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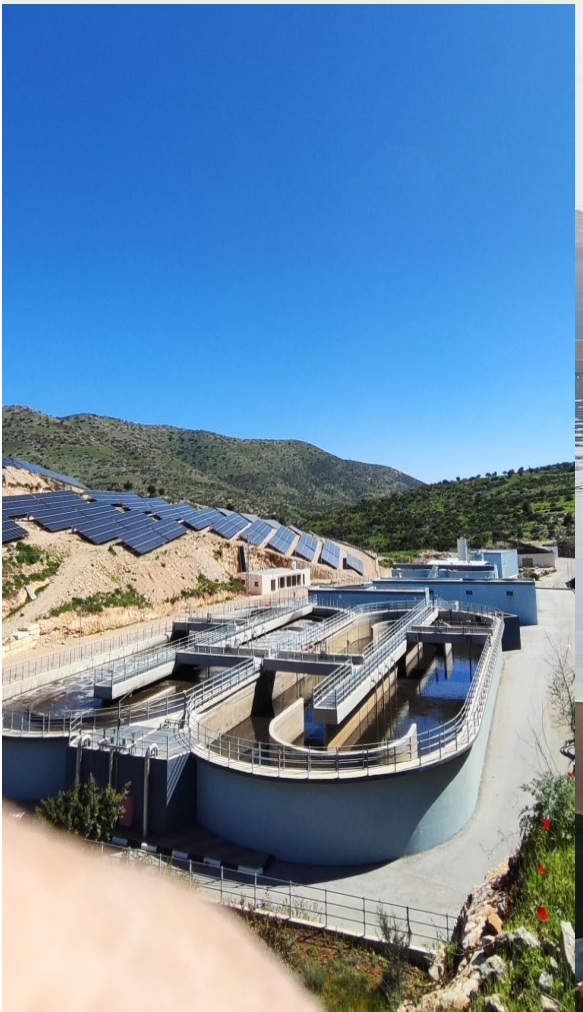
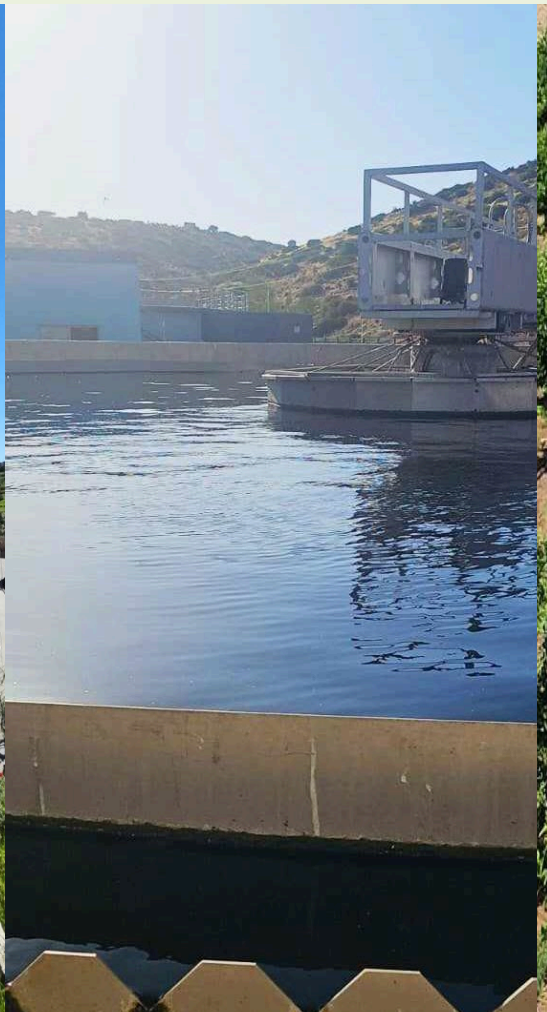
Integrated Water Resource Management Phase 2

Monography of the actual situation of sanitation and reuse For "Tubas Water Utility"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1 Introduction

Tubas Governorate is one of the 16 administrative divisions of the State of Palestine, located in the northeastern part of the West Bank. Covering an area of approximately 402 km², it shares borders with the Jordan River and Jordan to the east, Jenin and Nablus to the west, and Jericho to the south. Tubas city serves as the administrative center of the governorate.

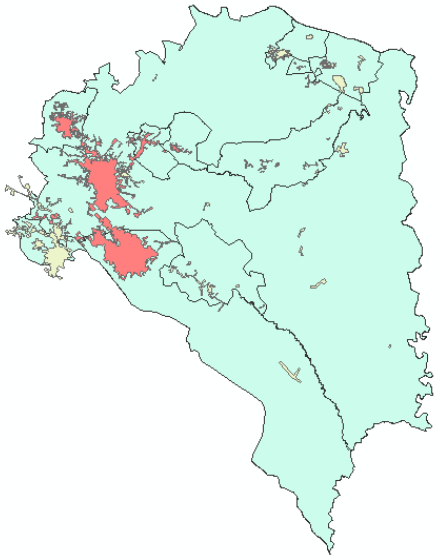
Tubas, gouvernorat faces significant challenges in sanitation and wastewater management. With a growing population and increasing demand for sustainable water resources, proper sanitation infrastructure and wastewater reuse have become critical for environmental protection and public health.

The wastewater management sector in Tubas Governorate experiences disparities in coverage, with some areas connected to sewer networks, while others rely on septic tanks. This situation poses environmental risks, such as groundwater contamination, and threatens public health. Meanwhile, all available opportunities for wastewater reuse are being utilized. However, the limited amount of treated water our from the treatment plant does not cover a significant portion of the agricultural land.

This monograph report will provide a comprehensive overview of the current sanitation and wastewater reuse situation in Tubas water utility communities area. It will assess the existing infrastructure, service management, challenges, and opportunities for improvement. By examining technical, financial, and institutional aspects, this study aims to identify sustainable solutions for enhancing sanitation services and optimizing the reuse of wastewater for agricultural and industrial purposes.

2 Tubas Water Utility

2.1 General Background of Tubas Water Utility



The Tubas Water Utility (WU) is the primary provider of water and wastewater services in Tubas Governorate, overseeing the distribution of these services across seven communities: Tubas, Tayaseer, Aqaba, Ras al Far'a, Khirbet 'Atuf, Al-Aqaba, and Tammun, as indicated in the figure highlighted in red. The utility is responsible for managing and operating the Tayaseer Wastewater Treatment Plant (WWTP), which serves four of these communities within the governorate.

Tubas WU currently oversees 11,686 water connections and 1,850 wastewater connections, ensuring reliable service delivery the utility employs 34 staff members.

