

Submitted to:



Submitted by:

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## LIST OF ACRONYMS AND ABBREVIATIONS

AFD	Agence Française de Développement (French Development Agency)
AMSL	Above Mean Sea Level
BOD	Biological Oxygen Demand
BLWWTP	Beit Lahia Wastewater Treatment Plant
CBO	Communities Based Organizations
CO	Carbon Monoxide
CO <sub>2</sub>	Carbon Dioxide
COD	Chemical Oxygen Demand
Cl	Chloride
CMWU	Coastal Municipalities Water Utilities
dB	Decibel
DED	Detailed Engineering Design
EA	Environmental Assessment
EC	European Commission
EC	Engineering Consultant
EEC	Electrical Conductivity
EoI	Expression of Interest
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EQA	Environmental Quality Authority
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
GDP	Gross Domestic Product
GS	Gaza Strip
ICRC	International Committee for the Red Cross
IDA	International Development Agency
IMF	International Monetary Fund
IUG	Islamic University of Gaza
JSC	Joint Service Council
LC	Letter of Credit
MENA	Middle East and North Africa
MoA	Ministry of Agriculture
MoH	Ministry of Health
MoU	Memorandums of Understanding
NAWQAM	Water Quality and Availability Management
NGESTP	North Gaza Emergency Sewage Treatment Project
NGO	Non-Governmental Organization
NJSC	North Gaza Join Service Council
NGWWTP	North Gaza Wastewater Treatment Plant
NIS	Shekel (Israeli currency)
NO <sub>2</sub>	Nitrate
NW	North West
OM	Organic Matter
OP	Operational Procedures
PAPs	Project Affected Persons
PARC	Palestinian Agricultural Relief Committee
PCBS	Palestinian Central Bureau of Statistics
PLA	Palestinian Land Authority
PLO	Palestinian Liberation Organization
PGA	Peak Ground Accelerates
PM	Particulate Matters
PNA	Palestinian National Authority
PRDP	Palestinian Reform and Development Plan



PS	Pumping Station
PS	Palestinian Standard
PWA	Palestinian Water Authority
RAP	Resettlement Action Plan
RPF	Resettlement Policy Framework
SDO	Social Development Officer
SESIA	Supplementary Environmental and Social Impact Assessment
SLA	Sustainable Livelihoods Analysis
SSI	Semi Structure Interview
SW	South West
ToR	Term of Reference
TS	Technical Specification
UAWC	Union for Agriculture Work Committee
UG	Universal Group
UNDP	United Nations Development Programme
UNEP	United Nations Environmental Programme
UNICEF	United Nation Children Fund
UNRWA	United Nation Relief and Work Agency
USAID	United States Agency for International Development
USD	United States Dollars
VMF	Visual Modflow
WB	World Bank
WHO	World Health Organization

**EXECUTIVE SUMMARY**

This executive summary aims at providing a summary for the ESIA update assignment carried out to reflect the changes in the second phase of the effluent recovery and reuse scheme components of the NGEST project in its original design and operational plans.

As indicated in the TOR, the consultant's team examined all the project's technical, environmental, socio-cultural, institutional, historical and political context, stakeholders' views and priorities resulting from the design change and schedule delay. Consequently, a mitigation and monitoring plan was placed to tackle the negative environmental and social impacts and to define the institutional responsibilities for implementing these measures where necessary.

The RAP is regarded as a mitigation policy and action to minimize the negative impact of involuntary land acquisition that might be triggered as part of the project.

While interventions of the Effluent Recovery, Irrigation Scheme and Remediation Works Project were previously identified during the preparation of the NGEST SESIA carried out in 2013, the project was included as a single component operating within the whole system. For this report however, all other system components, eg NWWTP are included only to the extent to which they affect the project. In other words, the scope is narrowed to include only the second stage of the Effluent Recovery, Irrigation Scheme and Remediation Works Project (C2). Based on the latter understanding, the update will aim at:

- Narrowing the scope down to include only the Recovery/Reuse scheme and agricultural components only rather than the whole system covered;
- Incorporating the operation of the new WWTP, accounting for the negative impacts of its five-year delay, (that implied an extension of the period of infiltration of partially treated sewage, consequently further pollution to the groundwater, beyond what was originally planned) in addition to the positive impacts expected after its recent operation ;
- Change in well locations design since last study in 2013;
- Incorporating new updated groundwater analysis;
- Incorporating the recent remediation of the infiltration basins carried out;
- Accounting for the new photovoltaic component of the project.

Using the new information on deviations/updates, the following will be carried out by the consultant:

Incorporating deviations/updates expected to affect environmental and social benefits/impacts previously addressed, the consultant will carry out a new analysis including:

- Identification of the possible environmental and social impacts of the proposed effluent recovery and reuse scheme.
- Identification of any potential temporary or permanent land acquisition requirements associated with civil works

- If Bank's Operations Policy 4.12 is determined to apply due to land acquisition requirements, preparation of draft terms of reference to formulate a Resettlement Action Plan (RAP) to manage, mitigate, and monitor the impacts of acquisitions
- An Environmental and Social Management Plan (ESMP) to manage, mitigate and monitor any possible negative impacts during the construction and operation phases of the project
- A capacity assessment of the implementing party to implement the ESMP and recommendations for any capacity-building needs

## 1. INTRODUCTION

The Palestinian Water Authority (PWA) together with Agence Française de Développement (AfD) have prepared the Terms of Reference (ToR) for updating the Supplementary Environmental and Social Impact Assessment (SESIA) carried out for the North Gaza Emergency Sewage Treatment Project (NGESTP) in 2013.

The SESIA update assignment will only cover the evaluation of the environmental and social risks and impacts of the Recovery and Reuse Scheme (part 'C2').

Part 'C1' has been financed by World Bank and this part, 'C2' (referred to as **the Project** in this document) is anticipated to be financed by AfD and the Green Climate Fund (GCF). The update assignment was announced in a competitive bid and awarded to the joint venture of EcoConServ and Universal Group Gaza.

This report is a fundamental deliverable for the SESIA update consultancy service which involves the updating of the SESIA based on the updated project description, including the Photovoltaic system component (PV) (that was not part of the initial project) and with recent information regarding the baseline and institutional context.

### 1.1 Background

The NGEST Project initiated in 2004, was initially planned to be implemented in two phases. Part A of the treatment scheme was the construction of the terminal sewage pumping station at the Beit Lahia Wastewater Treatment Plant (BLWWTP) site, construction of a pressure pipeline to a new site about seven kilometers to the East of Jabalia, construction of seven infiltration ponds at the new site, and commissioning of the pipeline to allow a large and dangerous emergency partial effluent pond at Beit Lahia to be drained.

Part B of the treatment scheme included constructing a wastewater treatment plant at the new site that was envisaged to handle up to 70,000 cubic meters of sewage daily. Other parts of the overall project was the remediation of the land that was formerly covered by a large partial effluent at Beit Lahia and for a pilot program to recover treated and infiltrated effluent from the ponds.

Part 'A' had been in operation since April 2009, and was entirely completed in 2010, pumping partially treated sewage from the old BLWWTP site to the new infiltration basins site.

Part B was originally expected to be completed in 2013, but had not actually started its operations until the first quarter of 2018.

Part C, was proposed at a later stage, to expand the effluent recovery and reuse scheme to the full planned effluent flow from the plant and provide long-term protection for the underlying aquifer.

A Supplementary Environmental and Social Impact Assessment Study was conducted in 2013 for the North Gaza Emergency Sewage Treatment Project for the Effluent Recovery and Reuse System and Remediation Works and the proposed reuse system distribution networks to :



- Provide an update to the situation which had changed as a result of the differing timeframes and delays in the phases A and phases B
- To accommodate for the newly placed specific remediation plan which included design and implementation of the remediation plan. allocated towards Part B of the project, namely for remediation of the drained effluent lake at Beit Lahia.
- To accommodate for the new component, according to the original plan, which was added to the project to recover and reuse the treated effluent after the new treatment plant (NGWWTP).

Because of the schedule shifts and delays in implementation, the situation considered in 2013 has changed. Design changes have been made to the system, phases B and C1 have been operational and the current ground water situation covered in the 2013 SEISA may have changed.

This update has therefore been made to cover the second stage of the third, supplementary phase, namely the reuse/recovery scheme (C2). In addition to the core project components of C2, an additional new solar component was proposed to secure reliable source of power supply to the project, and reduce its operations dependency on the grid.

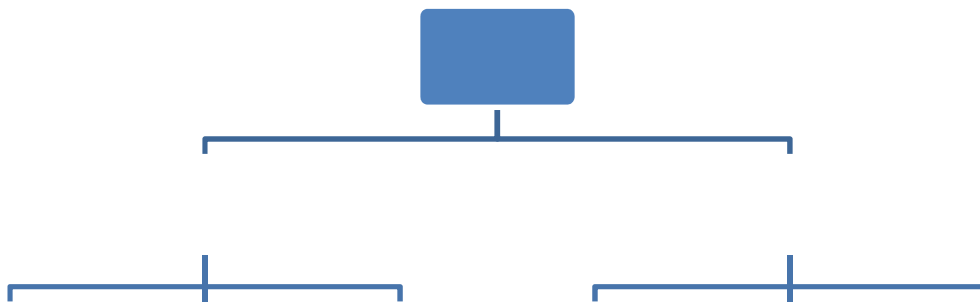
The joint venture between EcoConServ and Universal Group (UG) were hired by AfD and PWA to update the evaluation of the environmental and social risks and impacts of the Recovery and Reuse Scheme (part 'C2'). The Consultancy Term of Reference (ToR) identified the objective of the study in two parts: "Update the Environmental and Social Impact Assessment (ESIA) and Develop the Resettlement Action Plan of the proposed Recovery and Reuse Scheme, namely:

- The recovery and reuse scheme infrastructure, including the recovery wells, collection pipes and monitoring wells.
- The irrigation network scheme and the related environment, including the water tanks, booster pumping station and irrigation network.

## 2. PROJECT DESCRIPTION

### 1.2 Project components

The project is comprised of two parts, a recovery scheme and a reuse scheme. Figure 10 illustrates the different components of the project.



**Figure 1: Components of the recovery and reuse scheme**

### 1.2.1 Recovery Scheme

#### **Recovery Wells**

There are 28 recovery wells to be constructed across an area extending for approximately 1.3 x1.3 km<sup>2</sup>. These wells are split into 5 (groups) according to their geographical distribution. For each zone, there is a High-Voltage (22kV) node and an electrical service building.

The recovery wells will be able to capture water infiltrated from the NGEST WWTP (i.e.: 35,600 m<sup>3</sup>/day) in addition to an extra 10% (i.e.: 3,560 m<sup>3</sup>/day) necessary to guarantee that all infiltrated water is captured by the wells.

The number of recovery wells was calculated based on the maximum quantity of water that should be recovered during the peak month of October, which is equal to 50,885 m<sup>3</sup>/day. The total number of wells is 28 where each should have a capacity of pumping between 180 m<sup>3</sup>/hr to 200 m<sup>3</sup>/hr. 25 out of the 28 wells are assumed to be operational always with a capacity of 180 m<sup>3</sup>/hr. The three additional wells are included to give more flexibility to the system and serve as a backup in the event of a failure.

According to the numerical modelling results, the exact location of the 28 wells was selected to guarantee that all the water infiltrated from the basin is recovered within 1000 days and cannot move past the row of wells located the farthest (i.e. 750 m) from the infiltration basin itself.

#### **Monitoring wells**

The water pumped to the irrigation network should be monitored from the moment it is extracted from the ground to the point it is delivered to the farmers. Samples of water should be therefore be taken and analyzed randomly at farm level, trunk lines, water tanks, and irrigation networks.

Constant monitoring should be implemented across the recovery well system. To this extent, a system of 43 wells will be implemented by using the 5 existing monitoring wells, the 28 newly built recovery wells and 10 new monitoring wells.

Locations of the 24 recovery wells are shown in the figure below. Stage 1 (C1) wells, RW1-RW13 and RW21 have been completed and are currently operating.

The rest of the recovery wells, RW14-RW20, RW22-RW29, form stage 2, (C2), the current focus of this project.

#### **Piping networks**

The design of collection and irrigation networks was based on the adopted hydraulic model. Several diameters of ductile iron and UPVC pipes are used in both networks depending on the size of the pipe. The irrigation network diameters ranged from 900 mm (1200 mm inside the booster station) to 50 mm. The velocities ranged from 2.85 m/sec. to 0.65 m/sec .

**Water tanks :**

Two 4000 m<sup>3</sup> water tanks of 32 m diameter and 5 m height. Thicknesses of the water tank walls and foundation range from 400 mm to 600 mm.

The collection pipes from the recovery wells are connected to tank. The two tanks are connectetod each other to provide flexibility and are provided with washout and overflow pipes. The feeder from each tank to the booster pump stations is 1100 mm diameter with a main gate valve.

**Booster Pumping Station**

The booster pumps are located in a pumping hall together with the suction and pressure manifolds and with all necessary pipe weorks. The pumping station will serve both irrigation netwrks; the south area with three irrigation zones and north area with six irrigation zones. All pumps are identical, with a total of 8 duty pumps and 2 standby units installed parallel and pumping from a common suction manifold into a common pressure manifold . The pump size is selected based on the maximum system flow rate 6000 3m/hr.

**Irrigation Network and Agricultural Land**

Water supply pipelines (trunk lines) are used for transmitting the water from the booster pumping station to the agricultural land. Water networks are used for irrigation the agricultural lands.

Citrus is a crop grown in the project area with an area of 1198 dunum (fruitable and none-fruitable). Olives represent 614 dunum (fruitable and none-fruitable). Vegetables represent 280 dunum. The area of fruit trees is 120 dunum, whereas, the rain-fed area includes the grains and the demolished area occupying the most of the project area being 12,055 dunum .

**PV Component**

The power supply structure would be capable to support:

- To support on-grid mode – during times the facility is mainly supplied from the GEDCo network
- Off-grid mode – during times the facility has to generate required power itself

The Photovoltaic system will be composed of:

- PV Areas within the Treatment Plant Boundary: Within the treatment plant, suitable space is available on the roof-top of all major buildings with the exception of the power house (“Blower and Energy Building”). The areas around the facilities’ installations. Open space for ground-mounted systems are available at the boundaries of the plant. The total size of allocated land within the treatment plant is 47 dunums.

- Areas within Recovery Scheme: The second location with designated PV areas is the effluent recovery scheme behind the cemetery. The land is owned by the Ministry of the Endowment (Awqaf). PWA started negotiation to obtain this land in 2015.

### **Agriculture Land Proposed for irrigation**

The gross agricultural area is approximately 1,570 ha (15,700 du) and it is located at the northeast side of the Gaza Strip adjacent to the eastern border.

The net irrigated area is approximately 1,260 ha (12,600 du) whereas the remaining 300 ha (3,000 du) of land is for other uses such as industrial and residential areas and roads. For optimizing construction and operation scheduling, the entire project was originally subdivided into two main parts (A and B) relative to their locations with the infiltration basins. Part A extended for about 1,010 ha (10,100 du) and Part B for an additional 500 ha (5,000 du) and were respectively located to the north and to the south of the infiltration basins

According to the complementary feasibility study, the majority (22%) of the surveyed area is cultivated with mixed arable and vegetable crops. Almost half of the farms has a mixed crop pattern, mostly based on arable, vegetable and fruit tree crops, among which citrus and olive are the most important. Arable crops, such as wheat (14%) and barley (1%), are quite important as staple food for the household. On the other hand, onion, barley and potatoes represent together less than 5% of the cropping pattern.

About 24 % of the land is rain-fed, while the remaining 76% is being irrigated through wells.



### 3. LEGAL AND INSTITUTIONAL FRAMEWORK

#### National Law

The table below summarizes the most significant environmental laws and regulations related to the project. It is worth noting that most of the laws have not changed since the previous study, with the exception of **Decree Law No.14 of 2014 relating to the Water Law** that consists of 68 articles divided in twelve Chapters. The law aims at a better water management and development of Palestinian water resources, through establishing for a new phase for the water and wastewater sector, its governance and management. It states that the Water Authority will be under the responsibility of the Cabinet, splitting policy from regulatory functions, which was previously carried out by Palestinian Water Authority (PWA) since its establishment. The table below provides a summary of the environmental laws affecting the project.

Name of Law	Law Summary	Year
<b>Law 7/1999</b>	This basic enactment of the Palestinian Legislative creates a framework for the protection of the environment, public health and biodiversity in Palestine including marine areas. Its 82 sections are divided into 5 Titles: Definitions and general provisions (I); Environmental protection (II); Environmental impact assessment, licensing, inspection and administrative procedure (III); Penalties (IV); Final provisions (V). Article 1 contains an extensive list of definitions, including "natural reserv	1999
<b>Law 3/2002</b>	Palestinian Water Law	2002
	Regulations for Groundwater Pollution Control	
	Guidelines for Wastewater Reuse in the Gaza Strip, Palestine	2002
	Water Pollution Control System	
<b>Decree Law No.14 of 2014 relating to the Water Law</b>	Decree Law No.14 of 2014 relating to the Water Law	
<b>Decree No. 90/1995</b>	Regarding The establishment of Palestinian Water Authority (PWA)	1995
<b>Decree No. 6/2002</b>	The Environment Quality Authority was established by Presidential decree No 6/2002	2002

Name of Law	Law Summary	Year
<b>TS 34/2012</b>	The Palestinian Treated Wastewater Standard (Technical Specification)	2012
<b>Solid Waste regulations</b>	Solid Waste Management Regulations	2004

Name of Law	Law Summary	Year
<b>Law 7/2000</b>	Palestinian Labor Laws 7/2000	2000
	Health and safety	
<b>Law 3/2011</b>	Land Ownership	2011
<b>Law 2/1953</b>	Expropriation Law (Istmlak)	1953
<b>Antiquities Law 1966</b>	Palestinian Antiquities Law	1966
<b>Basic laws</b>	Basic Laws declaration for Palestinian Human Right	2003
<b>Law 21</b>	Consumer protection laws	2005

### IFC Performance Standards on Environmental and Social Sustainability

This section will shed lights on international social legislations that might influence the project and which of them should triggered:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 5: Land Acquisition and Involuntary Resettlement
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7: Indigenous Peoples
- Performance Standard 8: Cultural Heritage

### World Bank Safeguard Policies and Guidelines

The WB has ten environmental and social policies referred to as the Bank's "Safeguard Policies" that should be considered in its financed projects.

Among the ten safeguard policies of the WB, five are considered by the Consultant to be relevant to the NGESTP and have been taken into account during this ESIA study; these are listed and discussed below:

- Environmental Assessment (OP 4.01), that was previously discussed in section 3.4 of the current chapter.
- Involuntary Resettlement (OP 4.12)
- Natural Habitats (OP 4.04)
- Cultural Property (OPN 11.03)
- Directives related to sharing information and disclosure

#### 4. POTENTIALLY SIGNIFICANT ENVIRONMENTAL AND SOCIAL IMPACTS

The project construction and operation will result in numerous positive and negative impacts to the environment and to society. Identifying the possible expected impacts sets the scene for the management plan preparation and development.

Based on an the expected activities of the project, such as preparing the area, building the infrastructure necessary for proper operation, operating and maintenance of the project components (PV Power Plant, booster pumping station, recovery and monitoring wells and irrigation network) the impacts have been identified.

The impacts were classified into:

*Impacts during the planning, **mobilization, site preparation and construction phases** related to:*

- Hauling of construction materials and equipment
- Fencing the area for controlling the access
- Roads construction
- Leveling and preparing the land for setting the structures
- Assembling structures
- Placement of temporary infrastructure
- Construction of infrastructure

*Impacts during the **operation and maintenance phase** related to:*

- Well operation
- Well maintenance
- Operation of the booster pumping station
- Maintenance of the booster pumping station
- Operation of the solar plant and energy generation
- Maintenance of the solar plant
- Diesel generators

*Impacts during the **decommissioning** related to:*

- Disassembling the solar plant
- Disassembling the booster pumping station
- Closing the recovery and monitoring wells
- Cleaning the land

The following section identifies potential impacts together with relevant baseline information.

The focus will be made on the aspects of utmost interest or concern to local communities, stakeholders, regulators, and decision makers.

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
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Air quality impact by dust emissions of construction works of water distribution networks	Negative	Likely to raise PM in ambient air at the project sites.	temporary	Medium	Minimize the impacts to low	Palestinian
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Air quality impact by emissions of CO <sub>2</sub> , CO, SO <sub>2</sub> , NO <sub>x</sub> and PM <sub>10</sub> will result from the operation of the construction machinery and road vehicles during construction	Negative	Will raise pollutant levels in the air	Temporary	medium	Minimize the impacts to low	Palestinian
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Noise impacts	Negative	Impacts of construction is less likely at the cemetery area and water distribution network and part of the effluent lake that is far from the residential area	temporary	Medium at project sites except low at cemetery site	Minimize the impacts and maintain their control	Palestinian
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Vibration due to the equipment movement	Negative	Vibration impacts to the water distribution networks especially the site of the pumps and storage area have significant impact.	Temporary	Medium impact especially nearby cemetery area (site for storage area and pumping station)	Minimize the impact at the storage and pumping station area that is nearby El Shuhada cemetery area and maintain control at the other sites of the project	Palestinian
Risks of hazardous wastes	Negative	Likely to have workers exposure to hazardous waste if no hazardous waste facility is established before the project preparation	Temporary	Medium	Minimize the impacts	Palestinian
Change in the water hydrology and groundwater (quantity and quality)	None	Due to the depth of the groundwater between 30-70 m, no significant impacts is expected	None	No significant impacts	Mitigation measures is not required.	
Ecological Disturbance	Negative	There is a possibility that the water distribution network will be laid on agricultural land, and negatively affect on the crops and animals around the site.	Temporary	low to medium impacts		

Potential impact on the antiquities on the areas	Negative	the area is part of the Fertile Crescent region which was host to various ancient settlements and thus there is a possibility for chance-finds during excavation works. Finding such objects may, if not properly managed, risk their loss or damage during handling/storage in construction site.	Permenant	Minor properly managed if	*Work should be stopped in case of finding any antiquities *Inform the Antiquities authority	PF 4
Workforce	Positive	The project will result a wide range of job opportunities for construction workers (150 person)* The unskilled and unemployed workers may need to receive trainings prior to the construction activities to be able to work in the project. On the job training activities should be functioning in order to train the community young people who expressed their willingness to work in the project.* Increase access to job readiness through the provision of education and training for both the personnel of the project and the community.	Temporary	Low to medium	Not applicable	IFC Performance standard 2: labor and working conditions

Workforce	Negative	Demand for worker accommodation project AoI may stress the local housing resources and lead to displacement of low income or other vulnerable households.	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions & Performance standard 3: resource efficiency and pollution prevention
Workforce	Negative	Influx of construction workers in Jabalia and project AoI may stress local health services (e.g. Hospitals, clinics).	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions, Performance standard 3: resource efficiency and pollution prevention, IFC Performance standard 4: community health, safety, and security

Workforce	Negative	Influx of construction workers in the project AoI may stress local utilities (e.g. Potable water, sanitation, electricity, waste management).	Temporary	Low	Minor	Performance standard 3: resource efficiency and pollution prevention
Workforce	Negative	Influx of construction workers in the project AoI may lead to demographic imbalance and reduce social cohesion. The disrespect of norms and traditions might create problems with the local communities	Temporary	Low	Minor	Performance standard 4: community health, safety, and security
Workforce	<ul style="list-style-type: none"> <li>Negative</li> </ul>	<ul style="list-style-type: none"> <li>Workers may be exposed to occupational health and safety risks.</li> <li>Occupational Health and Safety: Job-related accidents, illnesses, and other adverse impacts on worker safety, health and welfare of staff and contractor workers</li> </ul>	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions
Workforce	Negative	<p>Inappropriate management of employment among the project areas:</p> <ul style="list-style-type: none"> <li>Not adhering to transparent employment might arouse community dissatisfaction due to the community inability to benefit from the employment prospects offered by the project.</li> </ul> <p>Raise the feeling of alienation among the community as a result of non-inclusive employment practices.</p>	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions

Workforce	<ul style="list-style-type: none"> <li>Negative</li> </ul>	<ul style="list-style-type: none"> <li>Access to electricity and potable water for site operation</li> <li>Use of public electricity and water networks could reduce availability for local residents.</li> </ul>	Permanent	Low	Minor	Performance standard 3: resource efficiency and pollution prevention
Occupational health and safety	Negative	<ul style="list-style-type: none"> <li>Potential infections</li> <li>probability of being affected by blood transmission diseases,</li> <li>sexual transmitted diseases,</li> <li>accidents result from working on heights or traffic accidents ,</li> <li>disease as a result of lack of hygienic behaviors, and ventilation deficiency might result in facing respiratory diseases,</li> </ul>	Short-term and localized	Low	Minor	
Impact on community health conditions	Negative	As 150 workers will be working in the project area of influence, they might transfer diseases to the surrounding communities.	Temporary	Low	Minor	Performance standard 4: community health, safety, and security

<p>Increased pressure on local services, related to the construction workers' use of community services</p>	<p>Negative</p>	<p>The project's impact on local potable water and electricity utilities, and the availability of these utilities to local households is expected to be limited as it will not affect the villages served by the Mining Company electricity network or the public water treatment and distribution system. As there will be limited changes during the construction phase, as once constructed, the Water reuse plant will generate electricity on site.</p>	<p>Temporary</p>	<p>Low</p>	<p>Minor</p>	
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Increased traffic on the roads	Negative	<ul style="list-style-type: none"> <li>Construction activities and traffic/road use may increase dust and decrease air quality, and also generate noise.</li> </ul> <p>Disturbance due to dust and noise – changes in air quality, dust, and noise could affect health, livelihoods (e.g. Agriculture) and quality of life. Such impact was raised as a concern by project AoI residents. Water reuse projects tend to result in dust and emissions during the construction.</p>	Permanent	Minor	Minimal	<p>Performance standard 3: resource efficiency and pollution prevention &amp; Performance standard 4: community health, safety, and security</p>
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Land acquisition	<ul style="list-style-type: none"> <li>Negative</li> </ul>	<ul style="list-style-type: none"> <li>Reduced livelihoods due to loss of land and/or resettlement.</li> <li>The project will result in acquiring lands to install 14 wells on 1158 meter square</li> <li>The project also will result in termination of 12 private wells, resulting in losing of source of water</li> <li>The project will result in affecting the livelihood of 15 well operators</li> <li>The pipelines will be installed in public lands. As such no land acquisition will be in place</li> </ul> <p>The solar plant will be constructed in the current plant as one of the future components. Additionally, the Ministry of Endowment agreed to give them additional 30 dunums outside the wastewater treatment plant.</p>	Permanent	Low	Minor	Performance standard 5: land acquisition and involuntary
Visual intrusion	Negative	The surrounding agriculture lands might be affected by construction works	Permanent	Minor	Irrelevant	Performance standard 1: assessment and management of environmental and social risks and impact



land use		<ul style="list-style-type: none"> <li>▪ lying of water distribution networks along or across main roads.</li> <li>▪ limited access road for the community during construction, this access difficulty will have more impacts on elderly people, handicapped and children, who may accidentally fall in open trenches or make tedious long cycles before they reach their targeted locations.</li> <li>▪ The impact of the PV component on land use will be limited. The areas inside the NGEST plant are already artificial surfaces covered with roads and paved areas. Only limited areas of the WWTP terrain are currently open space</li> </ul>	Temporary	Medium	Low	
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Table 1: Assessed Significance of Expected Impacts during Operation Phase

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Air Emissions and Noise Pollution	Negative	Noise generating sources in the project are pump rooms and generators in the Booster Pumping Station. The main noise concerns are related to the Pumping Station staff, which may be exposed to intermittent pumping noise, caused by intermittent pump switching controlled by level control. This may be uncomfortable to PS staff. Measures for compliance with noise standards, especially for the working environment, have been recommended in the ESMP and Monitoring Plan. However, the standard protection of the workers, including earmuffs, has to be practiced all the time, especially at the Pumping Station area.	Permanent	Medium	Minor	
Odour	Negative	The operation of the project components is not expected to have significant impacts from odour.	None	Low	None	
Vibration	Negative	Although the pumps and the generator will be installed in the room, but measures have to be taken to reduce the vibration impact at the pumping station and the generator to minimize	Permanent	Medium	mitigation measures to be developed to minimize	

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
		the impact due to the close distance with the El Shuhada cemetery.			the vibration impacts to low	
Impacts of Recovery Scheme on ground water table	Positive	Reduction in the water table elevation after two years of operation of the first stage of recovery wells.	Permanent	High		
Impacts of Recovery Scheme on ground water quality	Positive	As demonstrated by the model, the second stage of the recovery wells will restrict the expansion of the pollution plume; i.e. if only 14 wells continue to operate, the pollution will be extended, and more wells will be at risk in year 2025	Permanent	High	Positive impact with high significance	Palestinian, Jordanian and WHO
Water resource contamination (groundwater)	Combination of positive and negative impact	Reduce the severity of the impact by implementing the monitoring, operation and maintenance of the wells as specified in the monitoring plan		Medium likelihood	Moderate significance	Palestinian, Jordanian and WHO
Recovery water quantity and quality	Combination of positive and negative impact	Reduce the impacts by awareness and monitoring campaign for the farmers, the restriction of using recovered water, health and safety procedure dealing with recovered water		Medium likelihood for water distribution due to the restriction of water purposes and positive likelihood for better quality	Negative impact of medium significance	

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
				and quantity of the recovery water		
Positive Impacts of the photovoltaic panels	Positive	By adding the photovoltaic (PV) system to NGEST, the annual supply from the grid in 2018 is reduced by 24% and the required annual energy from the emergency diesel is taken down by 27% allowing the NGEST facility to reduce its diesel consumption by 30%, leading to the saving of 1,3 million liters of diesel fuel. This will result in lower emissions amounting in 70 989 tCo2 eq over the 20 years lifespan of the project.	Permanent	High	Highly significant	
Impacts on soil	Negative	<ul style="list-style-type: none"> <li>Several changes to the physical and chemical properties can result from the use of reclaimed water for irrigation. The type of soil and its physical and chemical characteristics, most common of which are salinity, sodicity, PH, toxicity and bacterial count.</li> </ul> <p>Using the recovered water for</p>	Permanent	High	Negative impact with high significance	Palestinian, Jordanian and WHO

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
		irrigation will result in the need for fertilizers to condition the soil. The amount used will depend on the crops used and cannot be determined at this stage.				
The potential change in source of income	Positive	<p>The market of recovery water reuse and sludge is a big market, if it is appropriately managed.</p> <ul style="list-style-type: none"> <li>■ In principle the sludge, which is very rich in nutrients (N, P, K) could be used as fertilizer and replace chemical fertilizer, which are currently imported from Israel. Indicating that relying on the sludge might save money needed to import the chemical fertilizers from Israel.</li> <li>■ The utilization of the recovered water of high quality and of proper price might work for the benefit of the farmers, increasing their profits.</li> </ul> <p>Generally speaking, farmers cultivate their lands using rains, rain fed irrigation. Using this type of irrigation, farmers cannot cultivate all types of crops.</p>	Permanent	Low	Minor	Performance standard 2: labor and working conditions

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
		Enabling continuous source of water can provide them with wide opts to cultivate the preferable crops of high productivity and revenue. PWA managed to prepare a full report about the impacts pertaining to crop cultivation and productivity of lands.				
Workforce	Positive	The project will result job opportunities for operation workers (50 person)	Permanent	Low	Minor	Performance standard 2: labor and working conditions
Workforce	Negative	Occupational health and safety: Workers on the Project will be exposed to a range of OHS risks during construction and operation, such as working at height, manual handling, contact with hazardous material, noise and vibration, amongst others. In the absence of appropriate standards and preventative practices, the health and safety of workers would not be adequately protected. IFC PS 2 addresses occupational health and safety.	Permanent	Low	Minor	Performance standard 2: labor and working conditions

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Impact on community health conditions	Positive	Using of treated water will reduce the sewage water that floods over, affecting people and their livelihood status. As well, the usage of untreated water due to the high cost of the municipality water might be reduced as the farmers will use the recovered water instead	Permanent	Medium	Not applicable	Performance standard 4: community health, safety, and security
Access to electricity and potable water for site operation	Negative	Use of public electricity and water networks could reduce availability for local residents.	Permanent	Low	Minor	Performance standard 3: resource efficiency and pollution prevention

## 5. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) AND MONITORING PLAN

The Environmental and Social Management Plan (ESMP) consists of a set of mitigation, management and monitoring measures to be taken during implementation of the project to avoid, reduce, mitigate, or compensate or offset any adverse social and environmental impacts. In addition, the ESMP defines procedures to ensure that the management of environmental and social issues during the different project phases are undertaken in accordance with national legislation and best practice procedures.

The successful implementation of the ESMP will depend on a range of different elements. To ensure a management plan that incorporates and successfully integrates with interface documents, the following elements must be considered and acted upon:

- The environmental and Social Management unit should be adequately staffed to ensure the proper implementation and monitoring of the ESMP. The organizational structure of the environmental and social PMU should also reflect the range of complete competencies to perform the tasks.
- The development and management of registers for the proper documentation and tracking of environmental and social training, environmental and social incidents and environmental and social related complaints.

The Environmental and Social Management Plan (ESMP) presented in this chapter reflects the implementation procedures and mechanisms for the mitigation measures and monitoring activities of the expected impacts previously discussed. The ESMP assigns certain tasks for different stakeholders according to their roles and responsibilities in the project.



Table 2: Environmental and Social Management Plan during construction

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
Health impact associated with fugitive dust generated due to the vehicles movements	<b>Implement a construction site management plan indicating:</b> <ul style="list-style-type: none"> <li>Pre-identified storage areas.</li> <li>Wet the network of unpaved roads on site. The use of water should be restricted to extremely active areas.</li> <li>Regulation of speed to a suitable speed (20 kmh) for all vehicles entering the village's boundaries.</li> <li>Localize the vehicle movements</li> <li>Implement preventive maintenance program for vehicles and equipment working on site and promptly repair vehicles with visible exhaust fume.</li> </ul>	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Potential dust nuisance to the population in the vicinity to the construction site due to the vehicles movement	Pavement of access road prior to usage in construction of the project component	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Impacts of dust emission of on vegetation survival, especially on the agricultural land	Keep the site nearby the agriculture land and plantation wet, especially during the hot and dry season	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Impacts of noise associated with heavy machineries and generators	<ul style="list-style-type: none"> <li>Noisy equipment, especially those that will be used in the construction works including generators should be supplied with adequate silencers</li> <li>Standard noise protection equipment for the construction workers</li> </ul>	Contractor ,equipment Supplier	Contractor cost in normal bid price
Impacts of noise on the psychology the neighboring communities	<ul style="list-style-type: none"> <li>Optimize the use of noisy machine</li> <li>Use acoustic barriers as necessary if complaints from neighbors were received</li> </ul>	Contractor	

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
<b>Vibration impacts</b> <ul style="list-style-type: none"> <li>at the location nearby El Shuhada cemetery area resulting from Vehicles movement</li> <li>resulting from construction work (concrete work) of facility of water distribution network.</li> </ul>	<ul style="list-style-type: none"> <li>Base camp and the storage of the equipment has to be on placed further from the cemetery area (on the future land dedicated for the future location for booster pumps and storage tank.</li> <li>Time management plan to reduce the overlapped heavy equipment</li> <li>Ready mix concrete is preferred instead of on site concrete mix with mixer.</li> </ul>	Contractor	Contractor cost in normal bid price
<b>Construction waste resulting from human wastes including wastewater and solid waste</b>	<ul style="list-style-type: none"> <li>Provision of onsite sewage collection and disposal</li> <li>Site waste management including storing, collection and removal</li> <li>Maximize the reuse and recycle of construction materials</li> <li>Notify the sanitary landfill of receiving the unusable construction wastes or damaged construction materials.</li> <li>Coordination with the landfill management for receiving the unusable construction waste</li> </ul>	Contractor	Contractor cost in normal bid price
<b>Changes in hydrology and groundwater quantity and quality: Potential leaks or spill chemical / fuel</b>	Proper waste management	Contractor	Contractor cost in normal bid price
<b>Potential leaks from temporary sewage storage tank</b>	Spill prevention measures	Contractor	Contractor cost in normal bid price
<b>Impact associated with waste generation</b>	Waste management plan	Contractor	Contractor cost in normal bid price
<b>Ecological disturbance to the crops and animal, especially at the water distribution network site</b>	Fences installation prior to the construction of the recovery water distribution networks	Contractor	Contractor cost in normal bid price
	Compensation preparation for destructed crops or plant	Contractor in coordination with MoA	Contractor cost in normal bid price

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
<b>Impacts pertaining to workforce</b>	<ul style="list-style-type: none"> <li>Conduct a health examination to workers prior to the onset of work</li> <li>Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>Grievance mechanism to be provided to local residents with a proper communication channels that enabled the community to voice their concerns.</li> <li>Influx Management Strategy will be developed to coordinate worker accommodation between various construction companies, track the number of non-local workers, and manage issues related to accommodation. Development of the strategy will include further investigation of existing residents and their concerns and vulnerability to change.</li> <li>Engagement with local communities to understand changes or issues that have developed since the start of construction.</li> </ul>		No cost as all activities are part of PWA /contractor's activities
<b>Workers health and safety</b>	<ul style="list-style-type: none"> <li>Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.</li> <li>Occupational Health and Safety Strategy will be developed to coordinate worker health and safety measures between various construction companies, track the</li> </ul>	PWA In cooperation with the contractor, Ministry of Health and Ministry of Labor	No cost as all activities are part of PWA /contractor's activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	number of workers infected or died, and manage issues related to health conditions. Development of the strategy will include further investigation of existing health and safety measures and workers concerns and vulnerability to change.		
<b>Increased pressure on local services, related to construction workers' use of community services</b>	<ul style="list-style-type: none"> <li>▪ The quantity of water supply should be calculated and negotiated with Water Company in order not to affect the local communities</li> <li>▪ Wells can be dug in the site to work as alternative source of water. Potable water also might be obtained from bottled water companies</li> <li>▪ Grievance mechanism to be availed to local residents with proper communication channels. This will provide the Project with any concerns or complaints, including potential issues related to utilities shortage.</li> <li>▪ Ongoing engagement with stakeholders water treatment plant and villages to identify concerns or changes in water availability, and ensure water resources are managed properly.</li> <li>▪ Engagement with local communities to understand changes or issues that have developed since the start of construction.</li> </ul>	The PMU in the PWA	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
<b>Increase traffic on roads</b>	<ul style="list-style-type: none"> <li>Developing of Traffic Management Plan that contains all mitigation measures related to traffic impacts. This plan should explain the limitation and roles of traffic monitoring staff. Also, it should contain all indicators of monitoring that will put limitation to the unfavorable impacts</li> <li>Grievance Mechanism to provide road users with a means of contacting the Project with any concerns or complaints, including potential issues related to traffic and road safety. One of the important communication channel to be available in the GRM should be the cell phone of traffic inspector. Any violation of traffic issues will be treated very seriously and appropriate corrective action(s) to be taken as needed.</li> <li>Engagement with communities, road users, and the villages located around the site to identify concerns regarding road safety and traffic impacts. Signage and outreach activities to improve public awareness of traffic changes and potential hazards will also be targeted for high-risk sections of public roads, including near the site and laydown areas.</li> <li>Engagement with regulatory authorities regarding traffic management and condition of public roads.</li> </ul>	The PMU in the PWA should work closely with the contractor In cooperation with the contractor and Traffic Department	No cost as all activities are part of PWA activities
<b>Impacts related to land acquisition</b>	<ul style="list-style-type: none"> <li>Apply restrict avoidance mechanism in order to reduce resettlement activities to the most necessary ones and avoid small plots of lands</li> </ul>	The PMU in the PWA should work closely with the municipalities, Awqaf and Land Authority to be assured that all PAPs have relocated and mitigated fairly	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	<ul style="list-style-type: none"> <li>Develop Resettlement Action Plan to be the foundation set for a Resettlement Action Plan</li> <li>Provide appropriate compensation strategy through the resettlement action plan RAP</li> <li>Develop and enforce efficient consultation strategy with the community people in order to reach the appropriate compensation that will be based on Laws and the desire of people</li> <li><b>Providing compensation to the land owners, tenants, house owners, tenants, Or provision of alternative lands</b></li> </ul>		

Table 3: Environmental and Social Management Plan during operational phase

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
Air emission and noise pollution impacts-Impact on noise especially for the PS staff at the water distribution network PS	<ul style="list-style-type: none"> <li>Ensure that all equipment comply with emissions and noise standards</li> <li>Standard protection for the workers including the ear muffs.</li> </ul>	CMWU as the authority	10,000 for initial purchase of equipment and 10,000 for monitoring Programme annually
Vibration impacts especially nearby the el shuhada cemetery of the installation of pumping station and generators	Heavy leafy tree plantation at the tree to absorb the vibration and noise associated with the PS and generators	CMWU in coordination with MoA MoA provide the suitable plantation can be sufficient for vibration and noise absorption	10,000
Workers' Occupational Health and Safety	<ul style="list-style-type: none"> <li>Maintenance of the machines and equipment has to be maximized.</li> <li>Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.</li> <li>Occupational Health and Safety Strategy will be developed to coordinate worker health and safety measures between various construction companies, track the number of workers infected or died, and manage issues related to health conditions. Development of the strategy will include further investigation of existing health and safety measures and</li> </ul>	CMWU In cooperation with the Ministry of Health and Ministry of Labor	Cost estimation is dependent on the average annual budget for pumping, generators and pipelines connections

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	workers concerns and vulnerability to change.		
Water resource contamination-Risk of improper functioning (capturing of contaminant ) of the recovery wells	The maintenance of the recovery well to meet the design criteria to capture the contaminant	PWA	Cost estimation is dependent on the local materials availability
Lowering of ground water table	Monitoring of pumping using pumping tests.	PWA	Cost is part of the monitoring budget
changes to the physical and chemical properties resulting from the use of reclaimed irrigation water. The type of soil and its physical and chemical characteristics, most common of which are salinity, sodicity, PH, toxicity and bacterial count.	<ul style="list-style-type: none"> <li>The soil should be monitored before and during the course of using wastewater for irrigation. Soil texture (leaching problem is higher), PH, salinity, cation exchange capacity and others are important mon characteristics that determine the limitation and the type of management of wastewater irrigation.</li> </ul>	PWA, MoA	Cost is part of the monitoring budget



Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	<ul style="list-style-type: none"> <li>Chemical amendments : The use of calcium source amendment such as gypsum is widely accepted for amelioration of soils with high percentage of Na in the cation exchange capacity (CEC) or whenever water high in SAR is used in irrigation. Na in soil is exchanged by Ca from gypsum and dispersion of the colloidal phase is reduced. Application of gypsum should be repeated periodically depending on the Na content in the water and the CEC of the soil. The farmers are advised to seek professional help to estimate the amount and frequency of the gypsum application required.</li> <li>Adapted irrigation system. Crust formation at the soil surface is the result of the irrigation with water high in SAR . The degree of the problem, however, is not the same with all irrigation systems. In general, the surface irrigation systems with water high in SAR creates thick surface crust. Similar results are obtained with sprinklers of high discharged capacity. This way, the soil water, permeability as well as soil aeration and emergence of the seeds are affected. When using many sprinklers and drippers of low discharge rates, the formation of surface soil crusting is reduced. The duration of irrigation is extended and</li> </ul>		

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	<p>sufficient time is allowed for water penetration into the soil. (Papadopoulos, 1995) .</p> <ul style="list-style-type: none"><li>Organic matter: The alkalinity problem can also be solved by addition of organic matter like straw, other plant materials or organic manure.</li></ul>		

Table 4: Environmental Monitoring Plan

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
<b>During Construction</b>					
Ambient Air Quality by dust emission of construction works	Ambient PM, dust complaint	Ambient PM closest farm at location of location of pumping station, water distribution network and nearby community	Sampling collection and laboratory analysis Recording and documentation of complaints	Once during the most activities at each location	contractor
Noise Impacts	Ambient noise, noise complaint from the neighboring communities	Project locations	Portable noise measurement to take representative of average noise, recording and documentation of complaints	Annual during operation and once during the construction activity	Contractor
Odour Impacts	Odor complaints from	Site location	Recording and documentation of	Monthly	PMU-EM

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	neighbors		complaints		
Vibration at the location nearby El Shuhada cemetery area	Vibration level	Site location close to el shuhada cemetery	Portable vibration measurement	Annual during operation and once during construction	Contractor during construction and CMWU during operation
Impact on construction waste and handling of hazardous waste	Amount of hazardous and non-hazardous waste generated	Project site locations	Estimation of the hazardous waste and nonhazardous waste in relation to the handling and transporting to the landfill	Weekly or monthly depending on the volume of waste	Contractor
Remediation works at the effluent lake	Clean up the site, edible tree plantation,	Project sites	Recording and documentation during the preparation of remediation and during the plantation period	monthly	contractor
Health and safety	Health records about occupational injuries and infectious diseases among workers	Clinic / hospital contracted by the project	Medical reporting on received cases	Quarterly / on received case	Occupational health clinic / hospital
Ecological	Record about biodiversity	Project sites	Recording and documenting and	monthly	contractor

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
disturbance	found, removed, handling over to relevant authority, damaged or replanted		reporting to the relevant authority		
During Operation / Maintenance					
Air Emissions and Noise Pollution	<ul style="list-style-type: none"> <li>▪ The contractor should monitor noise intensity at locations of workers in pumping stations. The measurements are to be undertaken annually under normal pumping stations working conditions.</li> <li>▪ Investigate and follow-up on noise complaints from workers and others</li> <li>▪ The contractor should</li> </ul>	▪			

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	<p>monitor exhaust emissions from standby generators against the stipulations of Law for carbon monoxide, sulphur dioxide, nitrogen oxides and total hydrocarbons. The monitoring is to be performed annually during the normal operation of the generators.</p>				
Contamination from Reuse of Recovery Water in Irrigation	<ul style="list-style-type: none"> <li>▪ BOD (Mg/l)</li> <li>▪ TSS (Mg/l)</li> <li>▪ Total-N (Mg/l)</li> <li>▪ F. coliforms</li> </ul>	Irrigation and recovery wells		Quarterly	

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	<ul style="list-style-type: none"> <li>Helminthes eggs</li> <li>Intestinal nematode</li> </ul>				
Impacts of the use of reclaimed wastewater for irrigation on soil quality	Periodic monitoring and control of soil physical, chemical and microbiological properties of the soil under wastewater irrigation is necessary to ensure successful and sustainable waste water application. Parameters recommended for monitoring were suggested in Table 3.	▪	As indicated in Table 3	Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, Atrazine At least once annually	
Impacts of recovery scheme on ground water	Nitrogen (N), phosphorous (N) and ammonia (NH <sub>4</sub> )	▪		should be measured four times	
Groundwater monitoring	Groundwater monitoring is presented below in section 8.9 below.				PWA

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
Impact on local agriculture, public health and water resource	Recording and documentation of Agriculture production, endemic or health related diseases due to recovery water usage on agriculture	Nearby community and farms connected with recovery water distributions	Sampling collection or survey, recording and documentations	Annually	MoA in coordination with MoH



## 2 STAKEHOLDER ENGAGEMENT ACTIVITIES

Stakeholder engagement chapter aims at highlighting the key consultation and community engagement activities and their outcomes, in addition to outlining the validity and reliability of the collected data.

### Stakeholder Engagement Objectives

The objective of the Stakeholder Engagement is to ensure safe and successful Project delivery by:

- Informing stakeholders, including persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively;
- Listening to their comments, ideas and concerns and recording the same for follow up;
- Communicating and implementing a viable community grievance mechanism.
- Avoiding conflict by addressing impacts and issues raised by stakeholders promptly; particularly with the communities that will not be served by the project
- Ensuring that fears and anxieties about the nature, scale and impact of the operation have been properly considered in the development and management of the Project;
- Accessing and making good use of existing local knowledge of the area;
- Avoiding any misconceptions about the project and properly manage expectations;

Thereafter the results will provide proper documentation of stakeholder feedback and enhance the ESIA accordingly.

### Consultation Methodology and Activities

The research team for this study has adopted multi-dimensional consultation activities that enable the marginalized, voiceless, youth and women to gain information about the project. As well, gaining information about their concerns and worries regarding the project during various implementation phases. Due to time constraints a team was mobilized to consult with community people and stakeholders in parallel.

Following are the main consultation activities to date that will be supplemented by additional engagement activities:

- The study team visited the project area in order to define various stakeholders during April 2018
- Meetings were conducted during April 2018 in order to develop an engagement plan that is locally tailored for the residential communities with the study team members
- Based on the identification of stakeholders, various questionnaires and guidelines were prepared in order to engage: i) the residents in the project areas, ii) Governmental municipalities, iii) the CBOs, iv) health facility, v) Ministry of Endowment and Ministry of Agriculture, vi) the EQA
- The study team divided various engagement activities of the project to:
  - a. Screening
  - b. Scoping phase and data collection phase and,
  - c. Public consultation phase.
  - d. Final report disclosure

### Project Stakeholders

The objectives of stakeholder identification include: a) establishing which organisations and individuals may be directly or indirectly affected (positively and negatively), or have an interest in the Project; and b) understanding their needs and expectations for engagement.

Stakeholder analysis enables engagement to be tailored appropriately to the needs and interests of different stakeholder groups to ensure their views and concerns are addressed in a suitable manner.

A systematic approach has been adopted to identify Project stakeholder which has included:

- defining the Project's AOI which basically covers Jabalia, Um El Nasr, Beit Hanoun and Beit Lahia;
- scoping and identifying stakeholder group that could be affected (directly or indirectly) by the Project, or have an interest in it;
- identifying vulnerable groups; and
- review AOI, stakeholders and vulnerable groups during each SEP update and, if necessary, revise based on current Project context.

In order to ensure that the engagement process is inclusive, individuals and groups who may find it more difficult to participate and those who may be 'directly and differentially or disproportionately affected by the Project, or disadvantaged in sharing development benefits and opportunities, because of their vulnerable status' were identified. It will be important for the Project to ensure specific steps are taken to access these groups and afford them the opportunity to engage in discussion about the Project and their interactions with it.

### Summary of discussion

Issue raised	Comment raised	Response	How it was responded to in the study

Issue raised	Comment raised	Response	How it was responded to in the study
<b>Health concerns</b>	<p>Some previous ground water tests show a high level of health related pollutants (ammonia as example), this should be considered.</p> <p>What are the tools that will be used to predict the project impact on ground water, and how to quantify this impact? The pilot project of Gaza municipality of waste water reuse in Sheikh Ajleen area, this can be revised as a case study.</p>	<p>PWA have an integrated sampling program for the plant, the infiltration ponds and groundwater reservoir. Which has been recently updated. The private wells will not be closed, we hope the project will provide the farmers a competitive service to use the recovered water. Certainly, the monitoring plan shall be developed. It may be extended to the crops irrigated by the recovered water.</p> <p>The Land Authority allocated the land of 14 wells from private lands. The compensation issue will be covered by this study.</p>	To be added in the mitigation section
<b>Institutional set-up</b>	The project should focus on the importance of the institutional framework as it is the basis for the operation and success of this project.	One of the outputs of the study is the environmental management plan, which assign who will	To be added in the institutional section

Issue raised	Comment raised	Response	How it was responded to in the study
	He explained that the Palestinian legislation classifies this water as groundwater because it mixes with groundwater after its infiltration.	do what. I suggest to form an institutional body from all the stakeholders to manage, organize, monitor, and operate the project components. This study should result a realistic and applicable procedures	
<b>Monitoring requirements</b>	There is a lack of monitoring in all project stages. It's recommended to engage the relevant authorities in this progress. He mentioned the Ministry of Health, Agriculture, Environment, and the municipalities.	PWA will develop a detailed monitoring scheme for all project activities including E&S performance	To be added in the monitoring sections
<b>Land acquisition and role of municipality</b>	Municipalities should be involved in the process of land acquisition and compensation to contribute in resolving disputes, if any. The Ministry of Agriculture and other Agricultural Institutions should be involved in the development of the project operation plan. He focus on Developing a clear vision of water pricing and whether there is a cost recovery.	In full compliance with the Palestinian land acquisition regulations, the municipalities will be engaged and consulted in the process of compensation	To be added in the mitigation sections and in the RAP study

Issue raised	Comment raised	Response	How it was responded to in the study
<b>Required updated data</b>	There are many updates regarding 2013 data, such as statistics, economic conditions in Gaza, water quality and suitability for agricultural use, farmers' crop pattern. He focused on the use of the nitrate existing in the waste water as soil fertilizer. Which also reduce its treatment cost.	The study team reviewed the current data disclosed on PCBS and obtained updated data from the PWA including the new layout	Updated data will be presented in the project description and baseline
<b>Water tariff</b>	How can the social impact be measured without a clear water tariff?  Emphasized on the importance of water pricing considering the operational capacity of the project. Modern agriculture should be supported through good pricing and product marketing. Solar energy is a very good proposition because it lowers water prices on farmers. Government support should be provided for this project. All possible emergency cases shall be considered and the study.	The tariff is still being discussed	To be added in stakeholder engagement requirements and concerns
<b>Need to recover all water</b>	The need to recover all the infiltrated water to minimize	PWA will exert effort to reuse all water,	To be added in stakeholder

Issue raised	Comment raised	Response	How it was responded to in the study
	the negative impact on the groundwater quality.	particularly due to the rigid need for water supply	engagement requirements and concerns
<b>Participation of community in the scoping session</b>	The absence of community institutions from all project activities! We recommend to engage the farmers in the consultative process of the project.	During scoping phase, we managed to meet with various community members in their premises. However, the scoping session is allocated for experts who might provide guidance to enrich the ESIA. This is in full compliance with EQA and IFC standards	Community people should be invited in the final consultation section
<b>Termination of private wells</b>	The Private wells within the area of the recovery wells, Will it be closed or merged with system	Few number of private wells will be terminated	To be added in the RAP
<b>Pollutants</b>	Is there any examination of the microbes (ex: hepatocellular virus) pollute the groundwater through infiltration?	PWA developed and will continue measuring various pollutants	To be added to mitigation plan
<b>Management of private wells</b>	How to manage the private wells exist within the project area?	PWA will cooperate with the farmers	To be added in the Stakeholder Engagement Plan
<b>Probability of Israeli incursion</b>	Concern of Israeli incursions into the destruction of irrigation networks.	All projects in Gaza have the same concern	To be added as a risk to the project

Issue raised	Comment raised	Response	How it was responded to in the study
Well operators mitigation measures	How well operators will be mitigated?	Well operators have been interviewed and mitigation measures will be proposed in the RAP study	To be added in the RAP and mitigation measures
Points to be added to the study	There are clay layers in the saturated zone that have not been studied in 2013 and may affect the infiltration process.	To be studied by the environmental expert	
Water usage in case of not used by farmers	Where will this water discharge if it is not used by farmers? I suggest a conveyor line to Wadi Gaza.	There is an emergency plan that proposes the measured to be taken in such case. However, given the shortage of water supply in Gaza Strip, water will be used	To be added in the emergency plan
Time plan	When the remaining components of the project are expected to be completed?	There is no time plan as the fund has not been secured to date	No action
Marketing for produced water	The importance of this water being marketed in a way that attracts the farmer to use it. He emphasized Developing a vision for the project regulatory body	This proposal will be discussed and handled by the PWA	To be added in the SEP





# 1 INTRODUCTION AND UPDATE ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT OBJECTIVES

## 1.1 Introduction

The Palestinian Water Authority (PWA) together with Agence Française de Développement (AfD) have prepared the Terms of Reference (ToR) for updating the Supplementary Environmental and Social Impact Assessment (SESIA) carried out for the North Gaza Emergency Sewage Treatment Project (NGESTP) in 2013.

The SESIA update assignment will only cover the evaluation of the environmental and social risks and impacts of the Recovery and Reuse Scheme (part 'C2').

Part 'C1' has been financed by World Bank and this part, 'C2' (referred to as **the Project** in this document) is anticipated to be financed by AfD and the Green Climate Fund (GCF). The update assignment was announced in a competitive bid and awarded to the joint venture of EcoConServ and Universal Group Gaza.

This report is a fundamental deliverable for the SESIA update consultancy service which involves the updating of the SESIA based on the updated project description, including the Photovoltaic system component (PV) (that was not part of the initial project) and with recent information regarding the baseline and institutional context.

## 1.2 Background

The NGEST Project initiated in 2004, was initially planned to be implemented in two phases. Part A of the treatment scheme was the construction of the terminal sewage pumping station at the Beit Lahia Wastewater Treatment Plant (BLWWTP) site, construction of a pressure pipeline to a new site about seven kilometers to the East of Jabalia, construction of seven infiltration ponds at the new site, and commissioning of the pipeline to allow a large and dangerous emergency partial effluent pond at Beit Lahia to be drained.

Part B of the treatment scheme included constructing a wastewater treatment plant at the new site that was envisaged to handle up to 70,000 cubic meters of sewage daily. Other parts of the overall project was the remediation of the land that was formerly covered by a large partial effluent at Beit Lahia and for a pilot program to recover treated and infiltrated effluent from the ponds.

Part 'A' had been in operation since April 2009, and was entirely completed in 2010, pumping partially treated sewage from the old BLWWTP site to the new infiltration basins site.

Part B was originally expected to be completed in 2013, but had not actually started its operations until the first quarter of 2018.

Part C, was proposed at a later stage, to expand the effluent recovery and reuse scheme to the full planned effluent flow from the plant and provide long-term protection for the underlying aquifer.

A Supplementary Environmental and Social Impact Assessment Study was conducted in 2013 for the North Gaza Emergency Sewage Treatment Project for the Effluent Recovery and Reuse System and Remediation Works and the proposed reuse system distribution networks to :

- Provide an update to the situation which had changed as a result of the differing timeframes and delays in the phases A and phases B
- To accommodate for the newly placed specific remediation plan which included design and implementation of the remediation plan. allocated towards Part B of the project, namely for remediation of the drained effluent lake at Beit Lahia.
- To accommodate for the new component, according to the original plan, which was added to the project to recover and reuse the treated effluent after the new treatment plant (NGWWTP).

Because of the schedule shifts and delays in implementation, the situation considered in 2013 has changed. Design changes have been made to the system, phases B and C1 have been operational and the current ground water situation covered in the 2013 SEISA may have changed.

This update has therefore been made to cover the second stage of the third, supplementary phase, namely the reuse/recovery scheme (C2). In addition to the core project components of C2, an additional new solar component was proposed to secure reliable source of power supply to the project, and reduce its operations dependency on the grid.

The joint venture between EcoConServ and Universal Group (UG) were hired by AfD and PWA to update the evaluation of the environmental and social risks and impacts of the Recovery and Reuse Scheme (part 'C2'). The Consultancy Term of Reference (ToR) identified the objective of the study in two parts: "Update the Environmental and Social Impact Assessment (ESIA) and Develop the Resettlement Action Plan of the proposed Recovery and Reuse Scheme, namely:

- The recovery and reuse scheme infrastructure, including the recovery wells, collection pipes and monitoring wells.
- The irrigation network scheme and the related environment, including the water tanks, booster pumping station and irrigation network.

### 1.3 Project Rationale

Gaza relies almost completely on a coastal aquifer as the sole source of freshwater. However, 95% of the aquifer's water is not safe for drinking without treatment (PWA, 2014). Years of over-abstraction have taken a heavy toll on Gaza's present and future water resources. Annual abstraction of water from the aquifer has been well above the recharge rate by over 100 million cubic meters, almost twice the sustainable rate. Consequently, groundwater levels have declined, seawater from the

Mediterranean has infiltrated and salinity levels have increased, making the water unsafe for drinking according to World Health Organization (WHO) standards (World Bank, 2009).

