Palestinian National Authority
PALESTINIAN WATER AUTHORITY
السلطة الوطنية الفلسطينية
سلطة المياه الفلسطينية

North Gaza Emergency Sewage Treatment Project
NGESTP

EFFLUENT RECOVERY AND REUSE SYSTEM AND REMEDIATION WORKS

Supplementary Environmental and Social Impact Assessment (SESIA)

FINAL REPORT

April 2013

EcoConServ
ENVIRONMENTAL SOLUTIONS

TABLE OF CONTENT

LIST OF ANNEXES

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^2	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
IBRD	International Bank for Reconstruction and Development
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_2	Nitrate
NW	North West
OM	Organic Matters

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

Introduction

This executive summary is prepared to summarize the deliverable for the Supplementary Environmental and Social Impact Assessment (SESIA) consultancy service which involves the preparation of an independent ESIA of the North Gaza Emergency Sewage Treatment Project (NGESTP), Effluent Recovery & Reuse System and Remediation Works.

The specific objectives related of this SESIA are as follow:

- Highlight the legislations under which the project will be implemented. Besides the Palestinian Laws and Regulations, the study also highlighted the Regional Laws and Regulations, especially from Jordan, Israel and Egypt, associated with wastewater reuse and sludge management and reuse. In addition, the International Standard and Guidelines, including World Bank (WB) procedures and FAO and WHO Guidelines were highlighted.
- Provide baseline environment and socio economic conditions of the project components.
- Identify of the possible positive and negative social impacts, permanent or temporary, of the project components. In addition, the analysis and mitigation measures will be developed to reduce the negative impacts resulted from the project component.
- Identify of any potential temporary or permanent land acquisition requirements associated with civil works. In addition, develop the outline of the vulnerable groups that might be affected by the project and identify the appropriate mitigation measures
- Develop an Environmental and Social Management Plan (ESMP) and monitoring plan to manage, mitigate and monitor any possible negative impacts. Moreover, a capacity assessment of the implementing party to implement the ESMP and recommendations for any capacity-building needs

In addition, special task for sludge management resulting from the North Gaza Wastewater Treatment Plant (NGWWTP) and intended to be used in the agricultural land as detailed in the effluent recovery and reuse scheme or in emergency cases to be dumped to landfill

The study was undertaken in throughout July - October 2012. The team has developed a cross-sectional study that uses a multi-data sources approach including site visits, primary data, secondary data, surveys and site measurements.

Environmental Baseline Condition of the Project Components

a. General Characteristics of the Project areas

<u>Beit Lahia Wastewater Treatment Plant (BLWWTP) and Effluent Lake</u>

- BLWWTP was constructed in 1976. It is located some 1.5 km east of the town center of the Beit Lahia, northern part of Gaza Strip.
- BLWWTP was built in sand dunes overlying a clay layer of variable thickness with un-continuous impermeable clay layer. It was constructed in stages and modification and rehabilitation activities were performed in order to increase capacity of the plant.
- During the past few years the situation escalated. With the increase of wastewater network connection, the volume of wastewater inflow had far exceeded the plant's

treatment capacity that have led to deterioration of the effluent quality and have led to clogging effects in the neighboring sand dune areas. The ongoing decrease of the infiltration capacity of the flooded areas and the increasing wastewater volumes have resulted in the formation of enduring ponds and finally a lake.

- Over the years the effluent lake had a volume of about 2 million m^3 of foul wastewater, which covers around 300 dunums and continued to rise and was threatening to flood the whole sewage collection system and the neighboring communities.
- Starting in 2007 (NGESTP was starting to be implemented), almost 90% of the effluent lake had been dried due to weathering and limited discharge to the lake. Currently the wet area occupies around 10% of the total lake.

Agriculture Land Proposed for irrigation / Sludge use

- The area in the vicinity of NGWWTP is assigned designated to benefit from the recovery water and the treated sewage sludge in the agricultural activities.
- The proposed area is divided into two zones according to its location from NGWWTP. Zone A (northern part of NGWWTP) with about 10,100 dunums whereas, Zone B (southern part of NGWWTP) with about 5,000 dunums. Most of the area is considered as under rain-fed conditions.
- Citrus, Olives, fruits and vegetables are among the crops grown in the proposed agriculture land for reuse scheme.

b. Physical and Biological Environment of the project areas

- The project sites have a typical semi-arid Mediterranean climate with long hot and dry summer (from 25ºC in summer and 13ºC in winter with maximum daily temperature can reach 29-30ºC and the minimum temperature is around 9ºC). The proximity of the Mediterranean Sea has a moderating effect on temperatures and promotes high humidity throughout the year. The prevailing wind direction is South West with an average speed of 4.2 m/s (winter) and from North West (summer).
- The average annual evaporation rate is around 1,900 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.
- Ambient air and noise quality at the project sites are consider normal with a slightly high on BLWWTP due to more rapid population surrounding the area.
- The dominate soil type in the irrigation area can be considered as heavy soil with a deep soil profile, which means will not limit root penetration for deep rooted crops. The irrigation scheme assessment was done with taking into account the climate change through the mentioned 10 years by increase the air temperature of 1.5ºC.
- The soil at different locations of the effluent lake has a normal pH range and Organic Matter content with negative and low Fecal Coliform. In addition, the Electrical Conductivity at the wet part indicates the higher number due to remaining heavy metal from the stabilized sludge that is present in the top layers of the effluent lake.
- No major fault type formations have been observed in Gaza Strip area.
- Mainly aquatic birds and the reptiles (rats, snake, crows, barn owl and other wild species) are present at the BLWWTP and the Effluent Lake. The effluent lake

provides breeding, nesting, roosting and feeding habitats for different birds' species. Typical effluent lake landscape consists of sand dunes covered with Acacia shrubs.

- In the proposed agriculture land for effluent recovery reuse, many Olive, Plum, Almond, Citrus or Orchards have been encountered at agriculture land allocated for irrigation of recovered water and sludge reuse. Many wildlife species; particularly birds were found to inhabit these agro-ecosystems.

c. Water (groundwater quality) of the project components

- The water quality in this study focused on chloride and nitrate concentrations (the most important contamination indicators in the groundwater in the Northern Gaza aquifer).
- The highest chloride sources are expected in the areas affected by seawater intrusion and the deeper groundwater layer (generally exceed 250 mg/l). 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.
- NO_3 concentration exceeds the WHO drinking water guidelines in most of the Northern Gaza aquifer. In 2003 at the infiltration site (adjacent to NGWWTP), the maximum nitrate concentration in the groundwater was about 30 mg/l due to the operation of the infiltration basin using partially treated wastewater.
- Cl concentration in the wells close to the infiltration basin ranges between 350 to 650 mg/l (till the middle of 2012). The trend of the chloride concentration recorded is steady since 2011 in some wells. In addition, Nitrate concentration for the same period ranges between 20 to 120mg/l.
- From the analysis it found that the groundwater is free of Salmonella, Nematodes and Amoeba & Gardia. However, the total Bacteria ranges between 30 to 395 cfu/ml and the total coliform ranges between 6 to 50 cfu/100 ml in some wells.
- The heavy metals concentrations in all analyzed wells were less than the Palestinian standard values for irrigation. However, there were some wells that have concentrations of Boron and Mercury higher than the standard values.
- The groundwater quality under the effluent lake and the BLWWTP sites is improving after drying the lake.
- According to the groundwater modeling result, the recovered water is not expected to have bacteria, including fecal coliform due to the infiltration process (treated by the soil). In fact, the water quality, especially after the NGWWTP will have better quality than the wastewater reuse. However, to ensure the public health concern related to wastewater and sludge reuse, the monitoring plan is determined in the monitoring plan (including the mitigation measures for epidemiology).
- There is no archeological or historical site as well as the protectorate areas nearby the project component sites. The only site consider important and respected (psychologically important) by the community is the El Shuhada Cemetery, which is nearby the location of storage tanks and booster pumps (water distribution network).

Positive Environmental and Social Impacts

The positive environmental and social impacts of the project are:

1. The recovered effluent from the groundwater will be an important source of irrigation water, as water resources in the Gaza Strip are scarce; especially during summer time, as a source of water will be continuously available.
2. The groundwater quality is suitable for Unrestricted Use. The only restriction is for the Total-N, which is higher than 15 mg/l. This could be considered as an advantage for agricultural use. However, it is advisable to restrict the use the recovered water for uncooked vegetables at least for the first year of implementation.
3. The recovery scheme will limit the horizontal dispersion and the vertical building up of the water table, which without recovery will have a negative impact on current land use.
4. Effluent reuse of the recovered water will solve the problem of the disposal of wastewater, as it will be treated and injected for agricultural use.
5. The groundwater quality after drying the lake is improving.
6. Sludge has a high content of organic matter that can help conserving soil organic matter, and sludge stimulates biological activity in the soil.
7. The sludge reuse brings possibility for farmers to supply their lands with organic fertilizer at low costs and reliably available. It is expected that the sludge will cost as low as the transport cost of around 1 NIS/50 kg (compare with 50 NIS/50 kg for Israeli imported fertilizer). Another level of competition reported was with the Palestinian organic fertilizers (each dunum needs about 8 cubic meter from this fertilizer. That cost around 850 shekel per ton which is relatively expensive). Thus, the produced sludge will be a competitive product if it cost less than 300 shekel/T.
8. The sludge reuse is environmentally the best solution compared to disposal inland fills or incineration plants and appealing solution for sustainable sludge management.
9. Sludge is one of the outputs of the project, and will increase the income for those who work in sludge trading,
10. Sludge reuse will work for reduction of chemical fertilizers.
11. Reduction of health risks associated with exposure of villagers or inhabitant surrounding the effluent lake and BLWWTP to environmental risks and nuisance released from the BLWWTP, such as effluent lake flooding and the risk of water borne disease, will be seen. In addition, the project will protect the livelihood status of people who suffered due to the flooding of BLWWTP,
12. The provision of recovered water will reduce the cost of water needed for irrigation in the area. The utilization of the recovered water of high quality and of less price might work for the benefit of the farmers (increase their profits)
13. The new lands gained due to the decommissioning of BLWWTP will be used in agriculture activities or as a recreational or residential place.
14. Potential increase of the price of lands and dwellings due to the implementation of the project,
15. Provision of jobs due to the implementation of the project components, both during construction and operation phase.
16. After decommissioning of BLWWRP, it will considerably reduce odor, mosquitoes and flies.
17. As soon as the NGWWTP is completed and starts its operation (2013) the infiltration of a high quality effluent in the infiltration ponds will begin to compensate the negative effects on groundwater

18. The construction of the site and the carrier line will improve the road network connecting the existing and the emergency area.

Negative Environmental Impact Analysis and Their Mitigations

a. During Construction Phase

1. Air Quality and Noise Pollution (low impact and temporary)

It is concluded that the air quality impacts associated with dust generation will be of "low" significance. However, whenever the dust emission becomes higher than normal and create disturbance to the workers and project activities, it is recommended to spray the location with water to reduce the impact.

2. Gaseous Emissions (low impact and temporary)

Air emission impacts associated with the proposed project will be of "low" significance. However, to reduce and minimize the impact, it is recommended to check the vehicles regularly for the exhaust gas and minimize the vehicles and heavy equipment movement at the same time.

3. Noise (low impact and temporary)

The noise generation is not expected to represent a significant issue to local residents (due to distance from the residential area, only during the day time and on a short period). The most affected people from noise impacts are the construction workers. The mitigation measures recommended in the ESMP and Monitoring Plan for control of noise and air emissions, especially to the workers are based on compliance with the Palestinian Outdoor Noise Standards.

4. Vibration (low to medium impact and temporary for the water distribution networks and low impact and temporary for other project components)

The closest sensitive structure to the site of the booster pumps (due to psychological perspective of the respected site according to the people in Gaza) is El Shuhada Cemetery (around 10 m away). Consequently, medium vibration impacts could be anticipated to occur. The mitigation measures proposed during the construction of water distribution network component (storage tank and booster pump), near the El Shuhada Cemetery area are as follow:

1. The base camp (workers site camp) and place for storage of equipment have to be on the future land dedicated for future expansion (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 and not overlapped.
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 mixing onsite and reduction of the hazardous wastes and other solid wastes on site, the vibrational load will be also reduced significantly (use of concrete pumps will be advantageous).
4. In addition, due to the sensitivity of the groundwater, the vibration around the wells construction site should be minimized in order to avoid groundwater contamination due to potential spills.

5. Construction Waste and Handling of Hazardous Waste (low to medium impacts)

Based on the expected waste generation associated with the proposed NGESTP project activities, the impact will be of "low to medium" significance. The following mitigation measures are proposed:

1. Onsite domestic sewage collection and disposal (adequate sanitation facilities) shall be provided by the contractor for construction workers' needs.

2. Site waste management plan should be developed by the contractor prior to commencement of construction works.
3. The burning of any type of wastes should be avoided.
4. The reused clay or excavated sand should be stockpiled and stored away from any waterway, drainage networks, existing wastewater networks and any other drainage patterns.
5. Nearby sanitary landfill should be notified to receive the unusable non-hazardous construction wastes or damaged construction materials.

6. <u>Soil Contamination during Decommissioning of BLWWTP (medium impacts)</u>

Soil may be exposed to contamination due to the movement of construction vehicles and equipment. The contamination will occur due to oil and fuel spills from the engines of machines, and also due to polluted wheels (importing pollutants from outside of the site). It is concluded, based on the above, impacts associated with soil contamination will be of "medium" significance. Mitigation measures proposed during the decommissioning of the treatment plant are as follows:

1. The decanting activities should be done with a care and the pipe should be have sufficient length to prevent the spillage to the ground
2. Preventive maintenance for any vehicle or equipment that has an engine that leaks oil or fuel.
3. Preparing a special fuelling and oil change station on site to contain any possible fuel or engine oil spill. Otherwise fuelling and oil change should be conduct in the private oil stations out of site (concrete paved station on site).
4. If any machine is broken on site, a containment system should be used to prevent the spill of oil or fuel on the soil.
5. The vehicles moving in and out of site should be checked at the inlet gates of BLWWTP to assure that they are not importing pollutants through the wheels.
6. The paved path / concrete paved parking or loading and uploading sites can be made to ensure that the vehicle will not transport the pollutant from the site.

7. <u>Remediation Works at the Effluent Lake</u>

The best options for financially and technically feasible options (excluded the land investment cost) are the Phytoremediation, clay placement and three layers clay placement. The most sensitive criteria for the remediation selection is the land investment. As the land is being rented and the longer term of the remediation activities will affect the initial cost, in addition, the three layers of clay cap is not necessary as the contamination does not need deep soil replacement, the clay cap placement is the most suitable option, financially and technically.

Heavy machinery and vehicles might be used are excavators and heavy trucks. Impacts associated with remediation works will be of "medium" significance. Mitigation measures proposed during the remediation works of the effluent lake are as follows:

1. Standard protection to the workers during the overall remediation activities
2. Special tools for handling the dangerous wildlife found
3. On site sanitation should be established for the workers
4. Avoid the disturbance of the existing plants and wildlife as much as possible during the site preparation
5. Handle with care found wildlife (catchment dangerous wildlife). It is recommended to seek the assistance from Ministry of Health and Ministry of Agriculture for the best practice for handling the catch dangerous wildlife
6. Minimize the soil contamination by site management plan (place for temporary storage, handling, transportation and disposal)

7. Replanting the affected plant that has to be displaced. If the replanting is not feasible, planting 2 new trees to compensate 1 removed tree has to be done by the contractor
8. Notification to the designated landfill should be done prior to the soil disposal.

8. <u>Changes in Hydrology and Groundwater Quantity and Quality (low impact)</u>

During the construction of the recovery scheme, remediation of effluent lake and decommissioning of BLWWTP there will be no impact on groundwater. It is expected the depth of the excavation will not significantly impact the groundwater but the wells construction. It is recommended to hire the highly qualified contractor for wells establishment. Therefore, the impact negligible for decommissioning and remediation activities and low impact on the water distribution networks (only for wells construction).

The mitigation measures to avoid the hydrology of groundwater quantity and quality are similar to the general wells construction. To reduce the impact on 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.

9. <u>Health and Safety (low to medium impacts)</u>

During the construction phase, as the proposed project are at a large distance from the nearest population or residential area and on the agriculture land, the health of the population is not expected to be significant and considered minimal.

Negative impacts will mainly concern the works for construction of new facilities, which are mainly within water distribution networks. It will have few limited negative impacts such as temporary discomfort and localized pollution to the communities caused by worksites (noise, exhaust fumes, dust and vibration, risk of accidents due to increased traffic in the project impact area, the presence of workers, very limited disruption of wildlife and vegetation, poor management of handled products: fuels and lubricants as well as worksite waste, etc.).

However, although the impact is considered low and temporary for the communities, the mitigation measures are developed to minimize the impact. In addition, due to the health and safety of the workers, which accidents might occur on site in various construction project activities, mitigation measures are as well developed to mitigate the risk of health and injuries to the workers. Mitigation measures developed to minimize the risk related to health and safety, both for community and workers are:

1. Raising awareness campaigns to workers and community members to promote safety, and health and safety monitor should be appointed. The monitor can be chosen from among community members who accepted to work in the project.
2. Workers should wear standard protection especially due to the dangerous wildlife on BLWWTP and effluent lake sites.
3. Workers should be trained to cover the completed parts and keep their work areas safe. In case of causing an accidents, the workers should be penalized either by deduction of salaries or dismissal.
4. Existing utilities (especially at BLWWTP and water distribution network), if exist, would be located and staked before construction begins, including and at intersections of other pipes and crossings. This would confirm the location and depth to ensure new construction does not impact the existing utilities.
5. The identification of the existing infrastructure (other pipelines, cables, etc) has to be identified prior to the construction phase.

6. Heavy equipment would not normally be operating over the existing utilities during construction of the new line. If heavy equipment or trucks must cross the existing utilities, thus additional soil cover is needed to protect the existing pipe.
7. Onsite inspectors would be present during construction to verify that the construction contractor is following engineering specifications and meeting regulatory requirements.
8. Workers should take the following steps to protect themselves from falls during high construction:
    a) Use 100% fall protection when working on higher construction site
    b) Participate in all training programs offered by the employer (contractor).
    c) Follow safe work practices identified by worker training programs.
    d) Inspect equipment daily and report any damage or deficiencies

As a mitigation measure, safety measures should be put into consideration and addressed with the workers. The contractor and the PMU are mainly responsible for any safety procedures to be applied

10. <u>Archaeological Disturbance (low impact)</u>

Surveys in the area of the BLWWTP and Effluent Lake concluded that there is no archaeological sites were identified. The confirmation letter was sent to the Archaeological Authority for assurance and clarification of the assessment and the replied letter indicating that the project components (including the irrigation lands) have non-existence of the archaeological site.

Although the sites do not have any archaeological importance, the Jordanian Antiquities Law still applicable and can be applied if there is any archaeological and valuable objects is found.

11. <u>Ecological Disturbance (medium impacts)</u>

Wetland ecosystem and vertebrates living at the area surrounding the BLWWTP and the effluent lake might be affected during the decommissioning of the treatment plant and the remediation works of the effluent lake.

Although the biodiversity, especially fauna identified within the vicinity of the project sites (effluent lake and BLWWTP), are commonly found, it is not belong to endanger wildlife and in fact it could cause a vertebrate pest outbreak or other health impact, the mitigation measures have to be developed to avoid the ecological disturbance and provide safe and adequate relocation for found wildlife and re-plantation for the fauna. Based on the ecological disturbance impact, the project at BLWWTP and effluent lake will have significant medium impacts.

However, due to the decommissioning activity and the remediation of the effluent lake, after the finalization of the works activities, the site will provide a permanent positive impact. The biodiversity disturbance of the site due to the remediation works and decommissioning activities, either by relocation, temporary shelter or re-plantation to another site or still within the project site area, will be compensated with the long term positive impact. In addition, as the fauna and flora found in the project site is a local and not belong to the endanger species, they will easily adapted and continue their life cycle.

Mitigation measures to reduce and minimize the impact of the existing wildlife and plantation within the BLWWTP and effluent lake are as follow:

1. Standard procedure for health and safety of the workers at the site, especially the equipment that protect them from the wildlife.
2. Equipment to handle the vertebrates should be prepared (this includes cages, snake sticks, net, etc.) in case of the found vertebrate during the activities.

3. Assistance from the staff of Ministry of Health and Ministry of Agriculture is needed to advice the contractor for temporary relocation of the found wildlife.
4. Re-plantation of the trees, if needed, should be done by the contractor, if it is needed. The re-plantation can be done within the area of the effluent lake.
5. Avoid the disturbance of the nesting, breeding site. The found nesting or breeding found has to be handled with care and replace it to the safe site.

Regarding the water distribution network site, there is an opportunity that the networks will be laid in agricultural land and impose on the existing crops and local animals around the site. 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.

Mitigation measures develop to avoid the crop and animal disturbances in the vicinity are as follow:

1. Temporary construction fences have to be installed prior to the construction of the water networks and other components for recovery water distribution to avoid the fallen of the local animal and to localize the site from the local animals.
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.
3. If it is needed, the replanting or trees relocation (temporary or permanently) has to be done. If the relocation or replanting of the existing trees is not feasible, the compensation of planting 2 trees (for removal of one tree) has to be done in the other area. It is advisable to plant locally trees.

12. <u>Land Use and Accessibility (medium impacts)</u>

During the decommissioning and remediation activities, the impact on land use and accessibility is considered "low". 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.

Mitigation measures proposed are as follow:

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.

b. During Operation Phase

1. Air Emissions and Noise Pollution (low to medium impacts)

The impact of such air emissions are considered minor, because the diesel generators are only expected to operate temporarily during power cut-offs. The compliance of generator emissions with Palestinian Standard for Ambient Air will be sufficient to safeguard against unacceptable air emissions impacts to the neighboring areas.

A relatively higher impact will be on the Pumping Station staff, which may be exposed to intermittent pumping noise. The standard protection of the workers, including earmuffs, has to be practiced all the time, especially at the Pumping Station area.

2. Odor

The operation of the water distribution network system is not expected to have significant impacts on odor. However, due to the remaining pond #7 that will be used as the emergency pond, the operation of anaerobic ponds will have significant impact associated with generation of odor (mainly H_2S) and vectors that mostly generated from raw sewage storage. The mitigation measures proposed for Pond #7 is as follow:

1. Minimum standard is set to consider as an emergency (monitoring plan is presented at ESMP section). Maximum permissible level of the overflow or raw wastewater discharge in the pond is 2 m height.
2. Maintaining high performance of biological treatment of wastewater. In addition, to be as far as possible from odor recipients and keeping buffer zones between odorous units and neighbors.
3. The aerator from the aeration tank can be installed on the pond to maintain reasonable dissolved oxygen in the water to avoid anaerobic conditions.

3. Vibration

Concerning the vibration at the effluent lake and the decommissioning site (including remaining pond #7 and the PS adjacent to pond #7), the impacts is considered negligible. The main impact (medium impact) expected during the operation of the water distribution network is on the site of booster pump (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). The mitigation measures 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 maximized (less than the standard period required).

4. Water Resource Contamination

The impacts on groundwater is one of the most important issues associated with the reuse project, as part of the project has been designed to prevent impacts on the groundwater from infiltrating partially treated sewage. To identify the impact of the groundwater, the verification of the available water quality monitoring (four rounds from PWA) has been analyzed and the groundwater modeling with different scenarios has been run (with and without recovery schemes and different scenarios of recovery wells implemented (12 wells and 25 wells) and during the different year of implementations; 12 wells implemented on the year 2013 and 2015). Based on the modeling results, the groundwater monitoring plan has been developed.

The groundwater monitoring programme is the key mitigation measures to indicate the water resource contamination. The groundwater monitoring programme will be explained in detailed on the following section, ESMP.

5. Impacts on Local Agriculture, Public Health and Water Resources

Based on the design project report three scenarios that considered the expected water quality recommended are as follows:

- Scenario I: It is more advisable to cultivate orchards on the available area to the west of the project along Al Karama Road. Based on crops water requirements, the available reclaimed water is just enough to irrigate 5,375 dunums divided into citrus, olives, fruit trees, alfalfa and grains (water quality does not have impact on the crops selection)
- Scenario II: 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^3 daily. This reclaimed water will be used to irrigate additional land to 7,525 dunums in total.
- 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^3/day) is expected for unrestricted use. The quantity of reclaimed water will be enough to irrigate about 12,577 dunums. In this scenario vegetable crops will be introduced with an area of 1,258 dunums.

6. Decommissioning of BLWWTP on Groundwater Quality (positive impacts)

After decommissioning the lake and BWWTP, a positive impact will be clearly found on the groundwater quality in the aquifer under the lake.

7. Recovery Water Quantity and Quality (medium impacts)

Based on the groundwater modeling and analyses, the recovery water quantity and quality is expected to be acceptable for agricultural irrigation for unrestricted crops, but unacceptable to be used for drinking water. Besides continuous groundwater monitoring, public awareness is needed to ensure that the community is not using the recovery water as a drinking water.

Although the NGWWTP is located nearby the Israeli border, the flood risk is not expected to cross the fence to Israeli border due to the topographical nature of the project site. In addition, as the groundwater modeling result from different scenarios, the plume will not be significantly crossed the Israeli border as the infiltration basins are located more than 300 m downstream of the border and with the recovery wells implementation, the wells will accelerate the flow in the downstream direction away from the Israeli border.

8. Land Use of Effluent Lake Remediate and Decommission of Beit Lahia Wastewater Treatment Plant (medium impacts)

In one year period, the remediation activities will be finalized. Afterward, the remediated effluent lake can be used for agriculture purposes or residential, depending on the Urban Planning of the area and El Awqaf future plan.

