495	1,495	1,495	1,560

2023 May

Monitoring item	2-May	3-May	4-May	6-May	7-May	8-May	9-May	10-May	11-May	13-May	14-May	15-May	16-May	17-May	18-May	20-May	21-May	22-May	23-May	
pH	7.4	7.3	7.1	7.2	7.3	7.0	7.3	7.1	7.1	7.3	7.1	7.2	7.4	7.3	7.2	7.3	7.2	7.4	7.4	7.2
EC (µS/cm)	2,312	2,366	2,150	2,000	2,020	2,135	2,250	1,900	2,250	1,984	2,021	2,015	2,015	2,240	2,100	1,990	2,460	2,200	2,000	2,121
TDS (mg/L)	1,550	1,585	1,440	1,340	1,198	1,280	1,350	1,140	1,350	1,190	1,113	1,209	1,344	1,260	1,194	1,476	1,476	1,308	1,200	1,273

## (2) Trunk No.19

2022 Nov.

Monitoring item	22-Nov	23-Nov	24-Nov	26-Nov
pH		7.2	9.0	7.0
EC (µS/cm)	1,500	1,658	1,750	1,120
TDS (mg/L)	700	700	850	695

2022 Dec.

Monitoring item	3-Dec	5-Dec	7-Dec	8-Dec	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	24-Dec	26-Dec	27-Dec	28-Dec	29-Dec	31-Dec	
pH	8.3	9.1	8.5	7.8	7.6	7.5	9.8	6.2	6.3	7.2	6.8	6.6	7.6	7.3	7.4	7.2	8.6	7.5	7.4	7.4	7.5	7.4
EC (µS/cm)	1,570	2,717	2,350	4,000	2,087	2,400	3,920	2,446	2,870	1,601	3,460	2,072	1,633	1,621	1,496	2,280	925	1,720	1,688	1,537	1,336	
TDS (mg/L)	862	1,493	1,136	1,950	1,149	1,240	1,900	1,244	1,440	824	1,770	1,046	837	812	761	682	480	875	798	784	680	

2023 Jan.

Monitoring item	2-Jan	3-Jan	4-Jan	5-Jan	8-Jan	9-Jan	11-Jan	12-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	21-Jan	24-Jan	25-Jan	26-Jan	28-Jan	29-Jan	30-Jan
pH	7.2	7.5	7.2	7.3	7.0	8.3	7.2	7.2	7.2	7.0	7.1	7.3	6.8	7.3	6.6	6.8	6.9	6.7	7.1	7.1	7.2
EC (µS/cm)	1,870	1,516	2,848	1,625	1,431	1,840	1,411	1,414	1,220	1,252	2,320	1,696	1,559	3,999	1,557	2,280	3,225	3,450	1,870	2,000	1,500
TDS (mg/L)	950	777	1,440	826	728	937	722	721	631	639	1,181	868	792	2,000	794	1,169	1,656	1,760	960	1,000	770

2023 Feb

Monitoring item	2-Feb	4-Feb	5-Feb	8-Feb	11-Feb	12-Feb	13-Feb	16-Feb	19-Feb	21-Feb	22-Feb	25-Feb	26-Feb	27-Feb	28-Feb
pH	6.5	6.6	7.0	7.2	7.1	8.4	8.5	7.4	8.6	7.1	8.8	7.4	8.3	7.3	7.1
EC (µS/cm)	1,398	1,470	1,629	1,450	2,500		5,600	4,720	3,250	2,100	2,604	3,975	3,861	3,668	1,206
TDS (mg/L)	716	740	830	798	1,200		3,000	2,404	1,660	1,079	1,320	2,100	1,970	1,870	616

2023 Mar.

Monitoring item	1-Mar	4-Mar	5-Mar	6-Mar	9-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	18-Mar	19-Mar	21-Mar	22-Mar	23-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar
pH	6.8	7.1	7.2	7.5	8.2	7.0	7.3	7.5	7.0	7.4	7.3	7.6	6.8	7.3	7.1	7.3	7.4	7.2	6.7	6.9	7.1	7.1
EC (µS/cm)	3,761	1,267	2,069	1,985	3,160	1,074	6,891	1,851	2,400	1,000	1,260	1,347	1,405	1,407	1,337	1,460	1,325	1,280	1,162	1,148	1,004	1,000
TDS (mg/L)	1,924	645	1,054	1,000	1,609	544	3,515	944	1,220	509	641	687	716	719	682	753	670	660	593	583	510	660

2023 Apr.

Monitoring item	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	15-Apr	17-Apr	18-Apr	19-Apr	25-Apr	26-Apr	27-Apr	29-Apr	30-Apr	
pH	7.0	7.2	6.9	7.0	7.0	7.1	7.0	7.0	7.1	7.2	7.2	7.0	7.0	7.0	7.0	7.0	7.1	7.1	6.8	6.8	6.9	7.3
EC (µS/cm)	1,050	1,020	970	800	1,102	980	780	980	880	880	450	420	1,531	1,011	1,017	1,460	1,092	3,000	1,326	1,193	1,284	
TDS (mg/L)	693	685	564	528	642	650	515	650	589	589	300	256	1,026	677	610	876	732	1,450	886	799	860	

2023 May

Monitoring item	2-May	3-May	4-May	6-May	7-May	8-May	9-May	10-May	11-May	13-May	14-May	15-May	16-May	17-May	18-May	20-May	21-May	22-May	23-May		
pH	7.2	7.1	7.0	7.0	7.1	7.3	7.1	7.0	7.1	7.0	7.0	7.1	7.2	6.8	7.2	7.1	7.0	7.3	7.1	6.9	
EC (µS/cm)	1,110	1,200	1,125	1,527	1,440	1,400	1,296	1,296	1,296	870	1,495	1,414	2,320	1,307	1,150	1,219	1,471	1,354	1,558		
TDS (mg/L)	744	804	754	1,023	1,001	840	778	778	778	522	897	848	1,392	784	690	731	883	812	835		

(3) WWTP Inflow sewage pit

2022 Nov.

Monitoring item	3-Nov	5-Nov	6-Nov	7-Nov	8-Nov	9-Nov	10-Nov	12-Nov	13-Nov	16-Nov	17-Nov	19-Nov	22-Nov	23-Nov	24-Nov	26-Nov
pH	7.7	7.9	8.0	7.9	7.9	8.1	8.4	8.1	8.0	8.0	7.6	7.9	8.7	7.7	9.0	9.5
EC (µS/cm)	2,147	2,343	1,286	1,182	2,100	1,755	1,671	1,070	1,338	1,407	916	2,327	2,400	2,630	2,500	2,039
TDS (mg/L)	1,174	1,288	707	649	1,230	964	916	590	732	774	503	1,274	1,371	1,450	1,369	1,123

2022 Dec.

Monitoring item	1-Dec	3-Dec	4-Dec	5-Dec	7-Dec	8-Dec	10-Dec	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	31-Dec
pH	7.8	8.7	8.2	8.4	8.7	8.6	9.1	7.9	8.0	8.6	7.5	7.4	7.4	7.3	7.3	7.4	7.5	7.4	7.2
EC (µS/cm)	2,550	2,250	1,890	2,080	1,794	2,200	2,100	2,240	1,814	3,131	2,198	2,024	1,775	1,890	2,015	2,087	2,020	1,890	1,800
TDS (mg/L)	1,380	1,230	1,040	1,140	984	1,200	1,136	1,100	990	1,725	1,123	1,030	904	940	1,023	1,066	1,050	950	920

2023 Jan.

Monitoring item	2-Jan	3-Jan	4-Jan	5-Jan	8-Jan	9-Jan	11-Jan	12-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	21-Jan	24-Jan	25-Jan	26-Jan
pH	7.4	7.5	7.6	7.1	7.1	7.0	7.5	7.2	7.0	7.3	7.1	7.3	7.3	7.2	7.4	7.0	7.3	7.2
EC (µS/cm)	1,880	1,848	1,820	1,870	1,856	1,856	1,820	1,800	1,960	2,057	1,891	2,046	1,600	2,196	2,170	2,190	2,115	2,250
TDS (mg/L)	960	937	930	950	945	945	900	900	1,000	1,053	967	1,044	830	1,120	1,110	1,117	1,078	1,150
CODcr (mg/L)										529	500	560		495	640	780	452	
BOD <sub>5</sub> (mg/L)															460			
T-N (mg/L)										68	44	90	93	86	91	135	119	
NO <sub>3</sub> <sup>-</sup> (mg/L)																		
NH <sub>4</sub> <sup>+</sup> (mg/L)																		
PO <sub>4</sub> -P (mg/L)										16	18	14	13	12	13	12	12	11

Water quality monitoring for these items has started on Jan 15, 2023, after the 1<sup>st</sup> procurement of reagents were completed.

2023 Feb.

Monitoring item	2-Feb	4-Feb	5-Feb	8-Feb	11-Feb	12-Feb	13-Feb	16-Feb	19-Feb	21-Feb	22-Feb	25-Feb	26-Feb	27-Feb	28-Feb
pH	6.8	7.0	7.0	7.0	7.1	7.5	7.3	7.4	7.4	7.4	7.4	7.7	7.2	7.2	7.3
EC (µS/cm)	2,050	1,960	2,001	2,052	2,090	2,900	2,820	2,470	2,279	2,317	2,690	2,390	2,699	2,230	2,420
TDS (mg/L)	1,000	980	1,020	1,032	1,050	1,500	1,400	1,270	1,160	1,182	1,360	1,222	1,370	1,150	1,237
CODcr (mg/L)			1,260		1,282	1,400		1,370	1,288	1,564		1,302			1,448
BOD <sub>5</sub> (mg/L)			340		280			640		81		79			440
T-N (mg/L)	98		71		49			71	93	81					99
NO <sub>3</sub> <sup>-</sup> (mg/L)			0												
NH <sub>4</sub> <sup>+</sup> (mg/L)			50												50
PO <sub>4</sub> -P (mg/L)	11		12		14	15						11			15



**Treated water**

2022 Nov.

Monitoring item	2-Nov	3-Nov	4-Dec	5-Dec	6-Nov	7-Nov	8-Nov	9-Nov	10-Nov	12-Nov	13-Nov	16-Nov	17-Nov	19-Nov	22-Nov	23-Nov	24-Nov	26-Nov	
pH	6.4	7.8	7.2	7.5	7.2	7.2	7.2	7.6	7.7	7.4	7.3	7.4	7.7	7.7	7.3	7.7	7.4	7.6	8.2
EC (µS/cm)	2,002	1,996	1,935	1,029	1,070	1,010	1,349	1,342	951	999	999	1,117	927	1,851	1,900	2,500	1,999	1,600	1,600
TDS (mg/L)	1,101	1,098	1,063	564	564	550	756	700	522	548	548	614	509	1,057	1,000	1,200	1,007	934	934
Turbidity (NTU)	9.1	6.1	4.7	3.3	2.7	3.2	2.2	1.8	1.4	1.2	1.2	3.0	3.0	3.6	3.9	2.8	2.4	2.6	2.6
DO (mg/L)	0.88	0.68	0.86	0.81	0.91	1.18	0.86	0.53	0.99	1.02	1.02	1.38	1.21	0.45	0.40	0.16	0.22	0.16	0.16
DO saturation (%)	11.7	9.0	11.2	10.6	12.0	15.5	11.2	6.9	12.8	13.2	13.2	17.9	15.7	5.8	5.1	2.1	2.8	2.8	2.0

2022 Dec.

Monitoring item	1-Dec	3-Dec	4-Dec	5-Dec	7-Dec	8-Dec	10-Dec	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec	17-Dec	18-Dec	19-Dec	20-Dec	21-Dec	22-Dec	24-Dec	26-Dec	27-Dec	28-Dec	29-Dec	31-Dec	
pH	7.3	6.8	6.9	7.8	7.5	7.5	7.4	7.5	7.1	6.9	7.0	7.1	7.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	5.9	6.9	6.9	7.0	7.0
EC (µS/cm)	1,605	1,740	1,600	1,587	1,400	1,667	1,726	1,630	1,290	1,800	1,650	1,660	1,770	1,600	1,630	1,620	1,603	1,600	1,643	1,500	1,500	1,352	1,340	1,370	1,440
TDS (mg/L)	852	953	870	870	900	919	919	896	710	980	820	850	900	815	831	833	810	822	836	770	690	685	700	739	739
Turbidity (NTU)	3.9	9.6	8.7	9.5	4.2	3.9	2.0	4.5	3.0	6.9	10.4	7.4	5.0	4.1	4.4	2.8	4.2	2.8	4.9	3.8	2.1	2.6	2.2	2.5	2.0
DO (mg/L)	1.01	0.60	2.20	0.82			0.51								3.27	2.89	2.84	3.34	3.34	3.40	3.40	1.80	2.40	2.80	2.90
DO saturation (%)	12.7	7.6	27.4	10.2			6.4								40.0	34.9	34.8	39.9	39.9	39.5	21.5	28.5	33.1	34.4	

2023 Jan.

Monitoring item	2-Jan	3-Jan	4-Jan	5-Jan	8-Jan	9-Jan	11-Jan	12-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	21-Jan	24-Jan	25-Jan	26-Jan	28-Jan	29-Jan	30-Jan				
pH	7.0	7.0	7.0	7.0	6.9	6.5	6.8	6.8	6.8	6.8	7.1	6.8	6.9	6.9	6.8	6.5	6.6	6.6	6.8	7.1	6.7	6.7			
EC (µS/cm)	1,420	1,480	1,506	1,520	1,515	1,560	1,600	1,580	1,609	1,617	1,617	1,617	1,614	1,600	1,851	1,800	1,820	2,030	2,000	1,949	1,930				
TDS (mg/L)	700	755	767	770	773	790	820	820	800	826	820	820	822	830	924	925	980	1,030	1,000	992	984				
Turbidity (NTU)	6.0	5.5	5.1	3.8	21.6	8.9	2.6	4.5	3.1	4.6	5.7	2.6	2.6	3.5	2.5	2.7	3.8	2.3	1.5	1.5	1.6				
DO (mg/L)	3.80	4.00	3.40	4.10	4.10	2.60	3.20	3.20	3.20	4.50	4.50	3.80	2.30	1.90	2.80	2.80	2.80	1.30	1.80	1.90	3.50				
DO saturation (%)	45.2	47.4	40.3	48.8	49.3	30.8	38.0	37.5	53.0	53.2	45.1	27.2	22.7	10.0	5.0	7.0	33.4	15.3	21.4	22.7	42.0				
CODcr (mg/L)																									
BOD <sub>5</sub> (mg/L)																									
T-N (mg/L)																									
NO <sub>3</sub> <sup>-</sup> (mg/L)																									
NH <sub>4</sub> <sup>+</sup> (mg/L)																									
PO <sub>4</sub> -P (mg/L)																									
TSS (mg/L)																									

Water quality monitoring for these items has started on Jan 15, 2023, after the 1<sup>st</sup> procurement of reagents were completed.







**WWTP Reactor tank**

2022 Nov.

Monitoring item	2-Nov	3-Nov	5-Nov	6-Nov	7-Nov	8-Nov	9-Nov	10-Nov	12-Nov	13-Nov	14-Nov	15-Nov	16-Nov	17-Nov	19-Nov	22-Nov	23-Nov	24-Nov	26-Nov
MLSS (mg/L)	2,650	2,850	2,600	1,700	2,000	2,150	2,300	2,500	2,850	3,200	3,200	2,950	2,330	2,410	2,800	2,800	2,800	3,000	3,400
SV30 (mL)	80	100	100	100	110	100	140	140	140	150	150	100	110	140	150	150	150	150	150
SV30 (%)	8.0	10.0	10.0	10.0	11.0	10.0	14.0	14.0	14.0	15.0	15.0	10.0	11.0	14.0	15.0	15.0	15.0	15.0	15.0
SVI (mL/g)	30.2	35.1	38.5	58.8	55.0	46.5	60.9	56.0	49.1	46.9	33.9	47.2	47.2	58.1	53.6	53.6	53.6	50.0	44.1
pH	7.0	7.1	7.4	7.2	7.3	7.1	7.6	7.5	7.2	7.5	6.9	7.5	7.7	7.2	7.1	7.3	7.3	8.0	7.8
EC (µS/cm)	1,953	1,928	1,923	1,024	1,088	1,029	1,371	1,330	942	1,390	915	1,838	1,700	2,120	2,110	1,687			

2022 Dec.

Monitoring item	1-Dec	3-Dec	4-Dec	5-Dec	7-Dec	8-Dec	10-Dec	11-Dec	12-Dec	13-Dec	14-Dec	15-Dec	18-Dec	20-Dec	21-Dec	22-Dec	24-Dec	26-Dec	28-Dec	29-Dec	31-Dec
MLSS (mg/L)	2,200	2,000	2,500	2,500	2,950	3,000	2,900	3,000	2,970	2,850	3,300	3,300	3,200	3,000	3,200	3,200	3,400	2,660	3,400	3,600	4,000
SV30 (mL)	160	150	150	150	150	160	140	150	140	140	190	210	160	150	150	150	150	210	250	250	260
SV30 (%)	16.0	15.0	15.0	15.0	15.0	16.0	14.0	15.0	14.0	19.0	21.0	21.0	16.0	15.0	15.0	15.0	15.0	21.0	25.0	25.0	26.0
SVI (mL/g)	72.7	75.0	60.0	60.0	50.8	53.3	48.3	50.0	47.1	66.7	63.6	70.0	50.0	46.9	46.9	46.9	44.1	78.9	73.5	69.4	65.0
pH	7.5	7.5	6.8	7.5	7.2	7.4	7.4	7.6	7.0	7.5	6.9	7.5	7.0	7.3	7.3	7.2	7.2	7.3	7.2	7.1	7.3
EC (µS/cm)	1,981	2,100	1,017	1,600	1,643	1,990	1,978	1,921	1,600	1,980	1,700	1,700	1,700	1,850	1,700	1,785	1,895	1,665	1,410	1,400	1,600

2023 Jan.

Monitoring item	2-Jan	3-Jan	4-Jan	5-Jan	8-Jan	9-Jan	11-Jan	12-Jan	14-Jan	15-Jan	16-Jan	17-Jan	18-Jan	19-Jan	21-Jan	24-Jan	25-Jan	26-Jan	28-Jan	29-Jan	30-Jan
MLSS (mg/L)	3,900	4,200	3,400	3,200	3,000	3,470	3,730	3,500	3,650	3,400	3,500	3,320	3,300	3,370	3,000	3,100	3,550	3,700	3,930	3,950	3,980
SV30 (mL)	210	220	220	220	250	220	240	250	240	240	270	230	230	250	240	250	230	250	250	250	250
SV30 (%)	21.0	22.0	22.0	22.0	25.0	22.0	24.0	25.0	24.0	24.0	27.0	23.0	23.0	25.0	24.0	25.0	23.0	25.0	25.0	25.0	25.0
SVI (mL/g)	53.8	52.4	64.7	68.8	83.3	63.4	64.3	71.4	65.8	70.6	77.1	69.3	75.8	71.2	83.3	80.6	64.8	67.6	63.6	63.3	62.8
pH	7.2	7.0	7.0	7.5		7.0	7.0	7.1	6.8	7.2	7.2	7.3	7.1	7.1	7.3	6.7	7.0	7.4	7.4	7.2	7.3
EC (µS/cm)	1,590	1,470	1,550	1,556		1,890	1,722	1,700	1,580	1,600	1,640	1,700	1,670	1,990	1,777	1,735	1,980	1,990	2,100	1,990	2,000

2023 Feb.

Monitoring item	2-Feb	4-Feb	5-Feb	8-Feb	11-Feb	12-Feb	13-Feb	16-Feb	19-Feb	21-Feb	22-Feb	25-Feb	26-Feb	27-Feb	28-Feb
MLSS (mg/L)	4,400	3,600	3,600	3,300	3,400	3,500	3,300	3,700	3,200	3,500	3,900	3,600	3,700	3,300	3,000
SV30 (mL)			250	200	200	200	210	220	190	200	200	110	120	110	110
SV30 (%)			25.0	20.0	20.0	20.0	21.0	22.0	19.0	20.0	20.0	11.0	12.0	11.0	11.0
SVI (mL/g)			69.4	60.6	58.8	57.1	63.6	59.5	59.4	57.1	51.3	30.6	32.4	33.3	36.7
pH		7.3	7.0	7.2	7.0	7.0	7.2	7.3	6.9	7.3	7.3	7.9	7.9	7.0	7.0
EC (µS/cm)		1,720	1,900	1,990	1,952	2,010	2,151	2,000	2,070	2,001	2,200	2,094	2,126	2,075	2,075

2023 Mar.

Monitoring item	1-Mar	4-Mar	5-Mar	6-Mar	9-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	18-Mar	19-Mar	21-Mar	22-Mar	23-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar
MLSS (mg/L)	3,300	3,345	4,050	4,200	4,000	3,600	3,450	2,600	2,900	3,000	3,100	2,700	2,600	3,200	3,400	2,800	1,500	1,800	2,100	1,970	2,300	1,770
SV30 (mL)	125	110	110	110	110	110	110	120	110	110	110	110	100	110	110	120	100	90	110	110	110	100
SV30 (%)	12.5	11.0	11.0	11.0	11.0	11.0	11.0	12.0	11.0	11.0	11.0	11.0	10.0	11.0	11.0	12.0	10.0	9.0	11.0	11.0	11.0	10.0
SVI (mL/g)	37.9	32.9	27.2	26.2	27.5	30.6	31.9	46.2	37.9	36.7	35.5	40.7	38.5	34.4	32.4	42.9	66.7	50.0	52.4	55.8	47.8	56.5
pH	7.2	6.8	7.2	7.2	7.3	7.3	7.3	7.1	7.0	7.1	7.4	7.0	7.2	7.4	7.2	7.2	7.4	7.2	6.3	6.3	7.0	6.9
EC (µS/cm)	2,172	2,136	2,200	2,134	2,150	2,354		2,040	2,033	1,800	1,900	1,860	1,940	1,998	1,860	1,860	1,848	1,950	1,816	1,970	1,575	1,605

2023 Apr.

Monitoring item	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	15-Apr	17-Apr	18-Apr	19-Apr	25-Apr	26-Apr	27-Apr	29-Apr	30-Apr
MLSS (mg/L)	1,500	1,550	1,700	1,870	2,000	2,600	2,700	3,700	2,650	2,900	3,100	3,000	3,200	3,000	2,900	2,800	2,700	2,430	2,700	2,770	2,900
SV30 (mL)	100	110	100	150	150	170	160	160	160	160	150	160	160	170	170	180	150	150	150	150	150
SV30 (%)	10.0	11.0	10.0	15.0	15.0	17.0	16.0	16.0	16.0	16.0	15.0	16.0	16.0	17.0	17.0	18.0	15.0	15.0	15.0	15.0	15.0
SVI (mL/g)	66.7	71.0	58.8	80.2	75.0	65.4	59.3	43.2	60.4	55.2	48.4	53.3	50.0	56.7	58.6	64.3	55.6	61.7	55.6	54.2	51.7
pH	6.9	7.1	7.1	7.0	7.0	7.1	7.0	7.0	7.3	7.1	7.0	7.2	7.2	7.2	7.1	7.0	7.0	6.4	6.8	6.8	6.8
EC (µS/cm)	1,595	1,550	1,585	1,440	1,540	1,600	1,560	1,800	1,880	1,700	1,636	1,700	1,750	1,600	1,750	1,750	1,749	1,737	1,760	1,749	1,755

2023 May

Monitoring item	2-May	3-May	4-May	6-May	7-May	8-May	9-May	10-May	11-May	13-May	14-May	15-May	16-May	17-May	18-May	20-May	21-May	22-May	23-May	
MLSS (mg/L)	2,700	2,500	2,500	2,400	2,600	2,450	2,200	2,190	2,400	2,450	2,650	2,700	2,800	2,650	2,700	2,900	2,900	2,800	2,700	
SV30 (mL)	150	150	150	170	160	160	160	160	160	180	180	190	200	190	180	200	200	200	200	
SV30 (%)	15.0	15.0	15.0	17.0	16.0	16.0	16.0	16.0	16.0	18.0	18.0	19.0	20.0	19.0	18.0	20.0	20.0	20.0	20.0	
SVI (mL/g)	55.6	60.0	60.0	70.8	61.5	65.3	72.7	73.1	66.7	73.5	67.9	70.4	71.4	71.7	66.7	69.0	71.4	74.1		
pH	7.0	7.1	7.1	7.3	7.3	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.8	6.8	7.0	7.0	7.0	7.0	7.0	
EC (µS/cm)	1,770	1,788	1,788	1,798	1,798	1,833	1,880	1,890	1,888	1,845	1,845	1,850	1,877	1,884	1,940	1,905	1,911	1,950	1,980	

## **Appendix 2.2.9**

### **Weekly Meeting Materials**

# Analysis of JWWTTP data (7-13/09/22)

Arwa A. Abusrour  
Lab Technician/ Jericho Municipality

1

# Outline

Effluent Data (7-13.Sep 2022)  
MLSS & SV30 data ( to reactor sample)  
Conclusion

2

# Effluent Data

Measurable items satisfy the standard values for irrigation use (Satisfy category A).

Item	7,9,22	8,9,22	9,9,22	11,9,22	12,9,22	13,9,22
Temp	33.4	33.5	33.6	33.4	33.78	3304
pH	7.435	7.365	7.395	7.4	7.43	7.37
DO	2.22	1.86	2.415		1.85	2.63
EC	1933	1988.5	2080	2000	2149	2469
TDS	1256	1289.5	1353	1300	1396	1604
Turbidity	5.425	1.265	1.755		1.41	2.01
TN	0.9					
Tpi	0.42					
BOD5						
COD	11.5					

3

# MLSS, SV30, SVI

We note a rise in SV30 in 10-11 Sep, But all data are acceptable according to standard data.

Item	07.09.22	08.09.22	10.09.22	11.09.22	12.09.22	13.09.22
MLSS	2102	2156	2830	3000	1700	2110 mg\Q
SV30	160	170	230	310	150	170 ml
SVI	76.12	78.85	81.07	103.3	88.24	80.6

4

### Case study: Measurement of TDS by ... and Evaporation

Because we have an increasing data of TDS, Mr. Omran help me to use a trial and measure it by tow ways, and comparing the results.

11.09.22	"..."	Evaporation	Unit
TDS	1300	1045	Mg# l

According to this data, and the present of long differences, the ... should be calibrated and I will search about ... information and going to solute the high reading data.

## Conclusion

5

6

## Questions

7



# JWWTP Lab Results

( 14-18/ 09/2022)

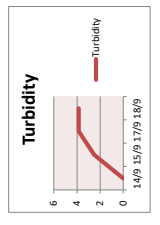
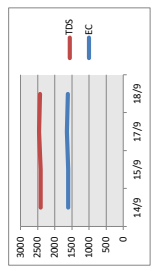
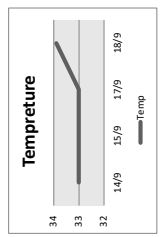
Arwa Abusrour/ Lab Technician

## OUTLINES:

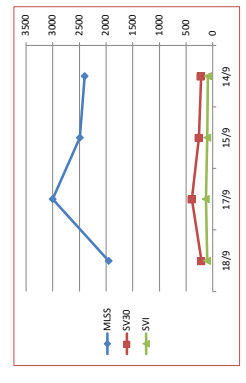
- Effluent data
- MLSS & SV30
- Conclusion

## Effluent Data:

Item	14/9	15/9	17/9	18/9	units
Temp	33	33	33	33.9	C
pH	7.38				need cal.
DO					need cal.
EC	1607	1608	1650	1635	mg/l
TDS	803	804	806	817	CFU, 100 ml
Turbidity	2.32	3.84	3.845		NTU
TN		<0.5			mg/l
TpI		0.58		5	mg/l
BOD5					mg/l
COD		22			mg/l
FC					CFU, 100ml



## MLSS & SV30:



An increasing of MLSS results were found at (17-09-2022)

# Questions



# JWWTP Lab Results ( 20-28 / 09/2022 )

Arwa Abusour/ Lab Technician

## OUTLINES:

Effluent data

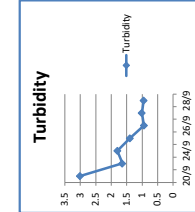
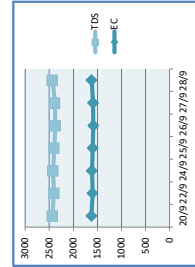
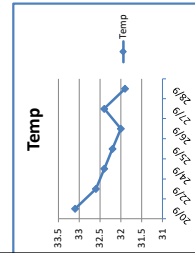
MLSS & SV30

Conclusion

## Effluent Data:

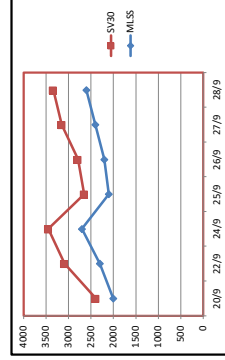
Effluent Data										
Temp	33.1	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9	32.9
pH	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1	8.1
DO	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62	4.62
EC	813	798	807	791	795	810	810	810	810	810
TDS	1.64	1.6	1.4	0.94	1.01	0.95	0.95	0.95	0.95	0.95
Turbidity	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
TP	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
TP005	14	14	14	14	14	14	14	14	14	14
TP010	14	14	14	14	14	14	14	14	14	14

Measurable items satisfy the standard values for irrigation use (Satisfy category A).



## MLSS & SV30:

MLSS & SV30									
Item	20	22	24	25	26	27	28	units	
MLSS	2000	2300	2700	2100	2200	2400	2600	mg/l	
SV30	390	790	750	550	550	750	740	ml	



Increasing of SV30 during this period

## Conclusion

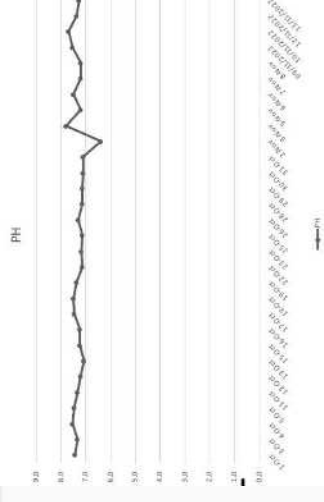
- The increased frequency of treated water quality monitoring has allowed us to see more clearly how the treated water quality is changing.
- From 1<sup>st</sup> of October, Inflow measurement will be recorded daily.

# Waste Water Treatment Quality Data

Arwa A. Abusour

1

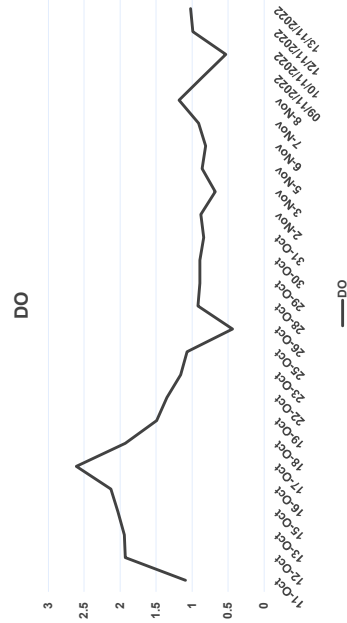
## Effluent Data/ pH Data



- pH for effluent between (7.3-7.8), and it's acceptable for treated water.

2

## Effluent DO Data



DO of effluent decreased among October and November, meanwhile that caused serious problem for treatment quality.

3

## Effluent Turbidity

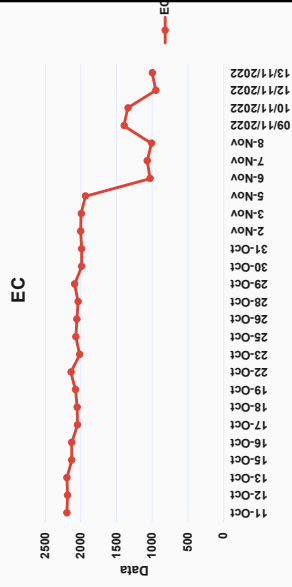


- The turbidity values of the treated water ranged between 1 - 10, which makes it within the Palestinian standards and does not exceed the limits that are usually found in the results of the station.

4

## Effluent EC

- Data of Effluent EC within station limits for treated water (as shown in graph)



5

## Influent Data

- Increase of total nitrogen that's incomes to station



6

## Water Problem



- With the beginning of November, dead fish were observed at service of treated water, instead of this problem, Most parameters for influent and effluent were done, to know the reason.
- After testing, total nitrogen of influent is high, meanwhile, DO in T.W decrease

7

# Water Quality in a WasteWater Treatment Plant

Arwa A. Abusrour/ Lab Technician



## About the problem

Date of problem: 19/11/2022  
 Time: 10:30 am  
 Type of Sample: Influent ( trunk No. 19)  
 Main cause: high EC/TDS, TSS

2

## Influent & Effluent Data

Item	Type of influent sample				Effluent	
	Trunk No.1	Trunk No.19	Tank	Jericho Gate Manhole	TW	
Temp	c	28.5	27.55	26.6	25.3	28.0
pH	-	7.87	7.76	7.38	8.32	7.87
DO	mg/l	0.43	0.47	0.35	0.36	0.45
EC	mg/l	2500	2940	3100	3400	1940
TDS	mg/l	1274	1611	1719	1873	1000
COD	mg/l	413	666			15
TSS			470			

3

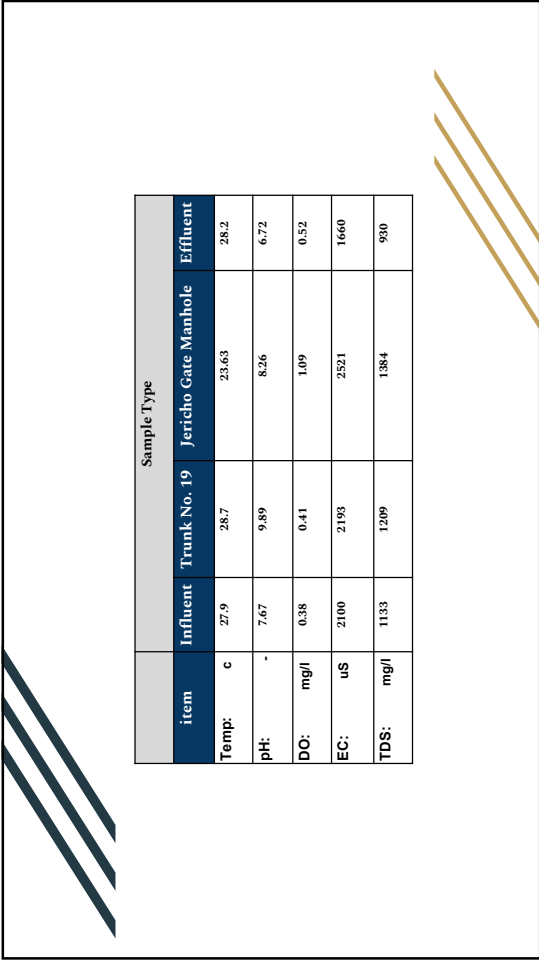
## About the data



- 19 Nov. Data shows high EC/TDS, with high TSS centered on trunk No. 19
- When making a field visit to the industrial area line outside the station, there was no pumping in the manhole.
- There is pumping in the Jericho Gate manhole, and the visible sample indicates a high conductivity, as shown in the picture.

Trunk No. 19 Trunk, Jericho Gate, TW  
 Arwa A. Abusrour/ Lab Technician

4



item	Sample Type		
	Influent	Trunk No. 19	Jericho Gate Manhole Effluent
Temp: c	27.9	28.7	23.63
pH:	7.67	9.89	8.26
DO: mg/l	0.38	0.41	1.09
EC: uS	2100	2193	2521
TDS: mg/l	1133	1209	1384

## **Appendix 2.2.10**

### **Workshop Presentation Materials**

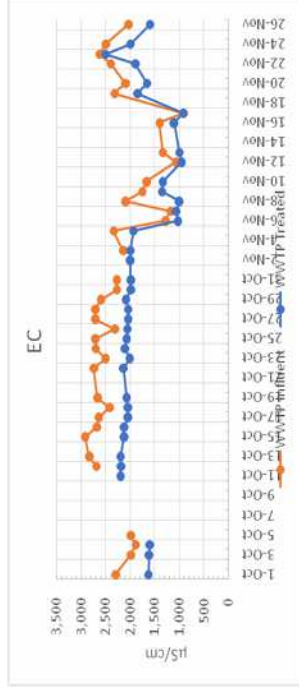




## EC Data

Graph 3:

- Shows the data of each Influent and Effluent EC. among october and November.



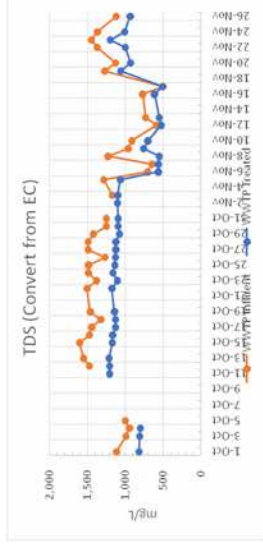
5

## TDS Data

Graph 4:

- Shows the data of each Influent and Effluent TDS. TDS of treated water is acceptable with palestinein standards (<1500)
- TDS convert from EC, with same trend.

Slide 5

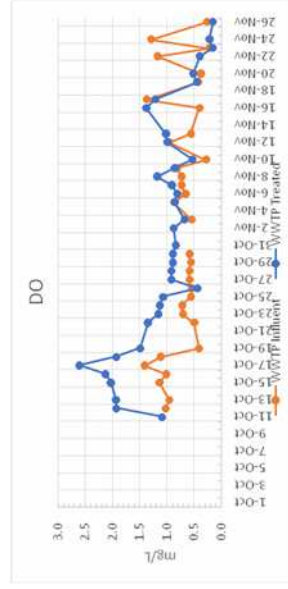


6

## DO Data

Graph 5:

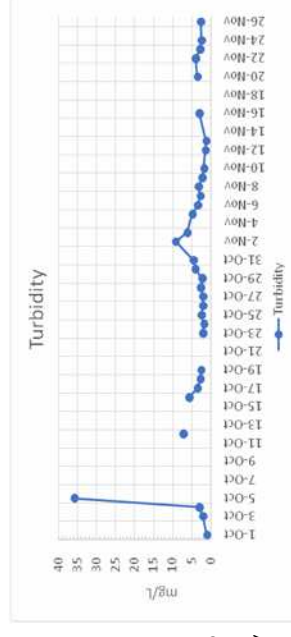
- Shows the data of each Influent and Effluent DO. DO of effluent decreased with November.



7

## Effluent Turbidity

- Graph show an effluent turbidity.
- Turbidity at all under palestinein standard
- Oct. 5, and that's related to sludge pumping.
- In general effluent turbidity confined between (1-10)



8

## Conclusion

- Effluent Data fulfills Palestineien standards.
- Water monitoring continuously done to ensure water quality
- To maintain the quality of water provided to farmers, we are researching many ways in order to develop tests and equipment in the laboratory,

# Water quality management of Treated Sewage in Jericho Municipality

1

## Our Activity

Managing the water quality to satisfy Treated Wastewater Effluent for Agricultural Purposes (P5742-2015), High quality (A).

- ✓ Regular water quality monitoring according to the Water quality monitoring plan.
- ✓ Monitoring WWTP operations by water quality monitoring data and improve WWTP operation process.



2

## Water Quality Monitoring Plan

Monitoring item and schedule

Monitoring object and location	Monitoring item	Monitoring schedule
Inflow sewer	Trunk No.1 and No.19	Water temperature, pH, EC and TDS COD <sub>cr</sub> , Total nitrogen and Phosphate (PO <sub>4</sub> -P)
	WWTP Inflow pit	Water temperature, pH, EC and TDS COD <sub>cr</sub> , Total nitrogen and Phosphate (PO <sub>4</sub> -P) Nitrate (NO <sub>3</sub> ) and Ammonia (NH <sub>4</sub> ) and BOD <sub>5</sub>
Treated water	Treated water tank	Water temperature, pH, EC, TDS, DO and Turbidity COD <sub>cr</sub> , Total nitrogen and PO <sub>4</sub> -P
		TSS NO <sub>3</sub> <sup>-</sup> , NH <sub>4</sub> <sup>+</sup> and BOD <sub>5</sub>

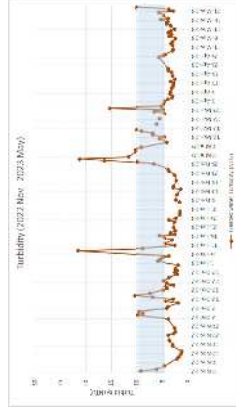
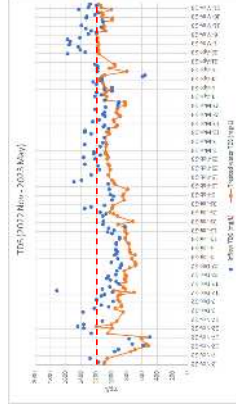
Focusing on **TDS** (means degree of salinity) and **Turbidity**: Daily monitoring item

3

## Monitoring of Treated water quality

TDS and Turbidity are satisfying Treated Wastewater Effluent for Agricultural Purposes (P5742-2015), High quality (A).

- ✓ TDS: 1,200 mg/L, Turbidity: 5-10NTU



If the treated water turbidity exceeds to NTU, the operating procedures of the WWTP are adjusted to reduce Turbidity to below 10 NTU immediately.

Even when TDS in excess of 1,200 mg/L flows in, sewage treatment reduces TDS to below 1,200 mg/L.

4



## **Appendix 2.2.11**

### **Cabinet Resolution 16-2013 House Connection to Sewer Network by Law**

**Cabinet resolution number (16) for the year 2013****On the House and Facilities' Connection System to the Public Sewage Network****The Cabinet:**

Based on the regulations of the amended Basic Law for the year 2003 and its modifications, particularly, article (70) and based on the Water Law number (3) for the year 2002, particularly article (42) and on the law of local councils number (1) of the year 1997 and the law number (7) of the year 1999 on Environment and after reviewing the Law of Standards and Specifications number (6) of the year 2000, and based on the appointment of the Minister of Local Government and the Head of the Water Authority, and based on the necessities of public interest and on the powers delegated to us by law, and based on what the Cabinet decided in its meeting held in the City of Ramallah on 02.12.2013

**We produced the following by-laws:****Article (1)**

The following expressions and phrases mentioned in these by-laws will have the below-listed specific meanings should the context not indicate otherwise:

**The Law:** Law of Local Government number (1) of the year 1997 or Water Law number (3) of the year 2002 or Law number (7) of the year 1999 on the Environment.

**Authority:** Palestinian Water Authority.

**Service Providers:** water and waste water service providers whether in local councils or joint service councils or regional water and waste water facilities or water associations or any other operator of a licensed water and waste water facility.

**Local Council:** local government unit in a specific geographic and administrative scope which provides water and waste water services.

**Board:** board of directors of water and waste water facility or the board of the local council.

**Head of the Board:** head of the local council board or head of the board of directors of water and waste water facilities.

**Franchise Area of the Service Provider:** is the area lying within the scope of work of the service provider and includes for the purpose of these by-laws any area connected to the service providers' sewage network.

**Water Tariff System:** the system issued based on the provisions of article (20) of the Water Law number (3) of the year 2002.

**The Competent Official Authorities:** includes all relevant sides such as: Ministry of Local Government, Ministry of Health, Ministry of National Economy, Ministry of Agriculture, Environment Quality Authority, Water Authority or any other side each according to its specialization.

**The Employee:** a person representing the service provider and specialized in applying these by-laws.

**The Way:** each paved or non-paved road, yard, square or path, **of a dead-end nature or not**, designated for the access of the general public and includes all canals, sewage, drainage and channels lying on the side of the road or above or below it.

**Land Area:** any land measured by square meter ready for residential, commercial, industrial, agricultural or any other use and which is connected to the Public Sewage Network.

**Construction Area:** construction area by square meter belonging to the proprietor and producing waste water.

**Residence (residential unit):** is a building or part of a building set as a residence for one family with a separate door or entrance or more than one separate door or entrance leading up to the public road or path without passing any other residential unit.

**Facility:** is a project or part of a project implementing one or more types of economic, commercial or service activities under one administration. The project could be owned by a natural or nominal personality or governmental body.

**Industrial Facility:** is any project having as its main aim transforming raw material into full or semi finished products or transforming semi –finished products into fully finished including mixing, separating, forming, aggregating, filling and packaging work on condition that part or all of these activities are mechanized. This applies also to knowledge and environment industries.

**Proprietor:** the person in whose name the property is registered. In case of joint ownership of the property, the person considered as proprietor is the owner of the unit or floor or any other part of the property. The owner can have a representative representing them.

**User of the Property:** is the person who operates the property whether they are the owner or beneficiary (tenant) or the person in whose name the water meter of any water authority or local council is registered.

**Person:** natural or nominal person.

**The Stream:** a pipe used for drainage in different diameters made out of metal, concrete or plastic or any other water-proof material that doesn't affect the process of waste water treatment and is not damaging to the environment.

**Private Stream:** is the stream lying inside the property's boundaries which belongs to the property owner or user and includes inspection holes and connections and all devices related to them.

**Residential Sewage Connection:** the stream which connects residential sewage to the public sewage network.

**Private Sewage Connection:** is the stream connecting private sewage (commercial or industrial) with the public sewage network.

**Public Stream:** is the stream owned and supervised by service providers and includes inspection holes, connections and all devices related to them.

**Public Sewage Network:** is a cluster of collection devices, pipelines, links and pumps specifically used for waste water drainage which is transported from its production location to the service providers waste water treatment station.

**Sewage System:** is a holistic sewage system including public sewage networks, links, inspection holes, pumps, treatment plants and their auxiliaries owned and maintained by service providers inside and outside their borders and residential areas and is used in the sewage and waste water treatment.