The over-abstraction and scarcity of drinking water have been exacerbated by crumbling sanitation infrastructure, while the Israeli blockade creates chronic shortages of electricity and fuel, which in turn aggravate contamination and the water crisis. The damage of contamination and over-abstraction is such that the aquifer may become unusable and, if unaddressed, the United Nations (UN) has stated the damage may be “irreversible” by 2020 (UNRWA, 2015a).

Throughout the project, the study team examined the anticipated effects to the groundwater aquifer for both the interim phase (before the treatment plant is commissioned) and the consequent effects of the full operation of the system. The basic assumption used in those scenarios was that there would be a time lag (around two years) between the two phases when poor-quality effluent will be discharged to the basins. To mitigate those negative effects during this interim phase, the study recommended a recovery scheme where the groundwater “polluted” with the recharged effluent will be captured through a chain of pumping wells (after its quality has improved) and used for agriculture.

The reality has changed since the EIA was prepared, and the timeframes envisaged for both phases have changed. Due to the closure of the Israeli borders with Gaza and lack of construction materials, phase A has taken more than four years to finish. Phase B was expected to be commissioned before the end of 2013 but has not been in operation until the first quarter of 2018. The effluent lake in Beit Lahia has been evacuated to the basins with sub-standard quality. Until then, inflow rate of partially-treated sewage to the basins was about 15,000 cubic meters daily and the remaining effluent was pumped daily to temporary ponds located near the north border with Israel (northwest Um Al-Nassr) and to the two basins adjacent to the existing BLWWTP.

A third, supplementary phase, namely the reuse/recovery scheme was later added to the project to recover and reuse the treated effluent after the new WWTP is completed. The treated sewage effluent will be disposed of into infiltration ponds, the water will seep through an unsaturated zone of soil which will facilitate nutrient and pathogen removal, and eventually make its way to the unconfined aquifer. There, the water will be extracted by 28 recovery wells surrounding the basins to capture the effluent, put into two storage reservoirs, and distributed throughout the network for irrigated agriculture.

The recovered effluent is expected to irrigate around 15,000 dunums of adjacent agricultural land.

## 1.4 Project Component Site

The project lies in the vicinity of NGWWTP and is designed to allow for reclamation of water in the agricultural activities. The existing situation of this area is illustrated hereafter according to a prefeasibility study prepared during the NGWWTP effluent recovery system (PWA, 2010).

The proposed agricultural area for ruse activities is divided into two zones (A and B) according to its location from NGWWTP. Zone A is the part located north of NGWWTP with about 10,100 dunum whereas, Zone B is located south of NGWWTP with about 5,000 dunum.

The recent distribution of cultivated crops in both zones (A and B) is shown in Table 1. Most of the area (about 12,000 dunum) is considered as under rain-fed conditions.

Citrus is a crop grown in the project area with an area of 1198 dunum (fruitable and non-fruitable). Olives represent 614 dunum (fruitable and non-fruitable). Vegetables represent 280 dunum. The area of fruit trees is 120 dunum, whereas, the rain-fed area includes the grains and the demolished area occupying the most of the project area being 12,055 dunum as shown in Figure1 and Figure 2.



Figure 2: Proposed project area

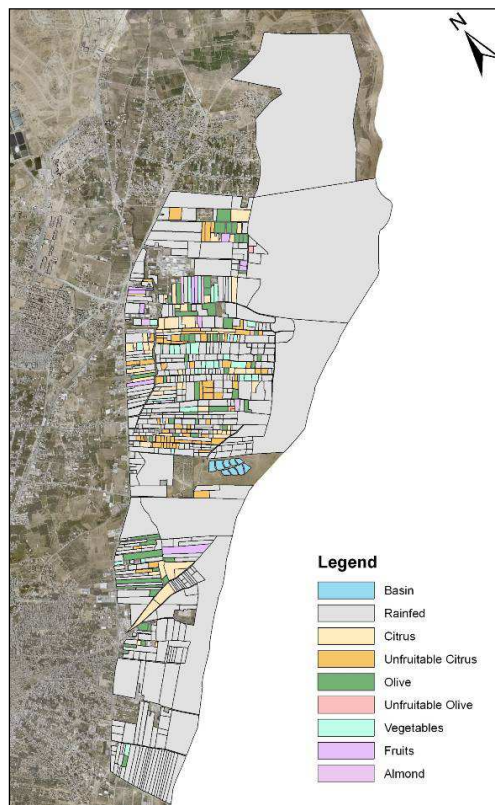


Figure 3: Existing crops in the project

Table 5: Distribution of cultivated crops in zone (A and B), Dec. 2009

Crops	Zone A1 (dunum)	Zone A2 (dunum)	Zone B (dunum)	Total
Rain-fed	3796.5	3796.5	4462	12055
Citrus	257.5	257.5	172	688
Olives	194	194	212	600
Vegetables	130	130	20	280
Fruit Trees	60	60	0	120
Almonds	26.5	26.5	64	117
Citrus (non-fruitable)	232	232	46	510
Olives (non-fruitable)	7	7	0	14
Total	4703.5	4703.5	4976	14,384

## 1.5 SESIA Update Objectives

The ESIA is an instrument that involves examining the project's technical, environmental, socio-cultural, institutional, historical and political context, and stakeholders' views and priorities. It aims to set a mitigation and monitoring plan to tackle the negative environmental and social impacts and defines the institutional responsibilities for implementing these measures. The Resettlement Action Plan (RAP) is regarded as a mitigation action to minimize the negative impact of involuntary land acquisition that might be triggered as part of the project.

In order to fully comply with Palestinian environmental law and World Bank safeguard policies, as well as to support the sustainability of the expected project outputs and outcomes, the following are to be delivered in this consultancy:

- Updated identification of the possible environmental and social impacts with focus on phase "C2" of the proposed effluent recovery and reuse scheme, taking into consideration all updates that have occurred since 2013.
- Updated identification of any potential temporary or permanent land acquisition requirements associated with civil works;
- if the Bank's Operations Policy 4.12 (see below) applies due to land acquisition requirements, preparation of draft terms of reference to formulate a Resettlement Action Plan (RAP) to manage, mitigate, and monitor the impacts of the acquisitions;
- An updated environmental and social impacts management plan (ESMP) based on the baseline relevant components of the ESMP in the SESIA update study to manage, mitigate, and monitor any possible negative impacts during the construction and operation phases of the project;

- v. a capacity assessment of the implementing party to implement the ESMP and recommendations for any capacity-building needs.

## 1.6 SESIA Update Requirements

Initial screening for applicable World Bank social and environmental safeguard policies indicate that the project might be triggered by:

- OP/BP 4.01- Environmental Assessment: According to World Bank screening, this project is classified as a category “A” project which requires an environmental assessment. The scope of assessment will include determination of any expected environmental and social impacts and preparation of an environmental management plan for managing, mitigating and monitoring risks and negative impacts.
- OP/BP 4.12- Involuntary Resettlement: Project activities are expected to require minimal land acquisition for the construction of wells, pumping stations, effluent reuse pipelines and storage tanks. While the Bank’s Operational Policy on Involuntary Land Acquisition and Resettlement (OP 4.12) does not apply in cases of public land acquisition or in circumstances of voluntary donation by private individuals, this supplementary ESIA will consider the totality of temporary and permanent land requirement for this project to ascertain if any lands will be involuntarily acquired through the principal of eminent domain. It will also clarify the nature of land ownership for each site (Waqf, public, or private). These sets of assessments will determine the applicability of OP 4.12 and hence the requirements to prepare safeguards instruments, if any.
- BP 17.50- Disclosure of Operational Information: The proposed project is subject to the bank's access to information policy concerning the disclosure of project information including the environmental and social impact assessments.
- Natural Habitats (OP 4.04) (revised on April 2013) : The proposed project is subject to the the bank’s natural habitats
- Cultural Property (OP 11.03)
- Project on International Waterways (OP 7.50)
- 2016 version of the World Bank Standards and applicable WB EHS Guidelines

This SESIA update follows the same structure as the original SEISA report, which was prepared in accordance with the National Environmental Impact Assessment (EIA) guidelines including the EIA brochure of the PNA. It also examined and recognized the international policies guidelines mentioned above.

In addition, the international guidelines from WHO and The Food and Agriculture Organization (FAO) have been examined in this SESIA update study to account for concerning the health impact of using treated wastewater.



## 2 THE ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT OBJECTIVES AND METHODOLOGY

### 2.1 Study objectives

While interventions of the Effluent Recovery, Irrigation Scheme and Remediation Works Project were previously identified during the preparation of the NGEST SESIA carried out in 2013, the project was included as a single component operating within the whole system. For this report however, all other system components are included only to the extent to which they are linked to the project. In other words, the scope is narrowed to include only the second stage of the Effluent Recovery, Irrigation Scheme and Remediation Works Project (C2). Based on the latter understanding, the update will aim at:

1. Narrowing the scope down to include only the Recovery/Reuse scheme and agricultural components only rather than the whole system covered;
2. Incorporating the operation of the new WWTP, accounting for the negative impacts of its five-year delay, (that implied an extension of the period of infiltration of partially treated sewage, consequently further pollution to the groundwater, beyond what was originally planned) in addition to the positive impacts expected after its recent operation ;
3. Change in well locations design since last study in 2013;
4. Incorporating new updated groundwater analysis;
5. Incorporating the recent remediation of the infiltration basins carried out;
6. Accounting for the new PV component of the project.

Using the new information on deviations/updates, the following will be carried out by the consultant:

Incorporating deviations/updates expected to affect environmental and social benefits/impacts previously addressed, the consultant will carry out a new analysis including:

1. Identification of the possible environmental and social impacts of the proposed effluent recovery and reuse scheme.
2. Identification of any potential temporary or permanent land acquisition requirements associated with civil works
3. If Bank's Operations Policy 4.12 is triggered due to land acquisition requirements, preparation of draft terms of reference to formulate a Resettlement Action Plan (RAP) to manage, mitigate, and monitor the impacts of acquisitions
4. An Environmental and Social Management Plan (ESMP) to manage, mitigate and monitor any possible negative impacts during the construction and operation phases of the project



5. A capacity assessment of the implementing party to implement the ESMP and recommendations for any capacity-building needs

## 2.2 Environmental Methodology

### 2.2.1 Water Analysis

Recent water analysis conducted by third party consultants commissioned by PWA, were shared with UG and EcoConServ. All measurements were carried out using the standard method and similar equipment used in the 2013 SEISA, the original EA of NGESTP of 2006 and for the design project..

Analysis spots considered were at the effluent of NWWTP, before entering the infiltration basin, right after leaving the infiltration basin, at the recovery well locations and monitoring wells. Since the wells of the first phase are already operating, analysis made at those wells were used.

Table 2 shows the parameters that were analyzed. Standards against which compliance was measured provided in Annex 1 of this report and are summarized in Table 8 in the Legal Framework chapter .

**Table 6: Proposed sampling parameters and locations**

Parameter	Groundwater (MW2, MW3, Q52)	Influent to infiltration Basin	Recovery well location
pH	x		
TDS	x		
BOD	x	x	x
COD	x	x	x
NO3	x	x	x
T.N &P	x	x	x
Cl	x	x	x
Detergent	x	x	x
F.C	x	x	x

The conventional testing procedures and instruments used for the sampling are listed in Table 5.

Table 7: Testing procedures and used instruments

Ser.	Parameter	Procedure	Name of instrument
Wastewater analysis			
1.	Temperature	Probe method	Digital TOC meter
2.	pH	Probe method	pH meter
3.	TDS	Probe method	TDS meter
4.	BOD	Oxitop method	Oxitop
5.	COD	Closed reflux method	Spectrophotometer & COD reactor
6.	TSS	2 hrImhofe cone	Imhofe cone
7.	Esi Coliform	Filtration technique	Incubator
8.	Fecal Coliform	Filtration technique	Incubator
9.	Heavy metal	Atomic method	Atomic
10.	Cations & anions	Cl	Argenometric method
11.		NO3	colorimetric method
12.		Na	Flam photometry
13.		Ca	Titration method
14.		K	Flam photometry
15.		Mg	Titration method
17.		CO3	Titration method
18.	Detergent (mg/l)	Absorption (UV-249 nm)	Spectrophotometer

### 2.2.2 Field measurements

The impact on ambient air quality and noise disturbance associated to this project will be determined during the construction of project components including booster pumping stations, irrigation pipe distribution network, infiltration basins and recovery wells.

Ambient air quality, Noise sampling, their parameters and durations are as follows:

1. Close to the Cemetery area (nearby the storage tank and booster pumping station (for the reuse scheme) will be constructed)
  - Ambient air (SO<sub>2</sub>, NO<sub>x</sub>, CO and SPM (and PM<sub>10</sub>) will be measured to identify the current air quality)
  - Noise

## 2. Infiltration Pond site

- Ambient air (SO<sub>2</sub>, NO<sub>x</sub>) will be measured to identify the current air quality. SPM (and PM<sub>10</sub>) does not need to be measured as the construction phase is completed and the soil characteristic, in addition to; the surrounding infiltration ponds are covered with a pavement (service road) and vegetation, thus the dust associated with the operation phase can be eliminated.
- Noise: At the infiltration ponds area, noise is not expected to be generated during the operation. Noise is only expected during the construction phase, which has already been completed, therefore, the noise measurement will not be necessarily conducted in this site.

During the operation phase, the management and monitoring will be prepared in accordance to their sensitivity. In addition, the ambient air management and monitoring plan during construction and the operation phase of the project components will be determined in accordance to the specific nature of the site, i.e. the prevailing wind direction, during summer and winter season, day and night as well dry or humid conditions.

### 2.2.3 Groundwater Analyses Verification and Modeling

The impacts on groundwater has always been the most important issue associated with the project, as the project has mainly been designed to prevent infiltration of partially treated sewage into the ground. The original EA of the NGEST Project estimated the water plume caused by infiltration of the partially treated sewage at the end of emergency phase will extend 700 m towards the sea, 300 m inland, 250 m north and south of the infiltration basin.

The EA had further assessed the impacts of chlorides, nitrates and pathogenic bacteria. The groundwater modeling prepared in the original EA of the project predicted that the groundwater quality will be improved after the operation of Part B as the new infiltrated plume will wash out the old plume of partially treated water. However, the EA has simulated a worst case scenario where the operation of Part B of the project is delayed and the EA recommended construction of remediation wells to pump out the effluent.

After the delay of Part B of the project, the design consultants have carried out another groundwater modeling for simulating the plume according to the recent conditions. According to this modeling exercise, the locations of the wells were identified along with their correspondent discharge rates and depths.

The team carefully reviewed the latest project design and the 2013 update to verify the expected achievements and positive impacts on the groundwater and assess the impact on abstraction wells in the region.

The consultant prepared and run an independent groundwater modeling study taking into consideration the setup of groundwater model developed by the design consultants. This was done to reach quantifiable assessment for groundwater quality impacts, and for groundwater movements. The assessment of the impacts on groundwater took into consideration the abstraction rates of the recovery wells, the possible recharge in the agricultural lands and different scenarios for project implementation. In addition, the model used the most recent available data provided by the Client.

For the current work, the existing groundwater modeling provided during the design project and EA of the original NGESTP study was assessed and used as a reference. The design consultant used Visual Modflow (VMF) version 4.2 and its integrated modules which was also used in the current study for update purposes. While the conceptual model in the design report is considered valid, the consultant updated the conceptual model to schematize the most actual hydro geological context and verify the original model using the latest available data.

The developed numerical model has been developed using a mesh approach (space elements), hydro geological properties have been kept constant, and the simulation period has been divided to time intervals required for assessment. The most up-to-date data provided by the client, included in **Annex 4** was used to replace any outdated data used in previous modelling.

#### 2.2.4 Secondary Data

Secondary activities involve collection of different national reports through reviewing available sources of secondary data and assess requirements for primary data collection.

A list of all reviewed data was prepared:

- Statistics of the Palestinian Central Bureau , Palestine Statistical Year Book, 2016
- Statistics of the Palestinian Central Bureau , Palestine Statistical Year Book, 2012
- Statistics of the Palestinian Central Bureau, Gaza Strip Governorates Statistical Year Book, 2015
- Websites i.e. Palestinian News and Info Agency
- Environmental Assessment, North Gaza Emergency Sewage Treatment Plant Project - November 2006
- Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works, October 2012
- Supplementary Environmental and Social Impact Assessment , Effluent recovery and reuse system and remediation works – April 2013
- The Palestinian Environmental Protection Law No 7 of year 1999
- Land acquisition laws and decrees pertaining to the project

- Complementary prefeasibility study, included in Annex 6
- GCF concept note, included in Annex 7
- 2016 version of the World Bank Standards
- World Bank Safeguard policies
- World bank Report on Assessment of Restrictions on Palestinian Water Sector Development
- WORLD BANK Environmental and Social Framework Setting Environmental and Social Standards for Investment Project Financing
- General EHS Guidelines
- EHS Guidelines for annual crop production
- EHS Guidelines for perennial crop production
- Environmental, Health, and Safety Guidelines for Water and Sanitation
- WHO standards
- Power Generation (Solar PV) for North Gaza Emergency Sewage Treatment Plant Feasibility Study Report

## 2.3 Social Study Objectives & Methodology

### 2.3.1 Social Study Objectives

This ESIA aimed at highlighting the following issues:

- Determine the area of influence that will be affected, positively or negatively, by the project activities .
- Update the socioeconomic data provided in 2012 study.
- Review any updates on the legal framework, particularly, adding the IFC performance standards
- Conduct a detailed social assessment of the local area, by utilizing participatory surveying tools i.e. focus group discussions (FGD) guidelines, in-depth interviews.
- Maintain proper engagement with identified key local stakeholders, and focus groups of relevant categories of local actor (including women and vulnerable groups), to discuss available options, listen to and consider proposals from the community, and determine which enjoy the broadest local support;
- Develop legal options for future use of the land;

### 2.3.2 Social Study Methodology

This study adopted a multidisciplinary approach that employ techniques reported in the Participatory Appraisal Approach. The study team developed various surveying tools that enabled the team to collect both qualitative and quantitative data from secondary and primary sources.

The data collection process was developed to collect similar data from various sources in order to verify the credibility of data collected. Figure 3 below presents the sources of data and tools used

Figure 4: Summary of source of data and tools used

### 2.3.3 Secondary data

Secondary activities involved collection of different national reports through reviewing available sources of secondary data and conduct meetings to collect data from the municipalities. The review of secondary data was implemented on the level of data published on the internet and the reports developed by various Palestinian Authorities.

Additionally, the team managed to collect relatively updated data from the Palestinian Central Bureau of Statistics (PCBS).

### 2.3.4 Primary Data

Primary data collection was intensively implemented during the ESIA report developed in 2012. During this stage, primary data collection was limited to conducting meeting with the key stakeholders and the project affected persons. As well as, visiting the project site and the area of

influence. In order to fulfill the requirements of this project, it was crucial to collect detailed information. Therefore, a Participatory Rapid Appraisal (PRA) methodology was adopted in order to enable the study team to fulfill the requirements accordingly during the planned period. However, the verification of data should be assured according to the multi levels' tools that might be applied on different social groups and stakeholders:

#### 1. Data collection

During this phase the study team has carried out the following activities in order to be able to collect the needed data based on a real situation with a clearer overview of the situation in different areas. Under this phase the following activities have been done:

- A kick off meeting about this assignment was conducted with PWA on the 8th of April 2018. The main objective of this meeting was to introduce the study objective and update the data required in the inception phase.
- Site visit and data collection were applied during April 2018. This date was considered to be the beginning of the Consultant team mobilization and preliminary data collection. EcoConServ and UG team accompanied by the Client representatives visited the project site and the lands that will be irrigated by used water.
- During April 2018, various meetings were conducted with the PAPs, the Endowment, municipalities and potential farmers



Figure 5: Meeting conducted with the PAP'S inside the treatment plant      Figure 6: Site visit to well location

- During April 2018, data was collected from the potential affected groups (well owners- well operators and land owners). The tool used was a semi-structured questionnaire that was modified to be used with each group





Figure 7: Well operator interview



Figure 8: Land owner interview

## 2. Data management and analysis

- Data was reviewed, edited and clustered based on the nature of stakeholders
- The quantitative data was coded and entered using Microsoft excel and analyzed using SPSS 19.

Applying different analysis techniques enriched the results of the data collected which enabled study team to verify data collected. Whenever data discrepancy was encountered, the team used the most reliable data available from other sources (both primary and secondary sources).

### 2.3.5 Targeted Groups Identification and Sample Selection

Given the fact that this study is limited to updating the study developed in 2012, the surveyed sample was limited as the 2012 ESIA covered a wide range of potential beneficiaries and various stakeholders. The selected sample was as follows:

- Palestinian Water Authority
- The Ministry of Endowment
- Ministry of Agriculture
- The Municipalities (Jabalia- Um El Nasr- Beit Lahia and Beit Hanoun
- Palestinian non- governmental Organization Network
- The project affected persons:
  - 11 well operators
  - 10 land owners
  - 11 well owners

## 2.4 Strengths and Weaknesses of the Adopted Methodology

The applied methodology involved a number of strengths that positively affected the quality of the gathered information and was highly informative for the ESIA process.



1. This methodology enabled the study team to fine tune project activities and enhanced the sense of ownership among various stakeholders
2. The process involved active participation from municipalities and Civil society Organization. The FGDs have been facilitated and hosted by local Civil Society Organizations (CSOs). This secured convenient venues for the FGDs' participants and allowed the Consultants and survey team to engage the CSOs members and introduce the project to them.
3. The tools were carefully selected to suit the type of interviewed stakeholders and the issues that need to be investigated.
4. Bringing all stakeholders together in the workshops and Public Consultation provided the study with verified, multi-perception data which enriched the study,
5. Based on the Consultant and research team previous experience and knowledge of the local settings, the survey and the FGDs samples were carefully selected to capture the various specificities of communities in Gaza Strip.
6. Multiple data analysis techniques were used in order to present the findings informatively. A combination of computer software for the analysis of quantitative data as well as manual compilation of transcripts and analysis of qualitative data were used. The presentation of the survey findings combined the various tools results.

One of the key challenges that faced the ESIA process is the limited time frame and international team permit issuance for Gaza Strip travels. In addition, the social surveys were further delayed due to its overlapping with Ramadan.

While not a methodological problem, the challenge affected the progress of the stakeholders' consultations and the planned field investigations as part of the ESIA consultancy assignment for the long term actions.

### 3 PROJECT DESCRIPTION

#### 3.1 Project Overview

The Northern Gaza Emergency Sewage Treatment (NGEST) implementation project has been planned in three phases. Phase A of the project comprised the construction of the terminal sewage pumping station at the Beit Lahia Wastewater Treatment Plant site (BLWWTP), the construction of a pressure pipeline to a new site about seven kilometers to the East of Jabalia, the construction of seven infiltration ponds at the new site and the commissioning of the pipeline to allow a large and dangerous emergency partial effluent pond at Beit Lahia to be drained. Phase A of the project was entirely completed in 2010.

Phase B of the project included the construction of the North Gaza Emergency Waste Water Treatment Plant (NGWWTP) at the new site. The first stage of the NGWWTP has been completed and fully functioning since March, 2018, with a treatment capacity of up to 35,600 m<sup>3</sup> of sewage daily. Future expansion of the plant would upgrade the total treatment capacity to 69,000 m<sup>3</sup>/day and requires the construction of an additional infiltration basin.

A third, supplementary phase was later added to the project to recover and reuse the treated effluent after the new Waste Water Treatment Plant (WWTP) is completed. The treated sewage effluent will be disposed of into infiltration ponds, the water will seep through an unsaturated zone of soil which will facilitate nutrient and pathogen removal, and eventually make its way to the unconfined aquifer. There, the water will be extracted by 28 recovery wells, put into two storage reservoirs, and distributed throughout the network for irrigated agriculture.

The third phase, has been split into two identical phases, Phase C1 and Phase C2 that are implemented into separate tendering procedures. Each will supply and install 14 recovery wells and concerned connection pipes, the civil works within the booster pumping station, five booster pumps, one 4,000 m<sup>3</sup> water tank and 5 monitoring wells in addition to small works related to the procurement and construction of the irrigation network for an area of 500 ha (5,000 du). Phase C1 has been financed by the World Bank and is currently in operation. Phase C2 is the focus of this study.

#### 3.2 Project location

The recovery and irrigation scheme is located in the Eastern part of the Northern Governorate in Gaza Strip. The irrigation network will serve agricultural land located in the north eastern part of Gaza Governorate. The location of the project within the Gaza context is depicted in Figure 9.

The distribution of wells also suits future extension of the recovery scheme for the 2025 design year.

Figure 9: Locations of the project within the Gaza Strip context

### 3.3 Scope of Recovery and Reuse Scheme

The project involves the rehabilitation of the 7 infiltration basins, drilling of 14 recovery wells “downstream” from the NGEST plant, drilling of 2 monitoring wells, construction of 2 reservoir, installation of primary, secondary and tertiary (drip irrigation) distribution networks over 1200 ha. The drip irrigation network will be installed on farm level where the main trunks pipeline will be installed in the main roads and streets. The installation of irrigation network in the farms might require temporary access paths that will be limited to installing the network. These temporary access roads will be determined based on the willingness of farmers who will benefit from the project. It is worth mentioning that the access roads will be dependent on the streets that are already in place.

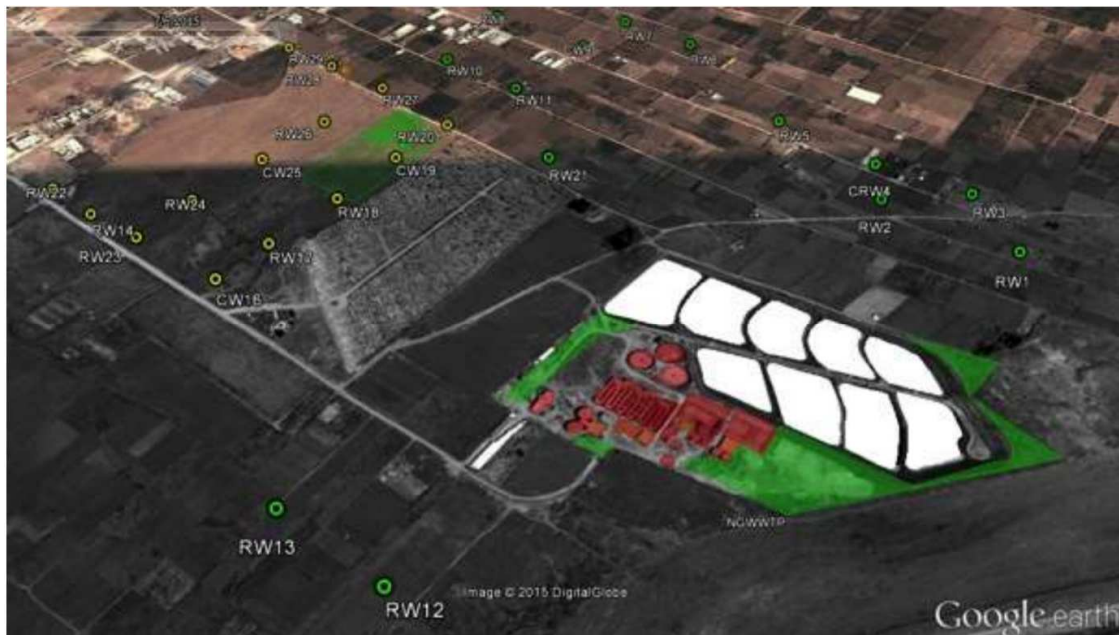


Figure 10: Recovery scheme wells for stage 1 (yellow) and for stage 2 (green)

### 3.4 Project components

The project is comprised of two parts, a recovery scheme and a reuse scheme. Figure 10 illustrates the different components of the project.

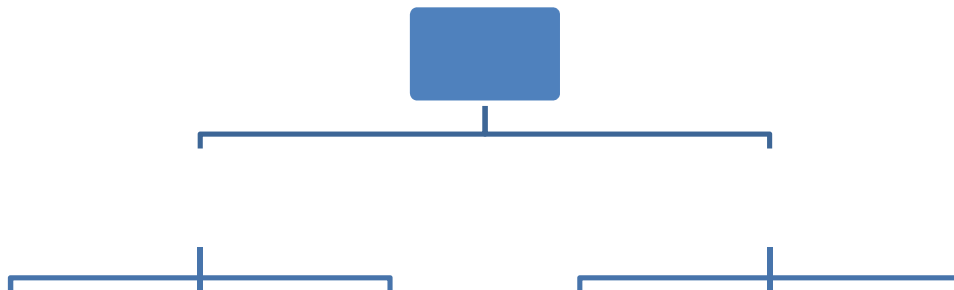


Figure 11: Components of the recovery and reuse scheme

#### 3.4.1.1 Recovery Wells

Recovery wells are designed to capture the infiltrated water in the appropriate time and quantity.

The recovery wells have been distributed around the infiltration basins in the north, west, and south directions as shown in Figure 10 below. The wells are distributed in rows in accordance with groundwater modeling outputs and existing hydrogeological conditions. The number and the

locations of the groundwater recovery wells have been chosen in order to be able to capture the infiltrated water in the appropriate time and quantity.

The distribution of wells also suits future extension of the recovery scheme for the 2025 design year.

Locations of the 28 recovery wells are shown in Figure 11 and 12 below. Stage 1 (C1) wells, RW1-RW13 and RW21 have been completed and are currently operating.

The rest of the recovery wells, RW14-RW20, RW22-RW29, form stage 2, (C2), the current focus of this project. Figure 11 illustrates the modified locations of the recovered wells. Exact locations and coordinates of these wells are included in **Annex 2** of this report.

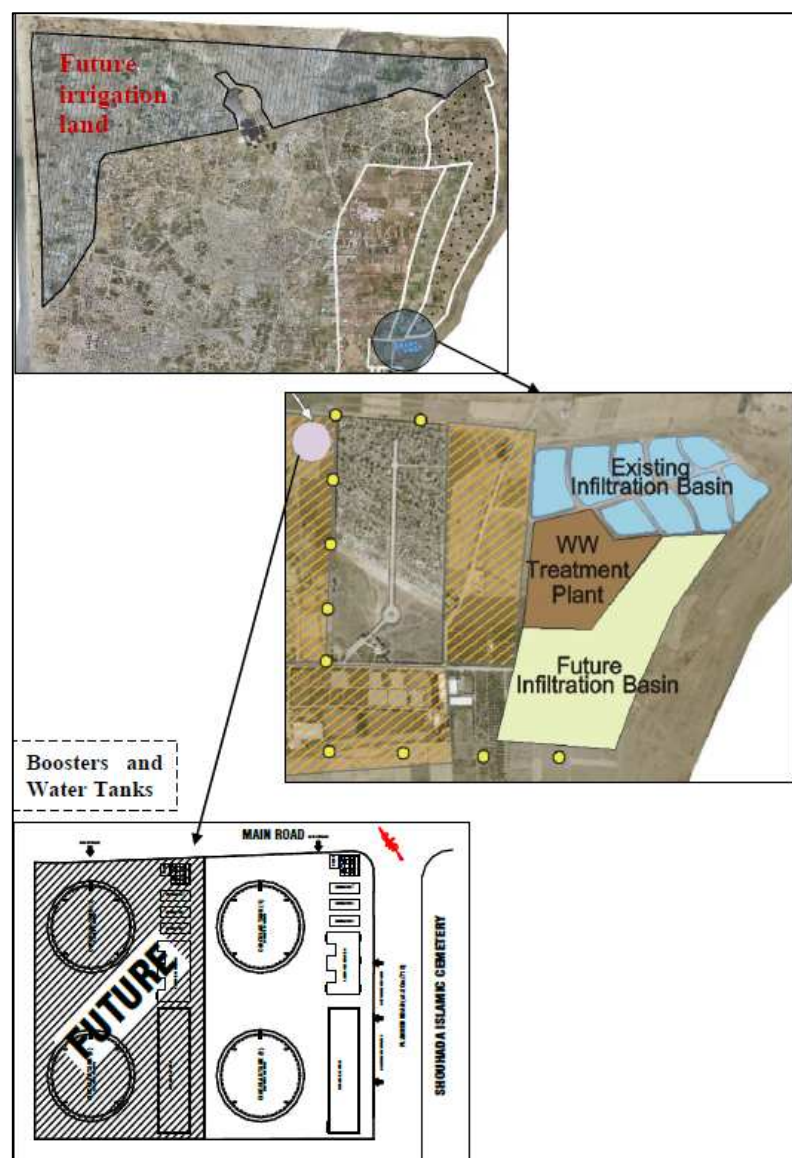


Figure 12: Location of boosters and water tanks within the site

#### 3.4.1.2 Collection Piping System

Collection pipes have been designed to collect and transmit the recovered water from the recovery wells to water tanks. The recovery wells are therefore connected to the water tanks using five collection pipe networks shown in Figure 10. The majority of the collection pipe networks are located in existing roads and the remaining networks are located in new proposed roads.

#### 3.4.1.3 Monitoring Wells

Monitoring wells are used to observe the groundwater table and the groundwater quality status. Two rows of monitoring wells are located before and after the recovery well rows. The monitoring wells have also been located at road sides to facilitate easy access.

**Figure 13: Locations of the Recovery Wells**

#### 3.4.1.4 Water Tanks and Booster pump station

The recovered water from the wells is collected into water tanks that are in turn connected to a booster pumping station. The booster pumping station is used to transmit the water from the tanks to the farms. The booster pumps will maintain a minimum pressure of 2.5 bars in the irrigation network at farm gates.

The water tanks and booster pumping station lie in the same site. The two 4000 m<sup>3</sup> water tanks, the booster pumping station, and associated facilities have been located to the north western side of the cemetery bounded by one road from the north.

A new road to the east of the site has been proposed by the consultant to be adjacent to the cemetery to provide access to the site as shown in Figure 13.

The site layout shown in Figure 13 has been determined such as to allow easy construction of the future components and enable the client to reserve the whole land for the project current and future use. For these purposes the area for initial phase was located at inner side of the site while the area for the current use was planned to be located at the outer side of the site adjacent to the road.

As for the project overall planning, the site lies almost in the middle of the agricultural land and close to the recovery wells which are distributed around it. These arrangements would result in efficient designs for the piping system connecting recovery wells with the water tanks, the recovery wells, the booster pumping station, and irrigation network. In this case the distances between the site and project physical components would be shorter compared to the case if the site was located at one end of the project area. It is also worth mentioning that the topography of the site including the water tank elevation is not critical since transmitting of water is carried out using pressure pipes which will be insignificantly influenced by small variation in the elevation head of the tanks.

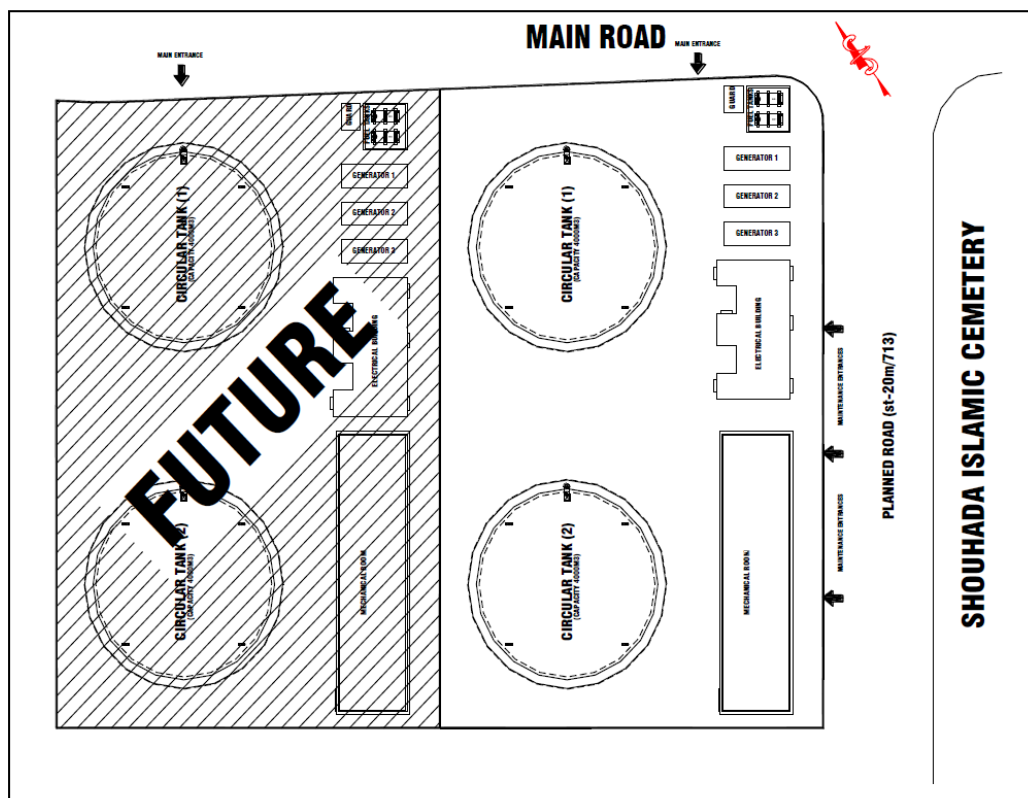


Figure 14: Site location and layout for the water tanks and booster pumping station



The booster pumps are located in a pumping hall together with the suction and pressure manifolds and with all necessary pipe works. The pumping station will serve both irrigation networks; the south area with three irrigation zones and north area with six irrigation zones.

There are all together 8 of duty pumps and 2 of stand-by units, all similar pumps, installed parallel and pumping from a common suction manifold into a common pressure manifold.

The pump size is selected based on the maximum system flow rate 6000 m<sup>3</sup>/hr with the total dynamic head (TDH) 101 m wc. The number of duty pumps for each pumping mode is selected based on the consultant analyses with pumping model software, and showing the pump discharge pressure for irrigation zones with different flows.

The booster pumping station buildings have all been completed, and are missing only the stage 2 pumps. Details of the system design are included in Annex 3.

#### 3.4.1.5 Irrigation Network and Agricultural Land

Water supply pipelines (trunk lines) are used for transmitting the water from the booster pumping station to the agricultural land. Water networks are used for irrigation the agricultural lands.

Citrus is a crop grown in the project area with an area of 1198 dunum (fruitable and none-fruitable). Olives represent 614 dunum (fruitable and none-fruitable). Vegetables represent 280 dunum. The area of fruit trees is 120 dunum, whereas, the rain-fed area includes the grains and the demolished area occupying the most of the project area being 12,055 dunum as shown in Figure 14



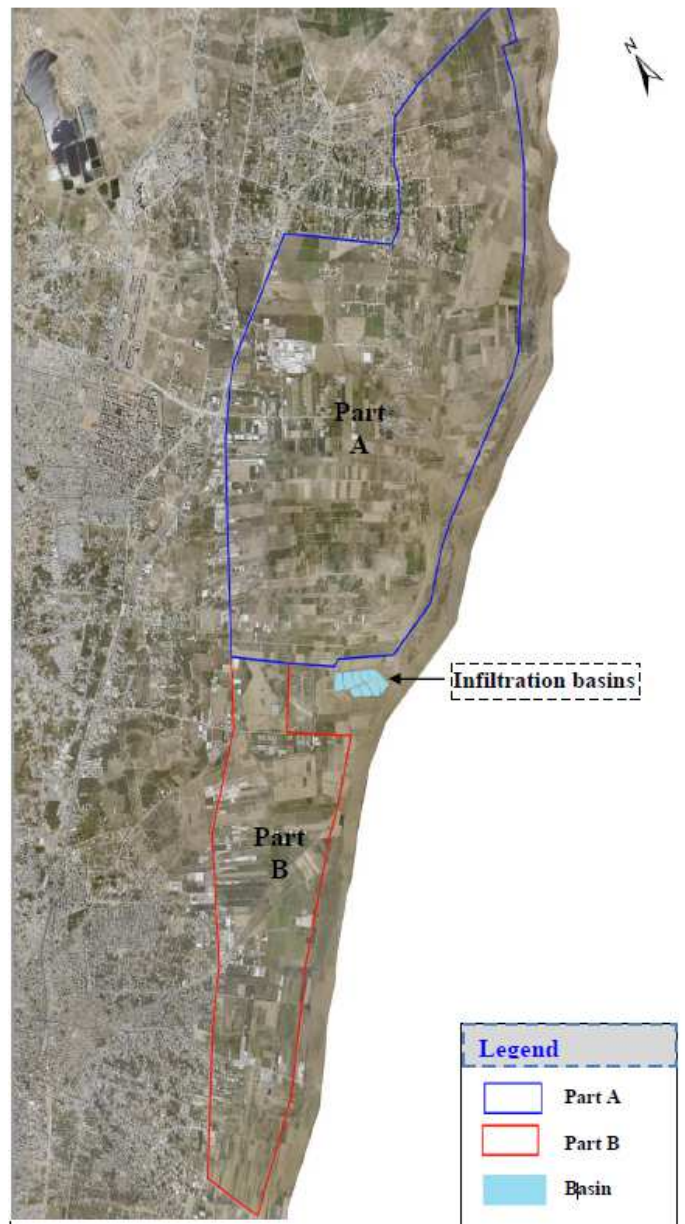


Figure 15: Location of the proposed irrigation land using recovery of water from NGEST

Data about the existing agricultural situation in the proposed project area was collected during site visits, interviews and through the first public consultation. The proposed area is currently cultivated with different crops: citrus, olives, fruits, grains and vegetables. The survey includes also the number and ownership of farms in each zone, crops type and their respective irrigation systems. The different types of irrigation systems and crops of proposed irrigation land for recovery water use are shown in Figure 15 and Table 7. Details have been included in Annex 3.

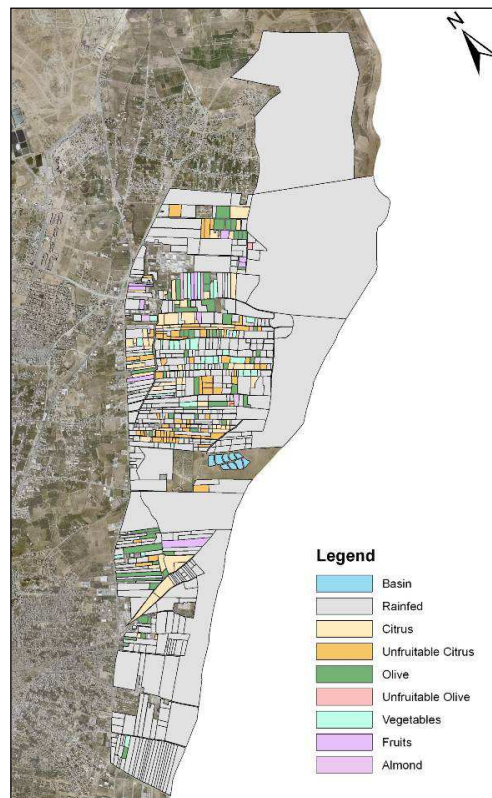


Figure 16: Different types of irrigation systems and crops of proposed irrigation land for recovery water use

Table 8: Distribution of cultivated crops in zone (A&B), December 2009.

Crops	Zone A (dunum)	Zone B (dunum)	Total
Rain-fed	7593	4462	12055
Citrus	515	172	688
Olives	388	212	600
Vegetables	260	20	280
Fruit Trees	120	0	120
Almonds	53	64	117
Citrus (non-fruitable)	464	46	510
Olives (non-fruitable)	14	0	14
Total	9407	4976	14,384

### 3.4.2 PV Component

The processing loads at the WWTP and the pumps at the recovery scheme have relatively high-energy consumption rate.

The unpredictable power supply situation in Gaza and the observed intermittent and constrained supply of the local distribution network therefore, necessitated an investigation into alternative solutions to bridge the supply gap arising from the load shedding.

The principal criteria in making the power supply decision has therefore been defined by the need to safeguard the continuous and uninterrupted operation of the effluent recovery scheme.

While diesel generators are normally used as primary on-site emergency solution to provide flexible and reliable energy, the purchase costs for the large fuel quantities required to run the facility in off-grid mode have a significant impact on the operational budget of the facility. This financial burden of fuel purchase costs triggers yet additional analysis aiming to utilize all possible options in order to ensure sustainable power supply.

Consequently, the factors motivating the review of alternative supply options for the NGEST project and the reuse are :

- that the distribution grid as main source may fail to technically provide steady and reliable supply
- The operation of the installed on-site emergency diesel generators incurs huge operational expenses as a result of the high fuel costs
- Inconsistent fuel supply situation in Gaza.

The NGEST project stakeholders aspire to catch the two ends of this challenge through an optimization of the existing set-up and the inclusion of a PV system that would offer:

- Higher independence from intermittent grid-based supply
- Fuel cost saving during times the grid is unavailable.

Given the availability of spare land within the areas attributed to NGEST and good solar resource in Gaza, the addition of a photovoltaic system to the portfolio was considered a logical intervention.

The power supply structure would be capable to support:

- 1) To support on-grid mode – during times the facility is mainly supplied from the GEDCo network
- 2) Off-grid mode – during times the facility has to generate required power itself

The embedded captive on-site generation (biogas, PV and diesel) would need to ensure the provision of the required power and heat. Renewable power from biogas and PV would serve as fuel-saver for the emergency diesel displacing costly fossil fuel as much as possible through operation as auto-producer.

The Photovoltaic system will be installed inside the current wastewater treatment. The additional land needed will be obtained from Waqf land. The Ministry of Endowment approved on hand over the land to PWA in return for an alternative plot of land from PWA.

Power Generation (Solar PV) for North Gaza Emergency Sewage Treatment Plant Feasibility Study Report developed in July 2015 recommended to establish a Photovoltaic system that is composed of:

- PV Areas within the Treatment Plant Boundary: Within the treatment plant, suitable space is available on the roof-top of all major buildings with the exception of the power house (“Blower and Energy Building”). The areas around the facilities’ installations. Open space for ground-mounted systems are available at the boundaries of the plant. The total size of allocated land within the treatment plant is 47 dunums. The areas are shown in the following Figure 16.

Figure 17: Overview of the sub-system at the WWTP

**Source: Power Generation (Solar PV) for North Gaza Emergency Sewage Treatment Plant Feasibility Study Report issued on July 2015**

- Areas within Recovery Scheme: The second location with designated PV areas is the effluent recovery scheme behind the cemetery, Figures 19 and 20.

Figure 18: Area designated for PV plant in the Effluent recovery scheme

Figure 19: PV unit on one of the control rooms

Figures 21 – 24 show the surroundings of the location designated for the PV areas in the effluent recovery scheme .

Figure 20: Recovery scheme area towards Jibalaya



Figure 21: Recovery scheme area towards East to the plant

Figure 22: Effluent recovery scheme area with cemetery to the left

Figure 23: Effluent recovery scheme area towards Jibaliya

### 3.5 Proposed Design

#### 3.5.1 Well Components

Figure 25 shows a typical detail diagram of the design of a recovery well) having the following characteristics:

- The external diameter of borehole is 20 inch.
- The diameter of screen is 12 inch, opening size is computed to retain 90% of gravel pack, therefore, the opening size will range between 0.6 mm to 0.8 mm and the opening slot percentage is 30%.
- The length of screen is 13 m located in sand or coarse sand layer below the water table. Stainless steel screens are used. The screen is located below the water table with a distance equal to double the expected drawdown of the water table after pumping of 200 m<sup>3</sup>/hr. Based on the pumping test report, the drawdown of the water table will be about 6 m, therefore, the shaft of the pump should be about between 10 m to 12 m below the groundwater table.
- The total length of pump housing depends on the depth of the water table, the depth of permeable layers (sand aquifer) and the drawdown of the water table. analysis of the permeable layer. Based on the design, the recommended range of D50 of gravel pack size is ranging from 2 mm to 4 mm. In addition, a sieve analysis curve is made for each gravel pack of each well.
- The distance between the recovery wells is estimated based on the water table drawdown records from observation wells during the pumping tests. It was found that in the case of pumping 200 m<sup>3</sup>/hr, the drawdown in the well is about 6 m and at 50 m the drawdown is 34 cm. With extrapolation of the drawdown curve, the zero drawdown is expected to be at 70 m from the well. Therefore, the distance between the wells should not be less than 140 m.

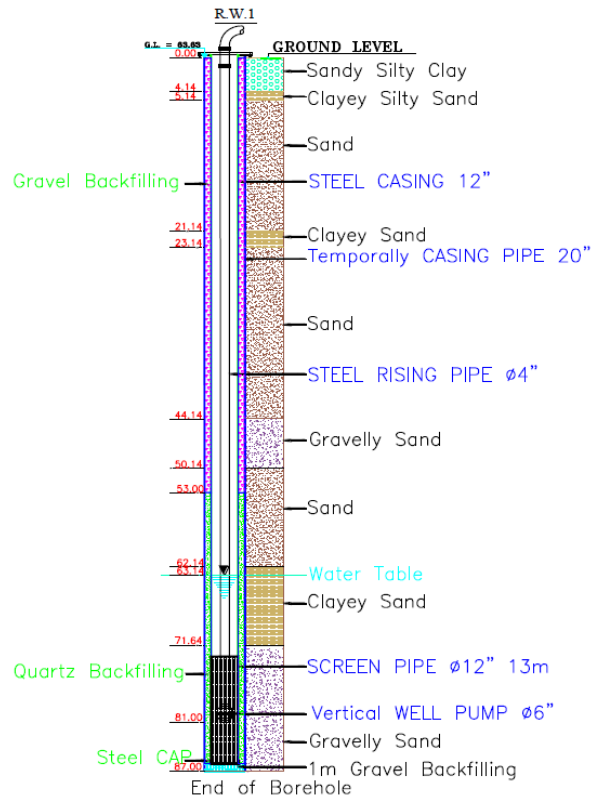


Figure 24: Prototype design example of a recovery well

Figure 26 shows the drawdown and the recommended radius of influence between the recovery wells.

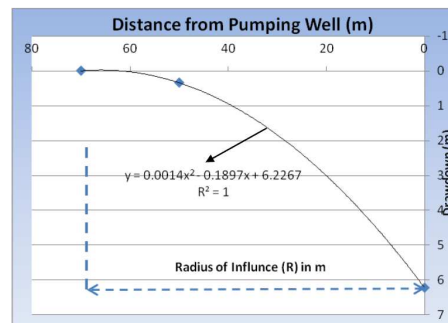


Figure 25: Distance-drawdown curve of 200 m<sup>3</sup>/hr pumping rate

### 3.5.2 Well Pump

Recovery well pump delivers the water to the intermediate tank. There are five individual pumping groups (G1....G5), containing five wells with a single pump in each well. The pressure pipeline of each pump in the group is connected to a common pipeline, which takes the total water flow of a group to the reservoir tank, where the water is discharged to the free water level of the tank. The principle of the pumping arrangement is shown in the Process flow diagram.

The pumps in a group form thus a hydraulic system where several pumps are pumping parallel in a common discharge pipeline. The pressure loss for each individual pump varies somewhat, due to the different length of the pump's pressure line prior to the common line. Two of the groups have also one additional well with the pump as a stand-by well unit.

The pump size is selected based on the maximum flow rate of a pumping group in m<sup>3</sup> per hour and the total dynamic head (TDH) in this hydraulic situation.

It's assumed that the geodetic head for each pump is approximately the same.

The pump type will be a vertical turbine pump, installed in the bottom of the recovery well, at the level of the screen pipe of the well. The pump unit will supported at the rising main by the discharge flange of the pump.

The pump design will be vertical single stage or multistage pumps with mixed or axial flow impeller design; broad hydraulic coverage provides best selection to meet specific operating conditions.

Fabricated or cast iron underground discharge head, shaft and bearing combinations promote long life with options of open or enclosed line shaft construction. The inside diameter of the well and the screen pipe is 12 ". The outside diameter of the discharge head and shaft shall be 10".

### 3.5.3 Monitoring Wells

The monitoring wells are distributed in two rows: around 400 to 500 m from the infiltration basin and the second row around 1100 to 1200 m from the basin. The first monitoring well row should be located before the first row of the recovery wells in the direction of infiltration basin. The second row of the monitoring wells should be located after the second row of the recovery wells to check the quality of groundwater outside the recovery well area. Figure 27 shows the location of the monitoring wells.

According to the distribution of the recovery wells, adequate number of observation wells is proposed to give accurate data about groundwater status. Ten new observation wells will be used for monitoring groundwater quality; in addition, 27 recovery wells and 5 existing monitoring wells will be used. The total number of monitoring wells will be 42. The water pumped to the irrigation network should also be monitored through samples of water from random farms taken to check the quality at the end use of water. Trunk lines, water tanks, and irrigation networks should also be monitored by taking random samples from each component.



Figure 26: Location of monitoring (observation) wells

A monitoring well consist of 12 in. casing and the inner pipe will be 4 in. and ends with a screen of 4.5 m length, located under the groundwater table in the sand or gravel layer. The depth of monitoring well depends on the hydrogeological profile of the area. Hydrogeological cross sections used in the design of the recovery wells are used to locate the screen of the monitoring well. Figure 28 shows typical design of a monitoring well and a hydrological profile.

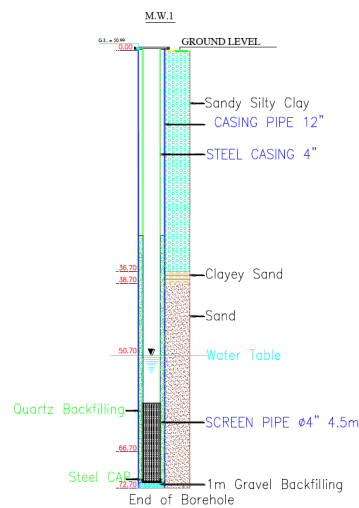


Figure 27: Typical design of a monitoring well

### 3.5.4 Water Networks

The design of the water network follows the water flow system mentioned in design criteria section. The components of the flow system which are considered in the design stage consist of two parts:

- Collection pipelines from recovery wells to water tanks.

- Irrigation network including the trunk lines from the booster pumps to the farms.
- The pipe network of a distribution system includes facilities to shut off the flow in the pipes, to empty and ventilate the pipes and to regulate the pressure and flow direction. In the design of a pipe network, consideration should be given to supply reliability and water through-put. The distribution system for the collection pipe from wells and water tanks and the pipes from the booster to the farms is selected as branching system. It is designed so that each point in the pipe network is fed from a single direction Figure 29.

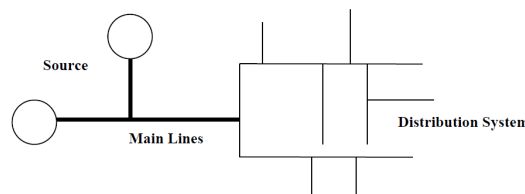


Figure 28: Typical water distribution network designed as a branching system (Delleur, 2007)

### 3.5.5 Water Tanks

The two tanks of 4000 m<sup>3</sup> each are shown in Figure 30. There are two inlet pipelines from well groups C and D with a diameter of 450 mm to Tank 1 and three inlet pipes with diameter equal to 450 mm from well groups A, B, and E to Tank 2. The two tanks are connected by a balancing pipe of 900 mm diameter. Washout pipes of 200 mm diameter are located in two places in the bottom of each tank. Overflow of 200 mm is to be connected with washout pipes out of the tank with a gate valve on the washout pipe. The overflow and washout pipes from the two tanks are connected to each other with a pipe of 300 mm diameter. The feeder from each tank to the booster pump stations is 800 mm diameter with main gate valve as explained in the following booster pumping station design section.

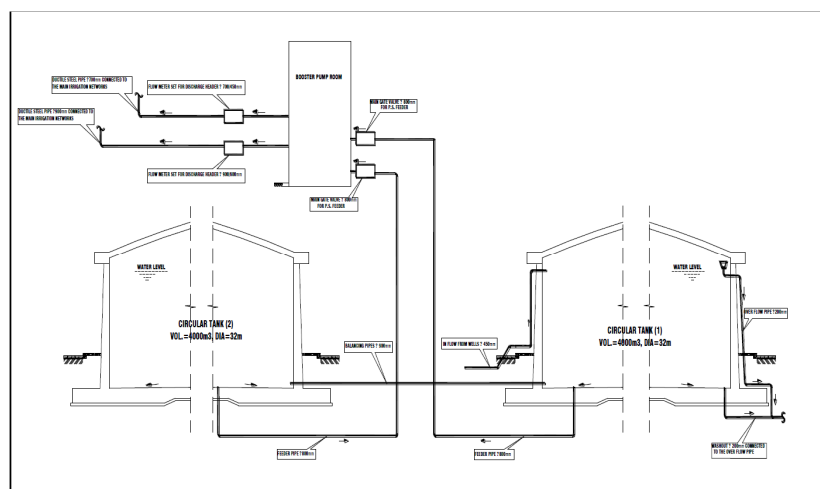


Figure 29: Water tanks piping system

### 3.5.6 Booster Pumping Station

The booster pumps are located in a pumping hall together with the suction and pressure manifolds and with all necessary pipe works. The pumping station will serve both irrigation network, the south area with three irrigation zones and north area with six irrigation zones.

There are all together 8 of duty pumps and 2 of stand-by units, all similar pumps, installed parallel and pumping from a common suction manifold into a common pressure manifold. The pumps will serve the irrigation zones according to Table 8.

The pump size is selected based on the max. system flow rate 6000 m<sup>3</sup>/hr with the total dynamic head (TDH) 101 m wc. The number of duty pumps for each pumping mode are as shown in Table 10. Figure 31 illustrates the cross section in the boost pumping station.

**Table 9: The number of operating Pumps and Irrigation Zones**

<b>Irrigation zone</b>	<b>Number of pumps</b>	
<b>North A1.</b>	<b>5</b>	Simultaneous pumping
<b>South A2</b>	<b>3</b>	
<b>North B1.</b>	<b>5</b>	Simultaneous pumping
<b>South B2</b>	<b>3</b>	
<b>North C1.</b>	<b>5</b>	Simultaneous pumping
<b>South C2</b>	<b>3</b>	
<b>North D</b>	<b>8</b>	
<b>North E</b>	<b>8</b>	
<b>North F</b>	<b>7</b>	

**Table 10: features and requirements of booster pumping station**

<b>Pos./marking</b>	<b>BP1, BP2, BP3, BP4, BP5, BP6, BP7, BP8, BP9, BP10</b>
<b>Number</b>	8 nos + 2 nos as stand-by
<b>Location</b>	Booster pumping hall Hall floor level + 44.30
<b>Type</b>	Dry-installed, single volute end suction pump, horizontal assembly with separate pump, coupling and motor, installed on a common steel frame. Horizontal axially suction end. Horizontal discharge end directing 90° towards suction end. Acc. to ISO 5199. Frequency controlled.
<b>Flow media</b>	Soil-aquifer treated effluent.
<b>Installation</b>	All pumps to be installed horizontally and parallel to each other on same floor level acc. to equipment layout drawings. Suction from a common suction manifold. Discharge to a common pressure manifold, divided in two parts.
<b>Duty point</b>	

Capacity	750 m <sup>3</sup> /h
Total head	101 m wc
Design revolution speed	≤ 1500 rpm
Materials of the pump	
Casing	High grade cast iron or CrNiMo-steel
Impeller	Cast iron, cast steel or CrNiMo-steel
Shaft	High tensile steel; parts which are in contact with water: acid proof steel or Duplex. steel (CrNiMo-steel)

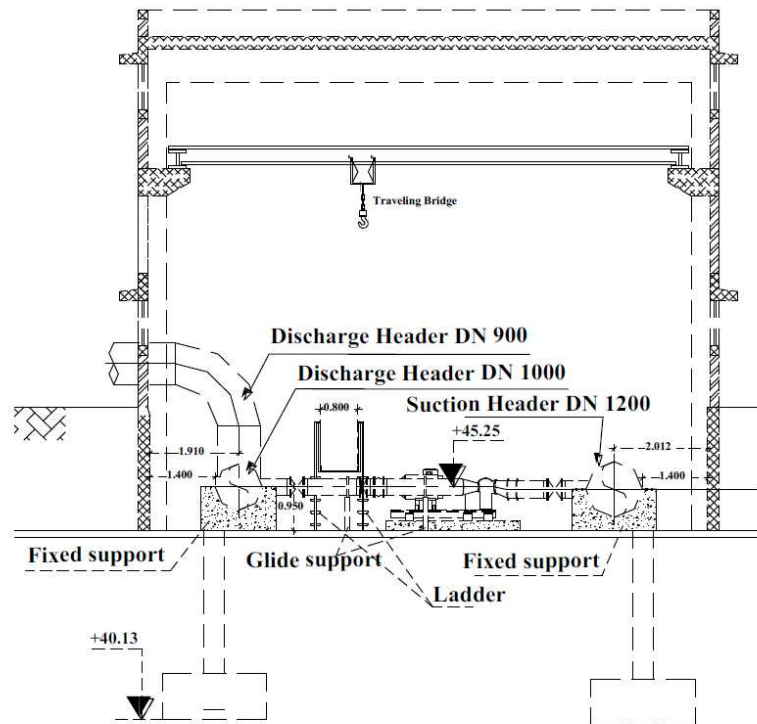


Figure 30: Cross section in the boost pumping station.