Institutional Development:

Water and wastewater services in Tubas were historically managed by a Joint Service Council (JSC) since 2010. In 2013, with funding from AFD, the JSC consolidated assets and teams to enhance service efficiency and facilitate the transition of municipal services under its management. By 2017, the JSC secured EU funding to expand the water and wastewater network, establish a wastewater treatment plant (WWTP), and construct two reservoirs to support water reuse projects. In accordance with the 2014 Water Law, the JSC was restructured into a Regional Water Utility (RWU) in 2023, strengthening its governance and service delivery capabilities.

3 Sanitation

3.1 Planning

Before diving into the study of sanitation services in Tubas Water Utility (TWU), it is essential to first assess whether there is an existing **planning framework** for the development and expansion of sanitation services.

- **Master plan :**

Currently, there is no micro-scale master plan for sanitation services in TWU service areas. While the Palestinian Water Authority (PWA) has developed a macro-scale master plan for the region, it lacks the detailed specifications necessary for effective implementation. This gap highlights the need for a more comprehensive, detailed master plan specifically tailored to the sanitation needs of TWU service areas. Such a plan would address local challenges, ensure optimal resource allocation, and guide the development and expansion of sanitation services to meet the evolving needs of the population.

- **Phases Operation Plan :**

During our meetings with Mr. Issa Dababat (TWU Executive manager), He confirmed that such a master plan should include a construction phases program. Since TWU serves multiple areas, including Tubas, Aqaba, Aqqaba, and Tayasir, he recommended that each phase of the master plan should cover parts of each area with varying priorities. The construction phases should begin with the zone that has the largest number of connection requests, ensuring that the most pressing needs are addressed first.

There is a known zoning plan to be served in Tubas, Aqaba,Al-Aqaba, and Tayasir as part of the tentative TWU master plan, with some zones receiving priority over others. Zone A is given top consideration due to its higher demand, while Zone Z comes last in the sequence, based on current needs and priorities.

The prioritization of regions (Tubas, Aqqapa,and Tayasir) is also determined by the quantity of water flow meters lacking sanitation services. The regions with the highest number of missing meters and sanitation gaps will be addressed first. This prioritization is further illustrated in the table and map that follow.

Region	Number of Water flow meters	Percent of priority for every region
Tubas	5430	70%
Aqqaba	1717	22%
Tayaser	611	8%

As shown in the attached Figure 1, the expansion plan outlines the short-term strategy from TWU for expanding the sewer network, with priorities assigned to each zone. The highest priority is given to Zone A (marked in red), based on several factors, with the primary consideration being the ability to connect to the existing Tayasir sewer plant while maximizing the influent flow and minimizing costs. The priority for each region is color-coded, reflecting the relative importance of each area within the expansion plan.

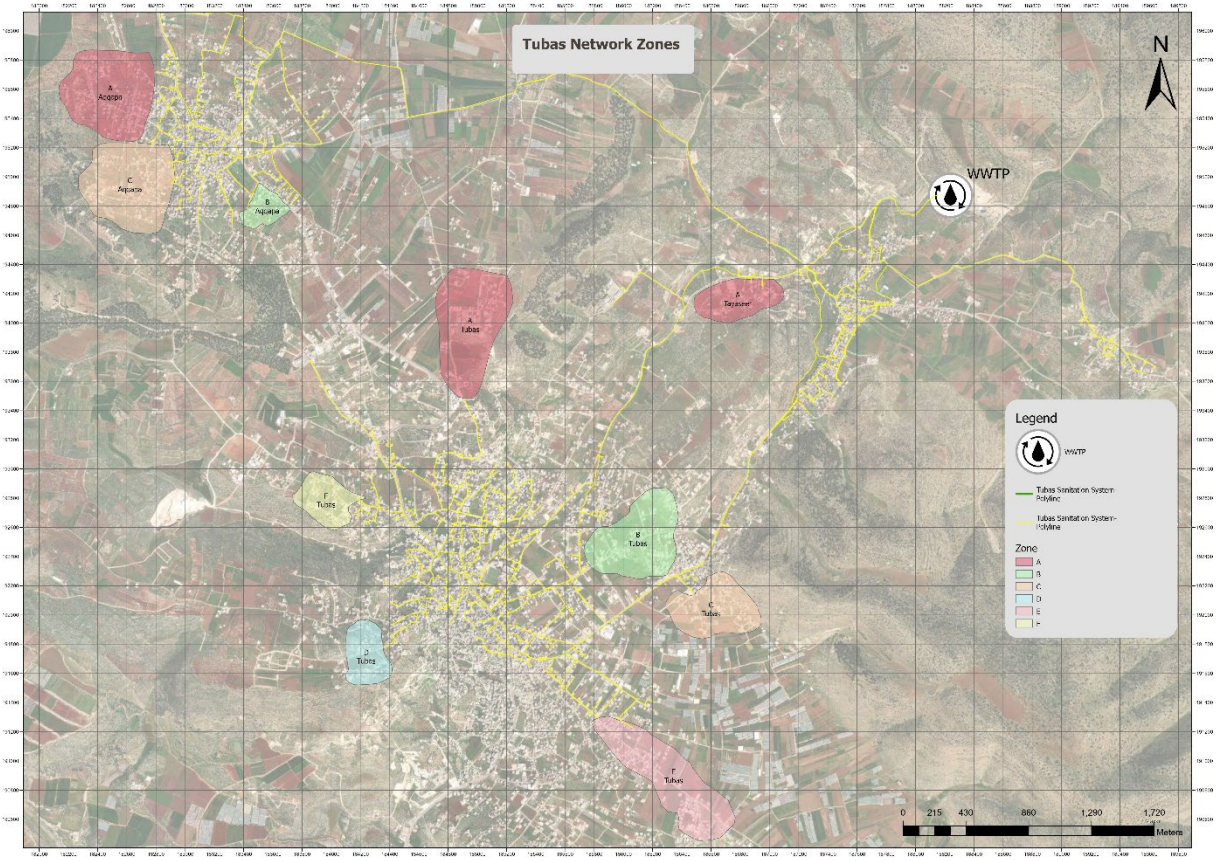


Figure 1 The expansion plan of Sanitation Network and Priorities Zones

3.2 Existing sewage network

3.2.1 Description

The table below provides general background data on the existing sewage network under the responsibility of TWU. It includes information on the construction date, length of the sewage network, the number of existing households connected to the system, and planned

connections. However, due to the lack of comprehensive data and the absence of a clear master plan for the sanitation system, the available information is limited and has been gathered through meetings with TWU.