After the completion of the remediation works, depending on the urban planning of the area and the future plan of Ministry El Awqaf, the land use of the effluent lake will be mitigated. Based on the soil assessment prior to the completion of the remediation works, there are two options of land use which can be applied:

1. To be used as an agriculture land. Although the area will not need additional filling or leveling, but due to the huge amount of the soil excavated at the nearby landfill site (Johr Eldeek) that will be implemented during 2018, if needed, the excavated soil can be transported to the effluent lake site as far as the soil is considered good. The soil quality has to be determined (soil analysis done at the landfill site, by the landfill management), before transporting it to another area.

   The agreement between Ministry of Awqaf and the Land Authority or the Ministry of Economic in addition to the agreement of the Landfill management shall be reached prior to transferring the soil to the effluent lake. According to the capacity analysis during the EA of NGESTP, a maximum of 1.5 million m^3 of soil can be transferred to fill the effluent lake
2. To be used for residential purposes. Additional soil for leveling and soil conditioning, if needed, at the effluent lake site when the urban planning of the area is dedicated for residential area. The soil analysis will not be crucial as the option 1 and the agreement shall be reached only between Ministry El Awqaf and the Ministry of Economic and Land Authority in addition to the agreement of the landfill management for transporting the soil to the remediated effluent lake.

Due to the remaining pond # 7, the mitigation measures are developed to minimize the impacts due to the operation of pond # 7. The impact on the land use and accessibility of the decommissioning land and remaining pond #7 is of “medium” significance. Mitigation measures developed to reduce the impacts are as follows:

1. Fences surrounding pond # 7 have to be constructed to reduce the accessibility of the community to the pond area. During the Public consultation, Beit Lahia Mayor announced that there is a budget allocated to build the permanent fence around the pond #7. The agreement between PWA and Beit Lahia Municipality can be reached on the construction procedures.
2. There should be 10-15 m distance between the pond area and the fences to be constructed on the surrounding pond.
3. The trees shall be planted nearby the fences, in order to reduce the odor or nuisance and separate the pond site from the surrounding neighboring area and future land use of the other decommissioning ponds. Planted trees will also bring positive impact on the visual impact.
4. The site is only connected to one main gate and the access road to the neighboring site in addition the pond site should be connected with the pumping station at the vicinity for ease access.

9. Public Health related to Using Recovery Water for Irrigation (medium impacts)

Health protection measures which can be applied to the agricultural use are:

- Crop restriction
- Human exposure control and promotion of hygiene
- Treatment of drainage water

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.

Control measures aimed at protecting agricultural field workers and crop handlers include:

- The provision (and insistence on the wearing) of protective clothing, the maintenance of high levels of hygiene and immunization against (or chemotherapeutic control) selected infections.
- Risks to consumers can be reduced through cooking the agricultural products before consumption and by high standards of food hygiene, which should be emphasized in the health education associated with irrigation schemes.
- Local residents should be kept fully informed on the use of recovery water in agriculture so that they, and their children, can avoid these areas.
- Special care must always be taken to ensure that agricultural workers or the public do not use irrigation water for drinking or domestic purposes by accident or for lack of an alternative.

All measures should be coordinated with the awareness campaign of using treated wastewater and pilot projects of using treated wastewater for irrigation. According to the clarification from the PWA team responsible for the effluent reuse study and pilot projects in Gaza, currently there are ongoing projects related to the awareness and the pilot projects, i.e. awareness workshops carried out for farmers, operators and managers of recovered wastewater (and more awareness will be carried out during the operationalization of the pilot projects).

Recovered water reuse, as it is demonstrated on the groundwater modeling concluded that there is no indication of bacteria or viruses, including the Fecal Coliform. The combination use of recovered water and the sludge for the same area proposed will not have significant impact to the soil, as only the nitrate is considered higher than standard (in this regard, it is not recommended to be used as a drinking but is considered an advantage for the agriculture).

Concerning the epidemiology due to the reuse of the recovered water and sludge for irrigation and soil at the irrigated land, based on the expected water quality, there will be no bacteria, viruses and other related pathogens that lead to the waterborne diseases, i.e. cholera, hookworm, diarrheal diseases or other helminthic infections is expected. However, 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 and sludge. 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 and sludge quality. The investigation should conclude the source of the infections or diseases.

When the source is due to the recovered water or sludge reuse, 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.

10. Contamination from Reuse and Disposal of Sludge (medium impacts)

When the sewage sludge fails to meet Rule 503 Class-A on sludge use requirements, it will pose hazardous health and environmental impacts if applied to the lands for agriculture use. The potential contamination will affect soil, air, groundwater and crops. If for some reason the sludge fails to meet Class-A requirements, it will be disposed in a landfill. The most probable impact is high concentration of pathogens (over 1000 cells/100 ml). High concentrations of heavy metals (higher than those in Class- A standards) are not expected as verified by the sludge analysis results.

Concerning the reuse of the recovered water and the reuse of the sludge at the same area proposed, according to the groundwater analysis and current measurement, the recovered water does not contain any possible health risk as well as heavy metal that could have a significant effect on crops. In addition, based on the sludge analysis and the treatment technology at NGWWTP and low content of heavy metal found, the sludge is already stabilized and predicted to meet the Class A rules for sludge reuse.

However, the importance parameter to be ensured for recovered water is the pH and for the sludge is the stability of the sludge. Using the combination of the recovered water and the sludge are not expected to have high significant negative impacts on crop and soil. In addition, with the sludge reuse implementation schedule, sludge monitoring plan and the groundwater monitoring plan implemented during the operation phase, the impact associated is considered low. The importance of the monitoring plan for sludge and recovered water are highly significant. Accordingly, with the possibility of lack of enforcement, the trained qualified personnel for management and monitoring plan has to be taken into consideration. The good management monitoring practice, documentations and reporting has to be well defined and prepared accordingly

Proposed mitigation measures for emergency situation when the sludge is not meeting the requirement of Rule 503 Class A include:

1. Sludge not meeting these requirements should not be used for agricultural purposes and should be disposed to landfills.
2. As a protection measure in this project, is limiting the sludge application for vegetables that are eaten uncooked despite the fact that Rule 503 Class A sludge allows sludge application for all types of vegetables.
3. Adhering to the monitoring and testing requirements
4. If the sludge does not meet the Class-A requirements especially with respect to pathogen concentration it should be mixed with lime (the same way that floating sludge is treated) and disposed to landfills.
5. Training and guidance for farmers and sludge transporters regarding healthy handling and usage of sludge in agriculture.
6. Some precautions to protect farmers are to wear suitable clothes, gloves and boots; washing before eating; and using a facemask if the sludge is dusty.
7. Vehicles should be carefully selected for their local suitability and transport routes chosen so as to minimize inconvenience to the public. Special care must be taken to prevent vehicles carrying mud onto the highway.
8. Enclosed trucks should be used for transporting treated sludge to prevent sludge spill and to avoid any odor release.
9. Keeping good communication between customer, regulator, public and stakeholders including landowners and retailers.

Negative Socio Economic Impacts and Their mitigations

- Decommission of the BLWWTP will reduce water that some of the farmers relied upon to water their plants. Indicating that their income might be affected that will be mitigated through: i) Provision of recovered water of a competitive price to minimize the potential impacts. ii) Due to the fact that the sewage untreated water should be banned, appropriate laws shall be developed to criminalize the use of untreated water

- Potential risk for the people in the adjacent areas due to having no fence around Pond #7 that might affect children. Mitigation measures will be through constructing fences.
- The use of lands might be limited due to the pond as having recreational activities; especially in case of not having a fence surrounding the pond #7. In addition, the construction of residential compounds in decommissioned area will be limited due to the existence of the pond. Again, the fence will be the most appropriate mitigation.
- The construction of the carrier pipes will have negative impact due to noise and obstruction of traffic and use of agricultural land during the construction stages. The project should reduce the disturbance to community using most appropriate environmental mitigation measures in addition to information sharing.
- Due to the unfavorable odor, mosquitoes and flies might affect the health of the adjacent communities. The flies should be combated using hygienic and environmentally friendly procedures.
- The sludge reuse for fertilizer might affect those who work in the chemical fertilizers sector in Gaza Strip, especially, those who import fertilizers. Integrating laborers in the new market could be an appropriate mitigation measure.
- Negative impact on the livelihood status of those who operate wells. Potential loss of income for those who own and operate the wells that will be closed due to project implementation. The laborers and the well owners might be affected severely. It could be mitigated by provision of appropriate compensation i.e. jobs or monetary.
- Put limitation to the plantation of certain crops in the beneficiaries who will use the recovered water. Orientation sessions should be presented to raise farmers awareness regarding the type of crops that should be planted using recovered water
- Expropriation for the areas of lands needed to construct the recovery well and lands needed for the project. The 27 well and the expansion of the treatment plant need about 18,175 m^2 (please note, during the social investigation, the wells implementation considered was 27, as it was stated on the design report). Mitigation measures include protective procedures should be applied to limit the resettlements; avoiding small plots in order not to raise poverty and compensation should be paid in a full market price.

Potential Affected Parties

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. The magnitude of their vulnerability shall 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- **Those who Rent Lands from Awqaf** for a few amount of money that includes the cost of water. They will be affected in sense of losing their lands and paying for water.
4- The **Owners of small plots of lands** who will be expropriated during the construction of the recovery 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 and the remaining land will be too small for any use.
5- Other **Project Affected Persons** due to the implementation of the project during the construction activities

The mitigation of impacts described in detailed 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 Action Plan in order to identify accurately the Project Affected Persons (PAPs), their entitlement, compensation valuation and mechanisms proposed for compensation.

Residual Impacts and Costs of Applying Mitigation Measure

This discussion will cover the whole potential impacts resulted due to land acquisition and expropriation during the preparation, construction and operation phase.

The estimated cost for applying the different activities related to the potential expropriation and land acquisition will be mainly based on:

- Cooperation with the municipalities and other organizations
- Negotiation with the Awqaf
- Negotiation with the affected people

Therefore, any budget estimations for such activities is based on non-solid rationale

Willingness to Pay, Cost Analysis and Tariff Survey

Surveys have been conducted for willingness to pay for the wastewater and sludge reuse, water distribution network and cost analysis including proposed tariffs for the effluent recovery. The result is a stand-alone report that is presented in Annex 8.
Regarding the increment cost of the reuse system, the draft vision toward the reuse system is under developed. The study includes tariff assessment; cost analysis for water reuse as well as the sludge reuse. However, the tariff survey and willingness to pay conducted under this study should be taken into consideration.

Resettlement Action Plan (RAP)

Based on findings and the consultant's recommendation in addition to the WB approval, the RAP should be prepared as a document due to the certainty of the OP 4.12 triggered.

Once the RAP ToR is cleared (by the donors), work towards the RAP is underway. In specific, the RAP should provide details on how the affected parties are identified, consulted on the project and the adverse impacts they will experience, the compensation, and the modes of grievance redress that is available to them. More specifically, detailed information on the operators of the wells (license or unlicensed), owners of wells, those who rent lands from the Awqaf should be developed, and owners of small plots of lands who will be affected /expropriated; permanently or temporary (due to the disturbances; i.e. land use and accessibility, traffic, etc) should be identified.

Project Alternative

Basically, the objectives of the Effluent Recovery and Reuse, in addition of decommissioning of BLLWTP and remediation works of Effluent Lake adjacent to BLWWTP is to improve the environmental, socio economic and public health conditions in Gaza Strip, especially at the project areas. Accordingly it is expected, by definition, that the environmental and social benefits will overweigh the impacts.

All the environmental and social negative impacts discussed are mainly site-specific and could be managed / minimized through implementing the proposed mitigation measures as described earlier. Comparing the benefits to the impacts in a strategic level, it could concluded that the "no project alternative" is not supported from the environmental and social perspective, given that the project impacts will be controlled as recommended in this ESIA.

In addition, the implementation shall be implemented and start to be operated before 2015, otherwise the recovery scheme will not be able to catch the pollution and they will affect the irrigation wells around the recovery wells.

Environmental and Social Management Plan (ESMP)

ESMP was developed to reduce or eliminate the negative impacts of the project component. The table of the ESMP both during construction and operation phase (environmental and social perspectives) are presented at the following tables (Table 1 – Table 3). The tables also include the monitoring plan, the institutional responsibility for inspection and monitoring including the budget proposed for management and monitoring proposed. The Institutional set up and the roles and responsibility for implementation and supervision during the construction and operation phase of the project components is presented on detailed on the main report of SESIA.

Grievances and Compensation

All grievances received verbally or in written shall be documented in a grievance register and handled by the PMU (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:

1. The petitioner has to be informed of the proposed corrective measure.
2. In case if a corrective action is not required, the petitioner has also to be informed accordingly.
3. Implementation of the corrective measure and its follow up has to be communicated to the complainant and recorded in the grievance register

The comprehensive grievance mechanism including the institutional responsibility, monitoring, responses procedure and disclosure of the grievance is presented at the main report of the SESIA.

Table 1 Environmental Management Plan

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
During Pre-Construction / Preparation					
Site clearance prior to water distribution network	Health and safety of the workers	standard procedure for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender process	
		Portable construction fences have to be prepared prior to the construction	Contractor (through tendering activity	None as a part of tender process	
		In case of potential destruction of crop or plants, the compensation has to be settled.	PWA (PMU-EM) in coordination with MoA	150.000	Compensation framework has to be developed accordingly
Biodiversity and site clearance prior to remediation of Effluent Lake	Health and safety of the workers due to the wetland ecosystem and vertebrate living at the area	Strictly standard procedures for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender process	
		Equipment to handle the vertebrates has to be prepared	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	
		Fauna found to be dangerous has to be isolated and handled with care	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	Procedures of handling of fauna found to be dangerous is presented in the annex 6, Soil Remediation Assessment for Effluent Lake
Biodiversity and site clearance prior to decommissioning of the BLWWTP	Health and safety of the workers due to the wetland ecosystem and vertebrate living at the area	Strictly standard procedures for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender process	The decommissioning activities will start after the startup of NGWWTP. Therefore, the proposed mitigation measures proposed in these activities can be combined with the
		Equipment to handle the vertebrates has to be prepared	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	
		Fauna found to be dangerous has to be isolated and handled with care	Contractor (through tendering activity) in assistance from MoH	None as a part of tender	

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
			and MoA	process	measures of the remediation of effluent lake that is assumed the site remediation has been completed.
Base camp preparation for the workers (for all project components)	Ambient air, noise and community disturbance	Base camp and storage of the equipment has to be defined to avoid the disturbances	Contractor	As a part of their financial budget during the bidding activities	
During Construction					
Ambient Air Quality by dust emission of construction works (for all project components)	Health impact associated with fugitive dust generated due to the vehicles movements	Localize the vehicle movements	Contractor	As a part of their financial budget during the bidding activities	Low impact and temporary
	Potential nuisance to the population in the vicinity to the construction site	Pavement of access roads prior to usage in construction of the project components			
	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	
Noise impacts (for all project component)	Construction activities associated with heavy machineries and generators	Noisy equipment, especially those that will be used in the construction works including generators should be supplied with adequate silencers	Supplier	None, as a part of the supplier offers	Short term duration
		Standard noise protection equipment for the construction workers			
	Psychological impacts among the neighboring area	Optimize the use of noisy machines	Contractor	None	Low impact as there is no major noise sensitive receptor is located in close proximity of the project

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		Use acoustic barriers as necessary if complaints from neighbors were received	Contractor	None	Secondary impacts. It is apply when the mitigation measure is not properly managed.
	Traffic congestion due to the heavy equipment movement and transportation of raw materials	Construction activities confined during day time	Contractor	None	
		Management of the main routing of construction vehicles	Contractor	None	Routing management shall be presented to the traffic department for approval.
Sludge drying during decommissioning of BLWWTP and during remediation works	Odor impacts due to the exposure to active sludge during the decommissioning or drying of the ponds at BLWWTP and wet areas of the effluent lake	Apply fresh soil from the effluent lake to cover the fresh sludge to reduce the release of H_2S.	Contractor	None, as a part of the contractor's offers	
Vehicles movement during the Construction work (concrete work) of the facility of water distribution network.	Vibration at the location nearby El Shuhada Cemetery area.	Base camp and the storage of the equipment have to be on place far from the Cemetery area (on the future land dedicated for the future location of the booster pumps and storage tank).	Contractor	None, as a part of the contractor's offers	
		Time management plan to reduce the overlapped heavy equipment	Contractor	None	
		Ready mix concrete is preferred instead of on site concrete mixing.	Contractor	None	
Handling of construction wastes and hazardous wastes	Impacts on soil, groundwater, air quality, as well as aesthetic impacts due to mishandling of construction wastes.	Provision of onsite sewage collection for the workers.	Contractor	None	Coordination with the landfill management for receiving the unusable construction waste.
		Site waste management including storage, collection and disposal.			
		Maximize the reuse and recycle of construction materials.			

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		Notify the sanitary landfill of receiving the unusable construction wastes or damaged construction materials.			
	Impacts on soil, groundwater, air quality, and health due to mishandling of hazardous wastes.	Site waste management including separate and safe storage of hazardous wastes.			
		Arrange for collection and disposal in licensed landfills.			
		Proper identification of hazardous wastes.			
Decommissioning of BLWWTP	Soil contamination due to oil or fuel spill from construction vehicles	Preventive maintenance for construction vehicle	Contractor	None	
		Fuel or oil change station shall be prepared		None	
		Containment system to avoid the spill of broken machine onsite		None	
	Impacts on air quality resulting from sludge removal from the lagoon to the selected drying area	Considering the prevailing wind is not directed from temporary drying area to the nearby community	Contractor	As a part of contractor's financial offer for decommissioning plan	
	Impacts on air quality due to transportation of backfilling materials.	Time plan for transporting of soil for backfilling	Contractor	None	Secondary impact. Coordination between contractor and traffic department
Remediation works at the effluent lake	Residual hazardous contaminants in the effluent lake	Soil replacement / removal of the wet area of the effluent lake	PWA	235,000	The cost is estimated for the soil cutting only (overall cost including workers, equipment and truck for transportation

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
					When the sand or soil need to be replaced, additional 105,000 will be needed to purchase the sand / soil and another 175,000 for sand / soil placement (workers, equipment and vehicles)
Construction works of effluent recovery network	Potential leaks or spill chemical / fuel	Proper waste management and spill prevention measures	Contractor	None	
	Potential leaks from temporary sewage storage tank	Spill prevention measures			
Construction Works of the project components	Risk of injury or accident to the construction workers	Safety measures and standard safety protection of the workers	Contractor	As a part of the contractor's financial offer	
Excavation works	Impacts related to archeological disturbance such as risk of unknown discovery of culturally valuable object / monument during excavation	When there a culturally valuable object/monument is discovered, the work should be stopped.	Contractor	None	Secondary impact. The antiquities authority needs to be notify prior to the construction works.
		The discovery should be informed to the administrative authority within 48 hours.			
		Excavations should be supervised by an inspector.			
		Record keeping, expert verification, chain of custody and criteria for potential temporary work stoppage			
All stages of excavation and construction-related works	Potential disturbance to the crops and animals, especially at the water distribution network site	Installation of fences prior to the construction of the recovery water distribution networks	Contractor	As a part of the contractor's financial offer	
		Compensation for destructed crops	Contractor in coordination with	This section will	

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		or plant.	MoA	be defined prior to the construction phase.	
	Risks to the workers from dangerous vertebrate, pets and fauna.	Strictly standard procedure especially at the wetland site	Contractor in coordination with the PWA (PMU)	Contractor in coordination with the PWA (PMU)	On the preparation stage, the tendering has been done to purchase the standard procedure for site clearance. However, the contractor shall put into consideration on their budget proposal
		Equipment to handle the vertebrates such as cages should be provided.			
		Dangerous fauna must be isolated and handled with care.			
Construction works for water distribution networks	Land use and accessibility such as road traffic impacts due to the laying of water distribution networks along or across main roads	Selection of temporary storage areas of construction materials, equipment, tools and machineries prior to the beginning of construction activities.	Contractor in coordination with PWA for site selection	None	
		Training on safe utilization for the machineries drivers	Contractor	As a part of the contractor's financial offer	On Job training as a standard training activities
		Clear signing for the project site and fences installation prior to the beginning of construction activities	Contractor		
		All activities shall be performed during daytime and have to be scheduled to avoid conjunction	Contractor	None	
		Inform Traffic Department for traffic management during congested time			
		Temporary resettlement has to be defined, prepared and compensated for.	Contractor in coordination with Land Authority for resettlement		RAP has to be developed accordingly in coordination with independent consultant

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
During Operation / Maintenance					
Operation of the PS at the remaining BLWWTP and water distribution networks	Noise impact especially for the PS staff at the water distribution network PS and the remaining BLWWTP	Standard protection for the workers including the ear muffs.	CMWU as the authority for collection and storing the recovery water and municipality of BLWWTP as the responsible entity for operation and maintenance of the plant	10,000 for initial purchase of equipment and 10,000 for monitoring programme annually	
Storage of raw sewage during emergency at the remaining pond#7 at BLWWTP	H_2S release due to raw sewage storage at the remaining BLWWTP	Maintaining high performance of biological treatment at the remaining pond	Municipality of BLWWTP	5,000	Operation cost is depending on the average annual budget for aerators maintenance and operations and energy consumption
		Installation of existing aerator at pond #7	Operators at BLWWTP in coordination with PWA (PMU)		Installation activities, there is not cost estimate for purchasing the aerator
Operation of machineries	Vibration impacts especially nearby the El Shuhada Cemetery of the installation of pumping station and generators	Heavy leafy tree plantation at the Cemetery area to absorb the vibration and noise associated with the PS and generators	CMWU in coordination with MoA	10,000	MoA provide the suitable plantation can be sufficient for vibration and noise absorption
		Maintenance of the machines and equipment has to be maximized.	CMWU	-	Cost estimation is depending on the average annual budget for pumping, generators and pipelines connections
		Maintenance of the trees planted at the Cemetery area	Contractor for trees maintenance (selected and supervised by CMWU)	7,500	Cost estimation is based on yearly maintenance. Cost includes the watering, plant

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
					observation and trimming of the trees done every 6 months. Please note that the water is collected from the treated wastewater.
Operation of recovery water scheme	Captured contaminant by the 25 recovery water wells installed as designed	The maintenance of the recovery well to meet the design criteria to captured the contaminant	PWA	-	Cost estimation is depending on the local materials availability
Water recovery for reuse in irrigation	Impact on local agriculture, public health and water resources. Risk of using the recovered water for the cultivation of unrestricted crops	Prohibition of using recovery water for drinking purposes (higher total N and possible other contaminations which are not recorded) Recommend the reuse of recovered water not for uncooked vegetables (especially during the first year of implementation	PWA in coordination with MoA and MoH through private communities, NGOs and farmer's associations	40,000	The cost estimates will be used for workshops, training, etc.
Preparation of the use of the former effluent lake and decommissioning of BLWWTP site	Impacts due to soil transportation for filling of the effluent lake and decommissioning, if needed	Agreement for soil transportation to the effluent lake and decommissioning land	El Awqaf in coordination with North Gaza Joint Service Council (NJSC) of Johr Eldeek landfill	-	The activities will be done after the handing over of the land. Soil placement will be considered, if needed for leveling, landscaping or soil conditioning
		Traffic route management for transferring the soil from John Eldeek to the effluent lake	PWA in coordination with traffic authority	None	Prior to the agreement between PWA and the NJSC, the PWA in coordination with traffic authority to identify the route
Operation of pond #7 for emergency purposes.	Limiting access for neighboring residential area and visual impacts due to	Construction of fences around the pond to reduce the accessibility to the pond and access road	Municipality of BLWWTP through tendering procedure	40,000	This cost estimated should be discussed with the municipality as it is

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
	the operation of pond#7 as the emergency pond	Keep distance of 10-15 m between the pond and the fences			mentioned that the fund is already available
		Plantation around the fences (to reduce odor, facility separation and for visual / aesthetic)			
		One gate and access road to be connected to the pumping station			
Water recovery for reuse in irrigation (related to public health)	Health impact for agricultural workers for using treated water and general public for consuming unrestricted crops	Institutional framework for monitor and control compliance with regulations and enforce them	PWA in coordination with MoA, MoH, farmers association and water usage and distribution, under PWA	Undefined	
		Farmer's awareness for crop restriction and assistance in development of a balanced mix of crops	MoH in coordination with MoA through private sectors or NGOs	20,000	This activities belong to the awareness campaign and training
	Public health impact for agriculture workers and families, crop handlers and inhabitant nearby the irrigated area	Provision of protection clothing, the maintenance of high levels of hygiene and immunization against selected infections	MoH in coordination with MoA through private sectors or NGOs	20,000	This activities belong to the awareness campaign and training
		Cooking the agriculture product before consumption and high standard of food hygiene	MoH in coordination with MoA through private sectors or NGOs	20,000	As a part of public awareness
		Health education associated with irrigation scheme			
		Special care for assurance of not using the irrigation water for drinking water or domestic purposes by accident or by lack of an alternative	MoH in coordination with MoA through private sectors or NGOs	20,000	As a part of public awareness
Reuse and disposal of Sludge	Risk of sludge not meeting the standards for reuse (sludge is contaminated with substances that	The sludge has to be dispose to the landfill	NGWWTP management with coordination of PMU	Undefined	NGWWTP in coordination with the NJSC for arrangement of disposal of

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
	cannot be used as fertilizers or soil conditioning)				contaminated sludge
		Traffic management for sludge transport to the landfill	NGWWTP management in coordination with the traffic authority	None	Discussion between NGWWTP management to define the approved route for sludge transportation
	Sludge reuse application for irrigation	Limiting the sludge application for uncooked vegetables	MoH in coordination with MoA through private sectors or NGOs	-	As a part of public awareness
		Monitoring and testing of the sludge before sending it to for reuse	NGWWTP (based on the assumption that the sludge testing and monitoring equipment is available at the NGWWTP laboratory) in coordination with CMWU	None	The equipment area already included in the budget of NGWWTP. The budget of chemical and spare part purchasing base on annual demand.
	Risks of sludge not meeting the standards due to pathogen concentration	Treated with the lime and transported into landfill	NGWWTP management with coordination with CMWU and NJSC	None	The budget of chemical and spare part purchasing base on annual demand. The budget is already included for O&M of NGWWTP
		Traffic management for sludge transportation	NGWWTP management in coordination with the traffic authority	None	
	Health and handling sludge in agriculture	Training and guidance for farmers and sludge transporter regarding health and handling sludge in agriculture	MoA	20,000	Cost estimation is based for each training session
		Health and safety protection shall be introduced to the farmers and the transporters			
	Inconvenience to the	Vehicle selection to reduce public	NGWWTP management	20,000	Cost estimation for