### 3.5.7 PV Component

The proposed 5.1 MWp design is mainly characterized by the following components:

- Arrays composed of poly-crystalline modules

Fixed 25 degree racking structure. This setup is simple to install and carries lower maintenance cost compared to tracking systems. Since Gaza is located in a relatively humid area all types of structure, racking, module frames, connectors, etc. should be made out of aluminium or galvanized steel.

- A decentralized inverter with sizes in between 15 and 25 kVA was chosen not only to avoid mismatching losses between differently aligned areas, but also because of its simplicity in maintenance. These inverters can be exchanged by one single person, if necessary.

Two different configurations are used in the 5.109 kWp PV plant:

1. **Free field** - ground mounted systems which hold with 18.986 modules (4.936.36 kWp) the major part of the installed power
2. **Rooftops** with 663 modules (172.38 kWp). In the free field always 22 modules in series create a string and are mounted on one table (independent mounting structure). Rooftop in general make up one string but this rule is more flexible and to reach highest utilization of roof-top space . The strings have been designed such as the limiting inverter parameters like, max and min MPP voltages, max system voltage or currents are never exceeded, considering local max and min temperatures.

Row spacing of 2.20 meters for free field and 1.10 meters for rooftop is necessary to avoid major shadowing from one row to the other and to avoid row shading on the shortest day in the year (21st of December) for at least 4 hours, assuming a PV plant aligned to South. The row spacing also ensures good work flow in installation and maintenance, i.e. allows installers to move in between rows or even vehicles if necessary.

### 3.5.8 Activities of the Construction Phase

**Planning and Construction Phase:** This phase includes :

- Preparation of a detailed design for the Project
- Planning
- transportation of construction materials to the site
- transportation of the various Project components to the site (e.g. PV modules, pumps for pumping station, casings for well construction, etc..)
- onsite preparation activities for installation of the PV arrays, concerned connection pipes for wells and various other components.
- fencing for all PV areas and integration in the overall security concept
- Before PV-plant is operated all protective equipment must be installed. Main NGEST PV-plant protective equipment and system are;
  - DC and AC circuit breakers,
  - Manual switchgears,
  - earth leakage and earthing system,
  - Short circuit protection system,
  - Lightning rod system,
  - On-grid connected inverters and PV and grid frequency regulation,
  - cut-offlines and separating breakers.

- Site preparation activities could include excavations, grading, levelling, drilling for well construction and land clearing activities.
- Irrigation network
- Construction of recovery wells, monitoring wells and concerned connection pipes
- the civil works within the booster pumping station, water tank construction, administration buildings and well control rooms
- Additionally the same period may exhibit a large influx of workers. H&S and housing (whether on-site in temporary accommodation or off-site) issues may arise.

### 3.6 Activities of the Operation Phase

#### 3.6.1 Recovery Wells

##### 1. Operation

Operation of the recovery wells involve pumping activities to recover infiltrated water.

##### 2. Maintenance

The performance of a well usually declines after some years of operation, resulting in higher drawdowns and higher pumping costs. The well is in need of rehabilitation when the specific capacity of the well becomes so small that the pumping costs increase or the discharge rate of the well can no longer be maintained. Before that time, the well needs to be rehabilitated. An effective well-maintenance program begins with good records being kept of the well's construction, including good records of the geological conditions, the position and types of aquifers and aquicludes, water quality, and the specific capacity of the well, determined during well testing.

Every type of well requires its own maintenance program. Driscoll (1986) provides a checklist to evaluate the performance of well. The major causes of a reduction in well performance are:

- A reduced well yield due to chemical encrustation or clogging of the screen due to bacteriological activity;
- Plugging the formation around the well screen by fine particles of clay and sand in the pores;
- Pumping of sand due to poor well design or corrosion of the well screen;
- Collapse of the well screen due to chemical or electrolyte corrosion of metal well screens.
- Deterioration of pump impellers due to for example the existence of high level percentage of sand in the pumped water.

Maintenance procedures may include the following

- The occurrence of iron bacteria in wells can be prevented by disinfecting the well and the pump immediately after installation. The use of hypochlorite is a relatively safe and convenient alternative to chlorine gas.
- Physical plugging by clay and silt particles can best be prevented by proper well development after the well screen has been installed. The removal of fine particles from the formation immediately around the screen can best be achieved by washing and brushing the screen with dispersing compounds such as sodium tripolyphosphate (STP) and other types of polyphosphates.
- Sand pumping causes the abrasion of pump bowls, which leads to failure of the pump. Sand pumping results from over-sized slots in screens, over-sized gravel pack, corrosion of the well screen, inadequate development of the well or too-high entrance velocities, causing the transport of sand from the formation toward the well. One of the above conditions, or a combination of them, results in sand from the formation entering the well. Remedying this problem may be uneconomical: it may be better to drill a new well. The best alternative, if possible, is to replace the screen or to place an inner screen inside the original well screen.
- Corrosion of well screens can severely reduce the lifetime of a well. Chemical corrosion occurs especially when metal well screens are used in aggressive and saline water loaded with gases like hydrogen sulfide, carbon dioxide, and oxygen. Corrosion can be prevented by applying nonmetal screens or, when the water is not aggressive, only metal screens of stainless steel and low-carbon steel. As mentioned earlier screens of stainless steel will be used in this project.
- Finally, to pump water from a well in the most economical way, proper maintenance of pumps and engines is a prerequisite. Pump and engine manufacturers prescribe periodical maintenance of their products. Maintenance procedures depend on the pump type. They include the adjustment and replacement of impellers, bearings, stuffing boxes, and bowl assemblies. A complete analysis of pump and engine maintenance is beyond the scope of this chapter, so readers are referred to the maintenance procedures specified by manufacturers.
- Complete well records can be kept at relatively minor expense, and these are indispensable in determining the causes of well failure and selecting the maintenance and rehabilitation program.

### 3.6.2 Booster pumping station

#### 1. Operation

During its operation, the booster pumping station will transmit the water from the tanks to the farms

#### 2. Maintenance

Pump and engine manufacturers prescribe periodical maintenance of their products. Maintenance procedures depend on the pump type. They include the adjustment and replacement of impellers, bearings and stuffing boxes. A complete analysis of pump and engine maintenance will generally be covered within the maintenance procedures specified by manufacturers.

### 3.6.3 Solar panels

This phase involves power production and maintenance of the PV Power Arrays and all the various electrical equipment. This includes, notably, regular PV module cleaning to prevent dust build-up which could affect their performance. PV plants have a reputation as low maintenance power plants nevertheless some actions should be considered to ensure the highest possible output of the system. All inspection work and maintenance is to be carried out according to the instructions. This includes:

1. Preventative maintenance: testing on equipment and systems based on a schedule or conditional wear monitoring.
  - **Cleaning:** The tilt angle of 25 degrees already secures a very good self-cleaning effect most of the dirt or snow will slip down the module and rain washes down the rest. For very dry seasons there should be the possibility to wash the modules using only water and soft brushes. To avoid power losses all cleaning or maintenance actions should be scheduled for the early morning hours or late afternoon when the system is producing on low scale.

Depending on the site conditions module cleaning can be done in certain periods, like every month, or can be established as first measure when significant power loss is recognized by the monitoring system.

Module cleaning is always according to PV module manufacturer specification. The water should be demineralized and low salt. Up to the time of completion of this ESIA, the water supply issue for cleaning is not known.



- **Maintenance Work:** Typical maintenance work that should be done on a quarterly basis is cutting vegetation and inspection. Bushes and high grass can cause shadowing and should be trimmed or cut completely in certain time intervals. Also inspections of modules, inverters and AC combiner boxes are recommended to prevent failures and keep the output of the PV plant constantly on a high level.
2. Breakdown maintenance: when maintenance is initiated on an as-needed basis with alerts from monitoring equipment.
  3. Predictive maintenance techniques: how to initiate a plan for lifecycle maintenance e.g. PVplant cleaning cycles depending on Gaza specific weather conditions/ any other sources of modules pollution in the area and replacing of repair parts. For all maintenance, repair and inspection work power supply of the PV-plant or its parts and power from the grid is to be turned off, and breakers of power supply are to be made secure against an unexpected restart. In addition to that, a warning plate against restarting should be placed.

## 4 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

One of the important tasks undertaken during the SESIA study was the reviewing of the laws, regulations and institutional set up relevant to environmental and social management in the Gaza Strip in particular and Palestine in general. National and international guidelines for environmental assessment, treatment plants and technical design requirements, including health and safety were reviewed and key points have been summarized and presented within this chapter. International Laws were presented to offer thresholds and fill in gaps, where certain standards were found missing in the Palestinian Law.

Table 4 is the summary of the Laws and Regulation reviewed and assessed during the preparation of the SESIA study. The detailed description of the Laws and Regulations is presented in detail in **Annex 1. Detail Policy, Legal and Institutional Legal Framework.**

### 4.1 Palestinian Laws and Regulations

**Table 11: Summary of the reviewed Palestinian laws**

Name of Law	Law Summary	Year
<b>Environmental laws and regulations</b>		
Law 7/1999	This basic enactment of the Palestinian Legislative creates a framework for the protection of the environment, public health and biodiversity in Palestine including marine areas. Its 82 sections are divided into 5 Titles: Definitions and general provisions (I); Environmental protection (II); Environmental impact assessment, licensing, inspection and administrative procedure (III); Penalties (IV); Final provisions (V). Article 1 contains an extensive list of definitions, including "natural reserves"	1999
Law 3/2002	Palestinian Water Law	2002
	Regulations for Groundwater Pollution Control	
	Guidelines for Wastewater Reuse in the Gaza Strip, Palestine	2002
	Water Pollution Control System	
Decree Law No.14 of 2014 relating to the Water Law	This Law, consisting of 68 articles divided in twelve Chapters, aims at a better water management and development of Palestinian water resources, through establishing for a new Phase for the water and wastewater sector, its governance and management. It states that the Water Authority will be under the responsibility of the Cabinet, splitting policy from regulatory functions, which was previously carried out by Palestinian Water Authority (PWA) since its establishment	
Decree No. 90/1995	Regarding The establishment of Palestinian Water Authority (PWA)	1995
Decree No.	The Environment Quality Authority was established by Presidential decree No 6/2002	2002

Name of Law	Law Summary	Year
6/2002		
TS 34/2012	The Palestinian Treated Wastewater Standard (Technical Specification)	2012
PS/2003-742	Standards for effluent reuse	
Solid Waste regulations	Solid Waste Management Regulations	2004
<b>Social laws and regulations</b>		
Law 7/2000	Palestinian Labor Laws 7/2000	2000
	Health and safety	
Law 3/2011	Land Ownership	2011
Law 2/1953	Expropriation Law (Istmlak)	1953
Antiquities Law 1966	Palestinian Antiquities Law	1966
Basic laws	Basic Laws declaration for Palestinian Human Right	2003
Law 21	Consumer protection laws	2005
<b>Other laws and regulations</b>		
JSC Regulations	Joint Service Council (JSC) Regulations	2006
PRDP	Palestinian Reform and Development Plan (2008 -2010)	2008-2010
Law 1/1997	Local Council Law	1997

## 4.2 Standards and limits considered within this document

The summary of the limits for different water parameters considered in the evaluations are listed in Table 5 and Table 6 below. The actual standards from which Table 5 was compiled are attached in Annex 1.

Table 12: Permissible limits for different parameters of water reclaimed for irrigation

	Palestinian Standards 34-2012 ( treated wastewater	Jordanian Standards for permissible limits for groundwater injection	WHO standards
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Chemical and biological (mg/l)	standards for irrigation purposes)								
	D	C	B	A	flowers	Field Crops, Industrial Crops and Critical Trees	Fruit trees and aspects of external roads and green spaces	Cooked vegetables, recreations parks, playgrounds and sideways inside cities	
BOD5	60	40	20	20	15		300	30	
TSS	90	50	30	30					
FC	1000	1000	1000	200					
COD	150	100	50	50	50	500	500	100	
DO	<1	<2	<3	<4	<2			<2	
TDS	1500	1500	1500	1200	15	300	200	50	2000
PH	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6.0 – 8.5
NO3-N	40	30	20	20	45	70	45	30	10
NH4-N	15	10	5	5					5
Total N	60	45	30	30	70	100	70	45	
Cl	400	400	400	400	400	400	400	400	
SO4	300	300	300	300	500	500	500	500	
Na	200	200	200	200	230	230	230	230	920
Mg	60	60	60	60	100	100	100	100	60
Ca	300	300	300	300	230	230	230	230	400
SAR	5.83	5.83	5.83	5.83	9	9	9	9	
PO4-P	30	30	30	30	30	30	30	30	2
Al	5	5	5	5	5	5	5	5	
As	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Cu	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Fe	5	5	5	5	5	5	5	5	
Mn	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Ni	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Pb	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Se	0.02	0.02	0.02	0.02	0.05	0.05	0.05	0.05	
Cd	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	
Zn	2	2	2	2	5	5	5	5	
Cr	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
B	0.7	0.7	0.7	0.7	1	1	1	1	0 – 2
E-Coli	1000	1000	1000	100	<1.1		1000	100	
K									0 – 2

Table 13: Recommended microbiological WHO quality guidelines for wastewater use in agriculture

Category	Reuse condition	Exposed group	Intestinal nematodes(arithmetic mean no. of eggs per liter	Faecal coliforms (geometric mean no. per 100 ml <sup>e</sup> )
A	Irrigation of crops likely to be eaten uncooked, sports fields, public parks <sup>d</sup>	Workers, consumers, public	<1	< 1000
B	Irrigation of cereal crops, industrial crops, fodder crops, pasture and trees <sup>e</sup>	Workers	< 1	No standard recommended
C	Localized irrigation of crops in category B if exposure of workers and	None	Not applicable	Not applicable

Category	Reuse condition	Exposed group	Intestinal nematodes(arithmetic mean no. of eggs per liter)	Faecal coliforms (geometric mean no. per 100 ml <sup>e</sup> )
	the public does not occur			

### 4.3 IFC Performance Standards on Environmental and Social Sustainability

This section will shed lights on international social legislations that might influence the project and which of them should be triggered:

Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts

Performance Standard 2: Labor and Working Conditions

Performance Standard 3: Resource Efficiency and Pollution Prevention

Performance Standard 4: Community Health, Safety, and Security

Performance Standard 5: Land Acquisition and Involuntary Resettlement

Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Standard 7: Indigenous Peoples

Performance Standard 8: Cultural Heritage

### 4.4 World Bank Safeguard Policies and Guidelines

The WB has ten environmental and social policies referred to as the Bank's "Safeguard Policies" that should be considered in its financed projects.

Based on the information to be collected of each project, the environmental initial assessment for each project is addressed through:

- Reviewing the safeguard policies and ensuring that the proposed project does not trigger a safeguard policy that makes it ineligible.
- Describing any safeguard issues and impacts associated with the construction of the project. Identifying and describe any potential large scale, significant and/or irreversible impacts.
- Describing any potential indirect and/or long term impacts due to anticipated future activities in the project area
- Describing measures taken to address safeguard policy issues. Provide an assessment of project proponent capacity to plan and implement the measures described.
- Identifying the key stakeholders and describing the mechanisms for consultation and disclosure of safeguard policies, with an emphasis on potentially affected people.

Among the ten safeguard policies of the WB, five are considered by the Consultant to be relevant to the NGESTP and have been taken into account during this ESIA study; these are listed and discussed below:

- Environmental Assessment (OP 4.01), that was previously discussed in section 3.4 of the current chapter.
- Involuntary Resettlement (OP 4.12)
- Disclosure (BP 17.50)
- Natural Habitats (OP 4.04)
- Cultural Property (OPN 11.03)

#### 4.4.1 OP 4.12 - Involuntary Resettlement

The WB Operational Policy OP 4.12 on Involuntary Resettlement deals with involuntary resettlement in wider terms than the physical displacement of people due to development projects. It rather considers individuals who might be subjected to other sorts of adverse economic impacts on their livelihoods.

The overall objectives of the Bank's policy on involuntary resettlement are:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs;
- Where it cannot be feasibly avoided, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the displaced persons to share the project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs and compensation measures; and,
- Displaced persons should be assisted in improving their livelihoods and standards of living or at least in restoring them, in real terms, to pre-displacement levels or to levels prevailing prior to project implementation, whichever is higher.
- The policy cover the involuntary taking of land resulting in relocation or loss of shelter, loss of or access to productive assets, or loss of sources of income or means of livelihood, whether or not the affected persons must move to another location. It also covers the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

#### 4.4.2 BP/OP 17.50 - Disclosure

WB policy OP 17.50 on Disclosure is also relevant to the project. This policy details the Bank's requirements for making operational information available to the public. The Bank reaffirms its

recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including non-governmental organizations, is essential for the effective implementation and sustainability of projects.

#### 4.4.3 OP 4.04 - Natural Habitats

The WB does not finance projects that degrade or convert critical habitats. Effects on non-critical habitats would be tolerated only if no alternatives are available and if acceptable mitigation measures are in place. It is essential to apply a precautionary approach to natural resource management to ensure opportunities for environmentally sustainable development.

#### 4.4.4 OP 11.03 – Cultural Property

The core requirements for this Safeguard Policy include investigation and inventory of cultural resources that are potentially affected by the project and set appropriate mitigation measures when there are adverse impacts on physical cultural resources.

#### 4.4.5 Israeli Palestinian Joint Water Committee

There is an agreement or understanding (Memorandum of Understanding) on guidelines and technical criteria for sewerage projects. The project component of reuse system has to follow this guideline. In particular, the guidelines concerning reuse scheme are as follows:

- Article 14 Effluent Reuse and Disposal; In general no discharge of effluent to wadis and / or to rivers and their tributaries is permitted. Under exceptional circumstances, and only in the absence of any other disposal route, discharging to certain wadis and river may be permitted by the Joint Water Committee in accordance with the quality specification in schedule 1 and 2. All precautions shall be taken to prevent any possible environmental hazards. The reuse of treated effluent for irrigation shall be in accordance with the provisions detailed in schedule 1 and 2 .
- Article 15 Sludge Reuse and Disposal; Disposal of sludge shall take place at an agreed waste disposal site or reused in accordance with the provision detailed in schedule 3 .

### 4.5 Regional Legal Frameworks (Jordan, Israel and Egypt) concerning wastewater reuse and Sludge Management and Reuse

For comparisons and lessons learned, the regional legal frameworks in the region (Jordan, Israel and Egypt) as well as International standard (FAO and WHO) concerning wastewater reuse and sludge management and reuse were reviewed and compared during the ESIA process.

#### 4.6 International Agreements involving PNA

The Oslo Accord I (1993) between the Palestinian and the Israelis stated that a joint committee should be established on Economic Cooperation to focus among other matters on environmental issues. The Oslo Accord II (1995), which has been ineffective since the Intifada in 2000, stated that the Israelis and the Palestinians agreed to cooperate in order to prevent damage to the environment. Both parties also agreed to adopt and comply with internationally recognized environmental standards for air and liquid emissions and to take appropriate measures to prevent pollution of soil and water resources.

#### 4.7 Relevant Ministries and Institutions

Figure 8 below, presents the relations between PWA and other organizations related to water, wastewater and sludge management. The coordination between the ministry and PWA related to this project is presented in the following chapter, Chapter 6 Environmental and Social Management Plan (ESMP).





Figure 31: Relevant ministries and institutions

## 5 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

### 5.1 Environmental Baseline Data

#### 5.1.1 Introduction

Environmental baseline data represent the existing situation in the project component areas, which could be influenced by the project. This chapter will present updated baseline data, with focus on part C2 of the recovery and reuse scheme, covering infiltration ponds (adjacent of the NGWWTP), recovery well field locations and the targeted areas for irrigation sites. The existing environmental conditions in Gaza in general and project component sites in particulars were also studied.

Environmental baseline data are presented in the following order:

- General view of the Gaza Strip
- Physical Environment
- Biological Environment
- Water Resources;

#### 5.1.2 Overview of the Gaza Strip

The Gaza Strip consists of five governorates, including a total of 33 villages and municipalities. It has a total surface area of 365 km<sup>2</sup>, a total length of 40 km and a variable width of 7-10 km. The main source of water in the Gaza Strip is the shallow aquifer that underlies the whole Strip. According to a 2016 estimate listed on The Palestinian Central Bureau of Statistics website, the population of the Gaza Strip is estimated to be 1,881,000, distributed between the five governorates including refugee camps. (Table 10 below). Population is expected to reach 5,672,829 towards the middle of the century, in 2050 (pcbs, 2017). This has been calculated based on an annual growth rate of 3.3% in 2016. This annual growth has been assumed to be constant for all governorates.

A road network already exist in the Gaza Strip with only one main road - Salah El Deen - linking the South to the North passing through the five governorates. UNRWA camps are scattered all over the strip and urban area are distributed over four main areas.

Table 14: Populations distribution in Gaza Strip (source: pbs, 2016)

Governorates	Populations
North Gaza	377,126
Gaza City	645,205
Middle Area	273,245
Khan Yunis	351,934
Rafah	233,490

## 5.2 Physical Environment

### 5.2.1 Climate

The Gaza Strip is located in a transitional zone between the temperate Mediterranean climate to the West and North and the arid desert climate of the Negev and Sinai deserts to the East and South. There are two well defined seasons: the wet season (October to April), and the dry season (May to September).

As a result, the project sites; The infiltration basins adjacent to NGWWTP, the recovery site and the proposed irrigation land has a typical semi-arid Mediterranean climate with long hot summer and dry summer cause by cast ward extension of the Azores high pressure and a mild wet resulted from penetration of mid latitude depressions accompanied by westerly wind moving eastward over the Mediterranean basin. The proximity of the Mediterranean Sea has a moderating effect on temperatures and promotes high humidity throughout the year.

The average daily temperature in Gaza Strip ranges from 25oC in Summer and 13oC in Winter, The maximum daily temperature can reach 29-30oC and the minimum temperature is around 9oC(UNDP/PAPP 2009; UNEP 2009; ARIJ 2015).

The prevailing wind direction is South West with an average speed of 4.2 m/s in winter and from North West during summer.

Evaporation is particularly high in the summer (the highest evaporation rate occurs in July) due to the rise in temperature, high incident solar radiation, and low humidity. Evaporation in the Gaza Strip is the lowest anywhere in Palestine (1580 mm per year), due to high relative humidity, lack of surface water and less intense solar radiation and fewer hours of sunlight. (ARIJ 2015)

## 5.3 Climate Change

One of the major century challenges is global warming. Studies on global warming and its effect on climatic change are being pursued vigorously as a multi-disciplinary problem. Global warming due to

enhanced greenhouse effect is expected to cause major changes in various climatic variables such as absolute humidity, precipitation and net terrestrial and global solar radiation etc.

Atmospheric temperature is probably the most widely used indicator of climatic changes both on global and regional. Climate change will lead to an intensification of extremes of the global hydrological and could have major impacts on water resources, both ground and surface water, irrigation and in stream ecosystem. Changes in the total amount of precipitation and in its frequency and intensity directly affect the magnitude and timing of runoff and the intensity of floods and drought.

Climate change is also projected to have significant impacts on conditions affecting agriculture. While some aspects of climate change such as longer growing seasons and warmer temperatures may bring benefits (in cold region), there will be also adverse impacts including reduced water availability, greater water demand, and more frequent extreme weather.

The evaluation of potential impacts of climate change on crop and irrigation water requirement has been studied and analyzed during the preparation of Irrigation scheme of Effluent Recovery scheme of NGESTP. The main factor for water demand determination in the report based on the type and percentage of crops in the project area, climate in the project area (rainfall, temperature, relative humidity, etc.) taking the climate changes in consideration, soil characteristic and irrigation method. The irrigation scheme was done with taking into account the climate change through the mentioned 10 years by increase the air temperature of 1.5oC / year.

**Table 15: Rainfall depth for the season 2010-2011 in GS**

	Rafah	Khuza'a	Khan Younis	Deir Elbala h	Gaza South	Gaza City	Jabalia	Beit Hanon	Beit Lahia
Accumulated Rainfall/ station (mm)	113	140.5	184.5	224	272	259.8	265.5	229.8	236.9
Normal Rainfall/ station (mm)	236	245	290	324	394	370	421	418	433

Source: different meteorological stations at GS

The average annual evaporation rate in the Gaza Strip is around 1900 mm/y (5.2 mm/day). The maximum evaporation rate increases during the summer and may reach over 6 mm/day between June and August(UNDP/PAPP 2009).

## 5.4 Ambient Air Quality

Ambient air quality (Concentrations of CO and CO<sub>2</sub>) nearby El Shuhada Cemetery where the booster pumps and storage tanks will be constructed as a part of the water distribution networks for irrigation are expected to be low since the areas have low population densities.

**Table 16: Coordinates of Sampling location for air and noise**

Location	Coordinates	
Air and noise1 (AN1)	31°33'15.15"N	34°30'54.11"E
Air and noise1 (AN1)	31°33'3.19"N	34°30'58.43"E

**Table 17: Air Quality at project sites (CO and CO<sub>2</sub>)**

Parameter		Effluent Lake (AN2)	El Shuhada Cemetery (AN1)
CO	ppm	0.1	0.1
CO <sub>2</sub>	ppm	380	344
PM <sub>5</sub>	ppm	306	345
PM <sub>2.5</sub>	ppm	53	60

## 5.5 Noise

Noise levels at similar points as air ambient measurements are expected to be low since the area is of low population density.

**Table 18: Noise measurements at project sites**

Location	Time	Result (dB)	Average (dB)
Effluent Lake (AN2)	9:00	42.7	40.5
	11:00	42	
	13:00	40	
	15:00	39	
	17:00	39	
El Shuhada Cemetery (AN1)	9:00	43.3	43.3
	11:00	43.3	
	13:00	43.3	
	15:00	43.3	
	17:00	43.3	

## 5.6 Soil Characteristics

The soil in the Gaza Strip is mainly composed of three types; sand, clay and loess as shown in Figure 33. The sandy soil is found along the coastline extending from South to outside the northern border of the Strip, in the form of sand dunes. The thickness of sand fluctuates between 2 - 50 meters due to the hilly shape of the dunes

The dominate soil type in the area can be considered as heavy soil with a deep soil profile, which means that the hardpan of soil profile is far away from the soil surface. Thus, hardpan and/or parent material will not limit root penetration for deep rooted crops. Detailed soil characteristics (physical and chemical) investigations were provided by PWA.

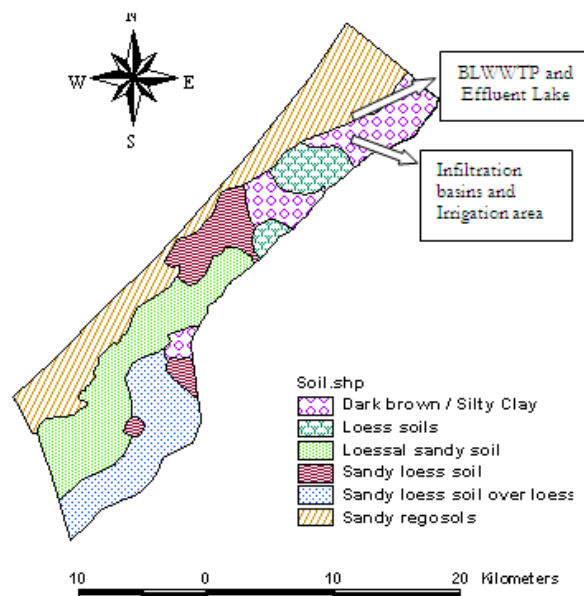


Figure 32: Soil Type of the Project Area for Effluent Recovery and Water Reuse

**Zone A** Loamy clay textured soils with dark brown to reddish brown color are dominated in the area (Figure 29). The calcium carbonate content ranges from 15 to 20%.

**Zone B** The north part of this area is loamy clay textured soil and the south part is loose textured soil and is yellow brown in color as shown in Figure 29.

The soil texture of the project area was first determined through soil investigation and reported in the soil report. The soil investigation showed that the texture of soils differs from loam to sandy loam (PWA, 2010).

Surface irrigation is common and predominant in the grooves. Most of the area (about 12,000 dunum) is considered as area under rain-fed conditions, which includes mainly the

demolished area and area cultivated with grains. This area would benefit from available reclaimed water and turn from rain-fed farming to irrigated land.

The socio-economic survey will indicate the willingness to pay and the willingness to use the available recovery water and sludge.

Zone A of the project site is characterized with loamy clay textured soils with dark brown to reddish brown color are dominated in the area and the Zone B is characterized with loamy clay textured soil in the northern side and loess textured soil and is yellow brown color, shown on Figure 34.

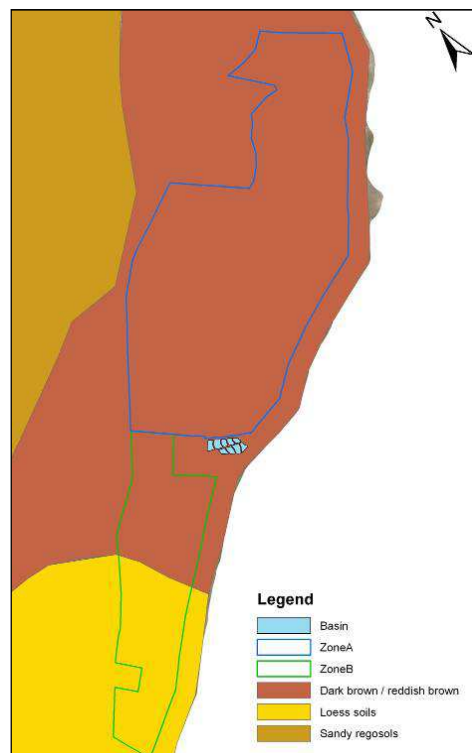


Figure 33: Gaza strip soil map and project area (MOA, 1994)

## 5.7 Topography and Physiography

The Gaza Strip topographical area is characterized by elongated ridges and depressions ,dry streambeds and shifting sand dunes. The ridges and depression generally extend in a North-North East (NNE) – South-South West (SSW) direction, parallel to the coastline. These are narrow and consist primarily of sandstone.

land surface of the strip attains its maximum elevation at the east of about 95m Above Mean Sea Level (AMSL). The general dipping of the surface is due west and northwest with different intensities. At project site, in the northern part, the maximum ground surface elevation ranges between 40-60 m (AMSL).

## 5.8 Geomorphology

Three small valleys (Wadi Bet Hanoon, Wadi Gaza and Wadi Salqah) cross the Gaza Strip from East to West; they have little water in Winter and are dry in Summer. Wadi Gaza is the only river inside the area and is characterized by a stream regime, where it grows from the limestone hills of Neqab and its stream develops with SE-NW direction, for about 7 km inside the Gaza Strip, then dividing into two sectors. The Wadi cuts through thick loess sediments overlying a gravel horizon on partly hardened calcareous sand (locally known as “Kurkar”).

Six sub-basins drain and discharge their water into Wadi Gaza through which it goes directly into the Mediterranean Sea. It was observed that the drainage patterns of the 6 sub-basins are at a considerable distance from the project sites. The coastal land with a width of 1.0 to 3.0 km along the sea is covered with sand dunes of 20-40m height AMSL.

## 5.9 Geology

Investigation of the Geology of the Gaza Strip was based on the following sources:

- Oil and gas exploitation logs – 2000 m depth - drilled by Israelis;
- Wells drilled during the Coastal Aquifer Management Project (Palestinian Water Authority and USAID 2000);
- Water wells drilled by PWA;
- Geophysical survey conducted in the Gaza Strip (Cooperative-International and Gaza 1997)

The geology of the Gaza Strip consists of a sequence of geological formations ranging from upper Cretaceous to Holocene. This sequence is gradually sloping westwards includes a tabular presentation of the geological history of the Gaza Strip. The formations of this sequence are:

### 1. Tertiary Formations

The Tertiary formations consist of Sakiya group (upper Eocene to Pliocene) with a thickness of 400 m to 1000 m underlined by Eocene Chalks and limestone.

### 2. Quaternary Formations

The Quaternary deposits throughout the Gaza Strip overlie the Sakiya group, while at the East they overlie the Eocene Chalks and limestones. The thickness of the Eocene deposits reaches to about 200 m. The coastal aquifer is composed of loose sand dunes (Holocene age) and Kurkar group (Pleistocene). The Kurkar group is composed of marine and Aeolian calcareous sandstone (locally known as "Kurkar"), reddish silty sandstone ("hamra"), silts, interlayers of clay deposited during the Last Glacial stage and during the Holocene, unconsolidated sand and conglomerates. Close to the present shoreline, the sequence of the Kurkar Group attains an



average thickness of 200 m in the South and around 120 m in the North, wedging gradually out towards the foothills of the Judea and Samaria Mountains in the East. The Holocene deposits are found at the top of the Pleistocene formation with a thickness up to 25m.

### 3. Sand Dunes

These dunes extend along the shoreline, and originate partly from Nile River sediments. The thickness of these dunes is about 15 m, and their width is small south of the Sofa site, increasing northward up to 3 km.

### 4. Sand, Loess and Gravel beds

This formation has a thickness of about 10 m and it is the main formation near the surface of Wadi Gaza.

### 5. Alluvial Deposits

These deposits spread in the area around Wadi Gaza and have a thickness of about 25m.

### 6. Beach Formation

This formation is composed of a relatively thin layer of sand with shell fragments. It is mainly unconsolidated, and in some places it is cemented due to the precipitation of calcium carbonate.

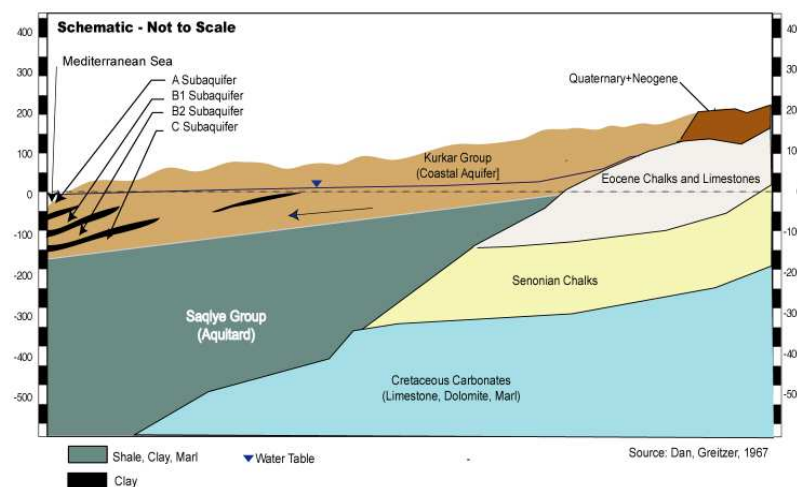


Figure 34: Typical hydrogeological cross section of the Gaza Strip(PWA/USAID 2000a)

## 5.10 Seismicity

Documented evidence of earthquake activity in Israel and adjacent areas is available over a period of 4000 years. The area is considered a medium seismicity region. Only a few large earthquakes with significant damages have occurred since the second century. The strongest earthquake being recorded in Palestine by modern seismographic equipment, took place in 1994 close to Jerusalem, this had a magnitude of 6 (Richter scale).

Figure 36 shows the variability of the peak ground acceleration (PGA) in Palestine, as developed by the Institute for Petroleum and Geophysical Research. The hazard is based on 10% probability of exceedance in 50 years (10/50), or a return period of circa 475 years. This hazard is mainly contributed by magnitude 6.0 - 6.5 earthquakes. Evidently, larger earthquakes ( $M > 7$ ) may occur in the region, once in 1000 to 6000 years on the average depending on the seismogenic zone, posing much higher hazard.

**Figure 35: Seismicity map of Palestine**

According to Figure 31, the maximum value of PGA is approximately 0.3 g, in the northern part of the Dead Sea fault. For structural design purposes in the Gaza strip, the PGA is taken as 0.075g which corresponds to an earthquake of magnitude 5 on Richter scale. According to the geological survey, no major fault type formations have been observed in Gaza Strip area.

## 5.11 Biological Environment

### 5.11.1 Flora

Despite its small size, Palestine is host to about 2,700 species of wild plants. What makes this floral diversity is the fact that Palestine is located where the Mediterranean, Irano-Turanian, Sudanian and Saharo-Arabian plant geographic zones intermingle in an area of varying climates and soil types. The Gaza Strip harbors a diversity of wild vascular plant species including Monocot and Dicot trees, shrubs and herbs. The following table indicates the most common floristic species prevailing in the vicinity of the project area. The plant cover of the area has many traditional uses, e.g. medicinal, nutritional and economical. The role of floristic species in providing vertebrate and invertebrate fauna with nesting, resting, feeding, roosting, sheltering and protection values is very considered.

Many aquatic birds including the Moorhen *Gallinula chloropus* and Coot *Fulica atra* in addition to many others usually use the Common Reed as nest material and site. Herons and egrets were found to use the Common Reed as roosting and foraging sites. Frogs are common inhabitants of reedy lagoons as they usually use the Common Reed for cover, rest, nest, breeding purposes and sunbasking. The plant has important ecological and environmental values as it benefits wildlife in different ways in addition to its role in wastewater treatment. The Acacia or Orange Wattle *Acacia cyanophylla* is about 5-meter high shrub growing in the sand dune ecosystem characterizing the western belt of the Gaza Strip. The plant is often used as windbreaks, sand soil fixation and for grazing. The shrubs were considered as a vital resource to the Palestinian community in the last few decades due to its exploitation as a fuel material. The Sycamore Fig *Ficus sycamorus* is one of the old and historic plant species in the Palestine coastal valley. It may grow to 20 meter tall. The tree carries its fruits nearly year long and these fruits are usually eaten fresh by locals. The species is under actual threat due to over-cutting and agricultural and residential creep.

The common floristic species recorded in the sand dunes of the Gaza Strip are presented in the Table 15 and Figure 37.

**Table 19: Common floristic species recorded in the sand dunes of the Gaza Strip**

Scientific Name	Common Name
<i>Cupressus sempervrens</i>	Evergreen Cypress
<i>Pancratium maritimum</i>	Sea Daffodil
<i>Phoenix dactylifera</i>	Date Palm
<i>Opuntia ficus-indica</i>	Tuna Cactus
<i>Salsola kali</i>	Russian Thistle
<i>Artemisia monosperma</i>	Sagebrush
<i>Silybum marianum</i>	Blessed Milk-thistle
<i>Ricinus communis</i>	Castor Oil Plant

Scientific Name	Common Name
<i>Acacia cyaophylla</i>	Acacia
<i>Acacia Arabica</i>	Gum Arabic Tree
<i>Alhagi maurorum</i>	Camel-thorn
<i>Ficus sycamoruz</i>	Sycamore Fig
<i>Eucalyptus camaldulensis</i>	River Red-gum Tree
<i>Ziziphus spina-christi</i>	Christ's thorn
<i>Nicotina glauca</i>	Tree Tobacco
<i>Tamarix nilotica</i>	Nile Tamarisk



Figure 36: Common Floristic species found in the project sites



## 5.12 Agricultural Fields

Many Olive, Plum, Almond, Citrus agricultural fields or orchards have been encountered at agriculture land allocated for irrigation of water distribution network of water recovery and reuse. Olive trees are usually found arranged in regular rows. The harvest of olive fruits starts in September. Many wildlife species; particularly birds were found to inhabit these agro-ecosystems; Chukars, Stone Curlews, Olivaceous Warblers, Olive-tree Warblers, Yellow-vented Bulbuls, Crested Larks and Barn Swallows are some examples.

## 5.13 Water Resources

### 5.13.1 Surface Water

There are no permanent surface water bodies in Gaza Strip. The surface water system in the Gaza Strip consists mainly of valleys (locally named Wadis), which only flood during very short periods during winter. Wadi Gaza is the major Wadi crossing the Gaza Strip in its central part. The geographical basin of the Wadi has a large catchment area where extends far beyond Bear Esaba as shown in the Figure 38 below. Since several decades, it rarely flows due to numerous water diversion and storage projects created upstream in Israel. The second Wadi is Wadi Halib which drains the depression of Beit Hanon. The third valley is Wadi Silka near Khan Younes, now a dry wash only flowing after torrential rains and no longer reaching the sea (Ubeid, 2010).

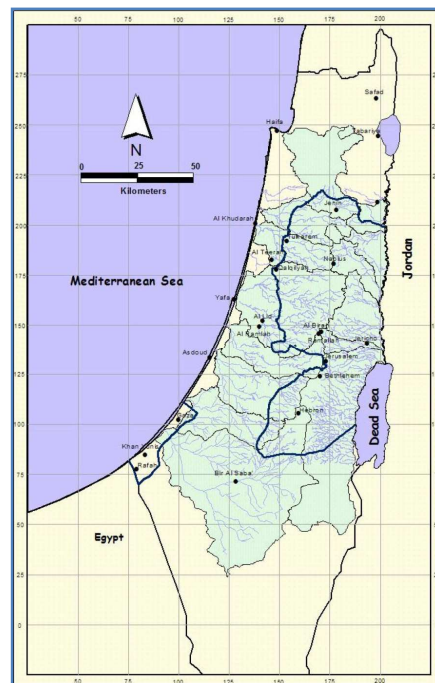


Figure 37:Wadi Gaza catchment area

### 5.13.2 Groundwater Aquifer

Gaza coastal aquifer has a considerable value for Palestinian people being the only fresh water source able to satisfy the daily consumption needs. The aquifer occupies the extreme western edge of the shallow coastal aquifer. The coastal aquifer is generally 10-15 km wide, and its thickness ranges from 0 - 200 m at the East and the coastline, respectively.

The coastal aquifer consists primarily of Kurkar Group deposits of Pleistocene age including calcareous and silty sandstones, silts, clays, unconsolidated sands, and conglomerates. Near the coast, coastal clays extend to around 2-5 km inland, and divide the aquifer sequence into three or four sub-aquifers, depending upon location (referred to as sub aquifers A, B1, B2, and C) as shown in the Figure 39 below. Towards the East, the clays pinch out and the aquifers are largely unconfined (phreatic).

Within the Gaza Strip, the total thickness of the Kurkar Group is about 100 m at the shore in the South, and about 200 m near Gaza City. At the eastern Gaza border, the saturated thickness is about 60-70 m in the North, and only a few meters in the South near Rafah. Perched water conditions exist throughout Gaza Strip due to the presence of shallow clays. The base of the coastal aquifer is marked by the top of the Saqiya Group, a thick sequence of marls, clay stones and shales that slopes towards the sea. The Saqiya Group pinches out about 10-15 km from the shore and the coastal aquifer rests directly on Eocene age chalks and limestones.

The results of aquifer tests carried out at different places in the Gaza Strip, show that the transmissivity values range between 700 and 5000 square meters per day ( $m^2/d$ ). The corresponding values of hydraulic conductivity  $K$  are mostly within a range of 20-80 meters per day ( $m/d$ ). Most of the tested wells are municipal wells screened across more than one sub-aquifer. Hence, little is known about any difference in hydraulic properties between sub-aquifers (PWA, 2000b). The estimated effective porosity is 25%, where is the Specific yield values are estimated to be about 15-30 percent and specific storativity is about 10 - 4 (PWA/USAID, 2000b) in Selmi, 2013.

Figure 38: Geological presentation of the Gaza Strip

The total water abstraction from the aquifer in 2009 was estimated between 160 and 165 x 106 m<sup>3</sup> while the average of replenishment was estimated between 100 – 110 x 106 m<sup>3</sup> (HWE report, 2010), this indicates a deficit in the aquifer balance ranging from 55 to 60 x 106 m<sup>3</sup>/yr.

### 5.13.3 Northern Aquifer

The ambient water quality in this study focused on chloride and nitrate concentrations since these are the most important contamination indicators in the groundwater in the Northern Gaza aquifer, according to historical statistics. The reference level over which the water is to be considered a source and under which the water is to be considered a sink is set as follows based on the World Health Organization drinking water guidelines: 50 mg/l for NO<sub>3</sub>, and 250 mg/l for Chloride.

The highest chloride sources are expected in the areas affected by seawater intrusion and the deeper groundwater layer. Figure 40 shows the chloride concentration map for year 2016 using the average quality values for year 2016. Examining its data, it is apparent that the seawater intrusion zone covers the western part with 2 to 3 km inland the aquifer. Most of the municipal wells were concentrated in this zone and due the high pumping rate of these wells resulted in accelerating the seawater intrusion. Generally, the chloride concentrations in the abstracted water exceed 250 mg/l in most of the Gaza Coastal Aquifer.

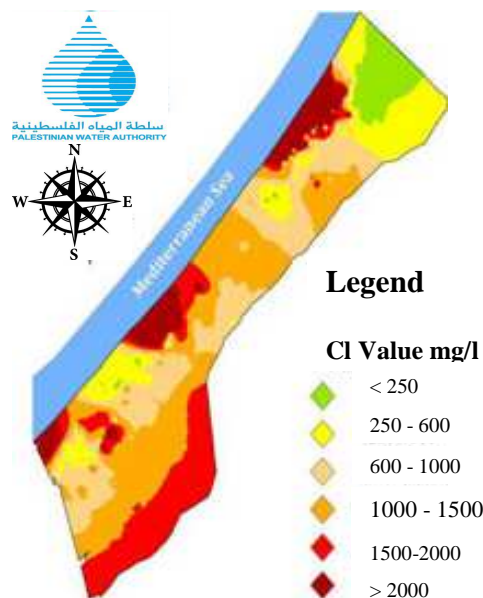


Figure 39:Chloride concentration contour maps for year 2016

Figure 41 shows the nitrate concentration contour maps for 2016 using the average quality values for 2016 collected from municipal and agricultural wells. The figure shows that NO<sub>3</sub> concentration exceeds the WHO drinking water and irrigation guidelines in most of the Northern Gaza aquifer.

In the area around the proposed infiltration site the average nitrate concentration ranged between 55 to 113 mg/l from a maximum nitrate concentration in the groundwater of 30 mg/l at the infiltration site in 2006. This indicates that the increase of the nitrate concentration is due to the operation of the infiltration basin using partially treated wastewater.

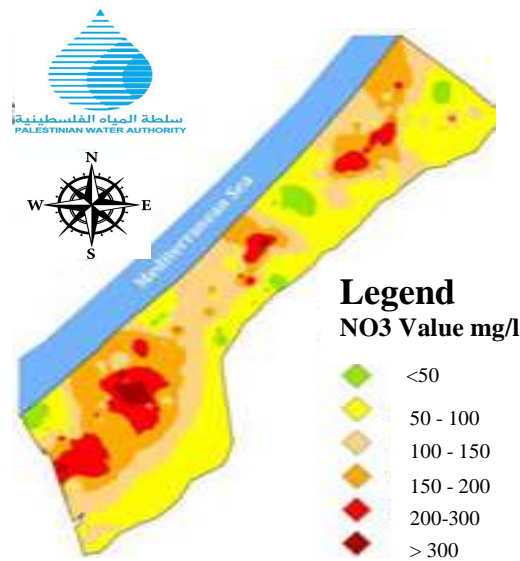


Figure 40: Nitrate concentration contour maps for year 2016

#### 5.13.4 Infiltration Site

The assessment of the aquifer water quality in the infiltration site has been based on:

- The aquifer water quality baseline survey carried out by PWA (Recovery Wells Geoinvestigations), included in Annex 4.
- The water sampling of the aquifer close to the basin carried out during design of the recovery scheme project through two circles as shown in Figure 42 and, the water analysis during the current project, .



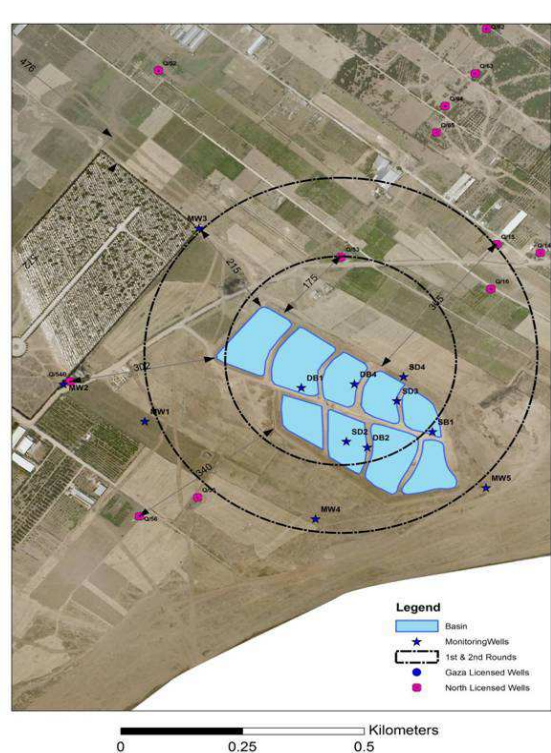


Figure 41: Location of Sampled Wells close to the infiltration basin

Figure 43 shows the results of Cl concentration in the wells close to the infiltration basin for the years 2007-2012. Chloride concentrations were found to range between 350 to 650 mg/l, after which the trend continued to be steady. Well Q53 was an exception where a decrease in the Cl concentration was exhibited, dropping from 610 mg/l in 2009 to 350 mg/l in mid-2012. This could have been as a result of the operation of the infiltration basin. The well is around 175 m from the basin which indicates that the infiltrated wastewater reached this well since the Cl concentration of this well is very close to the value of Cl concentration on the infiltration basin (around 330 mg/l).

Examining Figure 44, it can be seen that the steady trend is maintained, ranges being around 350-400 mg/l. The chloride values of the agricultural well Q53 is also in line with the results of the first stage recovery wells, where chloride concentrations have been found within the same range.

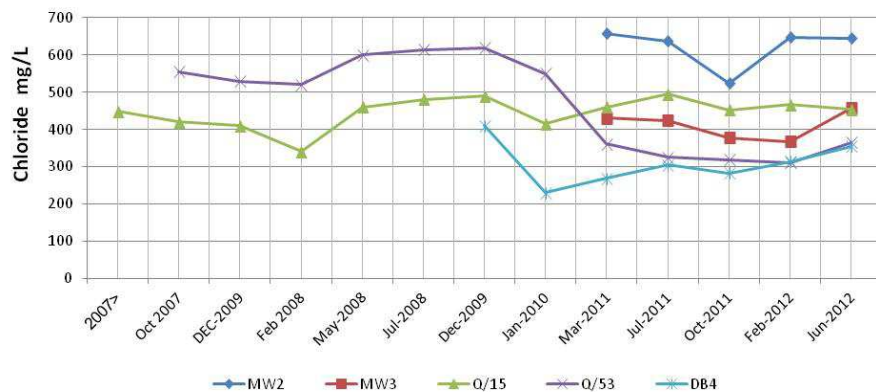


Figure 42:Cl Concentration in the Wells Close to the Infiltration Basins (2007-2012)

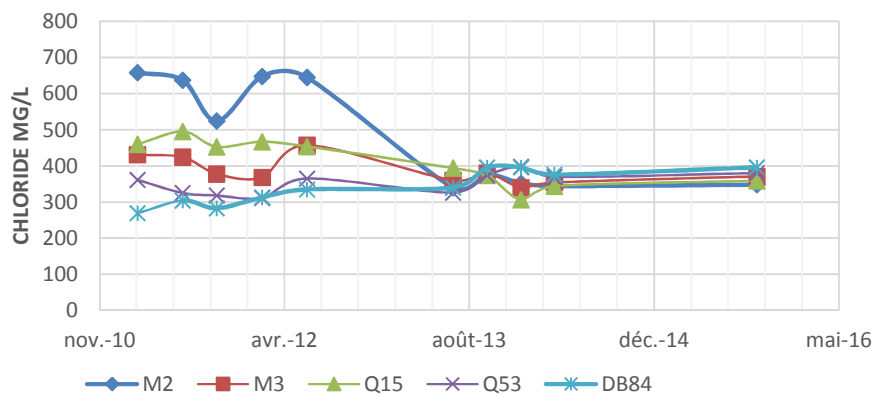


Figure 43:Cl Concentration in the Wells Close to the Infiltration Basins (2010-2014)

Looking at the nitrate results, it can be seen that concentrations range from 20mg/l to 150 mg/l in 2017, both in the monitoring wells and in the recovery wells, indicating some increase in nitrate concentrations since 2012. These numbers far exceed the WHO standards that indicate a maximum value of 30 mg/l . Figures 45 and 46 also shows that there is a drop of the nitrate concentration in the aquifer surrounding the basin; this may due to the reduction of agricultural practice in the area.

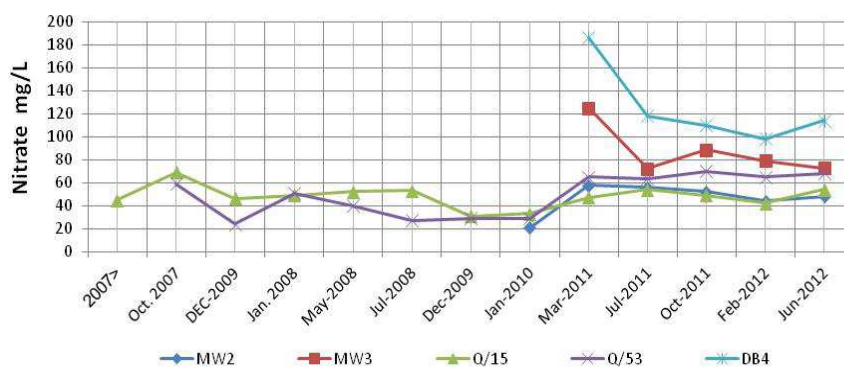


Figure 44: Nitrate concentration in the wells close to the infiltration (2007-2012)

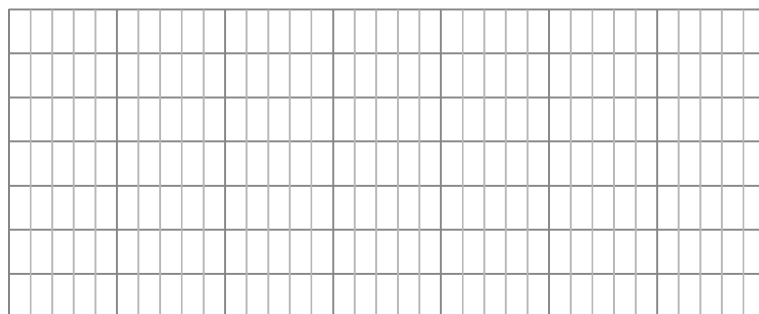


Figure 45: Nitrate concentration in the wells close to the infiltration (2010-2014)

Pathogenic bacteria is has also been investigated in the groundwater in wells in close proximity to the infiltration basin, since partially treated sewage has been infiltrating the aquifer for 9 years. Table 16 presents the microbiological analyses of groundwater samples from the wells close to the infiltration basin and Table 16-18 shows the analysis of BOD and COD in the same wells. The following can be concluded:

- the groundwater is free of Salmonella, Nematodes and Amoeba & Gardia.
- Total Bacteria count ranges between 30 to 395 cfu/ml and the total coliform ranges between 6 to 650 cfu /100ml. While no direct standards has been found indicating restrictions and permissible total bacterial count limits, use of reclaimed water for irrigation with high bacterial count should be exercised with care, especially in the case of crops that are to be eaten uncooked.
- Fecal coliform was found to be compliant with the Palestinian permissible limit of 200 for High quality water (Type A) in most wells with the exception of Q64. The reason of such FC existence may be attributed to the direct pollution through the well pipe from animal wastes such as birds.
- It can be seen that the BOD in the years 2014-2016 in most wells exceed 10mg/l.

Table 20: Microbiological analysis for groundwater samples from wells close to the infiltration basin

Well no.	2007-2012			2010-2014		
	Total Bacteria Count Stdcfu/1ml.	Total coliform cfu /100mL	Faecal coliform cfu /100mL	Total Bacteria Count Stdcfu/1ml. (2010)	Total coliform cfu /100mL	Faecal coliform cfu /100mL
Mw1	40-105	6	2	105	16-650	3
MW2	60-205	10	4	250	73-172	4-30
Mw3	40-350	14-25	9	350	11-150	5-46
Mw4	35-182	0	negative	182	39-106	2-10
Mw5	65	Over 300	7		50-6200	34-100
Site well	15-55	30	8	15	14-300	8
Q15	60-375	30-76	20	375	24-75	8-27
Q20	353-395	3-65	2	395	8-90	6-50
Q53	30-55	negative	negative	55	6-86	0-4
Q54B	33-85	40	25	33	65-74	26-33
<b>Q64</b>	<b>90-310</b>	<b>50-1100</b>	<b>22</b>	<b>310</b>	<b>108-656</b>	<b>88-252</b>
DB4	55-165	35-85	15-33	165	85-2000	6-33

Table 21: BOD5 Concentrations (O<sub>2</sub>/L) in wells close to the infiltration basin

	Mw1	MW2	Mw3	Mw4	Mw5	Site well	Q15	Q20	Q53	Q54B	Q64	DB4
	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
Mar-11	1.8	0.8	1.5	0	0	1.9	1.9	2	1.9	< 2.00	2	11
Jul-11	5	2	4	1.9	1.8	4.9	4.9	5	1.9	< 2	5	11
Oct-11	5	5	6	5.1	5.1	5.1	5.1	5	5.1	< 5	5	12
Feb-12	5	5	6.5	4.9	4.9	4.9	4.9	5	4.9	-----	5	11.5
Jun-12	5	5	6.2	4.8	4.8	4.9	4.9	5	4.9	< 5	5	12
Jul-13	4.5	5	8.1	5	15	5	15	0	20	0	2	0
Oct-13	4	5	0	10	10	2	7	2	8	9	8	1
Jan-14	5	5	10	5	10	10	5	10	15	30	35	
Apr-14	7	10	15	15	20	65	45	60	45	45	55	
Jun-14	9.0	12.5	14.5	12.5	16							
Oct-15	11.0	15	14	10	12	15	7	6	10	5	7	10
Dec-15	7.7	11.7	13.3	15.7	9.7	3.0	8.0	4.0	12.0	4.0	8.0	11.0
Apr-16	20.0	22.0	10.0	25.0	22.0		20.0	5.0	20.0	22.0	15.0	20.0
Jul-16	25.0	25.0	17.0	27.0	25.0	30.0	25.0	15.0	25.0	22.0	25.0	20.0

Table 22: COD Concentrations (O<sub>2</sub>/L) in wells close to the infiltration basin

	Mw1	MW2	Mw3	Mw4	Mw5	Site well	Q15	Q20	Q53	Q54B	Q64	DB4
Mar-11	5	2	3	0	0	3	3	2.5	3.5	3	2	25
Jul-11	7.2	2.8	8.4	3.2	0.8	13.6	9.6	9.6	4.8	5.6	8	25
Oct-11	4.8	7.2	8.4	2.4	2.5	7.2	8.5	7.8	5.6	6.2	2.4	24
Feb-12	4.2	4.4	7.2	2.8	2.4	5.6	6.2	5.4	4.4	-----	3.6	24
Jun-12	4.5	4.8	8	3	3.5	6.6	6.7	5.8	4.9	6.5	3.8	26
Jul-13	2	10	2	16	50	20	40	20	50	5	7	2
Oct-13	17	20	3	30	25	6	14	17	95	20	20	5
Jan-14	38	25	12	35	32	23	20	27	31	89	41	
Apr-14	20	20	30	40	46	170	95	120	40	100	120	
Oct-15	30	36	33	38	37	50	22		33			35

Metals ions were analyzed in the same wells close to the infiltration by PWA in mid of year 2016. As shown in Table 19, the metals concentrations in all analyzed wells were less than the Palestinian standard values for irrigation. However, there are some wells that have exhibited concentrations of Boron and Mercury higher than the standard values. The wells which have Boron concentration higher than the standard values are MW2, MW3, Q15, Q54B and Q64. The range of Boron concentration is between 0.4 to 1.39 mg/l. The mercury is also found in MW1, MW2, MW4, Q54B and Q64. The concentration of mercury in these wells ranges between 0.001 to 0.10 mg/l, which is higher than the standard value of 0.001 mg/l.