Network	Planned (2035)	Existing (2024)	
Date of construction		2015-2021	
Operational since		2019	
Total length (Km)		Around 107 Km • 75 km main lines • 32 km house connections	
No. of households connected.	South Tubas: North Tubas: 2,850 Aqqaba: 1,550 Al Aqaba: 35 Tayasir: 715 Total: 5,150	South Tubas:0 North Tubas: 991 Aqqaba: 521 Al Aqaba: 30 Tayasir: 156 Total: 1,698	The total percentage of households connected to the sewage system from the planned connections is **33%.**
No. of inhabitants connected.	South Tubas: North Tubas: 20,000 (61% of total population) Aqqaba: 11,000 (90%) Al Aqaba:234 (100%) Tayasir: 5,000 (98%) Total: 36,000	South Tubas North Tubas: 6,800 Aqqaba: 3,600 Al Aqaba: 210 Tayasir: 1,090 Total: 11,700	**Total 33%**[1]

[1] The figures in the table above come from the latest meeting with the head on wastewater department at TWU in April/2024

3.2.2 Sewage Network Management System and its Integration with Water Meters

TWU integrates the sanitary connection system with the water meters, where each household connected to the sanitary system is represented by its corresponding water meter. The maintenance fees for the sanitary system are directly linked to these water meters. This integration forms the core of the existing system for managing the sewage network, enabling efficient collection of maintenance fees through the water meter billing system.

The figure below illustrates the catchment area covered by TWU, where an existing sewer network is present. The northern part of Tubas has an operational sewage network, while the southern part remains unconnected to the sewer system. Tayasir is connected to the sewage network, and recently, Al-Aqaba has also been connected to the sewer system, which includes the installation of a pumping station.

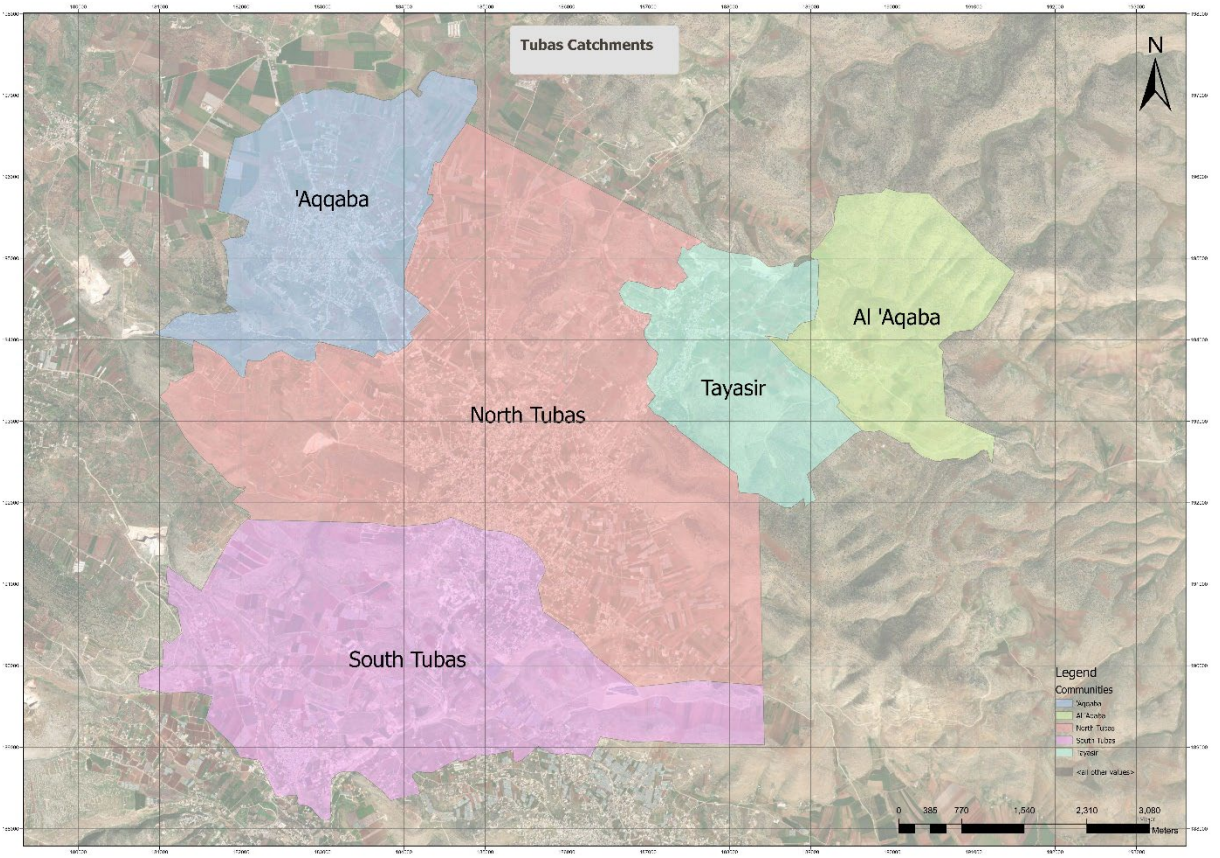


Figure 2 show the catchment area Covered with Sewage network in TWU

The second attached Figure shows all the elements and illustrates the sewage components, including pipes, pumping stations, and treatment plants under the responsibility of TWU. It also highlights the main trunk lines connecting each catchment area to the Tayasir treatment plant.

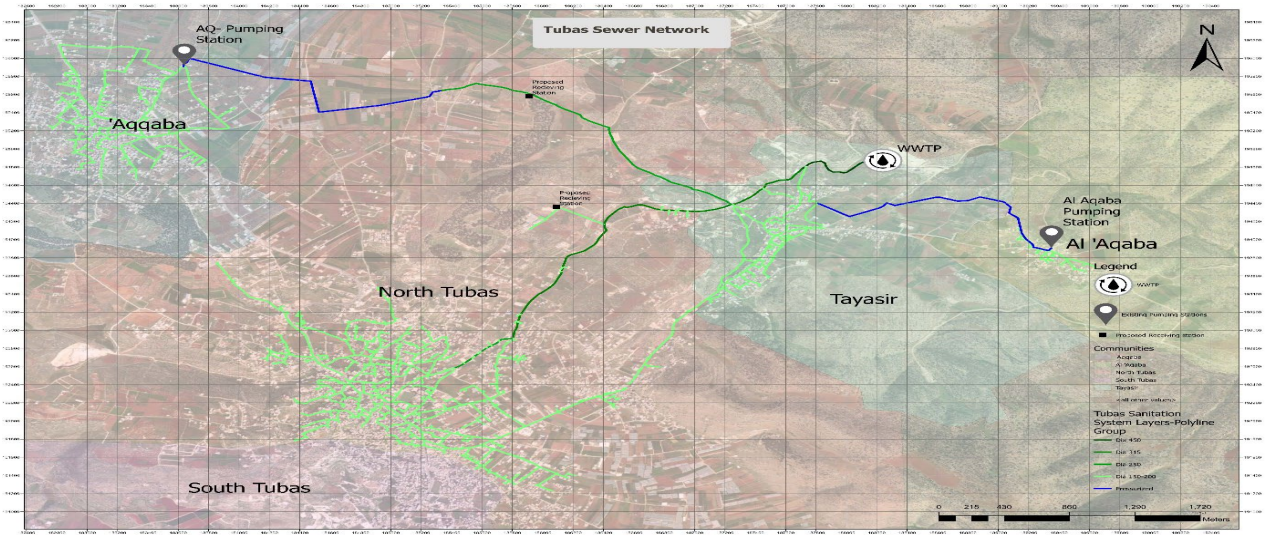


Figure 3: Sewage Components Under TWU's Responsibility

3.2.3 Current Status of the Wastewater Collection System in Tubas

For the current situation of the wastewater collection system in Tubas the following shall be highlighted:

1- For Tubas Network: 50% of the served area is connected to the sanitary system. (30% need H.Cs)
2- For Aqqaba Network: 65% of the served area is connected to the sanitary system. (30% need H.Cs)
3- For Tayaser Network: 70% of the served area is connected to the sanitary system. (25% need H.Cs)
4- For Alqaba Network: 95% of the served area is connected to the sanitary system.

The reasons for the not connected households can be summarized as follows:

1- Some inhabitants are willing to connect but they need a house connection (15-20m)
2- The remaining inhabitants are refusing to connect since they have a sufficient septic tank.

3.3 Tayasir wastewater treatment plant

3.3.1 Description

Tayasir WWTP is an important facility for treating wastewater in the area. The table below provides key information about the plant, including its construction period, operational status, treatment technology, types of treatment, capacity (m^3/day), and actual wastewater production in 2024.

Taysir WWTP	
Period of construction	2015- 2019
Operational since	2020
Treatment technology	Activated sludge
Types of treatment	Primary and secondary treatment Possibility of tertiary treatment by UV not operated because of insufficient flow and too high cost/m3 At now tertiary treatment is done by chlorination of TWW in the two irrigation reservoirs. The WUA is responsible for doing the treatment
Nominative capacity (m3/day)	4300 m3/day
Actual wastewater production (2024)	700 m3/day (16% of total capacity)[2]

3.3.2 Design and Ideal Case of the Tayasir WWTP

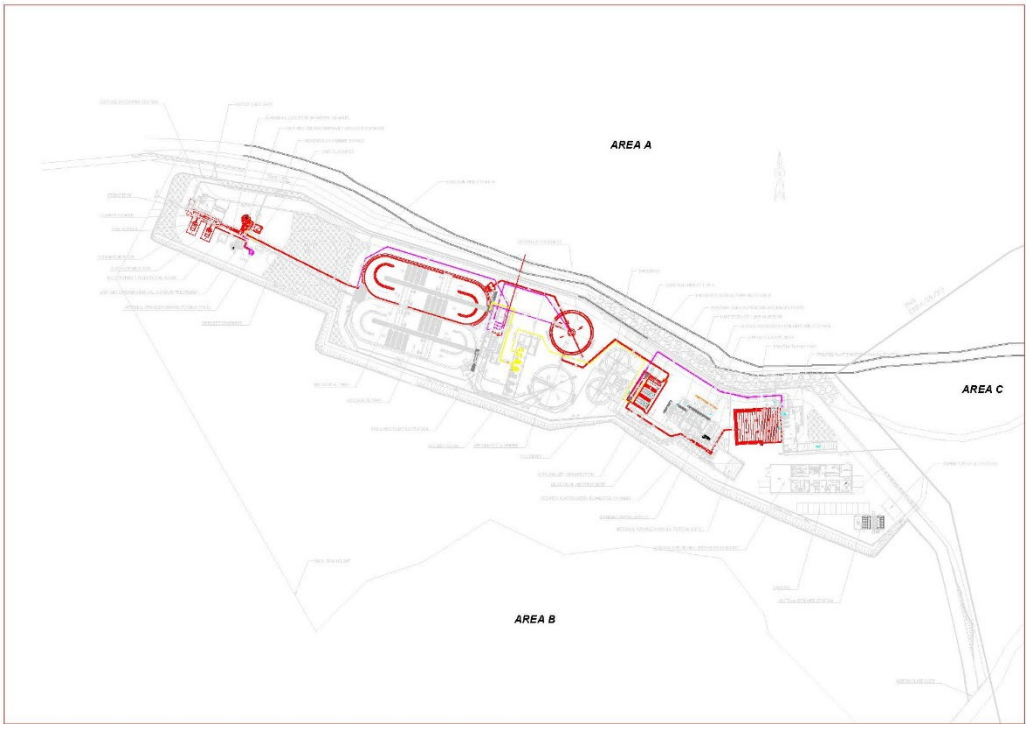
The construction stage of the Tayasir WWTP has been planned with a design horizon set for 2035. Two lines of aeration tanks and two sedimentation tanks were established for the 2035 design, with an average daily flow of **4,300 m³/day.** However, the current flow reaching the plant ranges between 850-1,000 m³/day, which is too low for the operation of two lines. Therefore, only one line of aeration tanks and sedimentation tanks is currently operated, as shown in red in Figure 2 below, which describes the working elements of the treatment plant

[2] The annual reports contain the layout and detailed description of equipment of the WWTP

3.3.3 Identified Issues and Challenges

3.3.3.1 UV Disinfection System Inoperative Due to Low Flow Conditions

The UV disinfection system at the plant is currently Non-operational due to insufficient water flow. This system requires a continuous flow of water to function effectively, as it relies on a consistent volume of water passing through the UV chambers for proper disinfection. The current low flow conditions are not suitable for the system to operate at its designed capacity, thus rendering the UV disinfection process ineffective at this time. Addressing the flow issue or adjusting operational parameters is crucial to restoring functionality to the UV disinfection system.



So far, the treated water has been disinfected manually by the farmers through the association from which they purchase the treated-water. Therefore, it is suggested to implement a chlorination system before the association's water tank that distributes water to the farmers.

3.3.3.2 Impact of High Septage Wastewater Load on WWTP Capacity and Operations

The wastewater treatment plant (WWTP) is currently facing significant challenges due to an influx of septage wastewater from areas such as Tammun, Tubas, Aqaaba, and Tayasier. The high volume of waste being transported by tanks exceeds the plant's capacity to process, as the WWTP can only handle about 10 percent of this incoming quantity. This results in an overload, leading to excessive oxygen demand within the system. As a consequence, there is a notable increase in electricity consumption and the need for more frequent maintenance to keep the plant operational. Addressing this imbalance is crucial to ensure the sustainability of the treatment process and reduce operational costs.

Septage wastewater often contains solid materials that cannot be treated directly, such as stones, dirt, metals, and non-biodegradable substances (like plastics and fabrics). These materials pose a significant challenge in the treatment process.