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
	public due to sludge transportation	inconvenience			operation and maintenance of the vehicle annually
		Transport route selections to minimize the public inconvenience and the raise Odor and noise nuisance	NGWWTP in coordination with traffic authority	None	
		Traffic route selected shall avoid the highway			
	Sludge spillage and Odor nuisance resulting from the sludge	Enclose sludge trucks	NGWWTP management	None	
		For transport optimization the sludge can be stored on farm with assurance of secure storage facilities			
	Risk due to uncontrolled sludge application on land	Controlling sludge rate of sludge application, nutrient addition, crop types, waiting period and sowing and harvesting constraint	MoA in coordination with farmers association (Union for Agriculture and PARC)	5,000	Cost estimates based on the annual operational cost
		Good communication between costumers, regulator, public and stakeholders	Palestinian Water Council	Undefined	
Using recovered water for irrigation purpose	climate change and crop management impact	Crops selections, irrigation method, water distribution management	MoA	25,000	Cost estimate is based on every two year study for climate change impact on irrigation

Table 2 Environmental Monitoring Plan

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
During Pre-Construction / Preparation						
Site clearance prior to water distribution network	Worker's injuries	Construction site location	Preparation of recording form of workers injure during the construction	Monthly	None	Contractor On the preparation stage, the tendering has been done to purchase the standard procedure for site clearance. However, the contractor shall put into consideration on their budget proposal
Site clearance prior to decommissioning of the BLWWTP and remediation work of effluent lake	Health and safety equipment, equipment for handling vertebrate	Project site for remediation and decommissioning sites	Purchasing equipment for the workers, equipment for handling vertebrates Preparation form of recording the number of vertebrate and fauna	Once during the preparation and prior to start the construction phase	None	
Base camp preparation for the workers	Neighbors' complaints	Project construction sites	Recording of complaint and type of complaint	Once during the preparation and prior to start the construction phase	None	
During Construction						
Monitoring ambient Air Quality during construction works	Ambient air (gas emissions) PM, dust complaint	Ambient air (gaseous emissions), PM at the closest farm of pumping station location, water distribution network and nearby community at the BLWWTP and effluent lake	Sampling collection and laboratory analysis Recording and documentation of complaints	Once during the most activities at each location	As a part of contractor's financial offer for decommissioning plan	Contractor
Monitoring Noise Impacts at the project sites	Ambient noise levels, noise complaints from the neighboring communities	Project locations	Portable noise measurement to take representative of average noise, recording and	Annual during operation and once during the construction	As a part of contractor's financial offer for decommissioning	Contractor

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
			documentation of complaints	activity	plan	
Monitoring of Odor Impacts during the construction activities	Odor complaints from neighbors	Site location	Recording and documentation of complaints	Monthly	None This monitoring activities is already established with the odor scrub at the BLWWTP PS	PMU-EM
Monitoring 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	As a part of contractor's financial offer for water distribution During the operation, the price for equipment is included on the ESMP table above	Contractor during construction and CMWU during operation
Management of construction waste and handling of hazardous waste	Amount of hazardous and nonhazardous waste generated	Project site locations	Estimation of the hazardous waste and non-hazardous waste in relation to the handling and transporting to the landfill	Weekly or monthly depending on the volume of waste	As a part of contractor's financial offer for wastes handling	Contractor
Monitoring soil contamination during decommissioning of BLWWTP	Area of spillage	Project sites	Visual observation Recording and documentation of spillage	weekly	As a part of contractor's financial offer for environmental monitoring	Contractor
Remediation works at the effluent lake	Replantation due to the soil removal from the top layers of contaminated soil Volume of the soil to be removed from the site and transported to the landfill	Project sites	Recording and documentation during the preparation of remediation and during the plantation period	monthly	As a part of contractor's financial offer for environmental monitoring	Contractor

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
Monitoring health and safety of the workers during the construction of the project components	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	The cost is undefined, depending on the cases	Occupational health clinic / hospital
Monitoring archeological disturbance during construction of the project components	Record of any artifact or antiquities found during construction	Project site	Recording and documenting and reporting to the relevant authority	On findings	-	Contractor
Monitoring of ecological disturbance during construction of the project components	Records about biodiversity found, removed, handle over to relevant authority, damaged or replanted	Project sites	Recording and documenting and reporting to the relevant authority	monthly	-	Contractor
Storage of the machines and construction materials of the project components	Complaints from neighboring communities and records and documentation of the temporary area for storage of materials or machineries	Project sites	Recording and documentation	monthly	-	Contractor
During Operation / Maintenance						
Groundwater monitoring plan for recovery water and reuse scheme	Presented below at separate subsection				22,400 The cost based on the identified monitoring wells monitored for four times a year and yearly water level monitoring presented in the monitoring plan section below	PWA

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
Recovered water reuse for irrigation purposes	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	18,000 The cost based on annual survey and documentation purposes but excluding the emergency response for the endemic emergency plan or health related disease related to the recovered water reuse (that is not expected) In addition the cost include the analysis samples of crops and soil at the pilot areas (please note, the water for irrigation is excluding as it is monitored from the groundwater monitoring done by PWA)	MoA in coordination with MoH The irrigation water monitoring is done by PWA; MoA and MoH will be responsible for reviewing the results
Monitoring of public health due to recovered water effluent reuse	Presented below at separate subsection				8,000 The cost is related to the recording from different hospitals and agricultural centers and random survey	MoH in cooperation with MoA

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
					for public health conditions on the area of reuse	
Monitoring sludge quality for reuse purposes	Presented below at separate subsection				Cost estimates is including on the operation and maintenance of the NGWWTP. It is estimated that the cost estimation will be around 10,500 as the 5 times sludge monitoring for two weeks period for 6 times a year	NGWWTP sludge management in cooperation with PWA (PMU)
Operation of Pond # 7 of BLWWTP (related to the emergency response plan due to failure)	Presented below at separate subsection				Cost estimated to be allocated during the Emergency plan should be discussed between PWA and CMWU. However, allocated budget should be kept at CMWU will be around 30,000 USD (under CMWU) to cover the mentioned activities during the Emergency.	CMWU

Table 3 Social Management and Monitoring Plan

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
During construction						
Reduction of sewage water that some of the farmers relied upon to water their plants.	• Provision of recovered water of a competitive price to minimize the potential impacts • Awareness raising programs to be provided to the adjacent communities in Beit Lahia	PWA Legislation Entities	PWA internal monitoring MENA external monitoring Ministry of Agriculture	1- Site visits observation shown that no farmers use sewage water 2- Increase the number of participants in the awareness raising activities 3- Photos for awareness events 4- No Grievances received related to this impacts	Monthly monitoring checklist Monthly monitoring checklist Monthly monitoring checklist	No additional cost as all activities lie under the direct supervision of each entity
Involuntary resettlement	• Apply strict avoidance mechanism in order to reduce resettlement activities to only necessary ones, and avoid small plots of land • Develop RAP • Provide appropriate compensation strategy through the RAP • 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 • Providing compensation to the land owners, tenants, house owners, tenants, or provision of alternative lands	PWA In cooperation with the Municipalities, Awqaf and Land Authority	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	1- Documentation of all procedures applied to minimize the PAPs show that the affected people were appropriately considered 2- Grievances received and how they were responses to 3- Lists of affected people 4- Lists of consulted affected people 5- Photos for different activities implemented with the PAPs 6- Documents related to affected people identification and how they were compensated 7- Post impact report results	Documentation for all mitigation and relocation Reports developed (Resettlement Policy Framework and/or Resettlement Action Plan)	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
Potential risk for the communities in the adjacent areas due to having no fence around pond 7	Fences should be constructed around the pond with protective wire at the top of fence in order to keep children away	PWA & Contractor	The PWA in cooperation with the local municipalities should monitor the guards in the areas until the completion of the fence construction	1- Site visits should be paid in order to warrantee that the fence is well established 2- Grievances received from the communities adjacent the fence will be reduced 3- Reduction in number of accidents resulted due to the construction of fence	Documentation of the site visits. Grievances from community people and municipalities	No cost
Community Disturbance impact during the construction of the carrier pipe. The fumes and dust affect the health of people in the adjacent area	• Provide the needed information to the community • Follow all mitigations mentioned under environmental management plan	Contractor PWA (HSE supervisor)	PMU in the PWA	1- Grievances received from the adjacent communities related to this impact are reduced 2- Intervention reports to minimize the impacts declared that they are mild 3- Environmental measurements and analysis are under the acceptable ranges 4- Reports developed by the supervisor showed that the impacts are in compliance with the environmental standards of the EQA and the WB	Site visits to be paid to the sites Documentation for site visits results Grievances from the community	No cost
During operation						
Due to the unfavorable odor, mosquitoes and flies might affect the health of communities adjacent to the infiltration ponds	• The flies should be combated by using environmentally hygienic procedures • Awareness raising programs should be developed to reduce the impacts due to having such insects	PWA in cooperation with the Ministry of Health	MENA in cooperation with the PMU in the PWA should monitor the implementation of mitigation measure	1- MENAs surveillance reports show no impact 2- Increase the number of combating campaigns 3- Enhancement in the health of communities adjacent the infiltration pond 4- Site visits shown that no flies in	Monthly reports Health centers reports	No cost

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
				the area		
Negative impact on the livelihood of the chemical fertilizers' traders.	• Try to integrate the labor force working in this sector in newly developed sludge trading. In addition, awareness raising programs about the benefits of sludge should be provided	PWA with traders	MENA in cooperation with the Ministry of Agriculture and the PMU in the PWA should monitor the implementation of mitigation measure	1- No grievances to be received from their side 2- How many of them were included in the project 3- No impact on their source of income reported 4- Increase in the awareness activities provided 5- List of participants for those who attended awareness session 6- High demand for the sludge	Monthly reports	No cost
Negative impact on the livelihood of the operators of wells and owners of wells	• The operators should be provided with job opportunities in the project • Well owners should be provided with subsidized water from the project and from the fresh water provided by the municipality • Full compensation for the cost of well digging	PWA Municipality	PWA and the municipalities	1- No grievances to be received from their side 2- Number of well operators employed 3- Their level of satisfaction with their new job 4- Site visits to the affected people	1- Compensation identification sheets 2- List of job opportunities provided to well operators 3- Receipt for the well owners that he got his full compensation	No cost
Put limitation to the plantation of certain crops in the beneficiaries who will use the recovered water	• Orientation sessions should be presented to raise farmers awareness regarding the type of crops that should be planted using recovered water	PWA Ministry of Agriculture	PWA	1- Increase the number of the farmers received awareness sessions 2- Registration sheets 3- Orientation sessions materials to be provided and published on the PWA website 4- Well documentation for all activities 5- Decrease the number of grievances received	1- List of participants 2- Photos 3- Minutes of sessions	No cost

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
The construction of the pond near the Shuhada Cemetery will cause some discomfort to the families of the deceased during the burial ceremonies.	• As the main disturbance will be from the odor, all procedures should be taken (environmental procedures) to minimize the Odor	PWA	PMU within the PWA	1- No grievances received 2- Site visits show no rejection to have the project close to the cemeteries	1. Site visits to be paid to the sites 2. Documentation for site visits results 3. Grievances from the community	No cost
Potential health hazards on the people eating the raw crops from fields	• Orientation sessions should be presented to raise people awareness regarding the type of crops that should be planted using recovered water	PWA in cooperation with the Ministry of Agriculture and NGOs	PWA	1- Reduction of the number of affected people 2- Orientation materials prepared and presented to people 3- No grievances reported related to this impact	1- List of participants 2- Photos 3- Minutes of sessions	No cost

Environmental and Social Monitoring Plan and Their Indicators and Emergency / Risk Plan

a. Groundwater Monitoring Plan

Monitoring Wells locations

The first monitoring well row should be 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 and used to monitor the infiltration basin. The locations of the monitoring wells are described in detail on the main SESIA report.

Parameters to be monitored

The parameters to be monitored is specified and presented at the main SESIA report. The main objective of monitoring is to check the groundwater quality after infiltration and check the operation of the Soil Aquifer Treatment process. Parameters, which could reflect the status of groundwater after infiltration of partially treated wastewater and could be analyzed in Gaza Strip laboratories, to be monitor and the period of monitoring is presented in detail on the main report.

b. Sludge Monitoring Plan

Sludge Quality monitoring

Required monitoring includes:

1. Monitoring of sewage sludge for 10 heavy metals (As, Cd, Cr, Hg, Mo, Ni, Se, and Zn)
2. Monitoring to determine pathogen concentrations (Fecal coliforms, Salmonella**,** Viable nematode eggs, Intestinal viruses)
3. Monitoring to ensure that conditions for vector attraction reduction (VAR) are maintained. Five samples of sewage sludge are analyzed for volatile solids content over a period of two weeks.

Monitoring frequency

Minimum frequency of monitoring for heavy metals, pathogen requirement and vector attraction depends on the amount of sewage sludge used or disposed annually. Five samples of sewage sludge should be analyzed for volatile solids content over a period of two weeks to guarantee that the minimum reduction volatile solids are 38%.

Sludge sampling location

Sampling locations should be as close as possible to the stage before final land application. In the NGWWTP, the sewage sludge should be sampled at the storage area from the sludge that has completed the 100 days storage period. For the sample to be representative, it should be a composite of samples from many locations within the storage area and at different depths.

c. Energy Demand, Plan of Energy Source Sustainability and Response Plan of Energy Shortage

Operation and maintenance of the treatment plant and the distribution network need a sustainable and reliable energy source as the power failure can degrade the quality and quantity of the network. In regards of the unreliability of the energy source in Gaza Strip, the PWA and CMWU as the main responsible entity for operation of NGEST and NGWWTP are preparing the plan for sustaining the energy sources and secure the reliability of the demand of the system. In addition, the emergency plan concerning the power failure are also prepared and planned as follows:

- For existing PS at BLWWTP; In case of electricity failure from local network, there are existing 2 standby diesel generators with capacity of 900 kVA. However, one generator is already sufficient to maintain operational load required. The second generator is reserved for the full load capacity.
- For NGWWTP; In case of electricity failure from local network, 3 standby diesel generators with capacity of 800 kVA each will be operated at NGWWTP. This power generation is sufficient to maintain operation load of the entire plant.
- For Recovery and Reuse System; In case of electricity failure from local network, 2 standby diesel generators with capacity of 500 kVA each will be operated for phase 1 while 3 others with 500 kVA to be used during phase 2. This power generation is sufficient to maintain operational load of the entire system.

d. Emergency Response Plan (ERP) for Operation of Pond # 7

The expected emergency situation that may be encountered under the scope of this study is related to the sudden failure of pond # 7, as it will be used as an overflow pond for the north central pumping station after the decommissioning of the BLWWTP. The anticipated emergency situation for the operation of pond # 7 include the pond # 7 failure, failure emergency procedure, testing the emergency response plan, budget constraint, documentation and incident investigation. The detailed procedures are presented at the main SESIA.

e. Risks to the Treatment Plant Structures and Its Operation (NGWWTP)

1. Power failure may occur during the operation of the NGWWTP In case of complete power failure no sludge (nor water) will be produced in out of the treatment plant.
2. Partial power failure may occur when the main power supply is cut and the treatment plant can use the gas storage available in the gas holder. The sludge quality during the partial power failure will not be affected since the treatment plant will be operating at its normal conditions in terms of treatment processes.
3. Another option that may be adapted during partial power failure is reducing the air supply to the oxidation ditches (by 50% for example). This option will give the opportunity of increasing the time of the treatment plant operation.
4. In all cases, the sludge quality following the power shortage should be carefully monitored and to dispose it to landfill in case it does not meet the standards of sludge use for agriculture.

f. Public Health Related Monitoring Plan for Using Recovery Water (treated wastewater)

Irrigation Water

All parameters presented in the SESIA report should be measured twice a year, during the minimum and maximum flows in February & August respectively (from the existing sampling sites in the pilot area).

Soil

The parameters should be measured in the soil once a year: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, and Atrazine

Crops

The parameters should be measured in crops at the harvesting period: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, and Atrazine

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.

g. Security Risk (especially for the storage tanks and booster pumps)

The location of the storage tanks and booster pump is within the buffer zone of the Israeli borders. The location has a high security risk in addition to the height of the tanks; there is possibility to be sabotaged by the Israeli Military. This sabotage might damage partially or overall infrastructure. The following are the measures to be considered during the operation of the storage tanks and booster pumps:

- For the prevention of the infrastructure, the clear sign that can be seen from above need to be written above the storage tanks with the colourful phosphoric paints to be able to differentiate between other infrastructures surrounding
- The concrete wall with no leakage is recommended to be built around the storage tank to avoid the spillage that can cause flooding to the surrounding areas. In addition, the stones can be place from the tank to around 2-3 meters to allow the water to be infiltrated to the groundwater. To avoid the water running to the Cemetery, the sloop to the direction of the North West of the site is recommended. In addition, if there is land availability, the open channel earthen channel can be built to accommodate the overflow. This channel to be connected with other drains (nearest drain with sufficient capacity).

h. 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 PMU.

In order to achieve this monitoring system the following personnel needed are (1) The Compensation Committee is responsible for the valuation of the compensation, and should be assessed by the governorates during the process of compensation. And (2) Social officer should be hired in order to do the tasks as part of the monitoring system

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
- SDO is trained in socio-economic issues, with a strong background in involuntary resettlement and public awareness campaigns.
- Site supervision is also needed. For back to back activities, it is recommended to have 2 staff under supervision. In addition, site supervision will help in documentation and recording during the project phases.
- After completion of the construction phase, another staff will need for follow up operation and maintenance including recording and documentation for the effluent recovery system.

Table 4 below presents the proposed Institutional Strengthening for implementation.

Table 4 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, MoH and WWDU (new entity for water distribution of reuse system – still under development)	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
Training on Emergency Plan (due to the risk of operation of Pond 7 for overflow and due to the Security Risk of the storage tank)	Description of Emergency Response Plan and the training and exercise of emergency plan	Once before implementation and annual training	PWA (PMU) and CMWU	25,000 annually	Classroom and On Job Training
Social assessment, community communications and community survey and inspections	Communication skills, mass communications, social survey, sampling, analysis and reporting	Once before implementation and once every two years	PWA (PMU), CMWU, Private organizations, NGO and farmer's associations (Union for Agriculture and PARC)	25,000 per sessions	Classroom with field visits and exercises.

Public Consultations

Consultation and participatory techniques were employed during the process of the SESIA preparation. The methodology of the preparation of the SESIA involved a bottom-up approach that depended on a diverse range of tools to serve the objectives of the various parts of the SESIA. The Consultant accessed large amounts of quantitative and qualitative information from various primary and secondary sources.

The key consultation activities during the course of the project are as follows:

1. The scoping and preparation of the SESIA

   A scoping session was conducted in Gaza on Tuesday, July 10, 2012. The scoping phase was attended by a wide range of stakeholders including various municipalities, International Organization in Gaza Strip (representative of UNICEF and the local representative of UNICEF), Academic, NGOs, local communities, Palestinian Water Authority, Ministries, Consultants (The German Consultant was attended besides the local partner) and Contractors of the new wastewater treatment plant; North Gaza Wastewater Treatment Plant (NGWWTP).

2. Consultations through surveying and participatory tools

   Consultation with various groups of stakeholders has been carried out during the scoping period through a comprehensive structured survey, in-depth interviews and FGDs with various types of stakeholders as explained in more details under Chapter 2 on the ESIA methodology was held during the period of July – September 2012). In addition to the social survey, the willingness survey and the cost tariff survey were conducted as well, during the period of July to September 2012.

   Although the water distribution network planned to be installed on El Awqaf land, however, it was confirmed that the involuntary resettlement will be triggered. Therefore, the involuntary resettlement were identified during the preparation of the study and presented in detailed in the main report. The RAP ToR is prepared and presented on the annexes of SESIA report.

3. Public Consultation of the SESIA

   After the submission of the draft SESIA the second Public Consultation was held on Monday the 22nd of October, 2012. The aim of the second public consultation is to present the findings of the study, environmentally and socioeconomically, including impact analysis, mitigation measures and management and monitoring plans during different phase of the project.

   Up to 80 people were invited among different institutes and stakeholders. 53 of them were responsive to the meeting, among which 17% were females (9 persons) and 83% were males (44 persons). It is worth noting that the enthusiasm of the International Agency (UNDP and UNRWA) toward the project, including the public consultation process is positive. The farmers and community's involvement and participation through the study process were appreciated.

   Based on the consultation processes, especially during the public consultation (both scoping phase and the second public presentation), the Table 4 below presents the summary of the stakeholders concerns raised during the public consultations.

Table 4. Summary of the Stakeholders and Consultations Results

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
The first Public Consultation			
Effluent recovery and reuse			
Water recovery	The model was planned and implemented for the recovery well that was used to irrigate the trees in 10 streets. We wish to have a share for Gaza city in the 27 wells (based on design report) that belong to the project.	The project is a promising water experience for water recovery and the municipality of Gaza will benefit from the project.	
	Is there any type of monitoring of the infiltration and the quality of groundwater?	There will be a complete monitoring system and there is a study for the groundwater before the injection during 2008 and afterwards the basins started operating and it is analyzed 5 times annually and the results were provided to the Ministry of Agriculture and Ministry of Environment.	
	To operate the treatment plant (NGWWTP) the energy consumption is high and we have a shortage in electricity. Is there any consideration for the energy consumption?	The treatment plant needs around 3 MW and it is independent with 60% of the energy consumption coming from the methane gas produced by the sludge. In addition, there are 4 standby generators that equally operate the treatment plant with full capacity that will be available. In the meantime, PWA still negotiating with the Israeli government to provide the treatment plant with the electricity, in addition, a funding agency (Islamic Bank) tried to provide the electricity from the Egyptian side.	
	The treated water is of excellent quality. Why is recovering underground water needed with it adding up extra costs?		
	Some experiments for the reuse of treated water were applied on different crops and produced good results but there is potential drawback if any increase or decrease in nutrient containment occurs. There is an ongoing study on these precise issues. Also, the PWA's plan to cultivate 5,000 different crops using treated water, recommends cooperating together in order to share the experience.	It is a pleasure as PWA to coordinate with the PARC and the Agriculture Union as part of the active players and it will defiantly cooperate with you through the Consultant.	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	Some of the wells are located at the east of Gaza (Israeli site), this issue should be taken in account	Some of those wells will be addressed and investigated.	
	Who will cover the operation costs in the future?	The operation cost was estimated during the study and the stakeholders will be contacted to define the mechanism needed for the operation cost; it is a project of high importance in Palestine. The water project is of a lot of significance , therefore , the desalination of sea water and the reuse of treated water is to be reconsidered	
Sludge reuse	The sludge is planned to move to the landfill and there is no information about sending it to the landfill.	The vast majority of the sludge is usable thus; the consultant during the impact assessment will address this issue through predicting the quantity of sludge that should be sent to the landfill. After that the draft report of the ESIA would be sent to the Municipality and stakeholders.	
	It is assumed that sludge produced is not much. Have you studied the land to use the sludge and the quality of the land and to what extend is it needed for the sludge land.		The treatment plant will produce huge quantity of sludge and gas according to the first study sample from sludge and soil which was analyzed and no indication of heavy metal occurred. Nevertheless,, the sludge shall be re investigated during this study.
Decommissioning of BLWWTP			
	The BOD resulted from the treatment plant might be used in agriculture. Is there any possibility for direct reuse or not?	Direct use is a bit costly. It is needed to add more ingredients. Therefore, the water injection to the groundwater is more acceptable to people as it is now considered as groundwater not the treated wastewater. In addition, the direct reuse needs bigger tanks to store the water. The second option will be even more costly.	
	Having the basin in BLWWTP attracted the attention to the people surrounding the site, moving the basin will reduce the attention paid to the community in Beit Lahia. The funding agency will pay less attention to the surrounding area		Part of the ESIA's task is to analyze both positive and negative impacts for the decommissioning of BLWWTP and measure this impact on the livelihood of the communities. In case of finding the negative impact, mitigation measures will be develop

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
			and implemented to reduce such unfavorable impact.
Remediation works			
	The issue of mosquitoes and its impacts of the treatment plant shall be put into consideration.	There will be no water services produce mosquitoes. Infiltration basins will not remain in more than a 2-3 day retention time.	
Institutional framework			
	What is the institutional framework for the reuse of treated water and what is the difference between this project with NGESTP and BLWWTP. Will the authority be for the management of treated water?	The current study for institutional framework is not agreed upon. We requested a more comprehensive study from the Consultant. Furthermore, regarding the ESIA there will be a clear institution.	
Other issues raised			
	Will it be continuity for the funding project implementation entirely	The fund is completely available for the treatment plant for phase A and the recovery scheme and we received many promises for phase B from AFD and WB and other international donors. There is an international interest to revive the agriculture sector there is no worry about the funding.	
	Did you develop and prepare the capacity building and the resources to run this project?	All technical assistance will be provided for the staff and the operators during the first couple of years as well as a lab inside the treatment plant to analyze all parameters. Currently PWA tries to analyze the capacity in order to identify the gap.	
	The time plan is not clear	The time plan is explained in details. It is estimated that the draft study will be presented by the end of August or the beginning of September by another Public Consultation for presenting the findings, management and monitoring plan as well as the cost estimation for the management and the monitoring plan.	
Land acquisition			
	Will people be consulted for the land acquisition issue?		Certainly there will be a probability for land acquisition, therefore; land acquisition will be mentioned in the