**Septic tanks:** are a solid waterproof reservoir made up of more than one part, produced from concrete, solid cement or any other material that is not leachable and is leakage proof designed and implemented according to technical standards and specifications that allow for the partial anaerobic decomposition of organic material found in liquid remnants being drained into it.

**Absorption Hole:** is a well or hole in which waste or waste water and other garbage are being stored and which does not leach or leak.

**Waste Water:** is polluted water due to solid, liquid, gaseous material or energy or other microorganisms emanating from residences, buildings or different facilities.

**Industrial Waste Water:** is the water emanating from using water in some or all phases of industry, cleaning or cooling whether treated or not.

**Commercial and Agricultural Waste Water:** is the water emanating from using water in non-industrial fields and contains additional pollutants such as: water emanating from restaurants, gas stations, carwash facilities, mechanic workshops, slaughterhouses, poultry and livestock farms, vocational workshops, shops selling live poultry as well as waste water emanating from medical facilities which do not contain dangerous material.

**Quarry Deposits:** deposits emanating from stone cutting.

**Treatment Station:** cluster of facilities and devices used for purifying and treating waste water.

**Treatment:** is the process of removing deposits from waste water by using natural and technical methods so that the water is treated according to specific specifications and for use in a specific manner. This treatment could be primary, secondary or tertiary.

**Biological Treatment of Waste Water:** is the treatment of waste water by using live aerobic or anaerobic microorganisms resulting in refined liquids and in separate sludge that contain a microbic mass mixed with pollutants. This treatment is used separately or in conjunction with other mechanical treatment processes or in advanced processes.



**Chemical Treatment of Waste Water:** treatment methods used to incur complete dissolution of dangerous material and mostly transforming them into non-lethal gases; or to modify the chemical characteristics of waste water, for example, by decreasing its dissolution capacity, its acidity or alkalinity.

**Mechanic Treatment of Waste Water:** is the treatment of waste water which leads to separating refined liquid waste from the sludge. Mechanic treatment is used side by side with biological treatment and advanced treatment. Mechanic treatment includes sedimentation and floatation.

**Treated Waste Water:** is the waste water that has some or no portable mass or sediments or any other material that has been dissolved in it chemically, physically or biologically.

**Fat Trap:** is a unit with a special engineering design linked to internal private stream installations in commercial kitchens, restaurants, food factories, hotels and other. The fat traps separate food oils and fats from the liquid remnants before draining them into the public stream or to the septic tanks.

**Oil Trap:** is a unit specifically designed to separate mineral oils and fats from sewage water emanating from carwash and auto- mechanic workshops.

**Perfusion Tank:** is a vehicle with an insulated metal tank designated and used by service providers and competent official authorities to extract and transport liquid remnants.

**Discharge Points:** are locations designated for discharging liquid remnants in treatment stations or any other place designated and defined by the service provider in cooperation with competent official authorities which transport the remnants by means of the perfusion tanks from the septic tanks.

**Capital Costs:** are the construction costs of the sewage system.

**Running Costs:** are all the operating and maintenance costs necessary to operate the sewage system.

**Environmental Approval:** is the conditional or unconditional approval emanating from the Ministry of Environment after completing all environmental requirements or completing the appropriate assessment measures for the development venture for purposes of issuing the permit (license) from the competent authority and which does not contradict with other laws and regulations.

**Environmental Impact:** is the process by which the potential negative environmental impact of the development venture is studied and reviewed prior to granting environmental approval.

**Assessment of Environmental Impact:** is an elaborate study to assess the negative impact based on the approved reference frameworks and the environmental assessment methodology.

**BOD5:** is the chemical oxygen requirement and it is the amount of oxygen necessary for the oxidation of organic material found in waste water through microorganisms within five days at 20 degrees centigrade and is measure by milligram/liter.

**COD:** is the chemical oxygen requirement and is the amount of oxygen required for the chemical oxidation found in waste water and is measured by milligram/liter.

**MBAS:** is a measurement indicating the concentration of chemical purifiers and which is considered a pollutant and is poisonous for water and soil.

### **Article (2)**

The regulations of these by-laws are applied on any person benefiting from water and waste water services; produces, transports or divests from waste water inside or outside the boundaries of the service providers.

### **Article (3)**

#### **Setting up the Sewage System**

1. The service provider takes the responsibility of setting up, administering, operating and maintaining the sewage system as well as implementing any task related to its operation including regular maintenance according to local plans and as part of previously agreed upon national plans and in line with current and future needs.
2. The service providers commit to setting up the sewage system and pipelines for the drainage of rainfall in streets and public spaces. Should this not be possible for technical reasons, the service provider has the right to set up the system partially or wholly on their private property and within the rebound area. If this is the case, the service provider has to fix any damage that may occur to the private properties as a result of this or pay fair compensation equal to the cost of the damage and in line with the valid law.
3. The service provider has to receive the necessary approval and permits for implementing works related to the sewage system outside the boundaries of local councils from the Ministry of Local Government and Water Authority.
4. In order to receive environmental approval, the service providers commit to conduct an assessment report on the negative environmental impact according to the requirements of the Palestinian environmental assessment policies for sewage systems.

### **Article (4)**

#### **Setting up of Treatment Stations**

1. The service provider takes over the responsibility to set up waste water treatment stations in locations that are remotely situated from potential future urban development areas. The locations are chosen in coordination with competent official authorities and their approval. Due relevance is granted to interact with the land owners and with the nearby population communities.
2. The service provider has to obtain the necessary approval and permits to set up the treatment stations from the Ministry of Local Government, Water Authority and the Environment Quality Authority.

3. The service provider commits to endorsing and encouraging the transfer of advanced techniques of waste water treatment taking into consideration the selection of appropriate techniques based on the cost of the operation, maintenance and energy saving; additionally efficiency should be taken into consideration which fulfills and maintains quality criteria in order to safeguard the environment and public health.

#### **Article (5)**

##### **Obligatory Connection to the Public Sewage Network**

1. The service provider has the authority to impose obligatory connection of all existing buildings within the scope of their franchise area.
2. In the case that the proprietor fails to abide by the obligatory connection, the service provider has the right to connect the private stream with the public stream and collect the due fees and wages in addition to 20% for administrative and supervisory expenses. These estimated amounts are considered final by the service providers. The proprietor has the right to object with any legal or official authority.

#### **Article (6)**

##### **Measures for Connection to Public Sewage Network**

1. The service provider makes the public stream available until the boundary of the proprietor's property. Hence, the beneficiary has to connect the private stream with the public sewage network on his own expense and under the supervision of the service provider after paying the fees which include covering the expense according to these by-laws and on condition that the property's private stream intended for connection with the public sewage network has fulfilled all licensing requirements.
2. The properties' proprietors and in the case that it is not possible to connect directly with the public sewage network, have to permit the passage of sewage connections in nearby lands which lay at a higher altitude than theirs and based on the approved master plan by the local council. It is necessary that this stream is within rebound. The owners of these connections have to provide a written assurance to maintain these connections on their own expense and change their routes in case they are impeding the freedom of the land owner to use their land and remove them when there is the possibility to directly connect with the public sewage network.
3. The proprietor, whose private stream has been connected to the public sewage network, has to empty the suction holes and the septic tanks that lay within the boundaries of his properties and to fill it with suitable material on their own expense within at most two months from the connection date and without harming public health.

4. Should it not be possible to discharge the property's or any other part of its waste water by connecting it to the public sewage network from the property (or through a nearby property) by natural flow, the proprietor will have to install a suitable pump in a manner that is approved by the service provider in order to raise the level of the waste water to the public stream's level or apply the regulations of article (7) of these by-laws.
5. The service provider has the right to conduct laboratory tests to all waste and running liquids in any private or public stream on the expense of the property user or facility owner and according to approved specifications and as needed.
6. The service provider has the right to request from the property user to provide necessary information to ensure abidance to the regulations of these by-laws.

### **Article (7)**

#### **Setting up Septic tanks**

1. The proprietor, and in the case that there is no public sewage network near their land, or in the case that for technical reasons it is not possible to connect the private stream with the public sewage network within the boundaries of the service provider, has to:
  - (a) Set up on their own account a septic tank in their private land, after submitting a request to receive the necessary approval for this from the service provider and the competent official authorities.
  - (b) Attach plans and specifications to the request to ensure compatibility to the service providers' requirements. These have to be in line with the volume of the septic tank and with the requirements of the service provider and the competent official authorities according to criteria and engineering principals.
  - (c) Put up warning signs in the appropriate place indicating the presence of a septic tank on the property and alert from the dangerous and polluted material it may contain in addition to the collection date of these materials inside the hole. The base and walls of the pool have to be leak-proof.
2. The user of the property has to perfuse the septic tank on their own account, regularly or as soon as it is full through perfusion tanks, and to empty it in the specified location within the boundaries of the waste water treatment station of the service provider or in the locations specified by the competent authorities based on a suggestion provided by the service provider.
3. The proprietor has to fill in the suction holes existing on their property and replace them by **septic tanks** according to the technical specifications approved by the service providers within their boundary and approved by the Ministry of Health outside the boundaries of the service provider within two years from the publishing date of these by-laws in official newspapers.
4. The proprietor or property user has to apply the above mentioned conditions in addition to any other conditions imposed by valid regulations and laws.

**Article (8)****Procedures for Emptying Septic tanks**

1. The companies, contractors and vehicles used in the field of waste water perfusion and licensed by the Ministry of Transport have to obtain the necessary permits to operate inside the boundaries of local councils from the service providers. In order to operate outside the boundaries of local councils, they have to obtain the necessary operation permits from the competent official authorities.
2. The companies, contractors and the perfusion vehicles used to empty septic tanks have to empty their load only in the designated location inside the waste water treatment station or in any other location designated by the service provider inside the local councils' boundaries or by the competent official authorities outside the boundaries of local councils.
3. If any company, contractor or perfusion vehicle does not honor their commitments in emptying the contents of septic tanks in the waste water treatment station or the designated location, they lose their permit for a period of at least one year and in case of repeating the violation once again they will be completely denied permits to empty septic tanks. They have to pay the expenses of removing the damage that they have caused.
4. The service provider can operate their own perfusion vehicles without paying the fees of emptying septic tanks.
5. The specifications of the waste water in septic tanks have to comply with the specifications of the waste water in the public sewage network. The proprietor or user has to commit to conduct the primary treatment if necessary.

**Article (9)****Discharge of Commercial, Industrial and Agricultural Waste Water**

1. It is prohibited to discharge commercial, industrial and agricultural waste water into the public sewage network until it is treated and a written approval is provided by the service provider in line with the instructions presented in the annex.
2. It is prohibited for any person to discharge, cause or allow the discharge any radioactive material or radioactive industrial isotopes into the public sewage network.
3. It is prohibited for any person to discharge or allow the discharge of waste water and waste emanating from medicine factories and polluted hospital remnants and the remains of disposables into the public sewage network unless after subjecting it to treatment and obtaining a special permit from the competent official authorities.

4. It is prohibited for any person to discharge, cause or allow the discharge of waste water and waste emanating from olive presses into the public stream. The owners of the presses have to modify the manufacturing process so as to abide by the instructions presented in the annex.
5. It is prohibited for any person to discharge, cause or allow the discharge of waste water from commercial kitchens, restaurants, food factories and hotels into the public stream unless after setting up a fat trap unit and after obtaining written approval from the service provider while committing to upholding maintenance of the fat trap.
6. It is prohibited for any person to discharge, cause or allow the discharge of waste water emanating from carwashes and auto-mechanic workshops to the public stream unless after setting up the oil trap unit and obtaining the written approval of the service provider, while upholding the maintenance of the oil trap.
7. It is prohibited for any person to discharge, cause or allow the discharge of waste water and sediments emanating from stone saws and construction material factories into the public sewage network or any other natural stream, valley or open space. The service provider has to provide for specified locations to dry and get rid of stone saw sediments.
8. It is prohibited to decrease the concentrations of pollutants in industrial waste water by mixing it with fresh water or potable water in order to obtain the required concentrations as mentioned in the instructions attached to these by-laws.

#### **Article (10)**

##### **Permits for Connecting Commercial, Industrial and Agricultural Facilities' Sewage**

1. The commercial, industrial and agricultural facilities with a valid license have to submit an application to obtain written approval to connect their sewage to the public sewage network and according to the approved forms of the service providers and after subjecting it to treatment so that it becomes compatible with household waste water according to the regulations of these by-laws. Final approval to connect the sewage is decided upon by the head of the local council. The applications should include the following details:
  - (a) The commercial or industrial operations conducted and from which emanate waste water.
  - (b) The chemical material used during these operations and what emanates from them.
  - (c) The amount of water used; its source and the amount of discharged water after the manufacturing process.
  - (d) The physical, chemical and biological characteristics of the waste water which is intended for connection to the public sewage network.
  - (e) The technical details of mechanical, chemical and biological operations of the primary treatment unit (if existing) and which is designed from an accredited authority.

- (f) The locations and volume of waste water collection tanks that must be used in emergencies such as: halt of the treatment station, the occurrence of a defect in the drainage of this water.
- (g) Any information deemed necessary by the service provider in order to consider the application for connection to the public sewage network.

### **Article (11)**

#### **Conditions for Connecting the Private Stream with the Public Sewage Network**

1. The following conditions have to be considered when connecting the private stream of commercial, industrial and agricultural facilities to the public sewage network:
  - (a) In its request to obtain a written approval to connect to the public sewage network, the commercial, industrial and agricultural facilities have to attach a plan indicating the method and specifications of setting up the private stream and inspection points taking into consideration their presence inside the boundaries of the factory or facility or any other appropriate location close to the public stream.
  - (b) The applicant has to abide by these plans once the service provider approves them. The applicant has to implement them on their own account and under the supervision of the service provider. The service provider keeps those plans for a period no less than 15 years at the least.
  - (c) The approval to allow commercial and industrial facilities to connect waste water to the public sewage system is issued based on the recommendation of the service provider's competent authority if this authority within the service providers sees no damage emanating from this connection to the sewage system and the quality of the treated water.
  - (d) The service provider can – on the applicant's account - request the assistance of any authority that they deem appropriate to participate and submit technical recommendations on any issue related to connecting the commercial and industrial facilities to the public sewage network such as the amount and quality of the flow of waste water and its impact on the public sewage network. The applicant bears the cost of rehabilitating the public stream to become appropriate to connect the commercial and industrial facilities to it.
2. The service provider or any other relevant supervisory body has to be informed of any changes in the production lines or the addition of a new production line or the activation of one of the idle production lines at the facility or change in the characteristics of the waste water emanating from the facility.

3. The preliminary approval to connect new or existing industrial, commercial and agricultural facilities is based on submitted information and information stated in the application to connect to the public sewage network which was submitted to the service provider. The application is reviewed in light of the actual results of tests on industrial waste water emanating from the facility within a period of 6 months from the start of the manufacturing process. In case of the results exceeding the specified concentrations according to the instructions of commercial and industrial waste water discharge, the owner of the facility has to modify the situation by removing the violating reasons during a time frame defined by the service provider and which should not exceed two months. The approval is deemed invalid if this duration has elapsed without modifying the situation while informing the competent official authorities about this so as appropriate legal proceedings are taken.
4. Renew the commercial, industrial and agricultural waste water connection permit annually. The permit is issued in writing by the head of the board.
5. It is prohibited for any person who has acquired a final approval to discharge waste water into the public sewage network to discharge any waste water that is different in its quality or that exceeds in its amount what was approved by the service provider. Otherwise, it is obligatory to duly obtain a new approval.
6. The service provider can request treatment of waste water prior to and after the approval to discharge it into the public sewage network if it is verified to harm the sewage system.
7. The service provider or the competent official authority can – for licensing purposes to connect to the public sewage network - collect or request to examine samples according to the schedule they see fit for each factory or facility and on the account of the beneficiaries.
8. The service provider has to be informed about transferring or changing the ownership, administration or operation of any existing facility using the public stream whether it was producing waste water or conveying it.

### **Article (12)**

#### **Treated Waste Water**

The service provider ensures that the treated water is compatible with the Palestinian standard specifications concerning treated water number (2003-742 mf), its amendments and the related binding regulations issued by the Institute of Specifications and Standards as well as the instruction manuals of the World Food and Agricultural Organization (FAO) and the World Health Organization (WHO) taking into considerations any arising requirements.



**Article (13)****Public Sewage Network Connection Fees (investment costs)**

The service provider collects fees for the public sewage network connection in order to retrieve the investment costs of setting up the public sewage network according to the following regulations:

1. Connection fees are levied on all lands and buildings that can be used for residential, commercial, industrial or institutional purposes and for which an approval for connection to public sewage network has been granted according to the water tariff system.
2. As far as existing residences and facilities are concerned, public sewage network connection fees are paid to the serviced provider when the connection request has been approved by the service provider.
3. Connection fees for residences and facilities that have been planned are due prior to issuing the final construction permit. They are paid by the proprietor when the plan to obtain a construction permit is submitted or when applying for a connection after the construction has been completed.
4. If the properties belong to more than one person, each person is responsible to pay the connection fees according to their share in the property.
5. For the purpose of defining fees, each piece of land has to be connected with one stream connection in the public sewage network. Nevertheless, it is possible to connect a number of buildings with one residential stream connection if the proprietors agree to pay the connection fees for all buildings so that the fees for each separate building are calculated.
6. The service provider has the right to approve the payment of fees in installments after providing the required guarantees to this end.
7. The water and sewage service provider commits to connect existing residences and facilities in a period of sixty days from the date of payment of connection fees and approval to grant a construction license.
8. A tariff for the connection and membership fees are put in place by the board according to the water tariff system.

**Article (14)****Fees for Clearing Septic tanks**

1. The water and sewage service provider collects fees for emptying septic tanks in order to recover part of the capital and running costs for its treatment at the waste water treatment stations. This also includes inspecting the quality of the contents of these holes and ensuring they are void of any material that can be damaging at the treatment station.

2. The owner of the perfusion vehicle or any other devices used in the transfer of the septic tank contents commits to paying clearing fees according to the rate defined by the water and sewage service provider.
3. Fees for clearing septic tanks are paid to the water and sewage service provider immediately when the perfusion vehicle arrives at the waste water treatment station upon which a payment receipt is handed out.
4. Clearing fees are levied on the bases of cubic meter of the septic tank.
5. The board establishes the clearing fees according to the water tariff system.

#### **Article (15)**

##### **Sewage System Maintenance and Operation Fees**

1. The water and sewage service provider collects fees for maintenance and operating work on the sewage system to cover costs according to the water tariff system.
2. Maintenance and operation fees of the sewage system are levied on all forms of water usage.
3. Water quantities that are used and are subjected to utility fees are established as follows:
  - (a) Registered water quantities according to a meter for residences and facilities being provided by water from water systems belonging to the water and sewage service provider.
  - (b) Registered water quantities according to a meter for residence and facilities that are provided with water from their private wells.
  - (c) Water quantities for residences and facilities being provided by water through private water tanks are established through a decision from the head of the board and based on a joint recommendation from the water and sewage service provider and the institution designated by the head of the water and sewage service provider.
  - (d) The total water quantities designated for residences and facilities being provided by water from more than one source.
4. Exemption from paying maintenance and operation fees for the sewage system is granted when there is no public sewage system and for waste water collected privately in **septic tanks** or tanks while perfusion fees are paid for the holes and tanks according to the water tariff system.
5. Water quantities used for commercial and industrial purposes and are part of the manufacturing process but are not discharged into the public stream are exempt from the sewage system fees. A request is submitted to the head of the board to this end and the water quantity is established by the head of the board based on the recommendation of a committee assigned by the head of the board.

6. The water and sewage service provider is committed to separate the water and sewage accounts from the other accounts and to open a unified bank account for all incoming revenues from the sewage service.

#### **Article (16)**

##### **Additional Fees for Maintenance and Operation**

1. The water and sewage service provider collects additional fees to those mentioned in article (15) of these by-laws from commercial and industrial facilities after issuing approval to connect them to the public sewage system. This ensues in case the required chemical oxygen concentration (COD) exceeds the maximum allowed concentration in waste water discharged into the public sewage system and which stands at (2000 milligram/liter) and in order to cover the additional expenses incurred on the water and sewage service provider during the treatment process.
2. The additional fees designated to cover treatment costs according to a formula decided by the water and sewage service provider and according to specifications in line with the principal of "the polluter pays".
3. The water and sewage service provider is responsible for issuing special claims for additional fees for facilities and factories that have been connected to the public sewage system.
4. The calculated average of the required chemical oxygen concentration is used to determine additional fees to cover the quarterly (every three months) treatment expenses on condition that the number of samples taken from the factory is not below one sample monthly if possible.

#### **Article (17)**

##### **The Duty to Pay Utility Fees**

1. The duty to pay maintenance and operation fees for the sewage system to water and sewage service providers lies with the proprietor or the user of the property whether the water meter was registered in their name or not.
2. The proprietor or user of the property is responsible for paying the sewage system's maintenance and operation fees according to their share in the joint ownership of the building which they own or operate. This occurs in case the property utilizes water services. In case the building or apartments are connected to one water meter, the person in whose name the meter is registered or the user of the property is considered collectively or individually responsible to pay sewage fees.
3. The user of the property is in charge of paying fees in the case of not being able to establish who the proprietor is.

4. Sewage system maintenance and operation fees have to be paid every month or every two months after completing reading the water meters or estimating the amount of used water by an employee designated by the water and sewage service provider.
5. Sewage system maintenance and operation fees are registered or integrated into the water fees in one bill issued by the water and sewage service provider.
6. The duty to pay sewage system maintenance and operation fees starts once the property is connected to the public sewage system.

### **Article (18)**

#### **Inspection and Administrative Oversight for Connecting Installations to the Public Sewage System**

1. The water and sewage service provider is responsible for inspection and administrative oversight to ensure abidance to the regulations of these by-laws inside the boundaries of the local council. Outside the boundaries of the local council, the responsibility lies with the water and sewage service provider and the Ministry of Local Government and the competent official authorities.
2. Each of the water and sewage service provider and the competent official authority work towards exchanging information in written form related to damage emanating from waste water management processes when they occur.
3. Inspectors from the competent official authorities, who have legal capacity according to their specific laws, have the power to monitor residences, monitor and inspect facilities as well as the sewage system. They have the authority to detect violations which occur in contravention to the laws and the regulations of these by-laws. They have the right to request any information or clarification from the proprietor of the residence or facility or the service provider for the sake of monitoring the waste water quantity which is discharged from the facilities and the industrial activities on a regular bases for the sake of checking their abidance to the approved specifications and instructions for discharged waste water. The purpose is to protect the environment and the vital sources according to the regulations of these by-laws and the attached instructions.
4. The water and sewage service provider and for the purpose of inspection and monitoring and in coordination with competent authorities, has to inspect the waste water quality through obtaining samples from the facility's discharge point.
5. The service providers have to conduct regular tests, measurements and analysis relevant for regulating waste water quality, waste water treatment and sludge according to the most modern standardized means issued by the Palestinian Institute for Specifications and Standards. The scientific analysis methodology contained in the following reference is to be used for this purpose: (Standard Methods for the Examination of Water and Waste Water).

6. The service providers have to conduct regular microbic, physical, chemical and biological analysis as mentioned in the previous paragraph and maintain documentation pertaining to it.
7. The Ministry of Health or the Environment Authority has the right to request from the water and sewage service provider additional samples for waste water discharged from industrial facilities or treated waste water.
8. The service providers abide by providing a regular report to the competent authorities on the activities of the service provider in the management of the treatment stations.

#### **Article (19)**

##### **Stopping or Suspending Approval to Connect Facilities with the Public Sewage Network**

The water and sewage service provider has the right to stop or suspend approval to connect any facility's private stream with the public sewage network for any period of time they see fit, while reserving the right to revert to the law to pursue the perpetrators of the following violations in criminal or civil courts:

1. Violating the regulations of these by-laws or any condition placed by the water and sewage service provider when granting approval.
2. Not allowing employees of the water and sewage service provider, any other approved authority or any other competent official authority to undertake their duty in inspection and monitoring.
3. Not abiding by the conditions or requirements deemed necessary and established by the water and sewage service provider to maintain the sewage system.
4. Not paying fees levied on relevant institution or facility.

#### **Article (20)**

1. It is prohibited for any person to discharge any waste water into water sources or into a natural stream or valley or any other exposed space unless after treating it and obtaining written approval from the service provider to discharge it. The Palestinian specifications number (2010-227 mf and its amendments) is used in addition to the Palestinian specification number (2003-742 mf and its amendments). Additionally, the obligatory technical instructions of relevance issued by the Palestinian Institute of Specifications and Standards should be used as reference.
2. It is prohibited for any person to discharge surface water and rainfall into the sewage system unless by written approval from the service provider.
3. The service providers commit to coordinate with the competent official authorities to apply the necessary standards and criteria on methods to collect, transfer, store and treat waste water in a sound manner to protect the environment and public health.

**Article (21)**

**Annulment**

All what is in contravention of these by-laws is null and void.

**Article (22)**

**Enforcement**

All competent authorities, each according to their competence, have to implement the regulations of these by-laws and abide by them starting from the date of their publication in the official newspaper.

**Issued at the City of Ramallah, on 03.12.2013 A.D.**

**30 Muharram 1435 Hijri**

**Rami Hamdallah  
Prime Minister**

**ANNEX****Instructions for Discharging Commercial, Industrial and Agricultural Waste Water into the Public Sewage Network****Article (1)**

It is prohibited to discharge polluted and non-polluted commercial and industrial waste water into the public sewage network unless after treating it and obtaining written approval from the service provider in line with these instructions.

**Article (2)**

It is prohibited for any person to discharge, cause or allow the discharge of the following water and waste into the public sewage network:

1. Any solid or liquid material in quantities, volumes or biological, chemical or physical characteristics that may lead to obstructing flow in the public sewage network pipes or cause damage to public health, cause the emission of odors, cause damage to the public sewage network and its employees, is in contravention with maintenance and operation works of treatment stations or the treatment process in these stations that may produce treated water that threatens public health and safety. For example amongst others ash, remains of burnt coal, sand, mud, hay, sawdust, metals, glass, clay, feathers, tar, plastic, wood, rubbish, blood, animal intestines, animal manure, hair, paper plates, bottles of all sizes, fats and greases and oils, acids, carbon, mineral salts, steam, hot gases, dyes, insecticides, liquid remains from olive presses, dairy products, animal blood emanating from slaughterhouses.
2. Any solid, liquid or gaseous material containing poisonous or mineral elements or heavy metals that may according to the opinion of the service provider cause damage or contradict with the treatment process or may individually or in interaction with other waste cause danger to human beings, animals or plants.
3. Any material that may lead to:
  - (a) Not being able to complete treatment during the treatment process.
  - (b) Form material that may precipitate, freeze or become sticky under temperatures between (0-40) degrees centigrade.

- (c) Obstruct the final use of treated water such as cause a high concentration of dissolved salts such as the liquid remains emanating from Sesame Oil (Tahini) presses and jeans wash workshops.
4. Any waste water discharged from a facility with a PH less than (0.5) and more than (9.5).
  5. Liquid remains emanating from stone saws, tile, marble and brick factories, cement mixer as well as any liquid remains in which the concentration of solid material clinging to it exceeds (50 milligram/liter) and with a weight exceeding (1.5 gram/cubic centimeter).
  6. Any liquid or steam the temperature of which exceeds (65) degrees centigrade. If the service provider establishes that these liquids and steams can be damaging to the sewage system or can cause any other damage at lower temperatures, then the service provider has the right to prohibit their discharge.
  7. Waste water that contains emulsified vegetable and animal oils, greases and fats or wax and with a concentration exceeding (100 milligram/liter).
  8. Any waste water or material containing cyanide or its ingredients with a concentration that may produce (2 milligram/liter) of a form of cyanide.
  9. Any waste water or material containing phenol components with a concentration exceeding (100 milligram/liter) in the form of phenol void of halogens.
  10. Any waste water or material containing sulphide with a concentration exceeding (2.0 milligram/liter) forming hydrogen sulphide.
  11. Any waste water or material containing chlorinated organic solvents.
  12. Any waste water or material containing chemical cleaners such as MBAS with a concentration exceeding (40 milligram/liter).
  13. Waste water containing mineral oils from cutting machines and distillators with a concentration exceeding (20 milligrams/liter).
  14. Any waste water or material containing Sulfate compounds (SO<sub>4</sub>) with a concentration exceeding (1000 milligram/liter).
  15. Any waste water or material containing chloride compounds (Cl) with a concentration exceeding (500 milligram/liter).
  16. Any waste water or material containing Fluoride compounds with a concentration exceeding (60 milligram/liter).
  17. Any waste water containing solid material (TSS) with a concentration exceeding (600 milligram/liter).



18. Any waste water in which the chemically absorbed oxygen (COD) exceeds (2000 milligram/liter).
19. Any waste water or material containing sodium compounds with a concentration exceeding (500 milligram/liter).

**Article (3)**  
**Heavy Elements**

It is prohibited to discharge any liquids or materials containing heavy or poisonous elements with concentration at discharge points exceeding those indicated below:

<b>Element</b>	<b>Concentration (milligram/liter)</b>
Chrome*	5
Copper*	4.5
Tin	10
Beryllium	5
Nickel*	4
Cadmium*	1
Arsenic	5
Baritone	10
Lead*	0.6
Magnesium	10
Silver*	1
Boron	5
Mercury*	0.5
Iron	50
Zinc	15
Cobalt*	0.05
Selenium*	0.05
Lithium	5
Vandiom*	0.1
Aluminum	10

\*On condition that the total of these elements collectively do not exceed (10 milligram/liter). The service provider has the right to modify the above table should a Palestinian specification be issued to this end.

**Article (4)**

It is prohibited to dilute the concentration of pollutants in industrial waste water by mixing it with fresh water or potable water in order to achieve the above mentioned concentrations.

## **Appendix 2.2.12**

# **PS 742-2015 Treated Wastewater in Agricultural Purposes**

## **Treated wastewater – Treated Wastewater Effluent for Agricultural Purposes (Restricted)**

### **1- Field**

This standard is concerned with the requirements that must be provided in the treated wastewater and effluent from wastewater treatment plants

### **2-Complementary References**

2-1 book for Standard methods for the examination of water and wastewater issued by the American Society of Public Health and the Federal Society of America for research and control of water pollution and its amendments

### **3-Definitions**

3-1 Wastewater: the water is contaminated by solid, liquid or gaseous substances or microorganisms that resulted from residences, buildings or different facilities.

3-2 Treated wastewater: it is wastewater that is to get rid of some or all of plankton, sediment, solutes and contaminants by natural or mechanical, chemical or biological (bio) either singly or in combination, which does not exceed the level limits mentioned in this standard

3-3 Transaction: any operation conducted on agricultural produce after harvest.

### **4-General Guidelines**

4-1 It should be match the treated waste water with properties in the table (1) by final use planned.

4-2 It should be used the pipe when treated waste water transfer in soil zones of high permeability and which may affect the groundwater or surface water used for drinking.

4-3 It does not allow treatment plants to ease the treated wastewater and then mixing in the treatment plant site with pure water in order to achieve the requirements of this standard.

4-4 It must stop irrigation crops before a month from the date of harvesting fruit trees that are eaten raw fruit (without cooking) and three weeks for crops that need special dealing after the harvest and dispose of fallen fruit and in contact with the ground

4-5 It prevents the use of treated wastewater to irrigate all types of vegetables.

### 5-Standard requirements

Must available in the treated wastewater the standard requirements contained in table (1) and according to the instructions and special regulations

Classification of treated wastewater according to their quality as shown in table (1)

<b>CATOGORIES OF TREATED WASTEWATER according with quality</b>				
Maximum limits for chemical and biological properties (mg/l) (unless otherwise specified)	<b>Catogery of Treated wastewater</b>			
	<b>High Quality (A)</b>	<b>Good Quality (B)</b>	<b>Medium Quality (B)</b>	<b>Low Quality (D)</b>
Biological Oxygen Demand ( BOD <sub>5</sub> )	20	20	40	60
Total suspended Solid (TSS)	30	30	50	90
FC ( 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
pH	6-9	6-9	6-9	6-9
Fat, Oil, & Grease	5	5	5	5
Phenol	0.002	0.002	0.002	0.002
MBAS	15	15	15	25
NO <sub>3</sub> -N	20	20	30	40
NH <sub>4</sub> -N	5	5	10	15
TOTAL -N	30	30	45	60
Cl <sup>-</sup>	400	400	400	400
SO <sub>4</sub> <sup>-2</sup>	300	300	300	300
Na <sup>+1</sup>	200	200	200	200
Mg <sup>+2</sup>	60	60	60	60
Ca <sup>+2</sup>	300	300	300	300
SAR	5.83	5.83	5.83	5.83
PO <sub>4</sub> -P	30	30	30	30
Al	5	5	5	5
As	0.1	0.1	0.1	0.1

Cu	0.2	0.2	0.2	0.2
Fe	5	5	5	5
Mn	0.2	0.2	0.2	0.2
Ni	0.2	0.2	0.2	0.2
Pb	0.2	0.2	0.2	0.2
Se	0.02	0.02	0.02	0.02
Cd	0.01	0.01	0.01	0.01
Zn	2	2	2	2
CN	0.05	0.05	0.05	0.05
Cr	0.1	0.1	0.1	0.1
Hg	0.001	0.001	0.001	0.001
Co	0.05	0.05	0.05	0.05
B	0.7	0.7	0.7	0.7
E. Coli ( Colony/ 100 ml)	100	1000	1000	1000
Nematodes (Egges/l)	≤1	≤1	≤1	≤1
Temperature (° C) as a maximum	35	35	35	35
The degree of turbidity	5-10	5-10	5-10	5-10

## 6- Quality control

### Quality control as follows:

6-1 the samples are represented and assembled throughout the day by every two hours for a period (24 hours) with the exception of properties that needs analyzed .it to the individual samples, as shown in Table 2 as a minimum

6-2 For the purposes of assessing the quality of treated wastewater used in agriculture depend on time periods as in the table (2)

6-3 When exceed in any of the properties for treated wastewater used for agriculture is taken a sample for additional confirmation from treated wastewater. If laboratory results showed the presence of exceed in the two samples is notified to the party concerned the need to rectify the situation as soon as possible and follow-up actions taken on the concerned party statement corrective actions.

6-4 When exceed in any of the properties for treated wastewater used for agriculture is taken a sample for additional confirmation from treated wastewater. If laboratory results showed the presence of exceed in the two samples is notified to the party concerned the need to rectify the situation and **if continue exceed for period determined by the control authority is shut down the use of treated wastewater until the stability of water quality** .

6-5 The sampling and analysis by the Palestinian Specifications. In case of non-availability is taken to international standards for treated wastewater.

6-6 On the owner of the project waste water treatment plant to be sure that the quality of treated water matching with the wastewater treatment standards as in table (1) and it should make the necessary lab tests and keep records for documentation and show it when requested by **control authorities**

6-7 Be iterative collect the sampling for **control authorities** and operating -as in the table (2)

Table (2) - Quality control

Wastewater treatment plants	Repetitive sampling		The evaluation period
	Control authorities	Operational party	
Mechanical (any mechanical treatment process)	Routine tests: 2 samples /month  physical &chemical properties : 2 samples /month  Nematodes: 2 samples /month  <b>الایشیریشیا کولای</b> 2 samples /month  FC : 8 samples /month ( Individual)	Routine tests: 8 samples /month ( composite sample)  physical &chemical properties : 3 samples /day ( Individual)  Nematodes: 4 samples /month ( composite sample)  <b>الایشیریشیا کولای</b> 8 samples /month ( Individual)  FC :8 samples /month ( Individual)	3 months A
Natural (Natural treatment process)	Routine tests: 1samples /month  physical &chemical properties : 1 samples /month  Nematodes: 1samples /month  <b>الایشیریشیا کولای</b> 1 samples /month  FC : 1 samples /month	Routine tests: 4 samples /month ( composite sample)  physical &chemical properties : 3 samples /day ( Individual)  Nematodes: 2 samples /month ( composite sample)  <b>الایشیریشیا کولای</b> 4 samples /month ( Individual)  FC :4 samples /month ( Individual)	6 months B

A: according the seasons (December - February), (March - May), (June-August), (September - November)

B: Summer & Winter (summer: May-October) (winter: November-April)

Note: Routine tests pH, DO, Turbidity, Temperature, NO<sub>3</sub>, BOD<sub>5</sub>, COD, TSS, T-N

6-8 for mechanical treatment plants which contain pools of refinement and natural treatment plants are calculated the chemical oxygen demand after Filtration

6-9 Engineering average is used to calculate the results of colon bacilli (E. coli) heat-resistant or الايشيريشيا كولاي when evaluate quality of treated water .

6-10 When evaluate the content of treated wastewater from the total nitrogen, calculated the average so that at least the number of samples included in the account on five samples

6-11 The results of examination of the colon bacilli (E. coli) heat-resistant substitute for the results of the examination الايشيريشيا كولاي at the lack of technical capabilities necessary for the examination

6-12 In the case of the need to identify the standards not include in the Palestinian standard are referenced to the Standards Institution to take the necessary action

6-13 في الحالات الوبائية على الجهات الرقابية والتشغيلية القيام بالتحري عن الجراثيم المعوية الممرضة الممكن تواجدها في المياه

## 7- Using of the treated wastewater:

The re-use of treated wastewater in agriculture as follows:

7-1 Agriculture restricted without barriers

7-1-1 Forest trees

7-1-2 Pastoral trees during the protection period, the Ministry of Agriculture determine the period of protection

7-1-3 الأراضي المستصلحة المشجرة بخلال السنة الأولى بشرط عدم وجود زراعات بينيه

7-1-4 Industrial crops such as cotton, fiber brooms

7-1-5 Crops are grown to produce seeds of agriculture and provision of seeds for watermelon.

7-1-6 Wood and stone crops that do not have contact with the public

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

7-1-8 Nurseries and productive plantation

7-1-9 decoration plants

7-2 Agriculture restricted with barriers

Table (3) shows the number & type of barriers.



Class A: High quality	Class B: Good quality	Class C: Medium quality	Class D: Low quality	Crop	Sand filtration or long retention or 10% effluents.	Disinfection treated water	Distance from drip- irrigation.	Plastic ground cover.
The number of required barriers					One of the 3			
Zero	Forbidden	F	F	Gardens, Play grounds, Parks				
Zero	Zero	Zero	F	Groundwater recharge by infiltration				
Zero	Zero	Zero	F	Discharge to the Sea, 500m far <sup>(1)</sup>				
Zero	Zero	Zero	Zero	Seeds crops				
Zero	3	3	4	Artichokes	+ <sup>(2)</sup>	+	++	+
Zero	3	3	4	Corn (edible).	+	+	++	+
Zero	Zero	Zero	F	Green Fodders				
Zero	Zero	Zero	Zero	Dry Fodders				
Zero	2	2	3	Citrus, with Drip irrigation	+	+	++	
Zero	3	3	4	Citrus, without Drip irrigation	+	+	+	
Zero	2	2	3	Crops with Inedible pill or shell almonds, pomegranate, pistachios.	+	+	++	
Zero	2	2	3	Deciduous trees (apple, prune, plum, pear, peaches, apricot) and cherry.	+	+	++	
Zero	2	2	3	Tropical fruits (mango, avocado, persimmon).	+	+	+	+
Zero	2	2	3	Grapes with high trellis.	+	+	++	+

Zero	2	2	3	Grapes with regular trellis.	+	+	+	+
Zero	2	2	3	Sabras (cactus)	+	+	++	+
Zero	2	2	3	Dates.	+	+	+++	+
Zero	2	2	3	Olives.	+	+	++	+
Zero	2	2	3	Flowers.	+	+	+	+
Zero	Zero	Zero	Zero	Forest with no public access				
Zero	Zero	Zero	Zero	Industrial and cereal crops				

### 8-Barriers used

One of the following methods to enable the farmer to use treated water on table(3)

- 8-1 A distance of at least 50 cm, above ground, between the drippers and the crop and the fruits, is considered as 2 barriers.
- 8-2 A distance of at least 25 cm above ground, between the drippers and the crop and the fruits is considered as 1 barrier.
- 8-3 A distance of at least 50 cm between under-canopy (branches) sprinklers or spray-irrigation, and between the fruits is considered as 1 barrier.
- 8-4 A plastic groundcover, between the effluent and the fruits, is considered as 1 barrier.
- 8-5 Subsurface drip-irrigation is considered 2 barriers.
- 8-6 Other Barriers
  - 8-6-1 Crop or a fruit with peel or shell an inedible is considered as barrier1
  - 8-6-2 Crop or a fruit that is eaten cooked only is considered as barrier1
  - 8-6-3 Sand filter is considered 1 barrier.
  - 8-6-4 Treated wastewater detention for a period not less than (15 days) is barrier 1
  - 8-6-5 Water pond that contains up to 10% of treated wastewater is barrier 1
  - 8-6-6 Disinfection of treated waste water with chlorine that at least for the remaining chlorine (0.5 mg / L) and the time of contact for at least half an hour or any other method of disinfection is one barrier.

## 9- Irrigation sprinkler

When the use of treated wastewater for irrigation sprinklers, there must be a buffer zone between the end of the wet area and between the public streets or residential areas or the whereabouts of citizens (waiting station), for example. This distance will depend on the quality of the treated wastewater.

And Table (4) shows these distances

Table 2 - The quality of treated wastewater and irrigation distance using sprinklers

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

## 10- General warnings

With respect to the warnings and conditions of public safety, take into account the instructions issued by the relevant authorities

### Reference

Obligatory Technical Instructions 34-2012 treated wastewater for agricultural irrigation (23/01/2012)

Jordanian Standard 893- 2006 water - household wastewater reclaimed

WHO guide lines for the safe use of wastewater, excreta and greywater





## **Appendix 2.2.13**

# **PSI TR-34 2012 Reuse of Treated Wastewater in Agricultural Irrigation**

## **Introduction**

These technical directions aim at the followings:

1. To put basics to use the treated water in agricultural irrigation in a way that will not affect badly the health of the human, animal, and plants.
2. Ensure that the treated sewage water in irrigation will not cause damage to any of the environmental elements including water soil, and air.

## **Article (1) The scope**

The provisions of these regulations are for the treated sewage water that comes out of the treatment stations for using in agricultural irrigation.

## **Article (2) Definitions**

For implementing the regulations of these directions, the following words and expressions have the stated meanings unless the context indicates otherwise:

- 2.1 The competent authority: is the party or the parties that determined by the cabinet in order to implement the regulations of these directions according to article (23) of the law of Standard Institution and other related applicable regulations.
- 2.2 User: a person, a contractor, or governmental, private, or civil institution that use or get benefit from the treated sewage water for agricultural irrigation.
- 2.3 Wastewater: the contaminated water with physical, chemical, biological, or radiological materials that resulted from the use of the domestic, industrial, commercial, or agricultural uses and becomes dangerous when being reused or discharged contrary to the provisions of relevant laws and regulations.
- 2.4 The Maximum Limits: Is the maximum concentration of a pollutant allowed to exist in treated sewage water, according to the limit mentioned in these instructions.
- 2.5 Treated sewage water: Is sewage water that has been clarified from some or all its suspended, sediment and dissolved materials by natural or mechanical, chemical or biological methods, whether individually or collectively, which do not exceed the maximum levels listed in these instructions.
- 2.6 Wastewater treatment station: group of facilities and equipment prepared to treat the wastewater by natural, chemical, mechanical, or biological methods, in order to improve the characteristics of wastewater to be reused it or discharged without any health or environment damages.

**Article (3)** The waste water for agricultural irrigation classified according to its quality to classifications mentioned in the Table (1)

**Article (4)** The following conditions should be implemented to use the treated water for agricultural irrigation:

- a) To be in accordance to these directions especially to the Table (1)
- b) Approval of the concerned authority on this agricultural irrigation use in accordance with permits issued by it for this purpose, consistent with the requirements of these instructions.

**Article (5)**

1-5 To transport the treated wastewater for agricultural irrigation in closed appropriate pipes and colored in purple and applicable to the Palestinian specifications.

2-5 if the treated wastewater is transferred by using a vehicle tanks, these tanks should be colored in purple and write on it with a clear obvious font visual from both sides (treated water for agricultural irrigation).

**Article (6)** The relevant authority shall set instructions explaining protective measures to be taken within the farm when dealing with the treated wastewater for agricultural irrigation

**Article (7)** The relevant authority shall monitor the quality of treated wastewater for agricultural irrigation by applying the control system described in Palestinian Standard No. 742

**Article (8)** Its prevented to use the treated wastewater for agricultural irrigation in the followings:

- a) Watering of livestock and poultry
- b) Irrigation for all types of vegetables
- c) Groundwater recharge by direct injection
- d) Fish farming

**Article (9)** User should not use the treated wastewater for irrigation in uses other than those identified by relevant agricultural irrigation party.

**Article (10)** When there is a conflict with the official documents issued by other parties, these documents should be modified to become in line with these instructions.

**Article (11)** These instructions are applicable from the date of the approval, and advertising.

**Article (12)** In case of any dispute in the interpretation of any text of these instructions, the interpretation of the regulations of the Technical Commission should be adopted.

**Article (13)** The concerned authority should develop a plan to implement all provisions of these regulations to include the stages of application and resources required to implement them, and should not exceed the duration of this plan for three years from the date of application of these regulations.