3.3.3.3 Challenges in Sludge Disposal Management

The main issue that the treatment plant has faced until now is that there is no treatment for the sludge produced from the water treatment process. If possible, a study could be conducted to explore the best method or propose a solution for sludge treatment.

The current sludge disposal process faces several challenges that need to be addressed :

- **High Disposal Costs**: The cost of disposing sludge at Zeharet Al-Fenjan is significantly high, placing a strain on the operational budget.
- **Regulatory Restrictions**: According to Palestinian standards, the reuse of sludge in agriculture is prohibited due to its high-water content, which is approximately 75%. This further limits options for beneficial reuse and increases the need for disposal.
- **Drainage Issues**: There is a continued practice of draining sludge into the Wadi due to the unavailability of transport trucks to the landfill throughout the year. This practice is not ideal, as it can lead to environmental contamination and other related issues.

3.3.4 Quality of water produced by WWTP

Routine analyses conducted internally by the Tayasir WWTP include COD, BOD5, TSS, NO3-N, NH4-N, and SVI. Additionally, complete official analyses are performed to ensure the treated wastewater meets the required environmental standards and regulations.

Parameter	Unit	Result
TSS	Mg/l	<5
BOD5	Mg/l	12
COD	Mg/l	20
Salinity	Mg/l	918.5
Total coliform	CFU/100 ml	1400
Fecal coliform	CFU/100 ml	22[3]

Role of the Tubas Agriculture Directorate in Monitoring Treated Water

The Tubas Agriculture Directorate is responsible for monitoring and inspecting treated water quality by collecting samples from the reuse tank to ensure compliance with agricultural standards. The most recent inspection report was provided by the Director of Agriculture on 14/06/2023 and the result was as following :

Parameter	Unit	Result
TSS	Mg/l	22.4
BOD5	PPM	33
COD	Mg/l	82
Salinity	Mg/l	1.2
Total coliform	CFU/100 ml	144
Fecal coliform	CFU/100 ml	62

[3] Tayasir WWTP annual report 2023

3.3.5 Conclusion

According to 2023 data, the connection rate to the sewage network is 33%, while the production of TWW is only 22% of the total capacity. The WWTP operator explained that approximately 1,000 m³/day of wastewater is used within the treatment process, which may contribute to the lower-than-expected TWW production.

As per the internal periodic tests and what is mentioned by MoA that the quality of treated water after the manual disinfection by chlorine is very good. From here came the need to solve the problem of tertiary treatment either by installing an automatic chlorination system or by operating the UV disinfection unit which can only be operated by increasing the flow.

4 Reuse

4.1 Existing network

4.1.1 WWTP Reuse Feasibility Study 2012

The collection and treatment of wastewater in the Tubas Governorate was poorly developed. Based on several studies, it was decided to move forward with the implementation of a sewerage project covering the localities of Tubas, 'Aqqaba, Tayasir, and Al 'Aqaba. A Joint Water and Sanitation Services Council (JWSSC) for the Tubas area was established in August 2010. The region is intensively cultivated with irrigated vegetables (such as tomatoes, eggplants, onions, and potatoes), as well as fruit trees (mainly olives and almonds), providing a good potential for the reuse of treated wastewater for irrigation. The project aims to establish a sewage collection network for the cities and villages in the area, a wastewater treatment plant capable of reusing treated water, and, when not possible, discharging water to the wadi. The project is also expected to establish a sound institutional and financial structure for the JWSSC to manage the system, along with public awareness to ensure successful implementation of all project components. The feasibility study for the Tayasir treatment plant was prepared in 2012, which included the reuse of treated wastewater in this study. A comprehensive feasibility study was conducted, including several workshops, such as economic and social studies, to assess the impact of the project on the local community and economy. This report, the Draft Final Report, presents the results and findings of all the feasibility study activities associated with the project, along with an Environmental and Social Impact Assessment conducted in parallel with the technical studies.

As shown in Figure 4, it describes the reuse area which studied in the feasibility study near the Tayasir Treatment Plant. This area is designated for the reuse of treated wastewater, providing an opportunity for sustainable irrigation and supporting agricultural activities in the region.

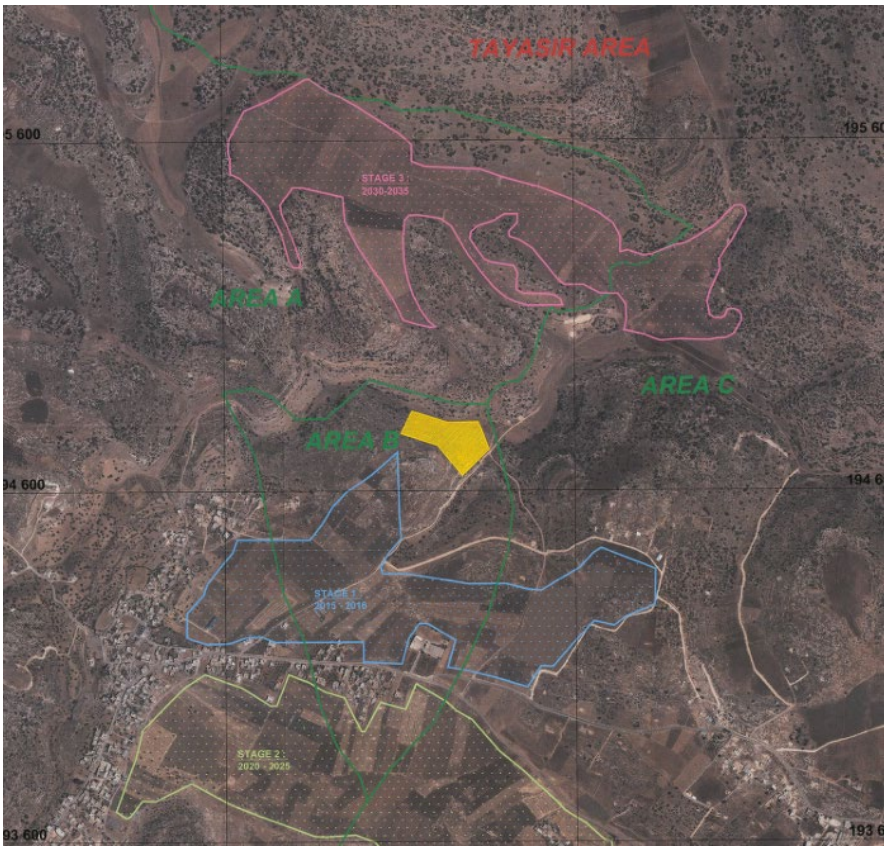


Figure 4 Reuse Area Targeted in WWTP Feasibility Study

4.1.2 Existing Reuse

After the treatment plant became operational and the wastewater was treated according to the standards, the need for reuse emerged.