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
			ESIA but the ESIA detailed study for Resettlement Action Plan (RAP) will be prepared later on that containing 7 main elements (description for the project, effected group and vulnerability, the impact of the project and mitigation measures, graveness mechanism and corresponding to it, cost estimation for the compensation, legal and institutional framework for land acquisition). The responsibility of ESIA study is responsible to develop the ToR for RAP further study will be developed if needed.
	Land acquisition is not acceptable. The focus is to have the government land or Awqaf owned land.	The lands focusing on Awqaf and governmental property have been reviewed. However, around 2 dunums are needed to the private land (it is relatively a limited area) and this will be applied with maximum mitigation measures in order to compromise with the land owners.	
The Second Public Consultation			
Effluent recovery and reuse			
Water recovery	Was there a study for the Cd? The average of Nitrate in the North Plant, Was there a study on the Nitrate?	Moving Nitrate is part of the national strategy to enhance water quality. In addition we have a desalination station for sea water that will provide 110 million cubic meters during the second phase.	The SESIA covered the Cd There is no specific study for Nitrate
	Methane Gas will provide only 60% of the electricity needed for the new plant. How will you find the rest of 40% of electricity	In order to have enough electricity we still negotiate with the WB, AFD, Israel and Egypt.	
	Recovered water should be distributed free of charge	I don't accept to distribute water for free in order to sustain the project. Cost recovery is essential for the project. It will be impossible to maintain and operate the project unless we have sustainable source of income	
	Cd is not a problem in North Gaza due to the nature of the soil		

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	Did you consider similar projects i.e. North Gaza project that cares about tree irrigation using the recovered water	This should be taken into consideration	
	Will the recovered water be useful to irrigate strawberry?	Recovered water is suitable to irrigate vegetables as it will be injected to the underground water	
	Can you tell us about the groups of people approved to use recovered water and sludge?		The study covered the following groups: farmers (consumer of water) wholesalers (consumer of vegetables and fruits) and customers (end consumer of vegetables and fruits) In addition to applying questionnaire with them some FGDs were conducted with them for further detailed information
	What is the source of the Cd?	Cd is a heavy metal resulted of fossil fuel combustion, phosphate fertilizers, natural sources, iron and steel production, cement production and related activities, nonferrous metals production, and municipal solid waste incineration. Bread, root crops, and vegetables also contribute to the cadmium in modern populations.	
	We need some detailed information about the quality of water		All measurements are included in the study
	We need to have a feasibility study about the potential revenue	We developed a feasibility study for the project	
Sludge reuse	Can the sludge be mixed with the composting? It will be more comfortable to people if you mix the sludge with compost Will the sludge be sufficient to fertilize the soil or other substances will be needed		Mixing sludge with composting will be considered in this study
	We (EQA) will recommend not to use the sludge for uncooked food during the first year		
Decommissioning of BLWWTP			

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	One of the negative impacts is the Asbestos, Is the landfill prepared to dispose Asbestos in?		The landfill in Johr Eldeek is prepared to dumb Asbestos
	I don't think we have Asbestos, it is just the old pipelines		
	Please consider the importance of the Emergency Basin	We will consider it	
	Kindly consider the aerator of pond 7, the fence and the pipeline. We signed an agreement with the Red Crescent to build a fence around pond 7	We will coordinate with Beit Lahia Municipality to build the fence and rehabilitate the pond	
Remediation works			
	What is the cost of moving the harvested plants that will be used to remediate the soil to Johr Eldeek landfill and what is the cost of moving the soil surface?	The cost of moving the harvested plants versus the cost of moving the soil will be considered	
	The basins in Beit Lahia should be stopped working, especially basin number one	The pumping of water to the basin is essential to secure the new project during emergency.	
Institutional framework			
	Regarding institutional framework we need detailed one on how to collect the sewage water, how to recover and distribute it.	We have a full study about the institutional framework, (still draft)	
	Will the municipalities be able to operate the project	We still revise the institutional study	
Other issues raised			
	There should be a training and guidance to the farmers on how to use recovered water Farmers should work under organizations or NGOs in order to provide them with the guidance through such institutes		Training is essential to the farmers. This is part of health and safety plan Integration of the farmers in unions will be more viable to provide the training through such organization.
	For the ESMP you mentioned consultation with the governmental agencies what about the civil society?		The NGOs and CPOs will play an important role in the project due to awareness raising and training activities

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	What about the emergency plan The implementation of the project was delayed do you have an emergency plan?	We have developed an emergency plan. Thus pond 7 was retained	
	We ask the PWA to check my well that is located nearby the new TP. Foams cover the surface of water	We will send someone from the PWA to investigate your well immediately	
	Can we compare the same project with similar ones in the Middle East?		The SESIA contained comparison between Egypt, Jordan and Israel
Land acquisition and resettlement activities			
	Our lands will be affected due to the project how will we be compensated? The prices of lands were reduced due to having the project The operators of wells who used to work for over 20 years now, what will they do?		All lands that will be affected due to the project will be clearly investigated, in addition to other project affected people. A Resettlement Action Plan (RAP) should be prepared. All affected people will be addressed; valuation of their affected assets, appropriate strategies of compensation will be highlighted. That will include the wells owners and operators
	According to the agreement between Awqaf department and the PWA the lands of the remediated plant should have been handed to the Awqaf in 2008, until now we received no lands. What will happen afterwards? The recovery wells are about 6 in Awqaf lands, what will you do to take the lands needed for the wells, will you rent or buy the lands?	We had an agreement with Awqaf, but as you know the delay in implementation resulted due to the political situation was the main problem we faced. In addition, we have a good relation with the Awqaf who are so supportive to the project. I had several meetings with HE the Minister of Awqaf.	

CHAPTER 1 INTRODUCTION AND SUPPLEMENT ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT OBJECTIVES

1.1. Introduction

The Palestinian Water Authority (PWA) has prepared the Term of Reference (ToR) for preparing a Supplementary Environmental and Social Impact Assessment (SESIA) regarding the North Gaza Emergency Sewage Treatment Project (NGESTP). The ToR prepared by PWA consists of 8 main tasks with one main special task related to the Sludge Management generated from North Gaza Wastewater Treatment Plant (NGWWTP). Kindly refer to Annex 1 for detailed tasks on the ToR for preparation of SESIA.

The SESIA assignment, funded by the International Development Agency (IDA), was announced as a competitive bid and awarded to the joint venture of EcoConServ and Universal Group (UG) Gaza, which sent the Expression of Interest (EoI) on December 8, 2011.

This report is a core deliverable for the SESIA consultancy service which involves the preparation of an independent SESIA of the NGESTP, Effluent Recovery & Reuse System and Remediation Works and a ToR for Resettlement Policy Framework (RPF)/Resettlement Action Plan (RAP) for the proposed reuse system distribution networks.

1.2. Project Background

The Palestinian Liberation Organization (PLO) for the benefit of the Palestinian Authority (PA) has applied for a grant from the IDA. Part of the proceeds of this grant will be used to undertake an SESIA for the NGESTP.

The PWA is executing the NGESTP initiated in 2004 and being implemented in two phases. Part A of the project is comprised of the construction of the terminal sewage Pumping Station (PS) 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 nine infiltration ponds at the new site, and commissioning of the pipeline to allow a large and dangerous emergency partial effluent pond at BLWWTP to be drained. This phase has been in operation since April 2009 and was entirely completed in 2010.

Part B of the project includes constructing a wastewater treatment plant at the new site that will ultimately be capable of treating up to 70,000 cubic meters of sewage daily[1]. Funding has also been provided for 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. This will be done via a well field designed to provide interim protection for the underlying aquifer and to provide treated effluent for reuse in irrigation. Part B is expected to be completed in 2013. An additional component of the project has been proposed to expand the effluent recovery and reuse the planned effluent flow from the plant and provide long-term protection for the underlying aquifer.

[1] Treatment capacity of 35,600 m^3 will be achieved at the completion of Part B

At the outset of the project, an Environmental and Social Impact Assessment (ESIA) was completed that assessed the possible impacts of Part A and Part B of the project as it was originally designed and provided a plan for mitigation. At that time, specific plans for remediation of the effluent lake or for an effluent recovery and reuse system had not yet been prepared. The PWA was seeking a well-qualified firm to carry out a SESIA in anticipation of restructuring the project to include expanded effluent recovery and reuse, and to assess the impacts of the specific plans for remediation of the land formerly covered by the Beit Lahia effluent lake, in addition to the decommissioning of BLWWTP after full operation of North Gaza Wastewater Treatment Plant (NGWWTP).

For decades, the BLWWTP has been receiving the wastewater from the communities in North Gaza. The original design of the plant in the late 1970s was to accommodate a few thousand cubic meters of sewage daily. The inflow rate has increased over time, to reach around 24,000 cubic meters daily by 2009. The treatment plant could not handle this inflow rate; the sewage outflow quality deteriorated and was discharged to the nearby sand dunes, forming a huge lake of sewage which contained around 2.5-3 million m^3 of poorly treated sewage by 2004.

The topographical setting of the sewage lake (located around 10 meters above the ground level of surrounding communities) and the random construction of the embankments around the lake posed an increasing risk to the communities. In one incident, one of the auxiliary lagoons collapsed flooded Um-Al-Nasr community and caused scores of casualties and deaths. The World Bank (WB), with co-financing from other donors,[2] responded to the urgent need of sanitation in North Gaza with a two-phase project. In the first phase, nine infiltration basins (with a total area of around 81 dunums) were constructed around seven km to the east, close to the eastern border. The sewage at BLWWTP and the effluent lake was transferred to the new basins via a pressure line connecting the two sites and a terminal pump station constructed near BLWWTP. The lake almost completely drained in September 2009. Phase B of the project is to construct a new NGWWTP near the infiltration basins to bring the effluent quality to a standard that can be reused for agriculture or for recharge of the aquifer.

Before project appraisal and as a World Bank (WB) category "A" project, an SESIA was conducted that looked into details of 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 is 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 would be arrested through a chain of pumping wells (after its quality had improved) and used for agriculture.

The reality has changed since the ESIA 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. Based on an optimistic estimate, Phase B is not expected to be commissioned before the end of 2013. The effluent lake in Beit Lahia has been evacuated to the basins with sub-standard quality. The current inflow rate of partially-treated sewage to the basins is around 15,000 m^3 daily (in fact the inflow rate is currently around 8,000 m^3/d) and the remaining

[2] AFD, Sida, EC, Belgium

effluent pumped daily to temporary ponds is located near the North border with Israel (Northwest Um Al-Nasr) and the two basins adjacent to the existing BLWWTP.

A new component, according to the original plan, has been added to the project to recover and reuse the treated effluent after the new treatment plant (NGWWTP) is completed. This system is composed of a chain of 27 recovery wells surrounding the basins to capture the effluent after it passes through the effluent ponds, storage reservoirs and a distribution network for agricultural reuse. The recovered effluent is expected to irrigate around 15,000 dunums of adjacent agricultural land.

In addition, funds have been allocated towards Part B of the project for remediation of the drained effluent lake at Beit Lahia. At the time of the initial ESIA for the project, a specific remediation plan was not in place. The new component of the project will include design and implementation of the remediation plan.

1.3. Current Project Progress

1.3.1 Background

The entire Part A was completed at the beginning of 2010, the scheme started in operation since April 28, 2009. The contract to construct the NGWWTP (Part B of the project) became effective on September 3, 2010. The original contract duration is 30 months and was planned to be completed by March 3, 2013. However, an extension of 126 days has been agreed upon by the contract parties as a result of the redesign of some facilities structures and inaccessibility to the site as per Israeli military instructions. As a result the contract is expected to be completed by July 7, 2013.

1.3.2 Project and Construction Contract Implementation Status

During the site visit conducted by the Consultant (on July 8, 2012), the aeration pond and sludge treatment building were completed. The clarifier had been tested for possible leaks and construction damages, if any, and the sludge dewatering facilities was in place. In addition the sludge storage tank (as a part of the sludge management stabilization) and the sludge silos were close to completion.

The infrastructure constructed under part A of the project (Pumping Station (PS), main transfer pipeline, and effluent infiltration basins) continues to be operated effectively by the Coastal Municipalities Water Utility (CMWU). The daily pumping rate to the infiltrations basins continues to be maintained below 15,000 m^3/day (currently only 8,000 m^3/d of untreated wastewater is infiltrated in the infiltration basins) in order to avoid severe clogging of the basins by partially treated effluent with a Biological Oxygen Demand (BOD) range of 80-90 mg/l. Around 12 million m^3 of partially treated effluent has been infiltrated at the new infiltration basins up to September 30, 2011. In normal condition, 2-3 days of retention time is needed to infiltrate the amount of partial wastewater to the infiltration basins.

1.3.3 Effluent Recovery and Reuse Scheme

The design consultant has completed the design report and Detailed Engineering Design (DED) and is currently finalizing the bidding documents. The complete design includes facilities to reuse the full design production capacity of the first phase of the NGWWTP that will produce about 35,600 m^3/d. The recovered effluent would irrigate about 1,500 hectares of land.

The first additional financing grant for NGESTP includes $7.6 million, which will be used in addition to the available IDA fund of SEK[3] 5 million (US$750,000) for a part of the effluent recovery reuse scheme (located adjacent to the new NGWWTP) of the reuse scheme on 500 hectares of land and recovering about 16,500 m^3 / day.

Groundwater flow modeling has determined that only partial removal of the infiltrated wastewater for reuse would lead, in the long-term, to some gradual pollution of the Gaza aquifer down-gradient. The project includes a groundwater monitoring program that was recently initiated. Five new monitoring wells have been constructed and are currently in operation. The program relies on data from 15 wells, including seven existing agricultural wells and three wells previously constructed under Part A of the project.

The total land area proposed to be irrigated with recovered water is 1,500 hectares with 27 recovery wells. The design minimizes land acquisition by laying pipes along roads and on land owned by the Ministry of Religious Endowments (*ElAwqaf*), but some wells will need to be located on private land. The mission reconfirmed that for this and other reasons, a RAP needs to be prepared, along with an updated ESIA.

The sludge generated from the NGWWTP will be reuse for agricultural purpose. During the design of the NGWWTP, the land to be implemented for the sludge reuse had not been addressed and proposed. In this SESIA, the proposed land for sludge reuse has been identified. Kindly refer to Chapter 1.4.3 for the existing situation of agriculture lands proposed for irrigation and sludge reuse.

1.4. Project Component Site

This section describes the project sites of this study; BLWWTP, Effluent Lake adjacent to BLWWTP and Irrigation Land for Reuse System (Recovery Water and Sludge Reuse).

1.4.1 Beit Lahia Wastewater Treatment Plant (BLWWTP)

BLWWTP was constructed in 1976 in the Northern part of the Gaza Strip at the outskirts of town of Beit Lahia. The system was designed as a secondary treatment plant with a capacity of 5,000 m^3/day to serve a population of 50,000 in the municipality of Jabalia and its surroundings. According to the original design, the treatment plant receives the sewage water from (1) Nazla, Okad (with future plans of receiving sewage from El Ghabary); (2) Jabalia Camp (Abu Rashid and El-Amay); (3) Beit Lahia and a future connection from Beit Hanoun. During the original design phase of the plant the idea was to use the effluent of the treatment plant for irrigation of the neighboring agricultural areas. This idea, however, was never realized.

The treatment plant was designed to treat the wastewater by aeration (4 lagoons are dedicated as aerated lagoons; Lagoons # 1, 2, 3 and 4) and further steps of 3 maturation lagoons (lagoon 5, 6 and 7) is applied according to the original design. The 7th lagoon is also considered a spillway or overflow. However, since the treatment plant is operated, the aerated lagoon no 1 and 2 were never been operated as an aerated lagoons but implemented as anaerobic lagoons (Refer to Annex 2, Layout plan of BLWWTP).

[3] Swedish Crona (Swedish currency)

Further detailed description of the treatment plant is presented in the following chapter, Chapter 4, section 4A.2.1.

According to the proposed project under this study, during the decommissioning of the BLWWTP, the pond or lagoon #7 will be maintained as sewage emergency flow when the NGWWTP is under full operation.

1.4.2 Effluent Lake Adjacent to Beit Lahia Wastewater Treatment Plant

Over the years, more communities were provided with sewage networks, which were subsequently connected to the BLWWTP. Consequently, as of April 2007, the volume of influents to the BLWWTP exceeded 20,000 m^3/day, which is substantially beyond the plant's capacity.

Over the years the effluent lake had a volume of about 2 million m^3 of foul wastewater, which covers around 300 dunums. The water level in this poorly treated effluent lake has continued to rise, and is threatening to flood the whole sewage collection system and the neighboring communities. Further detailed description of the effluent lake is presented in the following chapter, Chapter 4, section. 4A.2.1

1.4.3 Irrigation Land for Reuse System (Recovery Water and Sludge Reuse)

The area in the vicinity of NGWWTP is assigned designated to benefit from the recovery water and the treated sewage sludge in the agricultural activities. The existing situation of this area is illustrated hereafter according to a study (PWA, 2010) prepared during the NGWWTP effluent recovery system.

The proposed agricultural area for reuse 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 dunums, whereas, Zone B is located south of NGWWTP with about 5,000 dunums. Detailed description of the areas for irrigation land is presented in the following chapter, Chapter 4, section 4A.3.2.

1.5. SESIA Objectives

The ESIA is an instrument that involves examining the project's technical, environmental, socio-cultural, institutional, historical 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 RAP is regarded as a mitigation policy and action plan to minimize the negative impact of involuntary land acquisition that might be triggered due to the project.

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

(i) identification of the possible environmental and social impacts of the proposed effluent recovery and reuse scheme and the remediation plan for the former Beit Lahia effluent lake and the decommissioning of the existing BLWWTP after operating the new NGWWTP;

(ii) identification of any potential temporary or permanent land acquisition requirements associated with civil works;[4]

(iii) if the Bank's Operations Policy 4.12 (Involuntary Resettlement) is determined to apply due to land acquisition requirements, preparation of draft terms of reference to formulate a RAP to manage, mitigate, and monitor the impacts of the acquisitions;

(iv) an environmental and social impacts management plan (ESMP) 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. ESIA Requirements

Initial screening for applicable WB social and environmental safeguard policies indicate these policies might be triggered:

OP/BP 4.01- Environmental Assessment: According to WB screening, this project is classified as a category "A" project which requires an environmental and social assessment. The scope of assessment includes 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 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 Procedures (OP) 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 SESIA considers 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 also clarifies the nature of land ownership for each site (A*wqqf, public*, or private). These set of assessments determine the applicability of OP 4.12 and hence the requirements to prepare safeguards instruments.

OP 4.04 - Natural Habitats As part of its policy on the protection of natural habitats, the WB does not support any projects or sub-project that may lead to the significant loss or degradation of any Critical Natural Habitats, defined as any natural habitats that are either (1) legally protected, (2) officially proposed for protection, or (3) unprotected but of known high conservation value. Thus, the implementation of a project or sub-project in any of these areas immediately triggers this operational policy.

OP 7.50 – Project on International Waterways The project component, the reuse system is located nearby the Israeli border. The WB does not support the project

[4] This ESIA will assist in the determination of whether the Bank's Operational Policy OP 4.12 is applicable or not. This Operational Policy applies whenever in a Bank financed project, land is acquired involuntarily or access is restricted to legally designated parks and protected areas. The coverage of the policy includes "direct economic and social impacts that both result from Bank assisted investment projects, and are caused by the involuntary taking of land resulting in: i) relocation or loss of shelter; ii) loss of assets or access to assets; or iii) loss of income sources or means of livelihood, whether or not the affected persons must move to another location.

if there is indication that project that may lead to dispute or affect the international or two countries boundaries unless, the project is justified and the correction or mitigation measures are prepared.

OP 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.

This SESIA report has been prepared in accordance with the National EIA guidelines including the EIA brochure of the Palestine National Authority (PNA). It has also examined and recognized the international policies guidelines mentioned above.

In addition, concerning the health impact of using treated wastewater as well as the fertilizer management and guidelines of using sludge regarding the nutrient content and soil toxicity, the international guidelines from World Health Organization (WHO) and Food and Agriculture Organization (FAO) are recognized in this SESIA study.

CHAPTER 2 THE ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT OBJECTIVES AND METHODOLOGY

This chapter highlights the different objectives of the ESIA study, due to the fact that this is not a customary ESIA as it has more than one component that might need to be addressed using different tools that are not likely to fall under standard ESIA procedures i.e. measuring the willingness to pay and tariff survey for the water and sludge.

2.1. Study objectives

The interventions of the Effluent Recovery, Irrigation Scheme and Remediation Works Project were not previously identified during the preparation of the original ESIA for the NGEST project. Therefore, the justification for the SESIA is clear as the environmental and social benefits/impacts were not addressed in the original ESIA. The objective of the study is outlined in the following statement: "The supplementary ESIA is in anticipation of restructuring the project to include expanded effluent recovery and reuse and to assess the impacts of the specific plans for remediation of the land formerly covered by the Beit Lahia effluent lake." The study team identified five specific objectives for the ESIA, which is detailed at previous section; section 1.5.

Regarding land acquisition, the ESIA carried out an accurate identification of the footprint of the proposed project assets including utilities, such as wells, pipelines, and areas that might be needed for temporary storage of equipment, materials or waste. The ownership of the land that will be permanently or temporarily occupied by the project was identified and, accordingly, any land acquisition needed was highlighted.

Achieving this objective is a direct result from the previous objective. Once any requirements for land acquisition identified there was an assessment of whether the WB OP 4.12 regarding involuntary resettlement will be triggered or not. This assessment was not limited to direct land acquisition but extended to assess if the project impacts will lead to any dislocation, loss of shelter, loss of access to land or existing water supply (well) or loss of income for any social group. In such a case a clear well-defined ToR for preparing a detailed RAP is included in the ESIA.

The SESIA team prepared mitigation measures and monitoring activities for each of the assessed environmental and social impacts. The preparation of these mitigation measures and monitoring activities, as part of an integrated ESMP, includes roles and responsibilities of different stakeholders The ESMP is to be an important product of the ESIA, therefore, it should be practical and effective in minimizing negative impacts and maximizing positive impacts. According to the request of the Environmental Quality Authority (EQA), ESMP Arabic is prepared as a separate report to be used for the implementation of the project (both during construction and during operation phase).

Moreover, the SESIA consultants analyzed the institutional set-up of different project stakeholders; derive conclusions about the capacity of each stakeholder for implementing his assigned tasks and the needs for capacity-building at the level of each stakeholder.

2.2. Environmental Methodology

2.2.1. Field Measurements

Field measurements for ambient air quality and noise are important in order to assess the current environmental conditions at the project's sites. In addition, to run the groundwater modeling, water quality measurement was conducted, besides assessing current available water quality and quantity at the recovery system.

To identify the contamination level of the effluent lake due to the remaining sludge generated from the wastewater (in this case, most of the sludge had been stabilized for a long period due to the climate and dryness of the lake), the sludge and soil sample were assessed.

To predict the sludge generated from the NGWWTP, wet sludge was collected and assessed to identify the heavy metals contain. This sludge assessment was an important indication to determine whether the future sludge generated from NGWWTP was suitable for reuse or whether it has to be dumped to the sanitary landfill.

The Consultant performed the field measurements based on the site investigations and characteristics. The measurements were conducted on August 7 and 8, 2012 by Islamic University Lab. However, due to the doubted result on one of the soil samples, the soil, sludge and water samples were conducted again by Al Azhar Lab on September 4, 2012. The detailed environmental field measurement methodology and the standard equipment used (soil, sludge, water, air ambient and noise) is presented in Annex 3.

2.2.2. Groundwater Analyses Verification and Modeling

Perhaps the impact on groundwater was one of the most important issues associated with the project, as part of the project had been designed to prevent infiltration into the ground water by partially treated sewage.

The SESIA team carefully reviewed the available data from the groundwater modeling carried out by the project designer, verified the expected achievements and positive impacts on the groundwater and assessed the impact on abstraction wells in the region. In addition, the Consultant reviewed and verified the 4 sets of readily available data of groundwater samples and results provided by the PWA (namely water quality results, first to fourth round, conducted between March 2011 and February 2012 and the baseline groundwater quality report).

The Consultant prepared and ran an independent groundwater modeling study taking into consideration the setup of the groundwater model developed by the design consultant. The main objective of this approach was to reach a quantifiable assessment for groundwater quality impacts and movements. The assessment of the groundwater impacts 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.

The existing groundwater modeling provided during the design project and original NGESTP were assessed and used as reference. The design consultant used Visual Modflow (VMF) version 4.2 and its integrated modules which were used in the current study. Therefore, the conceptual model in the design report is considered valid; however, in this study, the approach consists of updating the conceptual model to schematize the most actual hydro geological context. The result of the modeling and assessment of the water quality contamination are presented in the following chapter, Chapter 4 and the groundwater modeling conceptual methodology is presented in Annex 5.

2.3. Social Study Methodology

2.3.1. Targeted Groups Identification and Sample Selection

Since the project is made up of different components that might result in different impacts and aspects, the study team applied all mechanisms and tools needed in order to have a representative sample for all project affected and target groups. In addition, the study assessed an appropriate mixed sample from different stakeholder that work on behalf of the potential project affected groups, for example, the Human Rights, municipality, Awqaf, and the Agriculture NGOs.

Due to applying different survey tools that varied between qualitative and quantitative. The sample was also selected according to the tools to be used. A detailed social study, including methodology, approaches and results are presented in Annex 9. Annex 9 also includes the Socioeconomic Baseline Environment and survey tools and willingness to pay survey results, cost analysis and tariff results.