Table 1: Classification of the treated wastewater according to its quality (PSI, TR-34, 2012)

Maximum limits for physical, chemical and biological properties *)		Quality of Treated Wastewater			
		High quality (A)	Good quality (B)	Medium quality (C)	Low quality (D)
1.	Potential of Hydrogen pH	6-9	6-9	6-9	6-9
2.	Dissolved Oxygen DO	> 1	> 1	> 1	> 1
3.	Biochemical Oxygen Demand BOD <sub>5</sub>	20	20	40	60
4.	Chemical Oxygen Demand COD	50	50	100	150
5.	Total Suspended Solids TSS	30	30	50	90
6.	Total Dissolved Solids TDS	1200	1500	1500	1500
7.	Nitrate Nitrogen NO <sub>3</sub> -N	20	20	30	40
8.	Ammonium Nitrogen NH <sub>4</sub> -N	5	5	10	15
9.	Total Nitrogen T-N	30	30	45	60
10.	Phosphate Phosphorus PO <sub>4</sub> -P	30	30	30	30
11.	Fat, Oil and Grease	5	5	5	5
12.	Phenol	0.002	0.002	0.002	0.002
13.	Detergents MBAS	15	15	15	25
14.	Chloride Cl	400	400	400	400
15.	Sulfate SO <sub>4</sub>	300	300	300	300
16.	Sodium Na	200	200	200	200
17.	Magnesium Mg	60	60	60	60
18.	Calcium Ca	300	300	300	300
19.	Sodium adsorption ratio SAR	5.83	5.83	5.83	5.83
20.	Aluminum Al	5	5	5	5
21.	Arsenic As	0.1	0.1	0.1	0.1
22.	Copper Cu	0.2	0.2	0.2	0.2
23.	Iron Fe	5	5	5	5
24.	Manganese Mn	0.2	0.2	0.2	0.2
25.	Nickel Ni	0.2	0.2	0.2	0.2
26.	Lead Pb	0.2	0.2	0.2	0.2
27.	Selenium Se	0.02	0.02	0.02	0.02
28.	Cadmium Cd	0.01	0.01	0.01	0.01
29.	Zinc Zn	2	2	2	2
30.	Chrome Cr	0.1	0.1	0.1	0.1
31.	Mercury Hg	0.001	0.001	0.001	0.001
32.	Cobalt Co	0.05	0.05	0.05	0.05
33.	Boron B	0.7	0.7	0.7	0.7
34.	Cyanide CN	0.05	0.05	0.05	0.05
35.	Fecal coliforms (colony/100 mL)	200	1000	1000	1000
36.	Bacteria E. coli (Colony/100 mL)	100	1000	1000	1000
37.	Nematodes (Eggs/L)	≤ 1	≤ 1	≤ 1	≤ 1

.All units are in mg/l otherwise stated (\*)

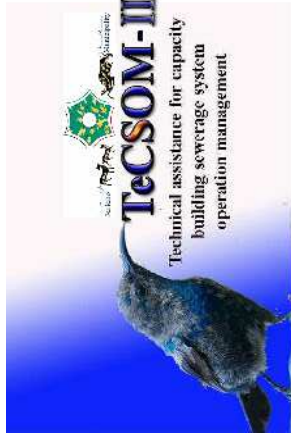
**:References**

- Law 7/1999: The Palestinian Environmental law, 1999.
- Law 3/2002: The Palestinian Water Law, 2002.
- Law 2/2003 : Agricultural Law ,2003
- Agreements with Israel, particularly the Memorandum of Understanding (MOU) of December 2003
- PS 742/2003: The Palestinian Treated Wastewater Standards, 2003.
- MoA Instructions/2011: The Ministry of Agriculture instructions for treated wastewater reuse in agriculture, 2011.
- TR 34/2012: Technical Regulations for the reuse treated wastewater in agricultural irrigation (PSI, TR-34, 2012)
- The Palestinian Water Law 2014.

## **Appendix 2.3.1**

### **MoA Treated Sludge Reuse**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Sewer Development & Sewage Sludge Reuse



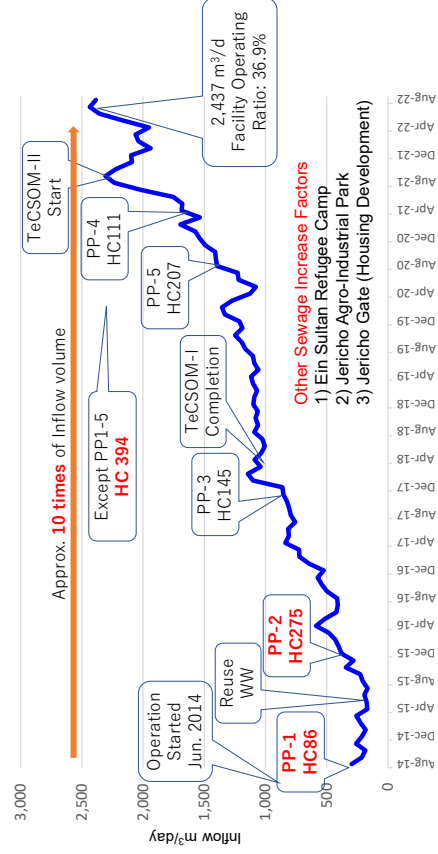
March 12, 2023  
Department of Water and Wastewater  
Director Mohammad Fityani

1

# 1. Sewer Development

2

## 1.1 Inflow to WWTP and Pilot Projects



3

## 1.2 JM Efforts (1)

### 1. Public Awareness (Early Stage)

- 1) Door to Door for explaining/persuading connection to sewers
- 2) Public meetings held by JM (Mayor, Director, Section Chiefs, etc.)
- 3) Lectures at elementary schools by JM staff
- 4) Receiving visitors from schools at the Jericho WWTP
- 5) PR Activities: Leaflets, Homepage, SNS, Mayor message by radio

### 2. Financial Aspect (Early Stage)

- 1) Discount campaign: Official sewerage fee 1.0NIS/m<sup>3</sup> ⇒ Temporary 0.5NIS/m<sup>3</sup>
- 2) Building permission: Building owner needs to pay a sewer connection fee (13NIS/m<sup>2</sup>)
- 3) Selling a treated wastewater for agricultural irrigation (0.5NIS/m<sup>3</sup>)

4

## Current JM Achievements (Phase II since 2021)

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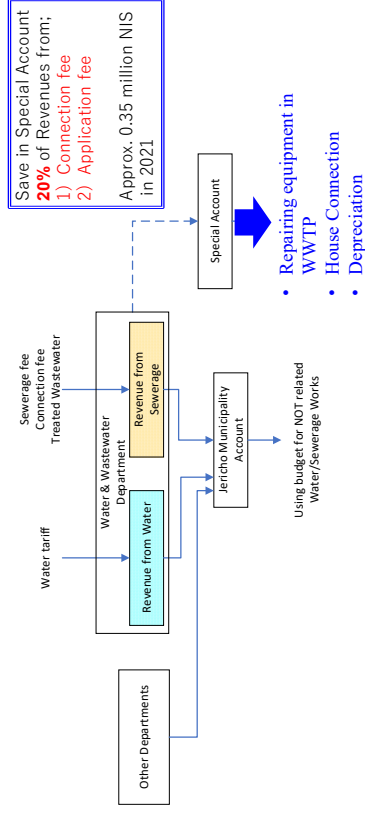
### 1.2 JM Efforts (2)

#### 3. Institutionalized Aspect (Phase II since 2021)

- 1) Establishment of the **Special Account** in the Water & Wastewater Dept. (see page 6)
- 2) Integrated collection of water and sewerage fees:  
Unpaid sewerage fee ratio 30% (2021)  $\Rightarrow$  0% (2022) by **encouragements**
- 3) Introduction of **penalty rules**: Suspension of water supply, Prevention of illegal dumping of cesspit sludge into manholes

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### 1.3 Special Account in WWD



Source: TeCSOM-II survey, 2022

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### 1.4 JM Efforts (2)

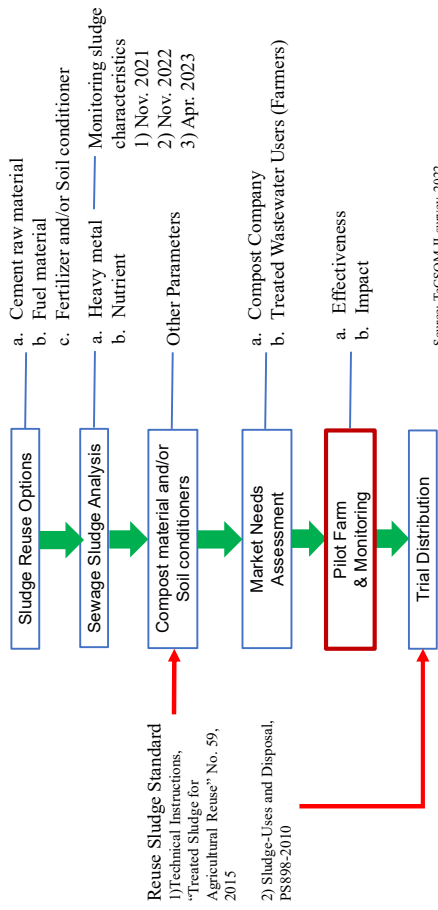
#### 4. Sewer Connection Promotion

- 1) **Sewer database developed with GIS** to existing sewers & houses, connected/unconnected (see page 7)
- 2) Identification of **priorities** for sewerage development areas /routes
- 3) Efficiency of sewer connection **application process**
- 4) Sewer **maintenance**

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## 2.2 Procedures on Sewage Sludge Reuse



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## 2.3 Maximum Concentration of Limits Reuse Treated Sludge of Agriculture Purposes

Parameters	59 for year 2015 <sup>1)</sup>	PS898-2010 <sup>2)</sup> Class I	Remarks
Cadmium	20	40	
Copper	1,000	1,500	
Nickel	300	300	
Lead	750	300	
Zinc	2,500	280	
Mercury	16	17	
Chromium	400	900	

Unit: mg/kg of dry matter

- 1) Certification of Obligatory Technical Instructions, Treated Sludge for Agricultural Reuse, 59 for year 2015
- 2) Sludge-uses and disposal, PS 898-2010

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## 2.4 Technical Instructions, 59 for year 2015 -Treated Sludge for Agricultural Reuse-

- 1) Treated sludge: To be treated biologically, chemically, **thermally**, etc.
- 2) Prevent reuse of treated sludge
  - a. Grassland or fodder crops
  - b. Fruits and vegetables, **but except a fruit tree**
  - c. Direct contact with soil

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## 2.5 Sludge Uses and Disposal, PS 898-2010

Field of Application	Reuse Purpose	Class I	Class II	Class III
1) Organic fertilizer for agricultural purposes	Applicable	Applicable	NA	NA
2) Improvement of soil properties	Applicable	Applicable	Applicable	NA
3) Disposal to landfill	-	-	-	Applicable

- 1) Not permitted to use Treated sludge
  - a. Vegetables
  - b. Park, home gardens, green spaces near public sites (not less than 250 m)
  - c. Root crops (radish, potatoes)
- 2) Treated sludge package for **sale** purpose  
Approval of the competent regulatory authorities is required.
- 3) Level of treated of sludge for first category  
Air drying: **dried in drying beds**

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## 2.6 Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine <sup>1)</sup>	Soil (Dec. 2014)	Sludge (Dec. 2014)	Sludge (Nov. 2015)	Sludge (Nov. 2021)	Sludge (Nov. 2022)
Cadmium	20	ND <sup>2)</sup>	3.2	1.94	ND	ND
Copper	1,000	33.6	279.5	153.3	0.179	1.81
Nickel	300	39.5	30.2	31.9	0.026	0.15
Lead	750	ND	29.7	15.7	0.018	0.15
Zinc	2,500	100.4	1,258	1,029	0.55	3.59
Mercury	16	0.0133	2.969	1.67	ND	ND
Chromium	400	42.4	ND	43.45	0.039	0.28

Unit: mg/kg of dry matter

1) Certification of Obligatory Technical Instructions, Treated Sludge for Agricultural Reuse, 59 for year 2015

2) ND: Not Detected

Data Source: JICA, TeCSOM Project Completion Report, 2018, TeCSOM-III Survey Results, 2022

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### 2.7 Pilot Plant at JWWTP

- Start in December 2014
- Jericho WWTP
- Palm Date, Orange, Lemon, Alfalfa, Corn
- Area: 1.75 dunam
- Potable Water vs Treated Wastewater
- Chemical Fertilizer vs Sewage Sludge
- Evaluation: Appearance, Fruit ingredients
- At present, Ongoing pilot

Source: TeCSOM-III survey, 2022

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## 2.8 Appearance, Fruit ingredients (Lemon)



Nov. 2015      Dec. 2022

Potable & Animal Sludge

Treated Wastewater & Sewage Sludge

Source: JICA, TeCSOM Project Completion Report, 2018

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## 2.9 Experimental Farm

Objective: Measuring the effectiveness of soil improvement with sewage sludge under general soil conditions.

- Location: Block Al Masna No. 33026 (Parcel 1+2)
- Target crops: 2 Date Palm trees, 15 Lemon trees
- Area: 2 dunam (2,000 m<sup>2</sup>)
- Reuse Option: Soil conditioner, mixing soil with dried sludge
- Schedule: End of November, fertilizer spraying season



Source: TeCSOM-III survey, 2022

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**2.11 Soil Conditioner Characteristics**

Parameters	unit	Sludge <sup>1)</sup> (Nov. 2021)	Sludge <sup>1)</sup> (Nov. 2022)	Samed <sup>2)</sup> Land Soil (Nov. 2022)	Soil Conditioner Standard <sup>3)</sup>	Improvement of Soil <sup>4)</sup>
Nitrogen (N)	%	2.855	4.0	0.085	> 1.5	
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/kg	219	215	22.6		
Kalium (K <sub>2</sub> O)	mg/kg	323	326	32.5		
pH		6.8	6.9	7.26	< 7.5	5.0-8.5
EC	dS/m	7.7	7.5	1.32	< 15	
Moisture Content	%	9.9	8.9	9.4	< 20	25-40
Total Fecal Coliform <sup>3)</sup>	CFU/100 ml	Nil	Nil	Nil	< 10	
Total Organic Matter	%	62.83	63.76	8.43	> 50	> 25
Carbon-Nitrogen ratio (C:N)		11	-	99.2	< 15:1	< 25:1

1) TeCSOM-II. Sewage analysis by An-Najah National University, 2021 & 2022  
 2) Palestine Standard PS609:2014; Organic fertilizers and soil conditioners  
 3) U.S. EPA. National Sanitation Foundation. Sanitation Technology: EPA sanitolites Class-A less than 1,000 MNP per 1 gram  
 4) Palestine Standard PS 2062:2011; Organic Fertilizer (Humus) Compost

22

**2.12 Dry Treated Sludge Reuse**

**[Safety]**

- There are **no factories** dealing with heavy metals in the sewerage planning area.
- There is also **no water distribution to the factory** in the water supply use category.

**[Assurance]**

- Phosphorus and potassium** components are small, **less than 2%** each, and are not suitable for fertilizers. However, the treated sludge' ingredients are higher than the Samed land soil.
- Sewage sludge is suitable for use as **Soil conditioner**.
- The dried treated sludge is **applicable for a sapling** to minimize consumers' concern to harvests.

**[Cheapness]**

- To disseminate / promote the reuse of dried treated sludge

23

**2.13 Trial Distribution of Dried Treated Sludge**

- Distributor: Jericho Municipality, Water and Wastewater Department
- Distribution Form: **Plastic Bag (25L)**
- Title: **"Soil Conditioner: Dried Treated Sludge"**

\*Not used word "sewage sludge". After drying the sewage sludge, it must be "Treated Sludge"

- Selling Price: **No Charge** (Due to dissemination campaign)
- Information on the Plastic Bag: see page 24
- User Information: see page 25

24

## 2.14 Available sizes of Treated Dried Sludge



particle size: ~20mm  
Sludge Density: 535 g/L



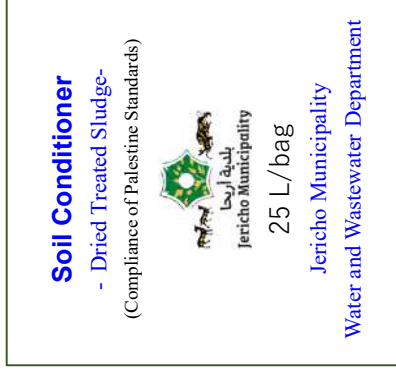
particle size: 0.5mm<  
Sludge Density: 805 g/L

Source: TeCSOM-II survey, 2021 & 2022

25

## 2.15 Plastic Bag Indication/Design

Front side



Back side



26

## 2.16 User Information

- Purpose: to grasp users, utilizations and quantity
- A user enters in a following form (draft)

No.	Date (yyyy/mm/dd)	Name	Address	Phone Number	Field Place	Number of Bags	JM Confirmation
1							
2							
3							

27

## 2.17 Schedule

1. Completion of soil composition & the 2nd sewage sludge composition analysis in Samed Land as baseline in Nov. 2022 (done)
2. The 3<sup>rd</sup> sewage sludge analysis in April 2023
3. Analysis of Soil conditioner in Samed Land (April 2023)
4. Further data will be accumulated from component analyses and a reuse policy will be finalized
5. Scheduled to end TeCSOM-II in June 2023. Handover to JM thereafter and continued observation of the Pilot Farm.

28

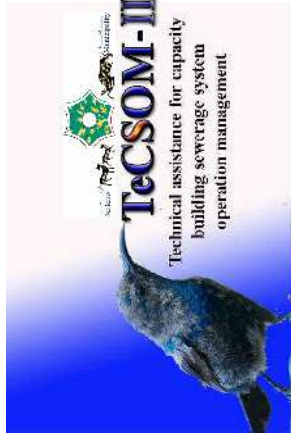
# Thank you very much for your Attention



## **Appendix 2.3.2**

# **Workshop on Treated Wastewater & Treated Sludge Reuse**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Treated Wastewater & Treated Sludge Reuse



June 7, 2023

Jericho Municipality, Department of Water and Wastewater  
Director Mohammad Fityani

1

1

### 1.1 SDGs in Jericho Sewerage Project



- 1) Solar power generation  
Covers about 1/5 of the power consumption of WWTP



- 2) Reuse of Treated Wastewater  
First sale of Treated Wastewater in Palestine  
Important source of income



- 3) Reuse of sewage sludge  
Reuse as soil conditioner



3

3

## 1. Sewerage System Development



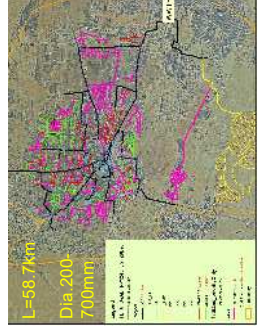
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2

### 1.2 Jericho Sanitation Circumstances

[Just After the JICA Project]

1. Improvement of knowledge and understanding on sewerage system for residents.
2. “Suffering to get consensus of a sewer connection and fee collection”
3. Slow increase in sewage inflow and low revenue

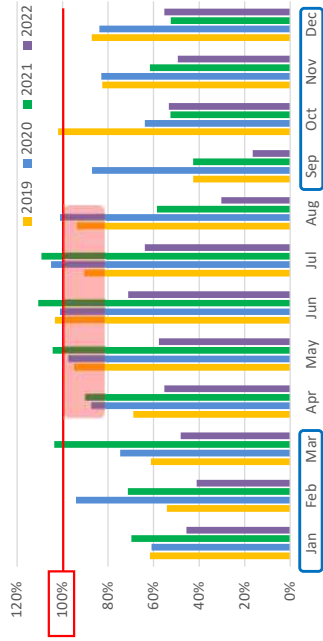


4

4



## 2.3 Reuse Ratio of Treated Wastewater



Reuse Ratio of Treated Wastewater

Source: JICA, TeCSOM-II Survey Results, 2021

9

## 2.4 Frame Owner Interview Survey

	Farmer-1	Farmer-2	Farmer-3	Farmer-4	Farmer-5
1 Reuse amount (m <sup>3</sup> /year)	55,092	32,080	56,907	168,613	59,821
2 Need more water	Yes	Yes	Yes	Yes	Yes
3 Crop Type	Date Palm	Date Palm	Date Palm	Date Palm	Date Palm
4 Irrigated area (dunam)	90 (1,000trees)	70	60 (2,000trees)	150	300
5 Mixing with groundwater	NO	Yes	NO	Yes	Yes, 90% GW
6 Expansion plan	Yes, if treated water available, by 70% increase	Yes, if treated water available by 33% increase	Yes, if treated water available for 550 dunam	NO	Yes, if treated water available
7 Current Fertilizer	Natural manure from cow dung, ammonia	Natural manure from cow dung, chemical fertilizer (potassium, ammonia)			

Source: JICA, TeCSOM-II Survey Results, 2022

10

## 2.5 Further Promotion of Treated Wastewater

### (1) User side

- 1) Institutionalization, **licensing system** for use
- 2) **Low cost** (Half price of water charge)
- 3) Risk management; Storing/ securing water source

### (2) Provider side

- 1) Risk management; **Water quality monitoring**, Emergency water supply suspension criteria
- 2) Risk communication; **Information disclosure** on water quality to users

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## 2.6 Maintenance/Clean of the Irrigation Tank

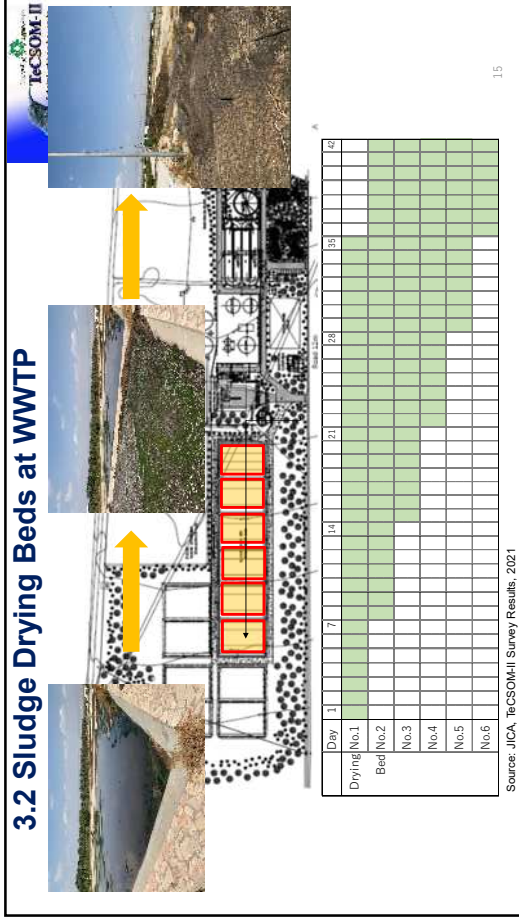
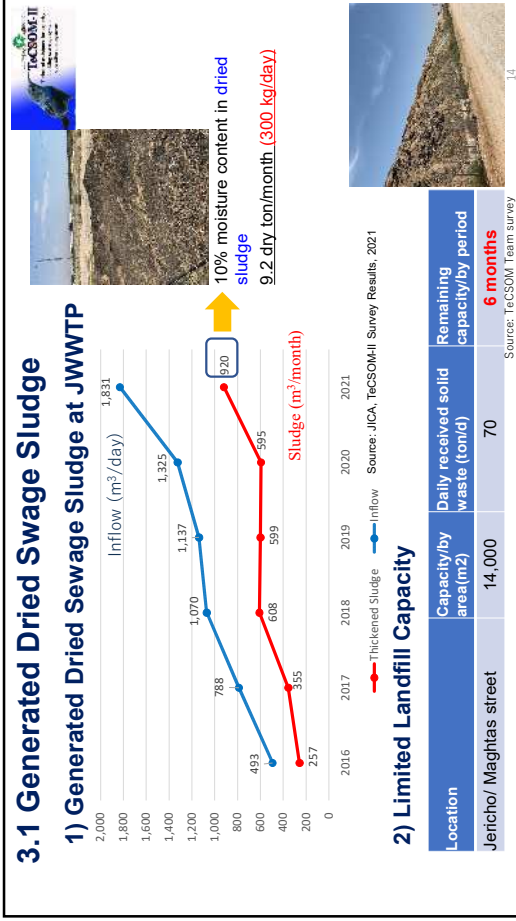


12

11

12

# 3. Reuse of Treated Sludge





### 3.4 Technical Instructions, 59 for year 2015 -Treated Sludge for Agricultural Reuse-

- 1) Treated sludge: To be treated biologically, chemically, **thermally**, etc.
- 2) Prevent reuse of treated sludge
  - a. Grassland or fodder crops
  - b. Fruits and vegetables, **but except a fruit tree**
  - c. Direct contact with soil

17

### 3.5 Sludge Uses and Disposal, PS 898-2010

- 1) Field of Application

Reuse Purpose	Class I	Class II	Class III
1) Organic fertilizer for agricultural purposes	Applicable	NA	NA
2) Improvement of soil properties	Applicable	Applicable	NA
3) Disposal to landfill	-	-	Applicable

- 2) Not permitted to use Treated sludge
  - a. Vegetables
  - b. Park, home gardens, green spaces near public sites (not less than 250 m)
  - c. Root crops (radish, potatoes)
- 3) Treated sludge package for **sale** purpose

Approval of the competent regulatory authorities is required.

- 4) Level of treated of sludge for first category

Air drying: **dried in drying beds**

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### 3.6 Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine <sup>b)</sup>	Soil (2014)	Sludge (2014)	Sludge (2015)	Sludge (2021)	Sludge (2022)	Sludge (2023)
Cadmium	20	ND <sup>2)</sup>	3.2	1.94	ND	ND	1.2
Copper	1,000	33.6	279.5	153.3	0.179	1.81	230.7
Nickel	300	39.5	30.2	31.9	0.026	0.15	24.8
Lead	750	ND	29.7	15.7	0.018	0.15	22.99
Zinc	2,500	100.4	1,258	1,029	0.55	3.59	518.9
Mercury	16	0.0133	2.969	1.67	ND	ND	ND
Chromium	400	42.4	ND	43.45	0.039	0.28	31.36

Unit: mg/kg of dry matter  
 1) Certification of Obligatory Technical Instructions, Treated Sludge for Agricultural Reuse, 59 for year 2015  
 2) ND: Not Detected

Data Source: JICA, TeCSOM Project Completion Report, 2018; TeCSOM-II Survey Results, 2022

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### 3.7 Pilot Plant at JWWTP

- Start in December 2014
- Jericho WWTP
- Palm Date, Orange, Lemon, Alfalfa, Corn
- Area: 1.75 dunam
- Potable Water vs Treated Wastewater
- Chemical Fertilizer vs Sewage Sludge
- Evaluation: Appearance, Fruit ingredients
- At present, Ongoing pilot

Source: TeCSOM-II survey, 2022

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### 3.8 Appearance, Fruit ingredients (Lemon)






Nov. 2015      Dec. 2022

Potable & Animal Sludge

Nov. 2015      Dec. 2022

Treated Wastewater & Sewage Sludge


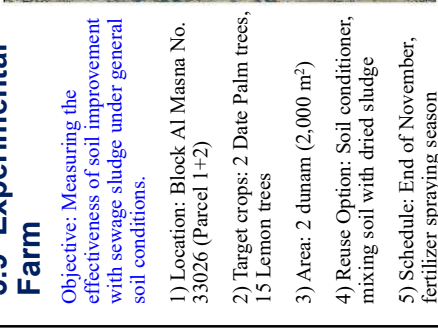
Source: JICA, TeCSOM Project Completion Report, 2018

21

### 3.9 Experimental Farm

Objective: Measuring the effectiveness of soil improvement with sewage sludge under general soil conditions.

- 1) Location: Block Al Masna No. 33026 (Parcel 1+2)
- 2) Target crops: 2 Date Palm trees, 15 Lemon trees
- 3) Area: 2 dunam (2,000 m<sup>2</sup>)
- 4) Reuse Option: Soil conditioner, mixing soil with dried sludge
- 5) Schedule: End of November, fertilizer spraying season

Source: TeCSOM-II survey, 2022

22

### 3.10 Samed Land



Before Cleaning  
13 February 2023



After Cleaning  
27 February 2023

Source: TeCSOM-II survey, 2023

23

### 3.11 Soil Conditioner Characteristics

Parameters	unit	Sludge <sup>b)</sup> (2021)	Sludge <sup>b)</sup> (2022)	Sludge <sup>b)</sup> (2022)	Samed <sup>b)</sup> Soil (2022)	Soil Conditioner Standard <sup>c)</sup>	Improvement of Soil <sup>d)</sup>
Nitrogen (N)	%	2.855	4.0	4.4	0.085	>1.5	
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/kg	219	215	205	22.6		
Potassium (K <sub>2</sub> O)	mg/kg	323	326	320	32.5		
pH		6.8	6.9	6.9	7.26	<7.5	5.0-8.5
EC	dS/m	7.7	7.5	8.7	1.32	<15	
Moisture Content	%	9.9	8.9	14.4	9.4	<20	25-40
Total Fecal Coliform <sup>3)</sup>	CFU/100 mL	Nil	Nil	Nil	Nil	<10	
Total Organic Matter	%	62.83	63.76	59.9	8.43	>50	>25
Carbon-Nitrogen ratio (C:N)		11:1	8:1	13:1	99.2	<15:1	<25:1

1) TeCSOM-II, Sewage analysis by An-Najah National University, 2021 & 2022.  
 2) Palestine Standard PS609:2014, Organic fertilizers and soil conditioners  
 3) U.S. EPA, 1999, Environmental Regulations and Technology, EPA stipulates Class A less than 1,000 MNP per 1 gram  
 4) Palestine Standard PS 2652:2011, Organic Fertilizer (Humus) Compost

24

### 3.12 Treated Dried Sludge Reuse

#### [Safety]

1. Heavy metals within the Reuse Standard
2. No bacteria, Dried (water content approximately 10%)

#### [Assurance]

1. Treated sludge's ingredients (Nitrogen) are higher than the Samed land soil.
2. Sewage sludge is suitable for use as **Soil conditioner**.
3. The treated dried sludge is **applicable for early stage of plantation (before harvesting)** to minimize consumers' concern to harvests.

25

### 3.13 Available sizes of Treated Dried Sludge



particle size: ~20mm  
Sludge Density: 535 g/L



particle size: 0.5mm<  
Sludge Density: 805 g/L

Source: TeCSOM-II survey, 2021 & 2022

26

25

26

### 3.14 Jericho Treated Sludge

- 1) Safety: Heavy metal content  
**100% Compliance** with the Palestine Standards
- 2) Effectiveness  
**Nutrients** (nitrogen, phosphorus, potassium) :  
**10 to 40 times** more compared to the Samed Land's soils
- 3) Barriers to Promoting Reuse
  - MoA cares about using treated sludge without license
  - Farm owners concerned about **reputational damage**



27

27

### 3.15 Plantation Project



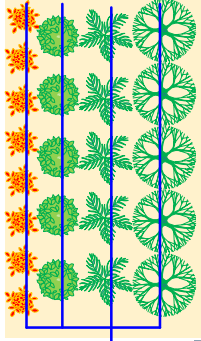
Approx. 7,000 m<sup>2</sup>

- **Plantation** (Palm tree, Olive, Paulownia)
- Reusing Treated Wastewater & Treated Sludge
- Effective publicity for visitors
- Reuse of treated wastewater & sludge
- Place of rest and recreation
- Contribution to JMIs strategic plan

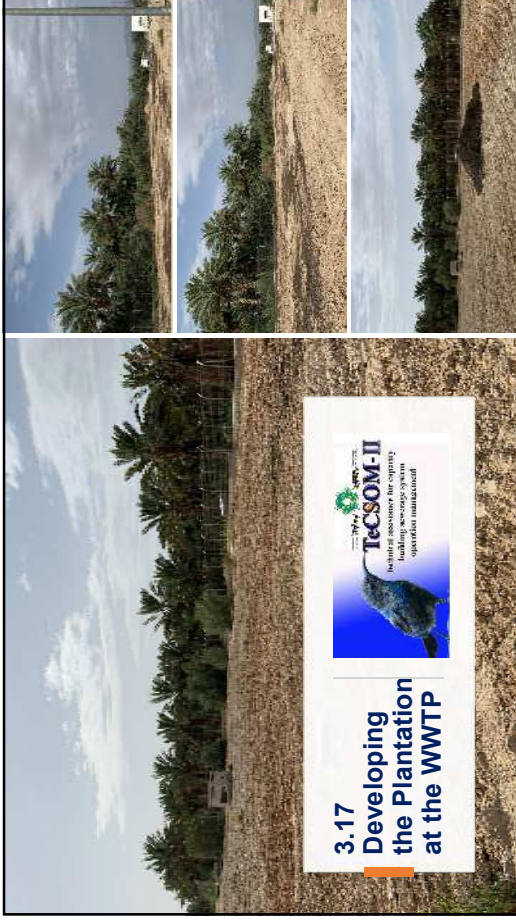
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28

### 3.16 Formation of Recycling-oriented Society



1. Implemented under JM control
2. Treated sludge cannot be distributed directly, but indirectly through commercialization
3. Appeal to visitors and other donors as a model case for a recycling-oriented society



### 18. JM Message

1. Continuously monitor the 3 Pilot Plants
2. Try to reuse the treated sludge to improve poor soil
3. To mitigate dumping capacity (land) issues in the West Bank
4. To achieve "Green City" in Jericho future vision



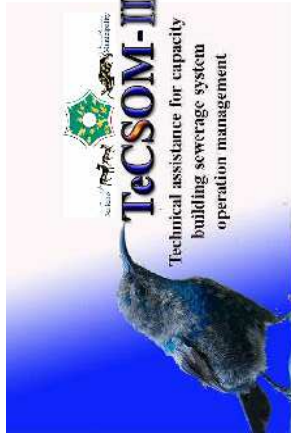
Thank you very much for your Attention



## **Appendix 2.3.3**

### **Plantation Project for Jericho Mayor & Council Member**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Forest Project



May 16, 2023

Department of Water and Wastewater  
Director Mohammad Fityani & Satoru Oniki

1

## 2. Jericho Treated Sewage Sludge

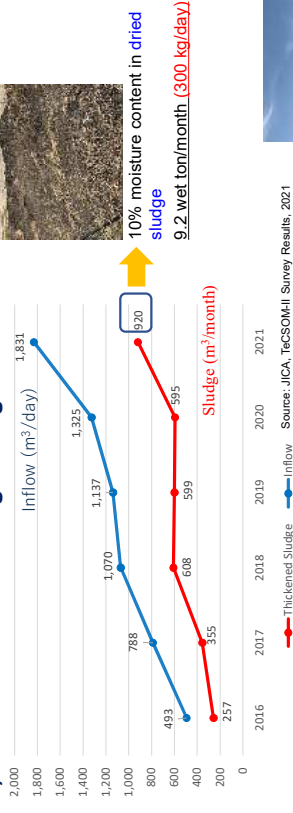
- 1) Safety: Heavy metal content **100% Compliance** with the Palestine Standards
- 2) Effectiveness **Nutrients** (nitrogen, phosphorus, potassium) : **10 to 40 times** more compared to the Samed Land's soils
- 3) Barriers to Promoting Reuse
  - MoA is **cautious**
  - Farm owners concerned about **reputational damage**



3

## 1. Generated Dried Sewage Sludge

### 1) Generated Dried Sewage Sludge at JWWT



### 2) Limited Landfill Capacity

Location	Capacity/by area (m2)	Daily received solid waste (ton/d)	Remaining capacity/by period
Jericho/ Maghtas street	14,000	70	<b>6 months</b>

Source: TeCSOM Team survey.

2

## 3. Forest Project



- **Plantation** (palm tree, citrus, lawn/grass)
- Reusing Treated Wastewater & Treated Sludge
- Effective publicity for visitors
- Reuse of treated wastewater & sludge
- Place of rest and recreation
- Contribution to JM's strategic plan

4

## 4. Formation of Recycling-oriented Society

Treated Wastewater

Plantation

Date seedling

Olive

Rose of Jericho

Accessory Tree

1. Implemented under JM control

2. Treated sludge cannot be distributed directly, but indirectly through commercialization

3. Appeal to visitors and other donors as a model case for a recycling-oriented society

TeCSOM-II

## **Appendix 2.3.4**

# **TI 59-2015 Use of Sewage Sludge in Agriculture**



### The Approval of the Private Mandatory Technical Instructions Form

The Title of the Mandatory Technical Instructions	The Use of Sewage Sludge in Agriculture	
No. of The Use of Sewage Sludge in Agriculture	59 for the year 2015	
Member State (s)	MOA PWA	
According to the article (16) of the standards and specifications law No. (6) for the year (2000) and after referring to the final draft of the Mandatory Technical Instructions for the use of the sludge in agriculture; we approved this as Mandatory Technical Instructions of the No. 59 for the year 2015.		
Date :		
Dr. Sufian Sultan Minister of Agriculture	Eng. Mazen Ghnaym Head of PWA	Abeer Ouda Head of Institution Minister of National Economic

**Dr. Jawad Naji**  
**Minister of National Economic**

**Subject: Mandatory Technical Instructions**

Based on your letter No. 480 on 24/2/2014, which includes our knowledge to the draft of the Mandatory Technical Instructions of the use of the sludge in agriculture; we inform your side that there is no objection to approve this subject in order to make this instructions generalized and working based on it.

**Yours Sincerely**

**Dear/ Abeer Ouda**  
**Minister of National Economic**

**Subject: the final draft of the Mandatory Technical Instructions**

In reference to the subject mentioned above about the final draft of the Mandatory Technical Instructions for the use of the sludge in agriculture; we would like to inform you that we decided to approve it.

**Yours Sincerely**

**The Use of Sewage Sludge in Agriculture (20.04.2009)**  
**(16/2/2014)**

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 human, thereby encouraging the correct use of such sewage sludge.

Article 2

For the purpose of this Directive:

1-2 “Sludge” means: solid materials with wet and dry texture remaining in:

- i. Waste water treatment plants that treat domestic or urban wastewaters or with similar composition.
- ii. Septic tanks and other similar installations for the treatment of sewage.
- iii. Waste water treatment plants other than those referred to in (i) and (ii).

2-2 “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 ferment ability and the health hazards resulting from its use.

2-3 “Agriculture” means: the growing of all types of (commercial, industrial and food) crops, and any other uses related to agricultural production like Reclamation of agricultural and producing seedlings.

2-4 “The use of sludge” means: the added the sludge on the soil or any other addition.

2-5 Soil salinity the soil where the Electricity Conductivity (EC) for the (Saturated paste extract) more than 2.5 (ds/L).

2-6 Producer: the party that produces the treated sludge locally or imports from abroad under a license issued by the Member state (s).

2-7 The Member state (s): party(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 3

1. The sludge must be treated and approved by the Member state (s) before the use in agriculture in accordance with this Instructions.

### Article 4

1-4 Concentrations of heavy metals in soil to which sludge is applied should not exceed the maximum limits that have been given in Annex (1).

2-4 Concentrations of heavy metals in treated sludge should not exceed the maximum limits that mentioned in Annex (2).

3-4 the maximum annual quantities for these heavy metals which may be provided to the soil and prepared for agriculture should not exceed the maximum limits that mentioned in Annex (3).

### Article 5

1. Member state (s) 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 (1) 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 state (s) 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 item (1-) being exceeded. To achieve this, they shall apply one or other of the procedures provided for in (a) and (b) below.

(a) Member state (s) 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 2.

(b) Member state (s) shall ensure observance of the limit values for the quantities of metals introduced into the soil per unit of area (Donum) as set out in Annex 3.

### Article 6

Without prejudice to Article 7, Sewage sludge producers shall regularly provide users and concerned parties with all the information referred to in Annex 4.

### Article 7

Member state (s) 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 state (s) 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

When using sludge, it should be taken into account the nutrient needs of the plants and that the quality of the soil and of the surface and groundwater is not impaired.

#### Article 9

1-9 Sludge and soil on which it is used shall be analyzed as outlined in Annexes (4) and (5).

2-9 The reference methods for sampling and analysis are indicated in Annex (6).

#### Article 10

1. Sludge producers 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 4.

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

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

2-10 The records shall be available to the Member state (s).

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

#### Article (11)

When transferring the treated sludge, it should be taken into account the environmental conditions to prevent the spill and pollution of the environment.

#### Article (12)

Member state (s) should develop a plan to implement all this instructions which includes the implementation stages and the required resources for the implementation in a period of time not exceed a year of the validity of these instructions.

Article (13)

These instructions is applied from the date of issue and announced.

Article (14)

In case of a dispute in the interpretation of one of the provisions of this Mandatory Technical Instructions; the interpretation that issued by the committee of Mandatory Technical Instructions should be adopted.

Article (15)

Each contrary to these instructions should be modified.

## ANNEX 1A

### Maximum 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 (ppm)
Cadmium	1
Copper	50
Nickel	30
Lead	50
Zinc	150
Mercury	1
Chromium	20

(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

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

(mg/kg of dry matter)

Parameters	Limit Values (ppm)
Cadmium	20
Copper	1000
Nickel	300
Lead	750
Zinc	2500
Mercury	16
Chromium	400



ANNEX 1C

Maximum Limit Values for Amounts of Heavy Metals which may be added annually to Agricultural Land, based on a 10- year Average  
(kg/donum/year)

Parameters	Limit Values
Cadmium	0.015
Copper	1.2
Nickel	0.3
Lead	1.5
Zinc	3
Mercury	0.01
Chromium	0.6

## Annex (4)

### Treated Sludge Analysis

1. Treated sludge should be analyzed once every 3 months at least.
2. If any changes happen to the waste water properties, analyzes should be conducted immediately with the increasing of the periodic analysis.
3. Analyzes should cover the followings:
  - Dry matter and organic matter.
  - Acidity.
  - Nitrogen and phosphorus.
  - Cadmium, copper, Nickel, Lead, Zinc, Mercury and Chromium.
  - Electrical conductivity.
  - Pathogenic micro-organisms.
  - Humidity.
  - Density.

## **Appendix 2.3.5**

# **PS 898-2010 Sludge Uses and Disposal**

**PS 898-2010**

**ICS: 13.060**

# **Sludge-uses and disposal**

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## Chapter I:

### 1-1 Field of application:

This standard is concerned with the requirements that must be met in the sludge generated from domestic sewage plants and intended to be reused to improve soil properties or as an organic fertilizer for agricultural purposes or to be disposed of in landfills, according to the requirements set out in this specification.

### 1-2 Supplementary References

Palestinian Standard :

PS 742-2003 Treated wastewater

External references:

Book of Standard Methods for Water and Wastewater Examination issued by the American Society for Public Health and the American Federal Society for Water Research and Pollution Control, 2001

### 1-3 Definitions:

#### 1-3-1 Sewage Sludge:

Solid materials with a wet or dry texture resulting from the treatment of domestic sewage before treatment.

#### 1-3-2 Wet Sludge:

Wet-textured materials resulting from domestic sewage treatment processes whose solids content ranges from 50-89%.

#### 1-3-3 Dry Sludge:

Dry-textured materials resulting from domestic sewage treatment processes whose moisture content doesn't exceed 10%.

#### 1-3-4 Treated Sludge:

The sludge that is treated by any of treatment methods and achieves the conditions of this standards.

#### 1-3-5 Wastewater:

It is the polluted water with solids, liquids, gases or microorganisms resulted from the domestic buildings and facilities.

#### 1-3-6 Weight of dry sludge:

Total solid weight after drying the sludge with (103-105 degree) until reaching stable weight.

#### 1-3-7 Producer:

The responsible party of treating the wastewater and producing the sewage sludge.

#### 1-3-8 Distributer:

The responsible party of transporting & distributing the sewage sludge to the end user.

#### 1-3-9 End user:

The party whom using the sewage sludge.

#### 1-3-10 Collection:

Sewage sludge collection process before and after treatment.

#### 1-3-11 Adding the Sludge to the Soil:

The process of spreading sludge on the surface of the soil or injecting sludge under the surface of the soil or mixing the soil with sludge

#### 1-3-12 Productive trees:

The trees that produces fruit for the human consumption.

#### 1-3-13 field crops :

Cereal and fodder crops harvested once or more per year

#### 1-3-14 Licensing body:

The relevant authorities that grant the license to use sludge



#### 1-3-15 Regulators:

Ministries and institutions that monitor the elements of the environment, health and public safety in accordance with the regulations, laws and instructions in force.

#### 1-3-16 landfills:

Sites specified by the competent authorities for the disposal of solid and liquid waste.

#### 1-3-17 The first class of sludge:

Sludge that is allowed to be used in all areas related to the application of this standard and which matches its quality, physical, chemical and bacterial content and concentrations shown in Table (2) of this standard.

#### 1-3-18 The second class of sludge:

The sludge that is allowed to be used to improve the properties of the soil and is allowed to be dumped in landfills, which matches its quality, physical, chemical and bacterial content and the concentrations shown in Table 2 of this specification.

#### 1-3-19 The third class of sludge:

Sludge that is allowed to be disposed of in landfills only and that matches its quality, physical, chemical and bacterial content and the concentrations shown in Table 2 of this specification.

#### 1-3-20 Fodder lands:

Land designated for the cultivation of fodder crops and/or pasture shrubs

#### 1-4 Symbols and abbreviations:

For the purposes of this specification, the abbreviated terms listed in Table 1 have the following symbols:

Table 1: Symbols and terms used in this specification:

Item	المصطلح المختصر	symbol	الرمز
	Arsenic		As
	Cadmium		Cd
	Chromium		Cr
	Copper		Cu
	Mercury		Hg
	Molybdenum		Mo
	Nickel		Ni
	Lead		Pb
	Selenium		Se
	Fecal Coliform		FC
	Zinc		Zn

## Chapter II:

### 2-1 General requirements:

2.1.1 Never use untreated sludge

2-1-2 No party or person is allowed to use treated sludge unless the requirements stipulated in this specification are met.

2-1-3 The producer shall submit to the licensing authority, the user and the regulatory authorities documents showing the results of the analyzes of the treated sludge from an approved body in accordance with the principles of this specification.