**Table 23: Ion concentrations in wells close to the infiltration basins**

Parameter	Palestinian Technical Specs 34-2012	MW1	MW2	MW3	MW4	Q15	Q54B	Q64
Silver, mg/l	1	0.005	0.005	0.005	0.01	0.01	0.01	0.01
Aluminum, mg/l	5	0.1	0.032	0.052	0.03	0.03	0.42	0.03
Boron, mg/l	0.7	1.557	1.396	1.21	0.4048	1.166	1.527	1.19
Cadmium, mg/l	0.01	0.0006	0.001	0.0006	0.001	0.001	0.001	0.001
Cobalt, mg/l	0.05	0.0032	0.002	0.0031	0.0069	0.001	0.0033	0.001
Chromium, mg/l	0.1	0.0173	0.01	0.0118	0.01	0.01	0.0303	0.01
Copper, mg/l	0.2	0.009	0.01	0.01	0.01	0.01	0.01	0.01
Iron, mg/l	5	2.7	0.66	0.67	0.67	0.26	0.17	0.27
Manganese, mg/l	0.2	0.21	0.005	0.005	0.0218	0.005	0.0883	0.005
Nickel, mg/l	0.2	0.004	0.001	0.0008	0.001	0.001	0.001	0.001
Lead, mg/l	0.2	0.095	0.088	0.093	0.099	0.092	0.09	0.089
Zinc, mg/l	2	0.05	0.014	0.012	0.027	0.008	0.0576	0.0257

Mercury, mg/l	0.001	0.001-0.0071	0.01	0.003	0.004	0.003	0.006	0.009
Phosphorus, mg/l	30	20	14-32	16-29	16-20	14-25	2-55	3-40

Table 24: Water analysis of major parameters in the stage 1 recovery wells

Parameter	RW24 (29/10/2017)		RW26 (12/10/2017)		RW27 (22/10/2017)		RW28 (21/10/2017)	RW29 (29/10/2017)	
	11:30A M 100m3/ h	16:00 200m3/ h	11:30AM 100m3/ h	16:00 200m3/ h	11:30A M 100m3/ h	16:00 200m3/ h	ND	11:30AM 100m3/h	16:00 200m3/ h
Acidity (PH)	7.62	7.445	8.386	8.123	7.461	7.451	8.104	8.021	7.461
E.C. (µS/cm)	2340	1405	2120	2130	2020	2000	2020	2140	2130
T.D.S (mg/l)	1405	1390	1272	1278	1212	1200	1212	1285	1278
T.A. (mg/l)	660	650	688	682	644	638	660	605	560
T.S.S. (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
B.O.D.	<10	<10	<10	<10	<10	<10	<10	<10	<10
NO3 (mg/l)	37	35	25	20	62	63	150	92	90
NH3-N (mg/l)	Nil	Nil	1	1	Nil	Nil	Nil	Nil	Nil
NO2	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Cl (mg/l)	444	440	444	386	444	425	367	386	452
PO4-P (mg/l)	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
SO4 (mg/l)	60	60	42	43	50	50	48	64	60
Na (mg/l)	450	445	404	406	380	385	385	422	420
K (mg/l)	3	3	10	11	10	10	8	3	3

Table 25: Comparison of key parameters of reclaimed water in Recovery Well 24

Parameter	RW24 (29/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m3/h	16:00 200m3/h			
Acidity (PH)	7.62	7.445	Compliant	Compliant	Compliant
E.C. (µS/cm)	2340	1405			
T.D.S (mg/l)	1405	1390	compliant with		

Parameter	RW24 (29/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m3/h	16:00 200m3/h			
			B,C &D		
T.A. (mg/l)	660	650			
T.S.S. (mg/l)	Nil	Nil	Compliant	Compliant	Compliant
B.O.D.	<10	<10	Falls in the A category	Compliant and suitable for unrestricted irrigation	Compliant
NO3 (mg/l)	37	35	Falls in the D category	Suitable for all types of crops except Cooked vegetables, recreations parks, playgrounds and sideways inside cities	Not Compliant
NH3-N (mg/l)	Nil	Nil	Compliant	Compliant	Compliant
NO2	Nil	Nil	Compliant	Compliant	Compliant
Cl (mg/l)	444	440	Slightly higher than permissible 400 mg/l	Slightly higher than permissible 400 mg/l	Slightly higher than permissible 400 mg/l
PO4-P (mg/l)	Nil	Nil	Compliant	Compliant	Compliant
SO4 (mg/l)	60	60	Compliant	Compliant	Compliant
Na (mg/l)	450	445	Not compliant	Not compliant	Compliant
K (mg/l)	3	3	No standards indicated	No standards indicated	Slightly higher than the permissible 2 mg/l
SAR	10.89		Exceeds SAR value of 5.83 me/l	Slightly exceeds SAR value of 9me/l	<15 Falls within permissible range

Table 26: Comparison of key parameters of reclaimed water in Recovery Well 26

Parameter	RW26 (12/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m3/h	16:00 200m3/h			
Acidity (PH)	8.386	8.123	Compliant	Compliant	Compliant
E.C. (µS/cm)	2120	2130			
T.D.S (mg/l)	1272	1278	Does not meet any of the water quality standards.	Non-Compliant	Compliant
T.A. (mg/l)	688	682			
T.S.S. (mg/l)	Nil	Nil			
B.O.D.	<10	<10	Falls in the A category	Compliant and suitable for unrestricted irrigation	Compliant
NO3 (mg/l)	25	20	Falls between the A-C category	Compliant and suitable for unrestricted irrigation	Compliant
NH3-N (mg/l)	1	1			
NO2	Nil	Nil			

Parameter	RW26 (12/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m3/h	16:00 200m3/h			
Cl (mg/l)	444	386	Non-compliant/marginal compliance	Non-compliant/marginal compliance	Not indicated
PO4-P (mg/l)	Nil	Nil			
SO4 (mg/l)	42	43	Well below limits, Compliant for unrestricted use	Well below limits, Compliant for unrestricted use	Well below limits, Compliant for unrestricted use
Na (mg/l)	404	406	Non-compliant	Non-compliant	Below requirement of 920 mg/l
K (mg/l)	10	11	Not indicated	Not indicated	Higher than required 2 mg/l

Table 27: Comparison of key parameters of reclaimed water in Recovery Well 27

Parameter	RW27 (22/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m3/h	16:00 200m3/h			
Acidity (PH)	7.461	7.451	Compliant	Compliant	Compliant
E.C. (µS/cm)	2020	2000			
T.D.S (mg/l)	1212	1200	Falls in categories B-D	Non-Compliant	Compliant
T.A. (mg/l)	644	638			
T.S.S. (mg/l)	Nil	Nil			
B.O.D.	<10	<10			
NO3 (mg/l)	62	63	Falls in category D	Not suitable for unrestricted irrigation- Marginally meets criteria for Field Crops, Industrial Crops and Critical Trees	Far exceeds permissible limits
NH3-N (mg/l)	Nil	Nil			
NO2	Nil	Nil			
Cl (mg/l)	444	425	Slightly exceeds permissible limits	Slightly exceeds permissible limits	Slightly exceeds permissible limits
PO4-P (mg/l)	Nil	Nil			
SO4 (mg/l)	50	50	Compliant	Compliant	Compliant
Na (mg/l)	380	385	Higher than permissible limits	Higher than permissible limits	Compliant
K (mg/l)	10	10	Higher than permissible limits	Higher than permissible limits	Higher than permissible limits

Table 28: Comparison of key parameters of reclaimed water in Recovery Well 28

Parameter	RW28 (21/10/2017)	Palestinian	Jordanian	WHO
	ND			
Acidity (PH)	8.104	Compliant	Compliant	Compliant



Parameter	RW28 (21/10/2017)	Palestinian	Jordanian	WHO
E.C. ( $\mu$ S/cm)	2020			
T.D.S (mg/l)	1212	Slightly exceeds the A category but meets categories B-D	Exceeds all limits	Compliant
T.A. (mg/l)	660			
T.S.S. (mg/l)	Nil			
B.O.D.	<10			
NO <sub>3</sub> (mg/l)	150	Far exceeds permissible limits	Far exceeds permissible limits	Far exceeds permissible limits
NH <sub>3</sub> -N (mg/l)	Nil			
NO <sub>2</sub>	Nil			
Cl (mg/l)	367	Borderline compliant with the permissible 400 mg/l	Borderline compliant with the permissible 400 mg/l	Borderline compliant with the permissible 400 mg/l
PO <sub>4</sub> -P (mg/l)	Nil			
SO <sub>4</sub> (mg/l)	48	Compliant	Compliant	Compliant
Na (mg/l)	385	Higher than permissible limits	Higher than permissible limits	Compliant
K (mg/l)	8	Higher than permissible limits	Higher than permissible limits	Higher than permissible limits

Table 29: Comparison of key parameters of reclaimed water in Recovery Well 29

Parameter	RW29 (29/10/2017)		Palestinian	Jordanian	WHO
	11:30AM 100m <sup>3</sup> /h	16:00 200m <sup>3</sup> /h			
Acidity (PH)	8.021	7.461			
E.C. ( $\mu$ S/cm)	2140	2130			
T.D.S (mg/l)	1285	1278	Slightly exceeds the A category but meets categories B-D	Exceeds all limits	Compliant
T.A.	605	560			

Parameter	RW29 (29/10/2017)		Palestinian	Jordanian	WHO
(mg/l)					
T.S.S. (mg/l)	Nil	Nil			
B.O.D.	<10	<10			
NO <sub>3</sub> (mg/l)	92	90	Far exceeds permissible limits	Far exceeds permissible limits	Far exceeds permissible limits
NH <sub>3</sub> -N (mg/l)	Nil	Nil			
NO <sub>2</sub>	Nil	Nil			
Cl (mg/l)	386	452	Slightly exceeds permissible limits	Slightly exceeds permissible limits	Slightly exceeds permissible limits
PO <sub>4</sub> -P (mg/l)	Nil	Nil			
SO <sub>4</sub> (mg/l)	64	60	Compliant	Compliant	Compliant
Na (mg/l)	422	420	Higher than permissible limits	Higher than permissible limits	Compliant
K (mg/l)	3	3	Slightly higher than permissible limits	Slightly higher than permissible limits	Slightly higher than permissible limits

Table 30: SAR Calculations

Parameter	RW24			RW26			RW27			RW28	RW29		
	S1	S2	Avg.	S1	S2	Avg.	S1	S2	Avg.	ND	S1	S2	Avg.
Na (meq/L)	19.57	19.36	19.47	17.57	17.66	17.62	16.52	16.75	16.64	16.74	18.36	18.27	18.32
Ca (meq/L)	3.72	3.58	3.65	4.20	4.11	4.16	3.45	3.38	3.42	3.67	3.08	2.99	3.04
Mg (meq/L)	2.79	2.69	2.74	3.14	3.08	3.11	2.58	2.53	2.56	2.75	2.31	2.24	2.28
SAR (meq/L)	10.89			9.24			9.63			9.34	11.24		

Table 31: Summary of concentrations and compliance to standards (WHO, Palestinian and Jordanian)

Parameter	Critical range in	Most stringent Limit	Compliance
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	wells (borderline to high)		criteria
BOD5	15-65	10	concentrations exceeding limits found
COD	50-170	Up to 50	Mostly within range
PH		6-9	All lie within range
NO3	53-79	55	concentrations exceeding limits found
Cl	262-891	250	Concentrations found exceeding limits
Heavy metals (in general)		Boron: 0.7 Murcury : 0.001	In just a few instances high concentrations of : <ul style="list-style-type: none"> <li>▪ Boron were exhibited in high concentrations, exceeding the allowable 0.7mg/l</li> <li>▪ Murcury was found to be in concentrations higher than the allowable limits in some measurements wells</li> </ul> Generally, all metals found well below limits
Phosphorus	30	2-55 & 3-40	Found to exceed allowable limits in 2 of the wells.
Total Bacteria count	6000 in MW5	2000	Found to exceed allowable limits in MW5 of the wells.
Fecal coliform count	10 for unrestricted irrigation	8-52	

#### 5.14 Water Status, Network and Utility in the Gaza Strip

The Gaza Strip is a semi-arid area where rainfalls in the winter season (from September to April), and ranges between 200mm/year in the south to about 400mm/year in the north, while the long term average rainfall rate in all of the Gaza Strip is about 317mm/year. Groundwater aquifers are the only water source for all kind of human usage in the Gaza Strip (domestic, agricultural and industrial) .

The Gaza aquifer, which is a classical coastal aquifer, represents the sole water source of the Gaza Strip covering an area of 360 (km<sup>2</sup>) with a total recharge of approximately 60 mcm/ yr. The Gaza

aquifer is threatened by seawater and salt ground water intrusion due to over pumping, and by pollution especially nitrates from the overuse of fertilizers and infiltration of sewage (Murad, 2004).

Groundwater has faced deterioration in both quality and quantity for many reasons, among them low rainfall, increased in the urban areas leading to a decrease in the recharge quantity of the aquifer, and also increasing population which depletes the aquifer and leads to seawater intrusion in some areas as a result of pressure differences between the groundwater elevation and sea water level. The groundwater aquifer beneath the Gaza Strip is limited in its area, while the natural boundary of this aquifer reaches Haifa in the North and goes to Sinai in Egypt in the south, and it's also bounded from Hebron in the East till the Mediterranean Sea in the west.

Fresh water production from the Gaza ground aquifer has become limited because the natural recharge from East and North is being trapped before reaching the political boundary of the Gaza Strip through drilling wells at the Eastern and Northern Gaza borders. This water added to that the dams which are being constructed along the upper stream of Wadi Gaza to stop the natural flow in the Wadi towards Gaza Strip, which makes the entire Wadi in the Gaza Strip dry.

The total length of water distribution networks in the Gaza strip is about 800 kilometers, with pipe diameters varying from 2 to 20 inches according to the purpose. The water network coverage in the Gaza Strip has reached 98%. The overall rate of water distribution in Gaza is between 70 to 85 liters per capita/day. The ratio of water distribution network efficiency is about 63%, including the illegal networks and leaks. The number of the water services subscribers is around 120 thousand, distributed over the Gaza governorates.

The size of the problem for Palestinians may be best illustrated by noting that the total available groundwater in Israel and the Palestinian Territory is 1,209 million cubic meters/year, out of which 1,046 mcm/year is currently being used by the Israelis, while the Palestinians are permitted to use only 259 mcm/year. The imbalance of current water use translates into an imbalance in water consumption. The Palestinian domestic per capita consumption of 35-80 l/day is far below the WHO standards, which assign a minimum of 100 l/capita/day. On the other end the Israeli per capita consumption exceeds 300 l/ day. Israel also uses about 800 mcm/ yr. of the total quantities of the Jordan River water, which means that most of Israel's water comes from rivers that originate outside the border, or from disputed lands.

During the recent surveys on present water consumption in Palestine, the industrial consumption could not be separated from domestic water consumption; therefore it is included in the figures of domestic water consumption. In Gaza, Palestinians are using about 177.4 mcm/yr. from groundwater, according to a 2010 estimate. With a safe yield of only 55 mcm/yr., there is an over pumping of about 87%, and it is for this reason that groundwater quality is deteriorating. The total

water consumption in Palestine was estimated at 326.8 mcm/yr. A. Summary of Water Supply and Consumption in Palestine is presented on following table, Table 28.

Table 32: Summary of Water Supply and Consumption in Palestine

Water production in Palestine		All figures expressed in Mm3/year											
		196.1	PWA, 2012			26.1	other source			80.0	TPAT estimation		
		2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)						290.4	309.5	316.7	335.6	303.6	311.2	326.8	
Palestine	wells					196.1	214.7	223.5	241.2	225.7	227.2	244.0	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					41.6	41.2	41.5	49.6	52.7	53.4	56.0	
West Bank	wells					50.6	70.2	70.5	77.7	69.7	68.2	71.5	
	springs					52.7	53.6	51.7	44.8	25.2	30.6	26.8	
	Mekhorot					37.6	37.2	37.5	45.0	47.9	48.7	51.1	
Gaza	wells					145.5	144.5	153.0	163.5	156.0	159.0	177.4	
	springs					0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Mekhorot					4.0	4.0	4.0	4.6	4.8	4.7	4.9	
						2004	2005	2006	2007	2008	2009	2010	2011
Water made available (wells, springs + purchase from Mekorot)						278.2	278.1	284.7	293.8	277.8	276.1	304.4	
Palestine	domestic					148.0	151.0	153.0	163.5	178.6	172.5	181.4	
	agriculture					130.2	127.1	131.7	130.3	99.2	103.6	123.0	
West Bank	domestic					80.0	80.0	80.0	85.5	96.6	86.5	85.0	
	agriculture					52.7	53.6	51.7	44.8	25.2	30.6	42.0	
Gaza	domestic	55.0	57.0	61.0	65.0	68.0	71.0	73.0	78.0	82.0	86.0	96.4	
	agriculture				79.5	77.5	73.5	80.0	85.5	74.0	73.0	81.0	
Gaza	water consumption	36.0	38.0	39.0	40.0	42.0	43.0	44.0	45.0	48.0	50.0	54.0	
	UFW	35%	33%	36%	38%	38%	39%	40%	42%	41%	42%	44%	

Source : National Water and Wastewater Strategy for Palestine, 2013

### 5.15 Current Status of Wastewater Treatment and Reuse

The term “wastewater” properly means any water that is no longer wanted, as no further benefits can be derived out of it. About 99 percent of wastewater is water, and only one percent is solid wastes.

For the last three decades or so, the benefits of promoting wastewater reuse as a means of supplementing water resources and avoidance of environmental degradation have been recognized by national governments. The value of wastewater is becoming increasingly understood in arid and semi-arid countries and many countries are now looking forward to ways of improving and expanding wastewater reuse practices. Research scientists, aware of both benefits and hazards, are evaluating it as one of the options for future water demands.

Although wastewater reuse in agriculture has been practiced since a long time in several communities around the world, it is becoming significantly an important means for facing the future water challenges. Its role is vital in achieving a reliable and sustainable integrated water resources management in modern societies.

The main challenge for wastewater reuse in agriculture remains in finding cheap and appropriate wastewater treatment systems that can improve the quality of wastewater to be safely used in irrigation without imposing risks on health or the environment. Banning irrigation with insufficiently treated wastewater will unlikely be stop it. Effective wastewater treatment might not be available for many years within a number of developing countries where wastewater is being used for crop irrigation. Therefore, governments must adopt appropriate and practical policies that offer other solutions, when adequate wastewater treatment is beyond their reach.

In the MENA region, wastewater reuse in agriculture is common. In many countries, especially those where water shortage is severe, access to freshwater for irrigation is limited and instead farmers use wastewater. But this is done in a semi-planned or unplanned manner. The primary problems associated with reusing insufficiently treated wastewater are the inherent health risks from wastewater containing bacteria, viruses, and a wide range of parasitic organisms, and the negative impacts of irrigation with wastewater on certain crops and the soil (World Bank 2001).

To overcome those implications and to utilize the full benefits of agricultural wastewater reuse, regulatory practices and the necessary institutional framework on both national and local levels and their adoption need to be reviewed and different stakeholders have to be recognized within a national policy context.

As discussed earlier, the oldest and largest reuse of wastewater is for irrigation of agricultural crops. Potential constraints in this type of application are:

- surface and groundwater pollution, if poorly planned and managed;
- marketability of crops and public acceptance;
- effect of water quality on soil, and crops;
- public health concerns related to pathogens.

The future of wastewater reuse seems to be promising in the Gaza Strip. The expected amount of wastewater to be used for irrigation will progressively increase on the coming twenty years saving more than half of groundwater needed for irrigation. To distribute the reclaimed wastewater to the agricultural areas and to the proposed infiltration basins, it is suggested to construct a main reclaimed wastewater carrier that will interconnect the three proposed regional WWTPs with the agricultural areas and the infiltration basins. The amount of well treated wastewater assumed to be used for irrigation by year 2005 will be around 19 Mm<sup>3</sup>/year and this will increase to about 53 Mm<sup>3</sup>/year by year 2020 (Tubail et. al., 2003).

Although the text of this task concentrates on using the treated wastewater in agricultural production, the treated wastewater will also feed the aquifer, and therefore reduce the deficit in the aquifer water balance.

The accepted recharging system type is to leave substantial soil below the bottom of the infiltration basin. This system will improve the quality of the water by Soil Aquifer Treatment (SAT) before reaching the groundwater. Thus, this type can be used for unrestricted irrigation without any risk to farmers' health.



## 6 SOCIAL BASELINE DATA

### 6.1.1 Socio-economic Environment

The potential impacts of any development project are affected by the different characteristics of the host community. Therefore, having a detailed description of the project area of influence (AoI) assists appropriate and accurate identification of the potential impacts. This section will discuss the socio-economic environment of the project areas (in terms of available data). The main sources of data are the following reports:

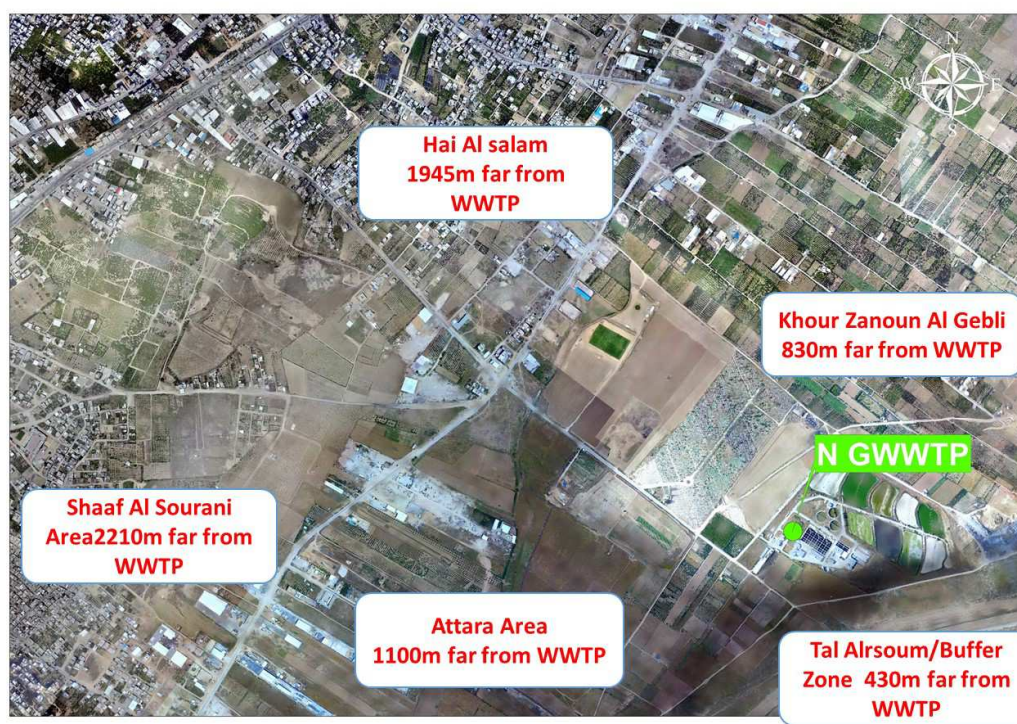
- Palestinian Census, 2017
- Palestinian Human Development Report 2014
- Environmental Assessment for North Gaza Emergency Sewage Treatment Plant Project- 2012
- Palestinian Statistical Year Book ,2012, Palestinian Central Bureau for Statistics
- PCBS Household Environmental Survey 2011
- Health conditions in the occupied Palestinian Territories, including east Jerusalem, and in the occupied Syrian Golan, WHO, Sixty- Fourth World Health Assembly A64/27-Provisional agenda item 15,2011

The project areas of influence is located in North Gaza Governorate. The project will mainly influence three settlement, namely, Jabalia, Beit Lahia and Beit Hanoun as well as Um El Nasr village. Figure 45a presents the project's areas of influence .



Figure 46 : Closest residential areas





**Figure 47: Project Area of Influence**

Gaza Strip is a small closed coastal area of a total surface area of 365 Km<sup>2</sup>. The Gaza Strip is amongst the most densely populated areas in the world. The environment in the Gaza Strip has been suffering from a great deal of abuse and negligence. The limited land resources, large and rapidly growing social and economic sectors, long-term isolation, and negligence as a result of the political circumstances have led to the deterioration of the natural resources and resulted in the amplification of several environmental shortcomings. The surface area in Gaza is very limited, with an average land availability of 0.26 dunum per person in 2007.

The latest census conducted by the Palestinian Central Bureau of Statistics (PCBS) in 2017 estimates the total population of the Palestinian Territories to be 4,780,978, of whom 2,881,687 live in the West Bank, and 1,899,291 live in the Gaza Strip.

With regards to the Area of Influence's settlements, Table 29 shows the area of each settlement.

**Table 33: Total area of Influence**

	Beit Hanoun	Beit Lahia	Um El Nasr	Jabalia
	12100 Dunum	38376 Dunum	800 Dunum	18.5 Km
<b>Total agriculture surface area</b>	4280 Dunum	2819 Dunum	260 Dunum	5694 Dunum

<b>Total Inhabited area</b>	3473 Dunum		153 Dunum	9328 Dunum
<b>Total Area of other Utilities</b>	900 Dunum		387 Dunum	52854 Dunum
<b>Source</b>	Source: Beit Hanoun 2017	Source: Palestinian Central Bureau of Statistics (2017)	Source: Palestinian Central Bureau of Statistics (2017)	Source: Directory of Population 2012- Jabalia municipality

Source: Beit Hanoun 2017

Source: Palestinian Central Bureau of Statistics (2017)

Source: Palestinian Central Bureau of Statistics (2017)

Source: Directory of Population 2012- Jabalia municipality

In terms of population, Jabalia village is considered of the biggest population (220,000 people). However, the smallest population was reported in Um El Nasr village (5,000 people). Female represent about 49.0% of the total population.

**Table 34: Distribution of population within the project areas**

	Beit Hanoun	Beit Lahia	Um El Nasr	Jabalia
<b>Total population</b>	52800	164346	5000	220,000
<b>Total number of males</b>	26928	83613	2550	112,200
<b>Total number of females</b>	25872	80733	2450	107,800
<b>Source</b>	Source: Beit Hanoun 2017	Source: Palestinian Central Bureau of Statistics (2017)	Source: Palestinian Central Bureau of Statistics (2017)	Source: Directory of Population 2012- Jabalia municipality

The population growth rate is approximately 2.82% per year; although this represents significant growth in population, the birth rates from 1997 to 2017 have actually declined.

### 6.1.2 Demographic Characteristics

In 2017, the Palestinian Census reported that 1,875,317 Palestinians reside in Gaza Strip. The population distribution reflected that the majority of people reside in Gaza Governorate 641,310 people. North Gaza Governorate's total population is 364,188 people. The other two main

Governorates are Khan Younis (population 366,823) in central Gaza, and Rafah (population 233,166) in the South. Regarding North Governorate, the total population is 364,188 people. The majority of people live in refugee camps<sup>1</sup>.

Table 35: Population in Palestine by Governorate and Sex, 2017

Governorate	Average Household Size	Households		Population					
				Females		Males		Both Sexes	
		%	Number	%	Number	%	Number	%	Number
Palestine	5.1	100	929,139	100	2,311,374	100	2,394,227	100	4,705,601
Gaza Strip	5.6	36.0	334,710	40.0	924,582	39.7	950,735	39.9	1,875,317
North Gaza	5.7	19.1	64,012	19.3	178,863	19.5	185,325	19.4	364,188
Gaza	5.7	33.8	113,238	34.1	315,068	34.3	326,242	34.2	641,310
Dier Al-Balah	5.5	14.7	49,202	14.5	134,185	14.3	135,645	14.4	269,830
Khan Yunis	5.5	19.9	66,510	19.6	180,795	19.6	186,028	19.6	366,823
Rafah	5.6	12.5	41,748	12.5	115,671	12.4	117,495	12.4	233,166

Source: Palestinian National Census, 2017

#### 6.1.2.1 Population distribution by sex in the AoI

The population of the North Gaza Governorate according to 2017 statistics is around 364,188. As could be observed from the table below, the population growth in project area of influence is high and was observed to increase during the last five years. The population projection calculated by the Feasibility Study was based on the assumption that a gradual decline in the population growth rate will be seen starting in 2012. It is anticipated that population growth will reach 1.11% by 2040, after peaking at 3.5% in 2011.

Table 36: Population Distribution by Sex and settlement (thousand) 2012

Area	Total in thousand	Male	Female
North Gaza Governorate	364.188*	185.325*	178.863*
Um Al-Naser	2.76	1.402	1.358
Beit Lahia	63.213	32.16	31.053

<sup>1</sup>Environmental Assessment of Gaza Strip, following the escalation of hostilities in December 2008 – January 2009 United Nations Environment Programme

<b>Beit Hanoun</b>	37.351	18.87	18.481
<b>Jabalia</b>	120.859	61.978	58.881

Source: Palestinian National Census, 2017, Palestinian Central Bureau for Statistics

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

#### 6.1.2.2 Age Structure

Age structure is a graphical illustration that shows the distribution of various age groups in a population (typically that of a country or region of the world), which forms the shape of a pyramid when the population is growing. It is also used in Ecology to determine the overall age distribution of a population; an indication of the reproductive capabilities and likelihood of the continuation of a species . Reviewing the age structure in the project area of influence , it can be concluded that the community has the potential for rapid, continuous growth. The majority of population in the four settlement are below 30 years old.

Figure 48: % distribution by the area of influence by age

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

Given the absence of detailed age distribution data in the National Census conducted in 2017, the social team relied on the detailed distribution of the population by age category available from 2012 Statistical Year Book. Data available shows that the difference according to gender is to some extent

limited, not exceeding 0.2% in total. The diversity according to gender is limited in all age categories. Taking into consideration that two thirds of the population is under 25 years old, there will be increasing demand for waste water recovery.

Figure 49: Percentage distribution for population in North Gaza Governorates by Age groups and sex

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

#### 6.1.2.3 Birth Rate,

The total birth rate in the Palestinian Territories was 4.4 child in 2017 that is less than the average birth rate in Gaza Strip (4.5 child), which is comparatively high in the region. In terms of pregnant women, four out of 10 attend antenatal care while virtually all women deliver in health institutions.

Table 37: Means number of children ever born to Ever Married Palestinian Women(15 Years and Over) in Palestine by Governorate, 2017

Governorate	Mean no. of children ever born
Palestine	4.4
Gaza Strip	4.5
North Gaza	4.5
Gaza	4.5
Dier Al-Balah	4.5
Khan Yunis	4.6
Rafah	4.6

Source: Palestinian National Census, 2017, Palestinian Central Bureau for Statistics

#### 6.1.2.4 Death Rate

The four leading causes of deaths in the occupied Palestinian Territories are non-communicable diseases such as heart diseases, cerebra-vascular diseases, cancer (led by trachea, colorectal and anal cancer) and inflammations of the respiratory system.

The infant mortality rate has shown little improvement in recent years (25.34 per 1000 live births: 22.9 per 1000 live births in the West Bank, 28.8 per 1000 live births in the Gaza Strip). The main causes of death among infants are pneumonia and other respiratory disorders (34.5%), congenital malformations (16.3%) followed by prematurity and low birth weight (13.4%).

There were 30 maternal deaths in 2008 and 2009 in the Gaza Strip, and 23 maternal deaths in 2009 in the West Bank, indicating a maternal mortality ratio of 29 per 100 000 live births in the Gaza Strip and 36.4 per 100 000 live births in the West Bank. Many pregnant women suffer from anemia (45% of pregnant women in the Gaza Strip and 20.6% in the West Bank). About a third of newly pregnant women are immunized against tetanus in the West Bank .

#### 6.1.2.5 Rate of Natural Increase

The total fertility rate in the Palestinian Territories has declined to be 4.4 births in 2017 compared to 4.6 births in 2007. Regional disaggregation indicates that the birth rate in the West Bank was 28.5 births compared to 35.8 births in the Gaza Strip in 2016 (source: PCBS). The majority of the population is under 25 years old. The natural increase in the Gaza Strip is higher than that in the West Bank. General notice was that Gaza is increasing steadily while the West Bank is decreasing with the same percentage.

#### 6.1.3 Household Size and Density

The average family size is one of the important indicators relevant to population growth. As could be observed from the table below, there is generally a high tendency for large family sizes that exceed eight persons. This observation supports the increase in the population growth rate during the last 5 years. This tendency is expected to affect the population growth rate during the coming years. Due to the absence of structured systems or interventions (e.g. family planning programmes) to tackle the large population growth, it is predicted that the preference for large family sizes will keep increasing the potential for high population growth. Overall, the average household size is 6.7 in the North Gaza Governorate. The biggest average household reported in Beit Hanoun 7.0 person/household. Whereas the least average household noticed in Jabalia 6.5 person/ household.

The Percent Distribution of Private Households in North Gaza Governorate by Locality and Household Size is illustrated in Table 34.

**Table 38: Percentage Distribution of Private Households in North Gaza Governorate by Locality and Household Size**

	North Gaza Governorate	Um Al-Naser	Beit Lahia	Beit Hanoun	Jabalia
Population	265355	2760	63213	37351	120859
Households	39604	413	9277	5328	18542
Average household size	6.7	6.7	6.8	7.0	6.5
	%	%	%	%	%
8+ persons	38.1	41.6	39.1	2.6	38.6
7 persons	12.5	10.4	12.8	7.4	13.4
6 persons	12.5	11.6	12.4	7.4	13.9
5 persons	10.9	9.7	11.1	67.7	12.0
4 persons	9.4	8.2	9.5	5.3	10.8
3 persons	7.5	4.1	7.3	4.5	0.9
2 persons	7.3	9.7	6.4	4.0	8.5
1 person	1.8	4.6	1.5	1.1	1.9

Source: Palestinian Statistical Year Book, 2012 Palestinian Central Bureau for Statistics

The analysis of the density by region showed that the Gaza Strip is of higher density than the West Bank, as about 45% of the Gazan population lives with more than 2 persons per room, while only 35.5% in the West bank are of the same category. Those who are less than 1 person per room represented 14.8% of the West Bank, while the same category represented 11.0% of the Gaza Strip. Literature reviews and meetings with resource persons showed that the family structure in Gaza is witnessing a shift from the domination of the extended family to a higher level of prevalence for the nuclear families which constitutes now more than 82.5% of the family structure in the Gaze Strip (PCBS, 2017).

#### 6.1.3.1 Type of Residence

One of the main indicators of living conditions and welfare of families is the type of dwelling. Based on the latest National Census Survey implemented in 2017, (59.7% ) reside in a house in Gaza Strip, whereas (29.8%) of the households in Gaza Strip reside in marginal/ caravan /barracks.



**Figure 50: Percentage distribution of dwelling by type of building and locality**

**Source: Palestinian National Census PCBS, 2017**

In the area of influence, the majority of households reside in apartments. In Um El Nasr village, 56.83% live in a house. This type of dwelling reflects the rural nature of the area.

**Figure 51: Percentage distribution of dwelling by type of building and locality**

**Source: Palestinian Statistical Year Book, 2012 Palestinian Central Bureau for Statistics**





Figure 52: Dwelling type in Beit Hanoun



Figure 53: Residential area in Beit Lahia

The majority of people use their units exclusively for living purposes in North Gaza Governorate (78.3%). Few of residents use the dwelling for both habitation and work.

Table 39: Building utilization

Building Utilization	Locality				
	North Gaza Gov.	Um Al-Naser	Beit Lahia	Beit Hanoun	Jabalia
Habitation	20108	387	438	2832	8297
Habitation & Work	2714	15	626	275	1292
Work	1901	11	337	274	875
Vacant	437	1	102	65	191
Closed	428	18	76	98	149
Deserted	106	0	13	35	45
Not Stated	2	0	0	0	2
Total	25696	432	5534	3579	10851

Source: Palestinian Statistical Year Book, 2012 Palestinian Central Bureau for Statistics

Table 40: Completed Buildings in North Gaza Gov by Locality and Utilization

Building Utilization	Locality				
	North Gaza Gov.	Um Al-Naser	Beit Lahia	Beit Hanoun	Jabalia
Habitation	20108	387	438	2832	8297
Habitation & Work	2714	15	626	275	1292
Work	1901	11	337	274	875
Vacant	437	1	102	65	191
Closed	428	18	76	98	149
Deserted	106	0	13	35	45
Not Stated	2	0	0	0	2
<b>Total</b>	<b>25696</b>	<b>432</b>	<b>5534</b>	<b>3579</b>	<b>10851</b>

Source: Palestinian Statistical Year Book, 2012 Palestinian Central Bureau for Statistics

### 6.1.3.2 Ownership of Residence

The ownership of the house can be an important indicator of the socioeconomic characteristics of the household. In the Gaza Strip the vast majority of the population owns their houses (91.6%), while only 4.7% rent their dwelling. In this case, ownership does not necessarily reflect high socioeconomic status of the community, but may instead reflect a custom and tradition of the community which encourages private ownership.

**Figure 54: Percentage distribution of households by tenure of housing unit in Gaza Strip**

Source: Palestinian Statistical Year Book, Volume 10, 2009, Palestinian Central Bureau for Statistics

### 6.1.4 Access to Basic Services

Regarding access to basic services, the government of Palestine gives a large proportion of its attention to water supply. Connectivity to the public water system was around 98% in 2012 in all project settlements.

**Table 41: Occupied Housing Units in North Gaza Gov. by Locality and Main Source of Water in the Housing Unit**

Locality	Not Stated		Other		Water Tanks		Springs		Well (to gather rain water)		Public Network	
	(%)	(No)	(%)	(No)	(%)	(No)	(%)	(No)	(%)	(No)	(%)	(No)
North Gaza Gov.	0	19	1	378	0.1	47	0	12	0.2	60	98.6	39088
Um Al-Naser	0	-	0	-	0	-	0	-	0.2	1	99.7	412
Beit Lahia	0	4	2.3	217	0.1	10	0	1	0.3	31	97.2	9014
Beit Hanoun	0	1	0.4	19	0.6	30	0	1	0.1	3	98.9	5274
Jabalia	0.1	13	0.8	142	0	7	0	8	0.1	25	98.9	18347

Source: Palestinian Statistical Year Book, 2012 Palestinian Central Bureau for Statistics

Electricity coverage is much higher, as almost all households are connected to the public electricity network. However, the continuity of electricity is affected by fuel supply problems. However, the continuity of electricity current remains one of the biggest problems facing developmental projects in Gaza Strip.



**Figure 55: Percentage distribution for access to electricity in the AoI**

Source: Palestinian Statistical Year Book 2012, Palestinian Central Bureau for Statistics

93.8% of households in North Gaza Governorate have access to the public sewage network. A detailed discussion of the type of sewage disposal used will be presented later.

The fourth basic service is the telephone lines, which serve 42.2% of the total households in the Palestinian Territories.

Figure 56: Percentage distribution of access to sanitary system in the AoI

Source: Palestinian Statistical Year Book 2012, Palestinian Central Bureau for Statistics

Water is one of the most challenging issues affecting environmental sustainability in the Palestinian Territories. The global Human Development Report 2006 noted that Palestinians, especially in Gaza, experience one of the highest levels of water scarcity per capita in the world, with physical availability and governance of shared water contributing to this shortage.

The unequal sharing of the aquifers below the West Bank between Israel and the Palestinian Territories is stark: average per capita water use by Israeli settlers in the West Bank is some nine times higher than by Palestinians. With only 13% of all wells in the West Bank, settlers account for 53% of groundwater extraction. The management of the western and coastal aquifers further demonstrates the problem. Part of the Jordan Basin, the western aquifer is the single most important source of renewable water for the Palestinian Territories. Nearly three quarters of the aquifer is recharged within the West Bank and flows to the coast of Israel. Much of the water is not accessible to Palestinians; this is a result partly, of the stringent regulation of the quantity and also depth of wells. Per capita access to water resources in the West Bank for Palestinians is a quarter of that for Israelis, and it is declining. There are similar problems with the waters from the Coastal Basin, which barely reach the Gaza Strip because of the high rates of extraction on the Israeli side.

It is estimated that the over-abstraction of the Coastal Basin—to approximately double the sustainable limit in 2000—is now reaching dangerous levels. Only 5% to 10% of the aquifer yields quality drinking water. The lowering of the water table coupled with increased salinization via sea water intrusion and pollution by raw sewage compromises both the quality and quantity of available water.

UNDP (2006) 'Beyond scarcity: Power, poverty and the global water crises, Human Development Report.

The Water Crisis in the Occupied Territories and its Resolution in the Final-Status Agreement Position Paper'.

The main contaminants in the water resources in the Gaza Strip are nitrates, chlorides, salinity, and potentially, fecal coliforms and fecal streptococcus. The Palestinian Hydrology Group contends that the current pollutant rates are four times higher than the 2005 figures.

The main source of potable water in Palestinian Territories is the public water network. 91.8% of the total population has access; 89.4% in the West Bank and 96.3% in the Gaza Strip. Water tanks and wells made up 9.2% of the total sources in the West Bank, while it was only 1.7% in the Gaza Strip.

Table 38:

**Table 42: Percentage distribution of households in the Palestinian Territories by the main mean of obtaining water and region 2011**

Region	Public Water Network %	Water tanks %	Domestic well %	Other %	Total %
<b>Palestinian Territories</b>	91.8	3.4	2.0	2.8	100
<b>West Bank</b>	89.4	4.7	4.5	1.4	100
<b>North of West Bank</b>	87.5	6.1	5.4	1.0	100
<b>Middle of West Bank</b>	97.8	0.5	0.6	1.1	100
<b>South of west Bank</b>	83.1	8.4	8.0	0.5	100
<b>Gaza Strip</b>	96.3	1.4	0.3	2.0	100

Source: PCBS: Household Environmental Survey 2011

The quality of water supply reflects not only the living conditions of the households but also their health status. The Gaza Strip experiences low quality of water, as only 5.3% of households reported good water quality, compared to 70.9% of the West Bank.

**Table 43: Percentage distribution of households in the Palestinian Territories by the Household evaluation of water quality and region, 2011**

Region	Public Water Network %	Water tanks %	Domestic well %	Other %	Total %
<b>Palestinian Territories</b>	91.8	3.4	2.0	2.8	100
<b>West Bank</b>	89.4	4.7	4.5	1.4	100
<b>North of West Bank</b>	87.5	6.1	5.4	1.0	100
<b>Middle of West Bank</b>	97.8	0.5	0.6	1.1	100
<b>South of west Bank</b>	83.1	8.4	8.0	0.5	100
<b>Gaza Strip</b>	96.3	1.4	0.3	2.0	100

Source: PCBS: Household Environmental Survey 2011

### 6.1.5 Health Conditions and Handicapped

The discussion of health conditions in the project areas is somewhat difficult due to the scarcity of secondary non-aggregated data. The study team mainly relied upon the WHO report on health conditions in the occupied territories as source for generic information. More detailed information might be presented during the discussion of field results.

#### 6.1.5.1 Health Status

Overall life expectancy is 70.5 years for males and 73.2 years for females. The population of the occupied Palestinian Territories grows at a rate of 2.9% (2.6% in the West Bank and 3.3% in the Gaza Strip). The crude birth rate declined over the last decade from 42.7 in 1997 to 29.6 in 2008. Many pregnant women suffer from anemia (45% in the Gaza Strip and 20.6% in the West Bank). About a third of newly pregnant women are immunized against tetanus in the West Bank.

The infant mortality rate has shown little improvement in recent years (25.34 per 1000 live births: 22.9 per 1000 live births in the West Bank, 28.8 per 1000 live births in the Gaza Strip). The main causes of death among infants are pneumonia and other respiratory disorders (34.5%), congenital malformations (16.3%) followed by prematurity and low birth weight (13.4%).

Despite the apparent difficulties that Palestinians faced over the reporting period, the WHO considers the general health status of the Palestinian Territories to be “commendably reasonable”. Malaria has been all but eradicated, incidences of HIV/AIDS are very low and the population is largely free of poliomyelitis, tuberculosis, and measles due to a series of successful immunization programmes. Palestinians are undergoing rapid epidemiological transition. Non-communicable diseases have overtaken communicable diseases as the main causes of morbidity and mortality.

The WHO, the Gaza Community Mental Health Project, and the Ministry of Health report that poor mental health is an increasing concern in the Palestinian Territories, particularly in the aftermath of Operation Cast Lead. A study from the Institute of Community and Public Health at Birzeit University noted that respondents demonstrated high levels of fear, threats to personal and family safety, loss of incomes, homes, and fear about their future and the future of their families. Respondents also reported feeling Hamm, meaning heaviness from worry, anxiety, grief, sorrow and distress, frustration, incapacitation and anger.

The UNDP’s Social Development Assessment in Gaza highlights shortcomings in psychosocial support – for children, but also for adults – in the aftermath of Operation Cast Lead. It was found that while there has been some psychosocial support for children provided through the educational system and via child focused agencies, there has been a paucity of support for adults with no focus on older persons. Older people consistently expressed feelings of fear, insecurity and anxiety immediately following the hostilities which have not been alleviated in the present. Their lack of emotional wellbeing is largely focused on concerns about the future resurrection of conflicts.

With regards to disability in North Gaza Governorate, 3.7% of the total population are disabled. Seeing and moving disability are most common among both males and females. Relatively, females have higher disability ratio that reaches 3.3%

**Table 44: Disabilities/Difficulties of Palestinian Population in North Gaza Governorate by Type of Disability/Difficulty and Sex, 2007**

	Percentage	Females	Percentage	Males	Percentage	Both Sexes
<b>Seeing</b>	1.8	2334	1.9	2592	1.9	4926
<b>Hearing</b>	0.8	1029	0.9	1181	0.8	221
<b>Moving</b>	1.4	1772	1.5	2024	1.4	3796

	Percentage	Females	Percentage	Males	Percentage	Both Sexes
<b>Cognition</b>	0.6	744	0.7	976	0.6	172
<b>Communication</b>	0.6	734	0.7	972	06	1706
<b>Total of Persons with Disability/Difficulty*</b>	3.3	4348	0.4	5451	3.7	9799
<b>Persons Without Disability/ Without Difficulty</b>	96.6	125758	95.9	129448	96.3	255206
<b>Not Stated</b>	0	49	0	31	0	80
<b>Total Population</b>	100	130155	100	13493	100	265085

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

There is significantly limited information about disability in the area of influence. However, based on the meetings conducted in 2018 with the municipalities in the area of influence, brief information was provided about disability in the areas:

After significant progress from 1990 to 2000, the reduction of the under-five mortality rate was slow during the period 2000 to 2008: in 2006 and 2007 the rate of 27 deaths per 1,000 live births was the same as in 1990. In 2008 the WHO documented a rate of 28.2 deaths per 1,000 indicating a regression in child mortality figures. The lack of progress during the reporting period, coupled with this deterioration, reflects declining health conditions. The Gaza Strip has historically had a higher child mortality rate than the West Bank. The Palestinian Millennium Development Goals Progress Report noted that mortality rates in the Gaza Strip

**Table 45:Disabilities/Difficulties of Palestinian Population in localities by Sex, 2018**

Locality	Below 10 years old		Above 10 years old	
	Females	Males	Females	Males
<b>Beit Hanoun</b>	Not available	1147	575	672
<b>Beit Lahia</b>	Not available	1493	600	893
<b>Um El Nasr</b>	Not available		37	52
<b>Jabaliala</b>	Not available	4269	1703	2566

Source: Meetings conducted with the four municipalities 2018

#### 6.1.5.2 Access to Health Services

The Ministry of Health, UNRWA, nongovernmental organizations and private, commercial organizations constitute the four main health providers of health services. The following health facilities are reported:



- Ministry of Health runs 59 primary health care centers in the Gaza Strip and 381 in the West Bank.
- UNRWA operates 18 primary health care centers in eight refugee camps in the Gaza Strip and 41 centers in the West Bank.
- The non-governmental organization sector manages 194 primary health care centers and general clinics (57 in the Gaza Strip, 137 in the West Bank).

There are 75 hospitals in the occupied Palestinian Territories (50 in the West Bank, 25 in the Gaza Strip), with a total of 5058 beds in government and nongovernment hospitals. Almost three quarters of them are general beds, 16.0% specialized beds, 3.8% beds for rehabilitation and 7.5% maternity beds. Overall, there are 12.9 beds per 10,000 population (12.7 beds in the West Bank and 13.5 beds in the Gaza Strip) .

The Ministry of Health, with the support of donors, has continued to develop the scope and range of public health services in the West Bank. The hospital sector in particular has benefited from significant investment in infrastructure and equipment with several hospitals being rehabilitated and services developed. The Ministry of Health has also sought to strengthen its institutional and governance capacity, not least by further efforts to improve the planning process. However, the Palestinian health-care system continues to face many challenges. These include restriction of movement and access to health services. Movement within the West Bank has become a little easier over the past year as a result of the removal of some of the checkpoints, but many checkpoints and closures still remain. There are particular difficulties of access to east Jerusalem, where the main tertiary health services are provided. Administrative restrictions also have an impact on the provision of health care in rural areas classified as “Area C” under the Oslo Accords.

In the Gaza Strip, the provision of adequate health services to the population continues to be severely affected both by the Israeli blockade and Palestinian internal political divisions between the West Bank and the Gaza Strip. While the hospitals and primary care clinics in the Gaza Strip continue to function, they face multiple challenges. For example, there have been growing shortages of essential drugs and consumables: 38% of essential drugs were out of stock at central store level at the beginning of January 2011. Recurrent power cuts and an unstable power supply have adversely affected medical care: sensitive medical equipment is damaged, supportive services have had to be suspended, treatments can be interrupted or need to be postponed. The functionality of medical equipment has also been deteriorating because of inadequate maintenance capacity and lack of spare parts (although a Programme supported by the Government of Italy and WHO has been seeking to address this).



Figure 57: Beit Hanoun health center



Figure 58: Um El Nasr health center



Figure 59: Indonesian hospital in Beit Lahia



Figure 60: : Governmental hospital in Beit Hanoun

The project sites are served by different health facilities. The total number of hospitals is two, one in Beit Hanoun and one in Jabalia. There are many hospitals that are run by the private sector. There are relatively lack of health facilities in Um El Nasr and Beit Lahia.

Table 46: Health facility within project areas

	Beit Hanoun		Beit Lahia		Um El Nasr		Jabalia	
Health facility	Number	Most frequent destination	Number	Most frequent destination	Number	Most frequent destination	Number	Most frequent destination
General Hospital	1	Beit Hanoun hospital	0				1	
Private Hospital	1	Beit Hanoun hospital	1	Balsam Military Hospital			1	
Medical Center	2	Health Work Committee	0					
Outpatients' facility	1	Al shawa facility	2				1	Governmental
Health Bureau								

<b>Health Unit</b>	<b>1</b>	Village's Unit						
<b>Childhood and maternity care</b>							<b>1</b>	
<b>Mobile Clinic (daily rate)</b>							<b>1</b>	Dental Care Clinic (UNRWA)
<b>Private Practice</b>			<b>3</b>		<b>1</b>			
<b>Pharmacy</b>			<b>15</b>					

Source: The four municipalities 2018

Various qualified health staff are not working because of the factional divide. It is also difficult to maintain or upgrade the professional knowledge and clinical skills of health staff because the Israeli restrictions on the movement of people in and out of the Gaza Strip prevent access to appropriate health care and up-to-date education and training. The closure of the Gaza Strip is undermining the functioning of the health-care system, hampering the provision of medical supplies and the training of health staff and preventing patients with serious medical conditions from receiving timely specialized treatment outside the Gaza Strip.

A total of 8161 patients were referred to treatment outside the occupied Palestinian Territories in 2009: 3399 patients came from the West Bank and 4762 from the Gaza Strip.

#### 6.1.5.3 Water Quality and Diseases

There is a high incidence of water related diseases. Water-borne disease is a major problem for Palestinians, creating substantial costs and losses. Epidemiological data is uneven, but there are many anecdotal stories of water related disease. In Nablus, for example, PWA explains: “We have a project to rehabilitate the waste water treatment plant. It is sorely needed. Yesterday 65 cases of diarrhea were treated in the hospital there.” At Burin near Nablus, there were recently 450 cases of Hepatitis A. Students in school were infected. The health impacts on smaller communities unconnected to the network, and for people living in Area C are particularly harsh.

The health impacts can be gauged by the high incidence of diarrhea amongst infants, and the health costs of poor water and sanitation services have been estimated at 0.4% of GDP.

The 2006 PAPFAM survey found that 12% of children under 5 had suffered from diarrhea in the two weeks preceding the survey. Diarrheal conditions are strongly associated with water quality, hygiene and sanitation. Some 54% of these cases had necessitated a medical consultation.

Extrapolating from the nature and cost of the medical treatments involved and without accounting for the losses of adult productivity, it has been estimated that the annual cost of the health impacts of poor water and sanitation on children 5-year old or less, is \$20 million, equivalent to 0.37% of GDP

## 6.1.6 Human Development Profile

### 6.1.6.1 Literacy Rate

As could be observed from the table below, the literacy level is generally high in the Gaza Strip, reaching almost 95% of the population above 15 years of age in North Gaza Governorate. Gender discrepancy is not significant, except in the groups above 45 years of age. This could be attributed to an increased level of awareness of the importance of girls' education.

**Table 47: Literacy Rates of AoI Population (15 Years and above) by Sex**

Locality		Literacy	Literacy %
North Gaza Governorate	Total	172436	94.84
	Male	89742	97.16
	Female	82694	92.44
Um Al-Naser	Total	1544	84.23
	Male	843	93.46
	Female	701	75.30
Beit Lahia	Total	40605	94.11
	Male	21172	96.51
	Female	344	16.22
Beit Hanoun	Total	23401	95.58
	Male	968	79.02
	Female	11408	93.25
Jabalia	Total	79807	95.35
	Male	41866	97.25
	Female	1356	33.36

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

### 6.1.6.2 Educational Attainment

In North Gaza Governorate, the level of attained education is shown in the figure below. As could be observed, the largest portion of literate population attained preparatory education 31.76%, followed by the elementary education 24.04%. Here there is relatively high gender equity as well, with similar percentages of men and women attaining various educational degrees.

Figure 61: Percentage Distribution of Gaza Strip Population (15 years of age and above) by Educational Attainment and Sex, 2012 in Gaza Strip

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

#### 6.1.6.3 Educational facilities

There is relatively sufficient number of schools in the project area of influence. The following table presents the number of educational facilities.

Table 48: Educational facilities

Utility	Beit Hanoun	Beit Lahia	Um El Nasr	Jabalia
Adult Literacy class		1		
Basic school	7	12	1	1
Preparatory school	6	10	1	1
General Secondary school	3	13	1	1
Vocational, Agricultural, and Commercial Schools	1	2		
Azhar Institute		1		
High Institutes/ Universities		3		1

Source: Local municipalities 2018



Figure 62: Basic school in Um El Nasr



Figure 63: Faculty of agriculture in Beit Hanoun



Figure 64: Palestine University in Beit Lahia



Figure 65: Religious institute in Beit Lahia

### 6.1.7 Employment Status

The general unemployment rate in the Palestinian Territories is considered high, the unemployment rate reported in the National Census Survey report, 2017 is 27.2%. There is relatively significant disparity between males and females. Unemployment rate among females is about 40.1% in Palestinian Territories.

Total labor force in Gaza Strip is 1,090,583 persons. Those who are economically active represent 44.2% of the total labor force. 48.2% of economic active within labor force are unemployed. This percentage increases significantly among females to be 63.3% of the total female labor force in Gaza Strip. Detailed description of employment status is presented in the table below:

Table 49: Employment status

Governorate		Palestine	Gaza Strip	North Gaza	Gaza	Dier Al-Balah	Khan Yunis	Rafah
Total labor force	Females	1,319,719	541,360	103,895	185,136	81,214	104,200	66,915
	Males	1,349,972	549,223	106,699	189,257	80,361	106,434	66,472
	Both Sexes	2,669,691	1,090,583	210,594	374,393	161,575	210,634	133,387
Not Stated	Females	380	13	4	7	2	0	0



Governorate		Palestine	Gaza Strip	North Gaza	Gaza	Dier Al-Balah	Khan Yunis	Rafah
	Males	948	32	8	22	2	0	0
	Both Sexes	1,328	45	12	29	4	0	0
Not Economically Active	Females	1,106,278	448,718	86,839	159,894	61,867	84,801	55,317
	Males	351,714	159,821	31,084	53,756	24,396	31,605	18,980
	Both Sexes	1,457,992	608,539	117,923	213,650	86,263	116,406	74,297
Unemployed	Females	85,364	58,676	10,541	13,862	12,602	13,482	8,189
	Males	243,536	173,804	30,590	54,308	26,149	36,618	26,139
	Both Sexes	328,900	232,480	41,131	68,170	38,751	50,100	34,328
Employed	Females	127,697	33,953	6,511	11,373	6,743	5,917	3,409
	Males	753,774	215,566	45,017	81,171	29,814	38,211	21,353
	Both Sexes	881,471	249,519	51,528	92,544	36,557	44,128	24,762
		1,210,371	481,999	92,659	160,714	75,308	94,228	59,090
	%Unemployed	27.2	48.2	44.4	42.4	51.5	53.2	58.1
	%Employed	72.8	51.8	55.6	57.6	48.5	46.8	41.9
	%Unemployed among females	40.1	63.3	61.8	54.9	65.1	69.5	70.6
	%Employed among females	59.9	36.7	38.2	45.1	34.9	30.5	29.4

Regarding the main sector of work, the majority of employees work in services (63.3%), while people working in commerce, hotels and restaurants are only account for 18.3%. The diversity according to gender is relatively high as 86.6% of females work in the services sector, while 59.6% of males work in the same sector. However, 20.7% of males work in commerce versus null of the females in the same field.

With regards to project area of influence, there is no available data about employment on the level of project sites. However, the statistical updated data for the four areas reflected that employment rate among males is (59.9%), while it is limited to (34.1%) among females ( source PCSB 2016).

The unemployment rate is high among females as it reaches about 64.8% of the female population within labor force. The unemployment among males is (37.8%). Unemployment ratio varies among different people in accordance to their level of education. Unemployment rate is (45.5%) among those who have university education, however, it reaches only (16.9%) among intermediate education graduates.

The total percentage of labor force is estimated at (67.3%) among males and (18.8%) among females.