2.3.1.1. Sample description of the social survey

Following is the description of the samples identified for the social survey:

Target Groups

Due to the nature of this project, the identification of the survey targeted groups was based on different components. Some determinants took part in identifying the targeted groups i.e. area, gender and project component. Particular attention was paid to the Project Affected Persons (PAPs), who were investigated along the process of data collection. Through the scoping phase the PAPs were defined as follows:

1- Land tenants (from *Awqaf*) who might be resettled due to the project
2- Land owners who will lose plots of their lands due to the construction of the wells as well as any potential activities resulting during the project expansion
3- Well owners who will lose their wells due to the project or will have restrictions to use their wells
4- Well operators who will lose their work due to the termination of the wells
5- The farmers who will use the recovered water, consequently, they will have restriction with regards to the types of crops that they might be able to cultivate

All above mentioned categories were targeted using different qualitative and quantitative tools. In order to enable them to spell out their worries freely, Focus Group Discussions (FGDs) were applied. In addition, the target groups were invited to the Second Public Consultation to integrate, consult and raise their concerns[5]

[5] The PAPs informed the social consultants at the end of the 2nd public consultation that they had the feeling that they were listened to as the results of the study reflected all their worries. The well operators expressed their satisfaction to be invited and consulted with because for the first time in their lives as "*poor people*" they felt they are part of the community who should be cared for

Sample selection based on survey tools

Both qualitative and quantitative tools were applied to obtain the baseline information needed. However, the quantitative sample was representative of the different components and the targeted households and the targeted population among different areas. The sample selection was guided by the WB OP.4.12 as the PAPs were the main groups the study focused on. In addition, they were the core for any tools developed in order to discuss their status with all stakeholders. The samples were selected as follows:

a. Quantitative Sample

Quantitative samples were covered using different structured questionnaires:

- Due to having a list of farmers who will use the recovered water, it was relatively easy to select 34 **farmers** which were selected randomly. However, it worth mentioning that the study team tried to investigate 110 farmers among which 34 farmers approved. The rest of farmers refused for two reasons: 1) some of them were among well owners who are not in favor of using recovered water, others were tired due to fasting during Ramadan. Thus, more FGDs were conducted to fill the gaps in information with 29 farmers among which 13 of them will be affected by the project
- Regarding the consumers of the agricultural products willingness to pay**, 51 dealers** (including retailers and wholesalers) were interviewed in three types of markets: one day market, supermarket and permanent market. The sample was not selected randomly due not to the lack of a list of traders.
- 696 of the customers in the different markets adjacent the project areas were selected conveniently during certain data collection periods. Thus the sample was statistically acceptable.

All data resulted from the sample was analyzed using SPSS. The majority of data was presented using charts. All details and charts were included in the Annex 9 Social Impact Assessment.

Based on the questionnaires sampling selections, there were three categories of sample that are:

- Trader sample The first group sampled was the traders who are up to 51 male traders from El Wasta and Gaza Governorate. Different types of markets were covered in order to have the diversity of all traders (from El Noseirat, Moasker El Sahtea market (The Beach Camp Market) and El Remal.

  The distributions of the trader sample by:

  - Type of market (from the one day market, the supermarket and the permanent market),
  - Age categories (50-59, 40-49 and 30-39); the diversity of age categories reflected on traders' responses and attitudes regarding the project.
  - Main education (secondary education, university graduates); the diversity according education is recommended in order to have a wide range of attitudes and diversity in perceptions.

  Investigating the owners of shops was not the target of this study; therefore, the owners' represented only a small percentage of the sample surveyed in addition to the workers. The vast majority was among fruit and vegetable sellers among them are vendors (mainly work in the mobile one day market).

- Consumer sample The second main target group interviewed was the consumers who were made up of 696 individuals (from El Wasta, Gaza and Khan Younis; the majority of the sample were Males

  The sample selected 13 markets in different governorates (El Noseirat, Deir El Balah, Khan Younis, El Moghazy and El Berieg). The markets were of different types and sizes (one day market, permanent markets and supermarkets).

  According to age distribution it was notable that the customers' age ranged between 18 to 70 years old. The younger age categories were the least (less than 29 years old).

  The diversity of the sample according to the type of education in gender was notified and reflected.

  Purchasing attitudes were covered under this study in order to have detailed information about their willingness to purchase as well as the motives to purchase from certain markets.

- Farmer sample The third sample interviewed were the farmers who will be the potential beneficiaries of the recovered water. Originally they were 644 farmers among which 34 interviewed. All of them have access to a source of water. They mainly plant citrus, olives and vegetable.

  The farmer sample was distributed by:

  - Age (between 20-29, 40-59 and 60+).
  - Socioeconomic characteristics (living in apartment, separate house, own their house or partially or rented house)
  - Main source of drinking water (municipal or wells)
  - Access to electricity; it worth noting that the whole sample survey has access to electricity.
  - Land area occupied by the farmers (indicated as per each household)
  - Income and expenditure distribution (variety of monthly incomes). The reliability of data was relatively high and consistent in comparison to income and expenditure.
  - The sufficiency of water supply

b. Qualitative Sample

Quantitative sample was using FGDs, workshops, opinion polls and in-depth interviews; the following were carried out:

- 2 FGDs with the surrounding communities of the decommissioning site, diversity regarding age categories and education was put into consideration
- 1 FGD with the well owners of wells in Jabalia
- 1 FGD with the farmers and well owners in Jabalia
- In- depth interviews with the relevant authorities, including NGOs
- Workshop was conducted for data collection

Based on the quantitative sampling selections, there were three categories of sample that are:

- FGDs sample 2 FGDs were conducted in Ezbet Abd Rabouh and Um El Nasr Village in order to identify the potential impacts of the decommissioning of BLWWTP. 11 persons attended the discussions. Following are their characteristics:

- Age; varied between 32-76 years old with mode age of 30-40 years old
- Education; varied between university, secondary, preparatory graduates and illiterate.
- Marital status Married with children
- Monthly expenditure; ranged between 400–3,500 Shekel monthly with mode value ranged 1000 -2000 shekel.
- Average family size ranged between 3- 13 persons with economical dependency ratio of 0.08

- In- depth sample conducted during the preparation of the study:
  - Al Mezan Center for Human Rights
  - PWA
  - Ministry of Endowment (Awqaf)
  - Gaza Municipality
  - Jabalia Municipality
  - Palestinian Agricultural Relief Committee (PARC)
- Workshops sample conducted during the preparation of the study were:
  - 11 from PWA, 2 with EQA, 1 from CMWU, 2 from PARC, 4 Gaza municipality
  - 1 Palestinian Contractor union, 1 Nasr NGO for Agricultural Development, 1 Human Rights Center, 1 Ministry of Endowment (Awqaf), UG consultant, 1 Ministry of Health (MoH) and 2 from the Islamic University of Gaza (IUG)

In addition to the above mentioned sample, scoping sessions were applied with different stakeholders to collect basic data that were the bases for verification and developing surveying tools. The detailed socio economic methodology including sample methodology and socio economic survey tools are presented in Annex 9.

2.3.2. Social Field Observations

Field observations were conducted to assess project areas, land use characteristics/ownership, community structure and planned development activities (including tourism and cultural properties). In-depth analysis of present and projected population, public health related to water use, gender issues as well as educational background were given. These analyses implicated the willingness to pay and contribute to the improved effluent scheme as well as acceptance of the effluent reuse purposes.

2.3.3. Primary and Secondary Data Selection and Assessment

a. Primary Data

Primary data collections involved collecting data primarily from different potential stakeholders and project target groups with special emphasis on the project affected persons. Due to having more than one component under this project, the study relied upon different sources of data using multi-levels of tools that enabled the project authority to apply proper mechanisms and decisions related to the project.

Data collection scoping phase:

a) **A kick off meeting** for the project introduction as well as the relevant project background for starting the assignment
b) **The first site visit and data collection** was done during the negotiation session on May 6 and 8, 2012. 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 two sites (old and new sites).

Pilot phase and tools testing:

a) **Site visits** in order to identify the current status of the workers inside each treatment plant,

b) **The first public consultation** that aimed at bringing the project forward to community people in order to get their perceptions, worries and comments on the methodologies. In addition, the session was to discuss with the participants the potential PAPs in order to develop appropriate strategy to consult those groups.

c) **Applied in-depth meetings** with the key players in order to investigate their main contribution to the project, potential impacts and mitigations, barriers and how to overcome, and community participation

d) **Two opinion poll[6] workshops** were applied with different stakeholder in order to discuss different issues related to the project. Land acquisition was one of the main issues raised during these workshops. Strategies for land acquisition and how to mitigate the affected people was essential to be covered with the different stakeholders

e) **Two FGDs** were implemented in the BLWWTP site and NGWWTP. The main objective of these two workshops was to investigate people's perception towards their willingness to use the treated water and sludge and their perception on the new treatment plant (NGWWTP) and the decommissioning of the old one (BLWWTP). Moreover, the aim was to investigate the PAPs who might lose their lands, assets or suffer the deterioration of their livelihood conditions

Data collection and analysis phase

The data collection process was planned to start from 11th of July till the 25th of July. Nevertheless, due to having Ramadan (the fasting month for Muslims) the data collection lasted till the beginning of August.

The primary data collection relied upon the following tools to collect the needed data:

a) Quantitative tools

The qualitative tools were divided into the following types based on the target group to be investigated:

1. Consumer structured questionnaire
2. Wholesalers and retailers structured questionnaire
3. Beneficiaries farmer who will use the reused water and sludge

b) Qualitative tools

Due to the diversity of the groups that should be covered by the qualitative tools, namely, in- depth and FGDs, the study team developed different guidelines to suit each groups. The majority of the in-depth guides were developed for the stakeholder on the governmental and non-governmental level. Special attention was paid to the PAPs through developing a FGD guideline tailored for them. The main topic discussed with all stakeholders, especially *Awqaf;* Ministry of

[6] An **opinion poll**, sometimes simply referred to as a **poll**, is a survey of public opinion from a particular sample. Source http://en.wikipedia.org/wiki/Opinion_poll

Endowment, Non-Governmental Organizations (NGOs) related to the farmers and the municipalities; whom will be the cornerstones for any potential land acquisition and resettlement activities.

b. Secondary Data

Secondary activities involved collection of different national reports through reviewing available sources of secondary data and assess requirements for primary data collection. In addition, due to the gaps within the Palestinian standard and technical specification; especially regarding the sludge management and reuse, required lesson learned and comparison of the standard limit from regional countries around Gaza Strips (GS), the wastewater reuse and sludge management and reuse from Jordan, Israel and Egypt were assessed. A list of all reviewed data was prepared and is presented in Annex 14.

2.3.4. Data management and analysis

The following activities were applied during the socio economic data analyses:

1- Data was reviewed, edited and entered
2- The quantitative data was analyzed using the SPSS 16; Statistical Package for the Social Science, which enabled the study to have a detailed analysis. As well, it enabled the team to enhance the quality of analysis for data
3- The content of quantitative data was analyzed using different methods, relying upon computerized techniques and manuals in order to have the rich text needed

2.4. Additional Consultation Activities

It is worth noting that the stakeholders' consultation activities were not limited to the activities mentioned above. Further public consultations were conducted through plenary events. This includes a scoping consultation session with the main objective of reviewing the ESIA scope of work and ToRs with stakeholders and obtaining their views on issues that need special attention during the field investigations and analysis.

Additionally a plenary public consultation session was conducted after drafting the ESIA in order to validate and review the study findings with the relevant stakeholders and PAPs. The Public Consultation preparation was following the WB requirements, that is the distribution of the invitation with the distribution of Executive Summaries (in English and Arabic) and the draft report, public announcement and the disclosure activities that includes uploading the Executive Summaries in the PWA's and the Consultants website. The results of the public consultation were included in the final ESIA. The various consultation and participatory activities largely contributed to enriching and validating the findings of this ESIA.

2.5. 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 thus highly informative for the ESIA process:

1- The most important strength is that the applied methodology enabled the Consultant to formulate the ESIA and the ESMP in the most practical manner driven from the adapted participatory approach during the ESIA preparation.
2- The practical application of the ESMP in the future is expected to be efficient because the ESIA process has already enhanced the stakeholders' sense of

ownership over the project and the project is a demand-driven intervention that local communities are ready to accept and contribute to.

3- The process involved active participation from municipalities and Community Based Organizations (CBO). The FGDs have been facilitated and hosted by local CBOs. This secured convenient venues for the FGDs' participants and allowed the Consultants and survey team to engage the CBOs members and introduce the project to them.
4- The tools were carefully selected to suit the type of interviewed stakeholders and the issues that need to be investigated.
5- Bringing all stakeholders together in the workshops and Public Consultation provided the study with verified, multi-perception data which enriched the study,
6- Having about 700 customers interviewed using quantitative tools enabled the study team to have more reliable data
7- Based on the consultant's and research team's 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 GS.
8- 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.
9- Mitigating the impact of effluent recovery and reuse system for irrigation at targeted area does fall within the scope of the ESIA for the long term. Accordingly the potential negative impacts on these groups should be examined as part of the ESIA for the short term activities. Despite this, the Consultant was keen on studying the informal sector as a key vulnerable social group that operates within the current poverty and unsecured context of GS and has strong relations to the project.

One of the key challenges that faced the ESIA process was the limited time frame and delayed process of contracts as well as permit acceptance of the international team to travel to GS due to the internal political situation in Egypt. In addition, due to Ramadan, the environmental and social surveys were further delayed.

Although this could not be regarded as a methodological problem, those challenges affected the progress of the stakeholders' consultations and the planned field investigations as part of the ESIA consultancy assignment for the long term actions.

CHAPTER 3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

One of the tasks included in the SESIA study is reviewing 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 are presented. Analysis of the gaps between Palestinian Laws and International Laws were presented in order to develop some mechanisms to fill in the gaps.

The following section 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 4. Detail Policy, Legal and Institutional Legal Framework.

3.1. Palestinian Laws and Regulations

Table 3.1. Summary of the reviewed Palestinian Laws

Name of Law	Law Summary	Year
Environmental laws and regulations		
Law 7/1999	Palestinian Environmental Law	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 No. 90/1995	Regarding The establishment of PWA	1995
Decree No. 6/2002	The Environment Quality Authority was established by Presidential decree No 6/2002	2002
TS 34/2012	The Palestinian Treated Wastewater Standard; (Technical Specification (TS))	2012
Solid Waste regulations	Solid Waste Management Regulations	2004
Social laws and regulations		
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
Other laws and regulations		
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

3.2. World Bank Operational Procedures (WB OP) and Safeguard Policies

- Environmental Assessment (OP 4.01)
- Involuntary Resettlement (OP 4.12)

- Disclosure (OP 17.50)
- Natural Habitats (OP 4.04)
- Cultural Property (OP 11.03)
- Project on International Waterways (OP 7.50)

3.3. 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.

3.4. 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.

3.5. Relevant Ministries and Institutions

Figure below, Figure 3.1 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 3.1. PWA relations with other organization related to water, wastewater and sludge management

CHAPTER 4 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

A. ENVIRONMENTAL BASELINE DATA

4.A.1 Introduction

Environmental baseline data presents the existing situation of the different component areas of the project that could be influenced by the project. Baseline data for BLWWTP and Effluent Lake adjacent to the treatment plant sites, infiltration ponds (adjacent of the NGWWTP) and the targeted areas for irrigation sites are presented in this chapter. The existing environmental conditions in Gaza in general and project component sites in particulars were also studied.

Environmental baseline data is presented in the following order:

- Overview of the Project Components
- Physical Environment
- Biological Environment
- Water Resources

4.A. 2 Overview of the Project Components

Project components of this study are divided into two parts; part A is the BLWWTP and the Effluent Lake adjacent to the BLWWTP and part B is the infiltration ponds and the targeted area for irrigation system of recovery effluent.

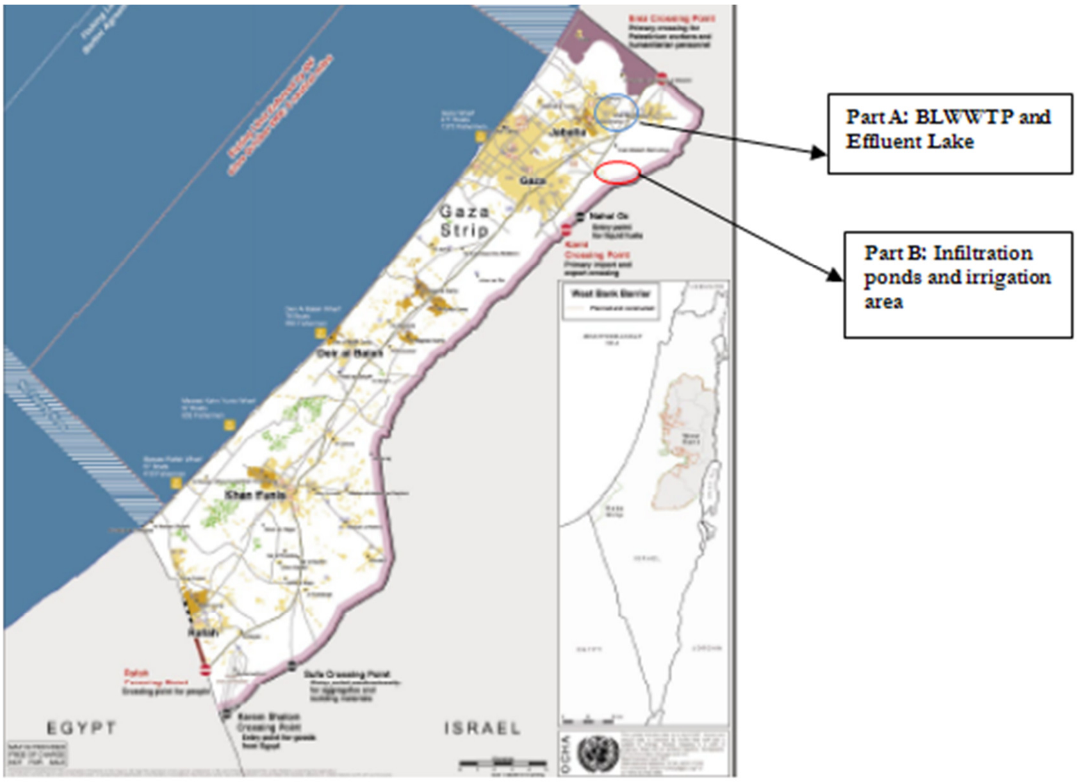


Figure4A. 1 Locations of the Project Components within the Gaza Strip context

4A.2.1. Part A: Beit Lahia Wastewater Treatment Plant (BLWWTP) and Effluent Lake Adjacent to BLWWTP

BLWWTP was constructed in 1976 and is located some 1.5 km east of the town center of Beit Lahia in the Northern part of GS (Figure 4A.2). According to PWA, the BLWWTP was built in sand dunes overlying a clay layer of variable thickness. The high level of nitrates and detergents in the surrounding wells ensures that this impermeable clay layer is not continuous. BLWWTP was constructed in stages and modification and rehabilitation activities were performed in order to increase capacity of the plant.

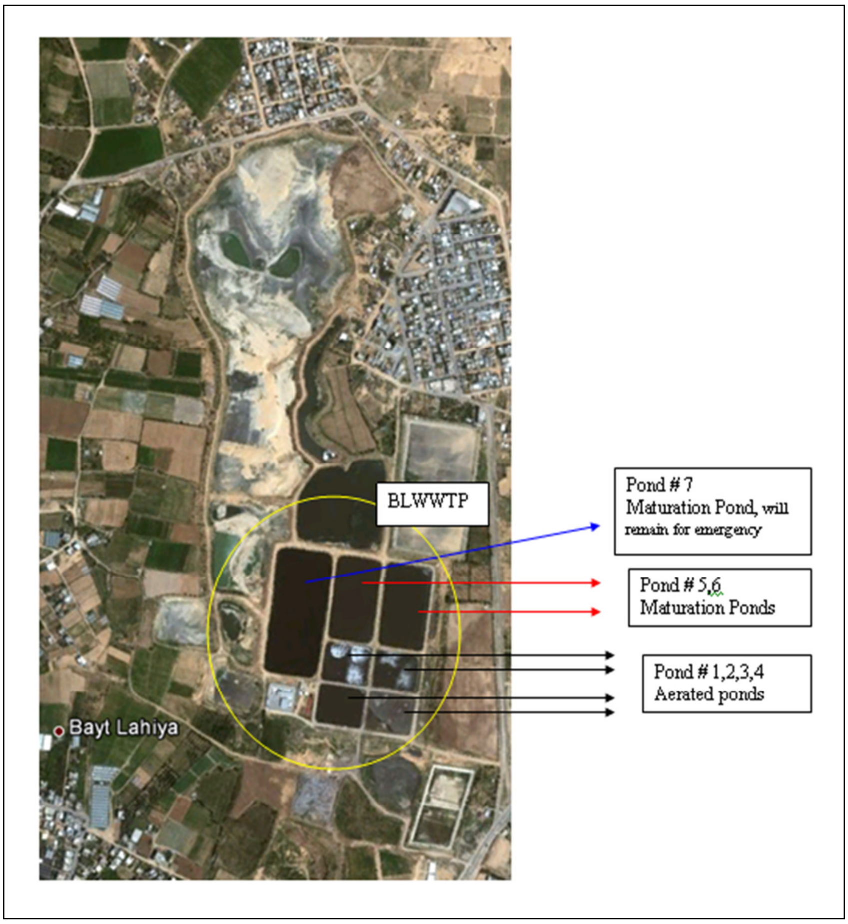


Figure 4A.2 Beit Lahia Wastewater Treatment Plant (BLWWTP)

In 1999, screen, grit removal and two infiltration basins were added to the plant. The function of the screen and grit removal unit was influenced by the fact that they aimed to avoid silting of the ponds and damaging the aerators of the aerated lagoons. Wastewater usually passes from one lagoon to another lagoon in serial and it finally accumulates in the effluent lake which covers around 40 hectares.

According to calculations, during the decommissioning of the BLWWTP around 7.7 ha (excluding Pond #7) will be demolished and the land will be returned back to the *El Awqaf*.

Pond # 1 (80% covered by sludge/wastes)

Pond # 4 (aeration pond)

Pond # 7 (maturation pond)

Beit Lahia Wastewater Treatment Plant

Figure 4A.3 Photo logs of Beit Lahia Wastewater Treatment Plant

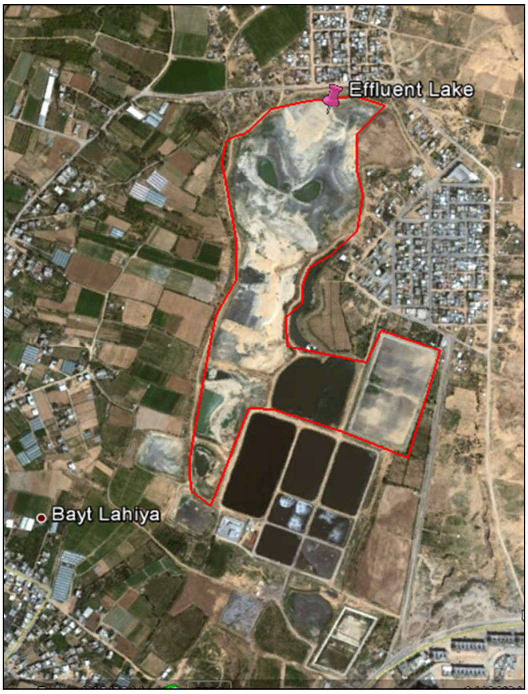
Over the years, more communities were provided with sewage networks, which were subsequently connected to the BLWWTP. Consequently, as of April 2007, the volume of influents to the BLWWTP had exceeded 20,000 m^3/day, which is substantially beyond the plant's capacity. Currently, the plant is serving a population of more than 200,000 from the municipalities of Jabalia (including the refugee camp), Beit Lahia, Beit Hanoun and Um Al Nasr.

Newly connected wastewater networks in the system have increased the amount of effluent reaching the treatment plant, which was then dumped to the surrounded infiltration basins. Those infiltration basins have become a lake over the years, as a result of insufficient capacity in the treatment plant. Due to poorly treated wastewater, this has resulted in clogging of the recharge basins, which lowers the infiltration rate to its minimum. This lake had a volume of about 2 million m^3 of foul wastewater, and covered around 300 dunums before the start of NGESTP. The water level in this poorly treated effluent lake had continued to rise, and was threatening to flood the whole sewage collection system and the neighboring communities.

To overcome the catastrophe of the increasing of effluent lake, CMWU with PWA, Environmental Quality Authority (EQA), United Nation United Nations International Children's Emergency Fund (UNICEF), International Committee of the Red Cross (ICRC) and other parties actively worked on implementing the planned activities which aim to ensure (a) re-functioning the wastewater system, (b) safety operation of the system and (c) protecting the local communities surrounding the BLWWTP.

The activities to overcome the catastrophe included the construction of two infiltration basins toward the North of Um El Nasr village in order to pump part of the effluent collected in the lake. In addition, the pressure pipeline from the existing effluent pumping station to the new infiltration basins has been constructed.

Mobile pumps are purchased, scientific and technical assessment has been conducted for necessary measures and currently, pumping an amount of treated effluent through the terminal pumping station and the mobile pumps at the embankment. Currently, an amount of maximum 15,000 m^3/day is passing through the new infiltration basins.



The area of the wet area represents around 10% of the total area for Effluent Lake

Figure 4A.4 Effluent Lake adjacent to BLWWTP

In 2007, when NGESTP was starting to be implemented, almost 90% of the total area of the effluent lake had been dried due to weathering and limited effluent discharge to the lake. The total area of the lake is estimated around 35.5 ha, while the wet area currently occupies around 3.9 ha (10% of the total effluent lake).

Concerning the area of the evacuated effluent lake, historical data about the physical, chemical and biological properties of the soil is available and presented in the Environmental Assessment report for NGEST Project. In addition to the soil sample analyses conducted under this SESIA, the historical data will be used as a basis for expecting the evolution of physical/chemical properties during the remediation process. The options of alternative land use after the soil remediation will be analyzed and presented in Chapter 5.