2-1-4 The user must obtain the necessary licenses through the licensing authorities and provide all the necessary data, including determining the location of production and use of treated sludge, nearby water sources, the quality of the soil at the site of use and the crops that will be grown. Also, these licenses must be renewed every two years. The supervisory authorities have the right to cancel the licenses in the event of violations.

2-1-5 The producer shall keep special records for a period of no less than five years showing the quantities and quality of the produced sludge, methods of treatment and circulation, in order to show them upon request according to the requirements of this specification.

2.1.6 The producer and the user shall put indicative signs at the site of sludge collection and/or use

2-1-7 If it is necessary to collect the treated sludge before use, it must be done in covered sites with a floor and impermeable sides and/or lined in a way that does not negatively affect its properties and the elements of the surrounding environment and so that the period of collection does not exceed three years.

2.1.8 It is forbidden to collect treated sludge near valleys, sites prone to flooding, irrigation channels, water bodies and sites that negatively affect ground and surface waters.

2-1-9 If treated sludge is used for agricultural purposes, it is added to the land during the months of December and January in the case of fruit trees, and during the months of September and October for field crops and pastures, and a week before the planting process in the irrigated areas

2-1-10 It is not permitted to use treated sludge to fertilize lands planted with vegetables, as well as parks, home gardens, and green spaces near population centers and public sites. It is not allowed to use it to fertilize lands planted with root crops such as radish, potatoes and others, whether they are eaten raw or cooked.t

2-1-11 The distributor shall abide by the health and environmental safety requirements in force during the transportation of sludge, which are:

2-1-11-1 Marking the treated sludge transport media with clear writing.

2-1-11-2 Preventing leakage and fluid flow from transportation means or sludge flying from the surface.

2-1-11-3 Keeping the means of transport in a state of complete cleanliness.

2-1-11-4 Cover all loads when transporting so that there is no trace of treated sludge on the sides of the means of transport.

2-1-12 The process of adding treated sludge should be homogeneous and within the parameters of this standard, and the following should be taken into account in the addition process:

2-1-12-1 Treated sludge is added in the irrigated areas on the planting lines and mixed with the surface layer of soil (10-20 cm) and a week before planting, and there is no specific time for adding.

2-1-12-2 The treated sludge is added in the rainy areas before the rainy season starting from October and mixed with the topsoil, taking into account that the slope of the land does not exceed 5%.

2-1-12-3 Treated sludge is added to pasture lands before the rainy season starting from October and mixed with the topsoil, taking into account that the plowing is contour and mixed with the surface layer of the soil.

2-1-13 The rate of adding treated sludge to the soil depends on the concentrations of nutrients and other elements and the characteristics mentioned in this specification.

2-1-13-1 taking into account the upper limit allowed for the accumulation of nutrients and other elements and properties mentioned in this specification.

1-2-1-2 The user of the treated sludge shall verify the nutrient content of the soil and the actual need for it for the crop

2-1-14 The regulatory authorities have the right to conduct the necessary examinations for the products and crops grown in the places where the treated sludge was used in order to ensure the safety of the products grown in the places where the treated sludge was used in order to ensure the safety of the product and without affecting the health and the environment in general.

2-1-15 The producer shall prepare a plan for sludge management and submit it to the regulatory authorities.

2-1-16 It is not allowed to throw sludge of all kinds into water areas, torrents, valleys, groundwater recharge areas, and sewage networks, with the exception of public treatment plants that receive the contents of household cesspits.

2-1-17 In the event that the sludge is treated and packaged for the purpose of sale, the approval of the competent regulatory authorities is required. In this case, the requirements of the US Environmental Protection Agency, the European Union and the World Health Organization can be used as a guide.

2-1-18 In the event that the treated sludge is desired to be used for purposes not mentioned in this specification (such as the rehabilitation of quarries and mines sites, etc.), prior to use, it is required to conduct integrated technical studies and submit them to the regulatory authorities and the licensing authority for approval.

## 2-2 Health and Environmental Requirements:

2-2-1 Prevents using the treated sludge that negatively affect the quality of ground and surface water, including valleys and water harvesting projects and flood-prone areas.

2-2-2 In some special cases, the supervisory authorities may display additional restrictions on those mentioned in this specification if they deem it necessary to preserve health and the environment.

2-2-3 The producer and the user to provide sanitary conditions and take measures for public safety and occupational health for those dealing with sludge.

2-2-4 The producer and the user must abide by the requirements of primary health care and the initial and periodic vaccination of workers against diseases and epidemics, and present this to the supervisory authorities upon request.

2-2-5 In the processes of collecting and using the treated sludge, the commitment to provide appropriate conditions to prevent the proliferation of disease-carrying insects shall be taken into account.

2-2-6 The treated sludge should be mixed with the soil within a period not exceeding two days from the date of addition.

2-2-7 It is prohibited to use treated sludge for the purposes of land reclamation in areas whose slope rates exceed 15%.

2-2-8 In the case of adding the treated sludge in areas close to the population centers, the distance between the addition site and the population centers should not be less than 250 meters.

2-2-9 It is not allowed to consume the fruits that fall or touch the ground to which the treated sludge has been added.

2-2-10 Cattle grazing is not allowed before a period of two months has passed since the addition of treated sludge.

2-2-11 Commitment to put general indicative signs on the land to which the treated sludge has been added in order to improve the quality of the soil to indicate the danger of entering it.

2-2-12 When adding treated sludge to the soil, mechanical methods should be used as much as possible.

## 2-3 Technical requirements

2-3-1 Sludge must be treated before use according to the treatment methods mentioned in this specification and any other approved method.

2-3-2 The sludge that is disposed of in landfills shall comply with the requirements of this standard.

2-3-3 Soil properties should be checked before adding the treated sludge for the first time.

2-3-4 Sludge is classified into three classes: first class, second class and third class for the purposes of applying this specification.

2-3-4-1 It is allowed to use Class I sludge as an organic fertilizer for agricultural purposes as well as for soil improvement purposes.

2-3-4-2 Class II sludge may be used for soil improvement purposes only.

2-3-4-3 Sludge that meets the requirements of the first, second and third classes is allowed to be dumped at landfill sites.

2-3-5 It is forbidden to add treated sludge whose specifications are specified in Table 2 at rates exceeding 6 metric tons per hectare annually.

2-3-6 Table 2 and table 3 show that, respectively, the maximum limits for the concentrations of elements and other parameters that must be available in the treated sludge, in addition to the annual maximum rates and cumulative limits for adding the elements present in it.

Table 2 Maximum limits allowed in sludge

Element	Symbol	Concentration/Type of Sludge Mg/kg dry weight(except as indicated)		
		Class I	Class II	Class III
Arsenic	As	41	75	75
Cadmium	Cd	40	40	85
Chromium	Cr	900	900	3000
Copper	Cu	1500	3000	4300
Mercury	Hg	17	57	57
Molybdenum	Mo	75	75	75
Nickel	Ni	300	400	420
Selenium	Se	100	100	100
Lead	Pb	300	840	840
Zinc	Zn	280	400	7500
Moisture Level	----	10	50*	----
Fecal Coliform Bacteria	FC	1000***	200000**	----
Salmonella	----	3***	----	----
Live intestinal worm eggs	----	1***	----	----
Enteroviruses	----	1****	----	----
Comments: *: Percentage **: maximum potential Number/gm or related unit / gm ***: bacilli/dry gm ****: unit/ 4 gm dry				

Table 3: Minor maximum rates and cumulative limits for the addition of elements present in the treated sludge.

Element	Symbol	Annual rate of addition of the element kg / hectare / 365 days.	Maximum cumulative limits in soil kg/ha.
Arsenic	As	1	20
Cadmium	Cd	1	20
Chromium	Cr	25	500
Copper	Cu	35	700
Mercury	Hg	0.85	17
Molybdenum	Mo	0.90	18
Nickel	Ni	5	100
Selenium	Se	2	40

Lead	Pb	11	220
Zinc	Zn	50	1000

## 2-4 Sludge treatment levels

### 2-5 The level of treatment of sludge for the first category:

Sludge is treated in one of the following ways.

#### 2-5-1 Fermentation:

This process is done by using and recovering by aeration or by placing the sludge in piles in which the solid mass remains at a temperature of not less than 40 degrees Celsius for a period of five days or at a temperature for a period of??? day.

#### 2-5-2 Thermal drying.

The sludge is dried by removing liquids from it using heat so that the moisture percentage drops to 10% or less and that the sludge temperature reaches 80 degrees Celsius at the end of the heating process.

#### 2-5-3 Air drying.

Liquid sludge is allowed to be filtered, or dried in drying beds where the thickness of the sludge does not exceed 25 centimeters, and the sludge must remain in these drying beds for a period of not less than 45 days.

#### 2-5-4 Thermal aerobic digestion.

The sludge is stirred in the presence of oxygen while maintaining the aerobic conditions for a period of ten days at a temperature of 55 to 60 degrees Celsius with a reduction of at least 38 % of the volatile solids.

#### 2-5-5 Any other method capable of meeting the technical requirements of this specification.

## 2-6 Class II sludge treatment level

Sludge is treated in one of the following methods :

#### 2-6-1 Aerobic digestion.

This process is carried out by stirring the sludge in the presence of air while maintaining the aerobic conditions for forty days at the air temperature with a reduction of at least 38 % of the volatile solids.

### 2-6-2 Air drying.

Sludge is allowed to be filtered or dried in sand basins, so that the thickness of the sludge does not exceed 25 centimeters, and the sludge must remain in the basins for a period of not less than thirty days.

### 2-6-3 Anaerobic digestion.

This process is carried out in the absence of air, provided that the sludge remains for a period of not less than 15 days at a temperature of not less than 37 ° C or for a period of not less than 24 days at a temperature of not less than 24 ° C, with a reduction of not less than 38% of the volatile solids. .

### 2-6-4 Any other method capable of achieving the requirements of this specification.

## 2-7 Class III sludge treatment level.

2-7-1 Condensation of the sludge so that the solids concentration in it is not less than 3%.

2-7-2 Any other method capable of meeting the technical requirements of this specification.

## Chapter Three : Examinations,

### 3-1 Quality control.

3-1-1 The treated sludge samples collected for laboratory testing purposes must be representative and from the last stage of treatment.

3-1-2 Sample collection equipment must be clean and dry, and for biological and bacteriological examinations, sample collection equipment and storage utensils must be sterile before use.

3-1-3 The treated sludge samples are collected, preserved, transported and analyzed within a specified period of time according to what is mentioned in the book of standard methods for wastewater analysis issued by the American Society for Public Health and the American Federal Society for Water Research and Pollution Control and any other approved method or analysis if it is not available in the reference referred to. For example, the guide for sludge collection and analysis issued by the US Environmental Protection Agency).

3-1-4 The necessary laboratory tests are carried out on the treated sludge samples in technical laboratories accredited and qualified by the Palestinian Standards Institution.

3-1-5 Regulatory authorities have the right to analyze samples of treated sludge, soil and agricultural crops according to the periodicity it deems appropriate.

3-1-6 The frequency of collecting samples and performing the chemical, biological and bacteriological tests mentioned in Table Two of this Standard shall be as shown in Table 4.



Table 4: Quantities of sludge produced and periodicity of examinations.

The amount of sludge produced metric tons per year.	Periodic examinations by regulatory authorities
Less than 300	1/ yr
300-1500	1/ 3 months
1500-15000	1/ 2 months
More than 150000	1/ month

### 3-2 Quality control of the treated sludge.

The user, through accredited and qualified technical laboratories, collects and analyzes three samples of the treated sludge to ensure its quality and the extent to which it fits with the determinants of this specification for the intended use.

### 4-References

Arabic Specifications :

Jordanian Specifications 1145 / 2006. Water - Sludge - Uses and Disposal of Treated Sludge

## **Appendix 2.3.6**

# **PS 609-2021 Organic Fertilizer and Soil Conditioners**

**PS 609-2021** instead of (609-2014)

# **Organic Fertilizers and soil conditioners**

## Contents

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## 1- Field of application:

This standard applies to the requirements for organic soil conditioners and organic fertilizers

## 2- Supplementary References

Palestinian Standard :

PS 163 Marketing label for the chemical productions

PS 898-2010 Sewage sludge-uses of the treated sewage sludge and its disposal.

PS 2652-2019 (Humic)Compost

## 3- Definitions:

### 3-1 Organic materials::

They are carbon materials of animal or vegetable origin or a mixture of both.

### 3-2 Organic soil conditioners:

They are organic materials added to the soil in order to improve its physical and biological properties. Organic soil conditioners are not classified as fertilizers because they contain a small percentage of the three main nutrients, namely nitrogen, phosphorous and potassium, which are usually less than 2% of the mass of the product. These organic materials should have been subjected to fermentation processes, which include sterilization by high temperature for a sufficient period of time to ensure that they are free from insect eggs and remnants of viable herbs. For growth and from harmful microorganisms such as fungi, bacteria ... etc.

### 3-3 Organic fertilizer:

It is the fertilizer resulting from the addition of the main nutrients and any other nutrients sourced from the process of biological decomposition of organic materials to the organic soil conditioner with a percentage exceeding 2% of the mass of the product

## 4 classification:

Organic fertilizers and solid organic soil conditioners are classified into the following categories:

4-1 Formed as granules, cylindrical pellets, or tablets.

4-2 Unformed (loose or packaged).

## 5 General requirements:

The following general requirements must be met in organic soil conditioner and organic fertilizer:

5-1 The product must be of animal and/or vegetable origin and the use of sludge from wastewater treatment plants or solid waste is not permitted.

5-2 The fertilizer must be free of any substances harmful to the soil and plants.

5-3 It shall be free from weed seeds, weeds and viable plant parts. T

5-4 To be free from pathogens and harmful insects.

5-5 The fertilizer must not contain foreign substances visible to the eye.

5-6 The compost must be homogeneous and free of lumps that could impede its uniform distribution in the soil.

5-7 Granular fertilizer should flow easily.

5-8 It should be dry according to (6-1-2) and item (6-2-2) and without bad smell.

5-9 The ratio of nitrogen, phosphorous and potassium must match the ratio specified on the label.

## 6 Ingredients Requirements:

The following structural requirements must be met:

6-1 Organic soil conditioner:

6-1-1 The weight percentage (dry ; weight/weight) of the organic matter of the sample in the original state from 50% .

6-1-2 The weight percentage of moisture shall not exceed 20% of the total weight

6-1-3 The weight percentage of total nitrogen shall not be less than 1.5%

6-1-4 The ratio of carbon to nitrogen should not exceed 15:1

6-1-5 The salinity, expressed in electrical conductivity, shall not exceed 15 mS/cm in an extract using 1:5 (Organic improver : distilled water).

6-1-6 pH not exceed 7.5 in an extract using 1:5 (Organic improver : distilled water).

6-2 Organic fertilizers:

6-2-1 The weight percentage the organic matter of the sample in the original state shall not be less than 45%

6-2-2 The weight percentage of moisture shall not exceed 15% of the total weight.

6-2-3 pH not exceed 7.5 in an extract using 1:5 (Organic fertilizer : distilled water).

### 6-3 Heavy metals:

The content of the heavy metals in the organic soil conditioners and organic fertilizers should not exceed the percentages specified in the table No.1:

Table No.1 maximum limits of the heavy metals:

Element	Symbol	Max allowable limit(mg/kg)
Arsenic	As	15
Cadmium	Cd	3
Chrome	Cr	100
Selenium	Se	4
Lead	Pb	120
Mercury	Hg	1.5
Nickel	Ni	50
Tin	Sn	10

## 7 Packaging, storage and transportation:

### 7-1 Packaging:

7-1-1 The product must be packed in safe packages that are resistant to tearing and abrasion and that withstand transport and handling conditions and that they are made of a moisture-proof material that is not chemically affected by the mentioned material, such as polyethylene or polypropylene bags lined with polyethylene or burlap Lined with polyethylene.

7-1-2 The containers must be tightly closed and in a manner that guarantees the purity and safety of the material.

### 2-7 Storage and transportation:

7-2-1 The organic fertilizer and soil conditioner shall be stored in dry stores that are not exposed to moisture, sunlight and pollution. They shall also be stored in containers. Especially according to clause (7-1-1) so that it bears loading and unloading.

7-2-2 When shipping and transporting, care should be taken to preserve the integrity of the packages and their contents.

7-2-3 In the case of bulk shipment of fertilizer and organic soil conditioner (without packaging) must be done in closed special trucks with taking All necessary precautions to ensure that they are not exposed to contamination.

7-2-4 There must be a separation between (organic fertilizers and organic soil conditioners), pesticides, and any other materials.

## 8- Marketing Label:

The name of the producer and importer, his address and his trademark, if any.

The name of the product to include the phrase "organic souad" or "organic improver".

Net mass or volume in international units kg or liters For packages containing up to 25 kg, the net mass shall be one of the following quantities: 1/2, 1, 2, 3, 4, 5, 10, 25 kg or liter.

The mass of the product in the package shall be at least as stated in the labeling on the package, and the mass of the bulk product shall be at least As shown in the attached certificate.

Principal Elements and Its Substances (NPK CaMgS) Any inorganic elements that are present and their dry weight percentage.

The source of the manure is animal dung, bird droppings, plant residues, etc.).

Determining the shape of the fertilizer (granules, discs or balls) This is for the compost Not edible for agricultural use only. Production date and shelf life.

Batch or lot number The bulk product is transported or shipped in bulk, along with a certificate detailing the previous items.

Any other instructions from the instructions of the chemical products label MF 163

## 9 Testing Methods:

According to the related Palestinian Specifications or any other approved international spec's.

## 10 Conformity and specifications

Should follow the PS 615 part1-Samplings.

## 11 Conventions

Plates: اقراص

Granules: حبيبات

Sludge: حمأة

Bulk: سماد سائب

## 12 References:



## **Appendix 4.1**

### **1<sup>st</sup> JCC Presentation Materials**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality 1st Joint Coordinating Committee



December 1, 2021  
 Mohammad Feyyani  
 Head of Water & Wastewater Dept.

1

## 1. TeCSOM-I Achievements & Issue (2012.12 – 2018.3)

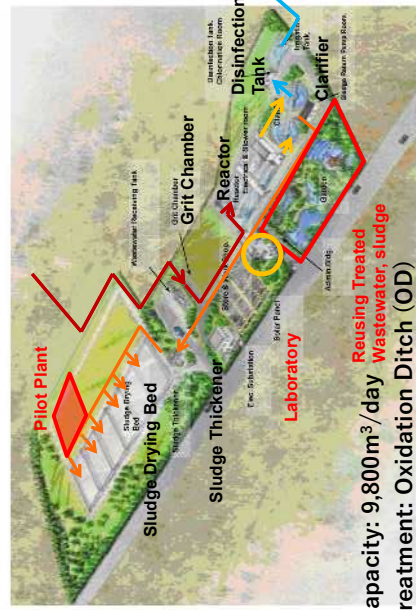
Project Purpose :  
 System for Operation and Management of Sewerage Works in Jericho Municipality is established

(1) Wastewater Dept. established	(3) Capacity on Maintenance of Sewers improved
1) Assigned staff 2) Sewerage By-law approved	1) Staff passed technical exam on Sewer Maintenance 2) 2000 private sewers connected
(2) Capacity on O&M of WWTP improved	(4) Capacity on Finance Management improved
1) Staff passed technical exam on O&M 2) Hazardous materials do NOT inflow into WWTP 3) Reuse of Treated Wastewater 4) Reuse of Sewage Sludge	1) Collection ratio exceeds 60% 2) Over 60% of users recognized sewerage fee 3) Income > Expenditure on Sewerage operation

Overall Goals :  
 Sewerage facilities in JM are operated and managed appropriately under sound financial conditions.

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## 2. Jericho WWTP



3

## Technical Difficulties for irrigation water network

### problems

- ❖ Pressure problems as results of high demand and limited water source.
- ❖ Direct pumping to the agricultural network, so high energy consumption.
- ❖ Negative pressure in some locations especially in C and D lines.
- ❖ Weakness in dealing with hydraulic model to simulate the network problems and to find the solution.
- ❖ Water meters installation and operation problems.
- ❖ Pollution problems in the open channel section.

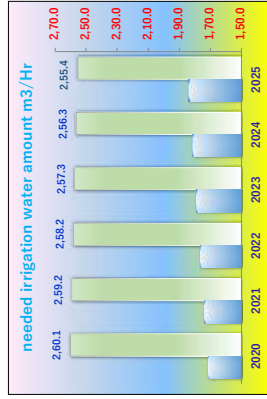
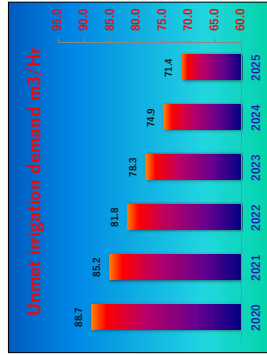
### solutions

- ❖ Increase supply amount by using the treated water from the waste water treatment plant.
- ❖ Construction of Reinforcing line for D pipe to increase pressure.
- ❖ Construction of elevated storage tank.
- ❖ Rehabilitation of water meters manholes.
- ❖ Complete hydraulic simulation of the network with EPANET or Water cad system.
- ❖ Design and realization of screening system.
- ❖ Increase the rate on groundwater abstraction by drilling new wells.

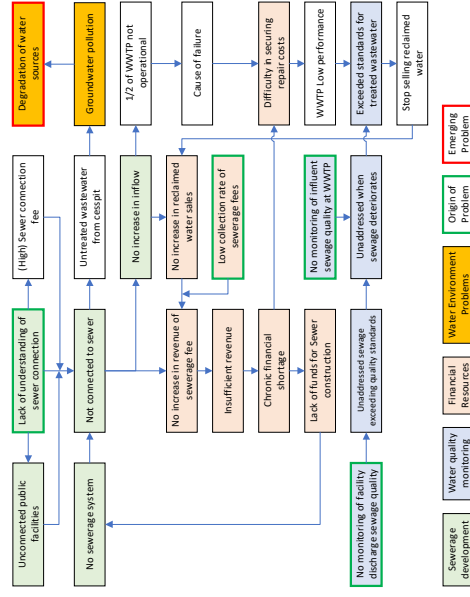
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### wastewater treatment plant effect on irrigation water shortage

Year	2018	2019	2020	2021	2022	2023	2024	2025
demand (m3/Hr)	2,620.5	2,610.9	2,601.3	2,591.8	2,582.3	2,572.9	2,563.5	2,554.1
available water (m3/Hr)	1,664.8	1,689.8	1,714.8	1,739.8	1,764.8	1,789.8	1,814.8	1,839.8
un met demand (m3/Hr)	955.7	921.1	886.6	852.0	817.6	783.1	748.7	714.3



### 4. Relationship among Issues (3)



### 5. Challenges on Sewerage Systems (1)

Subject	Challenges
Sewerage Management	I. Due to the stagnant number of sewer users 1) Increase the number of new house connections 2) Increase sewerage fee revenue 3) Increase the amount of sewage inflow at WWTP 4) Increase the amount of treated wastewater available for reuse 5) Increase the revenue from the sale of treated wastewater
	II. Consideration of increasing sewerage fees: Study whether the current sewerage fee can be raised to reflect increased costs for operation of WWTP.
	I. Study factors for non-collection of fees: Check and study the installation rate of water meters, lack of meter readers, setting water rates for low-income groups, analysis customer complaints, etc. II. Confirmation of fee collection rate for reclaimed water.
Sewer Development	I. Promotion of new house connections to sewers
	2) Promotion of sewer connections of public facilities

### 5. Challenges on Sewerage Systems (2)

Subject	Challenges
Sewer Development	I. Continuous explanation to residents of the need for and benefits of sewer connections, presentation of standard construction connection cost (NIS/m), information dissemination through public relations activities.
	II. Legislation on mandating sewer connections (private sewers).
	III. Strategic discussions with PWA, regarding attracting funding donors for sewerage expansion.
Sewer Development	I. Sewer connection for large facilities (government offices, schools, public facilities, commercial facilities, etc.) currently having individual (private) wastewater management systems.

### 5. Challenges on Sewerage Systems (3)

Subject	Challenges
1) Monitoring of water quality inflow to WWTP	i. Monitoring of influent sewage quality.
2) Monitoring of wastewater quality from JAIIP, etc.	i. Monitoring of wastewater quality for JAIIP. ii. Monitoring of wastewater quality for industrial discharges from meat industry, hospital and so on.
3) Establish an inspection system for influent water quality	i. Establishment of a water quality monitoring system. ii. Establishment of water quality testing system (improvement of water quality <b>testing capacity</b> , <b>development of manuals/SOPs</b> , securing of reagents, etc.). iii. Establishment of measures for monitoring water quality parameters that cannot be examined in the water quality laboratory at the WWTP.

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### 5. Challenges on Sewerage Systems (4)

Subject	Challenges
Reuse of dry sludge	i. Presentation of the safety of sewage sludge as fertilizer (with heavy metal content limited to be within standard values). ii. Public relations activities on the benefits of sewage sludge fertilizer. iii. Communication with NARC, Ministry of Agriculture.

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### 6. Project Purpose & Outputs

#### **A Sustainable Wastewater Management System is established in Jericho Municipality.**

Output-1 : Based on the current status and future projections of wastewater treatment in Jericho, including the water balance, the **Capacity to plan for the expansion of the sewer network to increase the inflow** to the Jericho Wastewater Treatment Plant is strengthened.

Output-2 : **Capacity for influent water quality testing** in the Jericho Wastewater Treatment Plant is strengthened.

Output-3 : Potential for **reuse of the sewage sludge** from the Jericho Wastewater Treatment plant is studied.

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### 7. Activities

Output	Activity
1	1-1 : <b>Analyze the management situation</b> of sewerage service in Jericho Municipality. 1-2: Grasp the <b>sewage influent volume</b> at the Jericho Sewage Treatment Plant and <b>estimate the future inflow</b> . (This includes understanding the water balance of the sewerage catchment area, estimating the sewer population, and reviewing the wastewater generation unit volume) 1-3: Support the development of a <b>plan for the expansion of the sewer network</b> in Jericho. 1-4: Support the study and implementation of methods for <b>securing funding for sewer network expansion</b> projects. 1-5: Support the promotion of exchange of opinions between related organizations for the sewerage expansion by PWA.

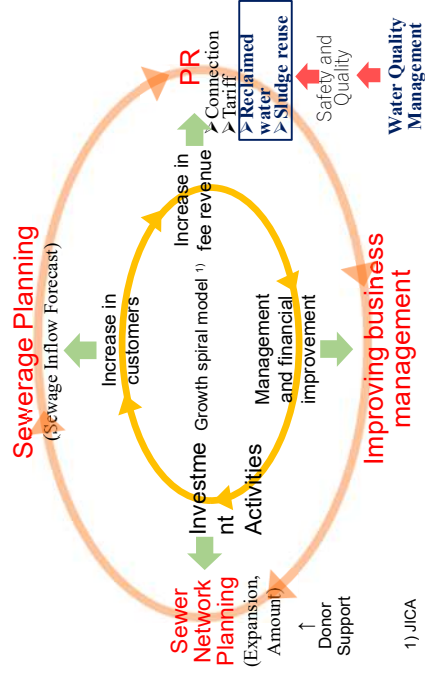
12

## 7. Activities

Object	Activity
2	<p>2-1 :Support the preparation of a <b>water quality SOPs/manuals</b> for the Water and Wastewater Department of Jericho Municipality.</p> <p>2-2: Conduct <b>training on testing the influent sewage quality</b> for operatives at the Wastewater Treatment Plant.</p> <p>2-3: Conduct a seminar on <b>how to evaluate and deal with water quality test results</b> for the Water and Wastewater Department in Jericho Municipality.</p>
3	<p>3-1 : To evaluate options for treatment of sludge discharged from the Jericho Wastewater Treatment Plant.</p> <p>3-2: To conduct training on <b>how to reuse the sewage sludge</b> and support the exchange of opinions between the Ministry of Agriculture and the project implementing agency.</p>

13

## 8. Growth Spiral Model



14

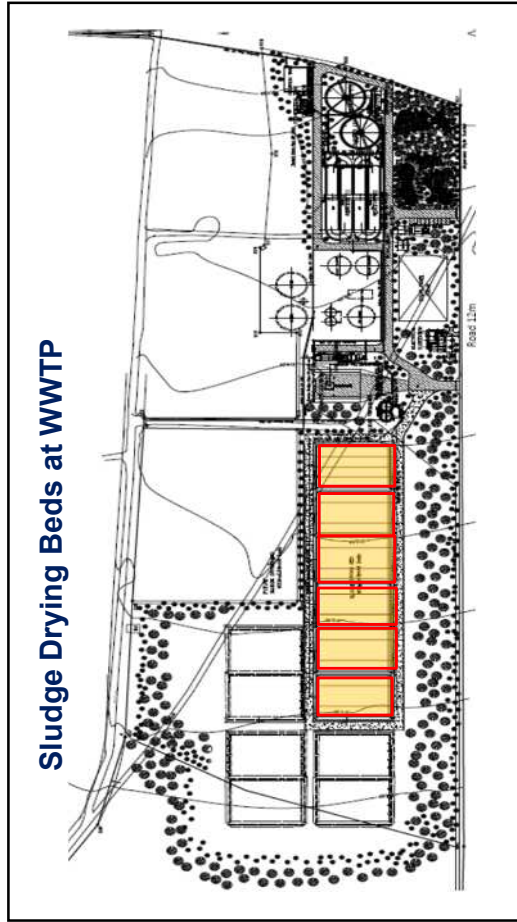
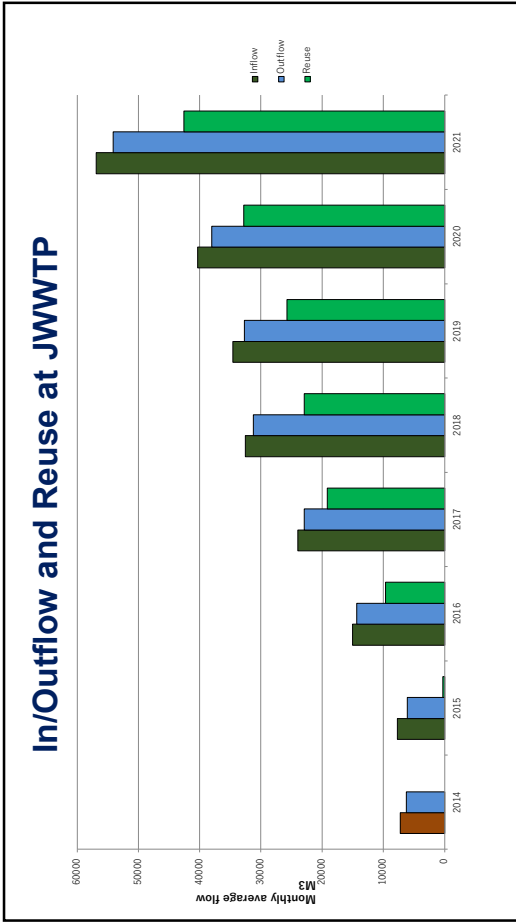
شكرا  
Thank you

15

  
**Outline of the Jericho Wastewater Treatment Plant**  
 JERICHO MUNICIPALITY

Operation of Wastewater Treatment Plant  
 Prepared by : Eng. Omran Khalaf  
 December 1, 2021

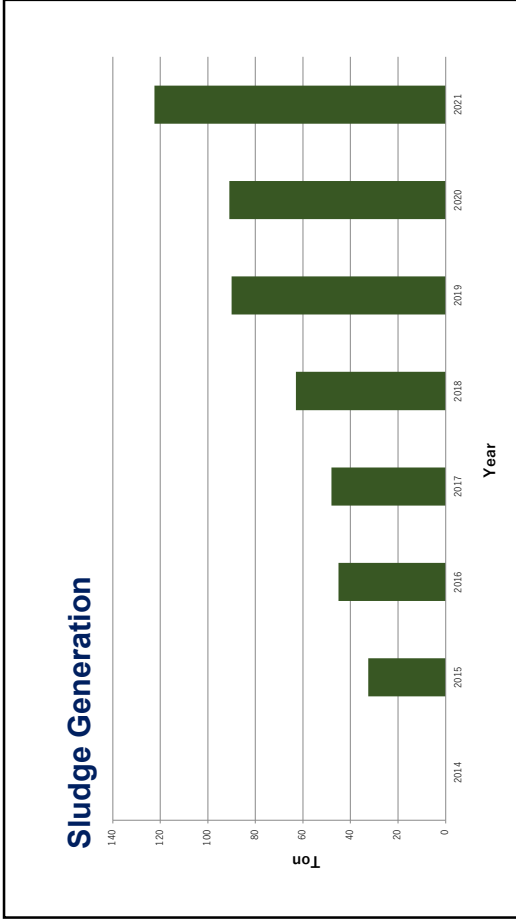
16



### Treated Wastewater Quality

SN	Test	Units	Standard Quality A	Inlet	Outlet	Removal Ratio
1	Bio Chemical Oxygen Demand (BOD)	mg/L	20	400	15	96.5%
2	Total suspended solid (TSS)	mg/L	30	952	4	99.6%
3	Chemical Oxygen Demand (COD)	mg/L	50	994	38	96.2%
4	Total Dissolved Solid (TDS)	mg/L	1200	1301	964	25.9%
5	Total Dissolved Solid (TDS)	mg/L	1200	1301	964	25.9%
6	Potential of Hydrogen (pH)	--	6.5-9	7.34	7.88	-
7	Fat, Oil and Grease	mg/L	5	67.2	0	100.0%
8	Nitrate Nitrogen (NO3-N)	mg/L	20	1.1	0.7	26.4%
9	Nitrite Nitrogen (NO2-N)	mg/L	5	80	0	100.0%
10	Ammonium Nitrogen (NH4-N)	mg/L	30	103	10	90.3%
11	Total Nitrogen (TN)	mg/L	300	109.3	26.7	11.5%
12	Sulfate (SO4)	mg/L	300	109.3	26.7	11.5%
13	Sulfate (SO4)	mg/L	300	109.3	26.7	11.5%
14	Sodium (Na)	mg/L	200	175.3	177.6	-
15	Magnesium (Mg)	mg/L	60	23.1	23	0.4%
16	Calcium (Ca)	mg/L	120	23.1	23	0.4%
17	Sulfate Absorption Ratio (SAR)	mg/L	5.83	23.1	15.9	21.2%
18	Phosphate Phosphorus (P0.4-P)	mg/L	20	3.2	2.3	28.1%
19	Aluminum (Al)	mg/L	5	1.364	0.268	80.4%
20	Copper (Cu)	mg/L	0.2	0.0568	0.016	71.8%
21	Iron (Fe)	mg/L	5	2.05	0.37	82.0%
22	Manganese (Mn)	mg/L	0.2	0.128	0.075	41.4%
23	Mercury (Hg)	mg/L	0.2	0.028	0.008	68.6%
24	Lead (Pb)	mg/L	0.2	0.028	0.008	68.6%
25	Selenium (Se)	mg/L	0.02	0.00582	0	-
26	Cadmium (Cd)	mg/L	0.01	0.00582	0.000146	61.8%
27	Cobalt (Co)	mg/L	0.05	0.0187	0.0078	100.0%
28	Chromium (Cr)	mg/L	0.1	0.0187	0.0065	73.3%
29	Chromium (Cr)	mg/L	0.1	0.0187	0.0065	73.3%
30	Chromium (Cr)	mg/L	0.1	0.0187	0.0065	73.3%
31	Cobalt (Co)	mg/L	0.05	0.00922	0.000737	63.5%
32	Mercury (Hg)	mg/L	0.01	0.0047	0.00037	21.5%
33	Lead (Pb)	mg/L	0.01	0.0047	0.00037	21.5%
34	<i>E. coli</i>	CFU / 100 ml	100	>11000	15	99.9%
35	<i>Nematodes</i>	Eggs / 100 ml	<1	~420	ND	100.0%







### Reuse of Sewage Sludge

Reuse Type	Reuse Option	Evaluation in Jericho
1) Agricultural use	Fertilizer	High demand
2) Energy use	Fuel	Incineration plant
3) Building material use	Cement raw materials	Cement plant


- Communication with Ministry of Agriculture
- Pilot Plant, meeting the standards (**heavy metals**), Fertilizer component, **information disclosure**
- From the user's viewpoint, (1) **safety**, (2) **effectiveness**, (3) **convenience**



Safety



Effectiveness



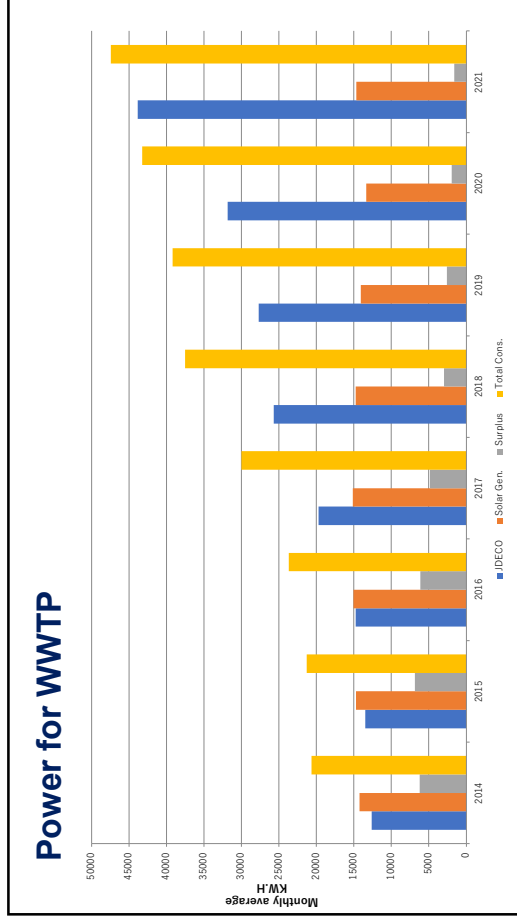
Convenience

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

Parameters	Palestine <sup>1)</sup>	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 <sup>2)</sup>	43.45

Unit: mg/kg of dry matter

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



# End of Show—Thank you for your attention!

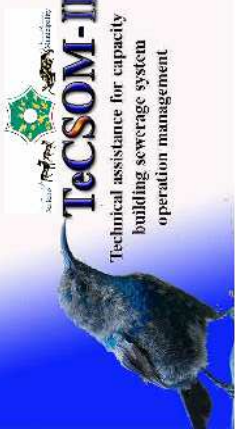
## QUESTIONS?

**Eng. Omran Khalaf**  
 Operator of Jericho WWTP  
 Jericho Municipality  
 Omran.Khalaf86@gmail.com

### Capacity Development for Sustainable Wastewater Management of Jericho Municipality

1<sup>st</sup> Joint Coordinating Committee (JCC)

#### Current Status of Municipality Finance

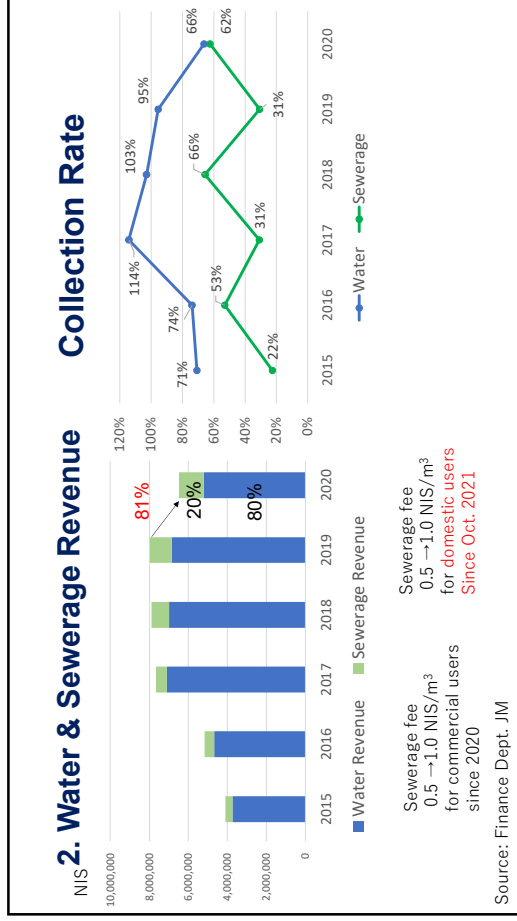


December 1, 2021  
 Abdul Fattah Haddad  
 Head of Collection Management Sec.

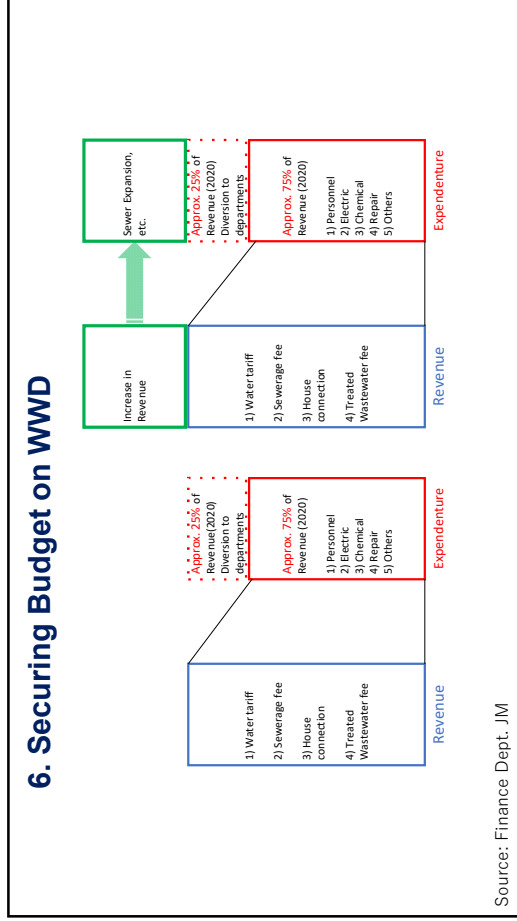
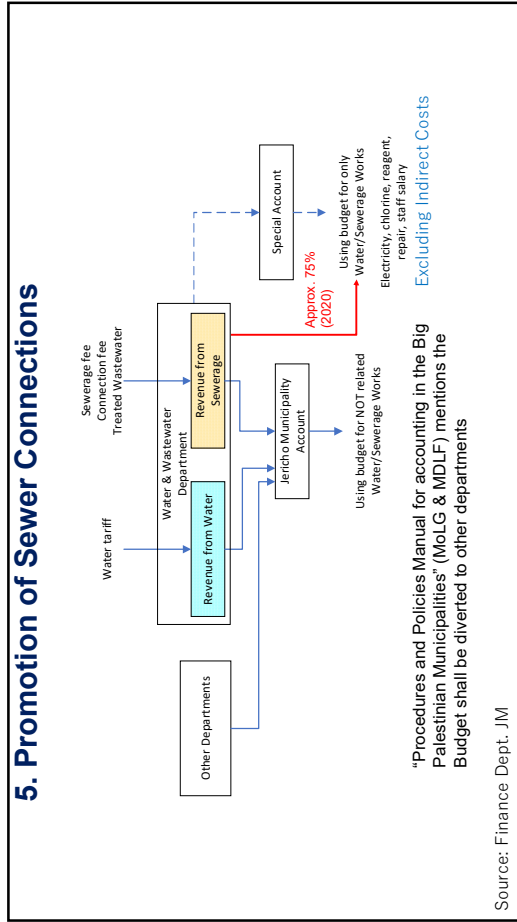
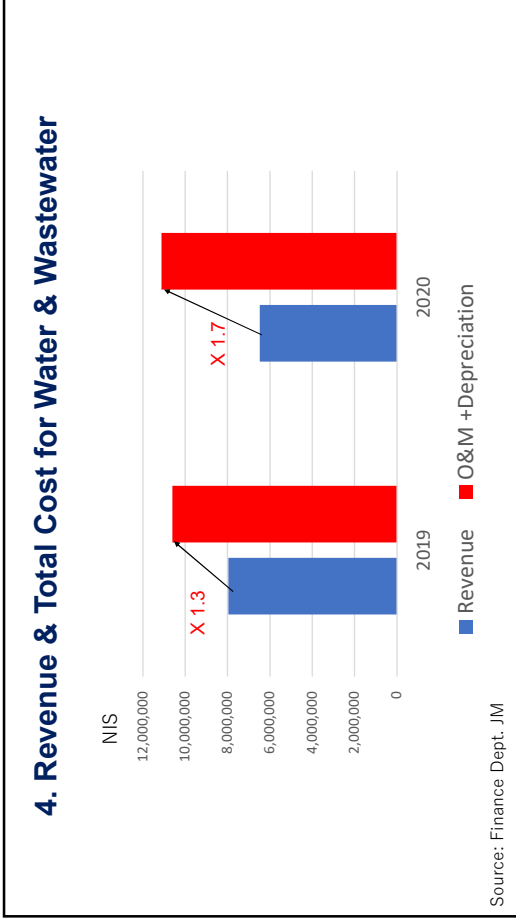
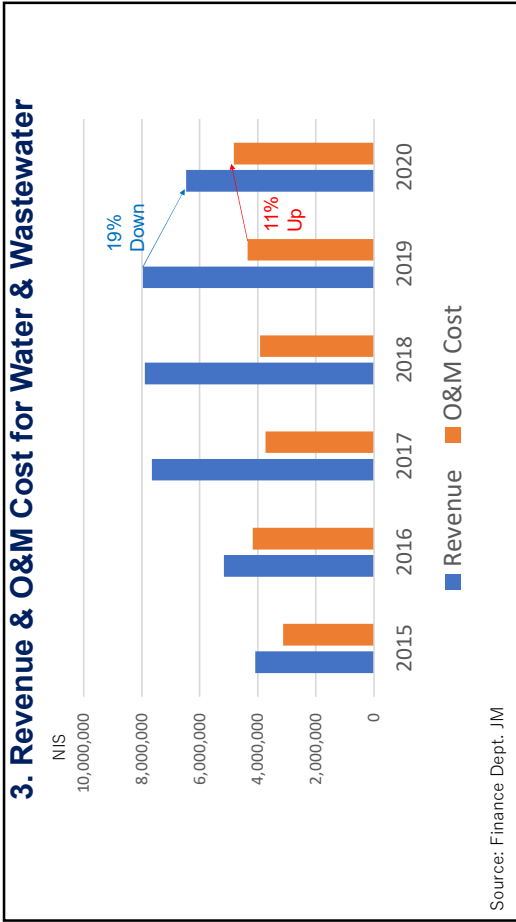
### 1. Revenue & Costs

Source: Finance Dept. JM

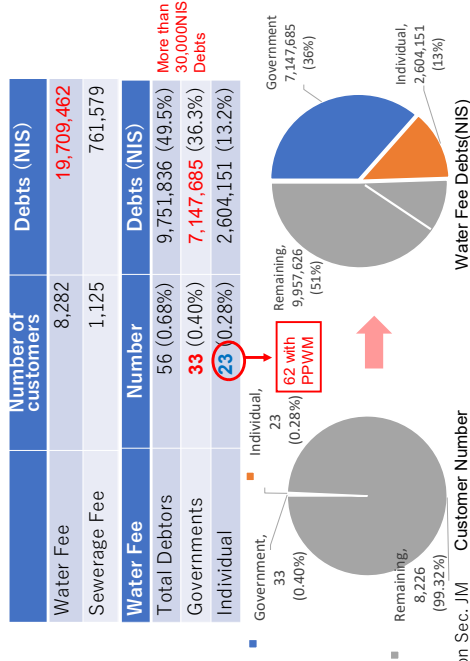
	2015	2016	2017	2018	2019	2020
Water Revenue	3,747,135	4,680,108	7,097,085	6,985,426	6,868,163	5,207,694
Sewerage Revenue	344,186	492,432	559,385	908,755	1,095,658	1,269,960
<b>Total Revenue</b>	<b>4,091,321</b>	<b>5,172,540</b>	<b>7,656,470</b>	<b>7,894,181</b>	<b>7,963,821</b>	<b>6,477,654</b>
O&M Cost (without Admin Costs)						
Water	2,684,009	3,468,091	3,209,631	3,280,580	3,575,011	4,240,928
Sewerage	444,008	706,451	517,110	643,600	780,891	585,319
<b>Total</b>	<b>3,128,017</b>	<b>4,174,542</b>	<b>3,726,741</b>	<b>3,924,180</b>	<b>4,355,902</b>	<b>4,826,247</b>
<b>Profit</b>						
Water	1,063,126	1,212,017	3,887,454	3,704,846	3,293,152	966,766
Sewerage	<b>-99,822</b>	<b>-214,019</b>	<b>42,275</b>	<b>265,155</b>	<b>314,767</b>	<b>684,641</b>
<b>Total</b>	<b>963,304</b>	<b>997,998</b>	<b>3,929,729</b>	<b>3,970,001</b>	<b>3,607,919</b>	<b>1,651,407</b>
Depreciation						
Water	1,971,421	1,971,421	1,971,421	1,971,421	1,971,421	2,024,345
Sewerage	4,270,474	4,270,474	4,270,474	4,270,474	4,270,497	4,270,497
<b>Total</b>	<b>6,241,895</b>	<b>6,241,895</b>	<b>6,241,895</b>	<b>6,241,895</b>	<b>6,241,918</b>	<b>6,294,842</b>
<b>Total Profit</b>	<b>-5,278,591</b>	<b>-5,243,897</b>	<b>-2,312,167</b>	<b>-2,271,895</b>	<b>-2,633,999</b>	<b>-4,643,436</b>







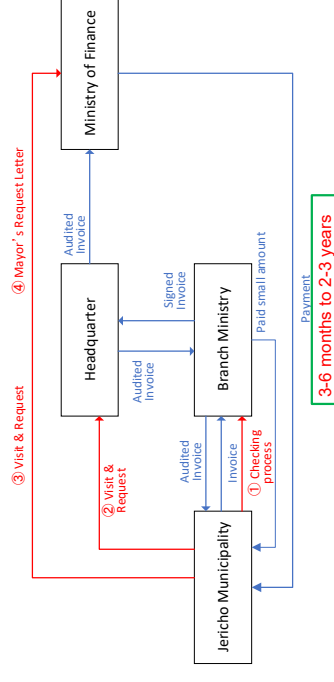
## 7. Unpaid Bills (till Sept. 2021)



Source: Collection Sec. JM

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## 8. Pressing for Payment Procedures



Source: Collection Sec. JM

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## 9. Summary (1)

- From 2019 to 2020, water fee revenue decreased. Sewerage fee revenue increased slightly. At the same time, the water fee collection rate decreased from 95% to 66%.
- Although O&M costs have been increasing, these costs have been covered by water and sewerage fee revenues. However, in 2020, the surplus is getting smaller with a 19% decrease in fee revenue. Jericho Municipality has to be concerned about the future increase in O&M expenses.
- In the Jericho Municipality's finances, the Water and Wastewater Department has a surplus of revenue in 2020, and approximately 25% of the revenue is collected as Administration cost, which is used to cover the expenses of other departments.
- The only means to save (reserve) for future equipment repairs and sewer extension (construction) is to increase revenues.