**Table 50: Percentage distribution of population (15 years and above) in the AoI by Sex and labor force status year 2012**

Locality		Unemployed Never Worked	Unemployed Ever Worked	Employed	Economically Active	Employment Rate
<b>North Gaza Governorate</b>	Total	8686	11365	33638	53689	62.7
	Male	7586	11059	29586	48231	61.3
	Female	11	36	4052	5458	74.2
<b>Um Al-Naser</b>	Total	155	153	199	507	39.3
	Male	146	151	190	487	39.0
	Female	9	2	9	20	45.0
<b>Beit Lahia</b>	Total	2007	2355	8157	12519	65.2
	Male	1997	2315	7362	11456	64.3
	Female	228	40	795	1063	74.8
<b>Beit Hanoun</b>	Total	1144	1541	419	6875	6.1
	Male	1027	15	3662	6189	59.2
	Female	117	41	528	686	77.0
<b>Jabalia</b>	Total	4374	5442	15854	25670	61.8
	Male	3847	5309	13818	22974	60.1
	Female	527	133	2036	2696	75.5

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

### 6.1.8 Economic Wellbeing

PCBS has calculated the Real Gross Domestic Product (GDP) . It was \$461 during the second quarter of 2014. Living standards in Gaza Strip deteriorated during the previous 4 years: GDP per capita in Gaza Strip is \$274. For the period of the second quarter of 2013 until the second quarter of 2014, growth in real GDP for Palestine overall was (0.9%). The GDP in Gaza Strip fell by (10.2%). (These figures consider the circumstances before the latest Israeli attack on Gaza, July-August 2014, which undoubtedly severely impacted the economy of the Gaza Strip, in particular.) These figures are representative of already severely limited economic activity before Operation Cast Lead, as it resulted in the destruction of significant remaining economic assets, which means that further decline is inevitable.

The International Financial Institutions highlight that, even more troubling than the negative growth rates over the past few years, is the changing composition of the economy: as GDP is increasingly driven by government and private consumption of donor aid and remittances respectively, investments have fallen to dangerously low levels, leaving little productive base for a self-sustaining



economy. The Palestinian economy is buttressed by enormous infusions of foreign aid: in 2008, budget support alone increased by nearly (80%) from its 2007 level, and at close to USD 1.8 billion, was equivalent to about (30%) of GDP. By comparison, in 2007 the estimated recurrent and developmental budget support added up to (5%) of GDP. This, impart, reflects the ‘West Bank first’ policy pursued by the international community in the aftermath of Hamas’s takeover of the Gaza Strip. The cost of living in the Palestinian Territories rose significantly over the reporting period.

The poverty rate according to the monthly consumptions of individuals in the Gaza Strip has decreased from around (50%) in 2007 to (33%) in 2009. However, the poverty rate using the same indicator of monthly consumption is much higher in the Gaza Strip than in the West Bank, recorded at (20%) and (15%) in 2007 and 2009 respectively. However, the Palestinian Human Development Report, using different poverty indicators, showed that about (34.5)% are under the poverty line in Palestinian Territories. This percentage is reduced in the West bank to (23.6%), and increased to (55.7%) in the Gaza Strip.

**Table 51: Proportion of population below national poverty line**

	Year			
Year	2004	2005	2006	2007
<b>Total</b>	<b>25.6</b>	<b>29.5</b>	<b>30.8</b>	<b>34.5</b>
<b>Male</b>	26.0	29.8	30.3	34.5
<b>Female</b>	21.0	25.0	35.6	34.5
<b>Urban</b>	24.4	24.9	29.3	33.1
<b>Rural</b>	24.6	32.5	29.5	30.3
<b>Camps</b>	31.6	39.9	38.6	47.7
<b>Gaza Strip</b>	37.2	43.7	50.7	55.7
<b>West Bank</b>	19.8	22.3	24	23.6

Source: Human Development Report 2009/10

It should be noted that poverty in Gaza is not limited to low levels of income. It is rather characterized by serious shortfalls in other dimensions. There is a serious level of insecurity of income, food, access to infrastructure and vulnerability resulting from the strong reliance on external assistance, with very limited ability to attain sustainability of livelihoods for a large portion of households. Many families are suffering from the consequences of war and blockade, and are generally overwhelmed by the economic and political situation .

The high level of poverty was clearly observed during the field work conducted as part of the ESIA. Some of the observations include the domination of short term employment modes and the high rate of unemployment among youth including university graduates, in addition to the various social implications on the household level. These observations are thought to be the key causes of poverty

and insecurity issues. There are several other signs that demonstrate poverty amongst the households; one example is the irregularity of paying the charges of various types of services including electricity, water and SWM. This was observed during surveys and other field investigation activities. This is partially attributed to the families' inability to pay these charges.

#### 6.1.9 Economic Activities

With a growing population and a shrinking economy, real Gross Domestic Product (GDP) per capita is close to 30% below the 1999 level. The overall economic picture is one of negative growth. PCBS estimates that the GDP in 2006 had a negative growth rate of 6.6 %. It estimates that real GDP growth in 2007 was a mere 0.5%, while results from the first quarter suggest that growth in 2008 is slightly negative. Similarly, the International Monetary Fund (IMF) recorded a drop in GDP of 0.5 % in 2007, and a modest growth of 0.8 % in 2008. This is probably due to a continued yet marginal drop in economic activity in Gaza, given its already low base, matched with a modest rise in economic activity (PCBS (2007) 'Economic forecasts for 2007'). Figures 65-66 are representative of already severely limited economic activity before Operation Cast Lead, as it resulted in the destruction of significant remaining economic assets, which means that further decline is inevitable.



Figure 66: Agriculture lands in Um El Nasr



Figure 67: City center in Beit Hanoun

With regards to human activities in the project sites, the estimations provided were based on the meetings conducted with the municipalities. This is just guiding information. Agriculture activities are the main employment activities in Beit Hanoun, Um El Nasr and Beit Lahia. However, the governmental posts are occupied by 62.4% of the labor force in Jabalia.

Regarding the main sector of work, the data showed that the majority of employees work in services (63.3%), while people working in commerce, hotels and restaurants are only 18.3%. The diversity according to gender is relatively high as 86.6% of the females work in services sector, while 59.6% of males work in the same sector. However, 20.7% of the males work in commerce versus null of the females in the same field.

Table 52: Number of Establishments in Operation and Persons Engaged in the Private Sector, Non-Governmental Organization Sector and Governmental Companies in the AoI

Locality	No of Persons Engaged			No of Est
	Females	Males	Total	
North Gaza Gov	1704	10137	11841	4777
Um Al-Naser	11	9	20	8
Beit Lahia	311	287	2398	978
Beit Hanoun	198	681	879	426
Jabaliala	829	5128	5957	2184

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

Table 53: Percentage Distribution of Employed Persons from Gaza Strip by Economic Activity and Sex

Economic Activities	Females	Males	Total	No of Est
North Gaza Gov	1704	10137	11841	4777
Agriculture, Farming of Cattle and other Animals	10	344	354	129
Mining & Quarrying	-	-	-	-
Manufacturing	47	1944	1991	513
Electricity And Water Supply	1	191	192	50
Construction	-	92	92	19
Wholesale, Retail Trade & Repairs	381	5153	5534	2929
Hotels and Restaurants	29	47	436	178
Transport, Storage & Communications	7	226	233	45
Financial Intermediation	16	79	95	37
Real Estate, Renting & Business Activities	38	284	322	172
Education	606	187	793	106
Health & Social Work	218	348	566	122
Other Community, Social & Personal Service	351	882	1233	477

Source: Palestine Annual Statistics Book (version 11), PCBS

#### 6.1.10 Sewage Status in the Gaza Strip

##### 6.1.10.1 Sewage Generation

The sewage is mainly generated from the households' consumption of water supply, which is about 17 million cubic meters. It is divided as follows: 11 million to the West Bank and 6 million to the Gaza Strip. Regarding the consumption ratio for water, it is 23 m<sup>3</sup> in the Palestinian Territories: 23.6 m<sup>3</sup> in the West Bank and 24.3 m<sup>3</sup> in the Gaza Strip

**Table 54: Amount of consumed water in the household sector in Palestinian Territories (1000m<sup>3</sup>) and household monthly average consumption of water (m<sup>3</sup>) by region, 2011**

Region	Household monthly average consumptions	Amount of consumed water in the household sector (thousand cubic meter )
<b>Palestinian Territories</b>	23.8m <sup>3</sup>	17.032.5 m <sup>3</sup>
<b>West Bank</b>	23.6 m <sup>3</sup>	11.063.0 m <sup>3</sup>
North of West Bank	23.4 m <sup>3</sup>	4.422.7 m <sup>3</sup>
Middle of West Bank	29.7 m <sup>3</sup>	4.247.1 m <sup>3</sup>
South of west Bank	17.5 m <sup>3</sup>	2.393.2 m <sup>3</sup>
<b>Gaza Strip</b>	24.3 m <sup>3</sup>	5.969.5 m <sup>3</sup>

Source: PCBS Household Environmental Survey 2011

#### 6.1.10.2 Wastewater networks and disposal

One of the main sources of wastewater is disposal from the public sewage network, which might reach (60.9%) in the urban areas among which 47.0% live in the West Bank and (83.3%) in urban areas in the Gaza Strip. However, the connectivity among those who live in rural areas is (10.3%). The highest connectivity rate reported was in the camps (90.9%). Yet, the Gaza Strip was of the highest connectivity ratio to the wastewater network which is (83.1%) in total.

**Table 55: Selected indicators of the household environment in the Palestinian Territories during years 2004, 2006,2008,2009,2011**

Indicator	2004	2006	2008	2009	2011
<b>Percentage distribution of households by:</b>					
Availability of public network water	89.2	88.6	88.2	88.4	91.8
<b>Quality of households water</b>					
Good	63.0	50.6	45.6	48.1	47.2
Fairly Good	27.5	26.3	30.3	23.7	37.9
Bad	9.5	23.1	24.1	28.2	14.9
<b>Wastewater disposal method</b>					
Wastewater network	42.9	45.3	45.5	52.1	55.0
Tight or porous cesspit	56.1	54.0	53.7	47.2	44.3
Others	1.0	0.7	0.8	0.7	0.7
<b>Exposure to smell</b>					
Seldom or no smell	79.6	73.6	76.6	76.4	72.2
Sometimes	10.3	11.0	12.3	8.3	12.1
Very often	10.1	15.4	11.1	15.3	15.7

Source: PCBS: Household Environmental Survey 2011

Regarding exposure to smells it was notified that 15.7% of the total population reported facing a smell problem. These odor problems often occur at irregular times.

**Table 56: Percentage distribution of households exposed to smell in the Palestinian Territories by time of exposure and region, 2011**

Region	Time of exposure				
	6 AM- 12 PM %	12 PM-8 PM %	8 PM- 6 AM %	No specific time %	Total
<b>Palestinian Territories</b>	<b>7.4</b>	<b>6.0</b>	<b>21.1</b>	<b>65.5</b>	<b>100</b>
<b>West Bank</b>	<b>10.3</b>	<b>7.2</b>	<b>13.7</b>	<b>68.8</b>	<b>100</b>
North of West Bank	17.9	8.5	15.4	58.2	100
Middle of West Bank	7.2	9.7	22.0	61.1	100
South of west Bank	1.7	2.1	1.8	94.4	100
<b>Gaza Strip</b>	<b>3.9</b>	<b>4.7</b>	<b>29.7</b>	<b>61.7</b>	<b>100</b>

Source: PCBS: Household Environmental Survey 2011

The source of smell was mainly from treated water as 37.1% in Palestinian Territories reported, while 39.6% of the Gaza Strip reported waste water as the main source of smell.

**Table 57: Percentage distribution of households exposed to smell in the Palestinian Territories by the most important source of smell and region, 2011**

Region	Source of smell					
	Waste water %	Dumping site %	Agricultural waste %	Traffic %	Others %	Total
<b>Palestinian Territories</b>	<b>37.1</b>	<b>30.0</b>	<b>26.0</b>	<b>3.0</b>	<b>3.9</b>	<b>100</b>
<b>West Bank</b>	<b>35.0</b>	<b>24.4</b>	<b>31.4</b>	<b>4.8</b>	<b>4.4</b>	<b>100</b>
North of West Bank	32.0	20.9	37.7	6.8	2.6	100
Middle of West Bank	41.1	32.3	16.8	5.5	4.3	100
South of west Bank	33.0	21.4	37.4	1.0	7.2	100
<b>Gaza Strip</b>	<b>39.6</b>	<b>36.5</b>	<b>19.7</b>	<b>0.8</b>	<b>3.4</b>	<b>100</b>

Source: PCBS: Household Environmental Survey 2011

#### 6.1.10.3 Cost

April 2009 Domestic tariffs for network supply are on the whole reasonable – but overall, water is a significant item in household expenditure. Generally, water supplied through the domestic network costs consumers around NIS 4/m<sup>3</sup>, and people find this fair. However, given the very low income levels, the PCBS 2003 survey found that average the expenditure on water from all sources was about 8% of household income – and much more for low income households. This level of water expenditure is double the standard of 3.5% of household expenditure recommended by UNICEF/WHO.

High costs and poor service contribute to low payment rates, which may lead to increased dependence on Israel. This high cost of water in relation to income is one reason why the cost recovery rate for network supply averages 50% nationwide. The government ends up footing the bill – and even then the cost is deducted at source by the Israelis. The case of Bethlehem illustrates how this failure to pay is undermining the utilities and creating distorted incentives to use Mekorot water, which increases dependence on Israel.

It is the poor unconnected consumers who pay the highest costs – up to nearly half of their household budget – and run the biggest health risks. The poorest and most vulnerable communities are those in Area C. They are vulnerable to both access controls and to the high cost and poor quality of water. The summer months of June-October are when these communities are most vulnerable. The PCBS 2003 survey was used to compare average water expenditure share of income for each income group. The poor who are dependent on tankers may pay out almost half their income on water, five times more than the poor who are connected. Survey results regarding the percent of income spent by low income households on tanker water appear uncommonly high in 2003, and may be subject to confirmatory updates carried out by the Water, Sanitation and Health Monitoring Program (WaSH MP) 41: “Occupation checkpoints and curfews severely limit tanker access to communities. (The survey showed) that there are 36 fixed checkpoints across the West Bank, including the gates of the Separation Barrier, that seriously affect access of water tankers and maintenance teams to communities....Given the risks faced by drivers for their physical safety coupled with the longer routes, the price of water through tankers has increased exponentially...”

WaSH MP has carried out research on the costs faced by communities before the M&A restrictions, and after. The survey found in 85 communities that water prices had increased by a minimum of 60%, and a maximum of 300%. Water prices that before the Intifada were generally in the range 5-10 NIS/m<sup>3</sup> were now typically in the range 10-20 NIS/m<sup>3</sup>. In addition, communities had reduced their purchases of tanker water by at least 50%.

GDP using PCBS 2003 data, a preliminary study estimated that the additional cost at the national level of the use of tanker water over network water could be as high as 176.5 million NIS annually, equivalent to 0.93% of GDP.<sup>43</sup> water tankers.

#### 4.2.11 Agriculture sector in Gaza

Agricultural activities are one of the main sectors in the Gaza Strip. The total amount of land allocated for agricultural activities is 107.9 km<sup>2</sup>. The lands are distributed according to the type of

crops (permanent or temporary) and the type of irrigation (irrigated or rain-fed). The majority of lands are permanently irrigated crops which cover about 75.6% of the total areas of lands, while rain-fed represented only 24.4%. That might reflect the necessity of having a permanent source of water.

**Table 58: Agricultural Land Use in Gaza Strip**

Agricultural Land Use in Gaza Strip		Cultivation Type							
Region/ Governorate	Total Agricultural land (Km <sup>2</sup> )	Permanent Crops (Km <sup>2</sup> )				Temporary Crops (Km <sup>2</sup> )			
		Irrigated		Rain-fed		Irrigated		Rain-fed	
		2007	2008	2007	2008	2007	2008	2007	2008
<b>North Gaza</b>	14.5	5.1	5.1	0.2	0.2	7.8	7.2	2.1	2.0
<b>Gaza</b>	16.7	22.0	13.4	0.6	3.1	1.3	1.1	1.4	1.1
<b>Deir El Balah</b>	21.8	12.6	12.6	1.6	1.6	6.5	5.0	2.7	2.6
<b>Khan Yunis</b>	37.5	14.5	14.5	2.5	2.5	12.3	10.5	12.4	10.0
<b>Rafah</b>	17.4	5.2	5.2	1.6	1.6	8.9	8.5	2.4	2.1
<b>Total Strip</b>	107.9	59.4	50.8	6.5	9.0	36.8	32.3	21.0	17.8

Source: Palestine Annual Statistics Book (version 11), PCBS

The main crops produced in the Gaza Strip are vegetables (215,251 tons), followed by crops (72,516 tons) and fruit trees (53,931 tons). This is very important as treated reused water is not recommended to be used with vegetables.

**Table 59: Production of field crops, fruit, trees and vegetables by region 2007/2008**

Region/Governorate	Field crops	Fruit trees	Vegetables
<b>North Gaza</b>	18,619	5,496	29,662
<b>Gaza</b>	863	22,606	9,400
<b>Deir El Balah</b>	3,506	12,750	38,074
<b>Khan Yunis</b>	26,572	8,066	64,827
<b>Rafah</b>	22,956	5,013	73,288
<b>Total Strip</b>	<b>72,516</b>	<b>53,931</b>	<b>215,251</b>
Production in Ton			

Source: Palestine Annual Statistics Book (version 11), PCBS

#### 6.1.11 Archaeology

The known history of Gaza spans 4,000 years. Gaza was ruled, destroyed and repopulated by various dynasties, empires, and people originally a Canaanite settlement, it came under the control of the ancient Egyptians for roughly 350 years before being conquered by the Philistines, who made it one of the principal cities of their pent polis in the 12th-century BCE. Gaza fell to the Israelite King David in about 1000 BCE and with the fall of the Kingdom of Israel in about 730 BCE, it became



part of the Assyrian empire, and subsequently, that of the Persian Achaemenid Empire. Alexander the Great besieged the city for five months before finally capturing it in 332 BCE. Most of the inhabitants were killed during the assault, and the city, which became a center for Hellenistic learning and philosophy, was resettled by nearby Bedouin Arabs. The area changed hands regularly between two Greek successor-kingdoms, the Seleucids of Syria and the Ptolemies of Egypt. The city was besieged and taken by the Hasmoneans in 96 BCE.

After the Roman Empire began its influence in the area in 63 BCE, Gaza was rebuilt under the command of Pompey Magnus, and granted to Herod the Great thirty years later. Throughout the Roman period, Gaza maintained its prosperity, receiving grants from several different emperors. A 500-member senate governed the city, and a diverse array of Greeks, Romans, Jews, Egyptians, Persians and Nabateans populated the city. On the breakup of the Roman Empire, Gaza became part of the Eastern Byzantine Empire. Conversion to Christianity in the city was spearheaded and completed under Saint Porphyrius, who destroyed its eight pagan temples between 396 and 420 CE.

Gaza was the first city in Palestine to be conquered by the Arab Rashidun Caliphate in 635 CE. The arrival of the Muslim rulers brought drastic changes, as its churches were transformed into mosques, the population swiftly adopted Islam as their religion, and Arabic became the official language. Under the Arab Muslims, the city went through periods of prosperity and decline. The Crusaders wrested control of Gaza from the Fatimids in 1100, and ruled until 1187, when the city was conquered by Saladin and the Ayyubids. Gaza was in Mamluk hands by the late 13th-century, and became the capital of an administrative unit of Bilad ash-Sham that stretched from the Sinai Peninsula to Caesarea. By the time of its incorporation into the Ottoman Empire in the 16th-century, it was but a small village. The Ottomans charged the Ridwan family with governance over the city in the early 16th-century. From the early 19th-century, Gaza was culturally dominated by neighboring Egypt, with significant numbers of Egyptian Muslims moving in and Muhammad Ali of Egypt conquered it in 1832. His brief rule ended in 1840, after the Ottomans defeated his forces outside the city. In 1917, the forces of the Triple Entente captured the city after a third battle against the Ottoman forces there.

The 20th-century began in Gaza with two destructive earthquakes in 1903 and 1914. The city also expanded in the first half of the 20th-century under the British Mandate for Palestine. According to the 1947 United Nations Partition Plan, Gaza was assigned to the Arab state. The population of the city and the Gaza Strip swelled as a result of the 1948 Arab-Israeli War. After the war, it was held and militarily administered by Egypt until the 1967 Six-Day War, when it was occupied by Israel. Gaza was a center of political resistance in the First Intifada, and under the Oslo Accords of 1993, it was assigned to be under the direct control of the newly-established Palestinian National Authority. In 2007, Hamas emerged as the victor in Palestinian factional fighting with Fatah in the city and in the



wider Gaza Strip and has since been the sole governing authority there. Israel has blockaded the Strip ever since and launched an assault in 2008–2009, which it characterized as a response to Qassam rocket attacks. The bombardment and ground assault reportedly left over 1,300 people dead in the territory, and destroyed over 4,000 buildings.

#### 6.1.12 Archaeological Conditions of Project Sites

Field surveys in the area of the BLWWTP did not identify any archaeological sites. The nearest archaeological remains in the area is Tell al-Khirb, situated in the eastern part of Beit Lahia, 500 m south of the WWTP. In the area, archaeological remains such as mosaic fragments and pottery shards can be found over the whole of the mound. They are dated to be from the Roman Byzantine period. Beit Lahia has an ancient hill and nearby ruins of an abandoned village. A mihrab, or mosque alcove indicating the direction of salaah (prayer), is all that remains of an ancient mosque to the west of Beit Lahia, dating to the end of the Fatimid period and beginning of the Ayyubid Dynasty of Saladin. In addition, there are two other mosques dating to the Ottoman period within the area.

There are many mosques and churches in the four project areas. Some of them dated 100 years ago and most of them are newly constructed

To ensure the non-existence of the archeological sites or artifacts, the Consultant sent the letter to the Antiquity authority. The reply confirmed the field surveys and interviews conducted by the Consultant and stated that no archeological objects or artifacts had been found and that the sites do not belong to the sensitive sites for archeological activities.

#### 6.1.13 Security status

The project area of influence is located in the buffer zone from Israeli. Israel imposed a 50-meter buffer zone in Gaza. In 2000, it was expanded to 150 meters. Following the 2005 Israeli disengagement from Gaza, an undefined buffer zone was maintained.

In 2009/2010, Israel expanded the buffer zone to 300 meters. In 2010, the UN estimated that 30 percent of the arable land in Gaza had been lost to the buffer zone. On 25 February 2013, pursuant to a November 2012 ceasefire, Israel declared a buffer zone of 100 meters on land. In the following month, the zone was changed to 300 meters and 3 nautical miles. Generally speaking, the buffer zone is titled to changes from the Israeli side.

In 2014, Israel invaded Gaza Strip and damaged most of crops in the project area of influence. Political situation in the project area of influence urged the residents to be keener to protect their lands and assets.

Total number of refugees 265,085 people 45.5% of the refugees reside in Jabalia, whereas about 23.8% of them reside in Beit Lahia.

Table 60: Refugee Status and Sex (thousand)

Locality	Total		Not Stated		Non-Refugee		Non-Registered Refugee		Registered Refugee	
	Females	Males	Females	Males	Females	Males	Females	Males	Females	Males
North Gaza Governorate	130.155	134.93	1	-	35.821	38.256	826	752	93.507	95.922
Um Al-Naser	1.358	1.402	-	-	51	63	10	12	1.297	1.327
Beit Lahia	31.001	32.159	-	-	13.162	14.01	217	148	17.622	18.001
Beit Hanoun	18.462	18.87	-	-	423	382	187	210	17.852	18.278
Jabalia Camp	20.571	20.574	1	-	73	41	80	61	20.417	20.472
Jabalia	58.763	61.925	-	-	22.112	23.76	332	321	36.319	37.844

Source: Palestinian Statistical Year Book, 2012, Palestinian Central Bureau for Statistics

#### 6.1.14 Description of the project affected persons

Based on the definition provided by the WB about the Project Affected Persons, the total project affected owners of lands are 19 people. The operators of the pumps that extract water out of wells are 15 persons. 202 partial well owners will be affected.

Two factors further caused inflation in the number of project-affected members, those being:

- 1- The average number of family members is about 7.45 people per each household
- 2- Most of the PAPs live with extended families

##### 6.1.14.1 Land owners

The total surveyed sample was limited to 12 people out of 16 persons. 17 of the PAPs are males and 2 are females. This section will present the results of these 12 project affected persons interviewed using structured questionnaire:

- Two people will lose only 4 meters square from their lands, while twelve people will lose 50 square meters each. Only Two persons will lose about 275 square meters of land each. The reason for land acquisition is mainly to establish a recovery well.
- All of the surveyed sample have legal ownership of their lands (*Tabou*)
- Their age category varies between 32 -75 years. The average age is estimated at 50.6 years old.
- Four of them have completed secondary education and five completed university level. The remaining completed preparatory education.
- The range of land ownership varies between 426 m<sup>2</sup>-10000 m<sup>2</sup>. The average owned land is about 2801.1. m<sup>2</sup>
- It was essential to calculate the percentage of land to be taken by the project in comparison to the total area of land owned by the PAPs. Based on the final census conducted by PWA, 16 land owners will lose parts of their lands. They are segregated as follows:
  - Two of them did not inform about their total area of land;

- Eleven will lose less than 5% of their lands;
- Two will lose about 10% of their lands;
- One will lose 46% of his land.
- The main occupation of the PAPs is farming; three of them, however, work as administrative staff, teacher, and businessperson. There is also one housewife who did not work.
- Three of the households' members reported having a disabled family member.
- Affected lands are mainly used for agricultural purposes. Few of the PAPs (2 persons) use their lands to raise poultry.
- The total estimated number of trees is 1200 (citrus-lemon-olive-stone fruit trees and other types of trees) to be re-calculated prior to the actual implementation.
- The average annual revenue of the lands cultivated by crops and trees is estimated at 800 \$. However, the cost of land expenses reported by the sample was 700 \$. That was an indication of the poor productivity of lands.
- The average price of the square meter in the affected land is about 38.5 JD (55 US\$)
- The majority of affected lands are cultivated by traditional crops. Few of them are cultivated by citrus, guava and other types of trees.

#### 6.1.14.2 Well owners

Based in the Final Complementary Feasibility study, the sole source of water for irrigation in the project area is groundwater, which is abstracted from private wells evenly distributed throughout the project area. Typically, the same well ("collective well") is shared by more than one farmer; each farmer provides the fuel necessary for his own shift, while maintenance and administrative costs are equally shared among the group. The survey shows that 92% of the farmers depend on the "collective well" system owned by the remaining 8%. There is one well owner who is authorized to dig the well and hosts the well in his land. The remaining partners are classified as water users. There are 12 well owners and 190 water users \ beneficiary

Wells must be authorized by the government. A legal well pays one-off 4,000 ILS plus 100 ILS/year license. However, there are also "non-legal" wells, estimated to be 3-4 times the number of the legal ones. The government does not close these wells but new unauthorized wells cannot be drilled.

The survey determined that water cost ranges<sup>2</sup> from 1 to 1.5 ILS/m<sup>3</sup>. Therefore, use of water is worthwhile only for economically competitive crops.

- Wells anticipated to be terminated or limited in use are 12 wells, owned by 12 people and 190 people has a share in these wells. 74.8% of the owners are males, while 25.2% are females.

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<sup>2</sup> The value is the average among the ones provided by farmers during the field survey. During the field survey, farmers provided the following rationale for their stated value for cost of water: a well's pump consumes 10 to 12 liters of diesel per hour to extract 40 to 60 m<sup>3</sup>/hours at an average depth of 60 to 70 meters. The cost of diesel, on average, is between 6 and 7 ILS/liter. For that reason, the cost of water ranges from a minimum of from 1 to a maximum of 2.1 ILS/m<sup>3</sup>. On average, it is therefore approximately 1.5 ILS/m<sup>3</sup> or more.

- Each well is owned by more than one person. A single well can be owned by up to 39 persons. On average the well was owned by 17 people.
- The 12 well owners declared the legality of ownership of their wells
- Well construction is significantly expensive in the Palestinian Territory. That was the motive of having more than one partial owner participating in well ownership.
- The average annual maintenance cost is 275 \$. However, in a few cases the maintenance cost might go up to 4500 \$.
- The PAPs reported that the well water extraction cost covers both the expenses of well operators and fuel. The cost does not, however, cover the price of water. The tariff of water is not defined to date as water sector is still under rehabilitation and upgrading. Upon completion of upgrading water sector, the farmers will pay the cost of water in full compliance with the national water tariff.
- Given the fact that PAPs use the wells' water to irrigate their farms, they were not able to calculate the annual revenue of the well. Additionally, providing water to irrigate their lands will be proper compensation that enables them to restore their livelihood conditions.

#### 6.1.14.3 Well operating workers

- The total number of well operators is 15 persons. They operate 12 wells. They have relatively the most vulnerable conditions. The study team managed to interview 11 of the well operators, all of whom were males.
- Most of the operators received limited education; 6 completed preparatory educations, 2 dropped out before completing primary school, 1 reached secondary education and only 1 completed university level education. 1 of the interviewed operators is completely illiterate. Such limited education will present a challenge to find alternative employment and possible job opportunities.
- The average household size is about 7 persons.
- Three of them have at least one disabled member of family, suffering either mental disorders or physical paralysis.
- The majority of them earn less than 267.5 US\$ per month. They however, spend about 322 US\$. This was an indication that they might have a secondary work. Each household has at least one working person.
- They allocate their whole salary to house expenses. However, their contribution represents only half of the required household expenses.
- Regarding social insurance, no one of them have any kind of social insurance. They can be described as daily wage workers.
- The well operators will be expected to lose their source of income with no potential compensation rather than the one mentioned in the Labor Law No. 7 of year 2000. Consequently, the Ministry of agriculture proposed to provide alternative jobs to those PAPs.

#### 6.1.14.4 Ministry of Endowment

- They are the highest governmental entity responsible for managing the land designated for charity. Regarding the 30 dunums, Awqaf informally enabled group of people to use the land after the cut-off date disclosed on the 29<sup>th</sup> of October 2015 by the PWA in full cooperation with the municipality of Jabalia. They allowed those people to use this land under one condition which is evacuating the land upon Awqaf request.
- The land users amicably evacuated Awqaf land upon Awqaf request in full compliance with their promise to Awqaf. Thereafter, Jabalia municipality will move all plants upon PWA request.



## 7 POTENTIALLY SIGNIFICANT ENVIRONMENTAL AND SOCIAL IMPACTS

The project operation will result in numerous positive and negative impacts to the environment and to society. Identifying the possible expected impacts sets the scene for the management plan preparation and development.

Based on the expected activities of the project, such as preparing the area, building the infrastructure necessary for proper operation, operating and maintenance of the project components (PV Power Plant, booster pumping station, recovery and monitoring wells and irrigation network) the impacts have been identified.

The impacts were classified into:

*Impacts during the planning, **mobilization, site preparation and construction phases** related to:*

- Hauling of construction materials and equipment
- Fencing the area for controlling the access
- Roads construction
- Leveling and preparing the land for setting the structures
- Assembling structures
- Placement of temporary infrastructure
- Construction of infrastructure

*Impacts during the **operation and maintenance phase** related to:*

- Well operation
- Well maintenance
- Operation of the booster pumping station
- Maintenance of the booster pumping station
- Operation of the solar plant and energy generation
- Maintenance of the solar plant
- Diesel generators

*Impacts during the **decommissioning** related to:*

- Disassembling the solar plant
- Disassembling the booster pumping station
- Closing the recovery and monitoring wells
- Cleaning the land

The following section identifies potential impacts together with relevant baseline information.

The focus will be made on the aspects of utmost interest or concern to local communities, stakeholders, regulators, and decision makers.

## 7.1 Potentially Negative Impacts during Construction

### 7.1.1 Air quality impacts

Air quality impacts can be classified as :

#### 1. *Dust Emissions*

Dust emissions during mobilization, preparation of land and construction are expected as a result of:

- Site clearing and earthworks including levelling, trenching, and other activities associated with the buildings housing the wells and well drilling
- Excavations for laying foundations of the water tanks, the booster pump station building, water tanks, administration buildings, and control rooms
- Excavation of top soil in construction sites for the water distribution networks
- Excavation for the base of the PV tracker systems and regular PV panels
- Excavation of clogged soil for the rehabilitation of the infiltration basins
- Excavation for stripping top soil and cut and fill for access roads will result in fugitive dust generated

The major dust sources will result from vehicle movement over un-paved areas and transportation of raw materials and equipment within the work site. The dust emissions result in temporary elevated levels of particulate matter in the ambient air near construction sites. Also there are other, relatively minor sources of air emissions, such as heavy equipment needed or construction trucks for transporting materials.

Palestinian Standard for ambient air, has specific standards to preserve the air quality; however there are no specific standards for dust emissions from diffuse sources. In controlling dust emissions from excavation, filling and installation of structures for water distribution networks activities, the Law has identified certain measures to be implemented during the construction activities including control of exhaust from fuel combustion machinery.

The occurrence and significance of fugitive dust generation will depend upon meteorological and ground conditions at the time and location of activities. However, under normal meteorological conditions, dust impacts will be limited to within several hundred meters of the construction area(s).

Dust can cause health risks and irritation or potential nuisance to the population in close vicinity to the construction site. In addition, dust can affect the ability of nearby vegetation to survive and maintain effective evapotranspiration, especially at areas of high vegetation cover (e.g. nearby existing farms). Considerable quantities of fugitive dust will be generated by construction activities such as earthmoving, levelling, grading and excavation.

The NGESTP project area is located in the downwind stream, i.e. all the emission will not directly affect the nearest populated area, so it is not anticipated that dust levels will impact greatly on existing settlements. The emissions of dust from construction activities will be localized and the dust is likely to settle in close proximity to the area where clearance activity or other earth work are being carried out.

In summary, fugitive dust impacts from the construction activities are expected to be minimal for the following reasons:

- Dust emissions from construction activities impacts will be limited in a small area in the vicinity of the project site and the dust is expected to settle in close proximity to the construction site(s).
- No residential areas have been developed in close proximity to the proposed project site (within 400 m or more).
- Construction is conducted in uncontaminated soils, therefore wind-blown dust is normally only considered a nuisance to these exposed.

## 2. Gaseous Emissions

Emissions of CO<sub>2</sub>, CO, SO<sub>2</sub>, NO<sub>x</sub> and PM<sub>10</sub> will result from the operation of the construction machinery and road vehicles during construction of the different components of the effluent recovery service buildings, well drilling and network (water distribution).

Impacts of gaseous emissions from the construction activities are not expected to be significant for the following reasons:

- Quantities of air pollutants emitted from construction machinery are generally small and non-stationary.
- The emissions are expected to be scattered over a large geographical area.
- The construction site is located in an open area where air pollutant dispersion is high.



- The emissions will be mostly limited to the construction phase and therefore are temporary.

Consequently, it was concluded that the air quality impacts associated with dust generation will be of “low” significance.

***The mitigation measures recommended in the Environmental and Social Management Plan (ESMP) and Monitoring Plan for control of air emissions are based on compliance with the law.***

#### 7.1.2 Noise impacts

The following activities are expected to be the most significant noise sources during the construction phase of the proposed project:

- Clearing and grading of the site area and axis roads inside the site and excavation works mentioned in 7.1.1.
- Generators
- Trenching.
- Backfilling
- Well drilling
- Installing the solar panels including construction of frames, mounting of panels onto the frames and connections between arrays and the substations (cables in underground ducts).

Noise in the construction phase is associated with heavy machinery, heavy trucks and generators. The noises of these equipment vary from continuous sources, such as loader, vacuum trucks and construction trucks, to intermittent impacts, from generators.

The most effected people of noise impacts are the construction workers. Palestinian outdoor noise standards has specified certain standards for noise intensity, number of impacts and exposure duration for the working environment, which should be respected during construction.

Noise can also have social impacts among the neighboring areas, as it can cause, if it exceeds the standards, psychological effects among exposed persons. Traffic congestions, which could be caused by transportation of raw material, can also have secondary effects on noise levels in the area, which may increase ambient average noise intensity levels.

The activities during the construction phase would be similar to those associated with typical construction sites and it will have temporary impacts. The equipment to be used mainly consists of graders, bulldozers, front loaders, trucks, vacuum tankers in addition to the concrete mixer, pumps and generators.

Construction activities are likely to be confined to daytime and noise will only affect the above-specified areas for a relatively short time, while the spread passes through. A relatively moderate number of heavy vehicles will be needed to transport raw materials to the work site.

The generation of noise is not expected to represent a significant issue to local residents for the following reasons:

- No major noise sensitive receptor is located in close proximity to the proposed project location.
- The main routing of construction vehicles will be along the main public roads.
- The construction noise is expected to be of a short duration and dispersion of the noise is likely to be about 100-150 meters from the construction area.
- Transportation and materials delivery will be limited to daylight hours.

Subsequently, the noise impact will be short-term only for the duration of construction activities, and therefore, the impact significance is considered "low".

***The mitigation measures recommended in the Environmental and Social Management Plan (ESMP) and Monitoring Plan for control of noise and air emissions are based on compliance with the law.***

#### 7.1.3 Vibration impacts

Construction activities would result in varying degrees of ground-borne vibration depending on the stage of construction, the equipment and construction methods employed, the distance from the construction locations to vibration-sensitive receptors and soil conditions.

The main source of vibration during the construction phase comes from the equipment movements during the *construction of the storage tanks, construction of booster pumping station, pump installation, well drilling, laying of water distribution network* and other activities associated with concrete construction works.

The closest sensitive structures to the site is the El Shuhada cemetery (around 10 m away from where the water distribution network will be laid, especially the booster pumps). The management plan and monitoring plan has to be proposed in detailed at the closest sensitive receptor and proposed project location at the surrounding site of El Shuhada site. Consequently, medium vibration impacts could be anticipated to occur.

***Mitigation measures have been recommended in the Environmental and Social Management Plan (ESMP) and Monitoring Plan for control of vibrations.***

#### 7.1.4 Construction Waste and Handling of Hazardous Waste

Waste generated during construction phase of the PV component, the rehabilitation of the infiltration basins, the distribution network and the access roads could be categorized as follows:

- Human wastes generated by construction labor, including sewage and garbage collected from labor camps in water distribution networks locations. Disposal of sewage and garbage generated from construction labor, if not transported to adequate sites, will be a continuation of the existing sanitation situation and contribute, although to a relatively low extent, to environmental deterioration. In this project, the ESMP and Monitoring Plan has recommended measures for sound management of such waste.
- Normal construction wastes including scrap concrete, steel, bricks, wood, etc., which are chemically inert, therefore the associated environmental risks with improper disposal of such waste is limited to aesthetic effects at the disposal site. By following the construction waste management plan and monitoring plan, these limited aesthetic effects will be minimized.
- Hazardous wastes: Mainly cleaning fluids, solvents, paints and their containers, handling, spills, emission (if any) will include others than solder from electrical connections.
- Miscellaneous solid wastes, including packaging waste, used drums, wood, scrap metal, and building rubble will be generated during the construction phase of the project (mainly from the water distribution network site).
- Extracted excavated soil from rehabilitation basins that is considered contaminated.

Based on the above, impacts due to waste generation associated with the proposed NGESTP project activities will be of “low” significance.

***Mitigation measures for managing construction waste have been recommended in the Environmental and Social Management Plan (ESMP) and Monitoring Plan.***

#### 7.1.5 Changes in Hydrology and Groundwater Quantity and Quality

During the construction of the recovery scheme and the depth of the excavation will not significantly impact the groundwater there will be no impact on groundwater since groundwater is about 30 to 70 m below the earth surface.

The wells construction however, can have significant impact on groundwater. The mitigation measures to avoid the hydrology of groundwater quantity and quality are similar to the general wells construction.

These have been recommended in ***the Environmental and Social Management Plan (ESMP) and Monitoring Plan***

#### 7.1.6 Ecological Disturbance

There is a possibility that the water distribution network will be laid on agricultural land, and negatively affect on the crops and animals around the site.

Therefore, mitigation measures shall be developed to limit and to reduce the impacts.

Based on the ecological assessment, the project will have low to medium impacts.

#### 7.1.7 Risks of Improper Management of Culturally Valuable Sites

Although no archaeological sites within the project area were identified during site visits nor classified by the Antiquity Authority, the area is part of the Fertile Crescent region which was host to various ancient settlements and thus there is a possibility for chance-finds during excavation works. Finding such objects may, if not properly managed, risk their loss or damage during handling/storage in construction site.

In case of chance finds, collaboration should be established between the Ministry of Tourism and Antiquities and the contractor in case of chance finds. These standards and requirements were addressed in the ESMP, which has defined procedures for chance-finds of antiquity objects, and measures for protection of antiquity sites during construction activities.

This impact is considered of medium significance but can be mitigated to low.

#### 7.1.8 Impacts pertaining to workforce

Adverse impacts can be expected as a result of interactions between construction workers and existing residents of Project area of influence AOI and its villages, where worker accommodation will be located.

The estimated construction workforce will peak at 150 workers. This might change if workers from surrounding villages and the area of influence are recruited. The contractors prefer teams be selected assembled from their full time workers. Skilled and semiskilled workers are primarily on project based workers who work with the subcontractors on the project. Unskilled laborers can be recruited from the vicinity areas.

Construction contractors provide accommodation for workers. Most of this accommodation is located in the camp and in the nearest village that might accommodate the 150 workers.

Due to the nature of work it is not anticipated to provide job opportunities to women, particularly, during the construction phase. Also, the subcontractors tend not to recruit women in construction activities. They are hired as administrative staff or engineers. Therefore, almost all workers during the construction phase will be primarily males. These workers might cause disturbance to the community, particularly, if they don't abide to the norms and traditions.

Considering also the hygienic behaviors adopted by workers and their health seeking behaviors, it is anticipated that they might transfer diseases to the local communities. Reviewing similar projects of

the same nature, there were no sexual intercourses between workers and community people in the project sites. Such attitude put limitation to Sexual Transmitted Infections that tend to be common in such projects. However, there is a percentage of homosexual males who might be seen in the site. These category will face health problems, especially, STIs. Therefore, workers will be in need to receive health orientation sessions prior to the onset of construction work.

The impact is expected to be localized to the neighborhoods surrounding the workforce residences, and is of short-term nature during construction period. However, due to the number of workers, there will be large degree of change from the baseline conditions, in terms of both relative population size and demographics.

Receptors are the existing residents of Jabalia, Beit Hanoun, Um El Nasr, Beit Lahia and surrounding areas, who may experience changes in the quality of life related to the presence and activities of the incoming workers.

As there is capacity to absorb extra residents, and assuming that existing residents are working class (and may include other construction workers), receptor vulnerability is likely **Low To Medium**.

#### 7.1.9 Potential implications for workers' Occupational health and safety

As 150 workers will be accommodated and work in the same place there will be different health risks.

Following are the main risks related to health:

- Potential infections by communal diseases i.e. respiratory diseases (tuberculosis, flu, swine flu) and skin diseases,
- As workers might share shaving tools and sometimes share tooth brush, there is a probability of being affected by blood transmission diseases,
- As they are all men, few of them might be homosexual. Thus, they might get affected by any of the sexual transmitted diseases,
- Workers also might get affected by accidents result from working on heights or traffic accidents ,
- In case of not adhering to hygienic behaviors, the workers might get lice and skin diseases. Additionally, the lack of ventilation might result in facing respiratory diseases,
- Not abiding to cleanliness in the kitchen might cause digestion and intestine infections. The cleanliness of pit latrine is essential to avoid any infections.

The impact is expected to be localized to the work place and roads to the project areas, and of short-term nature during construction period. However, due to the number of workers, there will be large degree of influence among the huge number of workers.

Receptors are the workers of the project who were recruited from Um El Nasr and Surrounding villages and other project areas, who may experience changes in their health conditions. As there is various preventive measures and precautions adopted by the, receptor vulnerability is likely Low.

#### 7.1.10 Increased pressure on local services, related to the construction workers' use of community services

An adverse impact may result from the project's excessive utilization of local potable water which also service the local villages. Impacts on public sanitary system and landfill systems are not expected as there is no proper sanitary system or waste landfills. Impacts related to public electricity grid tend to be of no relevance as the water reuse plant will rely on generators during the construction phase. Otherwise, a small electricity plant should be constructed prior to the construction phase.

Construction water (non-potable) will be brought to site by water tanks, and will eventually be abstracted from the water station in Jabalia, Beit Hanoun and Beit Lahia; therefore, construction water will not affect local public water systems.

The project will use local water to supply the site with potable water during the construction phase. Baseline studies indicated that water quality is not acceptable. Water should be obtained from the water stations and brought to areas using vehicles equipped with water tanks. This will not affect water network but it might affect the quantity of water allocated to the AOI. There should be a contract signed with Water and Wastewater company that contains the exact quantity of water to be provided.

As the project will rely upon its own sources of potable water and electricity, the community networks will not be subject to pre-existing shortages. The Project's use of these utilities will not result in more frequent or severe disruptions of water and electricity supply. Contracts with utility providers are understood to be in place.

The project's impact on local potable water and electricity utilities, and the availability of these utilities to local households is expected to be limited as it will not affect the villages served by the Mining Company electricity network or the public water treatment and distribution system. As there will be limited changes during the construction phase, as once constructed, the Water reuse plant will generate electricity on site. Yet, water will be always fetched from the Water station. However, the scale of the effect is considered to be Minor.

#### 7.1.11 Increased traffic on the Roads

Project-related traffic may adversely affect other users of the project AOI, Surrounding villages. This could lead to congestion, delays, and traffic accidents.

The roads in the vicinity areas are the main arterial road through the AOI, connecting all villages with the main cities. They are critical road for travel between various communities and used by local

residents to travel to and from the villages to main cities to access their works markets and other services.

Existing traffic levels are reported to be minor to moderate throughout the year with a good level of service. Travelling to and from Project AOI is relatively acceptable but travelling to the villages is difficult due to the absence of vehicles. The main means of transportation reported was the carts, minibuses and private cars, pickups and shared taxi. There are few accidents on the road due to the absence of light column. There were no reports about robbery or theft on the roads.

The main road will be used by the Project to transport equipment, supplies, and workers to and from the site, as well as carrying wastes (including solid waste, hazardous waste, and sewage) to authorized disposal facilities. Add up about 10 trips for water tanks and 8 trips for waste and waste water disposal. In case of accommodating workers in Surrounding villages , there is a probability of 10 trip to transport workers to and from the site.

Traffic impact is considered local and regional as it will extend along the surrounding villages road in the vicinity of the Project site. However, considering the traffic management plan and associated measures (including scheduling traffic to avoid off-peak hours, minimizing use of the road between the villages and the mother village and the site, and promoting safe driving practices through training and enforcement), the scale of impact is expected to be minor. Although there will be a substantial increase in vehicle numbers, including high goods vehicles, on the road, the identified management measures will minimize the escalation of traffic to avoid large-scale changes in congestion or accident rates. Traffic analysis conducted for the Project predicts that the Level of Service for the roads will remain good and therefore, traffic impacts remain **Low** .

#### 7.1.12 Impacts related to land acquisition and economic displacement

Project-related land acquisition impacts may adversely affect 16 owners of lands, source of water of 12 well owners and their 190 partners and the livelihood of 15 well operators.

The project will result on the adverse impacts pertaining to land acquisition and economic displacement:

1. Impact on the well owners whose wells will be terminated (12 wells). Faced by a sudden termination of their wells, these people are faced by a situation of losing source of water.
2. Impacts on the owners of small plots of lands who will be expropriated during the construction of the 14 wells. A total of 16 people are expected to be affected, some of whose lands are small plots with areas that do not exceed one dunum. Since wells will be constructed within the vicinity of the lands plot areas, the remaining plot of land will be of no use. The existence of a recovery well inside the land will additionally, result in a decline in the land value.
3. Economic impact on the operators of wells. Well termination will result in a total loss of income of those who made a living from operating the wells. The numbers of those faced with the situation is limited to 15 people; therefore, the magnitude of their vulnerability can be mitigated.

4. 30 dunums will be taken from Waqf land outside the waste water treatment plant. The land will be used to install solar plant in.  
Below is a summary of land related impacts

**Table 7-1: Project's impacts on lands**

Item	Square meters
Lands needed to construct the recovery component (recovery wells- monitoring wells)	
Wells within the area of the ground retrieval own / jurisdiction of the Municipality of Jabalia.	1158 m <sup>2</sup>
Dripping irrigation network will be installed in the main roads and streets. Temporary access roads to connect farms to irrigation scheme will be dependent on the willingness of farmers.	Not defined yet
Photovoltaic land will be constructed inside the current wastewater plant and outside the plant. Additional area of land will be acquired.	30,000 m <sup>2</sup>

Source: Palestinian Water Authority

Given the limited number of PAPs and the duration of impact, and acquisition and economic displacement impacts are classified as **Low**.

#### 7.1.13 Impacts related to visual intrusion and landscape

Construction activities can be seen in the project area of influence. Digging the land, construction of pipelines, and the moving of equipment will be noticed from the main road.

Project component pertaining to installation activities would produce visible activity and dust in dry soils. Project construction may be progressive, persevering over a significant period of time. Ground disturbance (e.g., trenching and grading) would result in visual impacts that produce contrasts of color, form, texture, and line. Soil scars and exposed slope faces could result from excavation, leveling, and equipment movement. Impacts pertaining to visual intrusion and landscaping remain Low

Local residents of the surrounding areas in the villages are the receptor of this potential impact. The residents are less impacted by the visual intrusion impact as they don't reside in the vicinity of project sites.

#### 7.1.14 Impacts related to land use

Regarding the land use and accessibility of the water distribution networks for the recovery reuse scheme, the main impact on roads traffic will be during possible lying of water distribution networks along or across main roads. In addition to the limited access road for the community during construction, this access difficulty will have more impacts on elderly people, handicapped and



children, who may accidentally fall in open trenches or make tedious long cycles before they reach their targeted locations.

The impact of the PV component on land use will be limited. The areas inside the NGEST plant are already artificial surfaces covered with roads and paved areas. Only limited areas of the WWTP terrain are currently open space. The impact on the aesthetic view is therefore very limited with no major change in the land use shape and no major excavation or change of morphology in the area. Table 57 summarizes the impacts expected during the construction phase.

Table 2: Assessed Significance of Expected Impacts during Construction Phase

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Air quality impact by dust emissions of construction works of water distribution networks	Negative	Likely to raise PM in ambient air at the project sites.	temporary	Medium	Minimize the impacts to low	Palestinian
Air quality impact by emissions of CO <sub>2</sub> , CO, SO <sub>2</sub> , NO <sub>x</sub> and PM <sub>10</sub> will result from the operation of the construction machinery and road vehicles during construction	Negative	Will raise pollutant levels in the air	Temporary	medium	Minimize the impacts to low	Palestinian
Noise impacts	Negative	Impacts of construction is less likely at the cemetery area and water distribution network and part of the effluent lake that is far from the residential area	temporary	Medium at project sites except low at cemetery site	Minimize the impacts and maintain their control	Palestinian

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Vibration due to the equipment movement	Negative	Vibration impacts to the water distribution networks especially the site of the pumps and storage area have significant impact.	Temporary	Medium impact especially nearby cemetery area (site for storage area and pumping station	Minimize the impact at the storage and pumping station area that is nearby El Shuhada cemetery area and maintain control at the other sites of the project	Palestinian
Risks of hazardous wastes	Negative	Likely to have workers exposure to hazardous waste if no hazardous waste facility is established before the project preparation	Temporary	Medium	Minimize the impacts	Palestinian
Change in the water hydrology a and groundwater (quantity and quality)	None	Due to the depth of the groundwater between 30-70 m, no significant impacts is expected	None	No significant impacts	Mitigation measures is not required.	
Ecological Disturbance	Negative	There is a possibility that the water distribution network will be laid on agricultural land, and negatively affect on the crops and animals around the site.	Temporary	low to medium impacts		

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Potential impact on the antiquities on the areas	Negative	the area is part of the Fertile Crescent region which was host to various ancient settlements and thus there is a possibility for chance-finds during excavation works. Finding such objects may, if not properly managed, risk their loss or damage during handling/storage in construction site.	Permenant	Minor if properly managed	*Work should be stopped in case of finding any antiquities *Inform the Antiquities authority	PF 4
Workforce	Positive	The project will result a wide range of job opportunities for construction workers (150 person)* The unskilled and unemployed workers may need to receive trainings prior to the construction activities to be able to work in the project. On the job training activities should be functioning in order to train the community young people who expressed their willingness to work in the project.* Increase access to job readiness through the provision of education and training for both the personnel of the project and the community.	Temporary	Low to medium	Not applicable	IFC Performance standard 2: labor and working conditions
Workforce	Negative	Demand for worker accommodation project AoI may stress the local housing resources and lead to displacement of low income or other vulnerable households.	Temporary	Low	Minor	IFC Performance standard 2: labor and working

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
						conditions &Performance standard 3: resource efficiency and pollution prevention
Workforce	Negative	Influx of construction workers in Jabalia and project AoI may stress local health services (e.g. Hospitals, clinics).	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions, Performance standard 3: resource efficiency and pollution prevention, IFC Performance standard 4: community health, safety, and security
Workforce	Negative	Influx of construction workers in the project AoI may stress local utilities (e.g. Potable water, sanitation, electricity, waste management).	Temporary	Low	Minor	Performance standard 3: resource efficiency and pollution prevention

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Workforce	Negative	Influx of construction workers in the project AoI may lead to demographic imbalance and reduce social cohesion. The disrespect of norms and traditions might create problems with the local communities	Temporary	Low	Minor	Performance standard 4: community health, safety, and security
Workforce	▪ Negative	<ul style="list-style-type: none"> <li>Workers may be exposed to occupational health and safety risks.</li> <li>Occupational Health and Safety: Job-related accidents, illnesses, and other adverse impacts on worker safety, health and welfare of staff and contractor workers</li> </ul>	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions
Workforce	Negative	<p>Inappropriate management of employment among the project areas:</p> <ul style="list-style-type: none"> <li>Not adhering to transparent employment might arouse community dissatisfaction due to the community inability to benefit from the employment prospects offered by the project.</li> </ul> <p>Raise the feeling of alienation among the community as a result of non-inclusive employment practices.</p>	Temporary	Low	Minor	IFC Performance standard 2: labor and working conditions

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
Workforce	▪ Negative	<ul style="list-style-type: none"> <li>▪ Access to electricity and potable water for site operation</li> </ul> Use of public electricity and water networks could reduce availability for local residents.	Permanent	Low	Minor	Performance standard 3: resource efficiency and pollution prevention
Occupational health and safety	Negative	<ul style="list-style-type: none"> <li>▪ Potential infections</li> <li>▪ probability of being affected by blood transmission diseases,</li> <li>▪ sexual transmitted diseases,</li> <li>▪ accidents result from working on heights or traffic accidents ,</li> <li>▪ disease as a result of lack of hygienic behaviors, and ventilation deficiency might result in facing respiratory diseases,</li> </ul>	Short-term and localized	Low	Minor	
Impact on community health conditions	Negative	As 150 workers will be working in the project area of influence, they might transfer diseases to the surrounding communities.	Temporary	Low	Minor	Performance standard 4: community health, safety, and security
Increased pressure on local services, related to the construction	Negative	The project's impact on local potable water and electricity utilities, and the availability of these utilities	Temporary	Low	Minor	

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
workers' use of community services		to local households is expected to be limited as it will not affect the villages served by the Mining Company electricity network or the public water treatment and distribution system. As there will be limited changes during the construction phase, as once constructed, the Water reuse plant will generate electricity on site.				
Increased traffic on the roads	Negative	<ul style="list-style-type: none"> <li>Construction activities and traffic/road use may increase dust and decrease air quality, and also generate noise.</li> </ul> Disturbance due to dust and noise – changes in air quality, dust, and noise could affect health, livelihoods (e.g. Agriculture) and quality of life. Such impact was raised as a concern by project AoI residents. Water reuse projects tend to result in dust and emissions during the construction.	Permanent	Minor	Minimal	Performance standard 3: resource efficiency and pollution prevention & Performance standard 4: community health, safety, and security
Land acquisition	• Negative	<ul style="list-style-type: none"> <li>Reduced livelihoods due to loss of land and/or resettlement.</li> <li>The project will result in acquiring lands to install 14 wells on 1158 meter square</li> <li>The project also will result</li> </ul>	Permanent	Low	Minor	Performance standard 5: land acquisition and involuntary



Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
		<p>in termination of 12 private wells, resulting in losing of source of water</p> <ul style="list-style-type: none"> <li>• The project will result in affecting the livelihood of 15 well operators</li> <li>• The pipelines will be installed in public lands. As such no land acquisition will be in place</li> </ul> <p>The solar plant will be constructed in the current plant as one of the future components. Additionally, the Ministry of Endowment agreed to give them additional 30 dunums outside the wastewater treatment plant.</p>				
Visual intrusion	Negative	The surrounding agriculture lands might be affected by construction works	Permanent	Minor	Irrelevant	Performance standard 1: assessment and management of environmental and social risks and impact
land use	Negative	<ul style="list-style-type: none"> <li>▪ lying of water distribution networks along or across main</li> </ul>	Temporary	Medium	Low	

Potential Impact	Type of impact	Description of the impact	Duration of impact	Significance	Mitigation Measures Effects	Standard governing the impact
		<p>roads.</p> <ul style="list-style-type: none"> <li>▪ limited access road for the community during construction, this access difficulty will have more impacts on elderly people, handicapped and children, who may accidentally fall in open trenches or make tedious long cycles before they reach their targeted locations.</li> <li>▪ The impact of the PV component on land use will be limited. The areas inside the NGEST plant are already artificial surfaces covered with roads and paved areas. Only limited areas of the WWTP terrain are currently open space</li> </ul>				

## 7.2 Potentially Positive Impacts during Operation

### 7.2.1 Potential positive socio-economic impacts during operation

Project operations will generate long-term economic benefits including opportunities for permanent employment and skills development, and economic growth through support for local businesses. As part of a larger effort to improve the capacity of Palestine sanitary infrastructure, the Project will also play an important role in improving access to, and reliability of water reuse throughout the region, with large numbers of direct and indirect beneficiaries as follows:

- Phase 1 about 3000 beneficiary who own up to 5 thousand dunums
- Phase 2 about Beneficiary who own up to 10 thousand dunums

### 7.2.2 Job creation and capacity building

A positive impact is expected as the project will generate long term opportunities for employment and skills development. During operation, the project is expected to employ 50 workers. Workers are expected to live in the AOI , particularly in project AOI or in Surrounding villages and the Area of Influence. The Project has expressed a commitment to local hiring, which also supports the expectation of various stakeholders consulted in Um El Nasr and project AOI . Workers will live in the local area as they are locally hired. The local hiring will be limited to males as women tend to be reluctant accepting such types of works. Project direct impacts would include the creation of new jobs for operation and maintenance workers and the associated income and taxes paid to the state. Any job opportunities will generate tax to be paid to state. That will work for the benefit of all communities.

Additional opportunities are predicted during the operation phase. They are related to increasing the possibilities for career development and advancement, as the stable and structured employment opportunity at the Water reuse plant will be play a major role in building skills and experience.

### 7.2.3 Availability of water effluent from the effluent recovery scheme for irrigation purposes

The project will result positive impacts on water resources in general, and ground water in particular. The effluent recovered from the groundwater will offer an additional water source of irrigation, as water resources in the Gaza Strip are scarce. It is of ultimate importance however, that the water quality is suitable for the type of crops and exposure to the farmers and the public.

In the analysis carried out in 2012, it was concluded that the expected water quality from the recovery wells would be suitable for unrestricted use in irrigation. The conclusion at the time was developed through groundwater modelling, using the water analysis of samples taken from existing monitoring

wells for calibration. Conclusions reached were mainly based on BOD, which was 5mg/l in the existing monitoring wells at the time.

Conducting a comparison using currently available data and analysis results of **constructed** recovery wells (presented in the baseline chapter), the modeling conclusion back in 2012 can be verified and confirmed. While BOD levels have increased from the 5mg/l back then, the values are still lower than the permissible 30mg/l, the Palestinian limit for unrestricted groundwater use (10mg/l).

Results of the model also shows that, at the beginning of year 2018, the pollution plume extends to a distance of about 500 m (nitrate concentration contour line is 80 mg/l) in the North-West direction of the basin (See Figure 49); as wastewater with bad quality has been infiltrated in the basins since 2009 (15,000 – 20,000 m<sup>3</sup>/day).