Part of the effluent lake that is dried already and consist of thin layer of sludge and sand

Part of effluent lake that is still wet of overflow from BLWWTP

Dried effluent lake with the part of the village behind the lake

Figure 4A.5 Photo logs of Effluent Lake

4.A.2.2 Infiltration Ponds and Irrigation Schemes of Effluent Recovery

The data about the existing agricultural situation in the proposed project area for irrigation and sludge reuse was collected during site visits and interviews. The proposed area is actually cultivated with different crops: citrus, olives, fruits, grains and vegetables. The survey also includes the number and ownership of farms in each zone, crops type and their respective irrigation systems.

The area in the vicinity of NGWWTP is designated to benefit from the recovery water and the treated sewage sludge in the agricultural activities. The existing situation of this area is illustrated hereafter according to a study (PWA, 2010) prepared during the NGWWTP effluent recovery system.

The proposed area is divided into two zones according to its location from NGWWTP (Figure 4A.6). Zone A is the part located North of NGWWTP with about 10,100 dunums whereas, Zone B is located south of NGWWTP with about 5,000 dunums. The recent distribution of cultivated crops in both zones (A &B) is shown in Table 4A.1. Most of the area (about 12,000 dunums) is considered as under rain-fed conditions.

Citrus is a crop grown in the project area with an area of 1,198 dunums (fruit able and none-fruit able). Olives represent 614 dunums (fruit able and none-fruit able). Vegetables represent 280 dunums (Figure 4A.7). Concerning Citrus and Olive, it takes around 5 – 6 years for the crops to grow and produce fruit; therefore, the fruit able crops is the crops that has grown and produced fruits (more than 6 years). The area of fruit trees is 120 dunums, whereas, the rain-fed area includes the grains and the demolished area occupying the most of the project area being 12,055 dunums.

Figure 4A.6. Location of proposed irrigation land using recovery water of NGESTP

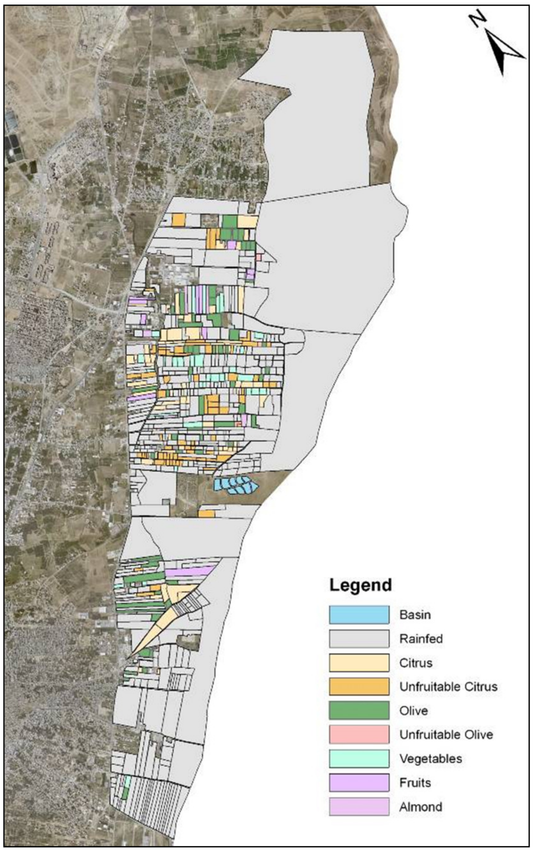


Figure 4A.7. Different type of irrigation system and crops of proposed irrigation land for recovery water reuse

Table 4A.1 Distribution of cultivated crops in zone A & B

Crops	Zone A (dunums)	Zone B (dunums)	Total
Rain-fed	7,593	4,462	12,055
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	9,407	4,976	14,384

Source: Special report concerning Irrigation Scheme, 2009
* Citrus and olive trees take between 5-6 years until they are fruit able

4.A.3 Physical Environment

4.A.3.1 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; BLWWTP, Effluent Lake, Infiltration basins adjacent to NGWWTP as well as 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 resulting 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 temperature and promotes high humidity throughout the year.

The average daily temperature in the Gaza Strip ranges from 25ºC in summer to 13ºC in winter. The maximum daily temperature can reach 29-30ºC and the minimum temperature is around 9ºC (UNDP / PAAP 2009; UNEP 2009) Besides the UNDP report, the climate of the project area (Effluent lake and BLWWTP) was reviewed through meteorological data from the Gaza office, recorded during 1999-2006 (Table 4A.2). The prevailing wind direction is South West with an average speed of 4.2 m/s in winter and from North West during summer.

Table 4A.2. Climatic Data of Project Area in Average (1997-2006)

Month	Rainfall(mm)	Min Temp (ºC)	Max Temp (ºC)	Relative Humidity	Wind (km/hr)	Sunshine (hours)
JAN	94.3	10.8	18.1	65	11.3	4.8
FEB	78.9	11	18.2	67	12.3	6.1
MAR	35.7	12.9	19.8	67	11.5	7.6
APR	10.6	16.3	22.9	67	11.0	8.4
MAY	0.1	19	24.6	72	10.2	9.7
JUN	0	21.7	27.2	74	9.8	9.8
JUL	0	23.8	29.6	74	9.7	10.7
AUG	011	24.5	30.2	72	10.1	10.6
SEP	13.2	23	29	68	10.5	9.7
OCT	42.6	20.3	26.7	67	10.5	8.3
NOV	68.5	16.3	23.5	62	10.6	6.2
DEC	114.4	12.6	19.6	64	10.9	4
Average	38.2	17.7	24.1	68	10.7	8

Source: Meteorological data from Gaza Office, 2006

4A.3.2 Climate Change

One of the major issues in the present century 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 the global and regional level. 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 temperature may bring benefits (in cold regions), there will also be adverse impacts including reduced water availability, greater water demand, and more frequent extreme weather.

According to the UNDP report on climate change for the Palestinian territory, the recent runs of the different modeling under the B2 emissions scenario confirm substantial temperature rises of up to 4°C for the eastern Mediterranean region (Hertig and Jacobeit 2007). Increases in inter-annual variability of temperatures, along, with mean warming, are also forecast to lead to a greater number of high temperature events (Giorgi and Lionello 2007).

The evaluation of potential impacts of climate change on crop and irrigation water requirements 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 1.5°C. The detailed assessment of irrigation schemes is presented in Annex 7.

4A. 3.3. Precipitation and Evaporation

Rainfall in GS is measured at 12 meteorological stations distributed over GS. The rainfall depth for the recent years (2010 – 2011) were collected and presented in Table 4A.3. In addition, the historical rainfall data and the comparison of the hydrogeological data in GS, is presented in Figure 4A.8 and figure 4A.9 show the average rainfall for the hydrological years 2006/2007 and 2010/2011, respectively.

Table 4A.3. Rainfall Depth for the season 2010 -2011 in GS

	Rafah	Khuza'a	Khan Younis	Deir Elbalah	Gaza South	Gaza City	Jabalia	Beit Hanoun	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 GS 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).

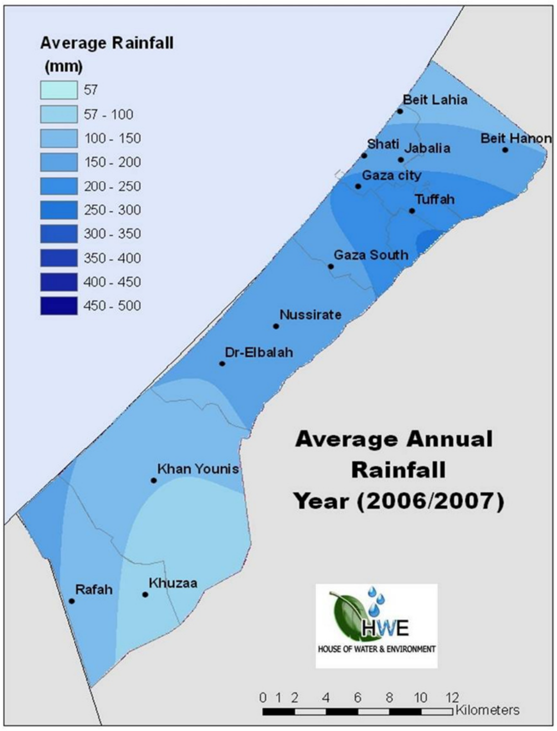


Figure 4A.8. Average rainfall intensity for the hydrological year 2006/2007 (PWA 2011)

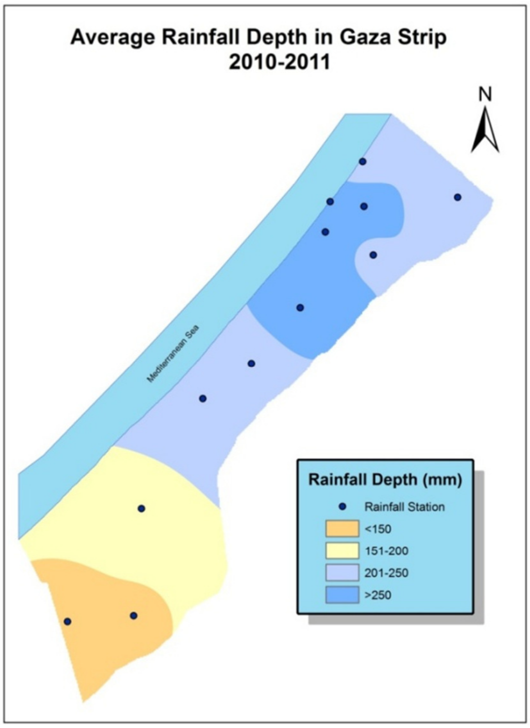


Figure 4A.9. Average rainfall intensity for the hydrological year 2010/2011 (PWA 2011)

4A.3.4. Ambient Air and Noise Quality

The Consultant carried out ambient air quality and noise measurements at the BLWWTP, Effluent Lake and nearby El Shuhada Cemetery (where the booster pumps and storage tanks will be constructed as a part of the water distribution networks for irrigation). The location of the samples for air ambient, noise, soil, and sludge are shown in the figure below (Figure 4.A.10 and 4A.11) and Table 4A.4 presents the coordinates of the sampling points.

The analyses were done by Islamic University Gaza, Environmental and Rural Research Center, Gaza. Air quality was measured against CO, CO_2, PM_5 and $PM_{2,5}$. The result of the analyses is presented in the section below and the report of the measurements is presented in Annex 3.

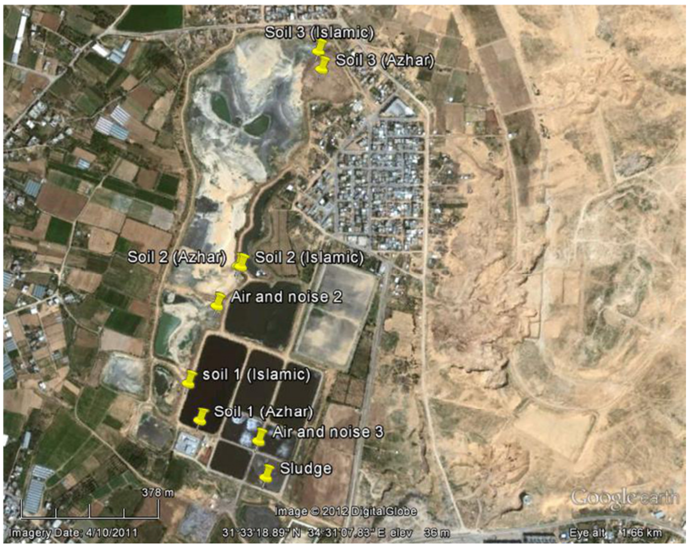


Figure 4A.10 Sampling location for air, noise, soil and sludge (BLWWTP and Effluent Lake)

Figure 4A.11 Sampling location for air and noise (El Shuhada Cemetery; booster pumps and storage tanks site)

Table 4A.4 Coordinates of Sampling location for air, noise, soil and sludge

Location	Coordinates	
Soil		
Soil 1 (S-1; Azhar)	31°33'4.96"N	34°30'52.29"E
Soil 1 (S 1; Islamic)	31°33'8.29"N	34°30'51.08"E
Soil 2 (S2; Azhar)	31°33'18.72"N	34°30'56.31"E
Soil 2 (S2; Islamic)	31°33'18.69"N	34°30'56.56"E
Soil 3 (S3; Azhar)	31°33'36.19"N	34°31'4.96"E
Soil 3 (S3; Islamic)	31°33'37.75"N	31°33'37.75"N
Air and noise		
Air and noise1 (AN1)	31°30'30.38"N	34°30'36.70"E
Air and noise 2 (AN2)	31°33'15.15"N	34°30'54.11"E
Air and noise 3 (AN3)	31°33'3.19"N	34°30'58.43"E
Sludge		
Sludge	31°32'59.98"N	34°30'59.18"E

Carbon Monoxide (CO) and Carbon Dioxide (CO_2)

Concentrations of CO and CO_2 in air samples were taken from different locations mentioned previously. The concentration of CO and CO_2 are presented in the table below.

Table 4A.5 Air Quality Measurement Result at project sites (CO and CO_2)

Parameter	Unit	BLWWTP (AN3)	Effluent Lake (AN2)	El Shuhada Cemetery (AN1)
CO	ppm	1.3	0.1	0.1
CO_2	ppm	442	380	344

The result indicated that the CO concentration is slightly higher at BLWWTP compared to the Effluent Lake and the nearby Cemetery. This result is explained by the higher population density at BLWWTP (nearer to the residential compounds) compared to the other locations; there are more residents using transportation that create gas CO. However, the concentration is still considered low. For comparison, the CO concentration at different days of the week at Gaza governorate according to UNDP / PAPP Report, 2009 is between 0-10 on Sunday, Monday, Wednesday, Thursday and Friday, between 0-20 on Tuesday and 0-5 on Saturday.

Accordingly, the CO_2 result is slightly higher as well at BLWWTP due to the same reason of more population on the surrounding area compared to the other areas. In addition, the effluent lake and the nearby Cemetery area have more plantation than the pond area of BLWWTP.

PM_5 and $PM_{2.5}$

The result of Particulate Matters (PM_5 and $PM_{2.5}$) testing is similar to the result of CO and CO_2. The PM_5 and $PM_{2.5}$ are slightly higher at the BLWWTP compared to Effluent Lake and nearby El Shuhada Cemetery. Particulate matters due to the movement at the nearby residential area at BLWWTP resulted in increasing figure of PM_5 and $PM_{2.5}$.

The result of the PM_5 and $PM_{2.5}$ at different locations are presented in the table below:

Table 4A.6 Air Quality Measurement Result at project sites (PM_5 and $PM_{2.5}$)

Parameter	Unit	BLWWTP (AN3)	Effluent Lake (AN2)	El Shuhada Cemetery (AN1)
PM_5	ppm	397	306	345
$PM_{2.5}$	ppm	69	53	60

Noise

Noise levels at similar points as air ambient measurements were carried out for environmental baseline conditions of different project sites. The noise measurement was conducted every two hours during working hours (09.00 – 17.00). The result of noise measurement at different locations is presented in the table below.

Table 4A.7 Noise Measurements Result at Project sites

Location	Time	Result (dB)	Average (dB)
BLWWTP (AN3)	09.00	64	54.1
	11.00	63	

Location	Time	Result (dB)	Average (dB)
	13.00	60.5	
	15.00	41.5	
	17.00	41.5	
Effluent Lake (AN2)	09.00	42.7	40.5
	11.00	42	
	13.00	40	
	15.00	39	
	17.00	39	
El Shuhada Cemetery (AN1)	09.00	43.3	43.3
	11.00	43.3	
	13.00	43.3	
	15.00	43.3	
	17.00	43.3	

Significantly, in comparison with the other parameters results, the noise measurement at BLWWTP is slightly higher than the two other locations. The noise at BLWWTP is higher than other two locations as a result of nearby community. However, the noise level at all locations is still considered below average.

4 A.3.5.Soil Characteristics

4A.3.5.1. General characteristics

The soil in the Gaza Strip is mainly composed of three types; sand, clay and loose as shown in Figure 4A.12. 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

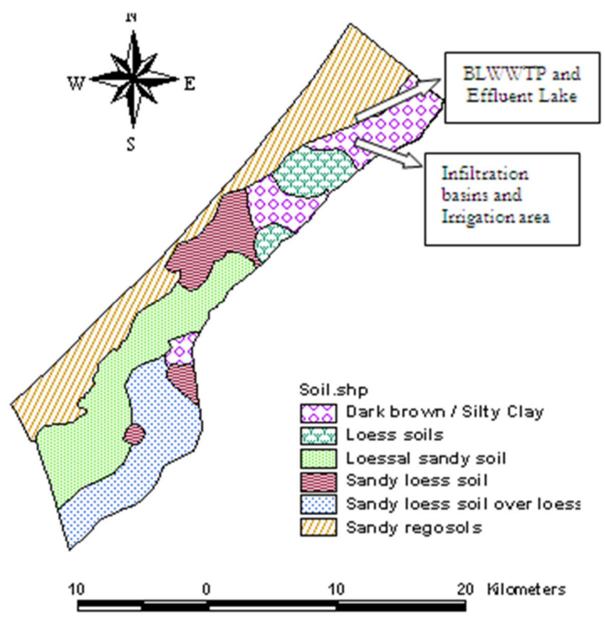


Figure 4A.12 General Characteristic of Soil in Gaza Strips

4A.3.5.2. Soil Type of the Project Area for Effluent Recovery, Water Reuse and Sludge Reuse

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.

The soil texture of the project area for irrigation land 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). As mentioned above, the proposed irrigated land is divided into 2 zones, A and B. The general characteristics of the soil at Zone A and B are:

Zone A Loamy clay textured soils with dark brown to reddish brown color are dominated in the area. 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 loess textured soil and is yellow brown in color.

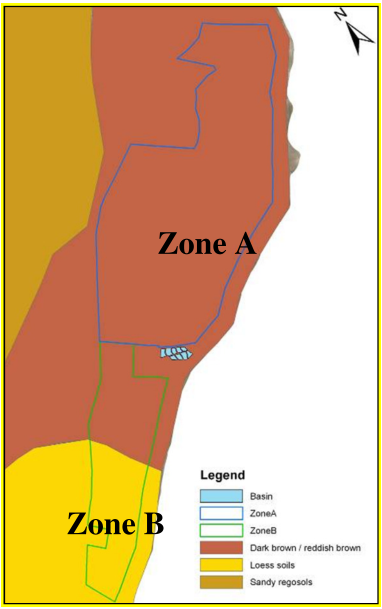


Figure 4A.13 Gaza strip soil map and project area (Ministry of Agriculture (MoA), 1994)

4A.3.5.3. Effluent Lake soil cover

As a part of this assignment, the soil at the effluent lake and sludge of the BLWWTP were sampled and analyzed. The analyses included soil samples from three different locations at the effluent lake site at two different depths, and one sludge sample from the anaerobic pond (pond #1). The results were discussed in consideration of different results from other references. In addition, the soil samples were taken to assess the remediation site of the effluent lake that is not yet designed and assessed. Supplementary assessment of remediation of the effluent lake to identify the best option for remediation is presented in detailed in Chapter 6.

According to the results of the soil samples, the soil at different locations of the effluent lake has a normal range of pH, Organic Matter (OM) content, with negative and low

Fecal Coliform present in the soil. In addition, the Electrical Conductivity (EC) at the soil location 2 indicated the higher number. This may be due to remaining heavy metal from the sludge that is present in the top layers of the effluent lake. Compared to the sludge analyses, the EC of soil on the middle of the effluent lake is almost half that of the normal wet sludge. This result indicated that the thin layer of sludge on the effluent lake is already stabilized.

Regarding the decommissioning of the BLWWTP, the sludge sample was carried out at the anaerobic Pond #1, to learn the sludge characteristics of the sewage wastewater. The sludge analysis result compared with the sludge analysis done for the Environmental Assessment (EA) of NGWWTP. This comparison is conducted to assume the expected sludge produced from the treatment plant.

From the sludge sample, the EC of the sludge is higher than the previously analyzed samples during the preparation of EA of NGESTP. In addition, the OM is also higher than the result of EA NGESTP. This might be due to heavy metal contamination at the present effluent wastewater and higher concentration of BOD and COD pollution load in the wastewater.

According to the sludge sample, it can be concluded that after the ponds are dried, with several years of retention time, the soil at the bottom of the pond is expected to have similar characteristics to the effluent lake. Therefore the land use after decommissioning of the BLWWTP can be expected to be similar to the Effluent Lake. However, a similar assessment (preferably more detailed) of remediation of the BLWWTP site shall be carried out to determine the exact site characteristics, site remediation method and propose land use to be considered for the BLWWTP.

4A.3.6 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. The land surface elevation at project site ranges between 40-60 m Above Mean Sea Level (AMSL). Detailed topographical map of GS is presented in the Figure 4A.14 below.

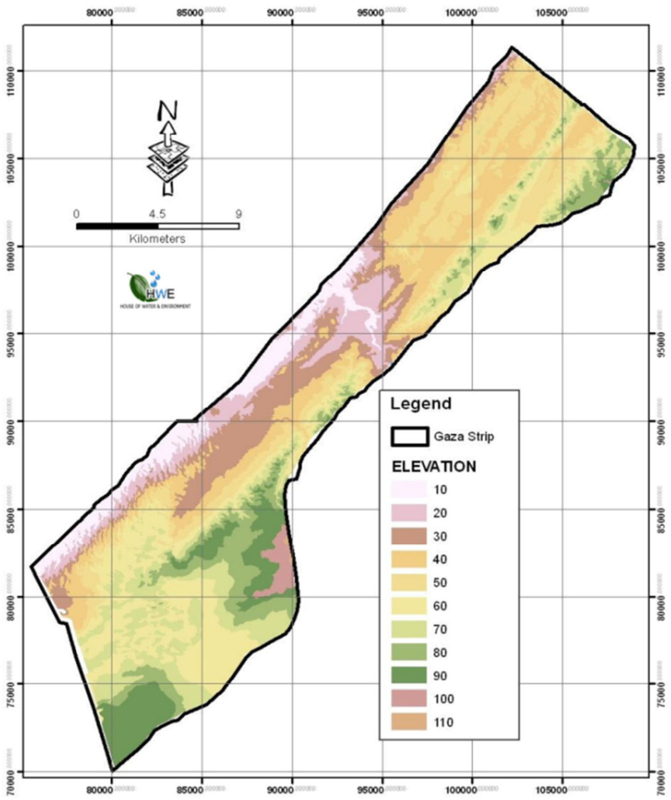


Figure 4A.14: Detailed topographic survey map of Gaza Strip

4A.3.7. Geomorphology

Three small valleys (Wadi Beit Hanoun, Wadi Gaza and Wadi Salqah) cross the Gaza Strip from East to West. The valleys 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 South East (SE) – North West (NW) direction, for about 7 km inside the Gaza Strip. This wadi, then divides into two sectors. The Wadi cuts through thick loose sediments overlying a gravel horizon on partly hardened calcareous sand (locally known as "Kurkar").

There are 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 20-40 m height AMSL.

4A.3.8. Geology

Investigation of the geology of the Gaza Strip was based in the following sources:

- Oil and gas exploitation logs – 2,000 m depth - drilled by Israelis;
- Wells drilled during the Coastal Aquifer Management Project (PWA and United States Agency for International Development (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 west wards includes a tabular presentation of the geological history of the Gaza Strip. The formations of this sequence (Figure 4A.15) are:

Tertiary Formations The Tertiary formations consist of Saqiya group (upper Eocene to Pliocene) with a thickness of 400 m to 1,000 m underlined by Eocene Chalks and limestone.

Quaternary Formations The Quaternary deposits throughout the Gaza Strip overlie the Saqiya group, while at the East they overlie the Eocene Chalks and lime stones. 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, inter layers 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 of up to 25m.

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 smaller in the middle and increasing Northward up to 3 km.

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.

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

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.

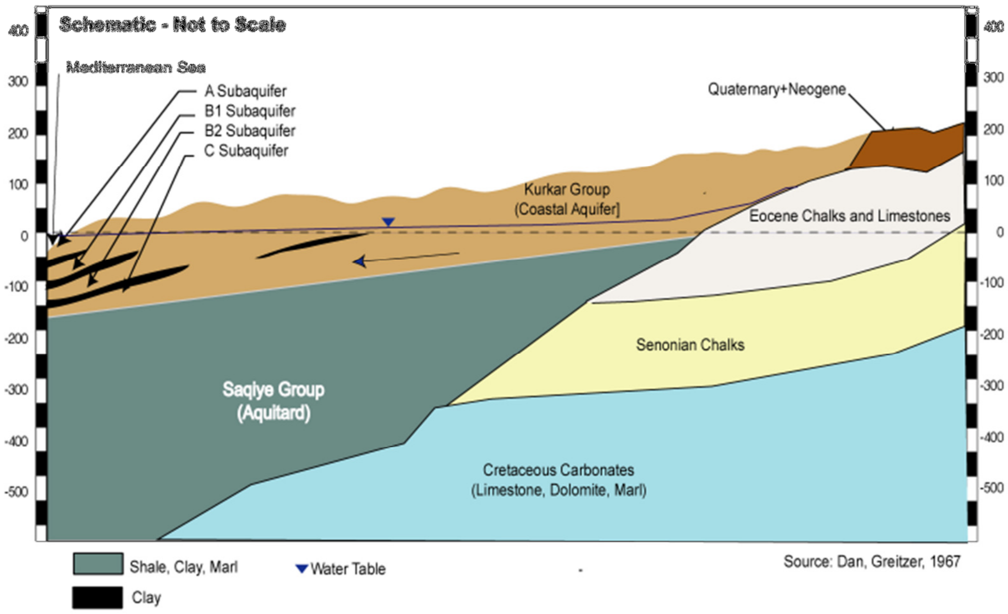


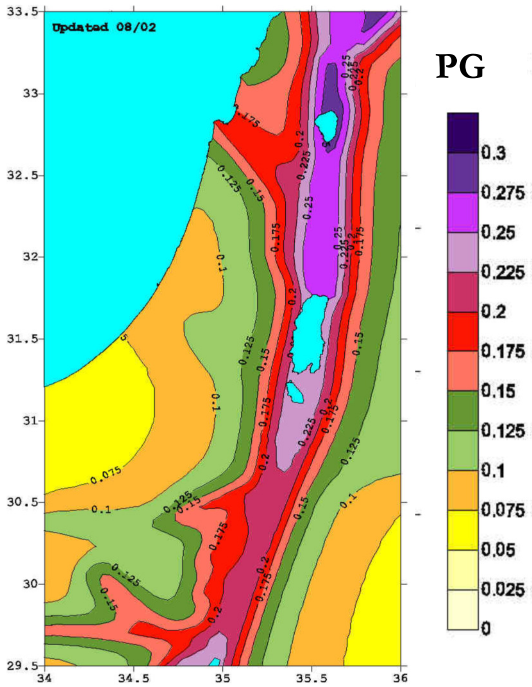
Figure 4A.15: Typical hydro geological cross section of the Gaza Strip (PWA/USAID 2000)

4A.3.9. Seismicity

Documented evidence of earthquake activity in Israel and adjacent areas is available over a period of 4,000 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 modem seismographic equipment, took place in 1994 close to Jerusalem with a magnitude of 6 Richter scale.