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## 9. Summary (2)

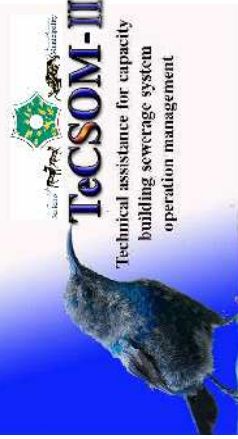
- The total amount of unpaid water and sewerage fees is approximately 20.5 million NIS as of September 2021, with approximately 19.7 million NIS for water and 0.8 million NIS for sewerage.
- When the unpaid amount of 30,000 NIS or more in water bills is extracted, there are 56 unpaid bills, which is approximately 50% of the total unpaid amount (19.7 million NIS). Furthermore, the government's debtors are 33 of the 56, which is only 0.4% of the total 8,282 customers, but the amount of debt is approximately 7.1 million NIS (approximately 36.3% of the total debt).
- Since collecting fees from the government is labor-intensive and time-consuming, and the amount of unpaid fees increases in the meantime, direct dialogue between Jericho Municipality and the Ministry of Finance is required.

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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### 1st Joint Coordinating Committee

#### Challenges & Schedule of TeCSOM-II



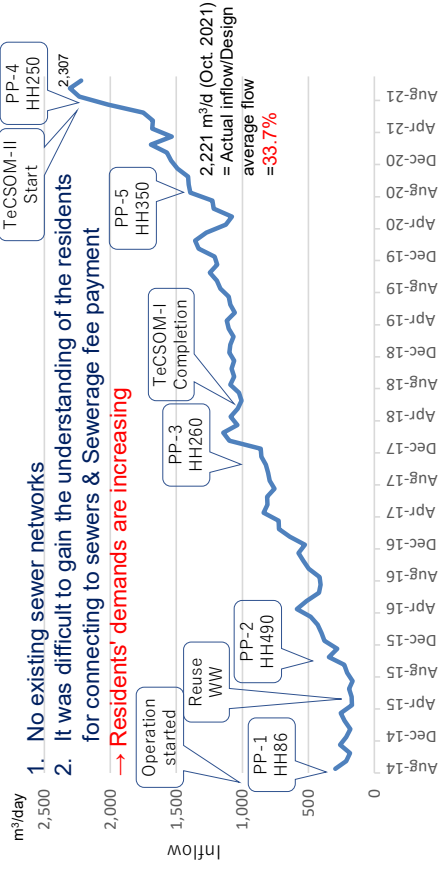
December 1, 2021  
Satoru Oniki  
Chief Advisor

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## 1. JM Achievements

1. No existing sewer networks
2. It was difficult to gain the understanding of the residents for connecting to sewers & Sewerage fee payment

→ Residents' demands are increasing



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## 2. Creation of Resource-Recycling Society



- 1) Solar power generation  
Covers about 1/3 of the power consumption of WWTP



- 2) Reuse of Treated Wastewater  
First sale of Treated Wastewater in Palestine  
Important source of income



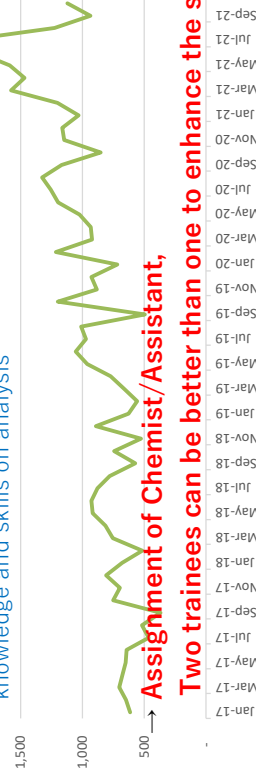
- 3) Reuse of sewage sludge  
Reuse as fertilizer



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## 3. JM Challenge -1 Establishment of Water Quality Monitoring System

1. JAIP's pre-treatment plant will start operation in April 2022
2. Most of treated wastewater has been sold to (8) farmers
3. TeCSOM-II will provide trainings of water quality monitoring to transfer knowledge and skills on analysis

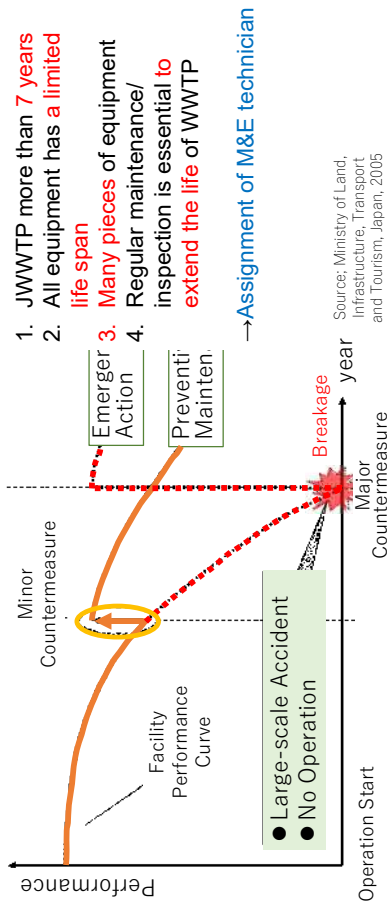


→ Assignment of Chemist/Assistant,

Two trainees can be better than one to enhance the system

40

### 3. JM Challenge -2 Implementation of Preventive Maintenance



41



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### 3. JM Challenge -3 Making attractive JWWTP & Sewerage

1. Japanese Garden & Pilot Plant for reusing Treated Wastewater in JWWTP, Samed Land as pilot farm for reusing sludge
2. Many students & delegation have visited JWWTP for observing and learning JM sewerage management & achievements
3. It must be a source of pride for Jericho city to introduce visitors to successful and attractive JWWTP

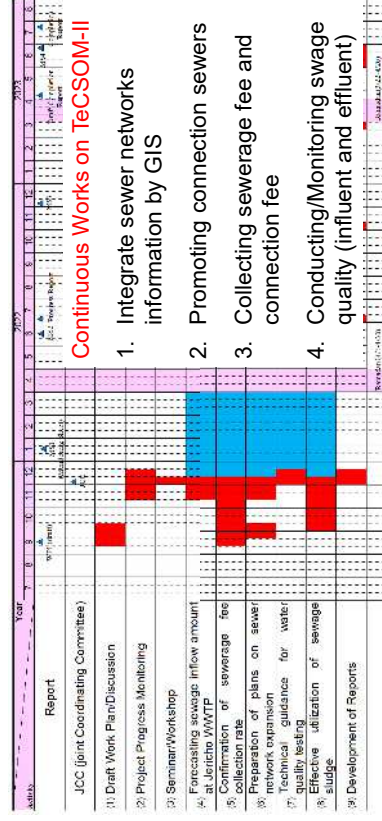
→Activating PR activities for sewerage management such as O&M from the beginning, sola panels, treated wastewater reuse, sludge reuse, public awareness from the beginning

- Proper maintenance of Garden, Plant & Farm
- Development of JWWTP Leaflet



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### 4. Implementation Schedule



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**Thank you very much for your attention**

## **Appendix 4.2**

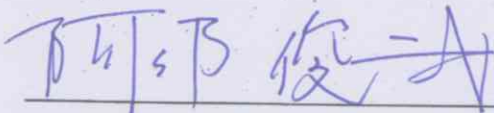
### **1<sup>st</sup> JCC Minutes of Meetings**

MINUTES OF MEETINGS  
ON  
CAPACITY DEVELOPMENT FOR SUSTAINABLE WASTEWATER  
MANAGEMENT OF  
JERICHO MUNICIPALITY (TeCSOM-II)

The First Joint Coordinating Committee Meeting (hereinafter referred to as "JCC") on the Capacity Development for Sustainable Wastewater Management of Jericho Municipality (hereinafter referred to as "the Project") was held on the 1st of December, 2021 with both the Palestine and Japanese sides.

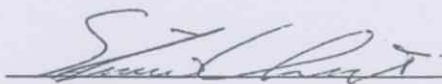
As a result of discussion in the JCC, both sides agreed the actions to be taken until the end of the Project.

[Date 1. December 2021]

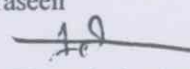


Mr. Toshiya Abe  
Chief Representative,  
JICA Palestine Office

Mr. Salem A. Ghrouf  
Mayor,  
Jericho Municipality



Dr. Satoru Oniki  
Chief Advisor,  
The Project

Mr. Adel Yaseen  
Director,   
Palestinian Water Authority

The 1<sup>st</sup> JCC was held on 1<sup>st</sup> December 2021 and the following agenda was presented and discussed among participants.

### **Main Point Discussed**

#### **1. Establishment of Water Quality Monitoring System**

The meeting confirmed that water quality analysis staffing needs to be supplemented based on the study of current water quality analysis organization at Jericho Municipality. There is currently one water quality analyst, however, there needs to be a dedicated water quality analyst included in a technician and/or assistant for the water facilities and one for the Jericho Wastewater Treatment Plant (JWWTP).

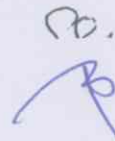
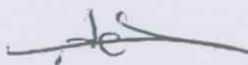
i) JAIP's pre-treatment plant will start operation in April 2022 and when it meets the sewage discharge standards, Jericho Municipality will accept sewage from JAIP. At that time, it will be more important to monitor influent water quality including JAIP. This monitoring is important because it directly relates to protecting the wastewater treatment process.

ii) All the treated wastewater has been currently sold to the farmers, which is an important source of income in Jericho Municipality. In the near future, with the increase in inflow, more treated wastewater will be sold to more farmers. Therefore, monitoring of treated wastewater quality as a commodity becomes important.

iii) The Project is being implemented for two years starting August 2021. One of the project objectives is to establish a water quality monitoring system at Jericho Municipality. The Project will provide trainings for water quality analyst and assistant to transfer knowledge and skills on water quality analysis. Therefore, two trainees can learn more than one, which it must lead to a stronger water quality monitoring system in Jericho Municipality.

iv) Palestine Water Authority (PWA) and Ministry of Agriculture (MoA) mentioned reuse of sewage sludge generated at the JWWTP could be safe and available as fertilizer since the sludge test results in TeCSOM-I showed compliance with the reuse sludge standards for agriculture in MoA.

#### **2. Implementation of Preventive Maintenance**





The meeting confirmed that assignment of electrical and mechanical technician who can maintain and inspect the equipment at the JWWTP is essential to extend the life of equipment of the JWWTP.

i) The JWWTP started operation in June 2014. The JWWTP has been running well for more than 7 years, however, all equipment has a limited life span. Without proper maintenance and repair, the equipment will break down at some point in the near future. While, the JWWTP can continue to operate properly for a longer time with regular maintenance.

ii) The preventive maintenance can be performed by recording operation and maintenance on a daily basis, and by regularly inspecting/repairing consumable parts and other components to ensure the long life of the equipment.

### 3. Fee Collection for Sound Sewerage Management

The meeting confirmed that Jericho Municipality will take the measure to set up prepaid water meters and collect mandatory fees for individual unpaid customers, excluding government unpaid customers.

While, since collecting fees from the governments is labor-intensive and time-consuming, and the amount of unpaid fees increases in the meantime, direct dialogue between Jericho Municipality and the Ministries is required.

i) The only means to save (reserve) budget for future equipment repairs and sewer extension (construction) is to increase revenues. There are mainly two methods to increase revenue: 1) raise the unit price of fees, and 2) increase the collection rate. Sewerage fee increase has already been implemented, and Jericho Municipality will now focus on improving the fee collection rate and collecting unpaid fees.

ii) To extend sewer networks and promote house connections (private sewers), donation supports are required.

iii) PWA mentioned that the project of the solar panels with 1Mega Watt at the JWWTP was approved by PWA. Regarding prepaid water meters, PWA shall try to find funds to increase the revenues of water and wastewater fees.



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#### 4. Development of Explanatory Materials for the JWWTP

The meeting confirmed that Jericho Municipality will develop leaflets/PR materials describing the achievements of the sewerage project for Jericho people and visitors.

i) Many visitors have come to the JWWTP to learn about the successful sewerage projects in Jericho since the operation start. These examples include: 1) starting a sewerage project from the very beginning, 2) the first sale of treated wastewater for agricultural use in Palestine, 3) a visit to a Japanese garden and an experimental farm (pilot plant) for reuse of treated wastewater, and 4) a new challenge for Jericho Municipality to reuse sewage sludge as fertilizer.

ii) Many visitors come with a high level of interest to learn about the achievements of the Jericho sewerage project, and a tour of the JWWTP's well-maintained facilities and the distribution of leaflets with the achievements of the sewerage project will promote visitor understanding.

In the course of discussion, both parties confirmed the progress of the Project and agreed the implementation of the Project.

Both sides acknowledged and agreed that the minutes of Meeting may be executed by electronic signature, which is considered as an original signature for all purposes and has the same force and effect as an original signature. "Electronic signature" includes faxed versions of an original signature or electronically scanned and transmitted versions (e.g., via pdf) of an original signature.



AG

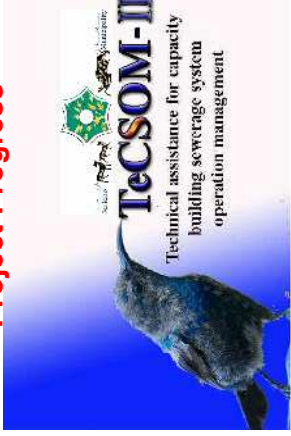
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## **Appendix 4.3**

### **2<sup>nd</sup> JCC Presentation Materials**

**Capacity Development for Sustainable  
Wastewater Management of Jericho Municipality  
2nd Joint Coordinating Committee  
Project Progress**



June 21, 2022  
Head of Water & Wastewater Dept.  
Mohammad Fityani

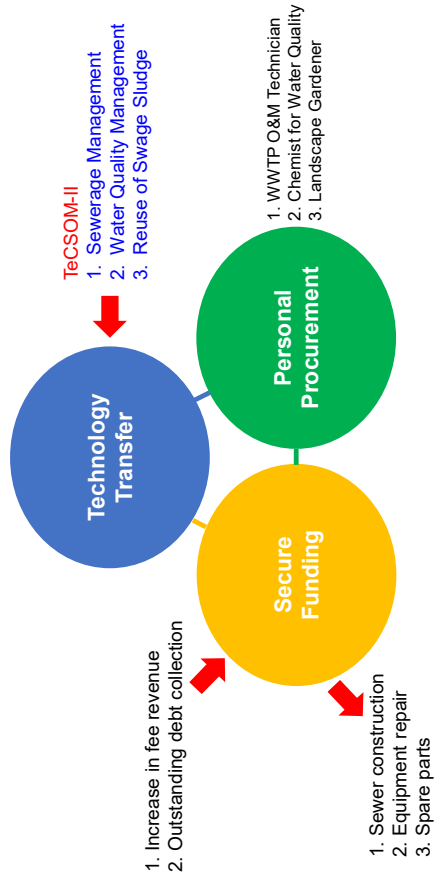
1

**1. Project Purpose**

**Sustainable Wastewater Management System  
is established in Jericho Municipality**

2

**2. Major Element of Management**



3

**3. Project Progress**

Reviewing 1<sup>st</sup> JCC Minute of Meeting held December 1 2021

**1) Establishment of Water Quality Monitoring System**

- Water quality analysis staffing (technician and/or assistant)

**2) Implementation of Preventive Maintenance**

- Electromechanical technician
- Coverage by Insurance (Company interview survey)

**3) Fee Collection for Sound Sewerage Management**

- To set up prepaid water meters and collect mandatory fees for individual unpaid customers,
- To collect fees from the governments

**4) Public Relations Activities**

4

#### 4. Establishment of Water Quality Monitoring System

- MoLG approved the JM budget included staffing for 2022
- JM has started staffing for **one (1) water quality laboratory technician** and/or assistant.
- By the end of July, new laboratory technician will be hired and participated in TeCSOM trainings.

5

#### 5. Implementation of Preventive Maintenance

- One (1) **Electromechanical technician** is being recruited.
- JM has started staffing for technicians.
- JM **dispatches a gardener to JWWTTP** to maintain the garden and pilot plant everyday.
- JM visited Nablus WWTP and discussed O&M and management in June 2022, also visited insurance company which Nablus WWTP has contracted for coverage incidents.
- JM has insurance for only human resource (staffs), and studying coverage targets such as **fire, disaster (earthquake) and also visitors.**

6

#### 6. Fee Collection for Sound Sewerage Management

- 1) Collection Rate;
    - Water: 95%(2019) → 66%(2020) → **60%(2021)**
    - Sewerage: 31%(2019) → 62%(2020) → **46%(2021)**
  - 2) The debt amount by large individual **decreased -22%**, on the other hand, the debt amount by government **increased 29.5%**.
- **In Financial analysis session, the detailed analysis will be reported.**

7

#### 7. Weekly meetings

- Jericho Municipality is conducting continuously the weekly meeting sharing the TeCSOM-II progress information and exchanging ideas about the related subjects with the municipality departments and units (Financial department , Planning & Projects Dept. , PR unit , Control unit , Quality unit ...etc.).
- Sometimes the weekly meeting conducted with Mr. Mayor's attendance so that he follows the TeCSOM-II and the WWTD requirements closely.



18<sup>th</sup> Weekly meeting with Mr. Mayor (19/5/2022)

8

## 8. Public Relations Activities

### Donor's First Approach

1. **Jericho Website**  
**Firstly**, Collecting and grasping information and situation on Jericho Sewerage Services.
2. **Visiting Jericho WWTP**  
  - > **Reflet/Pamphlet**: Donors/visitors can understand easily outline of Jericho Sewerage and share information with their colleagues
  - ⇒ Developed in English and Arabic version
  - > **Sign Boards (Entrance, Pilot Plant) & Cleaning in WWTP**: Visitors will revive emotional impression from well guidance

9

### (1) Jericho Website

Wastewater Treatment Plant

Put Wastewater Service Activities Information/Reports

10

### (1.1) Improvement of Jericho Website on Sewerage Services

	Arabic	English	In Charge
Window on Sewerage Services	Established	Established	• IT Section
News/Information	Yes	Ongoing	• Water & Wastewater Dept. for Manuscripts • PR Dept. for Publication

11

### (2.1) Visiting Jericho WWTP (Leaflet)

Developed Leaflets for Visitors English & Arabic

12

## (2.2) Visiting Jericho WWTP (Garden at Entrance) , & Experimental Farm

- The entrance is the face of Jericho WWTP.
- First-time visitors to the WWTP are first interested in what is in front of their eyes.



September 2021



May 2022



June 2022 ,  
Experimental farm for  
reusing the sewage  
sludge

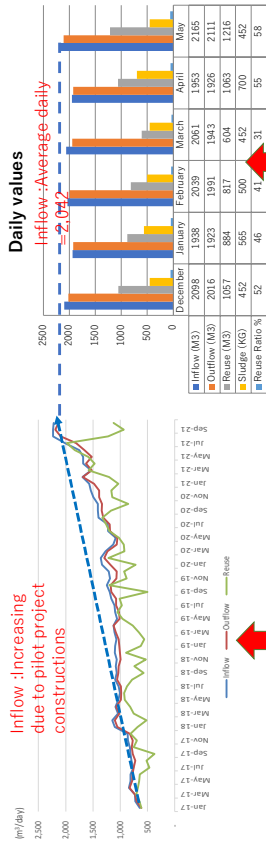
## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Outline of the Jericho Wastewater Treatment Plant



June 21, 2022

Prepared by : Eng. Omran Khalaf  
WWTP Operator

## Inflow ,Outflow ,Reuse & Sludge Generation



1st JCC data /December 2021 - May 2022

2nd JCC data/December 2021 - May 2022

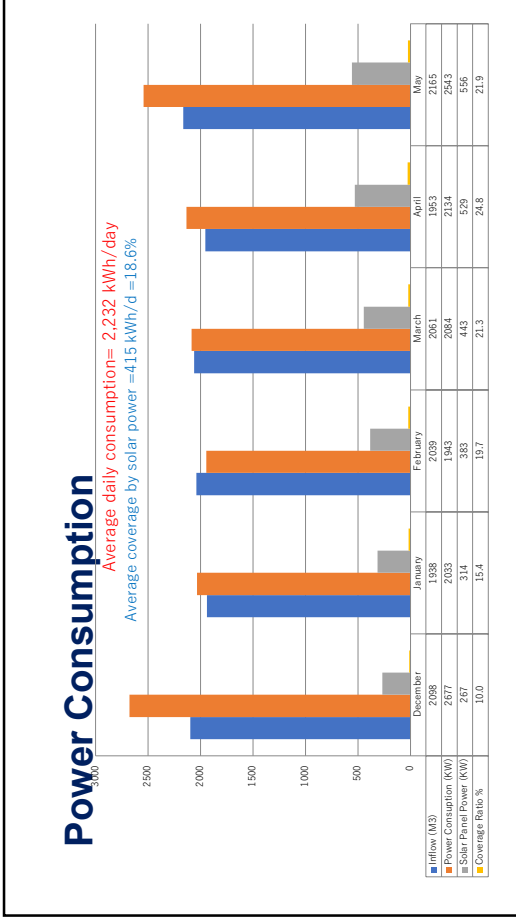
Inflow : The inflow is approximately constant due to limitation of house connection construction

Solution : JM will study announcing tender for connecting about 250 pending (due to resources limitations)households

## Inflow ,Outflow ,Reuse & Sludge Generation

### Remarks:

- JM will study announcing PP6 tender for connecting about 250-300 new households(pending applications by customers)
- 5 farmers / 8 Farmers requested treated wastewater during March
- The reuse of treated wastewater decreased in the 1<sup>st</sup> quarter of the year due to using the collected rain water from the wadi's by the farmers, in April the reuse amounts started increasing.



### Power Consumption

- Power consumption during December is high due to the increase in sewage pollution rates.
- Power consumption increases in June due to the operation of air conditioning systems.
- The power produced from solar Panels is gradually increasing as per the increase in daylight hours and the increase in solar radiation
- Existing Solar Panels (Capacity 100 kW) cover 18.6% of the total power consumption.

### Capacity Development for Sustainable Wastewater Management of Jericho Municipality

#### Outline of the Water Quality Monitoring in the WWTP

June 21<sup>st</sup>, 2022  
Sobhi Yaghi  
Lab Technician of JWWTP

### Contents in TeCSOM-II

The WWD Lab technician conducted an assessment for the WWTP laboratory assisted by the TeCSOM-II Water quality Expert(Dr.Morita)

1. Assessment for the monitoring parameters , test procedures(SOP's) , devices calibration.
2. Assessment for the monitoring frequency
3. Assessment in the HR (Lab technician availability).
4. Comparison situation with other WWTP in Palestine(Nablus WWTP).

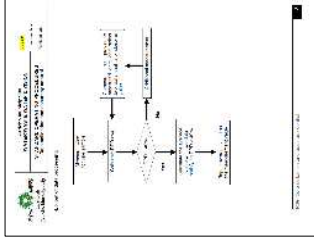
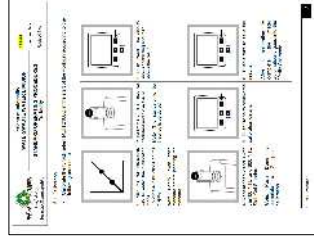


### Issues improved in TeCSOM-II

Item	TeCSOM-I (Achieved)	TeCSOM-II (In practice)
Test Frequency	Once /week	3 times /week
SOP's	SOP's established in TeCSOM-I	<ul style="list-style-type: none"> <li>Revision for the SOP's (BOD, Turbidity, pH / EC/ TDS etc.)</li> <li>SOPs for data quality management</li> </ul>
Calibration	Calibration is not regular	Calibration is regular (prior every test)
Human Resource	One Lab technician for Water & Wastewater	<ul style="list-style-type: none"> <li>Additional Lab technician assignment is requested</li> <li>Currently: the Existing Lab technician availability in WWTP increased to 3 d/week, furthermore JM will announce for additional Lab tech for WWTP</li> </ul>
Procurement Plan	No procurement plan for WWTP Lab (request items upon need)	Procurement plan is prepared after evaluating the Lab requirement, investigating the local market (visiting potential suppliers) and monitoring frequency is set up.

### Improvement in TeCSOM-II: SOPs

Prepare easy-to-understand SOPs with diagrams and flow chart



#### SOPs prepared until June

- pH/EC/TDS
- Turbidity
- BOD<sub>5</sub>
- Data collection and Accuracy control
- SOPs to be created in the next Expert's stay period
- TSS, COD, T-N, NO<sub>2</sub>-N, NO<sub>3</sub>-N, NH<sub>4</sub>-N, T-P, PO<sub>4</sub>-P, SV<sub>30</sub>, MLSS, SVI

### Improvement in TeCSOM-II: Monitoring plan

Category	Monitoring item	Frequency and monitoring date	JALP effluent (JALP treated water)	Monitoring point WWTP inflow	Monitoring point WWTP reactor tank	WWTP treated water
Inflow water quality monitoring	Water temperature		✓	✓	✓	✓
	pH		✓	✓	✓	✓
	EC (TDS)	3 times / week: Tuesday, Thursday and Sunday	✓	✓	✓ (EC only)	✓
	Turbidity		✓	✓	✓	✓
	DO		✓	✓	✓	✓
	Free residual chlorine		✓	✓	✓	✓
	BOD <sub>5</sub>	1 times / week: Tuesday - Sunday	✓	✓	✓	✓
	COD		✓	✓	✓	✓
	TSS		✓	✓	✓	✓
	T-N	1 times / week: Every Tuesday	✓	✓	✓	✓
Water treatment process monitoring	NO <sub>2</sub> -N		✓	✓	✓	✓
	NH <sub>4</sub> -N		✓	✓	✓	✓
	PO <sub>4</sub> -P		✓	✓	✓	✓
	SV <sub>30</sub>	3 times / week: Tuesday, Thursday and Sunday	✓	✓	✓	✓
Treated water quality monitoring	MLSS	3 times / week: Thursday and Sunday	✓	✓	✓	✓
	SVI		✓	✓	✓	✓

### Improvement in TeCSOM-II: Work schedule

Monitoring Item	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Water temperature	✓	✓	✓	✓	✓	✓	✓
pH	✓	✓	✓	✓	✓	✓	✓
EC (TDS)	✓	✓	✓	✓	✓	✓	✓
Turbidity	✓	✓	✓	✓	✓	✓	✓
DO	✓	✓	✓	✓	✓	✓	✓
Free residual chlorine	✓	✓	✓	✓	✓	✓	✓
BOD <sub>5</sub>		Sampling and preparation					Data collection and analysis
COD	✓	✓	✓	✓	✓	✓	✓
TSS	✓	✓	✓	✓	✓	✓	✓
T-N	✓	✓	✓	✓	✓	✓	✓
NO <sub>2</sub> -N	✓	✓	✓	✓	✓	✓	✓
NH <sub>4</sub> -N	✓	✓	✓	✓	✓	✓	✓
PO <sub>4</sub> -P	✓	✓	✓	✓	✓	✓	✓
SV <sub>30</sub>	✓	✓	✓	✓	✓	✓	✓
MLSS	✓	✓	✓	✓	✓	✓	✓
SVI	✓	✓	✓	✓	✓	✓	✓

## Issue in WWTP laboratory Limitation of capacity and equipment

- ✓ Can be monitoring in WWTP laboratory  
BOD, COD, Turbidity, TSS, TDS, Nitrogen compounds, Phosphate phosphorus, Residual chlorine: 13 Items
  - ✓ Items for which **outsourced analysis** should be considered  
**Inorganic matter, heavy metals, and microorganisms: 34 items**
- Jericho WWTP Lab does not have the equipment for analyze these items.  
Outsourcing: Considering **cooperation with An-Najah Univ.**

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### Lessons learnt :

- ❖ Analyze the results after the measurement process .
- ❖ Compare and verify the accuracy of the measurements.



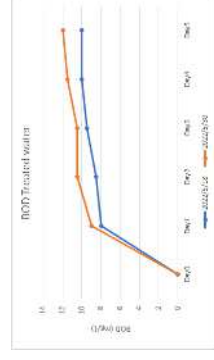
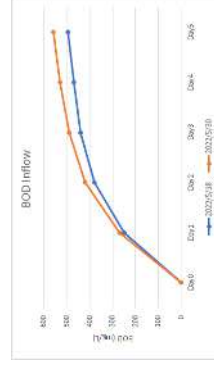
### Issue to develop:

- ❖ Develop a system to monitor water quality electronically by sensors linked electronically through special programs.

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## Lessons learnt: Implementation of correct experimentation in accordance with SOPs.

- Example: BOD test, Inflow and Treated water BOD
- Experiments with high repeatability can now be conducted.



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Conducted visit to the water laboratory of the wastewater treatment plant of Nablus Municipality in order to exchange experiences.



- Its understood that the daily monitoring is required to ensure the quality of water.
- In addition the JWWTP requires to have a procurement plan yearly

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## Challenges in water Quality

1. Increase laboratory staff: Assigning new Lab technician for the WWTP
2. Capacity enhancement of new staff:
3. Monitoring and supervision of JAIP effluents
4. Develop an annual budget for laboratory operations and a procurement plan
5. Visualization and more detailed analysis of water quality data using EXCEL (additional PCs in the sewage laboratory are desired).
6. Implementing national and international searches for academic information by improving the internet environment.

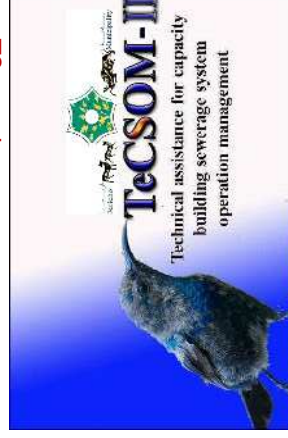
29

# THANK YOU

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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### Wastewater Network Updating\_ GIS



Eng.Majdi & Eng.Sarah

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### Building Sewer Database using GIS (Objectives):

- The sewer network projects' As-built drawings in is compiled.(JICA ,USAID , Pilot projects 1,2,3,4 &5)
- Using the sewer network data in doing network analysis is easy and accessible.
- Sewer network data is updated and shared with the related departments and sections.
- Sewer network project phases are easily categorized.
- Connected & unconnected buildings are visualized.
- Sewer network extension , planning is supported.

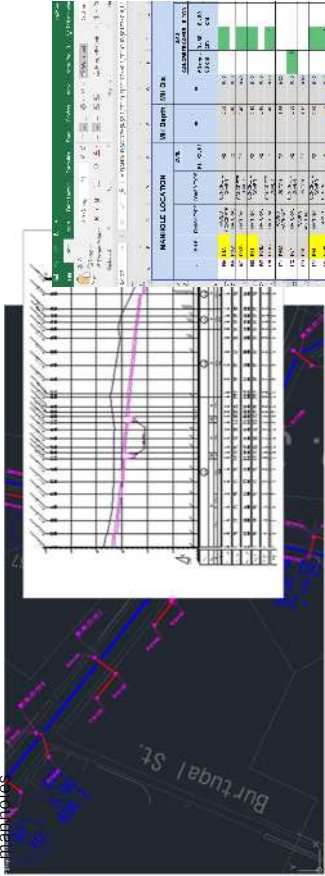
32

Existing data : AutoCAD drawings(plans , profiles) + Excel files for the pilot projects

Plans :Sewer pipelines and manholes

Profile

Excel data



Collecting data , cleaning up , reorganizing the lines and points , transferring to GIS and start digitizing and data entry:



Cleaned drawings ready to use in GIS data entry

## Methodology & Used tools:

Methodology:

- CREATE a **coherent** and **comprehensive** database in order to work with and assist to achieve the **TECSOM II** objectives
- DATA that we can **ARCHIVE** - **VIEW** - **ANALYZE** – **PROCESS** easily from one window

**Tools:**

**GIS Software** as a tool in order to achieve this objective

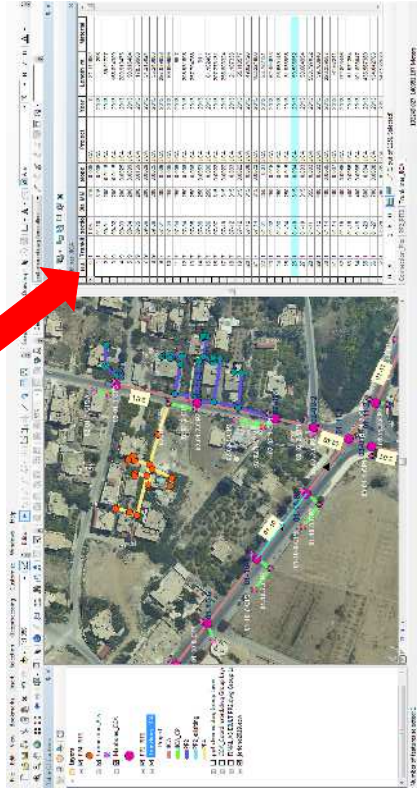
**IDEA** assemble different projects data into one file that connects the spatial and quantitative and qualitative data in the same interface

Jericho Sewer Network

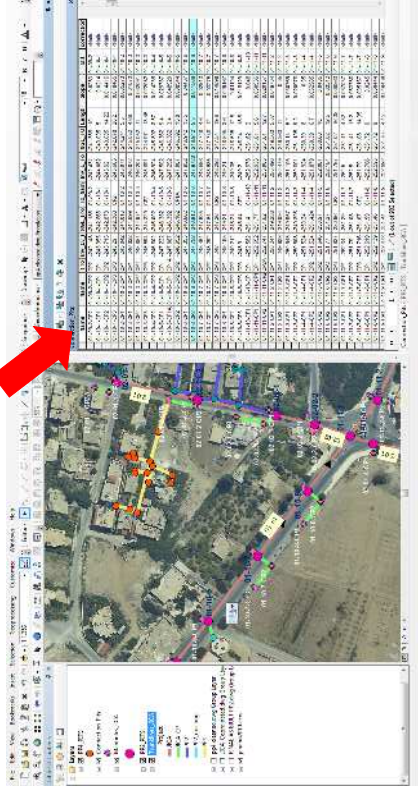


Sample of the sewer network updating on the GIS software

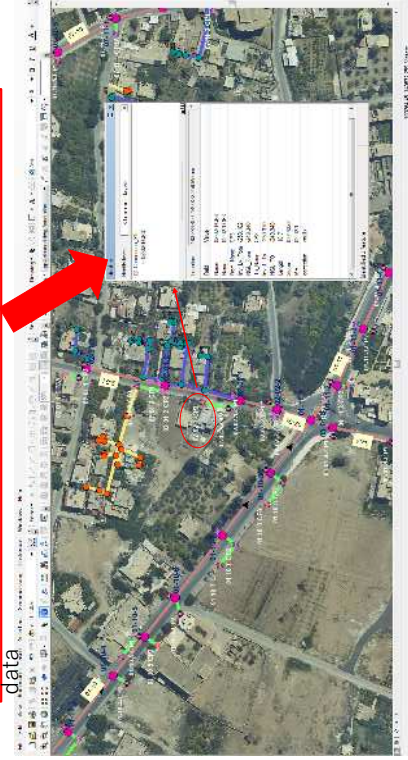
Sample of the sewer network updating on the GIS software : Sewer lines data



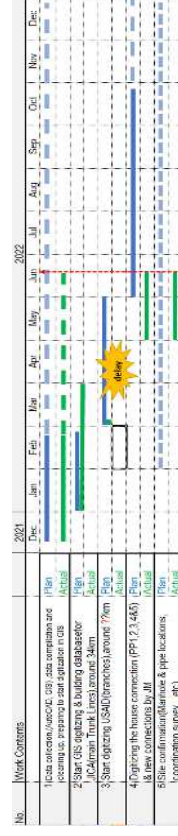
Sample of the sewer network updating on the GIS software : Manholes data



Sample of the sewer network updating on the GIS software : Configuration of one connection pit manhole data



## Work schedule and Accomplishment



## Work schedule and Accomplishment

- Data collection and processing: **JICA, PP2,PP3, PP4,PP5**
- Digitizing: JICA , PP2, PP4
  - Lines: 1251 section – 56.6km
- Database:
  - Main trunk lines data was entered manually: section name, diameter, slope, project ... etc. and lengths were calculated.
  - Main Manholes data was entered manually: manhole #, Invert level [In and out], type and height.
  - Connection pits numbers were assigned manually and detailed data was organized and connected to the database, which is: Main manhole association, Connection to and from with the associated invert levels and natural ground levels, lengths and slopes.
  - PP2 and PP4 manholes were separated on different shape files at this point, 50% of PP2 available manhole names were manually entered and the level.

Points: 2961 Manholes

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## Challenges

- No centric archiving for different projects and phases documents.
- Non-homogenous coordinate shift in network due to having ramified projects documents.
  - Site confirmation was needed to treat the geographical shifts when compiling the network components.
- Supporting human resources is needed to make fast site confirmation.