The model results showed that even after the operation of the treatment plant for seven years (up to year 2025), polluted zones will still exist and some agricultural wells will be affected in the absence of the project (pollutant levels reaching 80mg/l at some areas).

After the operation of stage 1 wells, the situation will be highly improved and the nitrate levels will be brought down to almost half the concentration. After the operation of stage 2 wells, the project of concern, the area of influence will be constrained and the polluted zone in the North-west direction will become smaller, until it disappears completely in 2042.

However, although the unrestricted use is considered, it is advisable not to use the recovered water for unrestricted use.

#### 7.2.4 Water resource contamination

The impact on groundwater is one of the most important issues associated with the project and is one of the main reasons the project was initially designed. The project will prevent negative impacts on the groundwater caused by the infiltration of partially treated sewage. The positive impact on groundwater quality was demonstrated through groundwater modeling, methodology of which is detailed in **Annex 5**.

The assessment of the impacts on groundwater considered the abstraction rates of the recovery wells, the possible recharge in the agricultural lands and different scenarios for project implementation. To demonstrate the

1. Without the implementation of recovery scheme.
2. With the implementation of recovery scheme. 28 recovery wells will be implemented on two stages; 14 wells that already constructed and to be operated by the end of 2019 and 13 wells to be operated by the end of 2021.

Both scenarios take into account the operation of the WWTP by the beginning of 2018. Therefore, partially treated wastewater will continue to be infiltrated until the beginning of 2018, then, 35,600 m<sup>3</sup>/day of treated wastewater will be infiltrated.

### 7.2.5 Modeling Results without Recovery Scheme

Results of the model shows that, at the beginning of year 2018, the pollution plume extends to a distance of about 500 m (nitrate concentration contour line is 80 mg/l) in the North-West direction of the basin (Figure 67); as wastewater with bad quality has been infiltrated in the basins since 2009 (15,000 – 20,000 m<sup>3</sup>/day).

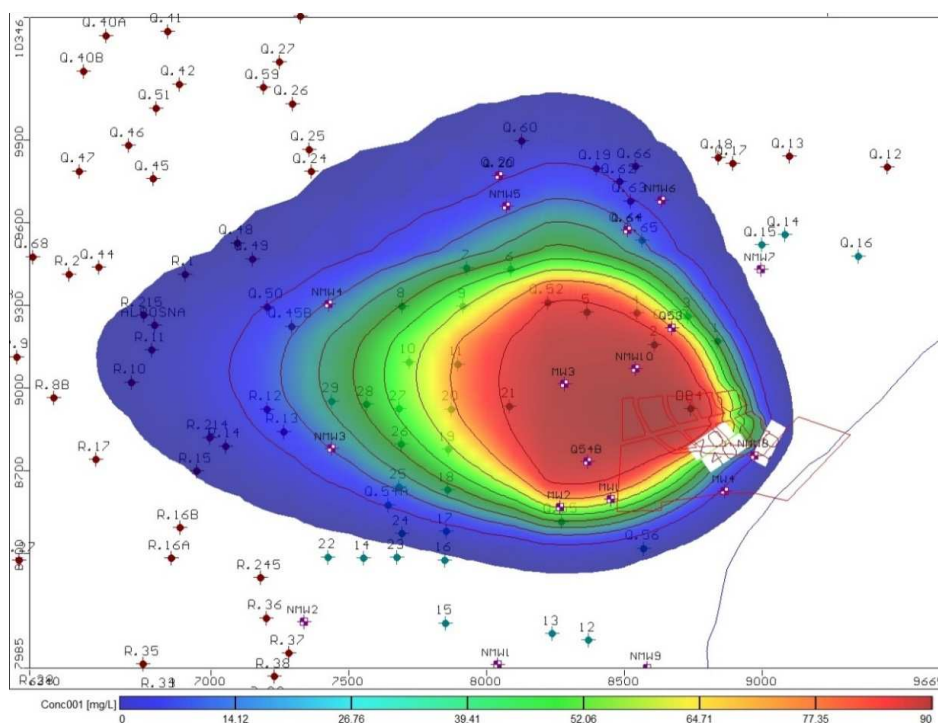


Figure 68: The pollution plume in year 2018 (before the infiltration of treated wastewater, no recovery)

Figure 68 shows the groundwater quality expectations in year 2019 after the operation of the treatment plant. Concentration of the infiltrated treated wastewater will be 10 mg/l. It can be noticed that there will still be polluted zones and some agricultural wells will be affected. Figure 69 shows the same scenario for year 2025 where the groundwater quality is highly improved. However, large polluted zone is still found in the North-west direction, where municipal and agricultural wells exist.

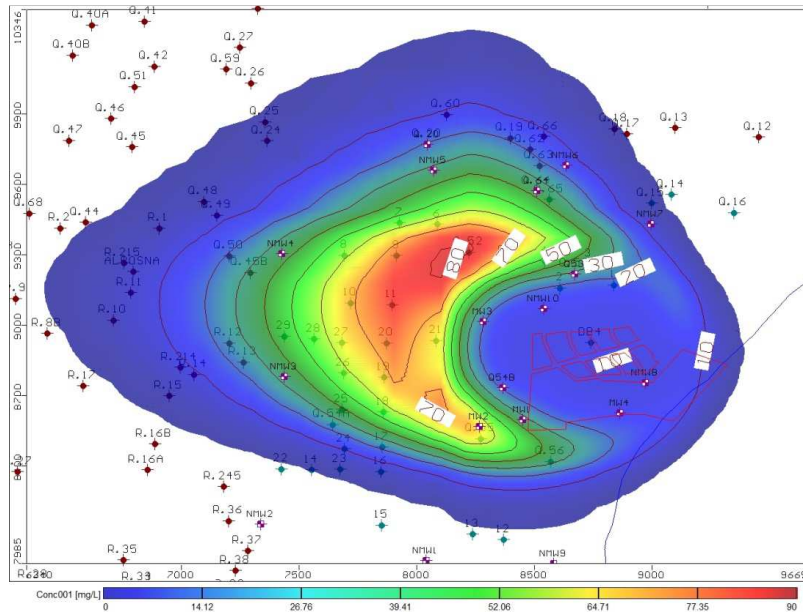


Figure 69: The pollution plume for year 2019 (35,600 m3 of treated wastewater is infiltrated starting from 2018)

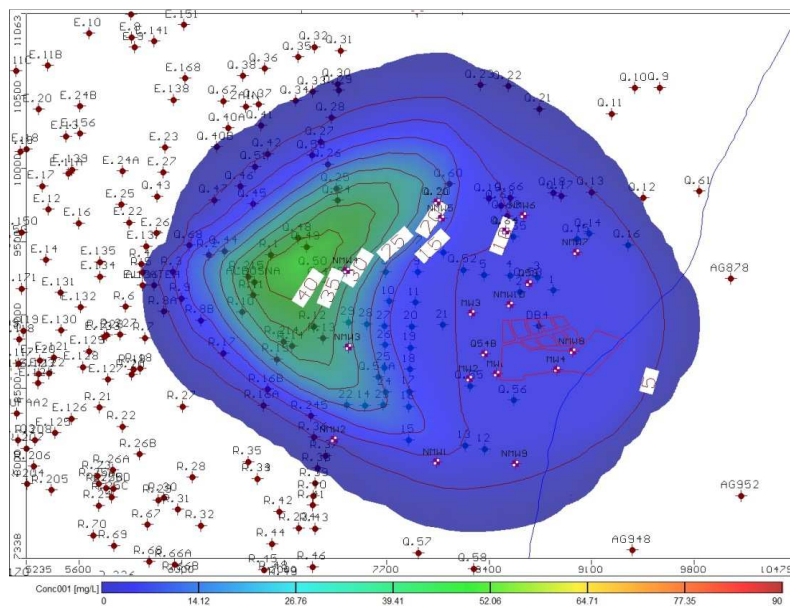


Figure 70: The pollution plume for year 2025 (35,600 m3 of treated wastewater is infiltrated starting from 2018)



- **Stage 2:** 13 wells, located in the North and the South direction of the basins, are designed to be operated by the end of 2021.

In order to specify the optimal locations of these wells, several runs of the model were carried out, as part of the project design, on the base that these wells should be able to capture all pollution; these locations were modified to go in line with the delay in the operation of the treatment plant. Figure 70 shows the pollution plume after the implementation of the first stage of the recovery wells, it can be noticed that the plume is restricted to pass the 14 recovery wells. In addition, it reduces the dilution of the pollutants in the area after the recovery wells.

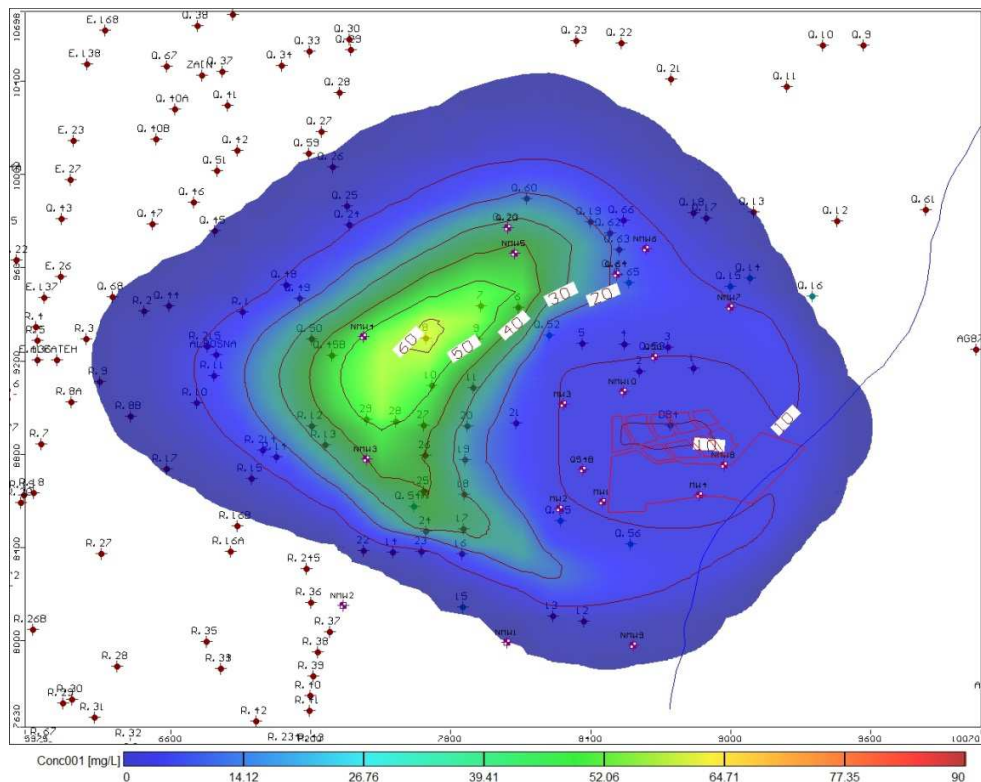


Figure 71: Pollution plume in 2021 (after the implementation of the first 14 wells in 2019)

The second stage of the recovery wells is intended to be implemented to restrict the expansion of the pollution plume; i.e. if only 14 wells continue to operate, the pollution will be extended and more wells will be at risk in year 2025 as shown in Figure 71 (a). In addition, polluted zone will be found in the North-west direction with concentration of pollution of 40 mg/l. While Figure 71(b) shows that the pollution plume is restricted to pass the 28 recovery wells. In addition, the area of the polluted zone in the North-west direction will be smaller than that the area in the case of operating 14 wells. The presence of this pollution zone in the north-west direction is due to the delay of construction and operation of the 14 wells (stage 1) and 13 wells (stage 2). The pollution escapes the recovery wells and it is difficult be recaptured using the recovery wells since the remaining polluted area is in

the downstream. This polluted area will disappear due the dilution with the existing groundwater which will take time. As shown in Figure 68 in year 2042 the pollution disappears.

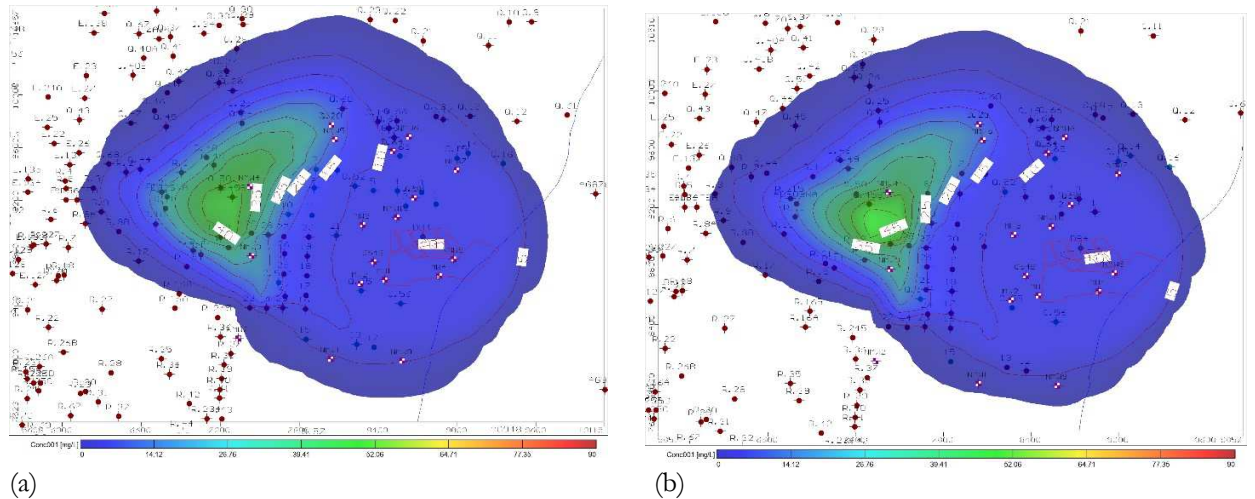


Figure 72:: Pollution plume in 2025: (a) without the implementation of Stage 2 of the recovery wells and (b) after the implementation of stage 2 of the recovery wells

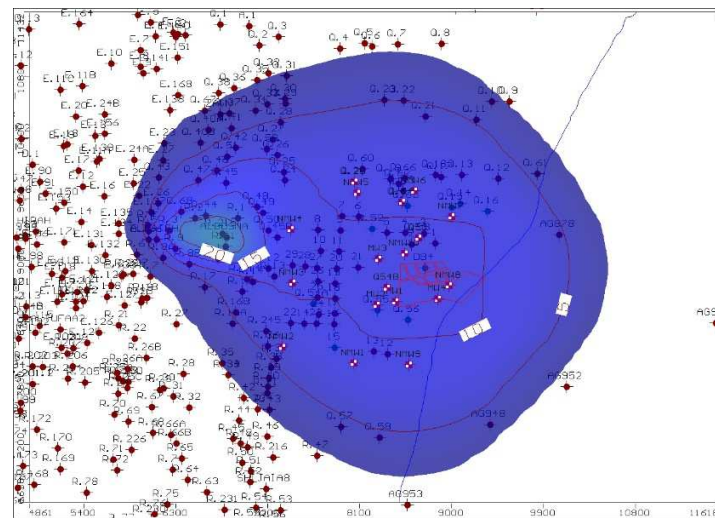


Figure 73: Pollution plume in 2042 after the implementation of stage 2 of the recovery wells

Based on the groundwater modeling and analysis, monitoring plan should be developed. The monitoring plan should include the mitigation measures which has to be considered during the operation of the effluent recovery scheme. The monitoring plan should include the provision of the monitoring wells location, monitoring indicators (parameters to be monitored) and monitoring frequency.



### 7.2.7 Reliability of project power supply (Photovoltaic component)

Securing the flow of unconventional water to the aquifer and its transfer to agricultural lands depends on the performance of the NGEST plant + Recovery Scheme (NGEST + RS) and, in particular, on the reliability of its power supply (mainly constrained by restrictions on access to electricity due to the geopolitical situation). By adding the photovoltaic (PV) system to NGEST, the annual supply from the grid in 2018 is reduced by 24% and the required annual energy from the emergency diesel is taken down by 27% allowing the NGEST facility to reduce its diesel consumption by 30%, leading to the saving of 1,3 million liters of diesel fuel. This will result in lower emissions amounting in 70 989 tCo2 eq over the 20 years lifespan of the project. Accordingly, the PV share in 2018 reaches 24% of the total annual power generation, the diesel share is 38,8 %, the grid share is 22,2 % and the biogas share is 16%.

The NGEST WWTP + RS power supply without PV and the current supply options lead to an overall Levelized Cost of Energy (LCOE) of 0,23 USD/kWh. NGEST with the PV option installed has an overall LCOE of 0,2 USD/kWh , making it 0,03 USD/kWh cheaper than the “no PV option”. This will generate a saving in present value of 15,5 MUSD.

### 7.2.8 Surplus electricity generation from the PV panels fed into the grid.

Positive impact can potentially be anticipated during the construction stage and later on during the operation stage especially when electricity generation from the PV panels starting and the surplus is fed into the grid.

Such surplus will benefit the local communities and they will enjoy more frequent electricity or longer supply hours and will likely improve the livelihood. This effect however, can only be finally confirmed once a final and reliable energy balance is generated as part of the feasibility study.

### 7.2.9 Impacts on Local Agriculture, Public Health and Water Resources

Based on the design project report three scenarios that considered the expected water quality were recommended as follows:

- Scenario I: In this Scenario it is more advisable to cultivate orchards on the available area to the west of the project along Al Karama Road, far away from the political boarder. The profiles of the soils on the area are deep enough to cultivate tree crops. Based on crops water requirements, the available reclaimed water (16,500 m3 daily) is just enough to irrigate 5375 dunum divided into citrus (1613 dunum), olives (1344 dunum), fruit trees (806 dunum), alfalfa (806 dunum) and grains (806 dunum). The expected quality of recovered water is suitable and has no impact on the crops selected under this scenario.
- Scenario II: In Scenario II the wastewater will be treated more effectively and consequently the effluent will be of better quality in general. The quantity of effluent diverted to the

- infiltration basin will increase to approximately 23,100 m<sup>3</sup> daily. This reclaimed water will be used to irrigate additional land amounting to 7525 dunum in total. The citrus area will increase to 2258 dunum, that for olives to 1881 dunum, fruits to 1129 dunum, alfalfa to 1129 dunum and grains to 1129 dunum.
- Scenario III: This Scenario assumes that the planned WWTP in East Jabalia will work with its full capacity by year 2025. The quality of reclaimed water (39,160m<sup>3</sup>/day which equals 35,600 plus 10% extra) is expected for unrestricted use as indicated in the table. The quantity of reclaimed water will be enough to irrigate about 12,577 dunum. The citrus area will increase to 3773 dunum, area for olives to 3144 dunum, fruit trees to 1887 dunum, and alfalfa and grains each will increase to 1258 dunum. In this scenario vegetable crops will be introduced with an area of 1258 dunum, as it is difficult to convince the farmers to accept the recovered water for cultivation of vegetables at the beginning of the project.

### 7.3 Potentially Negative Impacts during Operation

#### 7.3.1 Air Emissions and Noise Pollution

Noise generating sources in the project are expected from:

- Pump rooms and generators in the Booster Pumping Station
- Recovery well operations.
- No noise is expected during the operational phase of the PV plant
- No noise is expected during the operation of the infiltration basins or the irrigation networks
- Noise is expected during maintenance of all components

***Measures for compliance with noise standards, especially for the working environment, have been recommended in the ESMP and Monitoring Plan.***

#### 7.3.2 Vibration

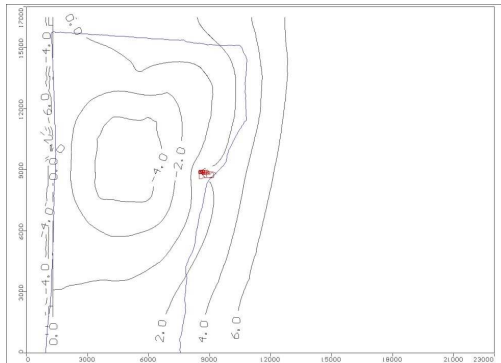
Although the pumps and the generator will be installed in the room, but special attention has to be made to reduce the vibration impact at the pumping station and the generator to minimize the impact due to the close distance with the El Shuhada cemetery.

It is expected, at the pumps and generators for the water distribution network will have “medium” impact.

#### 7.3.3 Impacts of Recovery Scheme on ground water table

The current water table elevation in the area around the basins is 2 m above mean sea level, as shown in Figure 73. After the operation of the first stage of recovery wells, about 20,000 m<sup>3</sup>/day of

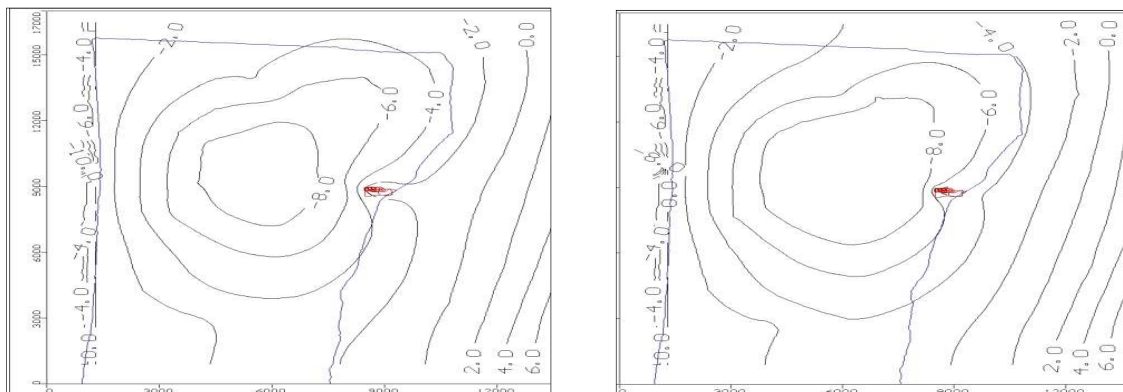
groundwater will be recovered (abstracted) by the end of year 2019. This will affect the groundwater table as shown in Figure 74 ; which indicates the reduction in the water table elevation after two years of operation of the first stage of recovery wells.



**Figure 74: Groundwater Table before the implementation of the first stage of recovery wells in 2018**

**Figure 75: Groundwater Table before the implementation of the second stage of recovery wells in 2021**

In 2030, the model estimated that the water table elevation, in the area around the basins, will be between 2 m and 4 m below mean sea level if the second stage of recovery wells is not implemented, as shown in Figure 75 (a). While, in the same area, the water table elevation will be between 4 m and 6 m below mean sea level if the second stage is implemented; as about 18,000 m<sup>3</sup>/day of groundwater will be abstracted through 14 recovery wells (See Figure 75 (b)).



**Figure 76: Ground water Table in 2030, (a): without the implementation of the second stage of the recovery wells, and (b): with the implementation of the second stage of the recovery wells**

### 7.3.4 Contamination from Reuse of Recovery Water in Irrigation

This section highlights the potential contamination of reusing recovery water in irrigation. The discussion was based on scientific background information and the data collected from potential

customers (consumers and traders) and the farmers. The reuse of recovered water might result the following impacts on health:

- The previous literature showed that the untreated or partially treated water might have bad health effect on the farmers using such water. Potential diseases are nematodes, hookworm infection, Ascaris infection, Anaemia and Protozoa. The probability of infection is high among younger age.
- Those who do the maintenance for irrigation systems might get infected. Irrigation systems might play a role in the magnitude of impact of the recovery water (Sprinkle Irrigation Systems have worse repetition than Flood and Furrowing irrigation system). However, localized irrigation systems like bubbler and drip irrigation are of better impact due to the limitation of hazards on the workers' health
- Potential impact on the consumers of the vegetative crops, especially, vegetables needed for salad i.e. lettuce, radishes, etc. That might infect consumers with nematode and Trichuris.

#### 7.3.5 Impacts of using reclaimed wastewater for irrigation on soil quality

Several changes to the physical and chemical properties of soil can result from the use of reclaimed wastewater, most common of which are salinity, sodicity, PH, toxicity and bacterial count.

The soil should therefore be monitored before and during the course of using wastewater for irrigation. Soil texture (leaching problem is higher), PH, salinity, cation exchange capacity and others are important characteristics that determine the limitation and the type of management of wastewater irrigation. Many of these were covered in the legal framework and analyzed in the baseline chapter.

Several soil management practices can be adopted at the field level to overcome the possible environmental and health hazards (salinity, sodicity, toxicity etc.) associated with the use of treated (reclaimed ) wastewater.

Steps must be taken to minimize potential hazards that might be associated or resulted from using reclaimed wastewater. These steps are to improve permanently existing conditions to facilitate and make irrigation with wastewater easier. Among these steps is leveling of land to a given grade, establishing adequate and efficient field drainage systems, either open or tiled drainage system or both, deep ploughing and leaching to reduce and control soil salinity.

Land leveling (grading) is important to achieve a good uniformity and acceptable water irrigation efficiencies when using surface (flood) irrigation. This will also avoid salt accumulation in the high spots area and water logging in the low spot areas, especially since the reclaimed wastewater (as demonstrated in first level recovery wells, RWs) have been found to contain appreciable amounts of dissolved salts (Sodium, chloride and TDS).

Laser techniques can be applied to level the land precisely which resulted in high level efficiencies and prevent salts accumulation or water logging. In addition, sub-soiling and deep chiseling can greatly enhance irrigation efficiency and water movement in the soil, especially in the case of the particular soil layers dominating the project site. (Zone A of the project site is characterized with loamy clay textured soils with dark brown to reddish brown color are dominated in the area and the Zone B is characterized with loamy clay textured soil in the northern side- Annex 4C) , resulting in impeding or preventing free movement of water through or beyond the root zone.

Periodic monitoring and control of soil physical, chemical and microbiological properties of the soil under wastewater irrigation is necessary to ensure successful and sustainable waste water application. Parameters recommended for monitoring were suggested in Table 3.

Dispersion of soil colloidal phase, stability of aggregates, soil structure and permeability, are very sensitive to the type of ions present in irrigation water. Even though leaching is allowed, the increase in soil alkalinity , which may occur with the reclaimed wastewater in the irrigation scheme due to high Na concentration found reduces soil's permeability for water , particularly at the soil surface, since soil clays tend to disperse and swell from the increased level of exchangeable Na. However at certain sodium adsorption ratio (SAR), the infiltration rate increases or decreases with the salinity level. Therefore, SAR and EC<sub>w</sub> should be used in combination to evaluate eventual potential problems (Rhoades, 1977).

#### 7.3.5.1 Potential implications for workers' health and safety

As 300 workers will be accommodated and work in the same place there will be different health risks. Following are the main risks related to health:

- Potential infections by communal diseases i.e. respiratory diseases (tuberculosis, flue, swine flu) and skin diseases,
- As workers might share shaving tools and sometimes share tooth brush, there is a probability of being affected by blood transmission diseases,
- As they are all men, few of them might be homosexual. Thus, they might get affected by any of the sexual transmitted diseases,
- Workers also might get affected by accidents result from working on heights or traffic accidents
- In case of not adhering to hygienic behaviors, the workers might get lice and skin diseases. Additionally, the lack of ventilation might result in facing respiratory diseases,
- Not abiding to cleanliness in the kitchen might cause digestion and intestine infections. The cleanliness of pit latrine is essential to avoid any infections.

The impact is expected to be localized to the work place and roads to the project areas, and of short-term nature during construction period. However, due to the number of workers, there will be large degree of influence among the workers.

Receptors are the workers of the project who were recruited from the AOI and surrounding villages and other project areas, who may experience changes in their health conditions. As there is various preventive measures and precautions adopted by the, receptor vulnerability is likely low.

#### 7.3.6 Potential impacts of irrigation network on natural habitats

As previously pointed out, certain species of plants, birds and small mammals are present in the area. However, given the relatively small footprint of the project facilities and the generally already built-up conditions of the area, the project is not expected to significantly impact the habitat of these species. Also, the irrigation network will cater only to existing farms and will not open up/convert new areas. Impacts on flora/fauna and overall biodiversity of the area is therefore considered low.

#### 7.3.7 Impacts on Vulnerable groups

The identification of the vulnerable groups, considering their interest and setting plans to mitigate for any negative impacts on them, lies within the core of social impact assessment. This mainly returns to the fact that vulnerable groups are more exposed to the implications of various impacts and are more likely threatened to get in more impoverishment. Identifying vulnerable groups and assessing the project impact is crucial in order to propose the appropriate procedures to be applied in order to reduce their agony.

By conventional definition, the vulnerable population are defined as those groups of people who are typically excluded, disadvantaged or marginalized based on their economic, environmental, social, or cultural characteristics. While various groups could fit within this description (e.g., women, youth, people with disabilities, refugees), a need for having a more specific and focused definition to identify the vulnerable groups relevant to the project raised as a necessity to the team. The SESIA analysis methodology for identifying the vulnerable groups and assessing project's impacts on them has been influenced by the Sustainable Livelihood Approach (SLA) which helped in setting the scene for describing the context, motivations and resources of the affected vulnerable households.

The Sustainable Livelihood Analysis to identify the vulnerable groups relied upon focusing on collecting information about the potential affected people, ranking them according to the severity of impact using different elements of the SLA which are:

1. Assets (social, physical, economical, human and natural assets)
2. Risks and vulnerability surrounding the targeted individuals

### 3. Policies and organizations that govern the implementation of mitigation measures

The level of vulnerability of certain group and the severity of the impact on these groups has been assessed by reviewing the individual's assets base using the sustainable livelihoods analysis (SLA) approach. The less assets base the affected groups have, the less alternatives and the less coping abilities they have and the more attention should be given in designing their compensation schemes and/or mitigation measures. The dimension of the asset base that affected population possesses has been considered and integrated in the various qualitative and quantitative tools designed by the Consultant.

The analysis of the vulnerability issues has been considered as a crosscutting issue in each of the mentioned impacts, including also the pure environmental impacts. It is believed that certain groups are more vulnerable to the environmental impacts than others due to higher level of exposure to these impacts or lack of alternatives or survival methods that allow for coping with these impacts. The presentation of the vulnerable groups, in that sense, has been integrated in each of the impacts (where applicable) and was addressed in deeper approach under the social impacts assessment. According to the ranking for the most affected groups who has no alternative livelihood approach were ranked and recognized as follow:

1. The operators of wells who are uneducated, untrained might suffer due the termination of wells. They are maximum 10 people, therefore, the magnitude of their vulnerability might be mitigated
2. The owners of wells who might be terminated will be badly affected due to losing a valuable asset (the well) As well as, being in critical need for alternative source of water which will cost a lot. In addition, some of them used to gain his income through selling water which will not be available indicating that his income will be badly affected
3. The owners of small plots of lands who will be expropriated during the construction of the 14 wells. Some of them have small plot of lands that don't exceed one dunum. The wells will pass in the middle of such plots of lands. They will not be able to make use of their lands.

#### 7.3.8 Impacts on water supply

The main pressure on water supply will occur during the operation phase due to panel cleaning and human water requirements.

Water for activities other than panel cleaning are estimated at around 50L per person per day. These are insignificant compared to the water required for panel cleaning.

The water needed for cleaning the PV panels from the dusts will create an additional issue of concern especially in the context of Gaza water crisis. Freshwater availability is already lacking for drinking and domestic use. Therefore, any additional fresh water quantity will put more pressure on the already scarce resources and depends on the quantity needed may escalate the demand and hence increase the cost of water for domestic use inside Gaza.

Additionally, the NGEST plant is surrounded by two dirt roads that are used by solid waste collection vehicles to transfer solid waste to the land fill used by Jabalia to the east of the plant. The dust created by vehicle movement will likely lower the efficiency of electricity generation from the PV panels and will require frequent cleaning (eg. by using water).

The existence of charcoal factory at nearly 300 m distance to the west of the plant has potential impact on the efficiency of the PV plants. Smoke resulting from the charcoal production might cover the PV panels and reduce the exposure to sunlight. This in turn will reduce the potential electricity production.

Table 58 present the summary of environmental and social significant of expected impacts during construction and operation of the project components, respectively.



Table 3: Assessed Significance of Expected Impacts during Operation Phase

Potential Impact	Type of impact	Duration of impact	Significance	Mitigation Measures Effects	Description of the impact	Standard governing the impact
Air Emissions and Noise Pollution	Negative	Permanent	Medium	Minor	Noise generating sources in the project are pump rooms and generators in the Booster Pumping Station. The main noise concerns are related to the Pumping Station staff, which may be exposed to intermittent pumping noise, caused by intermittent pump switching controlled by level control. This may be uncomfortable to PS staff. Measures for compliance with noise standards, especially for the working environment, have been recommended in the ESMP and Monitoring Plan. However, the standard protection of the workers, including earmuffs, has to be practiced all the time, especially at the Pumping Station area.	
Odour	Negative	None	Low	None	The operation of the project components is not expected to have significant impacts from odour.	
Vibration	Negative	Permanent	Medium	mitigation measures to be developed to minimize the vibration impacts to low	Although the pumps and the generator will be installed in the room, but measures have to be taken to reduce the vibration impact at the pumping station and the generator to minimize the impact due to the close distance with the El Shuhada cemetery.	
Impacts of Recovery Scheme on ground water	Positive	Permanent	High		Reduction in the water table elevation after two years of operation of the first stage of recovery wells.	

Potential Impact	Type of impact	Duration of impact	Significance	Mitigation Measures Effects	Description of the impact	Standard governing the impact
table						
Impacts of Recovery Scheme on ground water quality	Positive	Permanent	High	Positive impact with high significance	As demonstrated by the model, the second stage of the recovery wells will restrict the expansion of the pollution plume; i.e. if only 14 wells continue to operate, the pollution will be extended, and more wells will be at risk in year 2025	Palestinian, Jordanian and WHO
Water resource contamination (groundwater)	Combination of positive and negative impact		Medium likelihood	Moderate significance	Reduce the severity of the impact by implementing the monitoring, operation and maintenance of the wells as specified in the monitoring plan	Palestinian, Jordanian and WHO
Recovery water quantity and quality	Combination of positive and negative impact		Medium likelihood for water distribution due to the restriction of water purposes and positive likelihood for better quality and quantity of the recovery water	Negative impact of medium significance	Reduce the impacts by awareness and monitoring campaign for the farmers, the restriction of using recovered water, health and safety procedure dealing with recovered water	
Positive Impacts of the photovoltaic panels	Positive	Permanent	High	Highly significant	By adding the photovoltaic (PV) system to NGEST, the annual supply from the grid in 2018 is reduced by 24% and the required annual energy from the emergency diesel is	

Potential Impact	Type of impact	Duration of impact	Significance	Mitigation Measures Effects	Description of the impact	Standard governing the impact
					taken down by 27% allowing the NGEST facility to reduce its diesel consumption by 30%, leading to the saving of 1,3 million liters of diesel fuel. This will result in lower emissions amounting in 70 989 tCo2 eq over the 20 years lifespan of the project.	
Impacts on soil	Negative	Permanent	High	Negative impact with high significance	<ul style="list-style-type: none"> <li>Several changes to the physical and chemical properties can result from the use of reclaimed water for irrigation. The type of soil and its physical and chemical characteristics, most common of which are salinity, sodicity, PH, toxicity and bacterial count.</li> <li>Using the recovered water for irrigation will result in the need for fertilizers to condition the soil. The amount used will depend on the crops used and cannot be determined at this stage.</li> </ul>	Palestinian, Jordanian and WHO
The potential change in source of income	Positive	Permanent	Low	Minor	<p>The market of recovery water reuse and sludge is a big market, if it is appropriately managed.</p> <ul style="list-style-type: none"> <li>In principle the sludge, which is very rich in nutrients (N, P, K) could be used as fertilizer and replace chemical fertilizer, which are currently imported from Israel. Indicating that relying on the sludge might save money needed to import the chemical fertilizers from Israel.</li> </ul>	Performance standard 2: labor and working conditions

Potential Impact	Type of impact	Duration of impact	Significance	Mitigation Measures Effects	Description of the impact	Standard governing the impact
					<ul style="list-style-type: none"> <li>▪ The utilization of the recovered water of high quality and of proper price might work for the benefit of the farmers, increasing their profits.</li> <li>▪ Generally speaking, farmers cultivate their lands using rains, rain fed irrigation. Using this type of irrigation, farmers cannot cultivate all types of crops. Enabling continuous source of water can provide them with wide opts to cultivate the preferable crops of high productivity and revenue. PWA managed to prepare a full report about the impacts pertaining to crop cultivation and productivity of lands.</li> </ul>	
Workforce	Positive	Permanent	Low	Minor	The project will result job opportunities for operation workers (50 person)	Performance standard 2: labor and working conditions
Workforce	Negative	Permanent	Low	Minor	Occupational health and safety: Workers on the Project will be exposed to a range of OHS risks during construction and operation, such as working at height, manual handling, contact with hazardous material, noise and vibration, amongst others. In the absence of appropriate standards and preventative practices, the health and safety of workers would not be adequately protected. IFC PS 2 addresses occupational health and safety.	Performance standard 2: labor and working conditions

Potential Impact	Type of impact	Duration of impact	Significance	Mitigation Measures Effects	Description of the impact	Standard governing the impact
Impact on community health conditions	Positive	Permanent	Medium	Not applicable	Using of treated water will reduce the sewage water that floods over, affecting people and their livelihood status. As well, the usage of untreated water due to the high cost of the municipality water might be reduced as the farmers will use the recovered water instead	Performance standard 4: community health, safety, and security
Access to electricity and potable water for site operation	Negative	Permanent	Low	Minor	Use of public electricity and water networks could reduce availability for local residents.	Performance standard 3: resource efficiency and pollution prevention

## **8 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) AND MONITORING PLAN**

### **8.1 Introduction**

This chapter presents Environmental and Social Management Plan (ESMP) developed for NGESTP Effluent recovery scheme. This chapter consists of the following sections:

- Objectives of ESMP
- ESMP
- Guidance on Emergency Response Plans
- Roles and responsibilities in the implementation of the ESMP
- Cost Estimation

### **8.2 Objectives of ESMP and Monitoring Plan**

The Environmental and Social Management Plan (ESMP) consists of a set of mitigation, management and monitoring measures to be taken during implementation of the project to avoid, reduce, mitigate, or compensate or offset any adverse social and environmental impacts. In addition, the ESMP defines procedures to ensure that the management of environmental and social issues during the different project phases are undertaken in accordance with national legislation and best practice procedures.

The successful implementation of the ESMP will depend on a range of different elements. To ensure a management plan that incorporates and successfully integrates with interface documents, the following elements must be considered and acted upon:

- The environmental and Social Management unit should be adequately staffed to ensure the proper implementation and monitoring of the ESMP. The organizational structure of the environmental and social PMU should also reflect the range of complete competencies to perform the tasks.
- The development and management of registers for the proper documentation and tracking of environmental and social training, environmental and social incidents and environmental and social related complaints.

The Environmental and Social Management Plan (ESMP) presented in this chapter reflects the implementation procedures and mechanisms for the mitigation measures and monitoring activities of the expected impacts previously discussed. The ESMP assigns certain tasks for different stakeholders according to their roles and responsibilities in the project.



## 8.3 During Construction

### 8.3.1 Air Quality

#### Management activities

1. Air emissions of construction machinery should be within the Palestinian acceptable standards. This could be achieved by including this requirement in the tender document for construction works, and reviewing of contractor documentations about construction machinery exhaust emissions.
2. Implement a construction site management plan including the following measures:
  - Store construction materials in pre-identified storage areas.
  - Cover friable materials during storage.
  - Wet the network of unpaved roads on site. The use of water should be restricted to extremely active areas.
  - Regulation of speed to a suitable speed (20 kmh) for all vehicles entering the village's boundaries.
  - Implement preventive maintenance program for vehicles and equipment working on site and promptly repair vehicles with visible exhaust fume.

The implementation of these mitigation measures shall be the responsibility of the contractor, while PWA will supervise and document the contractor's compliance with the above measures in monthly reports.

#### Monitoring activities:

1. The monitoring of air emissions shall be limited to point sources including exhaust of construction machinery, as monitoring ambient air quality as result from non-point sources dust emissions may be misleading due to the possible interference of external sources of pollution. However the supervision consultant should observe unacceptable dust emissions and document them in monthly progress reports.
2. Measure HC, CO and opacity for construction machinery using a gas analyzer
3. Complaints recording would be undertaken by the supervision consultant. When complaints are received they should be recorded and documented in monthly progress reports.

Physical monitoring of noise shall be the responsibility of the contractor. The PWA should ensure that these monitoring activities are included in the tender document of the contractor.



### 8.3.2 Noise Pollution

#### Mitigation measures:

Noise in the construction phase is associated with heavy machinery, heavy trucks and generators. The noises of these equipment vary from continuous sources, such as loader, vacuum trucks and construction trucks, to intermittent impacts, from generators.

The most effected people of noise impacts are the construction workers. Palestinian outdoor noise standards has specified certain standards for noise intensity, number of impacts and exposure duration for the working environment, which should be respected during construction. The following mitigation measures are proposed

1. Minimization of exposure of construction workers to different noise levels and noise impacts according to the Law standards. This could be achieved through adjusting working hours, breaks, and exposure duration to be within permissible limits. Also construction workers should be provided with ear muffs, if needed, especially for those working near piling machines.
2. Minimize construction through nighttime whenever possible to reduce disturbance to residential areas
3. Measure ambient noise levels in noise critical areas, using a portable noise meter;
4. Investigate and follow-up on noise complaints from workers and others, on site.
5. Optimize the use of noisy construction equipment and turn off any equipment if not in use;
6. Regular maintenance of all equipment and vehicles
7. Implement an occupational health and safety plan which includes:
  - Provisions of Personal Protective Equipment (e.g. ear protectors) for the workers operation equipment that generates noise, especially the equipment that generates noise levels greater than 80 dBA. The protective earmuffs should be use especially for the workers who work continuously for 8 hours near heavy equipment.
  - Training on how and when to use protective equipment to be part of the workers' induction training;
  - Clear instructions in areas where noise emissions are significant;

#### Proposed monitoring activities

1. Monitoring of noise should also take the above mentioned strategy. Point sources noise monitoring should be undertaken beside noisy machinery in locations of workers' exposure. Ambient noise should be observed and noise complaints from neighboring locations should be registered.
2. Complaints recording would be undertaken by the supervision consultant. When complaints are received they should be recorded and documented in monthly progress reports.

Physical monitoring of noise shall be the responsibility of the contractor. The PWA should ensure that these monitoring activities are included in the tender document of the contractor.

### 8.3.3 Vibration

#### Mitigation measures:

The main source of vibration during the construction phase comes from the truck movements, construction of the storage tanks, pump installation, well drilling and other activities associated with concrete construction works.

The closest sensitive structures to the site is the El Shuhada cemetery (around 10 m away from where the water distribution network will be laid, especially the booster pumps). The mitigation measures has been proposed as follows:

The mitigation measures proposed during the construction of water distribution network component, near the El Shuhada area are as follows:

1. The base camp and the place for storage of the equipment has to be on the future land dedicated for the booster pumps and the storage tanks.
2. The construction of the storage tank and the booster pumps room including the generators and the electrical rooms have to be separated. The time management plan of separation works will reduce the numbers of the heavy equipment.
3. The ready mix concrete is preferred to be used instead of onsite concrete mix. Beside the reduction of the dust transmitted to the agricultural land due to chemical content of the concrete materials and reduction of the hazardous waste and solid waste on site, the vibrational load will be reduced significantly. In addition, the ready mix concrete mix tanker with pump will be advantageous.
4. Construction and other activities which are audible or have the potential to create vibration premises will be limited to the hours of operation i.e 7:00 AM to 5:00 PM.

#### Proposed monitoring activities

Vibration monitoring is only likely to be required where specific complaints are received from members of the public. Should vibration monitoring be required, this would be undertaken on an ad-hoc basis.

No significant adverse vibration impacts would be anticipated to occur and therefore, the impact is "low".

#### 8.3.4 Construction Waste and Handling of Hazardous Waste

The waste that would be generated during construction phase of the solar projects, the Rehabilitation of 7 infiltration basins, the distribution network and the access roads.

These could be mitigated as follows:

##### Mitigation Measures Proposed

1. Onsite domestic sewage collection and disposal shall be provided by the contractor for construction workers' needs.
2. Proper waste collection and storage plus regular (preferably twice a week) waste collection by licensed contractors will need to be arranged by developers or site management. To co-ordinate and control this, site management should develop a waste management plan for municipal solid waste and a plan for hazardous solid and liquid waste.
3. Site waste management plan should be developed by the contractor prior to commencement of construction works. This should include the designation of areas to store different type of wastes, collection and removal schedule. Supervision and monitoring of the solid waste management has to be developed by the Contractor.
4. The burning of any type of wastes should be avoided.
5. The stripped top soil will be backfilled carefully in position after the completion of construction activities. The top soil will be spread between the excavated space and the concrete. The excavated soil will be managed to cover the required volumes of backfilling soils.
6. Soil excavated from the infiltration basins should be properly hauled away to the nearest landfill.
7. The reused clay or excavated sand should be stockpile and stored away from any waterway, drainage networks, existing wastewater networks and any other drainage patterns.
8. Nearby sanitary landfill should be notified to receive the unusable construction wastes or damaged construction materials.

##### Proposed monitoring activities

1. Daily field observation
2. Regular checks of waste collection and storage sites;
3. Regular checks of storage of chemicals (e.g. cleaning fluids);
4. Regular checks and maintenance of any sanitary facility with liquid waste storage (e.g. septic tanks).
5. Documentation in monthly reports

### 8.3.5 Changes in Hydrology and Groundwater Quantity and Quality

The mitigation measures to avoid the hydrology of groundwater quantity and quality are similar to the general wells construction and include:

1. No mitigation measures required for the construction of the recovery scheme
2. To reduce the impact from wells construction, highly qualified contractor has to be contracted, isolate the access and the site area to avoid outside disturbance that can make the land fallen down to the wells.

### 8.3.6 Ecological Disturbance

#### Mitigation Measures Proposed

Mitigation measures develop to avoid the crop and animal disturbances in the vicinity are as follow:

1. Fences have to be installed prior to the construction of the water networks and other components for recovery water distribution.
2. In case the destruction of the crops or plants at the farms near the construction of the recovery water distribution network, compensation has to be settled. The compensation measures shall be developed prior to construction. The compensation shall be developing based on the compensation framework of the Ministry of Agriculture.
3. Strictly standard procedure for health and safety of the workers, especially for the worker at the wetland site, should be observed.
4. Equipment to handle the vertebrates has to be prepared.
5. The fauna found to be dangerous must be isolated and handled with care.

### 8.3.7 Improper management of archeological sites

#### Mitigation Measures Proposed

In case chance finds, antiquities or sensitive remains occur during excavation, a night guard shall be arranged until the responsible local authorities or the Ministries and Antiquities take over. Until that happens, the contractor will be responsible for:

1. Immediate hold of excavation works, leaving the antiquity object exactly on its found location, taking photographs to document time and status of the object, assigning guards to watch the found antiquity and contacting the Ministry of Tourism and Antiquities to handle the site.
2. Secure the site to prevent any damage or loss of removable objects.

The Project Environmental Officer will be notified, who in turn will notify the responsible local authorities and the Ministry of Tourism and Antiquities immediately (within 24 hours or less). The

Responsible local authorities and the Ministry of Tourism and Antiquities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of Ministry of Tourism and Antiquities. The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values. Decisions on how to handle the finding shall be taken by the responsible authorities and by Ministry of Tourism and Antiquities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage. All implementation for the authority decision concerning the management of the finding shall be communicated in writing by relevant local authorities according to the Environmental Management Plan. Construction works could resume only after permission is granted from the responsible local authorities.

#### 8.3.8 Impacts pertaining to workforce

An adverse impact could occur as a result of interactions between construction workers and existing residents of Project AOI and its villages, where worker accommodation will be located.

#### Mitigation Measures Proposed

1. Conduct a health examination to workers prior to the onset of work
2. Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.
3. Grievance mechanism to be provided to local residents with a proper communication channels that enabled the community to voice their concerns.
4. Influx Management Strategy will be developed to coordinate worker accommodation between various construction companies, track the number of non-local workers, and manage issues related to accommodation. Development of the strategy will include further investigation of existing residents and their concerns and vulnerability to change.
5. Engagement with local communities to understand changes or issues that have developed since the start of construction.

#### Embedded Controls and monitoring

1. The project's workforce accommodation will be carefully managed by the subcontractor companies. Accommodation will be availed in the site and monitored by security persons. The contractor and its subcontractors have committed to ensuring that

workers' accommodation meets the standards established by the IFC and other international authorities, and the Project management team will conduct inspections to ensure compliance in this regard.

2. Each worker should submit a health certificate that provides information about his health status, additionally, workers can be entitled to frequent health check and blood test must be applied each six month.
3. With regards to other diseases i.e. swine flu, tuberculosis and hepatitis B. Workers should have a health examination in order to avoid transmitting such diseases to the surrounding communities.
4. In addition, each company has a housing department and workers must inform this department if they plan to spend a night outside their designated accommodation.

After the implementation of the above mentioned mitigation measures, the significance of the residual impact is assessed as Minor.

#### Cumulative impacts

Given the nature of the project AOI where no industrial projects have been identified, the project will result in minor disturbance. However, applying the above mentioned mitigation measures will minimize the impact to Minor.

#### 8.3.9 Potential implications for workers' Occupational health and safety

As 150 workers will be accommodated and work in the same place there will be different health risks. Following are the main risks related to health:

##### Mitigation Measures Proposed

1. Apply a health examination to workers prior to the onset of work
2. Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.
3. Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.
4. Occupational Health and Safety Strategy will be developed to coordinate worker health and safety measures between various construction companies, track the number of workers infected or died, and manage issues related to health conditions. Development

of the strategy will include further investigation of existing health and safety measures and workers' concerns and vulnerability to change.

#### Embedded Controls and monitoring

1. The project's workforce's health condition will be carefully managed by the subcontractor companies. Health facilities will be available in the site and in the vicinity areas (Project AOI and Surrounding villages ) and will be monitored by occupational health and safety persons.
2. The contractor and its subcontractors have committed to ensuring that workers' health meets the standards established by the IFC (Performance Standard 2: Labor and Working Conditions ) and other international authorities, and the Project management team will conduct inspections to ensure compliance in this regard.
3. Each worker should submit a health certificate that provides information about his health status, additionally, workers can be entitled to frequent health check and blood test must be applied each six months.
4. With regards to other diseases i.e. swine flu, tuberculosis and hepatitis B. Workers should have a health examination in order to avoid transmitting such diseases to the surrounding communities.
5. For drivers working in the project they should have a first license certificate that enables them to drive all vehicles. They should be also entitled for drug test, particularly, the drugs that can be injected.

After the implementation of the above mentioned mitigation measures, the significance of the residual impact is assessed as Minor.

Such impact is limited to the work site and is not predicted to result in any cumulative impacts rather than facing with and epidemic disease.

#### 8.3.10 Increased pressure on local services, related to construction workers' use of community services

An adverse impact may result from the Project's excessive utilization of local potable water which also service the local villages. Impacts on public sanitary system and landfill systems are not expected as there is no proper sanitary system or waste landfills. However, impacts related to public electricity grid tend to be of no relevance as the Water reuse plant will rely on generators during the

construction phase. Otherwise, a small electricity plant should be constructed prior to the construction phase.

With regards to waste management, the Project is obliged to recruit a certified waste management contractor to collect, transport, and properly dispose of waste generated at the site. Additionally, hazardous wastes should be collected and transferred to the dumping station in Johr El Deik.

Construction water (non potable) will be brought to site by water tanks, and will eventually be abstracted from the water station in Jabalia , Beit Hanoun and Beit Lahia; therefore, construction water will not affect local public water systems.

#### Mitigation Measures Proposed

1. The quantity of water supply should be calculated and negotiated with Water Company in order not to affect the local communities
2. Wells can be dug in the site to work as alternative source of water. Potable water also might be obtained from bottled water companies
3. Grievance mechanism to be availed to local residents with proper communication channels. This will provide the Project with any concerns or complaints, including potential issues related to utilities shortage.
4. Ongoing engagement with stakeholders water treatment plant and villages to identify concerns or changes in water availability, and ensure water resources are managed properly.
5. Engagement with local communities to understand changes or issues that have developed since the start of construction.

#### Embedded Controls and monitoring

The Water and Wastewater Management Plan commits to monitoring the total volume of water obtained from the municipal water supply on a quarterly basis. This plan will predict a potential impact in terms of reduced availability for other water users, and also commits to regular measurement of water flows, and use of water reduction measures in construction activities (in line with Good International Industry Practice).

The Project also commits to regular engagement with stakeholders including regulatory authorities, community water users, and local businesses, with the purpose of collaboration and coordination to manage water resources.

As the project will rely on its sources of water and electricity, the impact and residual impacts tend to be minimal. In case if the water provided to the project affected the residents women will be particularly vulnerable to reductions in water and electricity provision due to their house chores and



their role in maintaining the household. Impacts will be reversed when the Project becomes operational, as electricity and potable water will be generated on site from wells for Project use. The project impact on utilities might be escalated in case if villages and agriculture projects consumed more water. There is general shortage of water supply in the area. Any increase in water demand will influence other projects in the area.

#### 8.3.11 Increased traffic on the Roads

Project-related traffic may adversely affect other users of the Project AOI, Surrounding villages. This could lead to congestion, delays, and traffic accidents.

##### Mitigation Measures Proposed

1. Developing of Traffic Management Plan that contains all mitigation measures related to traffic impacts. This plan should explain the limitation and roles of traffic monitoring staff. Also, it should contain all indicators of monitoring that will put limitation to the unfavorable impacts
2. Grievance Mechanism to provide road users with a means of contacting the Project with any concerns or complaints, including potential issues related to traffic and road safety. One of the important communication channel to be available in the GRM should be the cell phone of traffic inspector. Any violation of traffic issues will be treated very seriously and appropriate corrective action(s) to be taken as needed.
3. Engagement with communities, road users, and the villages located around the site to identify concerns regarding road safety and traffic impacts. Signage and outreach activities to improve public awareness of traffic changes and potential hazards will also be targeted for high-risk sections of public roads, including near the site and laydown areas.
4. Engagement with regulatory authorities regarding traffic management and condition of public roads.

##### Embedded Controls and monitoring

1. The Project is committed to establishing and maintaining a Traffic Management Plan. This plan will reflect good construction practices including scheduling of Project traffic to avoid peak travel times on local roads, construction shifts, and driver training and capacity building to promote safe driving.
2. The speed limit on the public road between the site and the laydown area should be 30-60 km/h maximum. Speed bumps, warning lights and signage are used to slow down all vehicles in this section.

3. Pedestrian movement between the site and the laydown area will be limited to a designated walkway independent from the access roads, and pedestrian crossings will be protected by speed barricade, traffic lights and warning signs.
4. Regular checks will be undertaken to ensure continued use of good practices, and daily visual inspections will be used to monitor increases in road congestion and/or travel times.
5. Performance of Project vehicles/drivers in accordance with the Traffic Management Plan will be enforced. All road traffic incidents involving project vehicles (including deliveries) must be reported to the contractor, who will keep records and cooperate with relevant authorities and Company.

The Project's Traffic Coordinator will be responsible for engaging the stakeholders and regulatory agencies to monitor conditions and address concerns. Monitoring will focus on roads and intersections in the immediate vicinity of the site, where traffic levels will be the highest and roadside services are increasingly dense, as well as other sections of the Road) where there is a high potential for interaction with the public. Additional mitigation measures may be identified in response to changing conditions and concerns. The residual impact significance is assessed as Minor.

Given the limited industrial activities and project in the area, The project will not significantly add up to the traffic load on the project areas. Relying upon negotiations, collaboration and coordination will minimize cumulative traffic impacts to be Minor.

#### 8.3.12 Impacts related to land acquisition and economic displacement

Project-related land acquisition impacts may adversely affect the owners of lands, wells and the livelihood of well operators.

#### Mitigation Measures Proposed

1. Developing of resettlement Action Plan that contains all mitigation measures related to traffic impacts. This plan should explain the limitation and roles of traffic monitoring staff. Also, it should contain all indicators of monitoring that will put limitation to the unfavorable impacts
2. Grievance Mechanism to provide road users with a means of contacting the Project with any concerns or complaints, including potential issues related to traffic and road safety. One of the important communication channel to be available in the GRM should be the cell phone of traffic

inspector. Any violation of traffic issues will be treated very seriously and appropriate corrective action(s) to be taken as needed.

3. Engagement with communities, PAPs, and the villages located around the site to identify concerns regarding road safety and traffic impacts. Signage and outreach activities to improve public awareness of traffic changes and potential hazards will also be targeted for high-risk sections of public roads, including near the site and laydown areas.

#### Embedded Controls and monitoring

The PWA prepared a Resettlement Action Plan that identifies project impacts pertaining to land acquisition and economic displacement. Mitigation measures and compensation strategy is intensively presented. As well as, consultation strategy with the project affected persons. The RAP encompasses a full chapter about all consultation activities.

The Project's land acquisition will be responsible for engaging the stakeholders and regulatory agencies to monitor conditions and address concerns. Monitoring will focus census conducted to the PAPs and remedial actions adopted. The impact will be classified as Minor.

There will be no cumulative impacts

#### 8.3.13 Impacts related to visual intrusion and landscape

Construction activities can be seen in the project area of influence. Digging the land, construction of pipelines, and the moving of equipment will be noticed from the main road.

Description of Impact

#### Mitigation Measures Proposed

1. The Project will implement a grievance mechanism to provide local residents with a means of contacting the Project with any concerns or complaints, including potential issues related to visual intrusion.
2. Engagement with local communities to understand changes or issues that have developed since the start of construction.

Visual intrusion impacts tend to be irreversible in touristic areas. No mitigation measures can minimize such impact. Thus, the impact remains of Irrelevant

Given the nature of area of influence and the existence of no industrial activities, the project will not add to the unfavorable landscape of the area. Thus, the impact remains of Minor significance.

#### 8.3.14 Impacts related to land use

#### Mitigation Measures Proposed

1. Selection of suitable location for temporary storage of construction materials, equipment, tools and machinery prior to starting construction, especially on the site that is close to El Shuhada Cemetery.
2. The employed machinery drivers should receive training on safe utilization of their machines to minimize accidents risks.
3. Clear signs indicating the project site and temporary fences shall be installed prior to the preparation of the site, especially the water distribution networks area.
4. Avoid the side of the road for all the temporary storage materials and the place for standby equipment.
5. All the activities have to be during the daytime and have to be scheduled to avoid conjunction with the school and working peak hours (morning and afternoon).
6. The traffic department should be informed and involved to manage the traffic during the congested time. In addition, the preferred route and an alternative road have to be recommended by the traffic department.
7. If the digging (open trenches) is not completed within a day period, the clear sign (by light or fluorescence lights) has to be considered to determine and identify the site during the night.
8. When the land use and accessibility is disturbed and the safety of the communities passing by the project location is triggered (especially to the children, handicapped or the elderly who might use the access road), the temporary access road has to be considered with the traffic department assistance.
9. Temporary resettlement that might occur during the preparation and the construction phase has to be defined and accordingly has to be compensated.

## 8.4 Potentially Negative Impacts during Operation

### 8.4.1 Air Emissions and Noise Pollution

#### Mitigation Measures Proposed

The main noise concerns are related to the Pumping Station staff, which may be exposed to intermittent pumping noise, caused by intermittent pump switching controlled by level control. This may be uncomfortable to PS staff. The standard protection of the workers, including earmuffs, has to be practiced all the time, especially at the Pumping Station area.

### Proposed monitoring activities

1. The contractor should monitor noise intensity at locations of workers in pumping stations. The measurements are to be undertaken annually under normal pumping stations working conditions.
2. Investigate and follow-up on noise complaints from workers and others
3. The contractor should monitor exhaust emissions from standby generators against the stipulations of Law for carbon monoxide, sulphur dioxide, nitrogen oxides and total hydrocarbons. The monitoring is to be performed annually during the normal operation of the generators.

#### 8.4.2 Odour

The operation of the the pumping station, infiltration basins, wells and distribution network system are not expected to have any odour impacts.