The variability of the Peak Ground Acceleration (PGA) in Palestine, as developed by the Institute for Petroleum and Geophysical Research were collected and presented in the Figure 4A.16 below. The hazard is based on 10% probability of going beyond the limit in 50 years (10/50), or a return period of circa 475 years. This hazard is mainly contributed to by magnitude 6.0 - 6.5 earthquakes. Evidently, larger earthquakes (M>7) may occur in the region, once in 1,000 to 6,000 years on the average depending on the seismogenic zone, posing a much higher hazard.

Figure 4A.16 below shows that 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 0.075 g 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.



Developed by Institute for Petroleum and geophysical research

Figure 4A.16 Seismicity condition at Gaza Strip

4A.4. Biological Environment

4A.4.1. Fauna at BLWWTP and Effluent Lake

Mainly aquatic birds and reptiles reside in the BLWWTP and the Effluent Lake. The effluent lake provides breeding, nesting, roosting and feeding habitats for different bird species. The community (both children and adults) surrounding the sites is targeting aquatic bird species by hunting or trapping them using different means. The table below presents the different birds' species found surrounding the sites (BLWWTP and Effluent Lake).

Table 4A.8. The Main Targeted Aquatic Birds Species Hunted in the Effluent Lake

Family	Scientific Name	Common Name
Threskiornitthidae	*Plefadisfalcinellus*	Glossy Ibis
Ardeidae	*Nyctiicoraxnycticorax*	Night Heron
	Ardeeolaralloides	Squacco Heron
	Egrettagarzetta	Little Egret
	Bubulcus Ibis	Cattle Egret
	Ardeapurpurea	Purple Heron
Anatidae	*Alopochenaegyptiacus*	Egyptian Goose
	Anasplatyrhynchos	Dwall
	Anasquequedula	Mallard
	Anasclypeata	Garganey
Rallidae	*Gallinulachloropus*	Shoveler
	Fulicaatra	Moorhen
Recurvirostridae	*Himantotopushimantopus*	Coot
Charadriidae	*Vanellusspinosus*	Black-winged Stilt

Aquatic ecosystems including wetlands are good habitats for wildlife of both vertebrate and invertebrate species. They provide wildlife with all necessary requirements such as shelter, protection, food and breeding, resting and roosting place.

Rats, snake crows, barn owl and other wild species are common vertebrates found in North. These animals were found to pose a variety of dangers to the people's cultivated and stored crops, possession and other properties. The three cosmopolitan nocturnal commensal rodent species (the house mouse, house or black rat, and norway or brown rat) are known to occur in the Gaza Strip, and were reported by inhabitants in the vicinity of BLWWTP. During the several visits to the BLWWTP and the effluent lake, the evidence of snakes and hiding spaces for rats were recorded, although there were no specimens were found. Figure below represent the current fauna and evidence found during the site visits.

Variety of Birds surrounding the BLWWTP

Birds at surrounding the wet area of effluent lake


Snake paths detected during the site visit


The Palestine Viper (an endemic venomous snake in the vicinity of BLWTTP)

Figure 4A.17 Avifauna and Reptiles at the project sites (BLWWTP and Effluent Lake)

4A.4.2. Flora at BLWWTP and Effluent Lake

Sand dunes are a characteristic feature of the western belt of the Gaza Strip. They are a vital resource providing various environmental and ecological values. The typical landscape of the areas (BLWWTP and Effluent Lake) consists of sand dunes covered with Acacia shrubs. The common floristic species recorded in the sand dunes of the Gaza Strip and the common floristic species that are found at the project sites of BLWWTP and Effluent Lake are presented in Table 4A.9 and Figure 4A.18 below.

Table 4A.9 Common Floristic Species Recorded in the Sand Dunes of the Gaza Strip

Scientific Name	Common Name
Cupressussempervrens	Evergreen Cypress
Pancratiummaritimum	Sea Daffodil
Phoenicdactylifera	Date Palm
Opuntiaficus-indica	Tuna Cactus
Salsola kali	Russian Thistle
Artemisia monosperma	Sagebrush
Silybummarianum	Blessed Milk-thistle
Ricinuscommunis	Castor Oil Plant
Acacia cyaophylla	Acacia
Acacia Arabica	Gum Arabic Tree
Alhagimaurorum	Camel-thorn
Ficussycamoruz	Sycamore Fig
Eucalyptus camaldulensis	River Red-gum Tree
Ziziphusspina-christi	Christ's thorn
Nicotinaglauca	Tree Tobacco
Tamarixnilotica	Nile Tamarisk

Figure 4A.18. Common Floristic species found in the project sites (BLWWTP and Effluent Lake)

4A.4.3 Biodiversity at proposed agricultural land for reuse scheme

Many Olive, Plum, Almond, Citrus agricultural fields or orchards have been encountered at the agricultural land allocated for irrigation of the water distribution network of recovery water and sludge 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.

4A.5. Water Resources

4A.5.1. General Characteristics

The coastal aquifer of the Gaza Strip is part of a regional groundwater system that stretches from the coastal areas of Sinai in the South to Haifa in the North. 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 Pleistocene age Kurkar Group deposits 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 Figure 4A.19. 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 lime stones. For the purpose of studying the geology of the aquifer layers, the Consultant has adopted the generated grid data produced from the CAMP model.

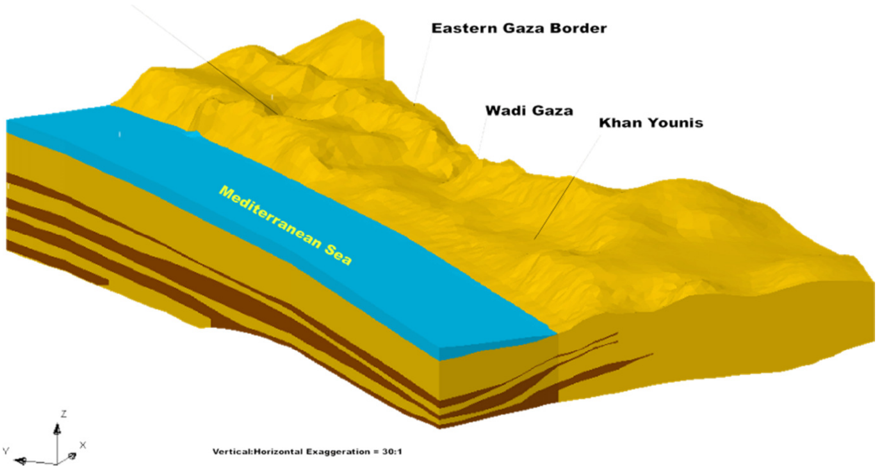


Figure 4A.19 Geological presentation of the Gaza Strip

4A.5.2. Current Water Quality

4A.5.2.1. 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. 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 WHO drinking water guidelines: 50 mg/l for NO_3, 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 4A.20 shows the average quality value of chloride concentration map for year 2011. The figure shows that the seawater intrusion zone covers the western part with 2 to 3 km inland the aquifer. Most of the municipal wells are concentrated in this zone and due to 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.

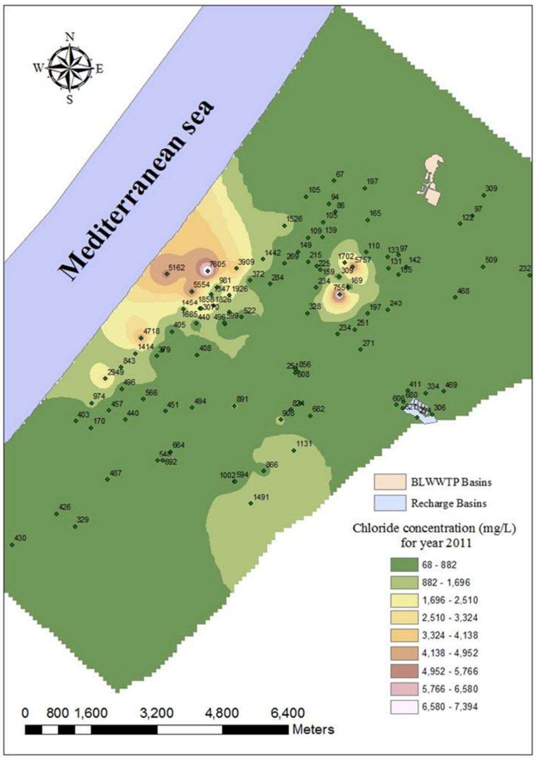


Figure 4A.20. Chloride concentration contour maps for year 2011

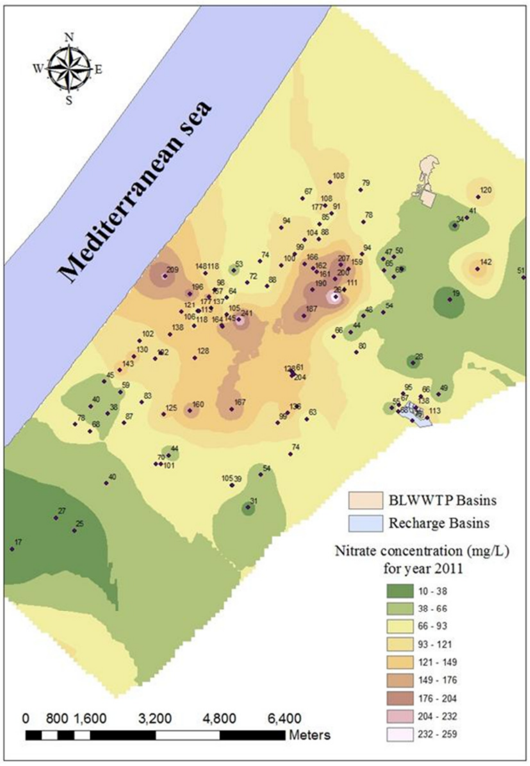


Figure 4A.21. Nitrate concentration contour maps for year 2011

Figure 4A.21 shows the average quality of nitrate concentration contour maps for 2011. The data was collected from municipal and agricultural wells. The figure shows that NO_3 concentration exceeds the WHO drinking water guidelines in most of the Northern Gaza aquifer. In the area around the proposed infiltration site the average nitrate concentration ranges between 55 to 113 mg/l. In a 2006 EIA study, it was noticed that in 2003 at the infiltration site, the maximum nitrate concentration in the groundwater was about 30 mg/l. This indicates that the increase of the nitrate concentration is due to the operation of the infiltration basin using partially treated wastewater.

4A.5.2.2. Infiltration Site

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

- The aquifer water quality baseline survey carried out by PWA (Water quality Rounds Sampling by PWA, 2011)
- 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 4A.22 and,
- The water analysis during the current project.

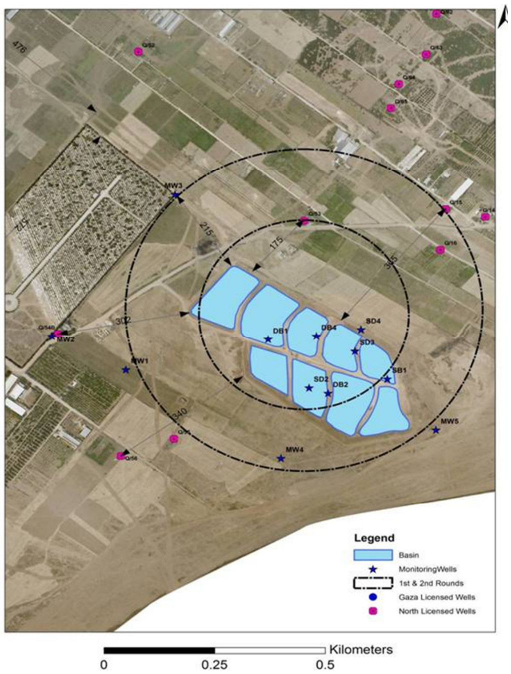


Figure 4A.22 Location of Sampled Wells close to the infiltration basin

Figure 4A.23 shows the results of Cl concentration in the wells close to the infiltration basin. The chloride concentration ranges between 350 to 650 mg/l in the wells surrounding the infiltration basins, up to the middle of 2012. The trend of the chloride concentration recorded to be steady since 2011 in some wells, whereas in well Q53 there is a decrease in the Cl concentration value from 610 mg/l in 2009 (the start of operation of the infiltration basin) to 350 mg/l in mid-2012. 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).

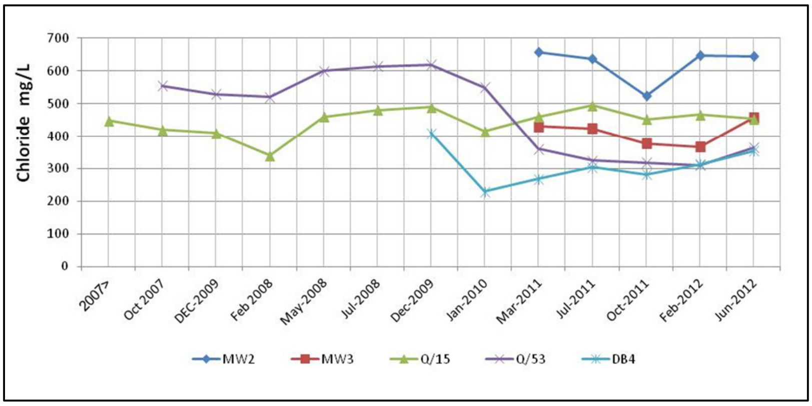


Figure 4A.23 Cl Concentration in the Wells Close to the Infiltration Basins

The nitrate concentration for the same period staring the operation of the infiltration basin in 2009 until the mid of year 2012 ranges between 20 to 120mg/l. Figure 4A.24 (results of the Nitrate in the wells close to the infiltration basin) shows that there is a steady trend of the nitrate concentration in the aquifer surrounding the basin. Only there is an increase in the nitrate concentration in Q53 which is also an indicator of the arrival of the infiltrated partially treated wastewater to this well. In year 2009 the nitrate concentration in well Q53 was 29 mg/l and in the mid of year 2012 it is 68 mg/l.

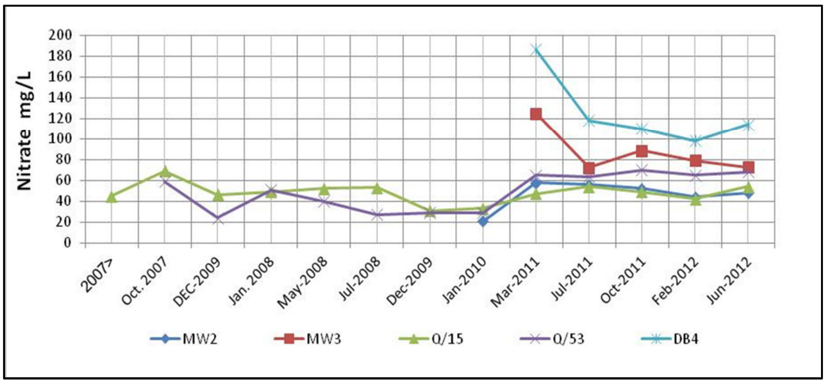


Figure 4A.24 NO_3 Concentration in the Wells Close to the Infiltration Basins.

Pathogenic bacteria should be expected in the groundwater near the infiltration basin since partially treated sewage has been infiltrating the aquifer for 3 years. Table 4A.10 presents the microbiological analyses of groundwater samples from the wells close to the infiltration basin. The table shows that the groundwater is free of Salmonella, Nematodes and Amoeba & Gardia. However, the total Bacteria ranges between 30 to 395 cfu/ml and the total coliform ranges between 6 to 50 cfu /100ml. Table 4A.11 shows the analysis of BOD and COD in the same wells. It can be seen that the BOD in all wells is less than 5 mg/l where only in DB4, which is directly under the basin; the BOD is about 12 mg/l.

Table 4A.10 Microbiological analysis for groundwater samples from wells close to the infiltration basin

Well no.	Total Bacteria Count cfu/1ml.	Total coliform cfu/100ml	Fecal coliform cfu/100 ml
MW1	40-105	6	2
MW2	60-205	10	4
MW3	40-350	14-25	9
MW4	35-182	0	negative
MW5	65	Over 300	7
Site well	15-55	30	8
Q15	60-375	30-76	20
Q20	353-395	3-65	2
Q53	30-55	negative	negative
Q54B	33-85	40	25
Q64	90-310	50-1100	22
DB4	55-165	35-85	15-33

Table 4A.11 BOD and COD concentrations in wells close to the infiltration basin

Well no.	BOD_5 mg O_2/l	COD mg O_2/l
MW1	< 5	4.2-7.2
MW2	< 5	2.8-4.8
MW3	< 5	7.2-8.4
MW4	< 5	2.8-3.2
MW5	< 5	0.8-3.5
Site well	< 5	3-13.6

Q15	< 5	3- 9.6
Q20	< 5	2.5-9.6
Q53	< 5	3.5-5.6
Q54B	< 5	0-6.5
Q64	< 5	2-8
DB4	11-12	24-26

Heavy metals were analyzed in the same wells close to the infiltration by PWA in mid-2012. As shown in Table 4A.12 the heavy metals concentrations in all analyzed wells were less than the Palestinian Standard values for irrigation. However, there are some wells that have 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 0.98 to 1.357 mg/l. The mercury is also found in MW1, MW2, MW4, Q54B and Q64. The concentration of mercury in these wells ranges between 0.004 to 0.10 mg/l, which is higher than the standard value of 0.001 mg/l.

Table 4A.12 Heavy Metals concentrations in wells close to the infiltration basin

Parameter (mg/l)	Standard Value	MW1	MW2	MW3	MW4	Q15	Q54B	Q64
Silver	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aluminum	5	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
Boron	0.70	0.1349	**1.322**	**0.9831**	0.1623	**1.165**	**1.357**	**1.19**
Cadmium	0.01	<0.0006	<0.000	<0.00	<0.000	<0.000	<0.000	<0.000
Cobalt	0.05	0.0018	0.0024	0.0031	0.0069	<0.000	0.0033	<0.000
Chromium	0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper	0.2	<0.009	<0.009	<0.00	<0.009	<0.009	<0.009	<0.009
Iron	5	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese	0.2	<0.005	<0.005	<0.00	<0.005	<0.005	<0.005	<0.005
Nickel	0.2	<0.001	<0.001	<0.00	<0.001	<0.001	<0.001	<0.001
Lead	1	<0.006	<0.006	<0.00	<0.006	<0.006	<0.006	<0.006
Zinc	2	0.0029	0.0025	0.0065	0.0061	<0.000	0.0044	<0.000
Arsenic	0.1	<0.008	<0.008	<0.00	<0.008	<0.008	<0.008	<0.008
Mercury	0.001	**0.0071**	**0.010**	<0.00	**0.004**	<0.003	**0.006**	**0.009**
Phosphorus	30	0.0417	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03

4A.5.2.3 the Existing BLWWTP and Effluent Lake

The Cl concentration in the wells close to the lake ranges between 93 mg/l to 309 mg/l. The figure is quite comparable to the WHO standard. Figure 4A.25 shows the nitrate concentration in wells close to the lake has a range between 34 to 120 mg/l. The nitrate concentration in wells A/180 and A/185, which are very close to the lake beside the existing BWWTP, is around 79 mg/l. It is important to note that the concentration of nitrate in the wells in year 2010 was 97 mg/l for well A/180 and 106 mg/l for well A/185, which indicates improvement in groundwater quality after drying the lake. Figure 4A.25 shows the decreasing trend of Nitrate concentration after emptying the lake.

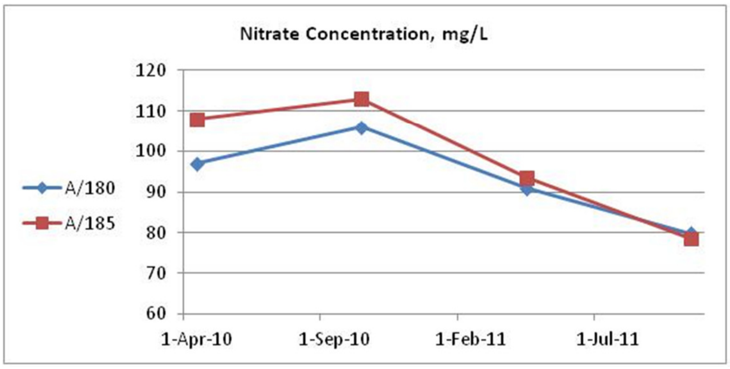


Figure 4A.25: NO_3 Concentration in A/180 and A/185 from year 2010 to 2011.

4A.6. Water Status, Network and Utility in the Gaza Strip

Groundwater aquifers are the only water source for all kind of human usage in the Gaza Strip (domestic, agricultural and industrial) (CMWU Annual Report on Water Status in the Gaza Strip 2010). The Gaza aquifer, which is a classical coastal aquifer, represents the sole water source of the Gaza Strip covering an area of 360 (km^2) 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, increase 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 the sea water level.

During the recent surveys on present water consumption in Palestine (1995), 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 103 mcm/yr water extracted from groundwater. 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.

4A.7. Current Status of Wastewater Treatment and Reuse

For the last three decades, 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.

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. 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).

Potential constraints of using treated wastewater in agriculture 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 is promising in the Gaza Strip. The expected amount of wastewater to be used for irrigation will progressively increase in the coming twenty years saving more than half of the groundwater needed for irrigation. (Tubail et. al., 2003) Although the text of this task concentrates on using the treated wastewater for irrigation, 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 or less to farmers' health.

4A.8. Sludge Management and Reuse

Sewage sludge is the solid/semi-solid, concentrated form of mainly organic, and some inorganic impurities (pollutants), generated as a result of treatment of wastewater. With the expansion of sewerage systems comes the ever-increasing problem of how best the sludge generated in wastewater treatment facilities can be disposed.

For successful sludge reuse, operational experience is available for handling systems, application systems, amount required per hectare and response of various types of vegetation. Sludge with a solid content of 30% or more can be handled with conventional end-loading equipment, and applied with agricultural manure spreaders. Liquid sludge, with solid content less than 6%, are managed and handled by normal hydraulic equipment. Agricultural use of sludge matches best with priorities in waste management. Sewage sludge contains nutrients in considerable amounts, which lead to fertilization of soil and organic matters that improve the soil through humic reactions.

The sludge standard, laws and regulations (national, international and regional) as well as comparison of the practices from different regional countries were assessed. The detailed assessment is presented in Annex 4. In conclusion, the Palestinian standard for sludge reuse in agriculture is following the International standard. In addition, the sludge monitoring plan developed in this study is based on the International standard of EPA that is used for design of the sludge treatment at NGWWTP.

4A.9. Public Health Concerns Related to Using Treated Wastewater for Irrigation

Public health concerns center around pathogenic organisms that are or could be present in wastewater in great variety. Survival of pathogens in wastewater and in environmental conditions other than their host organisms (mainly humans) is highly variable. Although the presence of the bacteria (including fecal coliform) is not expected from the effluent recovery water, the public health concerns related to using treated wastewater is presented by the Consultant. The detailed parameters, pollutants of treated wastewater, and agricultural significance of using treated wastewater are presented in detailed in Annex 8, Public Health concerns related to using treated wastewater for irrigation. In addition, the epidemiology concern toward the population is presented in detailed as well; although, similar to the public health concern, the epidemiology resulting from reuse of the recovered water is not expected.

B. SOCIAL BASELINE DATA

4B.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 Gaza Strip assists the 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).

Generally speaking, as mentioned in the environmental section of the GS above, the Gaza Strip is a small closed coastal area of a total surface area of 365 km^2. The Gaza Strip is among 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) estimates that the total population of the Palestinian Territories at 3,825,512, of whom 2,385,180 live in the West Bank, and 1,440,332 live in the Gaza Strip.

The Section below summarizes the socio economic and environmental condition of the Gaza Strip. The detailed socio economic environmental conditions are presented in Annex 8.

4B.1.1 Basic information about the project areas

In 1948, the Gaza Strip had a population of less than 100,000 people. By 2007, approximately 1.4 million Palestinians lived in the Gaza Strip, of whom almost one million were UN-registered refugees. The current population is estimated to be in excess of 1,510,968 inhabitants distributed across five Governorates:

1- Gaza City, which is the biggest governorate, has about 526,793 inhabitants.
2- Khan Younis (population 287,511) in central Gaza
3- Deir El Balah 219,336 people
4- Rafah population is 185,570 inhabitants
5- North Gaza is inhabited by 291,758

The majority of people live in refugee camps (Environmental Assessment of Gaza Strip, following the escalation of hostilities in December 2008 – January 2009 UNEP)

4B.1.2 Demographic characteristics

The population of the Gaza Strip, according to 2011 statistics, is around 1,500,000. The population growth in Gaza is high and was observed to increase during the last five years. The population projection calculated by the recent Feasibility Study done for Solid Waste Management at Gaza Strips 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.