Since the plant is located near agricultural lands, as shown and studied in the plant's feasibility study, it was proposed to start using the treated water for these nearby farmlands. However, there was a need for an organization to manage and distribute the water, which led to the creation of the Water Users Association. The Safah Al-Jiza Association was licensed by the Water Authority and the Ministry of Agriculture on January 25, 2023.

This table examines the irrigation reuse project, highlighting key aspects such as its construction timeline, operational status, network type, main pipeline length, number of irrigation hydrants, total irrigated area, and the number of farmers benefiting from the system. The objective is to assess the project's role in promoting sustainable water management by utilizing treated wastewater for irrigation, enhancing agricultural productivity, and supporting local farmers.

Reuse network	Existing (2024)
Date of construction	2021
Operational since	2021

Reuse network	Existing (2024)
Type of network	Main pipeline is pumping from WWTP to the Tank The distribution line is by Gravity
Length of network (main pipe)	WWTP – Irrigation Tanks = 1,380 m Dstribution main Network = 1,930 m
No. of irrigation hydrants	15
Irrigated area (dunum)	145 Du
Number of farmers concerned	9

The figure below shows all elements of the reuse project, including the main transport line that carries treated water from the treatment plant to the agricultural reuse tank and the distribution line to the agricultural areas, with the main control valve included in the line.

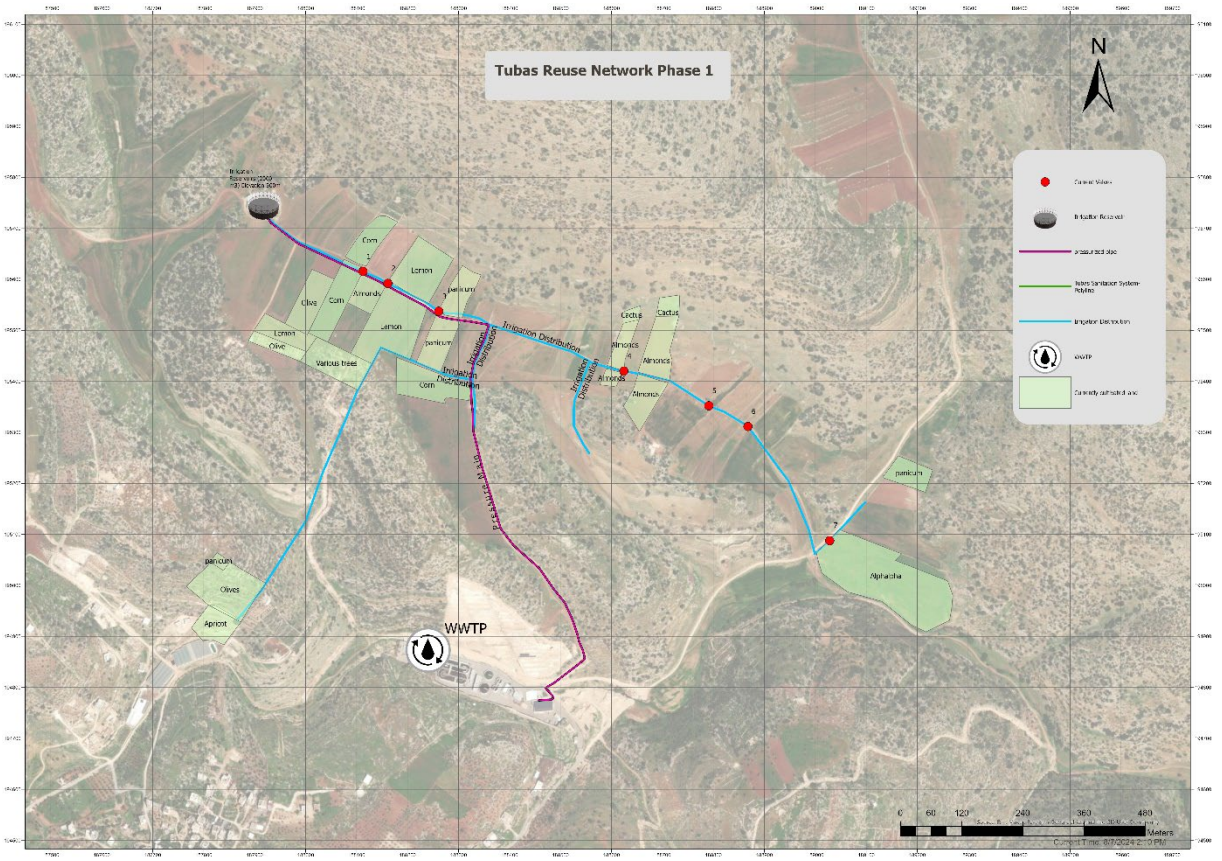


Figure 5 Reuse Project Network Phase 1

The attached figure 6 illustrate the land and farmer name for each land separately and the current valve location