### Mitigation Measures Proposed

No mitigation measures are required.

#### 8.4.3 Vibration

Although the pumps and the generator will be installed in the room, but special attention has to be made to reduce the vibration impact at the pumping station and the generator to minimize the impact due to the close distance with the El Shuhada cemetery.

It is expected, at the pumps and generators for the water distribution network will have “medium” impact.

### Mitigation Measures

The mitigation measures to be developed to minimize the vibration impacts of the machines are:

1. Tree plantation, heavy leaf trees to absorb the vibration and noise generated, is recommended to be planted at the cemetery area along the proposed main road at the other side of the pumping station.
2. Maintenance of the machines and equipment has to be maximize and if it is required less than the standard period required for maintenance and spare parts changes.

#### 8.4.4 Impacts on Local Agriculture, Public Health and Water Resources

Based on the design project report three scenarios that considered the expected water quality were recommended as follows:

1. Scenario I: In this Scenario it is more advisable to cultivate orchards on the available area to the west of the project along Al Karama Road, far away from the political boarder. The profiles of the soils on the area are deep enough to cultivate tree crops. Based on crops water requirements, the available reclaimed water (16,500 m<sup>3</sup> daily) is just enough to irrigate 5375 dunum divided into citrus (1613 dunum), olives (1344 dunum), fruit trees (806 dunum), alfalfa (806 dunum) and grains (806 dunum). The expected quality of recovered water is suitable and has no impact on the crops selected under this scenario.
2. Scenario II: In Scenario II the wastewater will be treated more effectively and consequently the effluent will be of better quality in general. The quantity of effluent diverted to the infiltration basin will increase to approximately 23,100 m<sup>3</sup> daily. This reclaimed water will be used to irrigate additional land amounting to 7525 dunum in total. The citrus area will increase to 2258 dunum, that for olives to 1881 dunum, fruits to 1129 dunum, alfalfa to 1129 dunum and grains to 1129 dunum.
3. Scenario III: This Scenario assumes that the planned WWTP in East Jabalia will work with its full capacity by year 2025. The quality of reclaimed water (39,160m<sup>3</sup>/day which equals 35,600 plus 10% extra) is expected for unrestricted use as indicated in table, Table 50. The quantity of reclaimed water will be enough to irrigate about 12,577 dunum. The citrus area will increase to 3773 dunum, area for olives to 3144 dunum, fruit trees to 1887 dunum, and alfalfa and grains each will increase to 1258 dunum. In this scenario vegetable crops will be introduced with an area of 1258 dunum, as it is difficult to convince the farmers to accept the recovered water for cultivation of vegetables at the beginning of the project.

#### 8.4.5 Contamination from Reuse of Recovery Water in Irrigation

##### Mitigation Measures Proposed

Health protection measures (general measures) which can be applied to the agricultural use of treated water include the following:

##### **1. Crop restriction**

Water of a high microbiological quality is needed for the irrigation of certain crops, especially vegetable crops eaten raw, but a lower quality is acceptable for other selected crops, where there is no exposure to the public. Crops can be categorized according to the exposed group and the degree to which health protection measures are required.

**Category A:** Protection required for consumers, agricultural workers, and the general public. This includes crops likely to be eaten uncooked, spray-irrigated fruits, and grass (sports fields, public parks and lawns).

**Category B:** Protection required for agricultural workers only. This includes cereal crops, industrial crops (such as cotton and sisal), food crops for canning, fodder crops, pasture and trees. In certain circumstances some vegetable crops might be considered as part of Category B if they are not eaten raw (potatoes, for instance), or if they grow well above the ground. In such cases it is necessary to ensure that the crop is not contaminated by sprinkler irrigation or by falling onto the ground, and that contamination of kitchens by such crops, before cooking, does not give rise to a health risk. These measures will protect consumers, but not farm workers and their families. Crop restriction is therefore not adequate on its own; it should be complemented by other measures such as human exposure control.

Crop restriction is therefore feasible under conditions where:

1. an irrigation project has a strong central management;
2. there is adequate demand for the crops allowed under crop restriction, and they fetch a reasonable price;
2. there is little market pressure in favor of excluded crops (i.e. those in Category A). Adopting crop restriction as a means of health protection in reuse schemes will require a strong institutional framework and the capacity to monitor and control compliance with regulations and to enforce them. Farmers must be advised why such crop restriction is necessary and be assisted in developing a balanced mix of crops so that production of surplus of a specific crop is avoided.

### 3. Human exposure control and promotion of hygiene

#### Proposed monitoring activities

The following table shows the effluent standards recommended by PWA for irrigation.

Table 4: Criteria Recommended by PWA for Effluent Standards (PS742, 2003)

Criteria	Restricted Use1	Unrestricted Use2
BOD (Mg/l)	30	20
TSS (Mg/l)	50	30
Total-N (Mg/l)	10-15	10-15

F. coliforms	Less than 1000	Less than 200
Helminthes eggs	Less than 1	Less than 1
Intestinal nematode	Less than 1 ova per litre	Less than 0.1 ova per litre

Notes:

- Restricted crops: Cereal crops, industrial crops, fodder crops, crops normally eaten cooked and trees, etc.
- Unrestricted crops: Crops normally eaten uncooked (vegetables), Sport fields, and parks.

#### 8.4.6 Impacts of the use of reclaimed wastewater for irrigation on soil quality

Steps must be taken to minimize potential hazards that might be associated or resulted from using reclaimed wastewater. These steps are to improve permanently existing conditions to facilitate and make irrigation with wastewater easier. Among these steps is leveling of land to a given grade, establishing adequate and efficient field drainage systems, either open or tiled drainage system or both, deep ploughing and leaching to reduce and control soil salinity.

Land leveling (grading) is important to achieve a good uniformity and acceptable water irrigation efficiencies when using surface (flood) irrigation. This will also avoid salt accumulation in the high spots area and water logging in the low spot areas, especially since the reclaimed wastewater (as demonstrated in first level recovery wells, RWs) have been found to contain appreciable amounts of dissolved salts (Sodium, chloride and TDS).

Laser techniques can be applied to level the land precisely which resulted in high level efficiencies and prevent salts accumulation or water logging. In addition, sub-soiling and deep chiseling can greatly enhance irrigation efficiency and water movement in the soil, especially in the case of the particular soil layers dominating the project site. (Zone A of the project site is characterized with loamy clay textured soils with dark brown to reddish brown color are dominated in the area and the Zone B is characterized with loamy clay textured soil in the northern side- Annex 4C) , resulting in impeding or preventing free movement of water through or beyond the root zone.

#### Mitigation Measures Proposed

1. Chemical amendments : The use of calcium source amendment such as gypsum is widely accepted for amelioration of soils with high percentage of Na in the cation exchange capacity (CEC) or whenever water high in SAR is used in irrigation. Na in soil is exchanged by Ca from gypsum and dispersion of the colloidal phase is reduced. Application of gypsum should be repeated periodically depending on the Na content in the water and the CEC of the soil. The farmers are advised to seek professional help to estimate the amount and frequency of the gypsum application required.



2. Adapted irrigation system. Crust formation at the soil surface is the result of the irrigation with water high in SAR . The degree of the problem, however, is not the same with all irrigation systems. In general, the surface irrigation systems with water high in SAR creates thick surface crust. Similar results are obtained with sprinklers of high discharged capacity. This way, the soil water, permeability as well as soil aeration and emergence of the seeds are affected. When using many sprinklers and drippers of low discharge rates, the formation of surface soil crusting is reduced. The duration of irrigation is extended and sufficient time is allowed for water penetration into the soil. (Papadopoulos, 1995) .
3. Organic matter: The alkalinity problem can also be solved by addition of organic matter like straw, other plant materials or organic manure.

### Monitoring Proposed

Periodic monitoring and control of soil physical, chemical and microbiological properties of the soil under wastewater irrigation is necessary to ensure successful and sustainable waste water application. Parameters recommended for monitoring were suggested in Table 3.

The soil should be monitored before and during the course of using wastewater for irrigation. Soil texture (leaching problem is higher), PH, salinity, cation exchange capacity and others are important characteristics that determine the limitation and the type of management of wastewater irrigation. Many of these were covered in the legal framework and analyzed in the baseline chapter.

Several soil management practices can be adopted at the field level to overcome the possible environmental and health hazards (salinity, sodicity, toxicity etc.) associated with the use of treated (reclaimed ) wastewater.

Dispersion of soil colloidal phase, stability of aggregates, soil structure and permeability, are very sensitive to the type of ions present in irrigation water. Even though leaching is allowed, the increase in soil alkalinity , which may occur with the reclaimed wastewater in the irrigation scheme due to high Na concentration found reduces soil's permeability for water , particularly at the soil surface, since soil clays tend to disperse and swell from the increased level of exchangeable Na. However at certain sodium adsorption ratio (SAR), the infiltration rate increases or decreases with the salinity level. Therefore, SAR and EC<sub>w</sub> should be used in combination to evaluate eventual potential problems (Rhoades, 1977).

The following parameters should be measured in the soil four times a year (quarter: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, Atrazine

#### 8.4.7 Impacts of recovery scheme on ground water

As an indirect impact of the recovery scheme, ground water may be potentially affected by the use of fertilizers that may accompany the switch from rain-fed agriculture to irrigated agriculture, especially as a result of the shallow groundwater table in the area. Exact pollutant loads will depend on the type of fertilizer, amount, irrigation schedule and other parameters that may have to be covered in greater detail.

##### Mitigation Measures Proposed

It is not possible to estimate such loads at this stage, especially that the type of crops and their distribution are not exactly known at this stage. It is necessary that a detailed agricultural study is made and designed, before the exact impacts are estimated quantitatively.

##### Monitoring Measures Proposed

Nitrogen (N), phosphorous (N) and ammonia (NH<sub>4</sub>) should be measured four times a year according to the water monitoring plan.

#### 8.4.7.1 Potential implications for workers' health and safety

As 300 workers will be accommodated and work in the same place there will be different health risks. Following are the main risks related to health:

##### Mitigation Measures Proposed

1. Apply a health examination to workers prior to the onset of work
2. Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.
3. Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.
4. Occupational Health and Safety Strategy will be developed to coordinate worker health and safety measures by the operator , track the number of workers infected or died, and manage issues related to health conditions. Development of the strategy will include further investigation of existing health and safety measures and workers concerns and vulnerability to change.

##### Monitoring Activities Proposed

The project's workforce's health condition will be carefully managed by the operator. Health facilities will be availed in the site and in the vicinity areas (Project AOI and Surrounding villages ) and will be monitored by occupational health and safety persons.

The operator will be committed to ensuring that workers' health meets the standards established by the IFC (Performance Standard 2: Labor and Working Conditions ) and other international

authorities, and the Project management team will conduct inspections to ensure compliance in this regard.

Each worker should submit a health certificate that provides information about his health status, additionally, workers can be entitled to frequent health check and blood test must be applied each six month.

With regards to other diseases i.e. swine flu, tuberculosis and hepatitis B. Workers should have a health examination in order to avoid transmitting such diseases to the surrounding communities.

For drivers working in the project they should have a first license certificate that enables them to drive all vehicles. They should be also entitled for drug test, particularly, the drugs that can be injected.

After the implementation of the above mentioned mitigation measures, the significance of the residual impact is assessed as Minor.

Such impact is limited to the work site and is not predicted to result in any cumulative impacts rather than facing with and epidemic disease. The significance of cumulative impact is Minor

#### 8.4.8 Vulnerable groups

##### Mitigation Measures Proposed

In order to reduce the impacts of the project vulnerable groups, it is recommended to apply the mitigation measures that can be summarized as follow:

The mitigation of impacts will be described in detail in the mitigation measures section. However the discussion of mitigation measures with the above mentioned affected groups based on the entitlement characteristics, any one that might be affected due to expropriation should be compensated. It is recommended to develop a Resettlement Policy Framework and Resettlement Action plan in order to identify the Project Affected Persons (PAPs), their entitlement, compensation valuation and mechanisms proposed for compensation.

Those who might be considered as project affected people can be summarized as follow:

1. The owners of wells: they should be provided with recovered water free of charge in addition in cooperation with the municipality they should be provided with fresh water of lower subsidized cost. The cost of digging their wells should be paid in a full market price.
2. The operators of wells should be provided with alternative job opportunity in the project itself or assessed by the agricultural entities to reduce their suffering.

3. The owners of small plots those groups should be completely avoided as they will be badly affected. Otherwise, they should be compensated in a full market price by the municipality

PWA does not provide any assistance to the affected people in terms of training or rehabilitation for the affected groups (which is not necessary for this project). As well, they are not the entity responsible for the compensation of any affected people especially those who will lose their lands. Therefore, they should apply the following strategy to minimize the unfavorable impacts:

Seeking for appropriate alternative for wells in order to reach the maximum limitation for the affected areas

- The wells in small plots of lands
- The wells that represent the sole source of income
- The wells should be compensated for the digging in a full market price

Cooperation with other entities to provide assistance or to mitigate affected persons appropriately

- Municipalities
- Ministry of Health
- Agricultural organizations
- Awqaf
- Other potential entities

Thinking about different strategies for compensation

- Provision of job opportunities.
- Supporting in the provision of appropriate compensation
- Supporting in the provision of alternative lands
- Provision of information to the affected people on strategies of compensation

#### 8.4.9 Impacts on water supply

##### Mitigation Measures Proposed

1. The dust created by vehicle movement can be mitigated through the pavement of the roads around the plant.
2. Possible mitigation will only be possible in the case of ceasing the dust emission from the dirt roads
3. using the water from the recovery wells of the NGEST plant for cleaning. This later will be subject to the quality of water from the recovery wells.

## 8.5 Other Management Measures

In addition to the potential impacts described above (Sections 4.2 and 4.3), compliance with the IFC Performance Standards requires careful consideration of other key social risks related to Project construction and operation, including site security arrangements, working conditions, and occupational health and safety. Although these considerations are addressed in the Company's policies and procedures, they are discussed below in the context of potential socio-economic risks and impacts.

### 8.5.1 Site Security

Protests or aggressive activities at the site may require intervention by security personnel. In accordance with IFC PS4, the use of security personnel needs to be carefully managed. Security arrangements should be proportionate to the needs of the local area, and personnel should be properly trained, equipped and monitored.

The CONTRACTOR Consortium's Construction ESMP describes site security arrangement as follows:

"A layered security plan including vetting and qualification of security staff (via national security agency of Palestine ) is in place for the Um El Nasr Site. This plan is coordinated with the local military and police organizations. Only Palestinian security forces will be allowed to carry firearms on the Site. This security plan is aligned to the Voluntary Principles on Security and Human Rights to which the Consortium commits; due to its nature this document is confidential."

The Security Plan has not been developed ; however, it should detail the Company's position and measures to address the use of force, training, equipping and monitoring security guards as well as investigating reports of unlawful behavior and preventing recurrence. Security shall be provided in a manner that does not jeopardize the community's safety and security, or the Project's relationship with the community. It will comply with national legislative requirements and with the requirements of IFC Performance Standard 4, which is consistent with good international industry practice. The commitment to align with the Voluntary Principles on Security and Human Rights is noted.

Any security personnel from private companies will be trained and will operate in accordance with the 'International Code of Conduct for Private Security Providers'. The Project will 'make reasonable enquiries to ensure that those providing security are not implicated in past abuses; will train them adequately in the use of force (and where applicable, firearms) and appropriate conduct toward workers and local communities; and require them to act within the applicable law'.

Appropriate information on the Project's security arrangements will be provided to local stakeholders and they will be engaged in discussions about these arrangements. The grievance mechanism for the

Project will capture all grievances raised in relation to security and safety issues. These will be addressed promptly and appropriate actions will be taken in consultation with affected parties.

The Project should also recognize that security standards and expectations in Palestine may not align with the practices required by IFC PS4, and security personnel may be predisposed to use force; thus, the Security Plan should openly address inter-cultural issues that may affect the successful implementation of the plan. The Project should also ensure that local stakeholders and public are aware of security activities at the site, are informed of their rights and any restrictions on access/activities, and are aware of the Project's grievance mechanism.

#### 8.5.2 Working Conditions

The Project will comply with Palestinian law Number 12 of year 2003, ILO conventions, and the international good practice of the IFC PS and related guidelines, in relation to labor and welfare standards, and freedom of association, with specific reference made to child and forced labor. Emphasis will also be placed on measures to ensure that workers are free of any discrimination, regardless of race, religion or belief, gender, disability, age, nationality, sexual orientation or ethnicity. The CONTRACTOR Consortium's Construction ESMP<sup>71</sup> addresses issues related to employment, human resources, and working conditions. There is also an HR Policy<sup>72</sup> for the Um El Nasr Project. The HR Policy (including occupational health and safety and other requirements) applies to all entities of the Project, including subcontractors and temporary workers. The Company has committed to align with the requirements of IFC PS2 and the Project's approach in relation to key elements is as follows:

##### HR Policy and Procedures

It is expected that the vast majority of workers will be Palestine, with any workers from the local communities filling positions for involving unskilled/low-skilled labor.

The Project commits to complying with Palestinian human resources and labor legislation including laws, executive regulations, Presidential and Ministerial decrees and laws related to labor, child labor and women's rights. Palestinian labor laws address key aspects of employment, including wages, overtime, sick-leave, communication, and non-discrimination, as applied to both permanent and temporary workers. As applicable to all such companies in Palestine, the Project (including construction contractors) must each have an HR policy that is aligned with Palestinian Labor Legislation.

The Project's HR policy and procedures will be clearly communicated to all Project workers and contractors. Copies of key documents will be posted in public places across the Project Site, including accommodation areas. The obligation to abide by the policy and procedures will be an integral, formal part of all contracts.

#### Working Conditions and Terms of Employment

The Project commits to ensuring competitive and fair remuneration, and will ensure that any migrant employees are engaged on equivalent terms as non-migrant workers. Terms of employment and working conditions will be clearly communicated to employees, including wages and benefits, hours of work, overtime and compensation, breaks, and provisions for leave.

#### Workers' Organizations

Under Palestinian law, certain labor unions are allowed and others unauthorized; currently there is no formal union for semi-skilled or unskilled workers. In any case, the Project will not limit or inhibit the rights of workers to join unions or otherwise associate or participate in collective bargaining.

#### Non-Discrimination and Equal Opportunity

The Project commits to ensuring that no discrimination by or of any employee (or in decisions on employment) is tolerated for reason of origin, nationality, religion, race, gender or age for any aspects of the employment relationship. This excludes where there are special measures of protection or assistance to remedy past discrimination in terms of national law. Discrimination, intolerance and any form of harassment (e.g. moral, sexual) shall be prohibited, actively tracked and eliminated. This principle shall be applied at all employment levels and in all circumstances.

#### Retrenchment

In the case of potential collective dismissals, the Project will take reasonable steps to reduce overall loss of employment by investigating suitable alternatives. Where these alternatives are not possible, reduction in the workforce shall be undertaken in accordance with a retrenchment plan developed by the Project through consultation with employees, and in line with national laws.

#### Grievance Mechanism

Worker grievances will be addressed through the Project's worker grievance mechanism, which was implemented in January 2016. This transparent mechanism is designed to receive and address grievances and objections for all direct employees. The Project will ensure that the grievance mechanism, or similar, is established for employees of contractors.

#### Child and Forced Labor

The Company states that they shall specifically monitor the health, working conditions and working hours and conditions of employees under the age of

18. Employment of minors is only permitted where such employment must ensure that it does not interfere in the child's education and or is not harmful to the minor's health, wellbeing or development, and where permitted by law. Employment of minors shall exclude any hazardous work and shall be in line with Palestinian regulations in terms of suitable work activities and additional specific conditions or requirements for young workers.

The CONTRACTOR Consortium commits that, in accordance with both Palestinian law and international good practice, no workers below the age of 18 will be hired. This will be monitored via the security controls and ID checks at the entrance gates.

The Project will actively ensure that there is no employment of forced labor (including indentured labor, bonded labor or similar contracting arrangements) or trafficked persons. The Project will not retain identification papers, work papers, or other important belongings to deny workers' rights to movement and resignation.

#### Contractors and Third Parties

The Project will take commercially reasonable measures to ensure that contractors are reputable enterprises, with management systems in place to ensure they operate in line with the Project's HR Policy (with the exception of retrenchment and supply chain policy statements). These requirements shall be included in contractual agreements and contractor compliance will be monitored on an ongoing basis. Recruitment agencies and other third parties will also be contractually obligated to align with this policy.

#### Supply Chain

The Project commits to reviewing the primary supply chain where there is a high risk of child and forced labor and significant safety issues, and identifying these risks. Where there is evidence of labor or safety incidents, the Project shall ensure appropriate steps are taken to remedy this. The implementation of these measures shall be monitored and where remedy is not possible, the Project shall shift the primary suppliers over time to those which can demonstrate alignment with the child and forced labor and safety statements contained within the Project's HR Policy.

#### Training

The Project will develop and provide adequate training programs in line with job descriptions of employees in order to enable employees to undertake their duties safely and with the expected technical competence.

Table 4-12 identifies specific considerations and recommendations related to labor and working conditions for the Project.

### 8.5.3 Occupational Health and Safety

Workers on the Project will be exposed to a range of OHS risks during construction and operation, such as working at height, manual handling, contact with hazardous material, noise and vibration, amongst others. In the absence of appropriate standards and preventative practices, the health and safety of workers would not be adequately protected. IFC PS 2 addresses occupational health and safety.



The Project has committed to implement an occupational health and safety management system in accordance with OHSAS 18001. This includes the development of an OHS management plans based on the identification and management of key hazards to which workers are exposed, and with the objective of ensuring that employees do not come to any harm. A quantitative risk assessment (QRA) has been conducted, including a hazard identification (HAZID) and evaluation of potential failure cases for the facility.

The Project is committed to complying with national labor, social security and occupational health and safety laws as well as the standards of IFC PS 2. The Project will have a robust OHS Plan in place for the duration of construction and operation

It will include measures to minimize the risk of accidents, illness and injury; document and report all incidents; and ensure appropriate emergency preparedness and response planning. A formal grievance procedure will be developed for workers and there will be occupational health and safety monitoring programs to verify the effectiveness of prevention and control strategies.

the EHS Manual for Project construction will encompass relevant policies, objectives, roles and responsibilities, and site protocols/regulations designed to manage risks associated with construction activities. The CONTRACTOR Consortium commits to a Zero Harm culture with objectives for zero incidents, accidents, occupational illnesses, or incidents affecting the environment or communities. Requirements for subcontractors are identified, as well as provisions for site access, environmental protection, health/hygiene, and protective equipment. Specific requirements are outlined for job activities such as working at height, excavations, and use of equipment.

The HR Policy also reinforces the Project's commitment to occupational health and safety, including worker accommodation. As defined in the HR Policy, the Project will provide safe and healthy conditions for working and accommodation for all employees, including subcontractor workers. The policy encompasses physical, chemical, biological and radiological hazards as well as specific threats to women. In regard to accommodation services, the Project commits to ensuring that they are of reasonable quality and include basic services including water, sanitation, ventilation, lighting, cooking facilities, and protection against the elements.

#### 8.5.4 Awareness raising activities

- During different stages of the project, different awareness raising activities should be carried out with the public and the laborers in order to minimize the impact related to the misconceptions, and to inform the community about the different stages of the project as well as expected duration of its completion.

- Another benefit of raising awareness is to train the community especially the women and children on the safety measures that should be applied in the areas of constructions.
- These awareness raising activities can be implemented through workshops, public meetings in public gathering places, printing pamphlets, and through the different social interaction websites.
- Awareness raising activities is a proactive approach that minimize conflicting with project stakeholders. Additionally, it is an active feedback channels that might predict the perception of community and working crew towards project activities.

Training plan for socio-economic issues as well as awareness raising activities is presented in the table below.

**Table 5: Recommended Training courses**

Training course	Type of training	Receptors	Proposed Scheduling	Cost Estimate In US \$
Information about clean steam Water reuse plants	Workshop + on the job training	Social Development Officers	Prior to the project	1000 \$
Promotion of Awareness Raising Activities	Workshop + on the job training	- Social Development Officers	Once before the project implementation Refreshment course during the implementation of the project	2000 \$
Communication Skills	Two days' Workshop + on the job training	Social Development Officers	- One workshop during the beginning of the project implementation	1000 \$
Grievance and redress mechanism	One day Workshop + on the job training	Social Development Officers	- One workshop during the beginning of the project implementation	1000 \$

Training course	Type of training	Receptors	Proposed Scheduling	Cost Estimate In US \$
Palestinian laws related to social aspects	One day Workshop + on the job training	Social Development Officers	- One workshop during the beginning of the project implementation	1000 \$
Community Participation Tools	One day Workshop + on the job training	Social Development Officers	- One workshop during the beginning of the project implementation	1000 \$
Monitoring and Evaluation mechanisms (M&E)	Two days' Workshop + on the job training	Social Development Officers Project management unit	- One workshop during the beginning of the project implementation	2000 \$

## 8.6 Tools for facilitating Mitigation Measures implementation

Roles and responsibilities for implementing the ESMP during the construction phase have been proposed based on the following set-up:

- The project owner company will develop detailed designs and tender documents, for construction of the Water reuse plant, which will include the environmental measures that should be undertaken by the construction contractor
- During tenders evaluation The project owner company assure that the approved offer must include the required environmental mitigation measures to be implemented during construction
- The project owner company will be responsible for the implementation and monitoring of the ESIA
  - During plant operation, the most critical responsibilities are the operation and maintenance of the equipment used to control and measure pollution discharges

- Reports on the results of environmental monitoring and other activities may have to be prepared and submitted to the PWA and lending institutions.
- Finally, compliance with all activities related to environmental compliance should be audited periodically throughout plant operation

The above-mentioned tasks were defined by the project owner company investments. The analysis of the following organic ram revealed that the social aspects were not entirely considered. In order to fill the gap noted, it is strongly recommended to hire a social development officer.

#### 8.6.1 Worker Code of Conduct

Workers will be required to acknowledge and comply with a Workforce Code of Conduct that sets out the behavior expected from employees. The Code will provide guidelines for what is acceptable behavior, as well as examples of prohibited actions or behavior that will be regarded as misconduct. The Code will govern behavior both on- and off-shift and include interactions with local communities. Compliance with the laws and regulations of Palestine, as well as with all relevant Project policies and procedures, will be required. Additionally, it will explain the consequences associated with violence, verbal abuse, harassment, and other anti-social behaviors.

The Company and contractor will ensure that the Code of Conduct is integrated into induction activities for all workers, including subcontractor employees, and all workers will be responsible for familiarizing themselves with the Code of Conduct and reporting any situation or activity that violates or appears to violate the Code.

The Project is committed to the principles of equal employment opportunities and anti-discrimination and strongly opposes and prohibits harassment of any kind, including sexual harassment and inappropriate sexual conduct, as well as all types of discrimination regardless of race, religion or belief, gender, disability, age, nationality, sexual orientation or ethnicity. The Project will not tolerate and prohibits any conduct which is contrary to applicable human rights legislation. Employees are responsible to report any violation of company policy or local and national laws, rules, or regulation. The proponent prohibits retaliation against any worker for filing a complaint or assisting in a complaint investigation.

#### 8.6.2 Influx Management Strategy

The Project will develop and implement a comprehensive and coordinated strategy to track and manage the influx and accommodation of workers associated with the Project (including Company, contractor, and subcontractors).

For each company, the following information will be recorded and monitored monthly:

- Number of workers;

- Place of residence (permanent or prior to hiring);
- Accommodation while employed with the Project;
- Duration of contract;
- Job classification;
- Induction process; and
- Training received.

The Influx Management Strategy will also identify the program for standardized inspections of workers' accommodation, including applicable regulations and standards, schedule, documentation, and reporting. Provisions for mitigation or remedial actions will also be identified.

The capacity and performance of local infrastructure and utilities (in the areas around worker housing) will also be monitored to identify any unacceptable impacts to service provision associated with pressure from influx. Should monitoring indicate that infrastructure is being affected, actions will need to be put in place to reduce them. This may include the identification of alternative housing options and/or discussions with representatives of the village or municipality in order to manage the increased demand on local facilities.

The Company, contractor and subcontractors will form a workforce management committee with a mandate to oversee workforce housing and related issues (e.g. access to services, interactions with communities). Where possible, the parties will align accommodation plans, standards of living, and worker transportation with the goal of minimizing adverse impacts. This committee will also regularly review stakeholder engagement records and grievances so as to proactively manage relevant issues.

As a result of the Influx Management Strategy, the Company and CONTRACTOR Consortium should have access to updated and consolidated information about workforce accommodation at any given time, including numbers of workers (local and non-local), location of apartment/camp, responsible company, inspection results, and follow-up actions.

#### 8.6.3 Stakeholder Engagement Plan (SEP)

A Stakeholder Engagement Plan (SEP) has been prepared for the Project and provides an overview of stakeholder engagement activities during both construction and operation. It has been designed to align with good international industry practice and meet all national regulatory requirements.

Stakeholder engagement is an ongoing process, and as such, the SEP is a working document that will be reviewed, and if necessary adjusted, as the project progresses. It provides a framework to manage effective and meaningful engagement with stakeholders. Its purpose is to establish and maintain a constructive relationship with a variety of external stakeholders over the life of the Project; it is a

fundamental management plan for the Project and an integral part of an effective and adaptive management system.

Many of the mitigation measures prescribed in this assessment, sit under the umbrella of the SEP and it will be important that it is implemented promptly, so that ongoing construction activities are appropriately managed. Additionally, the Project's proposed processes, such as the Grievance Mechanism need to be consulted on and amended, if necessary, to ensure their appropriateness and effectiveness.

The Social Development Officer (SDO), for the Project will be responsible for implementation of the SEP and actions therein, with support from others, as necessary. The SDO has not been hired to date, but EEHC intends to have hired and trained a team member by end of 2016. The roles and responsibilities of the SDO has been further elaborated in **section 8.7**

## 8.7 ESMP Institutional Set Up

Based on the Institutional Capacity Assessment for effluent recovery, the proposed institutional set up for project management is comprised of the following main features:

The PMU, during construction of the project components, shall include an Environmental Manager (PMU-EM) who will have the overall responsibility for implementing the ESMP and shall report directly to the PMU Director. The PMU-EM will have a supervisory role over different stakeholders and will be responsible to include the proposed mitigation measures and monitoring activities in the tender documents and equipment supply contracts.

During the construction phase (before starting) the contract of the Engineering Consultant (EC), who will supervise construction work, should include supervision component on the relevant mitigation measures that will be implemented by the construction contractor. The EC representative in each construction site should report directly to the PMU-EM about the performance of the contractor in implementing ESMP measures during his work, the approval of the contractor's invoices should include the signature of the PMU-EM based on the reports he receives about the contractor performance in implementing the ESMP measures.

The PMU-EM should not totally depend on the reports he receives from the EC, but he should also make site visits on regular basis to confirm the reports he receives about the implementation of the ESMP measures by the construction contractor.

Efficient implementation for the social management plan should involve tailored efforts for maximizing the positive social impacts and ensuring that they are reaching the local communities and minimizing the negative impacts that may hit the poor and vulnerable groups. The potentially-affected groups (particularly farmers and villagers and communities surrounding the project component and land owners) should be consulted along the process in order to ensure that their views are considered and that suitable measures are in place to eliminate the severity of negative impacts. Efficient consultations with stakeholders and high level of participation are seen as a prerequisite for a successful ESMP. It is strongly recommended to appoint a Social Development Officer (SDO) within the PMU. The SDO should be leading the various participatory activities.

During operation, different authority responsible for the operation and maintenance of the project components shall appoint the manager who will generally be responsible for implementing mitigation measures and monitoring activities during operation phase. The managers will supervise the ESMP measures at the different project sites, in addition to corresponding and cooperating with different authorities for monitoring the operation of the site, and will be the staff in charge of implementing the social mitigation measures.

Please note as indicated above, the responsibility during operation and maintenance of the reuse system is still under development. In addition, negotiations are being held to indicate the coverage cost and strategy to cope with the operational and maintenance cost of the reuse system.

## 8.8 Roles and Responsibilities for Implementation and Supervision

The mitigation measures and monitoring activities recommended shall be implemented according to the above-mentioned institutional set-up. The following 2 tables present the responsibilities of different stakeholders for mitigation measures and monitoring activities during construction/operation, remediation works and decommissioning phases.

The reporting of ESMP measures should be done on a monthly basis by the EC during the correspondent phase of the project. The monthly reports will be presented to the PMU-EM or CMWU-EM (or WWDU – EM) who shall make sure that the ESMP measures are implemented in due course according to the progress report. The PMU-EM should report for the PMU Manager on an annual basis. In case a corrective action is needed the PMU-EM should ask the PMU Manager for the resources to take corrective action and should adequately report the corrective action taken. These reports should include the following components:

- Monthly reports prepared by EC and submitted to PMU-EM;
- Annual report prepared by the PMU-EM and submitted to the PMU Manager or CMWU Manager depending on their project components.

The specific roles and responsibilities of the SDO planned to be appointed under the PMU are presented in Table 55 below.

The SDO should have a degree in social science or social development practice. He/she should be familiar with work in projects with similar scope and has very high communication and facilitation skills. Local university graduates, particularly women, should be encouraged to apply. To enable the SDO to efficiently fulfill his/her responsibilities, the capacity building and training modules presented in Box 6.2 are proposed. The SDO should receive these capacity building programs before start of the construction phase of the project.

Regarding the public health issues related to different orientation sessions and awareness raising activities, the social officer should prepare, implement and document the awareness raising activities provided to community people and project stakeholders. The main topics that will be covered by the SDO are:

- 1- Water problems in Gaza Strip and mechanisms to solve them
- 2- Sludge and recovered water benefits
- 3- Health preventive methods to be applied during usage of sludge/ recovered water



#### 4- How to combat insects in an environmentally safe way

Some of the proposed awareness sessions will require the SDO both in coordination with the Ministry of Health and Ministry of Agriculture

Regarding the monitoring issues during the operation and maintenance for the reuse system (recovered water reuse and the sludge reuse), the coordination between the PMU, MoA and MoH will be established. The monitoring procedures will be discussed in detailed on the following subsection, the monitoring plan

**Table 6: Key responsibilities of the Social Development Officer (SDO)**

- Establish dialogue with project affected groups, including local communities in the project sites, landowners and farmers and ensure the project is implemented in socially sensitive manners that consider the interests of these groups.
- Monitor the project performance and report challenges and propose measures to improve project performance.
- Design and implement awareness raising campaigns in cooperation with NGOs
- Facilitate the formation of various community based mechanisms including community-based monitoring committee and social committee as part of implantation of the Involuntary Resettlement Plan.
- Close facilitation for the execution of the Resettlement Action Plan and ensuring that compensations are reaching the PAPs.
- Maintain databases and efficient records for the PAPs as part of the ARAP
- Maintain database and efficient records of the farmers for distribution of recovery water and sludge reuse and work to integrate them in the various programmes and interventions to minimize the potential negative impact on them.
- Assist in developing strategies for the implementing the long term measures (e.g. raising the z wastewater reuse and sludge management and reuse, develop and enforce financial sustainability instruments)
- Ensure adapting participatory mechanisms in monitoring the project impacts and evaluating outcomes
- Prepare quarterly progress reports and raise it to the PMU and report to the World Bank where applicable.

Coordinate with other successful models for wastewater reuse and sludge management and recycling) to benefit from the experience and lesson learnt

The SDO should have a degree in social science or social development practice. He/she should be familiar with work in projects with similar scope and has very high communication and facilitation

skills. Local university graduates, particularly women, should be encouraged to apply. To enable the SDO to efficiently fulfil his/her responsibilities, the capacity building and training modules presented in Box 8.2 are proposed. The SDO should receive these capacity building programmes before start of the construction phase of the project.

**Table 7: Proposed Capacity Building Programmes for the SDO**

- |  |
|--|
| <ul style="list-style-type: none"><li>▪ OP 4.12 and Palestinian laws related to land ownership</li><li>▪ Communication Skills</li><li>▪ Community Participation Tools</li><li>▪ Consensus Building Techniques</li><li>▪ Participatory Monitoring and Evaluation (PM&amp;E)</li><li>▪ Promotion of Awareness Raising Activities</li></ul> |
|--|

Regarding the public health issues related to different orientation sessions and awareness raising activities, the social officer should prepare, implement and document the awareness raising activities provided to community people and project stakeholder. The main topics that will be covered by the SOD are:

1. Water problem in Gaza Strip and mechanism to solve
2. Sludge and recovered water benefits
3. Health preventive methods to be applied during usage of sludge/ recovered water
4. How to combat insects in environmentally wise approach

Some of the proposed awareness sessions will require SOD facilitation with Ministry of Health and Ministry of Agriculture

Table 8: Environmental and Social Management Plan during construction

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
Health impact associated with fugitive dust generated due to the vehicles movements	<b>Implement a construction site management plan indicating:</b> <ul style="list-style-type: none"> <li>Pre-identified storage areas.</li> <li>Wet the network of unpaved roads on site. The use of water should be restricted to extremely active areas.</li> <li>Regulation of speed to a suitable speed (20 kmh) for all vehicles entering the village's boundaries.</li> <li>Localize the vehicle movements</li> <li>Implement preventive maintenance program for vehicles and equipment working on site and promptly repair vehicles with visible exhaust fume.</li> </ul>	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Potential dust nuisance to the population in the vicinity to the construction site due to the vehicles movement	Pavement of access road prior to usage in construction of the project component	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Impacts of dust emission of on vegetation survival, especially on the agricultural land	Keep the site nearby the agriculture land and plantation wet, especially during the hot and dry season	Contractor as a part of their financial budget during the bidding activities	Contractor cost in normal bid price
Impacts of noise associated with heavy machineries and generators	<ul style="list-style-type: none"> <li>Noisy equipment, especially those that will be used in the construction works including generators should be supplied with adequate silencers</li> <li>Standard noise protection equipment for the construction workers</li> </ul>	Contractor ,equipment Supplier	Contractor cost in normal bid price
Impacts of noise on the psychology	<ul style="list-style-type: none"> <li>Optimize the use of noisy machine</li> </ul>	Contractor	

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
the neighboring communities	<ul style="list-style-type: none"> <li>Use acoustic barriers as necessary if complaints from neighbors were received</li> </ul>		
<b>Vibration impacts</b> <ul style="list-style-type: none"> <li>at the location nearby El Shuhada cemetery area resulting from Vehicles movement</li> <li>resulting from construction work (concrete work) of facility of water distribution network.</li> </ul>	<ul style="list-style-type: none"> <li>Base camp and the storage of the equipment has to be on placed further from the cemetery area (on the future land dedicated for the future location for booster pumps and storage tank.</li> <li>Time management plan to reduce the overlapped heavy equipment</li> <li>Ready mix concrete is preferred instead of on site concrete mix with mixer.</li> </ul>	Contractor	Contractor cost in normal bid price
Construction waste resulting from human wastes including wastewater and solid waste	<ul style="list-style-type: none"> <li>Provision of onsite sewage collection and disposal</li> <li>Site waste management including storing, collection and removal</li> <li>Maximize the reuse and recycle of construction materials</li> <li>Notify the sanitary landfill of receiving the unusable construction wastes or damaged construction materials.</li> <li>Coordination with the landfill management for receiving the unusable construction waste</li> </ul>	Contractor	Contractor cost in normal bid price
Changes in hydrology and groundwater quantity and quality: Potential leaks or spill chemical / fuel	Proper waste management	Contractor	Contractor cost in normal bid price
Potential leaks from temporary sewage storage tank	Spill prevention measures	Contractor	Contractor cost in normal bid price
Impact associated with waste generation	Waste management plan	Contractor	Contractor cost in normal bid price
Ecological disturbance to the crops and animal, especially at the water	Fences installation prior to the construction of the recovery water distribution networks	Contractor	Contractor cost in normal bid price

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
<b>distribution network site</b>	Compensation preparation for destructed crops or plant	Contractor in coordination with MoA	Contractor cost in normal bid price
<b>Impacts pertaining to workforce</b>	<ul style="list-style-type: none"> <li>Conduct a health examination to workers prior to the onset of work</li> <li>Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>Grievance mechanism to be provided to local residents with a proper communication channels that enabled the community to voice their concerns.</li> <li>Influx Management Strategy will be developed to coordinate worker accommodation between various construction companies, track the number of non-local workers, and manage issues related to accommodation. Development of the strategy will include further investigation of existing residents and their concerns and vulnerability to change.</li> <li>Engagement with local communities to understand changes or issues that have developed since the start of construction.</li> </ul>		No cost as all activities are part of PWA /contractor's activities
<b>Workers health and safety</b>	<ul style="list-style-type: none"> <li>Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.</li> <li>Occupational Health and Safety Strategy will be developed to coordinate worker</li> </ul>	PWA In cooperation with the contractor, Ministry of Health and Ministry of Labor	No cost as all activities are part of PWA /contractor's activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	health and safety measures between various construction companies, track the number of workers infected or died, and manage issues related to health conditions. Development of the strategy will include further investigation of existing health and safety measures and workers concerns and vulnerability to change.		
<b>Increased pressure on local services, related to construction workers' use of community services</b>	<ul style="list-style-type: none"> <li>▪ The quantity of water supply should be calculated and negotiated with Water Company in order not to affect the local communities</li> <li>▪ Wells can be dug in the site to work as alternative source of water. Potable water also might be obtained from bottled water companies</li> <li>▪ Grievance mechanism to be availed to local residents with proper communication channels. This will provide the Project with any concerns or complaints, including potential issues related to utilities shortage.</li> <li>▪ Ongoing engagement with stakeholders water treatment plant and villages to identify concerns or changes in water availability, and ensure water resources are managed properly.</li> <li>▪ Engagement with local communities to understand changes or issues that have developed since the start of construction.</li> </ul>	The PMU in the PWA	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
<b>Increase traffic on roads</b>	<ul style="list-style-type: none"> <li>Developing of Traffic Management Plan that contains all mitigation measures related to traffic impacts. This plan should explain the limitation and roles of traffic monitoring staff. Also, it should contain all indicators of monitoring that will put limitation to the unfavorable impacts</li> <li>Grievance Mechanism to provide road users with a means of contacting the Project with any concerns or complaints, including potential issues related to traffic and road safety. One of the important communication channel to be available in the GRM should be the cell phone of traffic inspector. Any violation of traffic issues will be treated very seriously and appropriate corrective action(s) to be taken as needed.</li> <li>Engagement with communities, road users, and the villages located around the site to identify concerns regarding road safety and traffic impacts. Signage and outreach activities to improve public awareness of traffic changes and potential hazards will also be targeted for high-risk sections of public roads, including near the site and laydown areas.</li> <li>Engagement with regulatory authorities regarding traffic management and condition of public roads.</li> </ul>	The PMU in the PWA should work closely with the contractor In cooperation with the contractor and Traffic Department	No cost as all activities are part of PWA activities
<b>Impacts related to land acquisition</b>	<ul style="list-style-type: none"> <li>Apply restrict avoidance mechanism in order to reduce resettlement activities to the most necessary ones and avoid small plots of lands</li> </ul>	The PMU in the PWA should work closely with the municipalities, Awqaf and Land Authority to be assured that all PAPs have relocated and mitigated fairly	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	<ul style="list-style-type: none"> <li>Develop Resettlement Action Plan to be the foundation set for a Resettlement Action Plan</li> <li>Provide appropriate compensation strategy through the resettlement action plan RAP</li> <li>Develop and enforce efficient consultation strategy with the community people in order to reach the appropriate compensation that will be based on Laws and the desire of people</li> <li><b>Providing compensation to the land owners, tenants, house owners, tenants, Or provision of alternative lands</b></li> </ul>		

Table 9: Mitigation measures during operational phase

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
Air emission and noise pollution impacts-Impact on noise especially for the PS staff at the water distribution network PS	<ul style="list-style-type: none"> <li>Ensure that all equipment comply with emissions and noise standards</li> <li>Standard protection for the workers including the ear muffs.</li> </ul>	CMWU as the authority	10,000 for initial purchase of equipment and 10,000 for monitoring Programme annually
Vibration impacts especially nearby the el shuhada cemetery of the installation of pumping station and generators	Heavy leafy tree plantation at the tree to absorb the vibration and noise associated with the PS and generators	CMWU in coordination with MoA MoA provide the suitable plantation can be sufficient for vibration and noise absorption	10,000



Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
Workers' Occupational Health and Safety	<ul style="list-style-type: none"> <li>▪ Maintenance of the machines and equipment has to be maximized.</li> <li>▪ Workers will be oriented and comply with a Code of Conduct governing behavior off-shift and interactions with local communities.</li> <li>▪ Grievance mechanism to be available to workers with a proper communication channels that enabled the workers to voice their concerns.</li> <li>▪ Occupational Health and Safety Strategy will be developed to coordinate worker health and safety measures between various construction companies, track the number of workers infected or died, and manage issues related to health conditions. Development of the strategy will include further investigation of existing health and safety measures and workers concerns and vulnerability to change.</li> </ul>	CMWU In cooperation with the Ministry of Health and Ministry of Labor	Cost estimation is dependent on the average annual budget for pumping, generators and pipelines connections
Water resource contamination-Risk of improper functioning (capturing of contaminant ) of the recovery wells	The maintenance of the recovery well to meet the design criteria to capture the contaminant	PWA	Cost estimation is dependent on the local materials availability
Lowering of ground water table	Monitoring of pumping using pumping tests.	PWA	Cost is part of the monitoring budget

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
changes to the physical and chemical properties resulting from the use of reclaimed irrigation water. The type of soil and its physical and chemical characteristics, most common of which are salinity, sodicity, PH, toxicity and bacterial count.	<ul style="list-style-type: none"> <li>▪ The soil should be monitored before and during the course of using wastewater for irrigation. Soil texture (leaching problem is higher), PH, salinity, cation exchange capacity and others are important mon characteristics that determine the limitation and the type of management of wastewater irrigation.</li> <li>▪ Chemical amendments : The use of calcium source amendment such as gypsum is widely accepted for amelioration of soils with high percentage of Na in the cation exchange capacity (CEC) or whenever water high in SAR is used in irrigation. Na in soil is exchanged by Ca from gypsum and dispersion of the colloidal phase is reduced. Application of gypsum should be repeated periodically depending on the Na content in the water and the CEC of the soil. The farmers are advised to seek professional help to estimate the amount and frequency of the gypsum application required.</li> </ul>	PWA, MoA	Cost is part of the monitoring budget

Impact	Mitigation measures	Responsibility of mitigation	Estimated Cost of supervision (USD)
	<ul style="list-style-type: none"> <li>Adapted irrigation system. Crust formation at the soil surface is the result of the irrigation with water high in SAR . The degree of the problem, however, is not the same with all irrigation systems. In general, the surface irrigation systems with water high in SAR creates thick surface crust. Similar results are obtained with sprinklers of high discharged capacity. This way, the soil water, permeability as well as soil aeration and emergence of the seeds are affected. When using many sprinklers and drippers of low discharge rates, the formation of surface soil crusting is reduced. The duration of irrigation is extended and sufficient time is allowed for water penetration into the soil. (Papadopoulos, 1995) .</li> <li>Organic matter: The alkalinity problem can also be solved by addition of organic matter like straw, other plant materials or organic manure.</li> </ul>		

**Table 10: Environmental Monitoring Plan**

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
<b>During Construction</b>					
Ambient Air Quality by dust emission of construction works	Ambient PM, dust complaint	Ambient PM closest farm at location of pumping station, water distribution network and nearby community	Sampling collection and laboratory analysis Recording and documentation of complaints	Once during the most activities at each location	contractor
Noise Impacts	Ambient noise, noise complaint from the neighboring communities	Project locations	Portable noise measurement to take representative of average noise, recording and documentation of complaints	Annual during operation and once during the construction activity	Contractor
Odour Impacts	Odor complaints from	Site location	Recording and documentation of	Monthly	PMU-EM

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	neighbors		complaints		
Vibration at the location nearby El Shuhada cemetery area	Vibration level	Site location close to el shuhada cemetery	Portable vibration measurement	Annual during operation and once during construction	Contractor during construction and CMWU during operation
Impact on construction waste and handling of hazardous waste	Amount of hazardous and non-hazardous waste generated	Project site locations	Estimation of the hazardous waste and nonhazardous waste in relation to the handling and transporting to the landfill	Weekly or monthly depending on the volume of waste	Contractor
Remediation works at the effluent lake	Clean up the site, edible tree plantation,	Project sites	Recording and documentation during the preparation of remediation and during the plantation period	monthly	contractor
Health and safety	Health records about occupational injuries and infectious diseases among workers	Clinic / hospital contracted by the project	Medical reporting on received cases	Quarterly / on received case	Occupational health clinic / hospital
Ecological	Record about biodiversity	Project sites	Recording and documenting and	monthly	contractor

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
disturbance	found, removed, handling over to relevant authority, damaged or replanted		reporting to the relevant authority		
During Operation / Maintenance					
Air Emissions and Noise Pollution	<ul style="list-style-type: none"> <li>▪ The contractor should monitor noise intensity at locations of workers in pumping stations. The measurements are to be undertaken annually under normal pumping stations working conditions.</li> <li>▪ Investigate and follow-up on noise complaints from workers and others</li> <li>▪ The contractor should</li> </ul>	▪			

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	monitor exhaust emissions from standby generators against the stipulations of Law for carbon monoxide, sulphur dioxide, nitrogen oxides and total hydrocarbons. The monitoring is to be performed annually during the normal operation of the generators.				
Contamination from Reuse of Recovery Water in Irrigation	<ul style="list-style-type: none"> <li>▪ BOD (Mg/l)</li> <li>▪ TSS (Mg/l)</li> <li>▪ Total-N (Mg/l)</li> <li>▪ F. coliforms</li> </ul>	Irrigation and recovery wells		Quarterly	

Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
	<ul style="list-style-type: none"> <li>Helminthes eggs</li> <li>Intestinal nematode</li> </ul>				
Impacts of the use of reclaimed wastewater for irrigation on soil quality	Periodic monitoring and control of soil physical, chemical and microbiological properties of the soil under wastewater irrigation is necessary to ensure successful and sustainable waste water application. Parameters recommended for monitoring were suggested in Table 3.	<ul style="list-style-type: none"> <li></li> </ul>	As indicated in Table 3	Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, Atrazine At least once annually	
Impacts of recovery scheme on ground water	Nitrogen (N), phosphorous (N) and ammonia (NH <sub>4</sub> )	<ul style="list-style-type: none"> <li></li> </ul>		should be measured four times	
Groundwater monitoring	Groundwater monitoring is presented below in section 8.9 below.				PWA



Proposed Mitigation Measures	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Responsibilities
Impact on local agriculture, public health and water resource	Recording and documentation of Agriculture production, endemic or health related diseases due to recovery water usage on agriculture	Nearby community and farms connected with recovery water distributions	Sampling collection or survey, recording and documentations	Annually	MoA in coordination with MoH

## 8.9 Groundwater Monitoring Plan

The basic purpose of the environmental control and monitoring plan is to guarantee compliance with the indications and protection measures contained in this Assessment. The monitoring of the mitigation of the impacts generated can be considered as one of the most important planning components, as well as the design of the Environmental Management programs. The purpose of this program is to verify the severity and distribution of the negative impacts and, in particular, when any unforeseen impacts occur, to assure the development of new mitigation measures or the appropriate compensations when needed.

To avoid the negative impacts, groundwater, public health indicators' and reclaimed water health concerns monitoring is prepared.

A comprehensive groundwater monitoring plan is prepared to maximize the expected positive impacts on the groundwater and monitor these impacts with adequate frequency.

After the operation of the infiltration basin using partially treated wastewater, an extension of the monitoring plan is required to be compatible with location of the recovery wells. The design report of the recovery scheme included a proposed monitoring plan. In the current section, this monitoring plan was assessed according to the updated groundwater modeling presented in previous sections. The types of data needed are usually defined by regulation; for other types of monitoring programs, the types of data needed are typically based on site-specific considerations. Water quality monitoring plays an important role in water management to protect the environment and human health.

The main objectives of the monitoring program are:

- to assess the quality of water entering the pilot area.
- to quantify the variation in irrigation and drainage water at the pilot area
- to assess the impact of the use of drainage water on crop production (quality & quantity).
- to assess the impact of the use of drainage water on the soil quality
- to provide the decision makers with the information required to propose and implement mitigation measures
- to develop public information and awareness programs on water quality

### 8.9.1.1 Monitoring Wells Locations

Locating the appropriate monitoring point locations is essential in designing a monitoring network capable of providing data of adequate quality to achieve the program objectives. At times, monitoring well locations may be prescribed by the regulations under which the groundwater monitoring program is being developed. For example, some regulations require monitoring locations to be placed at a designated “point of compliance,” which is often at the property boundary or a groundwater discharge location. For other groundwater monitoring programs, the groundwater professional should select monitoring locations that provide the most reliable data needed to detect or assess a groundwater contaminant plume. To verify that the monitoring network can accomplish this goal, target monitoring zones must be selected based on the site hydrogeological conditions and anticipated contaminant pathways.

The overall strategy of the groundwater monitoring program in this project is to evaluate the status of the groundwater quality after infiltration of partially treated and treated wastewater. The monitoring wells are distributed in two rows: the first around 400 to 500 m from the infiltration basin, and the second will be 1100 to 1200 m from the basin.

The first monitoring well row is located before the first row of recovery wells in the direction infiltration basin, and the second row of the monitoring wells should be located after the second row of the recovery wells, to check the quality of groundwater outside the recovery wells areas. The monitoring network will also use the existing 5 monitoring wells constructed recently by PWA to monitor the infiltration basin in addition to the stage 2 recovery wells . In addition, the recovery wells will be part of the monitoring network . Coordinates of the recovery wells have been attached in Annex 2. The monitoring network proposed in the design of recovery scheme project was found appropriate.

**Table 11: Stage 2 monitoring well coordinates**

	x-coordinates	y-coordinates
<b>MW1</b>	102862.41	101410.5
<b>MW5</b>	103879.64	101410.5
<b>MW7</b>	104483.92	101782.59
<b>MW8</b>	104350.46	101327.96
<b>MW9</b>	103291.12	101065.89

According to the distribution of the recovery wells, adequate number of observation wells is proposed to give accurate data about groundwater status. Additional observation wells will be used for monitoring groundwater quality; in addition, 27 recovery wells and 5 existing monitoring wells will be used. The total number of monitoring wells will be 42. The water pumped to the irrigation network should also be monitored through samples of water from random farms taken

to check the quality at the end use of water. Trunk lines, water tanks, and irrigation networks should also be monitored by taking random samples from each component.

#### 8.9.1.2 Groundwater quality monitoring

After determining the number and location of observation wells, the parameters to be monitored should be specified. The main objective of monitoring is to check the groundwater quality after infiltration and check the operation of the Soil Aquifer Treatment process. Critical parameters expected to provide insight on the status of groundwater after infiltration of partially treated wastewater are:

- Irrigation Water: All parameters should be measured four times a year, including the minimum and maximum river flows in February & August respectively (from the sampling sites in the pilot area). These parameters are the following:

**Table 12: Parameters to be monitored and frequency**

Parameter	Frequency of monitoring
Water level	Monthly
PH	Four times a year
TDS	Four times a year
BOD	Four times a year
COD	Four times a year
DOC	Four times a year
TC	Four times a year
Ammonia as N	Four times a year
NO <sub>3</sub>	Four times a year
TN	Four times a year
Cl	Four times a year
Detergent	Four times a year
FC	Four times a year
Phosphorous	Four times a year
Heavy metals	Four times a year
Mg	Four times a year

#### 8.9.2 Public Health Related Monitoring Plan for Using Recovery Water (treated wastewater)

Water quality monitoring plays an important role in water management to protect the environment and human health. The main objectives of the monitoring program are:

- To assess the quality of water entering the pilot area.
- To quantify the variation in irrigation and drainage water at the pilot area

- To assess the impact of the use of drainage water on crop production (quality & quantity).
- To assess the impact of the use of drainage water on the soil quality
- To provide the decision makers with the information required to propose and implement mitigation measures
- To develop public information and awareness programs on water quality

To achieve the above objectives, the following parameters need to be measured :

**1. Irrigation Water**

All parameters should be measured twice a year, during the minimum and maximum river flows in February & August respectively (from the sampling sites in the pilot area) are Inorganic elements (Aluminum, Arsenic, Cadmium, Cobalt, Copper, Iron, Manganese, Nickel, Lead, Selenium, Zinc and Molybdenum), pH, F, NO<sub>3</sub>, SO<sub>4</sub>, Cl, TDS, BOD, COD, Fecal Coliform, Oil and Grease, Benzene, Organic Compound (Trichloroacetaldehyde, Propionaldehyde, Phenol, AtrazineDimethoate, Chlorpyrifos).

**2. Soil**

The following parameters should be measured in the soil once a year: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, Atrazine

**3. Crops**

The following parameters should be measured in crops at the harvesting period: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, and Atrazine

**4. Epidemiology monitoring**

As mentioned previously, the monitoring of the epidemiological diseases shall be done by the Ministry of Health through the health centers, especially the health centers within the area of the irrigated land using the recovered water. Once there is indication of patient with symptom of the diseases mentioned above, the Ministry of Health shall report the case to PWA to investigate the water quality of the water distribution network. The investigation should conclude the source of the infections or diseases. The investigation team should be formed by PWA in accordance with the related governmental bodies such as the MoH, CMWU, Ministry of Local Government and Ministry of Agriculture. When the source is due to the recovered water, the emergency procedure shall be prepared by the PWA in coordination with CMWU to stop the distribution for further investigation. When the infections or diseases resulted from other source, the standard procedure of the Ministry of Health concerning the outbreak or endemic should be followed

## 8.10 Social Monitoring Guidelines

It was notable that the main activities that should be monitored are those related to expropriation of lands and valuation of units and lands. Moreover, the grievances should be also highlighted and reported.

This monitoring process necessitates some forms in order to be able to process the management and monitoring system appropriately:

The results of the monitoring and management system should be reported quarterly to the Headquarter of PWA. The monitoring and management will be implemented by the Project Management Unit.

In order to achieve this monitoring system the following personnel are needed. Regarding the compensation committee that is responsible for the valuation of the compensation

The Compensation Committee should be assessed by the governorates during the process of compensation.

In addition to that, a social officer should be hired in order to do the following tasks as part of the monitoring system:

## 8.11 Required Human Resources and Training

PMU-EM and SDO will be recruited on full time basis for the project. It is recommended to nominate staff from PWA from the existing training staff members from Environmental sector with background of monitoring and laboratory experience, while the SDO is trained with the socio economic with strong background from the involuntary and public awareness campaign.

Other staff needed is the site supervision. For back to back activities, it is recommended to have 2 staff under the supervision. In addition, the site supervision will help in documentation and recording during the project phases.

After completion of construction phase, another staff will needed for follow up operation and maintenance including recording and documentation for effluent recovery system. For the operation of the effluent lake, after completion to remove residual contaminant from the soil, the land will be return back to El Awqaf for future use, and the remaining pond will be similar as the existing set up. Table 62 below summarized the training needed for human resource of the effluent recovery system.

**Table 13: Institutional Strengthening and Training for Implementation**

Institutional Strengthening	Contents	Scheduling	Participants	Cost Estimation (\$)	Comments
Tailored training on Environmental Management Plan and Monitoring Plan	Project features, legal aspects, environmental impacts and mitigations, monitoring and evaluation and reporting and documenting (including template and forms)	Before starting the implementation	PMU staff, MCWU staff	20,000 per session	Classroom, field visits and exercises
Environmental Aspects of recovery water distributions and networks	Types and treatment process, international environmental standards, national and regional standards, water quality and quantity objectives, sludge management and distributions	Once before starting the implementation	PWA, CMWU, NGWWTP management, MENA, MoA	25,000 per session	Classroom with field visits and exercises
Environmental Auditing and Inspections	Environmental auditing technique, auditing checklist and environmental reporting	Once before starting the implementation and every two years	PWA (PMU), CMWU, farmer's association (Union for Agriculture and PARC), MENA, MoA and MoH	25,000 per sessions	Classroom
Social assessment, community	Communication skills, mass communications, social survey, sampling,	Once before implementation and	PWA (PMU), CMWU, Private	25,000 per sessions	Classroom with field visits and

Institutional Strengthening	Contents	Scheduling	Participants	Cost Estimation (\$)	Comments
communications and community survey and inspections	analysis and reporting	once every two years	organizations, NGO and farmer's associations (Union for Agriculture and PARC)		exercises.