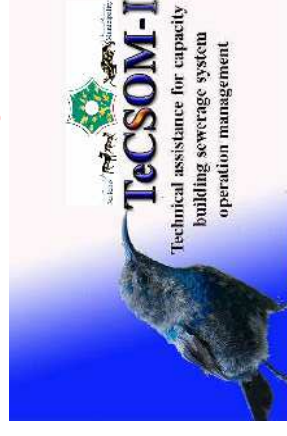
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Site confirmation by the head of sewer section using the GPS:



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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Financial Analysis



June 21, 2022

Head of Collection Management Section  
Abdul Fattah Haddad

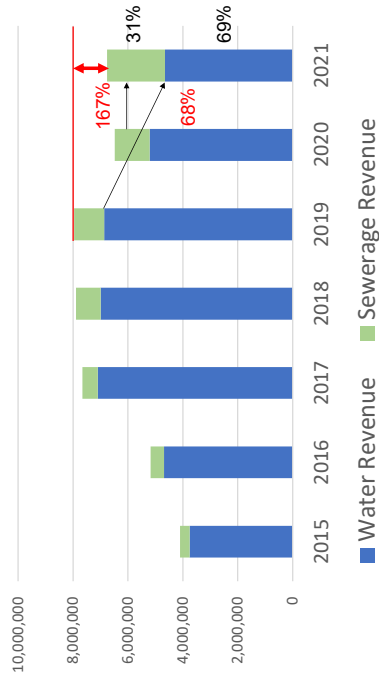
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## 1. Revenue & Costs of Water and Wastewater

	2015	2016	2017	2018	2019	2020	2021
Water Revenue	3,747,135	4,680,108	7,097,085	6,868,163	5,207,694	4,643,810	4,643,810
Sewerage Revenue	344,186	492,432	559,385	908,795	1,095,658	1,269,960	2,115,002
Total Revenue	4,091,321	5,172,540	7,656,470	7,894,181	7,963,821	6,477,654	6,758,812
<b>O&amp;M Cost (without Admin Costs)</b>							
Water	2,684,009	3,468,091	3,209,631	3,280,580	3,575,011	4,240,928	3,389,968
Sewerage	444,008	706,451	517,110	643,600	780,891	885,319	684,533
Total	3,128,017	4,174,542	3,726,741	3,924,180	4,355,902	4,826,247	4,074,501
Profit							
Water	1,063,126	1,212,017	3,887,454	3,704,846	3,293,152	966,766	1,253,842
Sewerage	-99,822	-214,019	42,275	265,155	314,767	684,641	1,430,469
Total	<b>963,304</b>	<b>997,998</b>	<b>3,929,729</b>	<b>3,970,001</b>	<b>3,607,919</b>	<b>1,651,407</b>	<b>2,684,311</b>
<b>Depreciation</b>							
Water	1,971,421	1,971,421	1,971,421	1,971,421	1,971,421	2,024,345	4,975,149
Sewerage	4,270,474	4,270,474	4,270,474	4,270,474	4,270,497	4,270,497	4,270,497
Total	6,241,895	6,241,895	6,241,895	6,241,895	6,241,918	6,294,842	9,245,646
Total Profit	<b>-5,278,591</b>	<b>-5,243,897</b>	<b>-2,312,167</b>	<b>-2,271,895</b>	<b>-2,633,999</b>	<b>-4,643,436</b>	<b>-6,561,335</b>

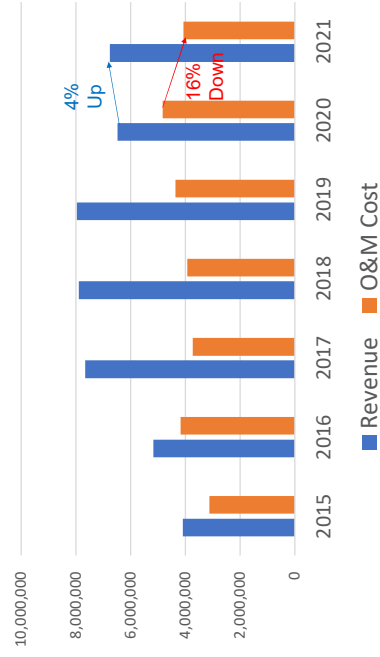
Source: Jericho Municipality Financial Data

## 2. Water & Sewerage Revenue



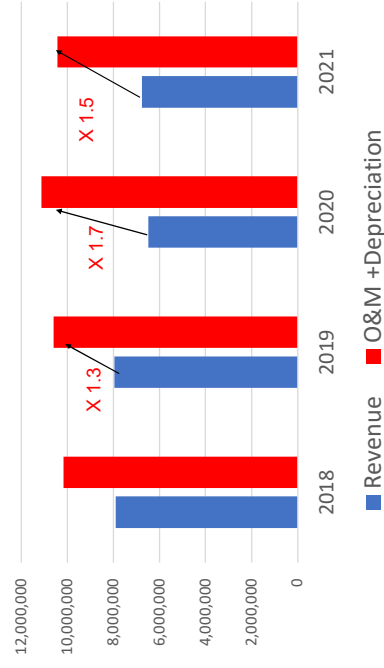
Source: Jericho Municipality Financial Data

## 3. Revenue & O&M Cost

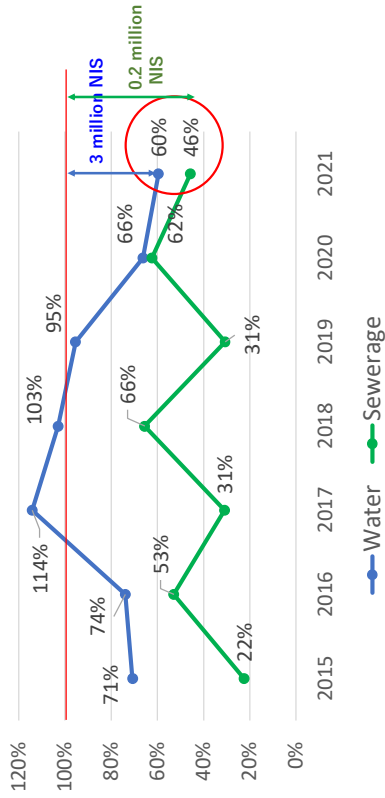


Source: Jericho Municipality Financial Data

## 4. Revenue & Total Cost



### 5. Collection Rate



Source: Jericho Municipality Financial Data

### 6. Total Debts (Unpaid Bill Amount)

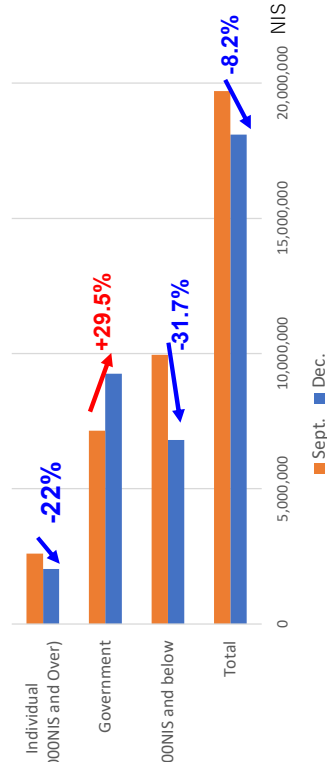
	Number of customers	Debits (NIS) Sept. 2021 A	Debits (NIS) Dec. 2021 B	Difference (NIS) C=B-A
Water Fee	8,282	19,709,462	18,091,941	-1,617,521 (-8.2%)
Sewerage Fee (Excluded PP4 &5)	1,125	761,579	681,412	-80,167 (-10.5%)

### 30,000 NIS and Over Debts

	September 2021	December 2021
Water Fee	Number: 56 (0.68%) Debits (NIS): 9,751,836 (49.5%)	Number: 62 (0.75%) Debits (NIS): 11,289,729 (62.4%) (+1,537,893)
Total Debtors	33 (0.40%) 7,147,685 (36.3%)	47 (0.57%) 9,259,256 (51.2%) (+2,111,571)
Individual	23 (0.28%) 2,604,151 (13.2%)	15 (0.18%) 2,030,473 (11.2%) (-573,678)

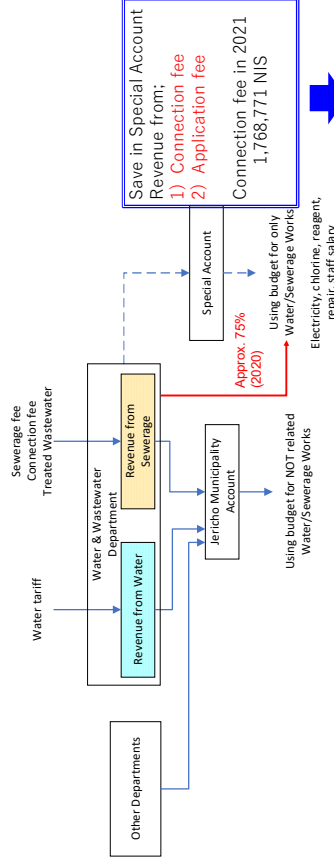
Source: Collection Sec. JM

### 7. Debts in 2021



- 1) Legalization of Water Disconnection (United Tariff Bylaw for Water and Wastewater, No(4)/2021)
- 2) Disconnection implementation (200 cases in 2021)
- 3) Target to more approx. 0.5 M NIS one individual debtor ⇒ Estimating new bill due to wrong meter

### 8. Save in WWD Special Account

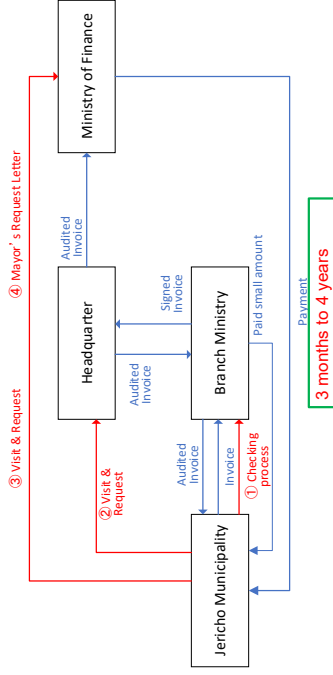


“Procedures and Policies Manual for accounting in the Big Palestinian Municipalities” (MoLG & MDLF) mentions the Budget shall be diverted to other departments

- Repairing equipment in WWTP
- House Connection
- Depreciation



## 9. Pressing for Payment Procedures



Source: Collection Sec. JM

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## 10. Comments

1. Water and sewerage revenues are in the profit relative to O&M (full cost recover). However, when depreciation is added, there is a deficit.
2. 100% collection rate for water and wastewater charges would result in the collection of approximately 3.2 million NIS.
3. After legalization of Water Disconnection according to the United Tariff Bylaw for Water and Wastewater, JM has started the disconnection to 200 individual debtors since January 2021.
4. The debt amount by large individual decreased -22%, on the other hand, the debt amount by government increased 29.5%.
5. Disconnection is a legal action against government buildings, but difficult to execute.
6. It is necessary for top management to collect the debts from the government, and to explain and persuade the government to do so.

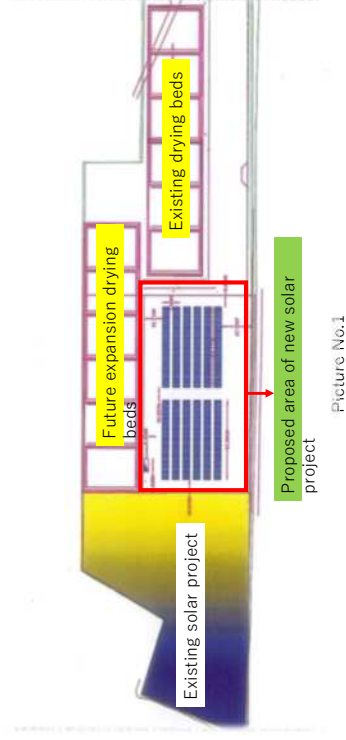
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## New Solar project in WWTP

- The new project will be constructed by JEDCo
- Jericho Municipality will provide the land for the project (inside WWTP). See picture No.1) and JDECo will benefit at least 20 years from the project.
- Capacity of the project is 1 Megawatt, Jericho municipality portion : 30%(after deducting the 10%), Remaining 70% for JDECo(including 10% instead of monitoring and maintenance by JDECo), if the WWTP does not consume the 30% of the produced power then the balances shall be secured for Jericho municipality.
- The surplus of the total capacity (1 Megawatt) will be for the JDECo benefit.
- The project is supposed to be constructed in (2022) and starts operation in (2023)
- Average daily portion for Jericho municipality will be about 1,247KWh/day which will increase the solar coverage rates up to 75% in the WWTP.

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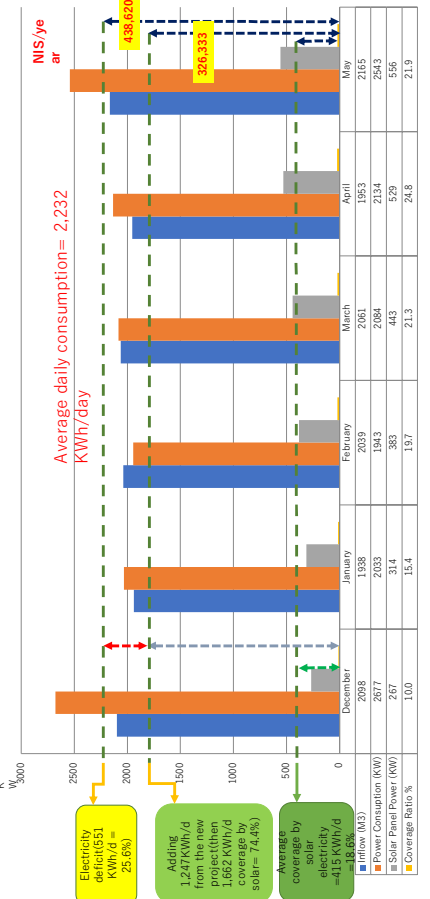
## New Solar project in Location WWTP



Picture No.1

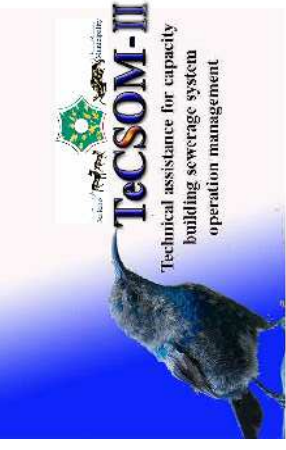
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### Current Power Consumption in WWTP & Future solar coverage Period(Dec2021-May2022)



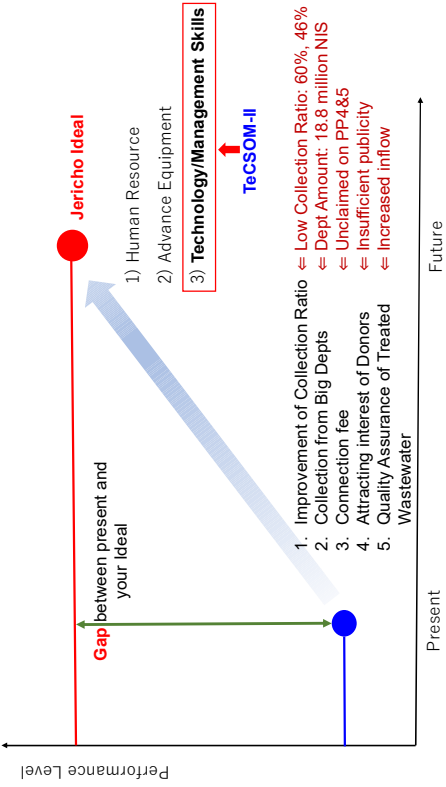
### Capacity Development for Sustainable Wastewater Management of Jericho Municipality

#### Challenges and Schedule

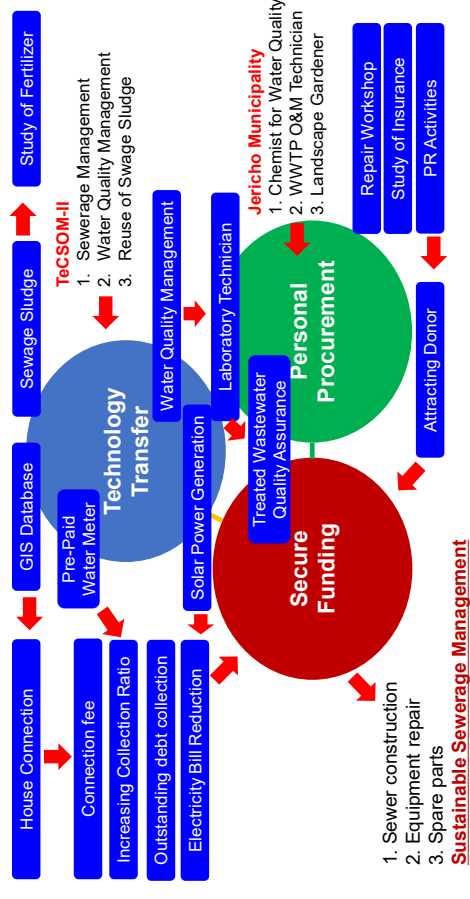


June 21, 2022  
Chief Advisor Satoru Oniki

### 1. Achieving Jericho Ideal



### 2. Major Elements of Management



### 3. Jericho Challenges (1)

#### 1. Improvement of Collection Ratio

To increase the rate of fee collection, promote the installation of Pre-Paid Water Meters and inform residents of the penalties such as waterline disconnection.

#### 2. Connection Fee on Pilot Project 4 & 5

Building measurements for Pilot Project (PP) 4 and PP5 are urgently needed for connection fee calculation. Simultaneously, sewerage fee collection will be started.

#### 3. Sewer Database Establishment

There are 240 applications for sewer connections as of May 2022. In order to quickly determine the feasibility of connection, the GIS database of culverts is urgently needed to be completed. The GIS database will also assist in sewer expansion planning.

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### 3. Jericho Challenges (2)

#### 4. PR Activity for Attracting Interest of Donors

Jericho municipality website will be updated with information on the sewerage services. Various leaflets for visitors to the Jericho Wastewater Treatment Plant will be prepared.

#### 5. Water Quality Management

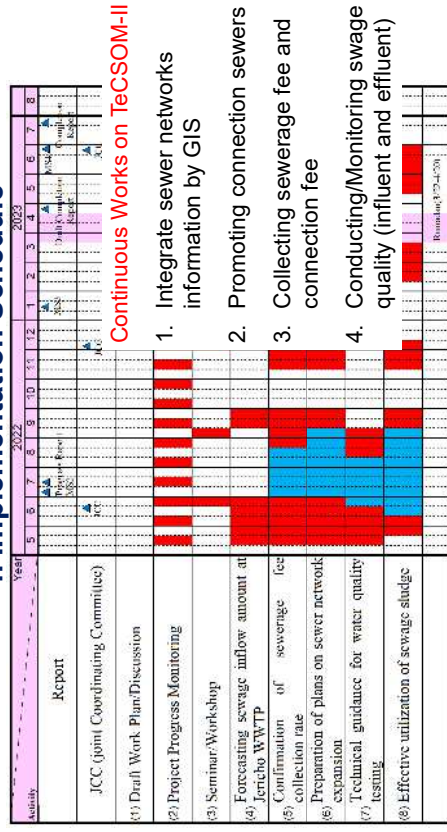
To ensure the quality of the treated wastewater sold, the quality of the influent and treated wastewater will be continuously measured and monitored. Water quality data will be disclosed.

#### 6. Study of sewage sludge reuse

With the cooperation of universities, the reuse of sewage sludge and treated wastewater will be studied.

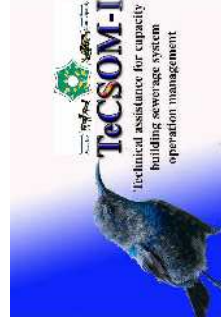
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### 4. Implementation Schedule



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# THANK YOU لكم وشكرا



## DISCUSSION TIME وقت للنقاش

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## **Appendix 4.4**

### **2<sup>nd</sup> JCC Minutes of Meetings**

**MINUTES OF MEETINGS**  
**ON**  
**CAPACITY DEVELOPMENT FOR SUSTAINABLE WASTEWATER**  
**MANAGEMENT OF**  
**JERICO MUNICIPALITY (TeCSOM-II)**

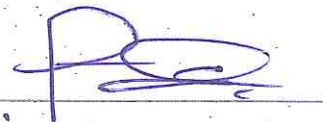
The Second Joint Coordinating Committee Meeting (hereinafter referred to as "JCC") on the Capacity Development for Sustainable Wastewater Management of Jericho Municipality (hereinafter referred to as "the Project") was held on the 21st of June, 2022 with both the Palestine and Japanese sides.

As a result of discussion in the JCC, both sides agreed the actions to be taken until the end of the Project.

[Date 21 June 2022]



Mr. Toshiya Abe  
Chief Representative,  
JICA Palestine Office



Mr. Abdulkarim Sidr  
Mayor,  
Jericho Municipality



Dr. Satoru Oniki  
Chief Advisor,  
The Project



Mr. Adel Yaseen  
Director,  
Palestinian Water Authority



The 2nd JCC was held on 21<sup>st</sup> June 2022 and the following agenda was presented and discussed among participants.

### Main Point Discussed

#### 1. Improvement of Collection Ratios of Water and Sewerage fees

The meeting confirmed that residents in Jericho city are informed of penalties such as waterline disconnection for bill debtors.

- i) After legalization of Water Disconnection according to the United Tariff Bylaw for Water and Wastewater No.4 2021, Jericho municipality has started the disconnection to 200 individual bill debtors since January 2021. Since this penalty has shown some effectiveness, it is recommended that residents be informed in advance.
- ii) It is necessary for top management to collect the debts from the governments, and to explain the governments the financial situation of Jericho municipality.
- iii) By administering the PPWM to collect unpaid amounts, it is expected to increase the collection ratio and reduce the amount of debt.

#### 2. Connection Fee on the Pilot Project (PP) 4 & 5

The meeting confirmed that Building measurements for Pilot Project (PP) 4 and PP5 are urgently needed for connection fee calculation. Simultaneously, sewerage fee collection will be started.

- i) PP4 and PP5 were completed in 2021 and 2020, respectively. However, the building area survey for fee calculation has not been completed and this survey is urgently needed.

#### 3. Sewer Database Establishment

The meeting confirmed that there are 240 applications for sewer connections for six months in 2022 as of May 2022. In order to quickly determine the feasibility of connection, the GIS database of culverts is urgently needed to be completed. The GIS database will also assist in sewer expansion planning.



#### 4. Public Relations Activity for Attracting Interest of Donors

The meeting confirmed that Jericho municipality's website will be continuously updated with information on the sewerage services. Much information on the Jericho sewerage services for donors/visitors will be published.

- i) By distributing leaflets/pamphlets, donors/visitors can understand easily outline of Jericho Sewerage and share information with their colleagues

#### 5. Water Quality Management

The meeting confirmed that the quality of the influent and treated wastewater will be continuously measured and monitored according to the water quality measurement schedule in order to ensure the quality of the treated wastewater sold. Water quality data measured needs to be disclosed.

Jericho municipality considers a procurement plan in TeCSOM-II for the purchase of reagents to ensure that water quality measurements are performed.

#### 6. Study of sewage sludge reuse

The meeting confirmed that the reuse of sewage sludge and treated wastewater will be studied with the cooperation of universities in addition to the pilot plant in TeCSOM-II.

- i) An-Najah National University has provided trainings in water quality analysis to Jericho municipality staffs since TeCSOM-I, and is also conducting (treated) wastewater quality measurements and sewage sludge analysis at TeCSOM-II (the Project). Al-Ouds University is also highly interested in the reuse of treated wastewater and sewage sludge. It is hoped that Jericho municipality will collaborate with these universities in researching the reuse of treated wastewater and sewage sludge.

In the course of discussion, both parties confirmed the progress of the Project and agreed the implementation of the Project.



Both sides acknowledged and agreed that the minutes of Meeting may be executed by electronic signature, which is considered as an original signature for all purposes and has the same force and effect as an original signature. "Electronic signature" includes faxed versions of an original signature of electronically scanned and transmitted versions (e.g., via pdf) of an original signature.



END



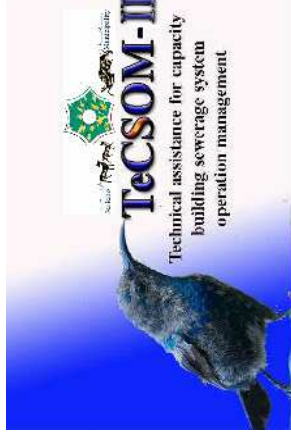


## **Appendix 4.5**

### **3<sup>rd</sup> JCC Presentation Materials**

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### Project Progress

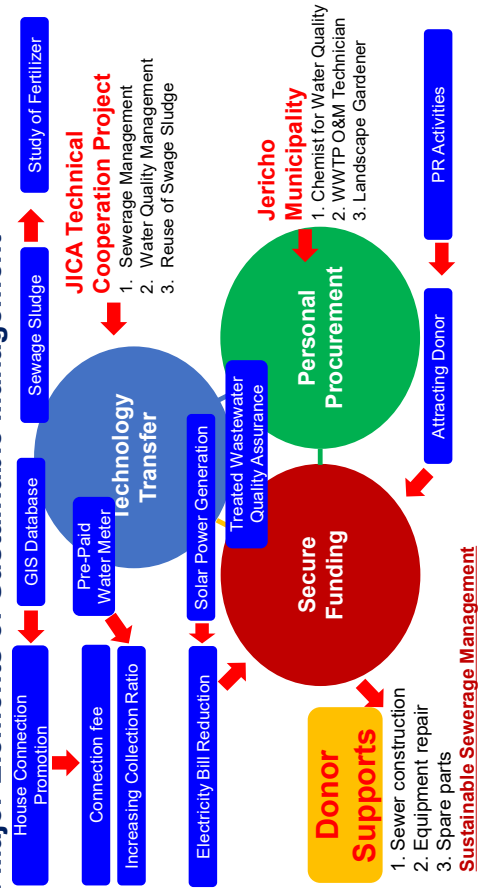


December 6, 2022  
 Head of Water & Wastewater Dept.  
 Mohammad Fityani

## 1. Project Purpose

**Sustainable Wastewater Management System is established in Jericho Municipality**

## 2. Major Elements of Sustainable Management



## 3. Project Progress Management (1)

Many issues are addressed by

- 1) Holding Weekly Meetings and,
- 2) Managing progress through Monitoring List



Weekly Meeting

Monitoring Meeting		Weekly Monitoring List	
Date	Time	Item	Remarks
12/06/2022	10:00 AM	1. Review the progress of the project.	
12/06/2022	10:00 AM	2. Discuss the issues raised during the meeting.	
12/06/2022	10:00 AM	3. Review the progress of the project.	
12/06/2022	10:00 AM	4. Discuss the issues raised during the meeting.	
12/06/2022	10:00 AM	5. Review the progress of the project.	
12/06/2022	10:00 AM	6. Discuss the issues raised during the meeting.	
12/06/2022	10:00 AM	7. Review the progress of the project.	
12/06/2022	10:00 AM	8. Discuss the issues raised during the meeting.	
12/06/2022	10:00 AM	9. Review the progress of the project.	
12/06/2022	10:00 AM	10. Discuss the issues raised during the meeting.	

Sharing Minutes of Meeting

### 3. Project Progress Management (2)

Purpose:

- Consider issues until they are resolved
- Remind stakeholders

#### Monitoring List

No	Project Subject	Responsible person (to follow up)	Department	Deadline	Status
1	Staff Welfare				Solved Topic
2	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
3	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
4	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
5	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
6	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
7	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
8	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
9	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
10	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
11	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
12	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
13	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
14	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
15	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
16	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
17	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
18	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
19	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
20	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
21	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
22	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
23	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
24	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
25	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
26	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
27	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
28	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
29	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	
30	UNIONIZATION OF STAFF	Dr. Khalid	HR & Admin	30-09-2022	

- 1) Responsible person,
- 2) Progress status
- 3) Deadline

Move resolved issues to the archive

### 3. Project Progress

Reviewing 2nd JCC Minute of Meeting held June 21 2022

- 1) Improvement of Collection Ratio
- 2) Connection Fee on Pilot Project 4 & 5
- 3) Sewer Database Establishment
- 4) Water Quality Management
- 5) Study of sewage sludge reuse

### 3.1 Improvement of Collection Ratio

- (1) Installation of Pre-Paid Water Meters
  - Total **525** PPWMs by JM . For debtors, 85 PPWMs installed till 14<sup>th</sup> Sept. 2022.
  - Collection Ratio: Water **60%**, Sewerage **54%** in the end of November 2022
- (2) Penalties such as watertime disconnection
  - Water Tariff Law “The unified tariff system for water and wastewater, No.4 of 2021”
  - Water providers can take measures to suspend water supply to persons who have not paid water and sewerage fees.
  - Number of disconnection : **152** in the end of October 2022
  - Number of reconnection: **94** out of 152 (**62%**)

- (3) AFD & Paris Support
  - 500-600 PPWMs equivalent to 100,000 EUR (JM will tender for PPWMs)

### 3.2 Connection Fee on Pilot Project 4 & 5

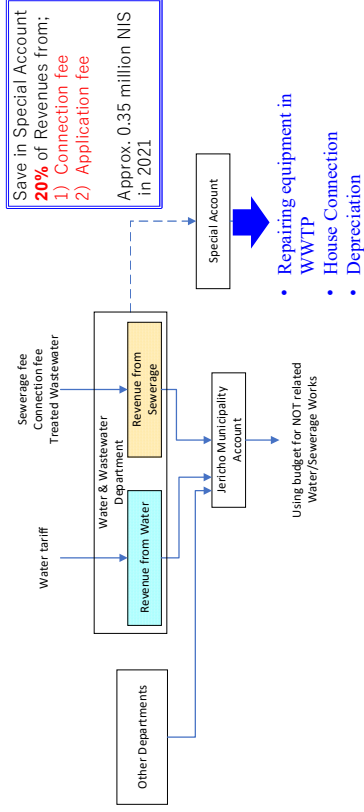
(1) Surveyed PP4 & 5

	PP4	PP5
No. of Buildings	105	200
No. of Subscribers	120	371

- Sewerage fees (Total 491 subscribers) will be charged from January 2022.
- Sewer connection fees (Total 305 buildings) will be collected from January 2023.

- (2) Special Account in Water & Wastewater Dept.
  - 20% of the sewer connection & application fees into Special Account since [January 2023](#)
  - For sewer construction

### 8. Save in WWD Special Account



### 3.3 Sewer Database Establishment

- (1) Efficiency of sewer connection application process
  - Currently, site checks were carried out on a one-by-one basis, which required manpower and time
  - Identification of the applicant's location /connection location
  - Immediate determination if a sewer connection is possible



- (2) Identification of priorities for sewerage development areas /routes
  - Identification of high densely residential areas and large water users
  - Selection of efficient routes
  - Planning of sewer construction
- (3) Sewer maintenance
  - Complaint areas, cleaning up sewers

### 3.4 Water Quality Management

- (1) Laboratory Technician for the WWTP hired from end-August 2022
  - OJT with revised SOPs
- (2) Periodic water quality monitoring
  - Data accumulation
  - Comparison with the treated wastewater reuse standards
- (3) Linkage to the WWTP operation and maintenance



Feedback in operation



Check by measuring water quality

### 3.5 Study of Sewage Sludge Reuse

Objective: Measuring the effectiveness of soil improvement with sewage sludge under general soil conditions.

- 1) Location: Block Al Masna No. 33026 (Parcel 1+2)
- 2) Target crops: 2 Date Palm trees, 15 Lemon trees
- 3) Area: 1.5 dunam (1,500 m<sup>2</sup>)
- 4) Reuse Option: Soil conditioner, mixing soil with dried sludge
- 5) Schedule: End of November, fertilizer spraying season



## 4. KPIs for Sewerage Service Provider

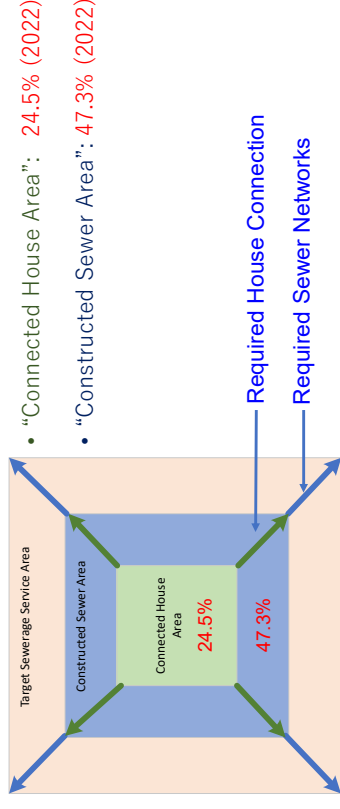
➤ Easily and objectively understand how Jericho Sewerage performs/improves in comparison with previous year.

➤ JM efforts and achievements are demonstrated using KPIs

- (1) Sewer Network Coverage Ratio
- (2) House Connection Coverage Ratio
- (3) Wastewater Quality Compliance
- (4) Sewage Sludge Quality Compliance
- (5) Facility Operating Ratio
- (6) Reuse Ratio of Treated Wastewater
- (7) Unit Treatment Cost
- (8) Operation Ratio
- (9) Collection Ratio

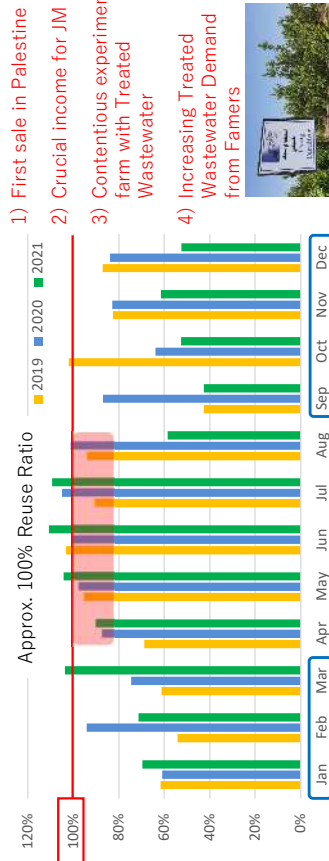
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## 4.1 Sewer Development



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## 4.2 Reuse Ratio of Treated Wastewater



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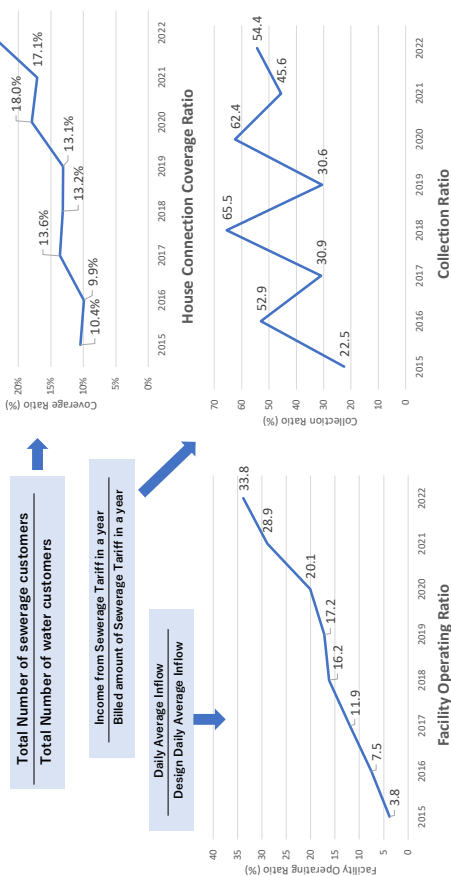
## 4.3 KPIs

KPI	Unit	2015	2016	2017	2018	2019	2020	2021	2022
1 Sewer Network Coverage Ratio	%	33.9	33.9	33.9	47.3	47.3	47.3	47.3	47.3
2 House Connection Coverage Ratio	%	10.4	9.9	13.6	13.2	13.1	18.2	17.1	24.5
3 Wastewater Quality Compliance	%	89	92	-	-	-	-	97.3	94.6
4 Sewage Sludge Quality Compliance	%	100	-	-	-	-	-	100	100
5 Facility Operating Ratio	%	3.8	7.5	11.9	16.2	17.2	20.1	28.9	33.8
6 Reuse Ratio of Treated Wastewater	%	0	0	84	73	79	86	75	-
7 Unit Treatment Cost	NIS/m <sup>3</sup>	1.14	1.03	1.05	1.04	1.06	1.06	1.05	-
8 Operation Ratio	%	24.57	11.74	13.98	4.45	11.35	3.25	4.22	-
9 Collection Ratio	%	22.5	52.9	30.9	65.5	30.6	62.4	45.6	54.4

Source: TeCSOM-II Survey Results, 2022

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#### 4.4 KPIs Transition



**Thank you very much.**

#### 5. Improvement of Sewerage Management Capacity in JM

- (1) Tackling the sewerage issues and managing with the Monitoring list
- (2) Sharing information among related departments & sections in the Weekly Meeting
- (3) Establishing water quality management with OJT & revised SOPs
- (4) Evaluating accumulated water quality data for influent & treated wastewater
- (5) Planning equipment maintenance & reagents procurement
- (6) Integrating sewer information with GIS, and planning sewer expansion
- (7) Securing the budget for sewerage services with the Special Account established
- (8) Improving fee collection with new tariff and application fee and survived PP4 & PPS
- (9) Studying the reuse of sewage sludge in the experimental farm
- (10) Promoting Public Awareness with Public Relations (PR)

⇒ **Further activities required**



#### Outline of the Jericho Wastewater Treatment Plant

Operation of Wastewater Treatment Plant

Prepared by : Eng. Omran Khalaf  
December 6, 2022

## Operation & Maintenance

Goals & Objectives:

- To ensure efficiency,
- Effectiveness
- Sustainability of wastewater treatment plant
- Water Quality meets the Standards

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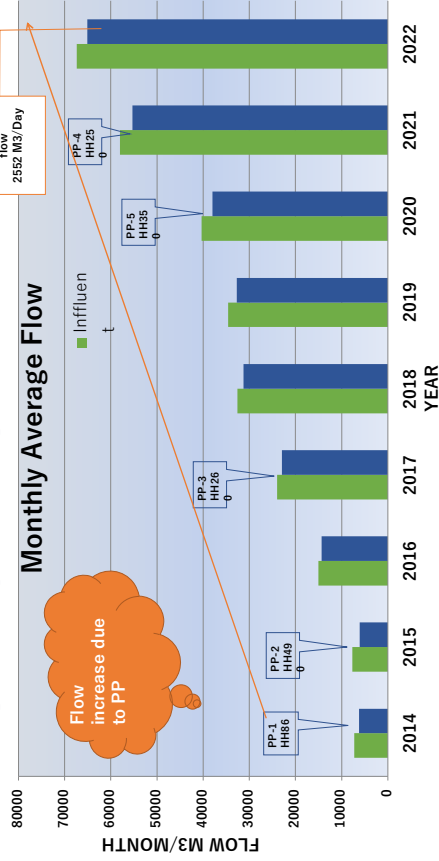
## Operation & Maintenance

### Tools & Methodology:

- ❖ Preventive maintenance
- ❖ Corrective maintenance
- ❖ Condition of operation
- ❖ Reporting & regular inspections

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## INFLUENT & EFFLUENT



23

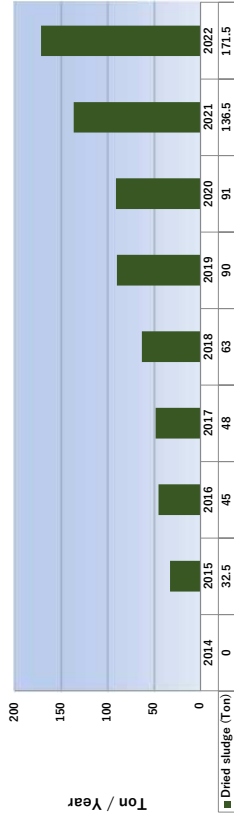
## INFLUENT & EFFLUENT

Notes:

- The inflow increase due to the continuous implementation of house connection projects by JICA , PWA & JM.
- After the 2021 the average inflow seemed stable (Avg: 2,552 m<sup>3</sup>/d) due to no house connection projects.

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## Sludge Generation



Notes:

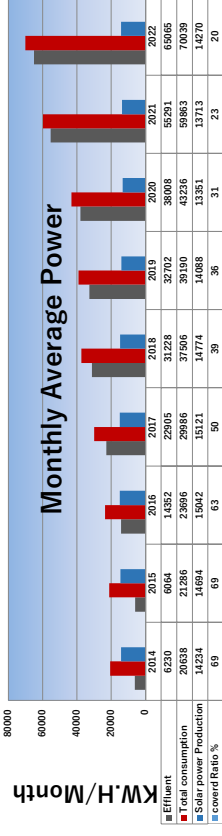
- Sludge being stored in the WWTP site, efforts are ongoing to study the reuse of sewage sludge.
- Sludge quality meets the MoA standards according to the conducted tests by TeCSOM-II project.

Sampling for dried sludge, Nov 2022



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## Power Consumption



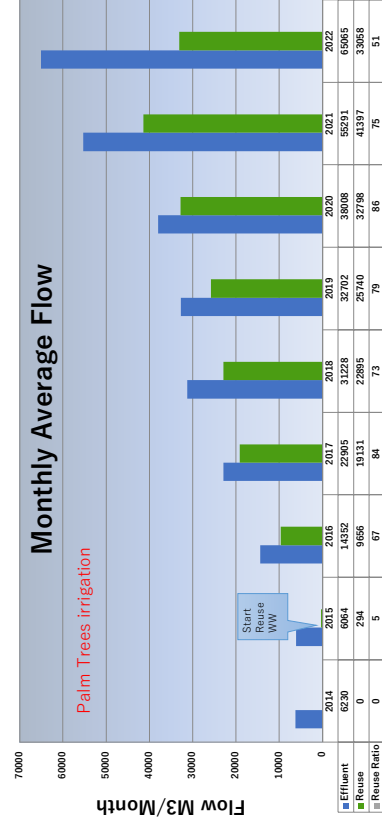
Notes:

- Solar Panels cover 20-25% of total power consumption in the WWTP.
- JM agreed two projects with private sector (Electricity company) to implement solar projects in WWTP. 1) 1.5 megawatt project (implemented in 2017). 2) 1 megawatt project (ongoing). But the produces electricity deducted from the total JM consumption including the WWTP.



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## Reuse Ratio of Treated Wastewater



Start Reuse WW

Palm Trees irrigation

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## Reuse Ratio of Treated Wastewater



Notes:

- Reuse ratio reaches about 100% in the high demand months (April-August)
- Remaining months the demand of irrigation water decreased due to : 1) winter time, 2) decrease the irrigation few weeks before the dates harvest.
- JM is studying to provide the treated wastewater to MEDISS (Mediterranean Integrated System for Water Supply) project that is being implemented through Jericho governorate in cooperation with the new "Irrigation Water Association" in Jericho and Jericho Municipality.

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## ment Maintenance & Spare parts anges:



### Maintenance:

- o Maintenance local workshop are limited(out of Jericho)
- o Long time of maintenance at the local workshop
- o High cost of repair

### Spare parts:

- o Some parts are not available in the local market
- o Shipping time is long
- o High cost of procurement

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## Visitors to WTP

□ WWTP receives visitors for the following purposes:

1. Educational visits from the universities and schools, or training groups.
2. Visitors from potential donors.

Following are some photos for the visits examples during the year 2022 :



Palestinian Affairs Department  
at the American Embassy in  
Jerusalem ,Aug2022



US Embassy ,RoJ & JICA  
visit to JWWTTP , Nov 2022



Swedish Embassy in Jordan &  
Palestine , May2022

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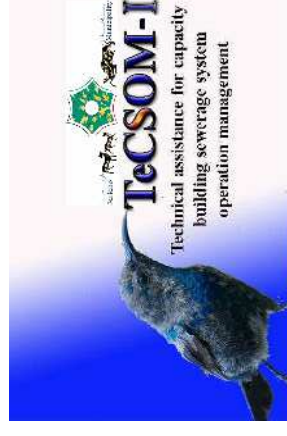
## Visitors to WTP

Educational visits from Al Quds university , Dec 2022.



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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality Water Quality Management



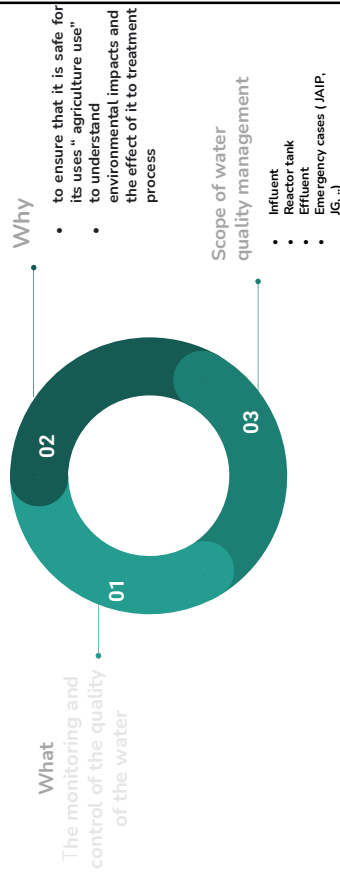
December 6, 2022

**Arwa A. Abusrouf**

Lab Technician/ Jericho Municipality

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## Water Quality Management



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## Water Quality Monitoring

- Sampling point and Monitoring item
- Sampling points and monitoring items

Sampling point	Monitoring item
Main trunk No.1 and No.19	Daily: Water temp., pH, EC, TDS, DO, ORP Every 5 days: BOD <sub>5</sub>
Inflow pit	Daily: Water temp., pH, EC, TDS, DO, ORP Every 5 days: BOD <sub>5</sub>
Reactor tank	Daily: Water temp., pH, EC, DO, ORP, MLSS, SV <sub>30</sub>
Treated water	Daily: Water temp., pH, EC, TDS, DO, ORP Every 5 days: BOD <sub>5</sub>

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## Challenge in Water Quality Monitoring (1)

- **Improvement SOPs**
  - Water quality analysis is carried out in accordance with SOPs.
  - SOPs: pH/EC\*, Turbidity, BOD<sub>5</sub>, Data collection and accuracy control.
  - \*pH/EC SOPs will be revised due to the replacement of pH/EC measuring equipment
  - SOPs will continue to be developed as the kinds of measurement items increases: NH<sub>4</sub>-N, NO<sub>3</sub>-N, T-N, PO<sub>4</sub>-P, COD, TSS, ORP
- **Conducting monitoring outside WWTP**
  - Decide monitoring points and implement regular water quality monitoring for major wastewater sources in order to operate WWTP appropriately and to generate appropriate quality of treated water and sludge for agricultural reuse.
  - The following locations are highlighted as locations where wastewater volumes will increase in the future due to ongoing development and sewerage connections:  
JAIP, Jericho gate, Urban areas and Refugee camps

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## Challenge in Water Quality Monitoring (2)

- **Promoting cooperation with universities and institutions**
  - The current equipment in water quality laboratory can't measure all parameters regulated by Cabinet resolution No. 16 2013 (Wastewater inflow criteria) and PS742-2015 (Treated wastewater effluent for agricultural reuse).
  - Analysis of elements (e.g. N, K) and heavy metals are carried out with the cooperation and guidance of universities and other institutions (e.g. An-Najah Univ.).
- **Strengthening of the operational management system of Water quality laboratory.**
  - The following plan will be developed to maintain the sustainable operation of water quality laboratories:
    - 1) Procurement plan
    - 2) Equipment maintenance plan

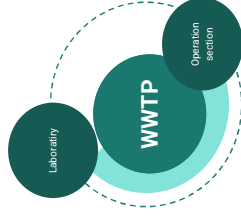
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## Plans to be established

- **Procurement Plan**
  - Supplier information
  - Stock management of reagent and maintenance / spare parts
  - Annual procurement schedule including expiry date of reagent and readtime
- **Equipment Maintenance Plan**
  - Calibration and maintenance schedule for each monitoring equipment
  - Record keeping of equipment maintenance history.
  - Stock control of calibration reagents / spare parts/ consumable parts.
  - Linked to the Procurement plan to ensure sustainable operation of the laboratory.

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## Cooperation between Water quality laboratory and WWTP operation section



- Laboratory section and WWTP operation section work in an integrated manner, in order to ensure the quality of the treated wastewater and sludge.
- The laboratory section provides the operation section the results of water quality data related to the treatment process management.
- In emergency cases, these two sections work intensively and to discover the problem and its source, with the administration section taking the measures until the problem is resolved by the WWTP operation section.

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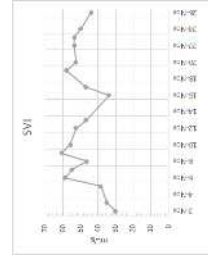
## Plans to be established

- **Procurement Plan**
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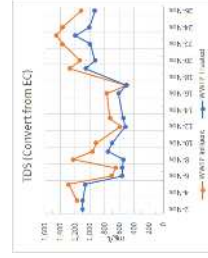
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## Cooperation between Water quality laboratory and WWTP operation section (2)

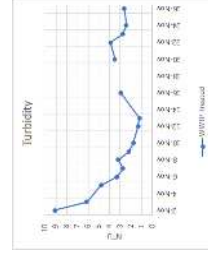
- Laboratory section shares the following water quality data with WWTP operation section and Administration section.
  - Examples of data taken from the November monitoring data are given below.
- Detailed water quality monitoring data is discussed in today's workshop.