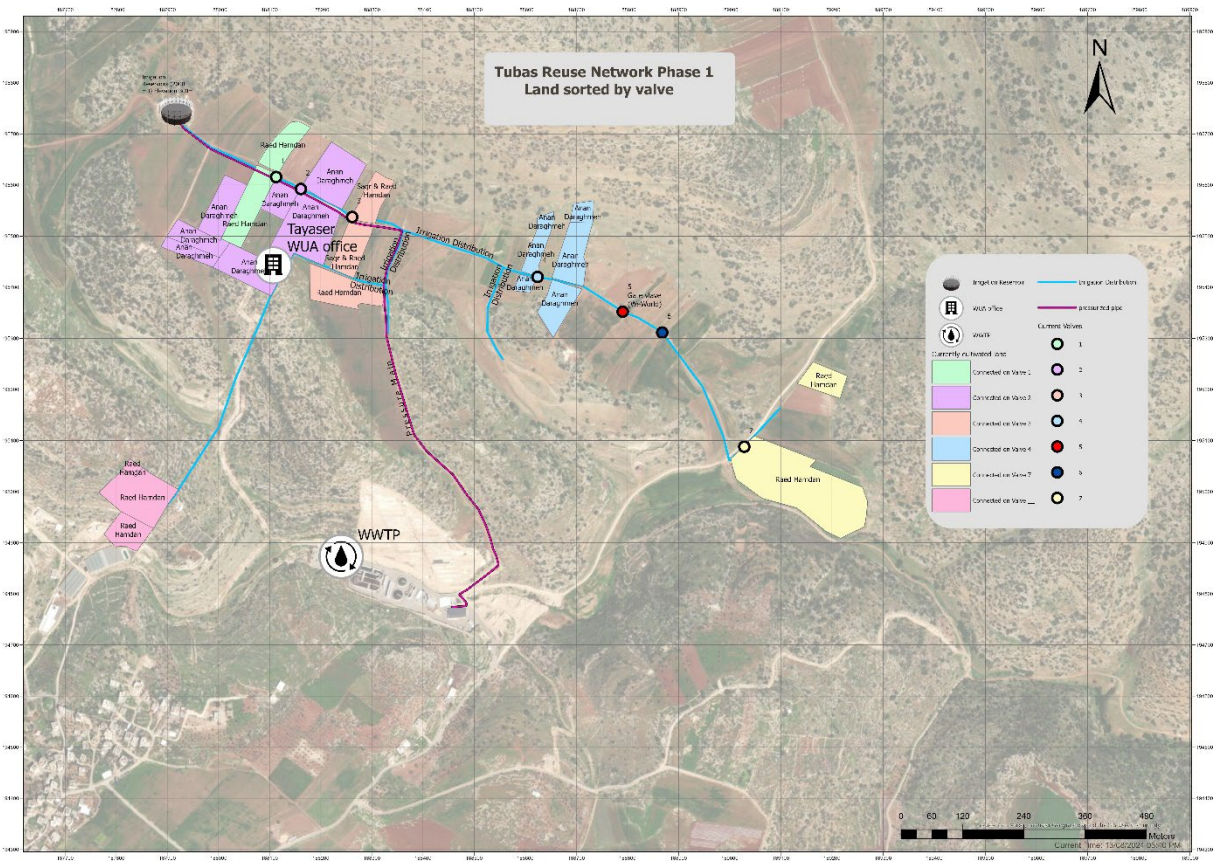


Figure 6 Tubas Reuse Network Phase 1 Land sorted by valve

4.2 Operation and maintenance

4.2.1 Operation of the network:

- **Tertiary treatment:**

  Since the tertiary treatment in the Tayasir Wastewater Treatment Plant (TWWP) is not functioning, the Safih Al-Jizah Water Users Association (WUA) manually adds chlorine to the irrigation steel tanks. The Ministry of Agriculture (MoA) conducts periodic water quality tests, and the WUA covers the costs of these tests.

- **Operation of the network**

How the network works:

The supply of water for all farmers is managed by the Safih Al-Jizah Water Users Association and mainly depends on water availability and the demand of each farmer.

For the current 9 farmers they have access to the water when they want. But when the new We World project operates they will give the new farmers only 150 m^3/day, Furthermore, an internal committee consisting of three We World project Farmers will

be tasked with organizing the quantity and distribution of water among the several We World sites.

The irrigation hydrants are opened and closed by an employee hired by the WUA, who is responsible for managing the process. However, since the nine farmers are members of the WUA, they also have access.

4.2.1.1 Maintenance of the network?

The maintenance is carried out by WUA

There are many problems that can be summarized as follows:

1. Lack of water.
2. The cover of the irrigation tanks is deteriorated, and this affects the quality of water since Algae grow up on the surface of the water that will affect the reuse network and will close the filters.
3. No connection between the level of the irrigation tanks and the reuse pumping station. The pumps are manually operated. And sometimes flooding occurs and a great loss of water happens.
4. There is no water meter at the irrigation reservoirs. Any losses at the transmission line cannot be noted.
5. Nonsufficient knowledge in HDPE pipes maintenance.
6. Lacke of Maintenance spare parts for HDPE in general.

4.3 Water user association

Presentation of the WUA

Official name	Safeh Al Jezah WUA
Date of creation	01/02/2023
Nber of agreement at MoA (if existing)	
Nber of members (annex the list of names and contacts if possible)	At creation:10 members 2024: 10
Name of board members (2024)	President: Mr. Raed Hamdan Secretary: N/A Treasurer: N/A
Name of administrators (2024)	Mr. Raed Hamdan Mr. Saqer Jaber Mr. Anan Ahmad

Date of founding general assembly	
Last annual general assembly	

- Goals and perspectives expressed by the WUA

The Safih Al-Jizah Water Users Association is seeking additional water sources to meet its growing needs. They aim to expand their agricultural production by cultivating a wider variety of crops and are open to experimenting with new types to enhance productivity and optimize water use.

They are cultivating various crops using treated wastewater with very good results. Some examples of these crops include:

The table presented highlights the various crop types that have been cultivated by the farmers from 2023 to the present.

	Year		
Crop Pattern	**2023**	**2024**	**2025**
Fruit Trees	**Area Dunum**		
Citrus	30	30	30
Almonds	X	X	X
Prickly Pear	X	20	20
Olives for Oil	10	10	10
Nectarine	X	20	23
Apricot	5	13	13
Olives	X	50	50
Fig	-	-	5
Table Grapes	-	-	-
Forage Crops			
Alfalfa	30	30	0
Buffel Grass	20	20	5
Barley	0	3	40
Sorghum	0	20	X

The WUA has implemented a new steel tank at a higher elevation than the existing ones. However, this presents a risk as the new tank will be located in Area C.

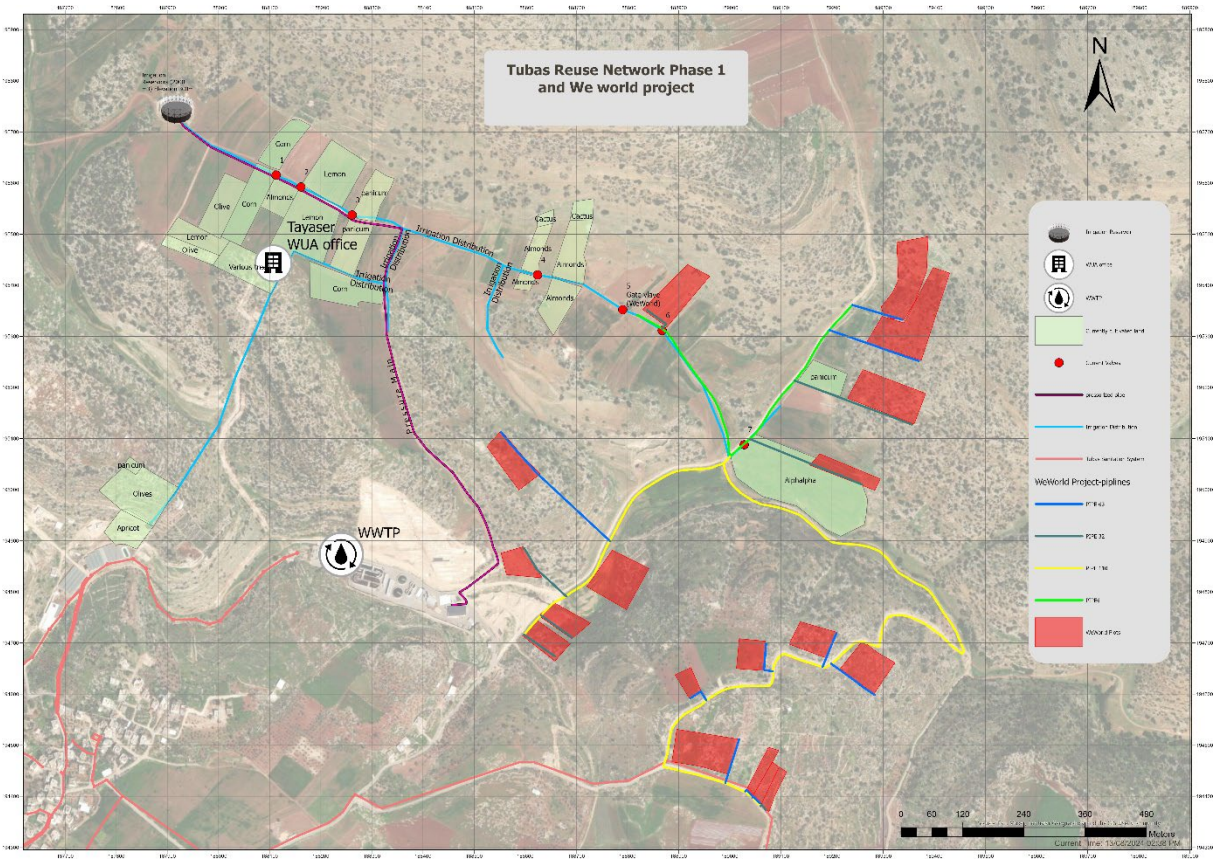
4.3.1 Challenges and needs faced by the WUA