## 8.12 ESMP Budget

The ESMP matrices and Monitoring matrices presented include many items that need to be allocated in the final budget of the project. Because the project is basically an environmental project the distinction between the budget for engineering works and environmental safeguard measures is difficult because ultimately the whole project will have clear environmental and social benefits. For distinguishing the ESMP budget from other cost items needed to implement the project, it has been assumed that all the measures included in Tables 55,56, 59 are included in the project budget

## 9 STAKEHOLDER ENGAGEMENT ACTIVITIES

Stakeholder engagement chapter aims at highlighting the key consultation and community engagement activities and their outcomes, in addition to outlining the validity and reliability of the collected data.

### 9.1 Regulatory Context

#### 9.1.1 National requirements for stakeholder engagement

The environmental Law No 7 of year 1999 emphasized on the importance of engaging various entities in the decision making of any developmental projects.

#### 9.1.2 World Bank requirements for stakeholder engagement and public consultation

The policies pertaining to stakeholder engagement activities according to the World Bank are:

- **Environmental and Social Standard 1:** Assessment and Management of Environmental and Social Risks and Impacts. The ESS1 stipulated that it sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project supported by the Bank through Investment Project Financing, in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs).  
**The borrower is obliged to:**(a) Conduct an environmental and social assessment of the proposed project, including stakeholder engagement; (b) Undertake stakeholder engagement and disclose appropriate information in accordance with ESS10; (c) Develop an ESCP, and implement all measures and actions set out in the legal agreement including the ESCP; and (d) Conduct monitoring and reporting on the environmental and social performance of the project against the ESSs.
- **Environmental and Social Standard 10:** Stakeholder Engagement and Information Disclosure). This ESS emphasized on the importance of open transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

### 9.1.3 IFC requirements for stakeholder engagement and public consultation

PWA has committed to developing the Project in line with international good practice standards and in particular the IFC PS 2012. The specific standard of reference is:

- PS1: Assessment and Management of Environmental and Social Risks and Impacts
- PS1 requires a systematic approach to stakeholder engagement, which considers the views, interests and concerns of stakeholders, particularly those within the AOI . Such an approach is designed to help build and maintain a constructive relationship with Project stakeholders. PS1 also requires the development of a Grievance Mechanism (GM) for the Project, which needs to be disclosed to affected communities and project workers, as appropriate, to ensure there is good understanding of the process.
- PS1 also states that in addition to meeting the requirements of the Performance Standards, ‘clients must comply with applicable national law, including those laws implementing host country obligations under international law’.

## 9.2 Stakeholder Engagement Objectives

The objective of the Stakeholder Engagement is to ensure safe and successful Project delivery by:

- Informing stakeholders, including persons or groups who are directly or indirectly affected by a project, as well as those who may have interests in a project and/or the ability to influence its outcome, either positively or negatively;
- Listening to their comments, ideas and concerns and recording the same for follow up;
- Communicating and implementing a viable community grievance mechanism.
- Avoiding conflict by addressing impacts and issues raised by stakeholders promptly; particularly with the communities that will not be served by the project
- Ensuring that fears and anxieties about the nature, scale and impact of the operation have been properly considered in the development and management of the Project;
- Accessing and making good use of existing local knowledge of the area;
- Avoiding any misconceptions about the project and properly manage expectations;

Thereafter the results will provide proper documentation of stakeholder feedback and enhance the ESIA accordingly.

### 9.2.1 Consultation Methodology and Activities

The research team for this study has adopted multi-dimensional consultation activities that enable the marginalized, voiceless, youth and women to gain information about the project. As well,

gaining information about their concerns and worries regarding the project during various implementation phases. Due to time constraints a team was mobilized to consult with community people and stakeholders in parallel.

Following are the main consultation activities to date that will be supplemented by additional engagement activities:

- The study team visited the project area in order to define various stakeholders during April 2018
- Community meetings were conducted during April 2018 in order to develop an engagement plan that is locally tailored for the residential communities with the study team members
- Based on the identification of stakeholders, various questionnaires and guidelines were prepared in order to engage: i) the residents in the project areas, ii) Governmental municipalities, iii) the CSOs, iv) health facility, v) Ministry of Endowment and Ministry of Agriculture, vi) the EQA
- The study team divided various engagement activities of the project to:
  - a) Screening
  - b) Scoping phase and data collection phase and,
  - c) Public consultation phase.
  - d) Final report disclosure

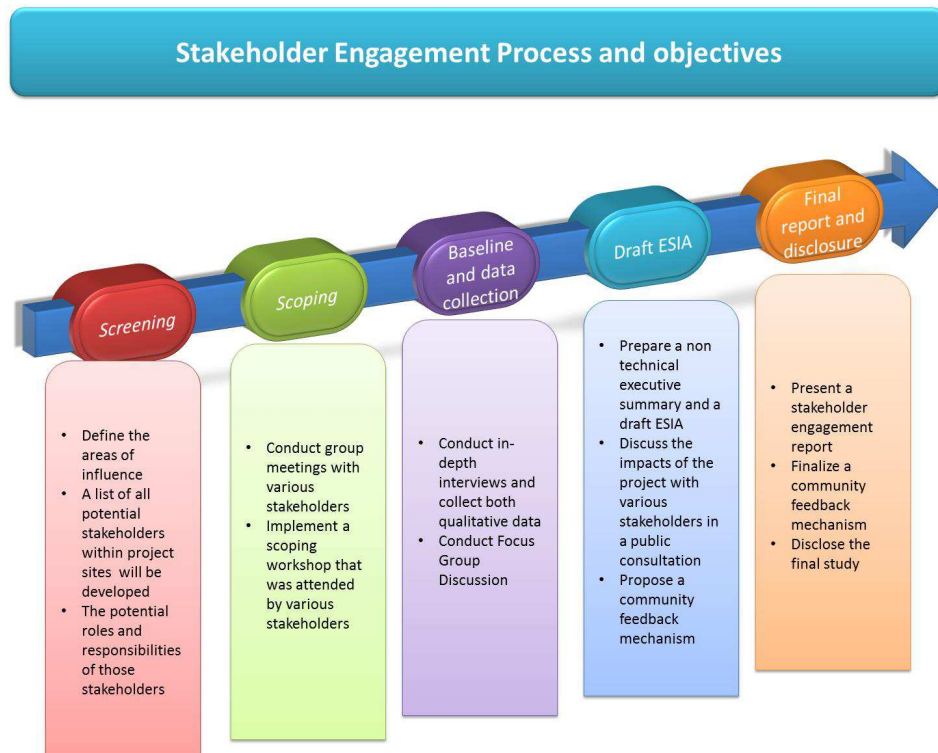


Figure 77: Stakeholder engagement process and objectives

- All activities conducted were documented with photos and lists of participants in order to warrantee appropriate level of transparency.

## 9.3 Strengths and Limitation of consultation

### 9.3.1 Strengths of the consultation

- 1) Local mobilizers were recruited from Gaza Strip in order to facilitate conducting consultation meetings and collecting primary data
- 2) The local mobilizes proposed the main stakeholders that will play role or have interest in the project based on a list of potential stakeholders provided by the consultant
- 3) They managed to facilitate various meetings conducted with the governmental and non-governmental entities in their premises
- 4) Prior to each consultation event, the local mobilizers exert remarkable effort to invite the community people. Through the distribution of flyers, posters and meeting with the local authorities

### 9.3.2 Limitation of the consultation

- 1) Consultation activities did not manage to meet with All PAPs who will lose their wells, lands...etc.
- 2) Concerns raised about the cost of water and the detailed of project implementation were not responded to due to the absence of information

## 9.4 Project Stakeholders

The objectives of stakeholder identification include: a) establishing which organizations and individuals may be directly or indirectly affected (positively and negatively), or have an interest in the Project; and b) understanding their needs and expectations for engagement.

Stakeholder analysis enables engagement to be tailored appropriately to the needs and interests of different stakeholder groups to ensure their views and concerns are addressed in a suitable manner.

A systematic approach has been adopted to identify Project stakeholder which has included:

- defining the Project's AOI which basically covers Jabalia, Um El Nasr, Beit Hanoun and Beit Lahia;
- scoping and identifying stakeholder group that could be affected (directly or indirectly) by the Project, or have an interest in it;
- identifying vulnerable groups; and
- review AOI, stakeholders and vulnerable groups during each SEP update and, if necessary, revise based on current Project context.

In order to ensure that the engagement process is inclusive, individuals and groups who may find it more difficult to participate and those who may be 'directly and differentially or disproportionately affected by the Project, or disadvantaged in sharing development benefits and opportunities, because of their vulnerable status' were identified. It will be important for the Project to ensure specific steps are taken to access these groups and afford them the opportunity to engage in discussion about the Project and their interactions with it.

**Table 14: Vulnerable groups**

Vulnerable Group	Description and Relationship to the Project
<b>Women and Female-headed households, and low-income women</b>	Women and female-headed households, widows and divorcees tend not to have the same access to income generation. They have often not received as much education as their male counterparts and it is not customary for women to work outside the home, therefore will not have the same opportunities for employment by the Project.  Female-headed households and women with limited access to income generation. They have often not received as much education as their male counterparts and it is not customary for women to work outside the home; therefore will not have the same opportunities for employment by the Project. Additionally, they are likely to have reduced opportunities for participation in public engagement (or other public activities) and potentially less access to information.
<b>People with disabilities or chronic diseases</b>	People with disabilities or chronic diseases often have a lower ability to gain employment and generate income. The physically disabled are likely to be particularly vulnerable members of the community as they tend to need more support and often rely on family care.

<b>Elderly (men and women)</b>	Elderly (men and women) are likely to have a more limited ability to work; there may be challenges for them to gain employment with the Project.
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The following table summarizes various stakeholders who have interest/influence of the project or might be affected by project activities.

**Table 15: Description of Project Stakeholders**

Stakeholder Category	Stakeholder Group	Potential Implications for Stakeholder Groups
<b>Communities in the Area of Influence (AOI)</b>	Residents of rural communities within the AoI including, but not limited to: <ul style="list-style-type: none"> <li>• Jabalia residents</li> <li>• Beit Lahia residents</li> <li>• Um El Nasr</li> <li>• Beit Hanoun</li> </ul>	Residents of these communities are more likely to be adversely affected by environmental and social impacts; for example noise and traffic during construction and other impacts relating to health, safety and security. Residents of local communities will also potentially benefit from job opportunities or other positive economic outcomes. They will have interest and will be impacted by project activities
	Vulnerable groups within the local communities	Vulnerable groups may be likely to be adversely affected by environmental and social impacts, while also being least likely to benefit from the Project. They will have interest and will be impacted by project activities
	Village family heads and influential, trusted leaders	As residents of the local communities, family heads are likely to be impacted by any social and environmental risks and impacts (positive and negative). Family heads are leaders in the community, representing the local families and often taking a key role in dispute resolution. They will have interest and will be impacted by project activities
	Small business owners	Local businesses have the potential to benefit economically from the Project. However, as local residents this group also have the potential to be impacted by any social and environmental risks and impacts (positive and/or negative). They will have interest and will be positively impacted by project activities

Stakeholder Category	Stakeholder Group	Potential Implications for Stakeholder Groups
<b>Businesses /Industry</b>	All businesses/industries	Other industries/businesses (e.g., food stalls) will have the potential to benefit economically (directly or indirectly) from the Project, particularly during construction.  They will have interest and will be positively impacted by project activities
<b>Project Workforce (both direct and through subcontractors)</b>	Project workers	The workforce is integral to the Project and a sound worker-management relationship is key for the sustainability of a company. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention, and can jeopardize a project.  They will have interest and will be positively impacted by project activities
<b>Property owners of workforce accommodation</b>	Property owners	The Project workforce is being accommodated in distinct properties, many of which are located in New Beni Suef. The Project will establish and maintain a database of property owners and, as needed, can engage with these stakeholders to understand any potential impacts posed by the Project workforce.  They will have interest and will be positively impacted by project activities
<b>Health care providers</b>	Local health care providers	The Project will need to establish procedures to minimize the risk of exacerbation of community exposure to health issues, as a result of worker influx.  They will have interest and will be positively impacted by project activities and they might be concerned about the project
<b>NGOs and civil society</b>	Community Development Associations in Jabalia, Beit Lahia and Om El Nasr	The Community Development Association in Jabalia, Beit Lahia and Um El Nasr is active in the AOI and a good partner and source of local knowledge.  They will have interest and will be positively impacted by project activities
<b>National government stakeholders</b>	Environmental Quality Agency (EQA)	The EQA has overall responsibility for permitting and the EIA process.  They have interest in the project
	Palestinian Water Authority	They are the project owner



Stakeholder Category	Stakeholder Group	Potential Implications for Stakeholder Groups
	Coastal Municipality Water Utility (CMWU)	They are responsible for providing the Gaza Strip' residents with integrated, distinct, and environmentally safe water and sanitation services through the optimal utilization of available resources and creative solutions. They will cooperate with the PWA in managing and operating the project
	Ministry of Agriculture / Agricultural Directorate	This Ministry is involved in crop valuation and irrigation scheme cost They have interest in the project
	Traffic department <a href="http://www.garblt.gov.eg/">http://www.garblt.gov.eg/</a>	Responsible for permitting related to any road work for the Project (e.g., road cutting). They have interest in the project
<b>Local/provincial government stakeholders</b>	Municipalities in Gaza, Jabalia, Beit Lahia	They will be responsible for provision of lands and other facilities to the project. They will participate in the operation phase They will have interest and will be positively impacted by project activities
<b>Civil society organization</b>	Palestinian non-governmental NGOs' network	They will be responsible for raising farmers awareness about irrigation water They will have interest and will be positively impacted by project activities
	Water Users Association	They will be the direct beneficiary of the project and will participate actively in project implementation procedures

## 9.5 Summary of Key consultation activities conducted to date (May 2018)

The key consultation activities during the course of the project could be divided into the following:

**Table 16: Summary of consultation activities conducted to date**

No	Stakeholder	Date	Meeting objectives	Meeting outcome
1.	PWA	8 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>A preliminary meeting to introduce the study objective and update the data required in the inception phase</li> </ul>	<ul style="list-style-type: none"> <li>PWA shared information about issues related to:               <ol style="list-style-type: none"> <li>Updating project information</li> <li>Challenges</li> <li>Land required</li> <li>Mitigation of unfavorable impacts</li> </ol> </li> </ul>
2.	the Ministry of Endowment representative	10 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>To inform the participant about the project</li> <li>To define any land</li> </ul>	<ul style="list-style-type: none"> <li>The Ministry of Endowment did not show any interest in this phase as they will not be affected.</li> </ul>

			needed by the project	
3.	Jabalia municipality	10 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>• Sharing information about the project rehabilitation activities</li> <li>• Collect information about their perception of the project</li> <li>• Awareness strategies and community participation</li> <li>• Capacity building of the municipality to monitor project activities</li> </ul>	<ul style="list-style-type: none"> <li>• The project positive impacts pertaining to environmental aspects</li> <li>• Potential measures required to put limitation of the adverse impacts</li> </ul>
4.	Beit Hanoun municipality	11 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>• Sharing information about the project rehabilitation activities</li> <li>• Collect information about their perception of the project</li> <li>• Awareness strategies and community participation</li> <li>• Capacity building of the municipality to monitor project activities</li> </ul>	<ul style="list-style-type: none"> <li>• The project positive impacts pertaining to environmental aspects</li> <li>• Potential measures required to put limitation of the adverse impacts</li> </ul>
5.	Gaza municipality	11 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>• Sharing information about the project rehabilitation activities</li> <li>• Collect information about their perception of the project</li> </ul>	<ul style="list-style-type: none"> <li>• The project positive impacts pertaining to environmental aspects</li> <li>• Potential measures required to put limitation of the adverse impacts</li> </ul>
6.	Ministry of Agriculture	11 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>• Land acquisition related to the project</li> <li>• The price of generated water</li> <li>• Farmers' perception of the reused water</li> <li>• Awareness raising requirement</li> </ul>	<ul style="list-style-type: none"> <li>• Limited reluctance from the farmers was reported</li> <li>• Awareness raising activities are essential</li> <li>• The exact water tariff to be shared with the farmers</li> </ul>
7.	Palestinian Land Authority	15 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>• Land acquisition related to the project procedures and responsibility</li> <li>• Price of lands</li> <li>• Responsibility for compensating wells operators and crops</li> </ul>	<ul style="list-style-type: none"> <li>• Land acquisition procedures to be adopted by the PLA</li> </ul>
8.	Ministry of Local	16 <sup>th</sup> of April	<ul style="list-style-type: none"> <li>• Defining the role of</li> </ul>	<ul style="list-style-type: none"> <li>• MLG role is limited to</li> </ul>

	Government	2018	MLG <ul style="list-style-type: none"> <li>Identify the proposed compensation and responsibility of compensation</li> </ul>	expropriation of lands <ul style="list-style-type: none"> <li>They review the urban development plans and assure no transections with the project</li> </ul>
9.	PWA, the consultant with the PAPs  This meeting with supplemented with site visits and additional meetings	22 <sup>nd</sup> of April 2018	<ul style="list-style-type: none"> <li>Provide information about the project</li> <li>Respond to farmers and PAPs concern</li> </ul>	<ul style="list-style-type: none"> <li>PWA provided the available information to date</li> <li>PWA and the consultant documented various concerns raised: <ol style="list-style-type: none"> <li>Land required to construct the wells</li> <li>Remedial actions</li> <li>The need not to terminate the private well until the project is fully and properly functioning</li> <li>Reduce water cost</li> </ol> </li> </ul>
10.	Palestinian non-governmental organizations network	24 <sup>th</sup> of April 2018	<ul style="list-style-type: none"> <li>Provide information about the project</li> <li>Define further engagement with the community</li> <li>Define the required data to be shared with farmers</li> <li>Propose awareness raising role in full cooperation with the NGOs</li> </ul>	<ul style="list-style-type: none"> <li>The required data needed was mainly: <ol style="list-style-type: none"> <li>Information about pricing system</li> <li>Required lands</li> <li>Compensation for lands</li> </ol> </li> </ul>



Figure 78: Meeting with El Awqaf



Figure 79: Meeting with Jabalia municipality



Figure 80: Meeting with Beit Hanoun municipality



Figure 81: Meeting with Gaza municipality



Figure 82: Ministry of Agriculture



Figure 83: Palestinian Land Authority



Figure 84: Meeting with the PAPs on the 22nd of April



Figure 85: Meeting with one of the PAPs

The above mentioned activities supplemented the activities conducted in 2012. Additionally, a scoping session was prepared and implemented.

## 9.6 The Scoping Consultation Event

The scoping meeting was held on the 23rd of April 2018 and was attended by a wide range of stakeholders including various municipalities, academics, NGOs, Palestinian Water Authority, Ministries and consultation firms.

The workshop was organized as per TOR requirements. The workshop took place from 9.30 to 12.40. There were 32 participants 5 of them were females and 4 speakers. The first session was opened by briefing the project components and followed by the environmental and social presentations, the second session was an open discussion.

The speakers were the following:

- E.Rebhi Al-Sheikh, Vice chairman of PWA
- E.Yaser Qishawi, PMU-PWA
- Dr.Tareq Genena, EcoConServ
- Dr.Zeinab Hafez, EcoConServ





Figure 86: The panel



Figure 87: Beit Lahia municipality representative



Figure 88: Ministry of health



Figure 89: Participants

Following is a summary of the main issues raised during the scoping session

#### 7.7.1 Summary of discussion

Issue raised	Comment raised	Response	How it was responded to in the study
Health concerns	<p>Some previous ground water tests show a high level of health related pollutants (ammonia as example), this should be considered.</p> <p>What are the tools that will be used to predict the project impact on ground water, and how to quantify this impact? The pilot project of Gaza municipality of waste water reuse in Sheikh Ajleen area, this can be revised as a case study.</p>	<p>PWA have an integrated sampling program for the plant, the infiltration ponds and groundwater reservoir. Which has been recently updated. The private wells will not be closed, we hope the project will provide the farmers a competitive service to use the recovered water. Certainly, the monitoring plan shall be developed. It may be extended to the</p>	To be added in the mitigation section

Issue raised	Comment raised	Response	How it was responded to in the study
		<p>crops irrigated by the recovered water.</p> <p>The Land Authority allocated the land of 14 wells from private lands. The compensation issue will be covered by this study.</p>	
<b>Institutional set-up</b>	<p>The project should focus on the importance of the institutional framework as it is the basis for the operation and success of this project. He explained that the Palestinian legislation classifies this water as groundwater because it mixes with groundwater after its infiltration.</p>	<p>One of the outputs of the study is the environmental management plan, which assign who will do what. I suggest to form an institutional body from all the stakeholders to manage, organize, monitor, and operate the project components.</p> <p>This study should result a realistic and applicable procedures</p>	To be added in the institutional section
<b>Monitoring requirements</b>	<p>There is a lack of monitoring in all project stages. It's recommended to engage the relevant authorities in this progress. He mentioned the Ministry of Health, Agriculture, Environment, and the municipalities.</p>	<p>PWA will develop a detailed monitoring scheme for all project activities including E&amp;S performance</p>	To be added in the monitoring sections
<b>Land acquisition and role of municipality</b>	<p>Municipalities should be involved in the process of land acquisition and compensation to contribute in resolving disputes, if any. The Ministry of Agriculture and other Agricultural Institutions should be involved in the development of the project operation plan. He focus on Developing a clear vision of water pricing and whether there is a cost recovery.</p>	<p>In full compliance with the Palestinian land acquisition regulations, the municipalities will be engaged and consulted in the process of compensation</p>	To be added in the mitigation sections and in the RAP study
<b>Required updated</b>	<p>There are many updates regarding</p>	<p>The study team reviewed the</p>	<p>Updated data will be</p>

Issue raised	Comment raised	Response	How it was responded to in the study
data	2013 data, such as statistics, economic conditions in Gaza, water quality and suitability for agricultural use, farmers' crop pattern. He focused on the use of the nitrate existing in the waste water as soil fertilizer. Which also reduce its treatment cost.	current data disclosed on PCBS and obtained updated data from the PWA including the new layout	presented in the project description and baseline
Water tariff	How can the social impact be measured without a clear water tariff?  Emphasized on the importance of water pricing considering the operational capacity of the project. Modern agriculture should be supported through good pricing and product marketing. Solar energy is a very good proposition because it lowers water prices on farmers. Government support should be provided for this project. All possible emergency cases shall be considered and the study.	The tariff is still being discussed. However PWA managed to prepare a full tariff strategy by the med of 2018	To be added in stakeholder engagement requirements and concerns
Need to recover all water	The need to recover all the infiltrated water to minimize the negative impact on the groundwater quality.	PWA will exert effort to reuse all water, particularly due to the rigid need for water supply	To be added in stakeholder engagement requirements and concerns
Participation of community in the scoping session	The absence of community institutions from all project activities! We recommend to engage the farmers in the consultative process of the project.	During scoping phase, we managed to meet with various community members in their premises. However, the scoping session is allocated for experts who might provide guidance to enrich the ESIA. This is in full compliance with EQA and IFC standards	Community people should be invited in the final consultation section
Termination of	The Private wells within the area of	Few number of private wells	To be added in the RAP



Issue raised	Comment raised	Response	How it was responded to in the study
private wells	the recovery wells, Will it be closed or merged with system	will be terminated	
Pollutants	Is there any examination of the microbes (ex: hepatocellular virus) pollute the groundwater through infiltration?	PWA developed and will continue measuring various pollutants	To be added to mitigation plan
Management of private wells	How to manage the private wells exist within the project area?	PWA will cooperate with the farmers	To be added in the Stakeholder Engagement Plan
Probability of Israeli incursion	Concern of Israeli incursions into the destruction of irrigation networks.	All projects in Gaza have the same concern	To be added as a risk to the project
Well operators mitigation measures	How well operators will be mitigated?	Well operators have been interviewed and mitigation measures will be proposed in the RAP study	To be added in the RAP and mitigation measures
Points to be added to the study	There are clay layers in the saturated zone that have not been studied in 2013 and may affect the infiltration process.	To be studied by the environmental expert	
Water usage in case of not used by farmers	Where will this water discharge if it is not used by farmers? I suggest a conveyor line to Wadi Gaza.	There is an emergency plan that proposes the measured to be taken in such case. However, given the shortage of water supply in Gaza Strip, water will be used	To be added in the emergency plan
Time plan	When the remaining components of the project are expected to be completed?	There is no time plan as the fund has not been secured to date	No action
Marketing for produced water	The importance of this water being marketed in a way that attracts the farmer to use it. He emphasized Developing a vision for the project regulatory body	This proposal will be discussed and handled by the PWA	To be added in the SEP

By the end of this session the PWA and ESIA consultant (UG/ ECOCONSERV) made it clear that all comments raised will be fully and properly addressed .

## 9.7 The Public Consultation Event

The workshop was organized as per TOR requirements. The workshop took place from 10:00 to 1:16. The workshop was conducted on Monday, 12<sup>th</sup> of July 2018 in Al-Mathaf Hotel – Gaza.

The venue selected to conduct final public consultation is accessible to all stakeholders defined.

Figure 90: Location of the public consultation event conducted on the 12th of July 2018 in El Mathaf Hotel

There were 40 participants and 4 speakers. 7 of participants were females. Young people were represented in the session. Palestinian Water Authority, Environmental Quality Assurance, NGOs, Universities, Ministry of Health, Municipality Union of Agricultural Work Committees (UAWC), Ministry of Endowment and various stakeholders from the community.



Figure 91: Participants attended the final public consultation

The first session started by provision of a brief description of project components and followed by the environmental and social presentations, the second session was an open discussion.

The speakers were the following:

- Eng.Zohair Mdoukh, Executive manager of UG
- E.Yaser Qishawi, PMU-PWA

- Dr.Ahmed Abu Foul, UG
- Dr.Ahmed Abu Shaaban, UG

**Yaser Qyshawi, PMU-PWA**

He welcomed the participants and appreciated the role of the Egyptian and the Palestinian consultant in this project.

He clarified that the results of this study were already used to bring funding for the remaining phases of the project. PWA is ready during the near period to tender for the operation of first phase`s wells to irrigate 5000 dunum. He confirmed that the tests for effluent water from the station are excellent, meet the criteria, and achieves the objectives of the NGEST.

**Dr.Ahmed Abu Foul, Environmental Expert**

He submitted a presentation on the environmental aspects of the study which included:

Project description and components, ESIA update objectives, Methodology for Biological Environment, Positive and Negative Impacts, Mitigation Measures, Environmental management plan, proposed institutional framework, Ground water model update, important environmental outcomes and considerations.

**Dr.Ahmed Abu Shaaban, Social Expert**

He presented the social aspects of the study which included:

Updating of the ESIA, Socioeconomic conditions, Potential social positive and negative impacts, Environmental and social management plan, Stakeholder engagement, Updating the Resettlement Action Plan, Identify the project affected persons, Review legal framework pertaining to land acquisition, Define aspects pertaining to land acquisition.



Figure 92: Environmental presentation Dr. Abdul Foul



Figure 93: EQA and municipalities



Figure 94: Social presentation Dr. Abu Shaaban



Figure 95: Union of Agricultural Work Committees (UAWC)

The following subjects were discussed:

- The updated components of the project, the objectives of this study, the methodology, the environmental and social issues.
- The updated data from 2013 up to now.
- The Ground Water Modeling.

All participants emphasized on the importance of this project that is highly related to the problem of water scarcity and its quality deterioration in the Gaza Strip. All participants thanked the consultant for their effective role in the success of this project.

Main areas of concern:

- Most of the attendees focused on their concern about water quality and the impact on health.
- They stressed on the need to clarify the institutional framework that will operate the project.
- There was a clear fear of water tariffs.
- Most of the attendees were concerned about the emergency cases and how to deal with it.

Table 17: Main issues raised in the final public consultation conducted on the 12<sup>th</sup> of July 2018 in El Mathaf Hotel

Main aspects	Raised concern	Response	Where to be added in the report
Role of EQA	The Environmental Quality Authority is not integrated, particularly in complaints section.	EQA is a key stakeholders and they are fully engaged in all project activities including grievance mechanism	Proposed grievance mechanism section 7.9 of this report
Awareness raising activities	The awareness campaign, will it be before or after the implementation of the project?	The PWA will consider implementation of awareness raising activities as an essential component of stakeholder management program	Section 7.8 of this report proposed Stakeholder Management Program

Main aspects	Raised concern	Response	Where to be added in the report
Water tariff	<p>Does the study take into consideration the unit price of the treated water, prepared by the World Bank?</p> <p>The water tariff must be competitive and drilling of wells must be prevented in the distribution area.</p>	<p>The price of tariff has been discussed in the feasibility study of this project.</p> <p>Feasibility study shed light on the importance of sharing sufficient information about water tariff. A budget item was allocated in the feasibility study to cover this aspect.</p> <p>Water pricing policy and institutional framework is very important, and the new WUA law will regulate the management of the process, but the monitoring part is the responsibility of the public sector. I emphasis on the role of the Ministry of Agriculture and Health in the monitoring process.</p>	<p>Informed about during the stakeholder engagement activities section 7 of this report</p> <p>As well, PWA provided a full tariff Annexed to this report</p>
Israeli occupation risk to the project	<p>The project area depend mainly on rain fed agriculture because of the repeated occupation of the land. Will the occupation accept to plant permanent trees?</p>	<p>Israeli occupation is one of major risks to be considered in the project sites.</p> <p>The project will prepare an emergency plan in case of any military invasion to the project sites.</p> <p>This risk was defined also by the social team. However such risk can't stand against provision of support to the farmers in the project sites</p>	<p>Comment is included in section 7 of this report</p>
Malfunction impacts	<p>In the case of station malfunction and the pollutants reached the agricultural land. Who will compensate farmers for their loss?</p>	<p>PWA has rigid operation obligations. They have developed systematic operation activities.</p> <p>Any damage will be handled in full compliance with the national laws</p>	<p>Comment is included in section 7 of this report</p>

Main aspects	Raised concern	Response	Where to be added in the report
Soil saturation impact	Has soil saturation of pollutants been taken into account over time?	The rehabilitation of the filtration basins from time to time will prevent the soil clogging. Another study took into consideration all the emergency cases of the NGEST and how to deal with them. PWA have tested all water parameters included detergents. The water network took into consideration the existing outline and was adjusted according to the ground.	Comment is included in section 7 of this report
Involvement of various stakeholders	All project stakeholders must be involved in the decision making process in a clear structural framework.	There is a stakeholder management program that will be revisited periodically to assure full engagement of various stakeholders	Stakeholder management program is included in section 7.8 of this report
Monitoring of water usage	I have concerns about the negative use of water by the farmers, so the citizen usage should be monitored continuously and develop strict laws for that.	As an executing agency, PWA monitor the quality of the effluent water, the other stakeholders should be involved in monitoring water of the tank, the network and the plants. The identification of the types of plants to be irrigated is the responsibility of a group of competent authorities.	Monitoring activities are included as a component of the mitigation activities
Avoid land acquisition	I suggest to revise the layout of the network, to avoid land acquisition and to ensure the quality of the network.	Land acquisition activities are not favored by the project. All measures to avoid or reduce land acquisition were taken into consideration. For example, monitoring wells were planned to be constructed in the public roads.	Avoidance mechanism was described in the Resettlement Action Plan study prepared in 2018

Main aspects	Raised concern	Response	Where to be added in the report
Health related impacts and Ministry of Health monitoring role	The Ministry of Health is concerned about any malfunction that may affect the health of the citizens, especially because of the unstable situation of Gaza. Were the detergents measured in the water tests? Can the Ministry of Health take random samples from these wells once operated?	This concern is considered and the Ministry of Health is essential to this project	Ministry of Health role should be added to the mitigation section of this report
Operation responsibility	Who will be responsible for the operational management of the project?	The organizational responsibility report was developed and will be added as an Annex to the ESIA report	Annex to be added to this study
Project continuity	What is the guarantee of the project continuity in case of any problems?	This project is essential to satisfy the shortage of water. The Palestinian Government will save no effort to support the project	Stakeholder engagement section 7
Crops contraindications	Are there any contraindications for certain crops?	The Ministry of Agriculture is responsible for identifying suitable crops for farmers.	Stakeholder engagement section 7. List of concerns raised
Explosive remnants	Is there a possibility of explosive remnants due to the occupation incursion into the region? Will it be dealt with?	Explosive remnants will be carefully handled along the life of the project	Stakeholder engagement section 7
Water extraction if it is not used	I emphasize the need to extract water because if it not used, the nitrates concentration will remain high.	An emergency plan should be developed in order to avoid any emergency related actions	Stakeholder engagement section 7. List of concerns raised

## 9.8 Resettlement Action Plan Consultation Activities Feedback

The project affected persons were consulted in the treatment plant and in their own lands in order to enable them to spell out their concerns and worries.





Figure 96: Meeting with the PAPs on the 22nd of April 2018



Figure 97: Meeting with one of the PAPs



Figure 98: Meeting with the PAPs in their land April 2018

Figure 99: Meeting with PAPs in the treatment plant

Following is a summary of the main issues raised during the scoping session related to resettlement

Table 18: Summary of RAP discussions

Issue raised	Comment raised	Response
Well operators mitigation measures	How well operators will be mitigated?	Well operators have been interviewed and mitigation measures will be proposed in the RAP study
Land acquisition	Municipalities should be involved in	In full compliance with the



Issue raised	Comment raised	Response
<b>and role of municipality</b>	the process of land acquisition and compensation to contribute in resolving disputes, if any. The Ministry of Agriculture and other Agricultural Institutions should be involved in the development of the project operation plan. He focuses on Developing a clear vision of water pricing and whether there is a cost recovery.	Palestinian land acquisition regulations, the municipalities will be engaged and consulted in the process of compensation
<b>Termination of private wells</b>	The Private wells within the area of the recovery wells, Will it be closed or merged with the recovery system.	Few number of private wells will be terminated.
<b>Location of the recovery wells</b>	Will the recovery wells be installed in the middle of PAPs lands?	<p>The consultant will recommend that the location of recovery wells should be on the borders of lands in order to minimize the impacts on the lands.</p> <p>PWA added that well locations were selected based on scientific criteria. However, if they are placed in the middle of land, their place might be changed</p>

## 9.9 Stakeholder Engagement Program

The section of the SEP provides details of the engagement to be undertaken during planning, construction and operation of the Project

### 9.9.1 Communication Methods

Community members indicated that they are comfortable receiving information about the Project via local leaders (family heads), teachers, religious leaders, representatives of civil society organizations, as well as elected members of parliament. They also suggested that a “SDO”

should be put in place by the Project. Since this suggestion was received, the Project has hired and put in place the Social team to liaise with the community on a regular basis.

Stakeholder engagement activities are being / planned to be conducted through the following engagement methods:

- Public hearing;
- letters and phone calls;
- notice boards;
- distribution of Project Information Documents (PIDs);
- key informant interviews (KIIs);
- focus group discussions (FGDs) with key stakeholders (including vulnerable);
- Comment forms as part of the grievance mechanism

#### 9.9.2 Proposed stakeholder engagement and disclosure activities

Following is a preliminary stakeholder engagement program that will be fine-tuned on quarterly basis during the construction and operation phases:

Table 19: Stakeholders Engagement & Disclosure Activities

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Preparation Phase					
Environmental and Social Impact Assessment results	<ul style="list-style-type: none"> <li>Non-technical summary</li> <li>ESIA final report, RAP and Stakeholder Engagement Plan</li> </ul>	Upon completion of the ESIA	PWA	<ul style="list-style-type: none"> <li>All stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>Hard copies to be shared with various stakeholders,</li> <li>Upload studies and reports on PWA website</li> </ul>
Land required and termination of private wells	<ul style="list-style-type: none"> <li>Brief summary about the lands required and potential impacts</li> <li>Lists of project affected persons (well owners- land owners – well operators)</li> <li></li> </ul>	Three months prior to any land acquisition	PWA	<ul style="list-style-type: none"> <li>PAPs</li> <li>Municipalities</li> <li>Ministry of Agriculture</li> <li>Palestinian Land Authority</li> <li>Awqaf</li> <li>Ministry of Local Government</li> </ul>	<ul style="list-style-type: none"> <li>Face to face meetings</li> <li>Group meetings</li> <li>Posters to be disclosed on the billboard</li> </ul>
Timeframe	<ul style="list-style-type: none"> <li>Time line of project activities</li> </ul>	One month prior to construction activities	PWA and the contractor	<ul style="list-style-type: none"> <li>Municipalities and local community people</li> </ul>	<ul style="list-style-type: none"> <li>Provide a time plan to the municipalities</li> </ul>

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Job opportunities	<ul style="list-style-type: none"> <li>○ List of available opportunities including duration and application details</li> <li>○ Monitoring reports;</li> <li>○ Health and safety instructions;</li> <li>○ Labor rights</li> </ul>	1 month prior to beginning of construction	Social Development Officer in PWA and the contractors	<ul style="list-style-type: none"> <li>○ Young people</li> <li>○ Workers unions</li> </ul>	<ul style="list-style-type: none"> <li>○ List of available opportunities at SDO office</li> <li>○ Posters in the municipalities and PWA premises</li> <li>○ Advertisement</li> </ul>
Construction of infrastructure	<ul style="list-style-type: none"> <li>○ Construction program and timing</li> <li>○ Project progress report upon finalization of construction activities, including environmental and social impacts, health and safety performance, and implementation of the external GRM</li> </ul>	Two weeks prior to construction)	SDO On-site engineer Relevant municipalities	<ul style="list-style-type: none"> <li>○ Area of influence municipalities</li> <li>○ Other interested bodies i.e. Ministry of Agriculture</li> </ul>	<p>Sharing brief updates on unified project's social media</p> <p>Face-to-face meetings, which could involve the whole community or smaller focus groups.</p> <p>Written updates posted at frequented locations like the local school and mosques;</p>

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Training and Capacity Building activities	Sharing capacity building opportunities and necessary requirements with community Monthly update	Once per month	SDO and training centers	<ul style="list-style-type: none"> <li>Area of influence municipalities</li> <li>Other interested bodies i.e. Ministry of Agriculture</li> </ul>	List of available capacity building opportunities at SDO office  Posters in the municipalities  Summary to be shared with target groups (hard copies)
Health and safety	Safety instructions and warning signs should be placed in a clear and understandable (visual preferred) manner on all relevant locations on site	Prior to construction activities. Ongoing.	On site engineer SDO	<ul style="list-style-type: none"> <li>Area of influence municipalities</li> <li>Other interested bodies i.e. Ministry of Agriculture</li> <li>Project workers</li> </ul>	Safety signs, instructions and emergency plan
Construction Phase					

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Job opportunities	<ul style="list-style-type: none"> <li>○ List of available opportunities including duration and application details</li> </ul>	3 weeks-1 month prior to beginning of operation	Social Development Officer in PWA and the contractors	<ul style="list-style-type: none"> <li>○ Young people</li> <li>○ Workers unions</li> </ul>	<ul style="list-style-type: none"> <li>○ List of available opportunities at SDO office</li> <li>○ Posters in the municipalities and PWA premises</li> <li>○ Advertisement</li> </ul>
Traffic	<ul style="list-style-type: none"> <li>○ Schedule of transportation including expected traffic peaks &amp; routs and numbers for grievances</li> <li>○ Traffic Management Plan</li> </ul>	1 week – 10 days prior to mobilization	Social Development Officer in PWA and the contractors	<ul style="list-style-type: none"> <li>○ Municipalities</li> <li>○ Traffic department and Ministry of Transportation</li> </ul>	<p>Schedule on site and at SDO office</p> <p>Schedule at municipalities</p>

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Site construction activities	<ul style="list-style-type: none"> <li>Construction program and timing</li> <li>Annual project progress reports, including environmental and social impacts, health and safety performance, and implementation of the external GRM</li> <li>Induction training to all workers.</li> <li>Prior to work a daily briefing to be given to the workers</li> <li>Regular bulletin disclosed on site; tool box talks; induction information for new workers</li> </ul>	<p>Two weeks prior to beginning of construction</p> <p>From beginning of project activities</p>	<p>SDO</p> <p>On-site engineer</p> <p>Relevant Developer</p>	<ul style="list-style-type: none"> <li>Area of influence municipalities</li> <li>Other interested bodies i.e. Ministry of Agriculture, Ministry of Local Government, and Farmers NGOs</li> </ul>	<p>Sharing brief updates on unified project's social media</p> <p>Face-to-face meetings, which could involve the whole community or smaller focus groups.</p> <p>Written updates posted at frequented locations like the local school and mosques;</p>
Health and safety	<ul style="list-style-type: none"> <li>Safety instructions and warning signs should be placed in a clear and understandable (visual preferred) manner on all relevant locations on site</li> </ul>	<p>Prior to beginning of construction activities on site. Ongoing.</p>	<p>On site engineer</p> <p>SDO</p>	Workers	Safety signs, instructions and emergency plan
Operation Phase					

Issue	Information & Documents for Disclosure	Disclosure timeframe	Responsibility	Target groups	Communication Channel
Operation activities	Update on operational performance, and ongoing communication on key issues, Annual reports Monitoring Plans; Progress of ESMP	Once per month	SDO, on-site engineer, Health and Safety specialist, relevant developer	<ul style="list-style-type: none"> <li>○ Area of influence municipalities</li> <li>○ Other interested bodies i.e. Ministry of Agriculture, Ministry of Local Government, and Farmers NGOs</li> </ul>	Monthly meeting with community leaders and municipalities
Emergency Plan	Sharing unified emergency procedures/plan including evacuation routes, rally points, emergency signals Contact information for emergency response facilities such as firefighting or first aid equipment	Prior to operation Weekly reminders and monthly drills	SDO, on-site engineer, Health and Safety specialist, relevant developer	<ul style="list-style-type: none"> <li>○ Area of influence municipalities</li> <li>○ Other interested bodies i.e. Ministry of Agriculture, Ministry of Local Government, and Farmers NGOs</li> </ul>	Emergency plan document shared with all site managers/engineers, health and safety officer



## 9.10 Proposed Grievance and Redress Mechanism

Grievances are a problematic issue for the majority of developmental projects. Thus, this section should be handled carefully in order to settle any potential disputes that might rise with the hosting communities. This section will cover the following issues:

- 1) Responsible entity for implementing the grievances' mechanism
- 2) Grievances tiers that encourage inclusion of marginalized group ( women, poor, illiterate and handicapped groups)
- 3) Grievances channels that are locally tailored
- 4) Response to grievances procedures
- 5) The role of locally based organizations
- 6) Dissemination of the results of the submitted grievances to the community
- 7) Monitoring of grievances activities

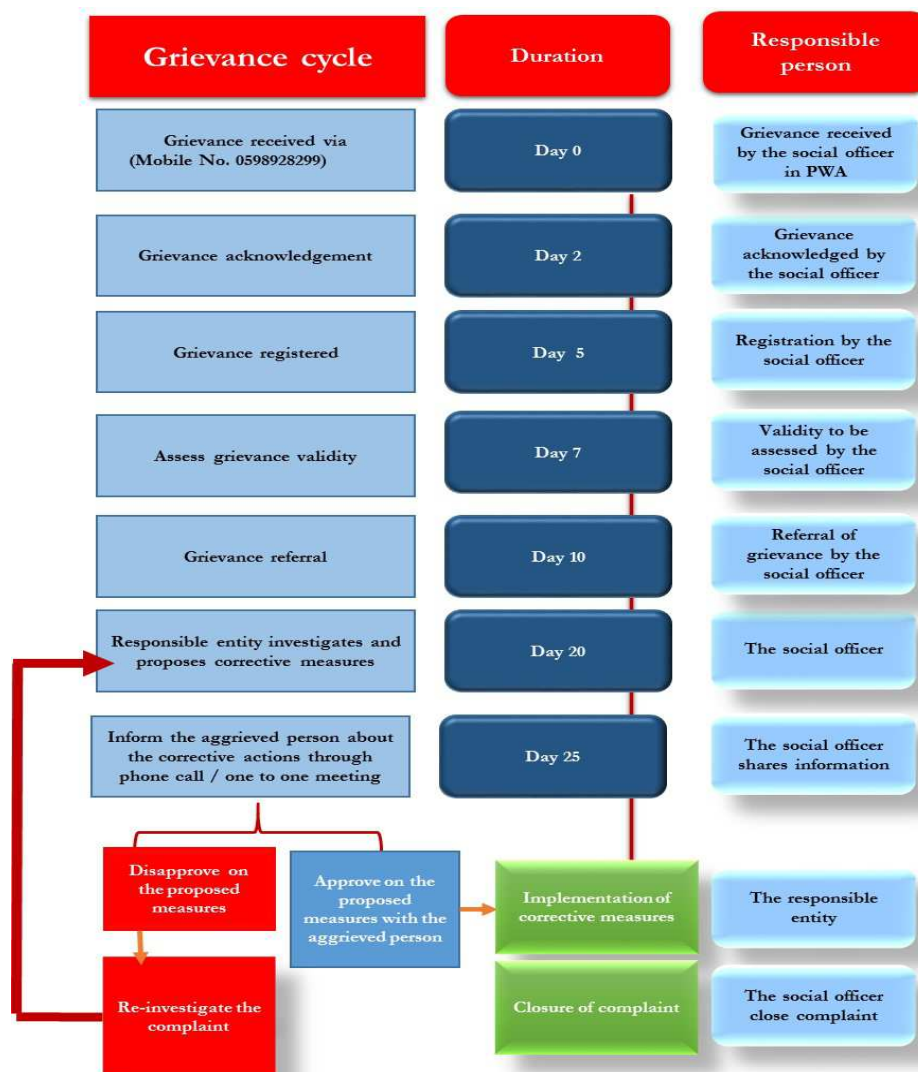


Figure 100: Grievance and Redress Mechanism Cycle

Generally speaking, all grievances received verbally or in written shall be documented in a grievance register, handled by the PMU in PWA. It is of importance to react as quickly as possible to the grievance of the citizens.

A best practice standard is to acknowledge all complaints within 10 days. Due to the different character of the complaints, some of them cannot be resolved immediately. In this case medium or long-term corrective actions are required, which need a formal procedure recommended to be implemented within 30 days:

- 8) The petitioner has to be informed of the proposed corrective measure.
- 9) In case if a corrective action is not required, the petitioner has also to be informed accordingly.
- 10) Implementation of the corrective measure and its follow up has to be communicated to the complainant and recorded in the grievance register

In order to enable the PWA to implement the grievances mechanism appropriately, a Social Development Officer should be hired and integrated in the PMU

#### **9.10.1.1 Institutional Responsibility for the Grievances**

Regarding the responsible entity that will handle the grievances, it will be mainly the PMU within the implementing agency (PWA). The Social Development Officer (SDO) working within the PWA in cooperation with the municipalities will address all grievances raised by community people, particularly the ones related to resettlement activities. The main tasks of the SDO are:

- 1) Raise people awareness about the exact grievances mechanisms
- 2) Collect the grievances received through different communication channel
- 3) Document grievances received
- 4) Direct the grievance to the responsible entities to solve the problem
- 5) Follow up how the problem was addressed and solved
- 6) Document, report and disseminate the grievances results
- 7) Monitoring of grievances activities
  - Raising community awareness about the grievance mechanism should be handled as follows: brochures should be developed and sent to the main stakeholders, PAPs, CSOs, municipalities, mosques and churches.
  - Documentation of the activities should be handled carefully and thoroughly. A monthly report should be prepared about received grievances, how they were solved and the level of satisfaction of the affected person towards the solution. This report should be published on the website.

#### 9.10.1.2 Grievances tiers

The World Bank's Environmental and Social Standards emphasize on having a multi-level of complaint system "first tier grievance management mechanism", which will be a function of the Project, to provide aggrieved people with an avenue for amicable settlement without necessarily pursuing a court case.

The absence of a first tier grievance mechanism in Palestinian law means there are difficulties addressing minor issues that otherwise should be resolved within a short period of time. The absence of such mechanism denies project affected groups the direct channel for grievance and delays resolution of disputes in an appropriate time prior to resettlement. In order to avoid delay in dispute resolution, it is essential for the government to consider adopting the first tier grievance redress mechanism advanced by the Bank OP 4.12. If need arises, aggrieved people would however remain free to open a Court case without having registered their grievance with this first-tier mechanism.

A grievance is an important process that should be tackled carefully. The PWA receives grievances from the petitioners, and any other channels. Based on the site visits, the Project affected persons don't know the appropriate channels through which they can submit their grievances. Thus the following procedures will be applied in order to have a clear grievance's mechanisms:

##### **First tier of grievances:**

1. The PWA assigned a Social Development Officer (might be more than one) who will be responsible of receiving all grievances from all different stakeholders.
  - o Ms. Rana Abu Al Soud (Mobile No. 0598928299)
  - o Mr. Abdel Nasser Kahla in the PWA
2. The SDO will inform the community about grievances mechanism, whom to address to solve the complaints, solution for the problems and document all grievances received. Moreover, the SDO will be responsible for following up the problem until it is solved. The turnaround time for the response /resolution should be 15 days.

##### **Second tier of grievances:**

In case of having unsolved complain, the affected person might follow the second level of grievances:

- 1) A Grievance Mediation Committee should be formed among the municipalities and other entities. It will be responsible for the discussion of the unsolved complains, propose solutions, as well as, take decision and play a mediation role with the affected persons. The EQA is essential to be participants in the mediation committee
- 2) A regular meeting should be assigned by the Compensation Committee. The complainants can attend these meetings

#### **9.10.1.3 Grievances channels**

Due to the diversity of the socioeconomic characteristics of the PAPs the communication channels to receive grievances were locally tailored to address all affected groups. The following are the main channels through which grievances will be received:

- 1) Hotline (a mobile number for the SDO to be informed to project affected areas).
- 2) The second channel is through religious institutes in the area (mosque or church)
- 3) CSOs will be appropriate channel among rural areas
- 4) Regular meetings with community people to be conducted and applied by the influence stakeholders
- 5) Website for educated people who have access to the internet
- 6) Influence people and Mediation Committee

#### **9.10.1.4 Response to grievances**

Response to grievance will be through the following channels

- 1) The response of the grievance will be through the same channel used to submit the problem. For example, those who sent their grievances in writing should receive their response in written form, those who used the website should receive an email, those who phoned should receive a telephone call from the SDO telling the solution of their problems
- 2) The second channel is through religious institutes in the area (mosque or church)
- 3) Response to grievances should be handled in appropriate timing limits in order to give the community people the feeling that their worries are responded to quickly and efficiently, that might put limitation to the problems

#### **9.10.1.5 Monitoring of grievances**

All grievances activities should be monitored in order to verify the process. Monitoring will be for the following indicators:

- 1) Number of received grievances monthly (Channel, gender, age, basic economic status of the complainants should be mentioned)
- 4) Type of grievance received (according to the topic of the complaint)
- 5) Number of grievances solved
- 6) Dissemination activities done
- 7) Satisfaction with solutions
- 8) Documentation efficiency
- 9) Efficiency of response to grievance provided

#### **9.10.1.6 Disclosure of grievances**

All grievances activities should be disclosed in the municipalities, CSOs and PWA website. A monthly report should be prepared for the most frequent grievances faced and how they were solved. This report will be disclosed through the PWA website, CSOs, municipalities.

#### **9.10.1.7 Responsibilities for Monitoring and Reporting**

Monitoring and documenting activities to be undertaken by the Social Development Officer in the environmental and social unit are described below:

- reviewing and revising, as needed, the list of stakeholders to ensure that the register is accurate and complete;
- monitoring consultation activities conducted with government representatives and local communities;
- monitoring the effectiveness of the engagement process in managing impacts by tracking feedback received during engagement activities;
- reviewing/auditing the implementation of SEP;
- monitoring and responding to grievances received; and
- Reviewing and revising, as needed, the engagement activities Programme to determine if additional activities are required.

All engagement activities are being documented by the E&S Team in order to review records and track performance.

The E&S will measure the performance of the SEP by documenting and tracking the indicators outlined in Table 64 below.

**Table 20: Proposed Stakeholder Engagement Performance Indicators**

Review Topics	Objectives	Indicators
Annual review of publically-available Project documents such as PIDs, flyers, website documents and other documents	<ul style="list-style-type: none"> <li>▪ Assess whether publically available Project documents are up-to-date</li> <li>▪ Assess cultural appropriateness of publically-available Project documents</li> <li>▪ Assess level distribution documents to ensure they are available to communities in the area of impact</li> </ul>	<ul style="list-style-type: none"> <li>• Date of publically-available Project documents; frequency of distribution</li> <li>• Level of understanding of documents by stakeholders</li> <li>• Level and location of distribution</li> </ul>
Quarterly review of consultation activities	<ul style="list-style-type: none"> <li>• Assess level of engagement with stakeholders through formal and informal means (e.g., meetings with government agencies, FGDs, public meetings; other community engagement)</li> <li>• Track issues raised by stakeholders</li> <li>• Ensure that issues are responded to in a timely manner</li> <li>• Ensure consultation activities include awareness raising about GM</li> </ul>	<ul style="list-style-type: none"> <li>• Number of engagement activities, (including place, time and number of participants involved)</li> <li>• Number and types of comments/feedback received by stakeholders</li> <li>• Number and timing of responses to comments received</li> <li>• Qualitative assessment of awareness of community stakeholders of GM through stakeholder engagement process</li> </ul>
Quarterly review of community grievances	<ul style="list-style-type: none"> <li>• Assess whether grievances are correctly classified</li> <li>• Identify trends in grievances</li> <li>• Ensure grievances are being addressed</li> </ul>	<ul style="list-style-type: none"> <li>• Number grievances by level and type</li> <li>• Number and percentage (%) of grievances closed according to level and type</li> <li>• Timeframes for resolution (and closure) by grievance level and type</li> <li>• Number of repeat grievance from the same stakeholder</li> <li>• Qualitative assessment of awareness of community stakeholders of GM through stakeholder engagement process</li> </ul>
Annual review of grievance mechanism	<ul style="list-style-type: none"> <li>• Assess compliance with the grievance management process</li> <li>• Evaluate progress in achieving GM objectives</li> <li>• Identify improvements and update GM</li> </ul>	<ul style="list-style-type: none"> <li>• Level of compliance with process</li> <li>• Completeness of grievance log</li> <li>• Number of grievances by level and type</li> <li>• Timeframes for resolution (and closure) by grievance level and type</li> <li>• Number and % of grievances closed according to level and type</li> <li>• Number of satisfied responses from complainants by grievance level and type</li> <li>• Number of repeat of a grievance from the same community stakeholder</li> <li>• Qualitative assessment of awareness of community stakeholders of GM through stakeholder engagement process</li> <li>• Qualitative assessment of trust in grievance management process through stakeholder engagement.</li> </ul>

#### 9.10.2 Internal Reporting

The SDO will produce quarterly reports for the Unit Manager that summaries the stakeholder engagement activities undertaken during the quarter. The report will include a summary of issues raised by stakeholders and responses from the Project, including any corrective actions or mitigation measure undertaken to address issues.

#### 9.10.3 Public Reporting

The Project will report annually to stakeholders on the outcomes of engagement and grievance management. The public report will be prepared in a manner that is culturally appropriate with supporting documents, as necessary.

The report will include information relating to:

- project activities and timelines;
- summary of engagement activities;
- any changes to the SEP (with rationale);
- summary of grievances.

The public report will be available via the MoT website and copies will be shared with the Ministries and the municipalities.

## 10 Lessons learned from phase 1

The phase 1 recovery scheme, Part C1 (named Stage I /Lot.1) involved the construction of 14 recovery wells, 5 Monitoring wells, 3500mr Collection pipes, Water Tank 4000m<sup>3</sup>, installation of 5 Booster Pumps and service buildings.

### 10.1 Preparation and construction phase

The project was implemented by a qualified consultant JV “Central for Engineering & Planning (CEP) & Finnish Consulting Group (FCG) who undertook all construction supervision and all monitoring procedures was his task. The consultant also assisted PWA in control and quality assurance of all project activities.

JV took all the following ESIA recommendations into consideration both in the construction and operational phases:

#### Construction phase

- Document potential health and safety concerns and resolutions
- Environmental elements were closely taken in account as instructed in the previous ESIA. All activities such as filling, excavating, trenching, or stockpiling of materials or waste on private or agricultural land were made in close coordination with and only with the approval of the project manager and site engineer.
- Selected excavated materials were reused as fill, re-shaping, or restoration purposes where the surplus materials was disposed to dumping area allocated by the engineer.
- Best management practices was implemented during construction, as recommended in the management plan to minimize the impact on air quality from dust and emissions.
- Control measures were implemented to avoid leaks and spills of contaminants in order not endangered current and future land use.
- Trucks were covered when transporting fine materials used for replacement of clay
- stockpiles of materials were wetted in windy conditions.
- Best management practices was applied during construction to minimize the impact on gas emissions from construction vehicles and machines (generators, loaders, excavators, etc.) to minimize the impact on air quality from dust and emissions.
- A traffic plan for vehicle movements was performed and not overload vehicles, especially trucks to minimize exhaust emissions.
- All vehicles and heavy equipment complied with local standards.



- Physical inspection for existing utilities was performed before started excavation works for collection pipelines.
- All damage done to existing facilities during construction was prepared or replace without delay.

### **Operational phase**

- Kept the schedule for the monitoring of the ground water quality and quantity parameters for recovery wells.
- Documented official correspondences with all stakeholders were kept in a good manner.
- Documented all phases, using photographs prior, during, and post-construction to ensure site restoration back to original characteristics as much as practical.

## **10.2 Technical challenges and lessons learned:**

Examining the monitoring results, the following conclusions were drawn as lessons learned:

- ***Lesson learned is that the infiltrated water needs to be of good quality since groundwater recharge is sensitive to changes in source water quality.*** For example, It was necessary to improve pre-treatment before infiltration because of the existence of organic and inorganic impurities in raw water. Otherwise, rapid clogging of infiltration basins would significantly harm the infiltration process. This was evident in the project and has resulted in a need for the rehabilitation of the infiltration basins.
- The first phase experience has shown that the infiltration of partially treated water for groundwater recharge resulted in the clogging of the infiltration basin, and poor ground water quality (as was demonstrated by extended nitrate plume , high chloride concentrations and biological concentrations). ***Lesson learned is that the final quality of groundwater is highly sensitive to changes in the source of water quality.***
- Favorable results of the operation of the recovery wells have been observed in the monitoring. Not only have chloride concentration drops been observed in some wells, but the literal values were found to be close to those in the infiltration basin (around 330 mg/l). ***Measurable results of dropped chloride concentrations, confirm that proper operation of the project.***
- The groundwater was found to be free of Salmonella, Nematodes and Amoeba & Gardia.

- Even after the operation of the wells, the total bacteria count was still found to be high, raising a flag on the use of reclaimed water for irrigation and indicating a need for careful handling.
- Fecal coliform was found to be compliant with the Palestinian permissible limit of 200 for high quality water (Type A) in most wells with the exception of Q64. ***Lessons that need to be learned from such an experience is the need to trace back the source of pollutants, which could be attributed to the direct pollution through the well pipe, from animal wastes such as birds.***

### 10.3 Logistical challenges and lessons learned

Some challenges relating to the entering of construction materials to Gaza were faced as a result of the blockade and closure on the Gaza Strip. PWA intervened by conducting periodic meetings with CLA\ Israeli side in presence of project's site manager and the contractor to expediate the process.

Lesson learned is the importance of proper coordination between PWA and the contractors to ensure smooth and timely handling of issues.

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