SVI: Indicator of settling of sludge in sewage treatment process. Within the appropriate range.



Treated water quality is shown by the blue line. TDS (Total dissolved solids) and Turbidity satisfy the Category -A for agricultural reuse.



## Highlights of The Training Period

- Learning about the types of water quality monitoring equipment used to water quality monitoring, along with the method of calibration and maintenance.
- Sampling and handling of samples.
- Relevant water quality regulations and standards.

### Challenge

- Enhance technical capacity to increase an accuracy/precision of water quality monitoring data
- Enhance data analysis capacity to provide more effective advice to operation section and administrative section



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A person is still learning daily  
what makes him realize that he  
does not know much

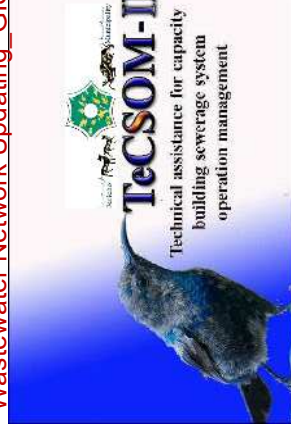
I welcome any inquiries and Thank you for your interest

6 December 2022

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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

Wastewater Network Updating\_ GIS



Eng. Shirad

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Objectives of GIS Integration:

**GIS systems are contributing for the following points:**

- Connected & Unconnected buildings are easily visualized and identified.
- Sharing the GIS data with other related department
- Usefulness for the network analysis and maintenance
- Easily establishment of phased construction plan for future

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Progress of GIS integration establishment:

1-As-built drawings of sewer network projects(Main & Branch lines):

Project	Length(As-Built, Km)	Progress of GIS integration (%)	Comments
JICA Project	29.5	95%	Brush up GIS shapefiles is ongoing
USAID-1A	12.4	60%	Pipelines & manholes are digitized, As-built data (pipeline & manhole profile) need to be collected
USAID-1B	13.5	80%	Brush up GIS shapefiles is ongoing

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## Development of Wastewater Construction Plan for Unconnected Area Using the GIS System

JM will need to develop the sewer network project in unserved areas in order to increase the amount of sewage inflow to the WWTP and protect the water quality of groundwater.

The following are the target areas for development.

- Area with undeveloped sewer network
- Unconnected house connection area along the existing sewers
- Unconnected house connection area in PP-1 to PP-5

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## Development of Wastewater Construction Plan for Unconnected Area Using the GIS System

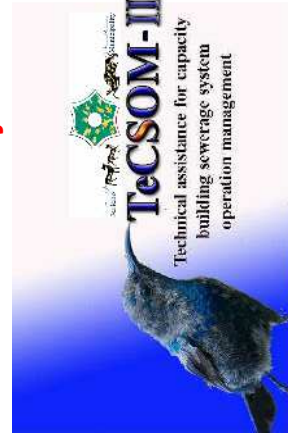
### Criteria of Prioritization on the Development

1. **Criteria of top priority for sewer network**
  - High density residential area in the undeveloped sewage area
  - Large water consuming users
2. **Criteria of top priority for house connection**
  - Houses with high connection requests from customers
  - Buildings with many residents
  - Applicable construction of house connection
3. **Criteria of second priority for sewer network and house connection**
  - Sewer networks and house connections other than the above Top Priority

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## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

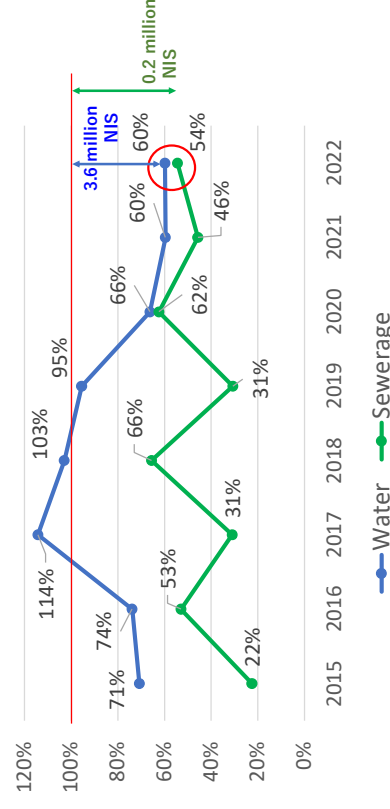
### Financial Analysis



December 6, 2022  
 Head of Collection Management Section  
 Abdul Fattah Haddad

55

## 1. Collection Rate



Source: Jericho Municipality Financial Data

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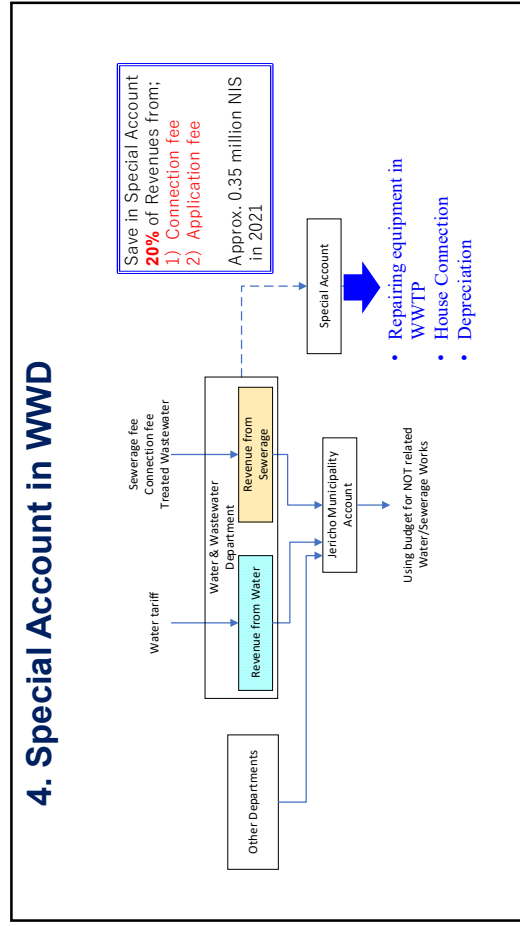
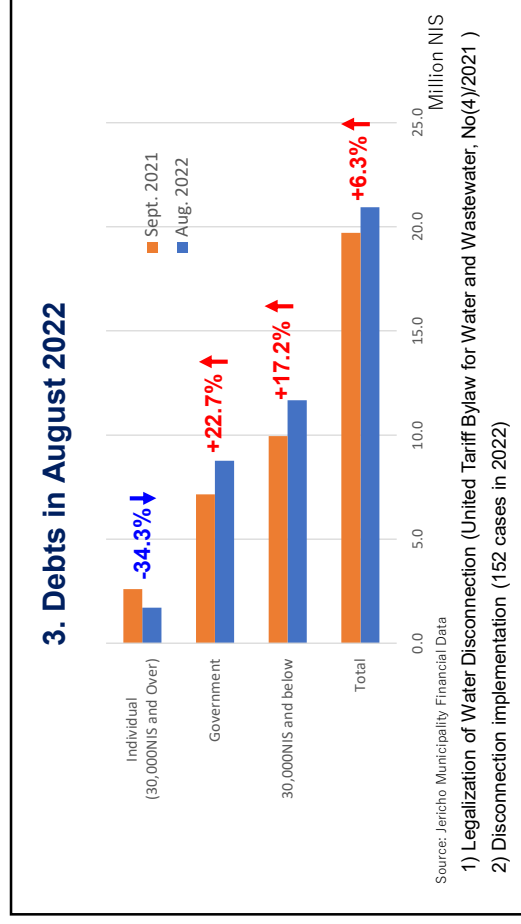
### 2. Total Debts (Unpaid Bill Amount)

	Number of customers	Debits (NIS)		Difference (NIS) C=B-A
		Sept. 2021 A	Aug. 2022 B	
Water Fee	8,282	19,709,462	20,950,581	+1,241,119 <b>(+6.3%)</b>
Sewerage Fee (Excluded PP4 &5)	1,125	761,579	883,371	+121,792 <b>(+16.0%)</b>

**30,000 NIS and Over Debts**

	September 2021		August 2022	
	Number	Debits (NIS)	Number	Debits (NIS)
Total Debtors	56 (0.68%)	9,751,836 (49.5%)	66 (0.80%)	11,666,041 (+1,914,205)
Governments	<b>33</b> (0.40%)	<b>7,147,685</b> (36.3%)	<b>39</b> (0.47%)	<b>8,768,069</b> (+1,620,384)
Individual	<b>23</b> (0.28%)	2,604,151 (13.2%)	<b>16</b> (0.19%)	1,711,766 (-892,385)

Source: Jericho Municipality Financial Data



### 5. JM initiatives on Increasing Revenues

**(1) Debt collection**

- Individual debts
- Governmental debts

**(2) Improvement of fee collection ratios**

- Promotion of PPWM adoption
- Introduction of new Billing System
- Introduction of penalty rules
- Collection of water and sewerage fees

**(3) Elimination of fees unbilled**

- Sewer connection and Sewerage fees from PP4 & PP5
- Replacement of defective water meters
- "0" reading: 1,200 ⇒ less than 200 meters

**(4) Increase in revenue sources**

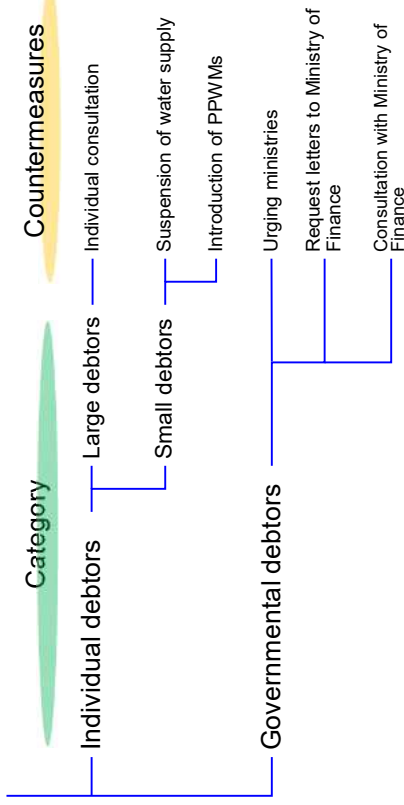
- Increase in water and sewerage fees
- Application fees of water and sewerage
- Extractions of houses with possible sewer connection by WWTD

**(5) Public Awareness**

- Collected fees are invested in the sewerage services

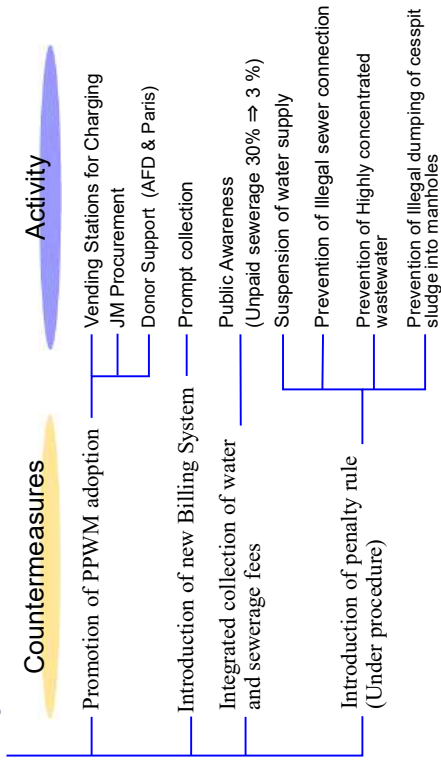


## 5.1 Debt Collection



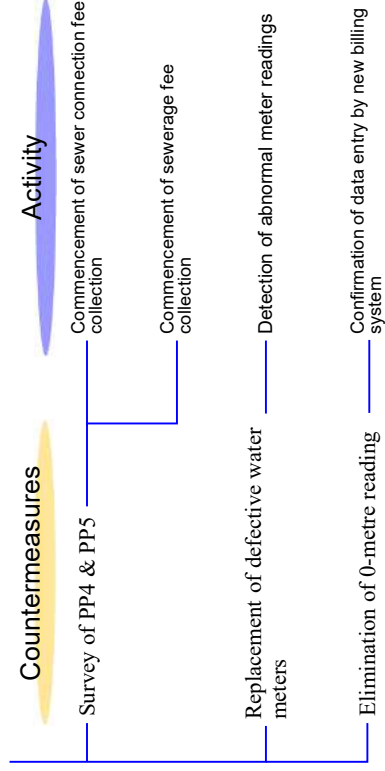
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## 5.2 Improvement of Fee Collection Ratios



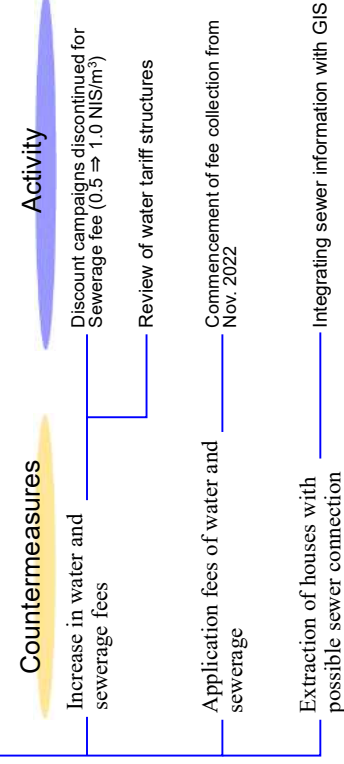
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## 5.3 Elimination of Fees Unbilled



63

## 5.4 Increase in Revenue Sources



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## 5.5 Public Awareness

### Countermeasures

Collected fees invested in sewerage services

Integrated collection of water and sewerage fees

### Activity

Special Account to accumulate funds for investment

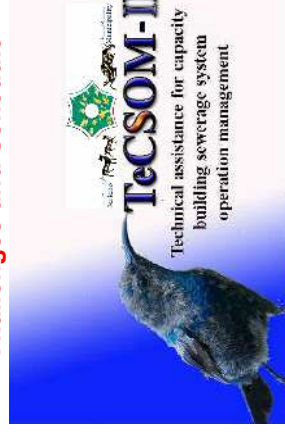
## 6. Comments

1. The difference between the current collection rate and the 100% collection rate corresponds to approximately 3.8 million NIS.
2. The debts for water and sewerage fees increased during one year.
3. However, the **individual debts decreased** by NIS 0.9 million.
4. This can be attributed to the **application of penalties** (water disconnection) and the installation of **PPWMs**.
5. The debt amount by government **increased 22.7%**.
6. The General accountant in the Ministry of Finance issued a decision to pay approximately 0.5 million NIS from the security agencies' debts in Jericho due to **JM's top management** to collect the debts from the government.

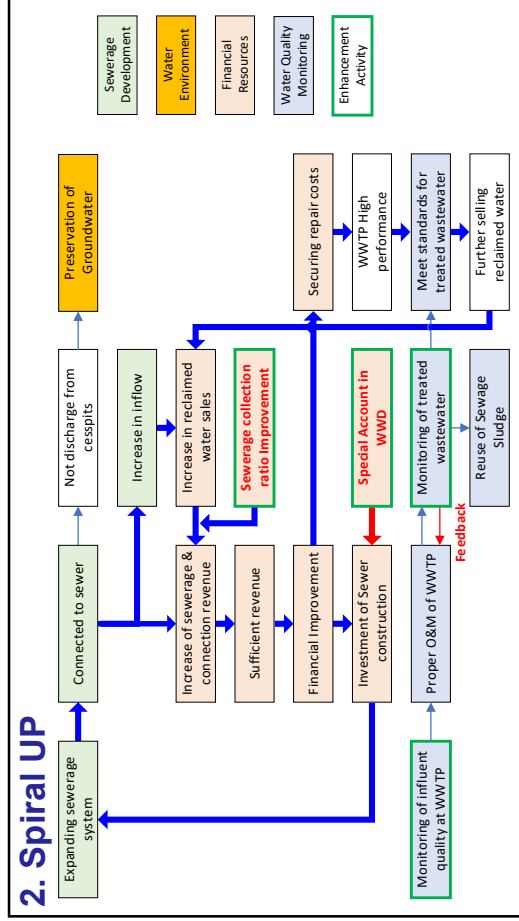
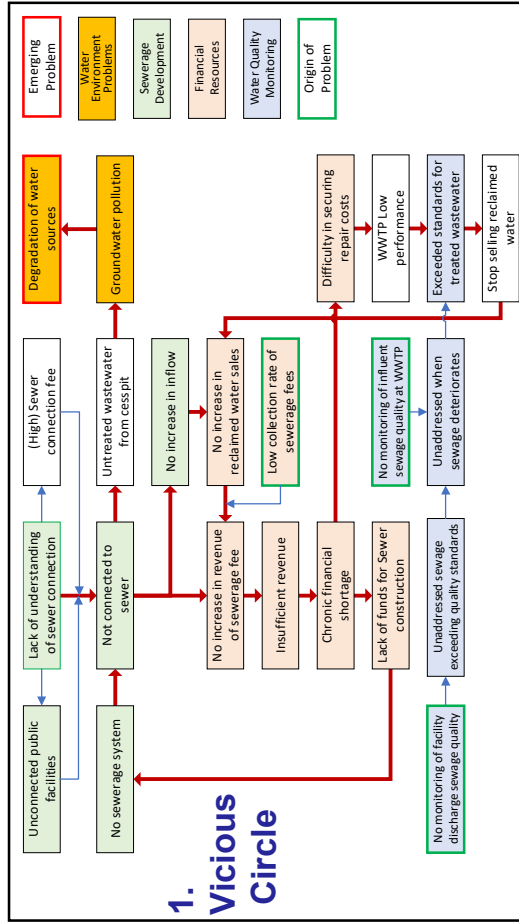
# Thank you very much.

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### Challenges and Schedule



December 6, 2022  
Chief Advisor Satoru Oniki



### 4.3 Improvement of TeCSOM-II

- 1) Improvement of Collection Ratios of Water and Sewerage Fees**  
⇒ Penalties and compulsory collection (PPWM) + Public awareness
- 2) Investment in Sewerage Projects with Sewer Connection Fees**  
⇒ Publicize to residents “a part of the fees will be used to improve sewerage services”
- 3) Visualization of business improvements through 9 KPIs**  
⇒ Improve sewerage services and information disclosure
- 4) Integrated Sewer Information Utilization**  
⇒ Possibility of sewer connection, promoting sewer connections, selecting priority sewer routes
- 5) Budgetary Control for Sewerage Services**  
⇒ Budget for sewerage services such as reagents for water quality testing and equipment repairs
- 6) Study of Sewerage Sludge Reuse**  
⇒ Experimental farm of dried sludge reuse as a soil conditioner

### 4. Implementation Schedule

## **Appendix 4.6**

### **3<sup>rd</sup> JCC Minutes of Meetings**

c.c. / c.h.

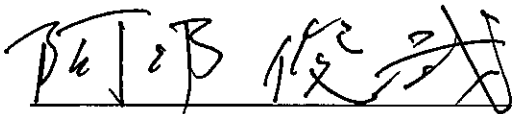
7. 12. 22

**MINUTES OF THE MEETING  
ON  
CAPACITY DEVELOPMENT FOR SUSTAINABLE WASTEWATER  
MANAGEMENT OF  
JERICHO MUNICIPALITY (TeCSOM-II)**

The third Joint Coordinating Committee Meeting (hereinafter referred to as “JCC”) on the Capacity Development for Sustainable Wastewater Management of Jericho municipality (hereinafter referred to as “the Project”) was held on the 6th of December 2022 with both the Palestinian and Japanese sides.

It was concluded and agreed by both parties in the 3<sup>rd</sup> JCC that the following actions will be taken until the end of the Project.

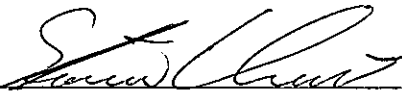
[Date: 6 December 2022]



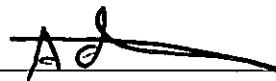
Mr. Toshiya Abe  
Chief Representative,  
JICA Palestine Office



Mr. Abdulkarim Sidr  
Mayor,  
Jericho Municipality



Dr. Satoru Oniki  
Chief Advisor,  
The Project



Mr. Adel Yaseen  
Director,  
Palestinian Water Authority

The 3rd JCC was held on 6<sup>th</sup> December 2022 and the following agenda was presented and discussed among participants.

### **Main Point Discussed**

#### **1. Improvement of Collection Ratios of Water and Sewerage Fees**

The meeting confirmed that Jericho municipality shall raise public awareness to the residents not only by adapting penalties and installing Pre-Paid Water Meters (PPWMs) to increase the collection ratio of water and wastewater fees.

- 1) Jericho municipality shall encourage residents to pay their water and sewerage bills through Public Relations activities.

#### **2. Investment in Sewerage Projects with Sewer Connection Fees**

The meeting confirmed that Jericho municipality shall inform the residents that the sewer connection fees collected will be invested in sewerage projects.

- 1) As a first step, the Water and Wastewater Department shall reserve 20% of the sewer connection fees to the Special Account authorized for the sewerage projects such as sewer connection, equipment repair and depreciation.
- 2) Jericho municipality will try to gain publicity through information dissemination, that a part of the fees will be used to improve sewerage services.

#### **3. Visualization of Sewerage Service Improvements through the Key Performance Indicators (KPIs)**

The meeting confirmed that Jericho municipality shall use the KPIs to measure improvements in the sewerage management.

- 1) Jericho municipality shall accumulate data related to the sewerage sector and shall calculate the KPIs periodically.
- 2) The KPIs are shared with the sewerage stakeholders and shall be used to improve sewerage services.

#### **4. Integrated Sewer Information Utilization**

The meeting confirmed that Jericho municipality shall use the sewer data integrated in the GIS (information of sewer geographic locations) to promote or enhance sewerage connections and sewer development.

- 1) Jericho municipality will use the information on the sewer locations to quickly determine whether a connection to the sewer is possible and to promote sewer



connections. Information on sewer locations contributes to reducing the workload of staff by reducing the work required to check sites.

- 2) Jericho municipality will use the information on sewer locations to identify houses that can be connected to sewers and to encourage house connections to sewers.
- 3) Jericho municipality can develop a sewer network plan by selecting priority sewer construction routes based on the information on existing sewers and building locations.

#### **5. Budgetary Control for Sewerage Services**

The meeting confirmed that Jericho municipality shall estimate the budget required for sewerage services such as reagents for water quality testing and equipment repairs, and shall secure the budget for these.

- 1) Jericho municipality will develop an annual plan for water quality measurements and estimate the quantity of reagents required with appropriate specifications for regular testing of water quality. Jericho municipality will conduct water quality tests, and will disclose the water quality data measured.
- 2) The Jericho Wastewater Treatment Plant has been in operation for nine (9) years and repairs to equipment have occurred. Jericho municipality will endeavor to prepare a budget for equipment repair and renewal under proper operation and maintenance.

#### **6. Study of Sewage Sludge Reuse**

The meeting confirmed that Jericho municipality shall need to demonstrate not only safety but also effectiveness for the sewage sludge reuse.

- 1) Jericho municipality has initiated an experimental farm of dried sludge reuse as a soil conditioner at the municipality owned Samed Land. Jericho municipality will analyze and evaluate soils and disclose information to stakeholders.

In the course of the discussions, both parties confirmed the progress of the Project and agreed the implementation of the Project.

Both sides acknowledged and agreed that the minutes of Meeting may be executed by electronic signatures, which will be considered as original signatures for all purposes and shall have the same force and effect as an original signature. "Electronic signature" includes faxed versions of an original signature of electronically scanned and/or transmitted versions (e.g., via pdf) of an original signature.

END

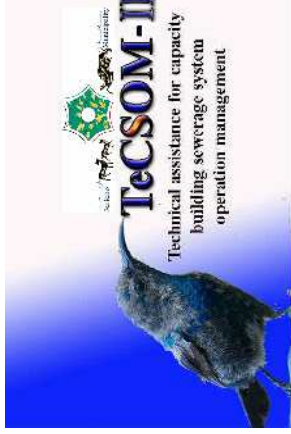


## **Appendix 4.7**

### **4<sup>th</sup> JCC Presentation Materials**



Capacity Development for Sustainable  
Wastewater Management of Jericho Municipality  
**Project Activities and Achievements**



June 22, 2023

Jericho Municipality, Department of Water and Wastewater  
Director Mohammad Fityani

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# 1. Project Purpose



2

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## 1.1 Project Purpose

**Sustainable Wastewater Management System is established in Jericho Municipality**

Overall Goals :  
Sewerage facilities in JM are operated and managed appropriately under sound financial conditions.



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## 1.2 Project Outputs

- Output-1 : Sewer System Development
- Output-2 : Water Quality Management Improvement
- Output-3 : Reuse of the Treated Sewage Sludge is studied



4

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### 1.3 Activities

Output	Activity
Output 1	1-1: <b>Analyze</b> sewerage service management 1-2: <b>Estimate</b> sewage inflow volume at the WWTP 1-3: Plan for the <b>sewer network expansion</b> 1-4: Study securing the <b>funds</b> options 1-5: <b>Donor support</b> promotion in cooperation with PWA

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### 1.3 Activities

Output	Activity
Output 2	2-1: Water quality <b>SOPs/manuals</b> revision 2-2: OJT for water <b>quality</b> testing. 2-3: Conduct a <b>seminar</b> on how to evaluate and deal with water quality test results.
Output 3	3-1: <b>Study sewage sludge</b> treatment 3-2: <b>Reuse</b> treated sewage sludge

6

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## Output-1

## 2. Sewer System Development

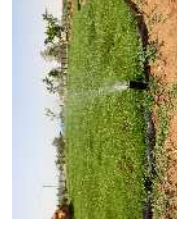
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### 2.1 SDGs in Jericho Sewerage Project



1) Solar power generation  
Covers about 1/5 of the power consumption of WWTP



2) Reuse of Treated Wastewater  
First sale of Treated Wastewater in Palestine  
Important source of income



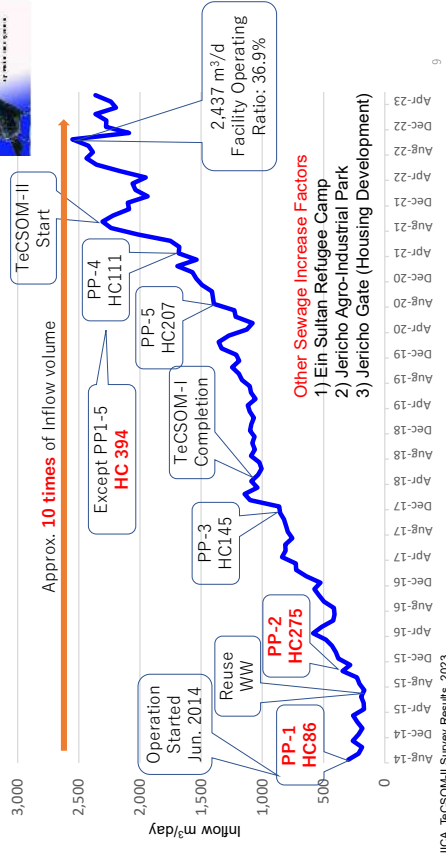
3) Reuse of sewage sludge  
**Reuse as soil conditioner**



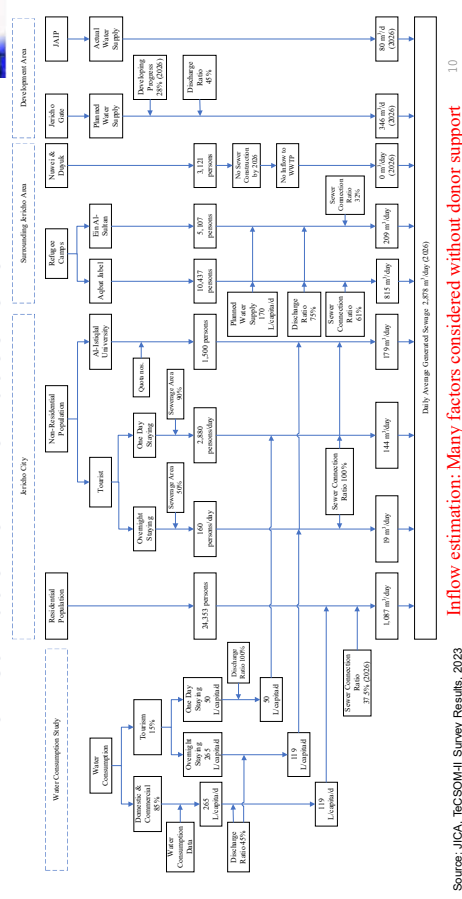
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## 2.2 Inflow to WWTP and Pilot Projects



## 2.3 Estimation of inflow at Jericho WWTP



## 2.4 Planned Daily Maximum Inflow

Year	2022	2023	2024	2025	2026
Planned Daily Average Inflow (m³/day)	2,053	2,294	2,618	2,744	2,878
Planned Daily Maximum Inflow (m³/day)	2,690	3,005	3,430	3,595	3,771
Reactor No.1	On	On	On	On	On
Reactor No.2	-	-	On	On	On

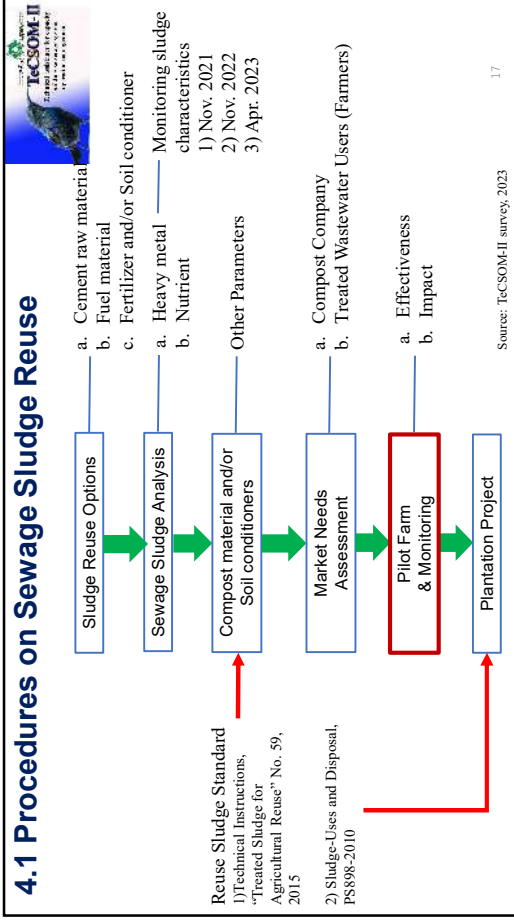
← 2<sup>nd</sup> Reactor of the WWTP will start

Source: JICA, TeCSOM-II Survey Results, 2023

# Output-2

## 3. Reuse of Treated Wastewater





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### 4.2 Technical Instructions, 59 for year 2015 -Treated Sludge for Agricultural Reuse-

- Treated sludge: To be treated biologically, chemically, **thermally**, etc.
- Prevent reuse of treated sludge
  - Grassland or fodder crops
  - Fruits and vegetables, **but except a fruit tree**
  - Direct contact with soil

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### 4.3 Sludge Uses and Disposal, PS 898-2010

- Field of Application
 

Reuse Purpose	Class I	Class II	Class III
1) Organic fertilizer for agricultural purposes	Applicable	NA	NA
2) Improvement of soil properties	Applicable	Applicable	NA
3) Disposal to landfill	-	-	Applicable
- Not permitted to use Treated sludge
  - Vegetables
  - Park, home gardens, green spaces near public sites (not less than 250 m)
  - Root crops (radish, potatoes)
- Treated sludge package for **sale purpose**  
Approval of the competent regulatory authorities is required.
- Level of treated of sludge for first category  
Air drying: **dried in drying beds**

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### 4.4 Heavy Metal Concentrations in Sludge for Use in Agriculture

Parameters	Palestine <sup>b</sup>	Soil (2014)	Sludge (2014)	Sludge (2015)	Sludge (2021)	Sludge (2022)	Sludge (2023)
Cadmium	20	ND <sup>2)</sup>	3.2	1.94	ND	ND	1.2
Copper	1,000	33.6	279.5	153.3	0.179	1.81	230.7
Nickel	300	39.5	30.2	31.9	0.026	0.15	24.8
Lead	750	ND	29.7	15.7	0.018	0.15	22.99
Zinc	2,500	100.4	1,258	1,029	0.55	3.59	518.9
Mercury	16	0.0133	2.969	1.67	ND	ND	ND
Chromium	400	42.4	ND	43.45	0.039	0.28	31.36

Unit: mg/kg of dry matter

1) Certification of Obligatory Technical Instructions, Treated Sludge for Agricultural Reuse, 59 for year 2015  
2) ND: Not Detected  
Data Source: JICA, TeCSOM Project Completion Report, 2018, TeCSOM-II Survey Results, 2023

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### 4.5 Pilot Plant at JWWTP

- Start in December 2014
- Jericho WWTP
- Palm Date, Orange, Lemon, Alfalfa, Corn
- Area: 1.75 dunam
- Potable Water vs Treated Wastewater
- Chemical Fertilizer vs Sewage Sludge
- Evaluation: Appearance, Fruit ingredients
- At present, Ongoing pilot

Source: TeCSOM-II survey, 2023

### 4.6 Experimental Farm

Objective: Measuring the effectiveness of soil improvement with sewage sludge under general soil conditions.

- 1) Location: Block Al Masna No. 33026 (Parcel 1+2)
- 2) Target crops: 2 Date Palm trees, 15 Lemon trees
- 3) Area: 2 dunam (2,000 m<sup>2</sup>)
- 4) Reuse Option: Soil conditioner, mixing soil with dried sludge
- 5) Schedule: End of November, fertilizer spraying season

Source: TeCSOM-II survey, 2023

### 4.7 Samed Land

**Before Cleaning**  
13 February 2023

**After Cleaning**  
27 February 2023

Source: TeCSOM-II survey, 2023

### 4.8 Soil Conditioner Characteristics

Parameters	unit	Sludge <sup>1)</sup> (2021)	Sludge <sup>1)</sup> (2022)	Sludge <sup>1)</sup> (2023)	Samed <sup>2)</sup> Soil (2022)	Soil Conditioner Standard <sup>3)</sup>	Improve ment of Soil <sup>4)</sup>
Nitrogen (N)	%	2.855	4.0	4.4	0.085	>1.5	
Phosphate (P <sub>2</sub> O <sub>5</sub> )	mg/kg	219	215	205	22.6		
Kalium (K <sub>2</sub> O)	mg/kg	323	326	320	32.5		
pH		6.8	6.9	6.9	7.26	<7.5	5.0-8.5
EC	dS/m	7.7	7.5	8.7	1.32	<15	
Moisture Content	%	9.9	8.9	14.4	9.4	<20	25-40
Total Fecal Coliform <sup>3)</sup>	CFU/100 mL	Nil	Nil	Nil	Nil	<10	
Total Organic Matter	%	62.83	63.76	59.9	8.43	>50	>25
Carbon-Nitrogen ratio (C:N)		11:1	8:1	13:1	99.2	<15:1	<25:1

1) TeCSOM-II, Sewage analysis by An-Najah National University, TeCSOM-II Survey Results, 2023  
 2) Palestine Standard PS609:2014, Organic fertilizers and soil conditioners  
 3) U.S. EPA, 1999, Environmental Regulations and Technology, EPA stipulates Class A less than 1,000 MNP per 1 gram  
 4) Palestine Standard PS 2652:2011, Organic Fertilizer (Humus) Compost

#### 4.9 Jericho Treated Sludge

- 1) Safety: Heavy metal content
  - 100% Compliance** with the Palestine Standards
- 2) Effectiveness
  - Nutrients** (nitrogen, phosphorus, potassium) :
  - 10 to 40 times** more compared to the Samed Land's soils
- 3) Barriers to Promoting Reuse
  - MoA cares about using treated sludge without license
  - Farm owners concerned about **reputational damage**



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#### 4.10 Different Situations between Treated Wastewater and Sewage Sludge Reuse

- (1) Treated Wastewater
    - Restriction of new water resources in Area C
    - High water demand for agricultural use / shortage of water
    - Higher salinity in groundwater
    - Higher cost of groundwater production due to electricity costs
  - (2) Sewage Sludge
    - Alternative products in markets (chemical, animal, compost, etc.)
    - Avoidance of sewage sludge due to human waste
    - Unclean image
- Advantages: Low moisture content (10%), Total Fecal Coliform: Nil (Zero), Nutrition (Nitrogen)



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#### 4.11 Workshop on Reuse

- 1) Workshop with the MoA & Palm Farmers' Cooperative Association (PFCA) in Jericho
  - Introduce of Reuse of Treated Wastewater and Treated Sludge
  - Water Quality Management at the Jericho WWTP
- 2) After the workshop, some negative opinions (by the farmers) changed to positive, for example :
  - The head of PFCA (**Not treated wastewater user**) requested 3 trucks of the treated sewage sludge to use experiment/pilot in his own palm farm
  - PFCA deputy (**treated wastewater user**) encourage the MoA and all stakeholders to establish committee to study the reuse of the treated sewage sludge.



Head of PFCA recommendations



WWTD Director showing sample of treated sludge

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#### 4.12 Plastic Bag Indication/Design

Front side

##### Soil Conditioner

- Dried Treated Sludge-  
(Compliance of Palestine Standards)



25 L/ bag

Jericho Municipality

Water and Wastewater Department

Back side

- 1) Appropriate quantity and Use  
Approximately 1 m<sup>3</sup>/dunum/year  
Non-productive age tree (preferable)
- 2) Ingredient label with standard values  
**Heavy metals, components, PSI**  
(See page 15 & 20)
- 3) Use prohibited items  
grassland, fodder crops, fruit, vegetables, root crops, park home gardens, green spaces
- 4) Contact & Message  
Reuse, SDGs  
Jericho Municipality, Water and Wastewater Department, E-mail, phone number

\*Information Written in English and Arabic

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### 4.13 Plantation Project

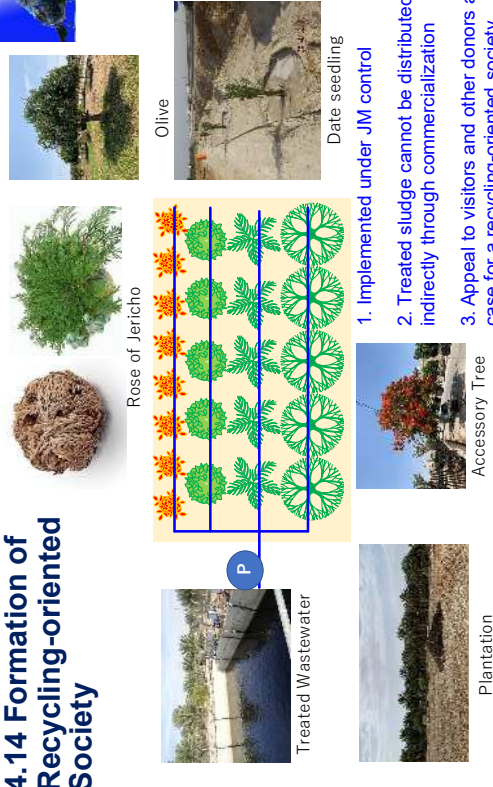


Approx. 7,000 m<sup>2</sup>

- **Plantation** (Palm tree, Olive, Paulownia)
- Reusing Treated Wastewater & Treated Sludge
- Effective publicity for visitors
- Reuse of treated wastewater & sludge
- Place of rest and recreation
- Contribution to JM's strategic plan

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### 4.14 Formation of Recycling-oriented Society



Treated Wastewater

Rose of Jericho

Olive

Date seedling


Accessory Tree

Plantation

1. Implemented under JM control
2. Treated sludge cannot be distributed directly, but indirectly through commercialization
3. Appeal to visitors and other donors as a model case for a recycling-oriented society

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### 4.15 Plantation Project



Under Construction as of 21 June 2023

20 Olive Trees planted  
With dried sludge 10 trucks (160 m<sup>3</sup>)

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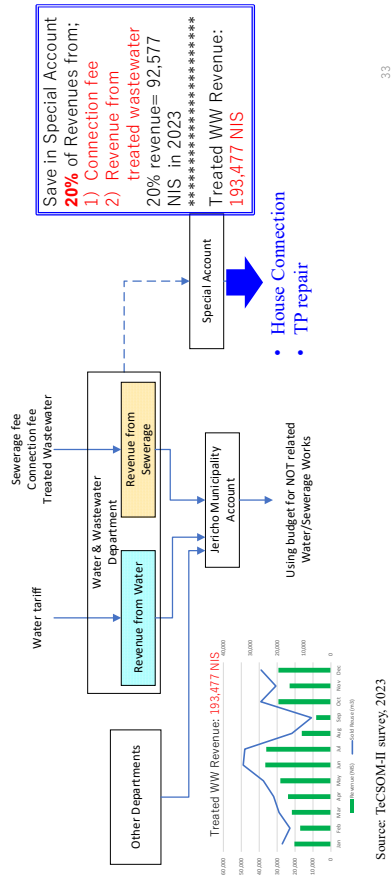
## Output 1

# 5. Sewerage Management

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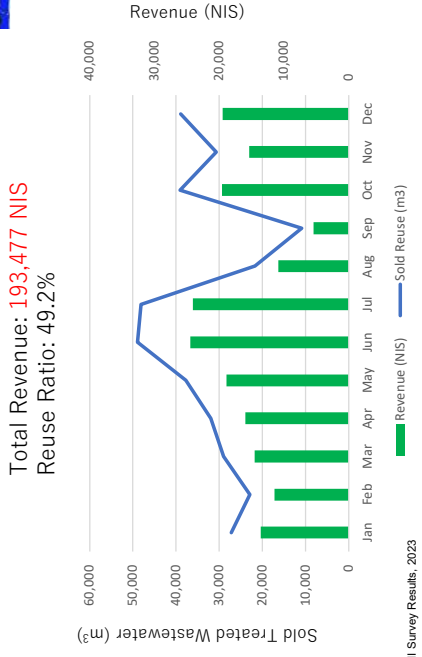


## 5.1 Special Account in WWD



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## 5.2 Treated Wastewater Revenue in 2022



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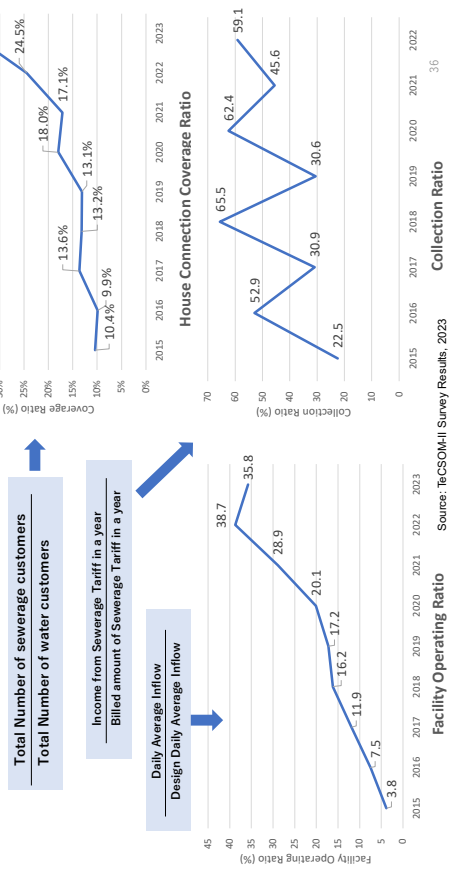
## 5.3 KPIs

KPI	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023
1 Sewer Network Coverage Ratio	%	33.9	33.9	33.9	47.3	47.3	47.3	47.3	47.3	47.3
2 House Connection Coverage Ratio	%	10.4	9.9	13.6	13.2	13.1	18.2	17.1	24.5	36.0
3 Wastewater Quality Compliance	%	89	92	-	-	-	-	97.3	94.6	100
4 Sewage Sludge Quality Compliance	%	100	-	-	-	-	-	100	100	100
5 Facility Operating Ratio	%	3.8	7.5	11.9	16.2	17.2	20.1	28.9	38.7	35.8
6 Reuse Ratio of Treated Wastewater	%	0	0	84	73	79	86	75	49	51
7 Unit Treatment Cost	NIS /m³	1.14	1.03	1.05	1.04	1.06	1.06	1.05	0.96	-
8 Operation Ratio	%	24.57	11.74	13.98	4.45	11.35	3.25	4.22	2.77	-
9 Collection Ratio	%	22.5	52.9	30.9	65.5	30.6	62.4	45.6	59.1	-

Source: TeCSOM-II Survey Results, 2023

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## 5.4 KPIs Transition



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## 5.3 KPIs

KPI	Unit	2015	2016	2017	2018	2019	2020	2021	2022	2023
1 Sewer Network Coverage Ratio	%	33.9	33.9	33.9	47.3	47.3	47.3	47.3	47.3	47.3
2 House Connection Coverage Ratio	%	10.4	9.9	13.6	13.2	13.1	18.2	17.1	24.5	36.0
3 Wastewater Quality Compliance	%	89	92	-	-	-	-	97.3	94.6	100
4 Sewage Sludge Quality Compliance	%	100	-	-	-	-	-	100	100	100
5 Facility Operating Ratio	%	3.8	7.5	11.9	16.2	17.2	20.1	28.9	38.7	35.8
6 Reuse Ratio of Treated Wastewater	%	0	0	84	73	79	86	75	49	51
7 Unit Treatment Cost	NIS /m³	1.14	1.03	1.05	1.04	1.06	1.06	1.05	0.96	-
8 Operation Ratio	%	24.57	11.74	13.98	4.45	11.35	3.25	4.22	2.77	-
9 Collection Ratio	%	22.5	52.9	30.9	65.5	30.6	62.4	45.6	59.1	-