The Water Users Association (WUA) has several essential **needs** to improve its irrigation and water management system:

- **Chlorination System**: A chlorination device is available; however, a solar power system and a water pump are required for its operation. They need a water meter for the distribution network.
- The irrigation tanks need to be covered.
- Need to install a fence around the irrigation steel tanks.
- The association needs a permanent office in the field to meet farmers' needs and facilitate their visits. Currently, it does not own a dedicated office but operates from a rented space that lacks essential office equipment such as tables and computers. Providing a well-equipped office will improve efficiency and make it easier for farmers to access the association's services.
- The pressure of the network look very low and need to study how can be improved by installing a pump? building a new tank in higher location? need to study all scenario for that.
- Study how we can supply the electricity to the reservoir area ?

They face a problem with the manual operation od the reuse pumping station that causes flooding and a great water loss.

They face a problem with the growth of algae on the surface os the treated water at the irrigation tanks that is becouse of the damage of the cover.



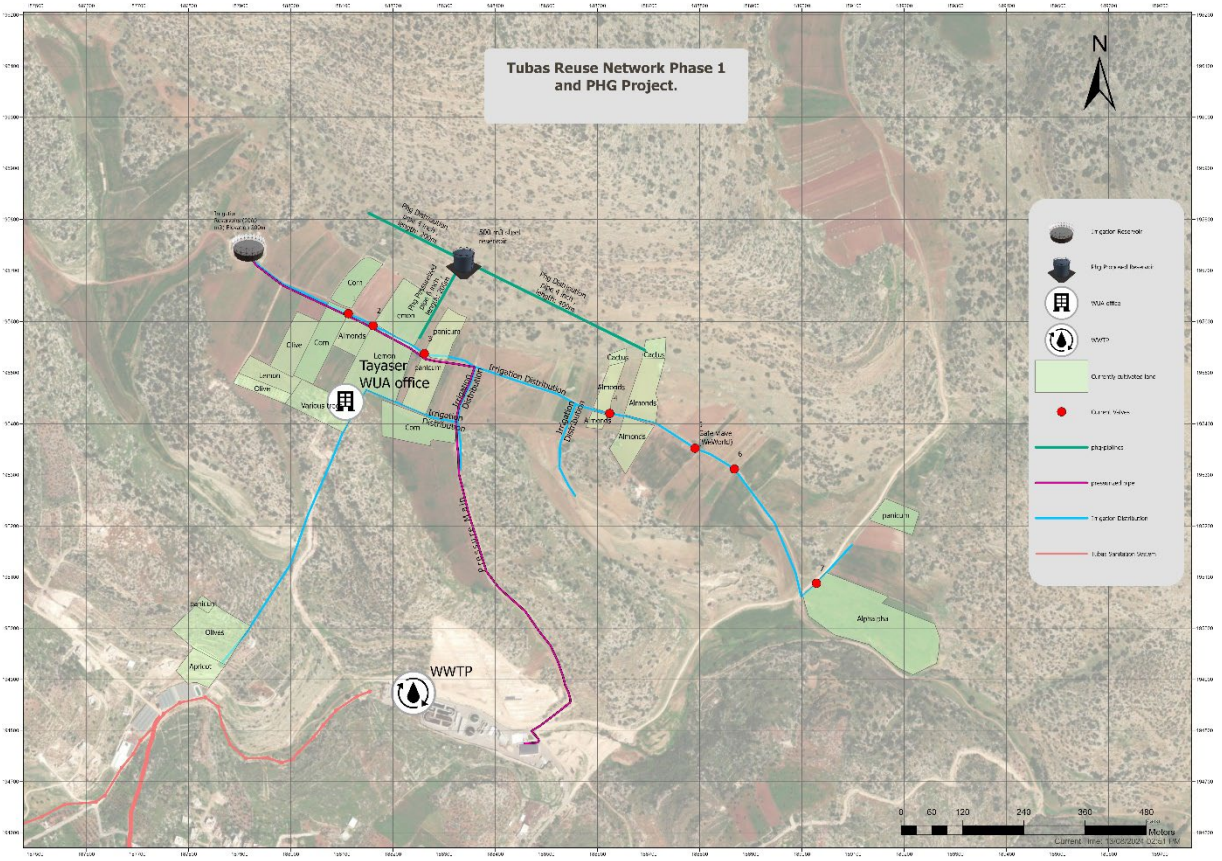
4.5.2 PHG project

PHG Project components : it is mainly an infrastructure project with total budget of **59000 $.** The project will be implemented with 20% sharing from Tayaseer WUA.

It consists of the following:

A- Cover for the existing **Two** irrigation steel tanks (1000 m^3 the capacity for each tank)
B- Installation of steel fence around the steel tanks.
C- Extension & Rehabilitation of the existing irrigation network.

According to the most recent update, the project has changed to include the installation of a 500 m3 steel tank.
Additionally, supply two 4-inch distribution pipelines, each with a length of 400 and 200 meters, as well as a 6-inch convenience pipeline.


Tubas Reuse Network Phase 1 and PHG Project.
N
Tayaser WUA office
WWTP
Irrigation Distribution
Irrigation Reservoir
PHG Proposed Reservoir
WUA office
WWTP
Currently cultivated land
phg pipeline
pressurized pipe
Irrigation Distribution
Tubas Sanitation Network
0 60 120 240 360 480
Meters