Source: TeCSOM-II Survey Results, 2023

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## 5.5 JM initiatives on Increasing Revenues

### (1) Debt collection

- Individual debts
- Governmental debts

### (2) Improvement of fee collection ratios

- Promotion of PPWM adoption
- Introduction of new Billing System
- Introduction of penalty rules
- Collection of water and sewerage fees

### (3) Elimination of fees unbilled

- Sewer connection and Sewerage fees from PP4 & PP5
- Replacement of defective water meters
- "0" reading: 1,200 ⇒ less than 100 meters

### (4) Increase in revenue sources

- Increase in water and sewerage fees
- Application fees of water
- Extraction of houses with possible sewer connection by WWD

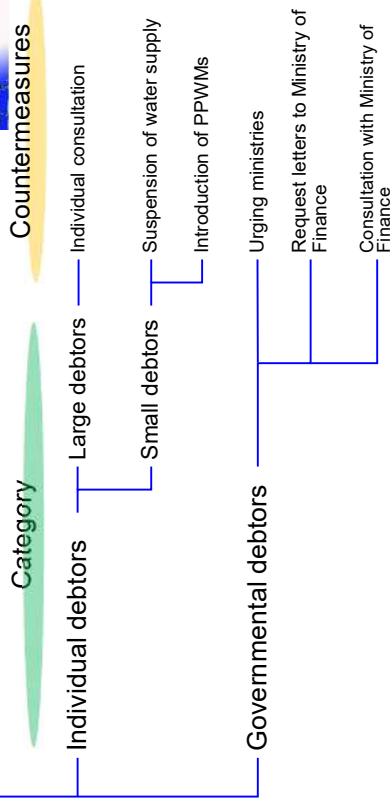
### (5) Public Awareness

- Collected fees are invested in the sewerage services

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## 5.6 Debt Collection



Source: TeCSOM-II Survey Results, 2023

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## 5.7 Improvement of Fee Collection Ratios

### Countermeasures

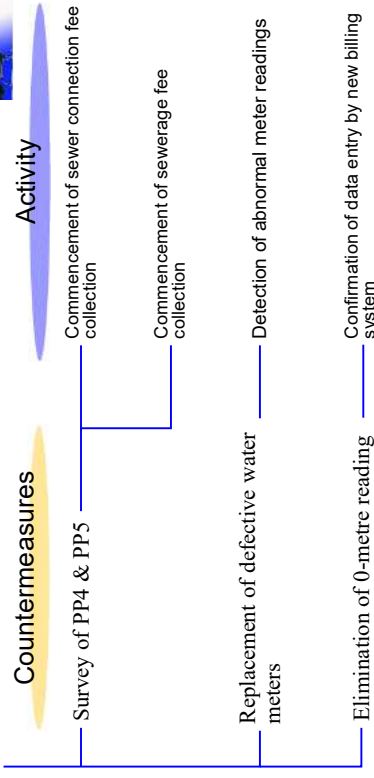


Source: TeCSOM-II Survey Results, 2023

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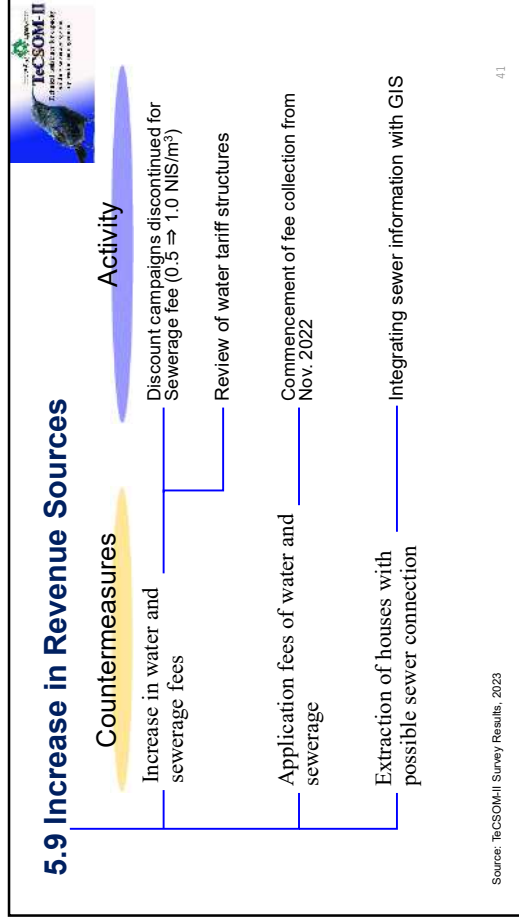
## 5.8 Elimination of Fees Unbilled



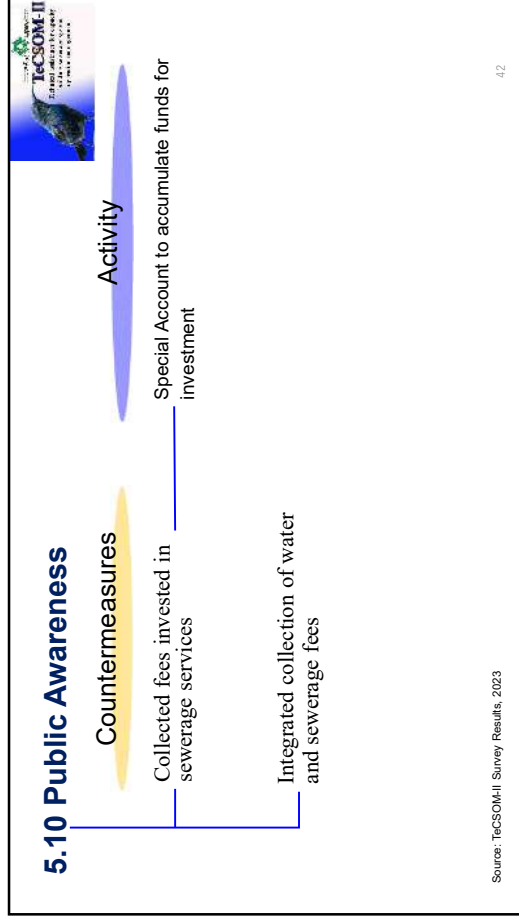
Source: TeCSOM-II Survey Results, 2023

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**6. Jericho Municipality Message**

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**8. JM Message**

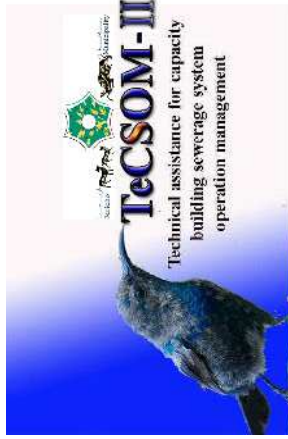
To achieve “Green City” in Jericho future vision

1. To achieve “Green City” in Jericho future vision
2. Improvement of the living environment and groundwater conservation through sewerage development
3. Maintaining treated wastewater quality through appropriate O&M and water quality management
4. Maintaining sewers and Jericho WWTP
5. Tackle to first reuse the treated sludge to improve poor soil and to mitigate damping capacity (land) issues in the West Bank
6. Increase in sewerage fees and expansion of specific financial resources (Special Account) for sound sewerage management.
7. Enhance public relations activities (for the public and for donors)

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44

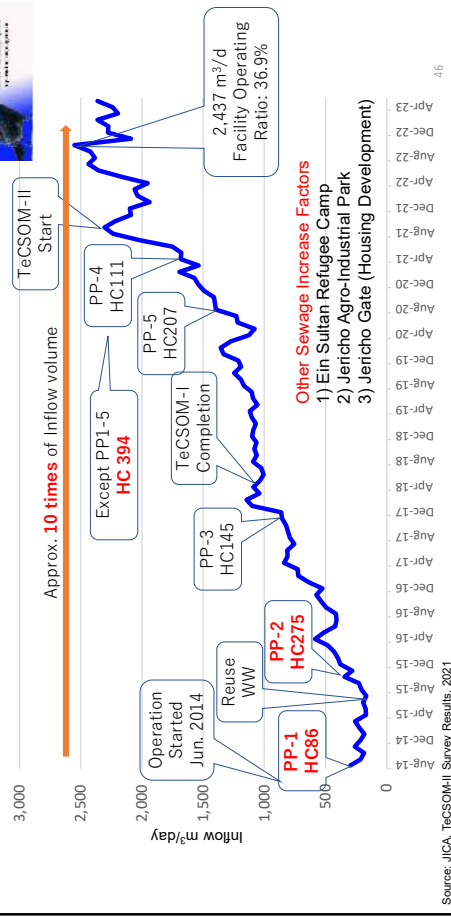
## Sustainable Wastewater Management of Jericho Municipality Reuse of Treated Wastewater and WWTP O&M



June 22, 2023  
Eng. Omran Khalaf, WWTP Chief Operator

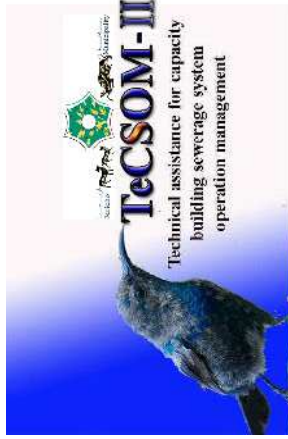
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## 4.2 Inflow to WWTP and Pilot Projects (NEW)



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## 2. Reuse Ratio of Treated Wastewater



June 22, 2023  
Eng. Omran Khalaf, WWTP Chief Operator

45

- 1) First sale in Palestine
- 2) Crucial income for JM
- 3) Contentious experimental farm with Treated Wastewater
- 4) Increasing Treated Wastewater Demand from Fame owners

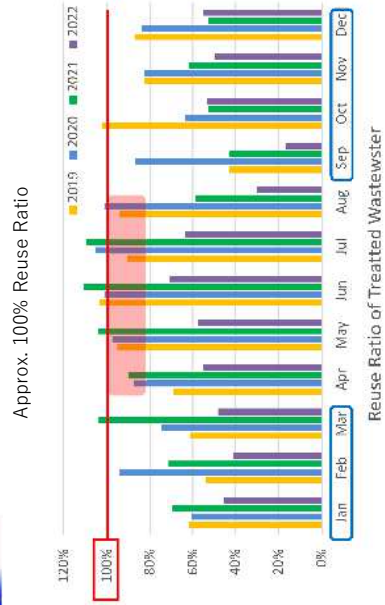


Photo: JICA, TeCSOM Team

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## 3. Cooperation with Water Quality Management

- (1) Water Quality Tests in the Laboratory in the Jericho WWTP
  - OJT with revised SOPs conducted by Japanese Experts
- (2) Periodic water quality monitoring
  - Data accumulation
  - Data analysis (the reuse standards, operation factors, etc.)
- (3) Linkage to the WWTP operation and maintenance
- (4) **Treated wastewater quality assurance**



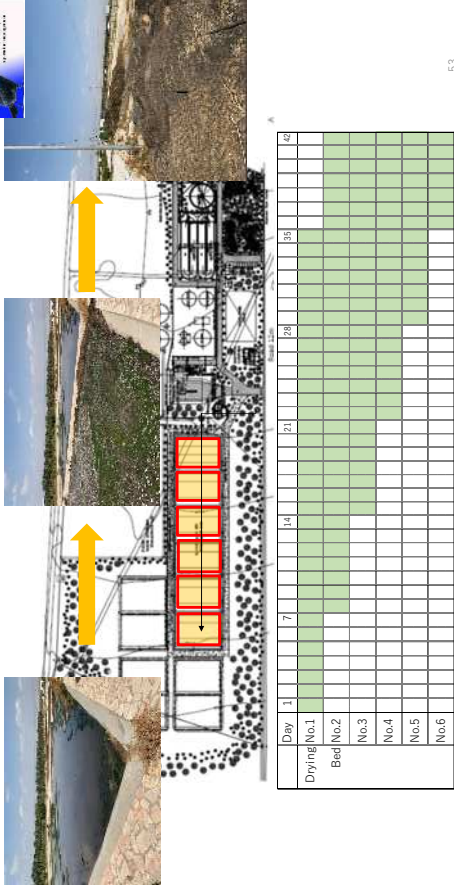
Feedback in operation  
Check by measuring water quality

Photo: JICA, TeCSOM Team

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## 9. Sludge Drying Beds at WWTP



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## 10. Challenges

1. Guarantying water quality by proper operation
2. Extending the lifetime of the WWTP with proper maintenance
3. Studying tenders for outsource
  - JM initially tried to recruit elector mechanical engineer/technician, however, there was NO applicant.
4. Secure the budget for outsource by sold treated wastewater

## Capacity Development for Sustainable Wastewater Management of Jericho Municipality

### Water Quality Management



June 22, 2023  
Lab Technician  
Arwa A. Abusrouf

## Part 1 Activities in TeCSOM-II

1. Revision of water quality management manual and SOPs

*Purpose:* To implement systematic and reliable water quality monitoring

- Develop monitoring plan
- Revise SOPs
- Develop response plan on unusual sewage inflow
- Develop procurement plan

## Revision of water quality management manuals and SOPs

### Water quality monitoring plan

- Monitoring of influent sewage, reactor tank and treated wastewater according to schedule
- Daily monitoring enables proper control of the reactor tank and water quality.
- 12 of the 38 items in the water quality standards for irrigation use of treated sewage (PL742-2015) are monitored.

Category of monitoring	Monitoring Item	Schedule
Inflow sewer	Trunk No.19 and No.1	Water temperature, pH, EC and TDS COD, Total nitrogen and Phosphate (PO <sub>4</sub> -P)
	WWTP Inflow pit	Water temperature, pH, EC and TDS COD, Total nitrogen and Phosphate (PO <sub>4</sub> -P) and BOD <sub>5</sub> Nitrate (NO <sub>3</sub> <sup>-</sup> ) and Ammonia (NH <sub>4</sub> <sup>+</sup> )
Treatment process	Reactor tank	Water temperature, pH, EC, SV <sub>30</sub> , MLSS Water temperature, pH, EC, TDS, DO and Turbidity
	Treated water tank	COD, Total nitrogen and PO <sub>4</sub> -P TSS
Treated wastewater	NO <sub>3</sub> <sup>-</sup> , NH <sub>4</sub> <sup>+</sup> and BOD <sub>5</sub>	Weekly

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## Revision of water quality management manuals and SOPs

### List of revised SOPs

- Develop SOPs for water quality measurement, use of analytical equipment, sampling and data quality control.

Item	Contents
pH/EC/TDS	pH/EC/TDS measurement by pH/EC / TDSmeter
Turbidity	Turbidity measurement by turbidity meter
BOD <sub>5</sub>	BOD <sub>5</sub> measurement using respirometer
Phyto spectrometer guide	Simple operation guide of spectro photometer
NH <sub>4</sub> -N (Low range / High range)	Ammonia measurement by colorimetry using spectrometer.
NO <sub>3</sub> -N (Low range / High range)	Nitrate measurement by colorimetry using spectrometer.
T-N (Low range / High range) *	Total nitrogen measurement by colorimetry using spectrometer.
COD (Low range / High range) *	COD measurement by colorimetry using spectrometer.
PO <sub>4</sub> -P (Low range / High range)	Phosphate measurement by colorimetry using spectrometer.
TSS	TSS measurement by gravimetry
Sampling procedure	Technical instruction of sampling procedure
Analysis data quality management	Technical instruction of monitoring data quality control

\*Different SOPs for high and low concentration measurements were developed.

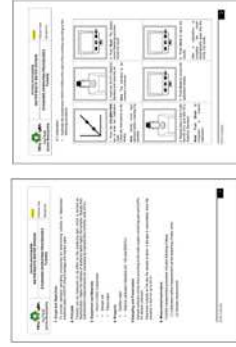
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## Revision of water quality management manuals and SOPs

### Revise SOPs

- Revised concise SOPs that can be referred to at any time during laboratory operations
- SOPs for water quality analysis performed in WWTP laboratory, sampling and data quality control has been in place



### Features of revised SOPs

- Describes only the essentials of the measurement operation
- Easy-to-understand description system with diagrams

## Develop response plan on unusual sewage inflow

This Response plan aims to protect treated wastewater quality for agricultural re-use

- pH and TDS, for which data can be obtained in situ, as indicators of abnormal sewage quality
- Response plans were developed for each of pH and TDS

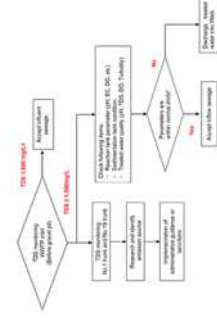
Response plan for unusual TDS level of inflow sewage

- Action level was defined for pH and TDS.
- pH: When deviating from the range defined by pL742-2015 (6 < pH < 9).
- TDS: Determined from TDS data of influent sewage and treated wastewater and the removal ratio of TDS.

Features of Response plan

Framework of Response plan

- Even in case of unusual sewage inflow in WWTP, sewage treatment is continued.
- However, treated wastewater is not led to clear water tank and is discharged from the bypass gate



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## Develop Procurement Plan

### Development of annual procurement plan

- Procurement plans was determined in accordance with the monitoring plan
- Reagent procurement is conducted by six months or one year in accordance with the procurement rule of Jericho Municipality.

Reagent procurement plan: Quantity estimation (extract)

Item	Sample place	Reference Raw and Criteria	Test/month tests / sample)	Test /year (Month x 12)	Reagent
Total Nitrogen	Effluent	PS742-2015: High quality (A)	28	336	TN-LR
	Influent	Jericho WWTP Design parameter	20	240	TN-HR
	Trunk No.1	Jericho WWTP Design parameter	8	96	TN-HR
	Trunk No.19	Jericho WWTP Design parameter	8	96	TN-HR
COD	Effluent	PS742-2015: High quality (A)	28	336	COD LR
	Influent	Jericho WWTP Design parameter	20	240	COD HR
	Trunk No.1	Cabinet resolution No.16-2013	8	96	COD HR
	Trunk No.19	Cabinet resolution No.16-2013	8	96	COD HR

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## Part 1 Activities in TeCSOM-II

### 2. OJT on water quality monitoring

**Purpose:** To implement accurate water quality monitoring

- Training in the correct use of analytical equipment
- Conduct monitoring in accordance with SOPs and Monitoring plan
- Accuracy control of analytical equipment by the regular calibration

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## OJT on Water quality monitoring

### Conduct OJT

- OJT was is conducted in the regular water quality monitoring work according with the monitoring plan

#### Regular sampling point

Regular monitoring is sampled at the WWTP site

Category of monitoring	Schedule
Trunk No.19 and	Daily
Inflow sewer	Weekly
WWTP inflow pit	Daily
	2 times / Week
Treatment process	Weekly
Reactor tank	Daily
Treated wastewater	Daily
	3 times / week
	2 times / week
	Weekly



## OJT on Water Quality Monitoring

### Outcome of OJT

- Enhancement of knowledge and skills of water quality management and water quality analysis
- Data quality management on water quality analyze
- Utilization of monitoring data



Sampling and on-site monitoring

Calibration

Sample preparation for spectrometric analysis

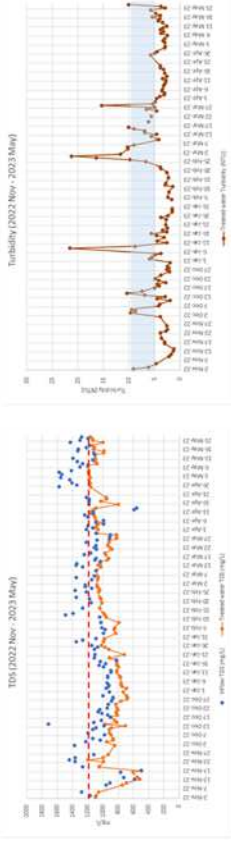
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## OJT on Water Quality Monitoring

Outcome of OJT: Introduce water quality data



TDS and Turbidity of treated wastewater almost satisfy PS742-2015 High quality Category

- The continuous water quality measurement and accumulation of monitoring data have helped me to understand trends in water quality change and baseline water quality of Jericho's sewer.

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## OJT on Water Quality Monitoring

Outcome of OJT: Introduce water quality data



Organic matter (COD) and nitrogen compounds (total nitrogen) are removed by the WWTP treatment process.

- Learning various kinds of data analysis methods allows me to understand and explain water quality change and features of WWTP.

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## Part1: Activities in TeCSOM-II

### 3.Enhancement capacity of monitoring data utilization

*Purpose:* Enhance capacity of monitoring data utilization

- Presentation and discussion of monitoring data
- Share water quality information with WWTP operator and improve WWTP operation
- Provide water quality data to the public and gain their understanding of treated wastewater reuse

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### Enhancement Capacity of Monitoring Data Utilization

Sharing of water quality information in JM

- Daily report
- Weekly meeting (TeCSOM-II)
- Discussion with WWTP operator



Discussion with WWTP staff

Presentation and discussion at weekly meeting

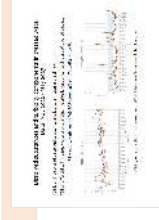
- Provides basic information to improve water quality
- Identifies problems and issues

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**Enhancement Capacity of Monitoring Data Utilization**

**Publicity of water quality information**

- Presentation at workshop
- Information disclosure on the Jericho Municipality Web
- Public disclosure of water quality data to the public



2022 Dec.6 3rd JCC and Workshop



2023 Jun.7 PECA workshop

- Water quality information on the web (preparing for publication)
- Provide information to citizens with clear explanations and graphs

**Part2: Outcomes**  
**Lessons learnt from TeCSOM-II training**

**Enhancement capacity of water quality monitoring**

- ✓ Obtaining reliable water quality data in accordance with SOPs and monitoring plan

**Accumulation of water quality data and its use**

- ✓ Understanding of water quality baselines (degree of usual water quality) through the accumulation of reliable data
- ✓ The water quality baseline data provides the awareness of abnormality of water quality and treatment processes.

**Importance of credible water quality data**

- ✓ Reliable water quality data is important to explain to the public the safety of reusing treated wastewater and treated sludge.

**In conclusion**

- Water Quality monitoring and testing skills were learned & improved
- Procurement Planning was considered and improved.

Thank You For Your Attention

**Capacity Development for Sustainable Wastewater Management of Jericho Municipality**  
**Sewer Network Data Integration \_GIS & Sewer Planning**



Eng. Shirad Alsafadi & Eng. Mohammad Fityani  
22<sup>nd</sup> June ,2023

**Discussion topics:**

- ❑ Sewer Data comparison before & after TeCSOM-II
- ❑ Review the decided objectives for the sewer data integration with GIS
- ❑ Summary of the sewer data integration progress
- ❑ Future development on the integrated GIS data

**Sewer Data comparison before & after TeCSOM-II**

Available data:  
 1) Plans :Sewer pipelines and manholes ,  
 2) Sewer pipe profiles , 3 ) Excel data.

Result on GIS:  
 Integrated data on GIS (Systematic)

Each Department/section has separately data (not systematic)

**Review the decided objectives for the sewer data integration with GIS**

**Building Sewer Data integration using GIS (Objectives):**

1. The sewer network projects' As-built drawings in is compiled.(JICA ,USAID , Pilot projects 1,2,3,4 &5)
2. Using the sewer network data in doing network analysis is easy and accessible.
3. Sewer network data is updated and shared with the related departments and sections.
4. Sewer network project phases are easily categorized.
5. Connected & unconnected buildings are visualized.
6. Sewer network extension , planning is supported.

**Building Sewer Data integration using GIS (Objectives 1+4):**

1. & 4 The sewer network projects' As-built drawings in is compiled.(JICA ,USAID , Pilot projects 1,2,3,4 &5) ,/Sewer network project phases are easily categorized.

- Compiled sewer network , different sewer projects can be shown now with different colors in the same interface.
- Sewer project phases can be visualized ,symbolized and analyzed easily.

**Building Sewer Data integration using GIS (Objectives 2):**

2. Using the sewer network data in doing network analysis is easy and accessible.

Field	Length	Minimum	Elevation
Count	231	0	252.7772131
Minimum	0.015028	0	252.7772131
Maximum	127.717182	0	252.7772131
Sum	127.717182	0	252.7772131
Standard Deviation	25.754305	0	252.7772131
Variance	0	0	252.7772131
Mode	0	0	252.7772131

**GIS data utilization in WWD work and sewer planning**

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**Building Sewer Data integration using GIS (Objectives 3):**

3. Sewer network data is updated and shared with the related departments and sections.

WWD/ Head of CSS using the GIS data in the daily work

WWD director &/ Head of CSS using the GIS data for the sewer planning survey with USAD(potential future support to JM)

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**Building Sewer Data integration using GIS (Objectives 5):**

5. Connected & unconnected buildings are visualized.

- Connected buildings were marked within the served area by the WWD/head of CSS
- Data being used to plan for the future house connections for the unconnected buildings.

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### Building Sewer Data integration using GIS (Objectives 6):

6. Sewer network extension, planning is supported.

- High densely residential areas and large water users were identified
- Efficient routes were selected
- Future sewer planned

→

- The First priority routes: approximately 32 km and the project cost estimated
- Number of Beneficiaries/Buildings

→

- Quick responses to a donor's inquiries
- Ease to adjust the scope of works

Source: TICSOM-II survey, 2023

### Building Sewer Data integration using GIS (Objectives 6):

6. Sewer network extension, sewer planning is supported.

- “Connected House Area”: 36% (2022)
- “Constructed Sewer Area”: 47.3% (2022)

Required House Connections

Required Sewer Networks

Figure: JICA, TICSOM Team

### Summary of the sewer data integration progress

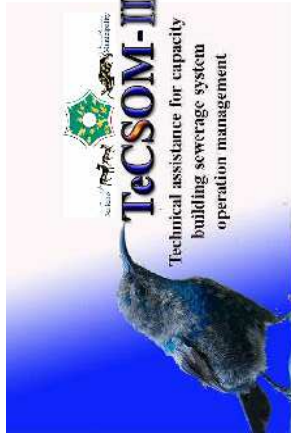
Project Name	Progress Status	Key Findings / Actions
PPFDMA	100% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	90% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	80% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	70% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	60% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	50% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	40% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	30% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	20% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.
PPFDCA	10% finished	JM is to conduct further site survey in order to improve the house coordinates and indicate the parts in the public road more precisely.

Source: TICSOM-II survey, 2023

### Future development on the integrated GIS data

- Increase the accuracy of the sewer locations after transferring the data to the GIS. (requires the site survey by the GPS).
- Complete filling the attribute tables related to the geographic shapefiles. (Requires the GIS data entry).
- Improve the archiving system for the sewer as built data (GIS section in cooperation with related departments).
- Indicate any new sewer construction on the GIS established files. (WWD in cooperation with GIS section)

Capacity Development for Sustainable  
Wastewater Management of Jericho Municipality  
**Project Evaluation and Recommendations**



June 22, 2023  
Chief Advisor, Satoru Oniki

# 1. Self-Evaluation of TeCSOM-II with 6 Criteria

## 1.1 Project Purpose

**Sustainable Wastewater Management System is established in Jericho Municipality**

Overall Goals :  
Sewerage facilities in JM are operated and managed appropriately under sound financial conditions.

## 1.2 Six (6) Evaluation Criteria

### 1. Relevance

- Policies of Palestine
- Needs of target groups
- Japan's ODA policy

### 2. Coherence

- Interventions by the same organization
- Synergies and interlinkages
- International norms and standards

### 3. Effectiveness

- Project purpose achieved
- Factors influencing achievement
- Outputs produced by Project contribute

### 4. Efficiency

- Outputs produced by using inputs resources

### 5. Impact

- Overall goal will be achieved
- Expected and unexpected effects

### 6. Sustainability

- Policies to endorse activities
- Organizational arrangements
- Adequate skills/knowledge
- Budgets sufficiently allocated

**(1) Relevance**

Low Relatively Low Moderate Relatively High High

**1) Development Policy of the State of Palestine**



- The National Policy Agenda of the State of the Palestine (2017-22) & National Water and Wastewater Policy and Strategy for Palestine (2013)

**2) Counterpart Needs**

- JM aims to a **recycling-oriented society**. Aims to reduce CO<sub>2</sub> emissions by solar power facilities, To reuse treated wastewater, To reuse treated sewage sludge.

**3) Japan's ODA Policy**

- The Government of Japan has stated in its 'Corridors of Peace and Prosperity' to strengthen the economic and social infrastructure of the Jordan Valley.
- Jericho WWTP plays a major role** in the initiative and is a basic infrastructure for the socio-economic development of the region.



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**(2) Coherence**

Low Relatively Low Moderate Relatively High High

- Policy and donor support aim to **increase sewerage coverage**.
- JICA developed the **WWTP and sewers** (29.5 km) in 2014 and USAID constructed **sewers** (29.2 km) in 2018. Sewers & **sewer house connections** (Pilot Project) were installed with the support of JICA and PWA.
- A survey and design are being carried out by USAID to support the development of sewers in 2023. The design will include approx. 30 km of sewers, sewer house connections.

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**(3) Effectiveness**

Low Relatively Low Moderate Relatively High High

**1) Prospects for Achieving the Project Purpose**  
All outputs & 10 activities have been achieved

**2) Contributing Factors for Achieving the Project Purpose**  
JM: WWD, Finance Dept., PR sect., Control unit, Health and Environment Dept., Quality unit, Mayor and Council member, and others

**3) Communication and Ownership of the C/Ps**

- Establishment of a 'Special Account'
- New laboratory technician
- Reagents for water quality testing
- Revenue of treated wastewater (**outsourcing costs of WWTP maintenance**)
- Collection of water and sewerage fees
- Prepaid water meter installation
- Suspending water supply due to unpaid water bills
- Collection of debt from government institutions
- Increased water tariffs for **commercial users and villa**
- 3 Pilot plants for reuse of treated wastewater and treated sewage sludge

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**(4) Efficiency**

Low Relatively Low Moderate Relatively High High



**1) Japanese Side:** 3 Experts (for 19.5 man-months in total)

**2) JM Side**

- A total number of 18 staff members
- Meetings
  - JCC: 4 times
  - Weekly Meeting: 49 times
  - Related Authorities: 76 times
- To review Project issues, measures and progress & Minutes/memos of each meeting were distributed

**3) Ownership of the Project**

- Importance of **allocating and executing the necessary budget**. Regular and close communication between TeCSOM team and C/Ps contributed to the efficiency of the Project.

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**(5) Impact**

**1) Prospect for Achieving the Overall Goal**

- 9 KPIs were set to evaluate sewerage services.
- 1) C/Ps' regular reporting to the PWA of activities and improvements in sewerage services management, 2) PWA's participation in the ICC, 3) PWA's decision led to recommendations to other donors.

**2) Other Impacts:** Visitors from outside Jericho

- 1) Visit to the Jericho WWTP
- 2) School social studies
- 3) Learning about the WWTP O&M
- 4) Treated wastewater discharges and sewage sludge generation
- 5) Initiatives for reuse of treated wastewater and sludge

- JM has disseminated its activities on its website/social networking site, and positive impact was observed as a good practice.

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**1.1 Project Purpose**

**Sustainable Wastewater Management System is established in Jericho Municipality**

**Overall Goals :**  
**Sewerage facilities in JM are operated and managed appropriately under sound financial conditions.**

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**(6) Sustainability**

**1) Policy Aspect**

- **Strategic four-year plan including the expansion of further sewers.** JM has a green city vision, and treated wastewater is continuously effectively reused for irrigation. The treated sewage sludge for reuse as a soil conditioner.

**2) Technical Aspect**

- Water quality measurement skills, analytical and assessment capacities were improved. The WWTP being properly operated on the basis of water quality data.

**3) Financial Aspect**

- **To promote sewer connections.** WWD has started to accumulate funds in Special Account for sewer house connections and outsourcing costs for the WWTP.
- Increased water tariffs, eliminating zero-reading (replacement of water meters) and installing prepaid water meters.
- With donor support, **increased connections to sewerage systems** are expected to increase the amount of wastewater and treated wastewater. Revenues from 1) Sewer connection fees, 2) Sewerage fees, 3) Sale of treated wastewater, and reduced electricity costs with a new solar power generation facility.

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**1.3 Conclusion**

**Relevance** High

**Coherence** High

**Effectiveness** High

**Efficiency** Relatively High

**Impact** Relatively High

**Sustainability** Relatively High

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## 1.1 Perspectives on the 6 Evaluation Criteria (1)

Criteria	Perspectives of Evaluation
<b>Relevance</b>	<p>Was the Project objective/purpose consistent with</p> <ul style="list-style-type: none"> <li>Development policies of Palestine?</li> <li>Development needs of target groups/beneficiaries?</li> <li>Japan's ODA policy for recipient country?</li> </ul>
<b>Coherence</b>	<p>Was the Project consistent with</p> <ul style="list-style-type: none"> <li>Interventions by the same organization/government?</li> <li>Synergies and interlinkages of other interventions?</li> <li>International norms and standards followed by the organization/government?</li> </ul>
<b>Effectiveness</b>	<ul style="list-style-type: none"> <li>Was the Project purpose achieved?</li> <li>What were the major factors influencing achievement or non-achievement of the Project purpose?</li> <li>Were the outputs produced by the Project contribute to the achievement of the Project purpose?</li> </ul>

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## 1.1 Perspectives on the 6 Evaluation Criteria (2)

Criteria	Perspectives of Evaluation
<b>Efficiency</b>	<ul style="list-style-type: none"> <li>Were the outputs produced by using inputs resources efficiently?</li> </ul>
<b>Impact</b>	<ul style="list-style-type: none"> <li>Will the overall goal be achieved?</li> <li>What are the positive and negative changes as a result of the Project (expected and unexpected effects)?</li> </ul>
<b>Sustainability</b>	<p>Are the effects of the Project likely to continue in terms of the following aspects?</p> <ul style="list-style-type: none"> <li>Are there any policies to endorse activities to sustain project effects?</li> <li>Are these necessary organizational arrangements?</li> <li>Do the staff have adequate skills/knowledge?</li> <li>Are the budgets sufficiently allocated for activities to sustain project effects?</li> </ul>

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## (1) Relevance

High

- Development policy of the State of Palestine**
  - The National Policy Agenda of the State of the Palestine (2017-22) identifies the management and treatment of sewage and the expansion of its reuse as a priority. In its National Water and Wastewater Policy and Strategy for Palestine (2013), the PWA advocates 1) prevention of environmental pollution by sewage; 2) promotion of sewage system development; 3) agricultural use of treated wastewater as a new water source; and 4) proper sludge treatment and disposal.
- Counterpart Needs**
  - Jericho Municipality is obliged to promote the development of sewerage facilities, control the quality of treated wastewater, collect sewerage fees and manage human and financial resources to keep the sewerage facilities in good condition. Jericho Municipality aims to a recycling-oriented society. Jericho Municipality aims to reduce CO<sub>2</sub> emissions by installing solar power facilities (SDG target 7), reuse treated wastewater as a new water source (SDG target 6), and promote plant growth by reusing treated sewage sludge as a soil conditioner (SDG target 2).
- Japan's ODA Policy**
  - The Government of Japan has stated in its 'Corridors of Peace and Prosperity' initiative that it will strengthen the economic and social infrastructure of the Jordan Valley. The Jericho WWTP plays a major role in the initiative and is a basic infrastructure for the socio-economic development of the region as a whole. The Project, which contributes in terms of improving sewerage management capacity and strengthening the financial base, is also consistent with Japan's ODA policy.

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## (2) Coherence

High

- Policy and donor support aims to promote sewerage development projects and increase sewerage coverage.
- With donor support, JICA developed a WWTP and sewers (29.5 km in length) in 2014 and USAID constructed sewers (29.2 km in length) in 2018. In addition to the sewers, sewer house connections (Pilot Project) were installed with the support of JICA and PWA and increased connections to the sewerage system.
- A survey and design are being carried out by USAID to support the development of sewers in 2023. The design will include construction of approximately 30 km of sewers as well as sewer house connections. Once completed, the Project will contribute to a further increase in sewerage coverage.

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### (3) Effectiveness

High

- 1) Prospects for Achieving the Project Purpose
  - All outputs have been achieved, and the Project purpose is mostly achieved since ten activities were implemented to achieve three outputs.
- 2) Contributing Factors for Achieving the Project Purpose
  - Jericho Municipality has contributed to the effectiveness of the Project not only through the Water and Wastewater Department, which directly manages and supervises the sewage works, but also through information sharing and collaboration with the other departments, including the Finance Department, the Public Relations Department, the Legal unit, the Health and Environment Department, which manages pilot plants including Samed Land and carries out the plantation project.
- 3) Communication and Ownership of the Counterparts (C/Ps)
  - 1) Establishment of a 'Special Account' to secure funding for the construction of a sewer house connection; 2) Employment of a new water quality technician; 3) Recruitment of a mechanical and electrical engineer/technician (budgeted for, but resulted in no applicants); 4) Securing a budget to purchase reagents for water quality testing; 5) Specific financial resources for profits from sale of treated wastewater (outsourcing costs of WWTP maintenance); 6) Promotion of integrated collection of water and sewerage fees; 7) Promotion of prepaid water meter installation; 8) Regulations for suspending water supply due to unpaid water bills; 9) Collection of debt amounts from government institutions; 10) Securing financial resources through increased water tariffs for commercial users and villas; 11) Implementation of pilot plots for reuse of treated wastewater and treated sewage sludge and budgetary measures.

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### (4) Efficiency

Relatively High

- 1) Japanese Side
  - 3 Experts (for 19.5 man-months in total)
- 2) Jericho Side
  - A total number of 18 staff members were assigned from the departments/sections associated with the Jericho Municipality.
  - Meetings
    - JCC: 4 times
    - Weekly Meeting: 49 times
    - Related Authorities: 76 times
  - To review Project issues, measures and progress.
  - Minutes/memos of each meeting were prepared and distributed to the relevant parties to inform them of the proceedings.
- 3) Ownership of the Project
  - The C/Ps recognized the importance of allocating and executing the necessary budget. Regular and close communication between the TeCSOM team and the C/Ps also contributed to the effectiveness of the Project.

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### (5) Impact

Relatively High

- 1) Prospect for achieving the Overall Goal
  - 9 KPIs were set in the Project to assess sewerage services management. The C/Ps will need to continue monitoring sewerage management and implementing improvement measures against KPI values. The C/Ps' regular reporting to the PWA of activities and improvements in sewerage services management, the PWA's participation in the JCC, which has resulted in a high evaluation of Jericho Municipality's commitments to sewerage services management, and the PWA's decision that it was worthy of additional investments, led to recommendations to other donors, in particular the EU.
- 2) Other Impacts
  - Other impacts include visitors from outside Jericho visiting the Jericho WWTP. The objectives of the visit were: 1) a visit to the Jericho WWTP; 2) a school social studies visit; 3) learning about the WWTP operation and maintenance; 4) dealing with treated wastewater discharges and sewage sludge generation in the surrounding environment; and 5) initiatives for reuse of treated wastewater and sludge. The Public Relations Department of Jericho Municipality has disseminated its activities on its website/social networking site, and positive impact was observed as a good practice.

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### (6) Sustainability

Relatively High

- 1) Policy Aspect
  - Jericho Municipality is formulating a strategic four-year plan, which will include the expansion of further sewers in the next four years and in the future. Jericho Municipality has a green city as one of its visions, and treated wastewater generated from the WWTP will be continuously effectively reused for irrigation. The treated sewage sludge is targeted for reuse as a soil conditioner.
- 2) Technical Aspect
  - In water quality management, the C/Ps' water quality measurement skills and analytical and assessment capacities were improved during the project period. The WWTP is properly operated on the basis of accumulated water quality data. In the maintenance of the WWTP, attempts were made to recruit an engineer/technician but there were no applicants, and the policy was changed to outsourcing to cover the shortage of engineers and equipment repairs and procurements.
- 3) Financial Aspect
  - To promote sewer connections, the Water and Wastewater Department has started to accumulate funds in a newly established Special Account in order to secure funds for construction of sewer house connections. Profits from sale of treated wastewater are used to secure outsourcing costs for the WWTP.
  - In the water supply services, Jericho Municipality is increasing water tariffs for commercial users and new buildings, eliminating zero-reading (replacement of water meters) and installing prepaid water meters to secure financial resources.
  - Increased connections to sewerage systems with donor support are expected to increase the amount of wastewater and treated wastewater. The increase in sewerage users and treated wastewater is expected to be financed by revenues from sewer connection fees, increased sewerage fees, increased profits from sale of treated wastewater, and reduced electricity costs from installation of a new solar power generation facility.

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## 1.2 Conclusion

The effectiveness of the Project is rated high because it has improved the capacity of C/Ps in Jericho Municipality to manage sewerage services, and the Project targets are expected to be achieved. The Project relevance and coherence are rated high and the efficiency is relatively high. Impact is relatively high. The Project sustainability of the is relatively high, and could be further enhanced if financial resources are secured and appropriate facility maintenance is continued.

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## 2. Recommendations

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### 2. Recommendations (1)

#### (1) Regular Reports on Activities to Relevant authorities

- The C/Ps regularly report to the PWA on the activities and achievements of the Jericho sewerage services management. It is recommended that the C/Ps report on their efforts to promote the reuse of treated wastewater and treated sewage sludge through proper WWTP operation and maintenance and water quality management.

#### (2) Continuation of Water Quality Management and Sludge Measurements

- The C/Ps shall carry out regular water quality measurements and secure reagents, as well as analyzing the composition of the sludge, in particular the heavy metal contents. Water quality and heavy metal parameters that cannot be measured in the water quality laboratory should be outsourced and budgeted for. The measured data shall be used to demonstrate safety and to monitor the pilot project (including the status of tree growth).

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### 2. Recommendations (2)

#### (3) Publicity for Sewerage Project Activities

- It is recommended that the operational status of the WWTP, water quality data and sludge composition be disclosed on a regular basis on the Jericho Municipality's website. To inform the public of the activities of the sewerage services, the information is published on the website.

#### (4) Sewage Received from JAIP

- In receiving sewage from the JAIP, which plays a central role in the Japanese Government's "Corridor for Peace and Prosperity", an appropriate system should be established in full coordination with the relevant authorities for monitoring water quality, including the operation and maintenance of pre-treatment plant constructed by the RoJ support. It is expected that the Jericho WWTP shall start receiving sewage from the JAIP.

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# See You Again!!



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## **Appendix 4.8**

### **4<sup>th</sup> JCC Minutes of Meetings**

**MINUTES OF THE MEETING**  
**ON**  
**CAPACITY DEVELOPMENT FOR SUSTAINABLE WASTEWATER**  
**MANAGEMENT OF**  
**JERICHO MUNICIPALITY (TeCSOM-II)**

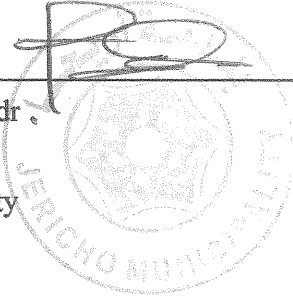
The fourth Joint Coordinating Committee Meeting (hereinafter referred to as “JCC”) on the Capacity Development for Sustainable Wastewater Management of the Jericho Municipality (hereinafter referred to as “the Project”) was held on the 22<sup>nd</sup> of June 2023 attended by both parties - the Palestinian and Japanese delegations.

It was concluded and agreed by both parties during the 4<sup>th</sup> JCC that the following Project post completion actions will be taken:

[Date: 22 June 2023]



Mr. Mitsutaka Hoshi  
Chief Representative,  
JICA Palestine Office



Mr. Abdulkarim Sidr  
Mayor,  
Jericho Municipality



Dr. Satoru Oniki  
Chief Advisor,  
The Project



Mr. Adel Yaseen  
Director,  
Palestinian Water Authority

The 4<sup>th</sup>/Final JCC was held on 22<sup>nd</sup> June 2023 and the following agenda was presented and agreed among the participants.

### **Main Points Discussed and Recommended**

#### **1. Regular Reports on Activities to Relevant Authorities**

The counterparts regularly report to the Palestinian Water Authority on the activities and achievements of the Jericho sewerage services management. It is recommended that the counterparts report on their efforts to promote the reuse of treated wastewater and treated sewage sludge through proper Wastewater Treatment Plant operation and maintenance and water quality management.

#### **2. Continuation of Water Quality Management and Sludge Composition Measurements**

The counterparts shall carry out regular water quality measurements and secure reagents, as well as analyze the composition of the sludge, in particular the heavy metal contents. Water quality and heavy metal parameters that cannot be measured in the water quality laboratory should be outsourced and budgeted for. The measured data shall be used to demonstrate safety and to monitor the pilot plants (including the status of tree growth).

#### **3. Publicity for Sewerage Project Activities**

It is recommended that the operational status of the Jericho Wastewater Treatment Plant, water quality data and sludge composition be disclosed on a regular basis on the Jericho Municipality's website. To inform the public of the activities of the sewerage services, the information is published on the website.

#### **4. Sewage Received from Jericho Agro-Industrial Park**

In receiving sewage from the Jericho Agro-Industrial Park, which plays a central role in the Japanese Government's "Corridor for Peace and Prosperity", the Jericho Municipality shall advise to establish an appropriate system in full coordination with the relevant authorities for monitoring water quality, including the operation and maintenance (O&M) of a pre-treatment plant constructed by the Representative Office of Japan to Palestine (RoJ) support. It is expected that the Jericho Wastewater Treatment Plant shall start receiving sewage from the Jericho Agro-Industrial Park.

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In the course of the discussions, both parties confirmed the recommendations of the Project and agreed on the project post completion follow-up.

Both sides acknowledged and agreed that the Minutes of Meeting may be executed by electronic signatures, which will be considered as original signatures for all purposes and shall have the same force and effect as an original signature. "Electronic signature" includes faxed versions of an original signature of electronically scanned and/or transmitted versions (e.g., via pdf) of an original signature.

END