Reviewing the age structure in the Palestinian Territories, it can be concluded that the community has the potential for rapid, continuous growth. The detailed distribution of the population by age category shows that the difference according to gender is limited to some extent, 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 recovery.

The total fertility rate in the Palestinian Territories has declined with 4.6 births per thousand in 2007 compared to 6.0 births in 1997. Regional disaggregation indicates that the birth rate in the West Bank was 30.6 births compared to 35.6 births in the Gaza Strip in 2008. 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. The proposed project may serve a population that is as much as 10% higher than the current numbers.

4B.1.3 Living conditions

There is generally a high tendency for large family sizes that exceed seven 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 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 5.8 in the Palestinian Territories, with the average household in the West Bank having 5.5 members, compared to 6.5 in the Gaza Strip.

Regarding the type of dwelling, it is notified that the majority of the population (68.1%) in the Gaza Strip live in a house (that is a typical Palestinian type of residents), followed by 22.8% in larger residential buildings. The majority of people use their units exclusively for living purposes (75.3%), 10.7% use the dwelling for both habitation and work, and 8.4% of the dwellings are used for work only. 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 socio-economic status of the community, but may instead reflect a custom and tradition of the community which encourages private ownership

Regarding access to basic services, the government of Palestine significantly focuses its attention on water supply. Connectivity to the public water system was around 88% in 2008 and 2009. 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.

Only 52.1% of households have access to the public sewage network. The fourth basic service is telephone lines, which serve 103,543 households in Gaza strip. A detailed discussion of the living conditions in the Gaza Strip is presented in detail in Annex 9 Socio Impact Assessment.

4B.1.4 Human Development Profile

The literacy level is generally high in the Gaza Strip, reaching almost 95% of the population above 15 years of age. 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. The largest portion of literate population attained preparatory education (36.0%), followed by the secondary education certificate (25.0%). Here, there is relatively high gender equity as well, with similar percentages of men and women attaining various educational degrees.

The general unemployment rate in the Palestinian Territories is considered high, at 24.5% of the labor force. Unemployment in Gaza is double the rate observed in the

West Bank (38.6% versus 17.8% in 2010). Within the Gaza Strip, Gaza City has the lowest unemployment rate at 31%. Unemployment is slightly higher for women than men in the Palestinian Territories (26.4% versus 24.1%). However, the gap is relatively high in the Gaza Strip as 37.3% of males are unemployed, whereas 45.8% of females are not working.

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 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'). 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.

4B.1.5 Wastewater network 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 at 90.9%. Yet, the Gaza Strip was of the highest connectivity ratio to the wastewater network which is 83.1% in total.

4B.1. 6 Archeological status in the 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.

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. The correspondence is presented in Annex 10 Letters of Ministry of Antiquities and Fatwa.

CHAPTER 5 ENVIRONMENTAL AND SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES

5.1. Positive Environmental Impacts and Their Enhancement

The aim of the effluent recovery scheme of NGESTP is to achieve environmental and social improvements in the project areas by providing sustainable and safe reuse of recovery water and sludge to areas which were previously deprived of these services. The NGESTP also includes the decommissioning of the existing BLWWTP and remediation works of the adjacent effluent lake, increasing the overall environmental and socio-economic sustainability of the area.

The environmental and social benefits expected from the different components of the project are discussed in the following sections.

5.1.1. Positive Impacts of Effluent Recovery Scheme (Water Effluent)

The project will have many positive impacts on water resources. The recovered effluent from the groundwater will be an important source of irrigation water, as water resources in the Gaza Strip are scarce.

According to the groundwater modeling developed by the Consultant, based on water analysis of samples taken from existing monitoring wells recorded by PWA in year 2012, it is concluded that the groundwater quality is suitable for unrestricted use since BOD in the groundwater is less than 30 mg/l (BOD analysis at the existing monitoring wells are less than 5 mg/l); as per the value of the Palestinian Limit for unrestricted use of groundwater; and Fecal Coliform and helminthes eggs are not available. The only restriction is for the Total-N, which is higher than 15 mg/l. This could be considered an advantage for agricultural use. However, although the unrestricted use is considered, it is advisable not to use the recovered water to irrigate the uncooked vegetables.

Regarding the horizontal dispersion and vertical building up of the groundwater, the recovery will limit the horizontal dispersion and the vertical build-up of the water table, which without recovery will have a negative impact on current land use. Horizontal dispersion of the contamination will be captured by the recovery schemes within 1,000 m from the basin, and without recovery the wider area will be employed. The vertical build-up of the water table in this area will be used as an underground reservoir for treated wastewater. As stated in the modeling results, without recovery this will have a negative impact on current land use and the wells for an extension of 2 to 3 km inland.

5.1.2. Positive Impacts of Using Sewage Sludge as Fertilizer

The use of sewage sludge that meets the standard requirements (Rule 503 Class A sludge) for agricultural use has many benefits as explained hereafter:

1. Sludge has a high content of organic matter that can help conserving soil organic matter, and sludge stimulates biological activity in the soil (Stamatiadis et al. 1999). Thus, sludge application helps to reduce soil erosion and improves the soil quality as a plant growth medium.
2. The fertilizer effect of sludge enables a reduction in cost for nitrogen and phosphorus mineral fertilizers and may improve crop yield on sludge treated fields (Wild and Jones 1991). By using sludge, a possibility is created for farmers to supply their lands with organic fertilizer at low costs. Palestinian farmers rely on imported fertilizers from Israel that cost 50 NIS/50 kg and purchase manure

for 35 NIS/50 kg (KfW, 2005). It is expected that the sludge will cost as low as the transport cost of around 1 NIS/50 kg. Moreover, the sludge will be reliably available compared to imported fertilizers which are subjected to import difficulties due to the political instability and the imposed blockade on Gaza. The organic fertilizers imported from Israel that were manufactured from poultry litter and cows manure. Those fertilizers are organic nutrients that increase the abundance of soil organisms by providing organic matter and micronutrients for organisms such as fungal mycorrhiza. The ton cost up to 1,000 shekel. This is relatively costly and expensive product.

3. Another level of competition reported was with the Palestinian organic fertilizers (each dunum needs about 8 cubic meters from this fertilizer. That cost around 850 shekel which is relatively expensive).Thus, the produced sludge will be a competitive product if it costs less than 300 shekel per ton.
4. Recycling of sludge for agricultural purpose is an appealing solution for sustainable management of sludge. It is environmentally the best solution compared to disposal of inland fills or incineration plants.

5.1.3. Positive Impacts of Remediation Works and Decommissioning of Beit Lahia Wastewater Treatment Plant (BLWWTP)

After decommissioning the BWWTP and remediation works of the effluent lake, a positive impact will be clearly found on the groundwater quality in the aquifer under the lake (and BLWWTP). This was found from the analyses of NO_3 concentrations in two groundwater wells close to the lake (A/180 and A/185). As mentioned in the evaluation, of the existing groundwater statues in BWWTP in Chapter 4, Figure 4A.25, the NO_3 concentration is around 79 mg/l, which indicates an improvement of the groundwater quality after drying the lake.

In addition, reduction of health risks associated with exposure of villagers or inhabitants surrounding the effluent lake and BLWWTP to environmental risks and nuisance released from the BLWWTP, such as effluent lake flooding and the risk of water borne disease, mosquitoes and odor will be seen.

5.2. Negative Environmental Impacts and their Mitigations

5.2.1. Negative Environmental Impact during Construction Phase

5.2.1.1. Air Quality and Noise Pollution

Dust Emissions

The excavation of top soil in construction sites will generate fugitive dust, which will also result from site clearing and earthworks including leveling, trenching, and other activities associated with the decommissioning of the BLWWP and remediation of the effluent lake as well as the wastewater distribution networks. Other major dust sources will be vehicle movement over un-paved areas and transportation of raw materials and equipment within the work site. The dust emissions resulted 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 Standards for ambient air have specific limits to preserve the air quality; however there are no specific standards for dust emissions from diffuse sources. In controlling dust emissions from excavation, filling, earthmoving, leveling, grading 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 the location of activities. The NGESTP project area is located in the downwind stream, i.e. all the emissions will not directly affect the nearest populated area, which is located around 400 m away from the BLWWTP and 250 m or more away from the water distribution network, as indicated by a red dotted line in Figures 5.1 and Figure 5.2, respectively. Some boundaries of the effluent lake are located at only 150 m from residential areas as shown in Figure 5.1. However, remediation in the effluent lake is only concentrated on the site which is considered a wet area, and there are no construction activities within this area and no heavy machineries are needed. So it is not anticipated that dust levels will impact greatly on existing settlements.

In conclusion, 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 works are being carried out. Blue circles of 150m radius are included in Figure 5. 1 to show the minimum buffer zone around different project activities (wet areas in the effluent lake), inside which the effect of air and noise emissions would require mitigation (i.e. critical zone or expected dust impact will occur).

The movement of vehicles may also generate dust. This will be expected only from movement of the workers and trucks to transport the waste / soil to and from the site. The maneuvering of the vehicles and other activities shall be done far from the residential areas.

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*)* as shown in Figure 5.1. Minimization of such impacts requires mitigation measures such as spraying excavated soil and unpaved roads.

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

- Impact of dust emissions due to construction activities will be limited to 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.
- The soil at the construction site is not considered desert or light sand, therefore the wind-blown dust will not transfer contaminants to humans and vegetation exposed.

It is concluded that the air quality impacts associated with dust generation will be of “low” significance. However, whenever the dust emission is to become higher than expected and disturbance is created for the workers and project activities, it is recommended to spray the location with water to reduce the impact.

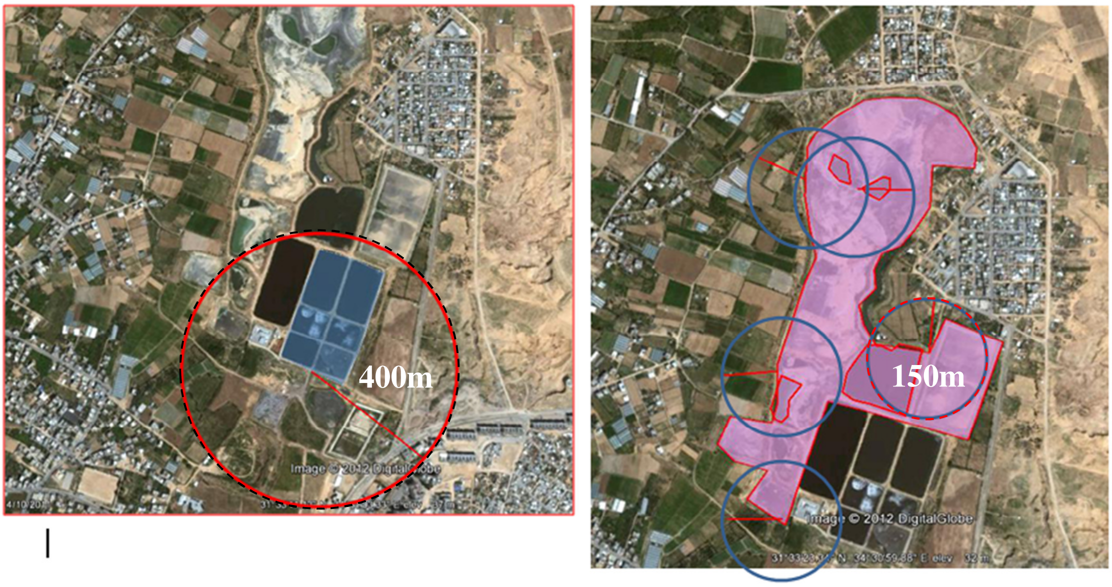


Figure 5.1 Residential areas and buffer zone for dust emission (BLWWTP and Effluent Lake)

Figure 5.2 Water distribution network project area and around residential area

Gaseous Emissions

Emissions of CO_2, CO, SO_2, NO_X and $PM_{5\ \text{and}\ 2.5}$ will result from the operation of the construction machinery and road vehicles during construction of the effluent recovery network (water distribution), decommissioning of BLWWTP and Remediation of Effluent Lake.

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 in addition to the fact that only a small number of heavy machineries will be needed.

- The emissions are expected to be scattered over a large geographical area.
- The construction site is located in an open area where the impact of air pollutants on workers will be relatively weak as compared to a closed work environment.
- The emissions will be mostly limited to the construction phase (mainly for the construction of the water distribution network) and therefore are temporary.

Based on the description above and the distances between the project components and the nearest residential areas that might be affected during the construction activities of the water distribution network, decommissioning activities and remediation works (as shown in Figure 5.1 and Figure 5.2) the air emission impacts associated with the proposed project will be of "low" significance.

However, to reduce and minimize the impact, it is recommended to check the vehicles regularly for exhaust gas and minimize vehicle and heavy equipment movement at the same time.

Noise

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.
- Trenching.
- Backfilling

Noise will also be associated with construction activities associated with heavy machinery for piling and filling, heavy trucks and generators. The noises of this equipment vary from continuous sources, such as loaders, vacuum trucks and construction trucks, to intermittent impacts, from piling and demolition works.

The most affected people from noise impacts are the construction workers. Palestinian Outdoor Noise Standards have specified certain limits for noise intensity, number of impacts and exposure duration for the working environment, which should be respected during construction. The mitigation measures recommended in the Environmental and Social Management Plan (ESMP) and Monitoring Plan for control of noise and air emissions, especially to the workers are based on compliance with the Law.

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 (mainly for the water distribution network) would be similar to those associated with typical construction sites and it will have a temporary impact. The equipment to be used mainly consists of front loaders, trucks, vacuum tankers in addition to concrete mixers, pumps and generators.

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

In addition, as the project components will not be constructed all at the same time, and are divided into different site areas (water distribution networks for irrigation, the effluent lake and BLWWTP), noise impacts from material mobilization and construction activities are unlikely to be a matter of concern. However, if truck routes are not carefully selected there could be some disturbance to the populated areas and sensitive receptors such as El Shuhada Cemetery and neighboring residential compound around the BLWWTP and effluent lake.

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

- The construction noise is expected to be of short duration and noise attenuation is likely to occur only on spot and during the operation of heavy machineries.
- No major noise sensitive receptor is located within 150m radius of the proposed project location as previously indicated in Figures 5.1 and 5.2. The exception to this would be El Shuhada Cemetery which could be also affected by vibration as discussed in the following section.
- The main routing of construction vehicles will be along the main public roads.
- Transportation and materials delivery will be limited to daylight hours
- The booster pump and storage tanks are among the main components causing noise disturbance. As shown in Figure 5.3, the radius

Figure 5.3 below shows the locations of the main noise sources during the construction activities of the water distribution network (booster pump and storage tanks). The radius of 150 m was drawn surrounding this location to indicate the needed buffer zone.

Subsequently, according to the distance of the sensitive recipient, the nature of the construction of the component and the proper management during construction activities expected to be conducted by the contractor, the noise impact will be short-term only for the duration of construction activities. Therefore, the impact significance is considered "low".

The main impact on workers should be mitigated by providing noise protection equipment for the workers operating equipment that generates noise, especially the equipment that generates noise levels greater than 80 dB. The protective earmuffs should be use especially for the workers who work continuously for 8 hours near heavy equipment.

Figure 5.3 Buffer zones (150 m radius) around the main noise sources during construction of water distribution network (booster pump and storage tanks)

5.2.1.2. Vibration

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.

According to the proposed activities during the construction phase of the water distribution networks and the remediation work of the effluent lake as well as the decommissioning of the BLWWTP, the concern of vibration comes from the truck movements and construction of the storage tanks, pump installation, and other activities associated with concrete construction works.

Due to psychological perspective of the respected site according to the people in Gaza, El Shuhada Cemetery (around 10 m away from project site) is considered a sensitive receptor. The closest sensitive structure to the sensitive receptor of the distribution network is the booster pumps. Consequently, medium vibration impacts are anticipated to occur.

The mitigation measures proposed during the construction of water distribution network's component (Storage tank and booster pump), near the El Shuhada area are as follows:

1. The base camp (site camp for the workers) and the place for storage of the equipment have 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 and not overlapped. 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 mixing on site and reduction of the hazardous wastes and other solid wastes on site, the vibrational load will also be reduced significantly. In addition, the use of concrete pumps will be advantageous.
   It is worth noting that during the Public Consultation, it was confirmed that the common practice for construction work in GS is using ready concrete mix.

In addition, due to the sensitivity of the groundwater, the vibration around the wells construction site should be minimized in order to avoid groundwater contamination due to potential spills.

During the decommissioning and remediation works period, many of the vibration causing equipment would be used on an intermittent basis (i.e. short-term and temporary in nature. Consequently, no significant adverse vibration impacts would be anticipated to occur and therefore, the impact is "low" at the decommissioning and remediation areas.

5.2.1.3. Construction Waste and Handling of Hazardous Waste

The waste that would be generated during construction could be categorized as follows:

- <u>Human wastes (sanitary waste)</u> Human wastes generated by construction labor, including sewage (sanitary wastewater) and garbage collected from labor camps or construction sites in water distribution networks and BLWWTP and effluent lake 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 have recommended measures for sound management of such waste.

- Hazardous and non-hazardous waste Non-hazardous waste includes normal construction wastes (including scrap concrete, steel, bricks, wood, etc.) and hazardous waste might be from unearthing pipes from decommissioning of BLWWTP that might contain Asbestos. Therefore the associated environmental risk with improper disposal of such waste is limited to aesthetic effects at the disposal site. By following the construction site waste management plan and monitoring plan (prepared by the contractor prior to the construction activities), these limited aesthetic effects will be minimized.
  During the Public Consultation, the pipelines content of Asbestos is doubtful (it was mentioned it might only be made up of old pipelines without Asbestos). However, the ESMP will include the management and monitoring plan in case of Asbestos is found.

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). In addition, during the decommissioning of the treatment plant and the remediation of the effluent lake, organic waste and hazardous waste potentially generated from the removed plant will be expected.

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.

Based on the above, impacts due to waste generation associated with the proposed NGESTP project activities will be of "low to medium" significance. The following mitigation measures are proposed:

1. Onsite domestic sewage collection and disposal (adequate sanitation facilities) shall be provided by the contractor for construction worker's needs.
2. 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 (hazardous and non-hazardous wastes), collection and removal schedule in addition to the provision of onsite sanitation facilities to the workers. The disposal site and storage areas have to be discussed and approved by the Project Management Unit (PMU) and the supervision and monitoring of the solid waste management has to be developed, discussed and approved between the Contractor and the Management Unit (PMU).
   During the preparation of the bidding document, the PMU shall include the development of the site waste management plan in addition to the specific ToR to the contractor. Prior to the commencement of the construction activities, the contractor should develop the site waste management plan and submit it to PMU for approval.
3. The burning of any type of wastes should be avoided.
4. The reused clay or excavated sand should be stockpiled and stored away from any waterway, drainage networks, existing wastewater networks and any other drainage patterns.
5. Nearby sanitary landfill should be notified to receive the unusable non-hazardous construction wastes or damaged construction materials. Please note that during development of the site waste management plan (done by contractor), the agreement between the contractor and sanitary landfill management (approved by the PMU) for disposal of the construction wastes should be done.

Please note that the existing hazardous waste cell at Johr Eldeek Landfill can accept the old pipelines (that might contain Asbestos) during the commissioning of the BLWWTP. However, this has to be communicated and confirmed with the landfill management if Asbestos is found.

5.2.1.4. Soil Contamination during Decommissioning of BLWWTP

The decommissioning works of BLWWTP will include the following activities:

- Decanting the wastewater from treatment lagoons to pond #7 using portable pumps.
- Removing sludge from the lagoons and transferring it to a selected drying area in the BLWWTP site.
- Unearthing pipelines networks
- Importing selected backfilling material to fill the lagoons to the existing ground level.

Heavy machinery and vehicles will be used to conduct these activities such as front loaders, excavators, vacuum tankers, heavy trucks, portable pumps, and diesel powered generators. Soil may be exposed to contamination due to the movement of these vehicles and equipment. The contamination will occur due to oil and fuel spills from the engines of these machines, and also due to polluted wheels (importing pollutants from outside of the site). Based on the above, impacts associated with soil contamination will be of "medium" significance.

Mitigation measures proposed during the decommissioning of the treatment plant are as follows:

1. The decanting activities should be done with care and the pipe should have sufficient length to prevent spillage to the ground
2. Preventive maintenance for any vehicle or equipment that has an engine that leaks oil or fuel.
3. Preparing a special fuelling and oil change station on site to contain any possible fuel or engine oil spill. Otherwise fuelling and oil change should be conduct in the private oil stations out of site (concrete paved station on site).
4. If any machine is broken on site, a containment system should be used to prevent the spill of oil or fuel on the soil.
5. The vehicles moving in and out of site should be checked at the inlet gates of BLWWTP to assure that they are not importing pollutants through the wheels. The paved path / concrete paved parking or loading and uploading sites can be made to ensure that the vehicle will not transport the pollutant from the site during the decommissioning phase.

5.2.1.5. Remediation Works at the Effluent Lake

The design of the remediation works of the Effluent Lake has not been assessed. The Consultant has conducted the general assessment of the remediation technique for optimum use of the effluent lake, based only on the soil sampling (at different depths) conducted at several places at the effluent lake. The soil remediation works are presented in detailed in Annex 6. In addition, the assessment was based on the urban planning of the area (different urban planning of the 4 governorates and of each governorate is presented in Annex 6 as well). However, the options of the remediation works will be done for the site to be able to use it for agricultural and residential purposes.

Based on the soil assessment for remediation works, three different options are proposed. The selection of the options will depend on the PWA selection, based on the financial and timeframe constrains. However, the selection of the appropriate method is based on the Consultant's analysis of the technical capability and the time and implementation cost analysis. The duration and cost analysis is presented in the following table, Table 5.1.

Table 5.1 Estimated Duration and Costs for Remediation Alternatives

No	Type of remediation	Duration (years)	Total cost* (M USD)
1	Doing nothing – limiting access to the site	6.0	9.31
2	Phytoremediation	3.0	5.23
3	Placement of clay cap	1.0	3.59
4	Placement of three-layer cap.	1.5	5.50
5	Encapsulation of the site	2.5	11.28
6	Rinsing of soil	6.0	24.75

*The total cost is based on the estimation

As it is mentioned above, the cost is a sensitive indicator for selection of the option for remediation. The cost analysis was conducted to determine the cost estimate for each option, with comparison measures of environmental satisfaction. The following figure, Figure 5.4 presents the comparative cost for remediation alternatives.

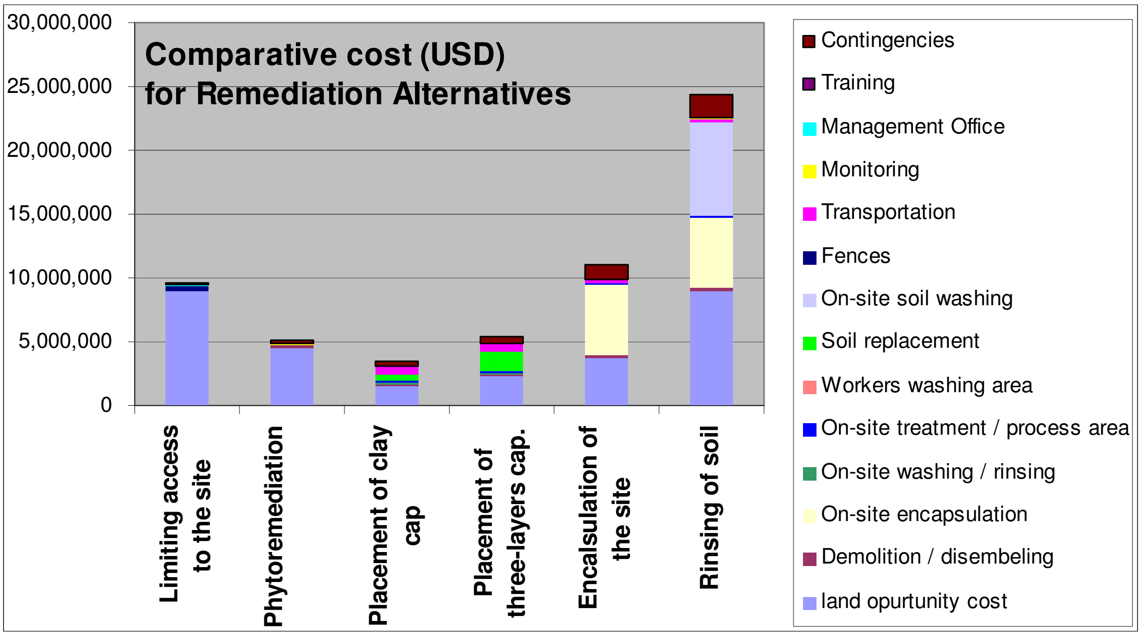


Figure 5.4. Comparative Cost for Remediation Alternatives of the Effluent Lake

The best options of the financially and technically feasible options available (excluded the land investment cost) are the Phytoremediation, clay placement and three layers clay placement. The most sensitive parameter for the remediation selection is the land investment. As the land is being rented and the longer term of the remediation activities will affect the initial cost. In addition, the three layers of clay cap are not necessary as the contamination does not need deep soil replacement. Therefore, the clay cap placement is the most suitable option, financially and technically.

Based on the outcome of the cost analysis model, it is recommended to replace the top layer (average 50 cm) of the contaminated part of the soil (around 4.3 ha), with cleaner sand from the adjacent area. The total cost is estimated at 3.6 million USD, and can be done for up to a period of maximum one year.

The remediation works of effluent lake will include the following activities:

- Drying the remaining wet area
- Site preparation by trees replacement (replanting to the nearby area within the site that will not be remediated by soil cleaning or replacement).
- Excavate the top soil (within maximum of 50 cm on the wet part of the lake and around 100 m further from the wet site.
- Loading to the vehicle truck to be sent to the designated landfill.
- If it is required, the top soil removed will be replaced by the soil or sand from the nearby area (loading, transport unloading of soil / sand)

Heavy machinery and vehicles might be used to conduct these activities such as excavators and heavy trucks. Based on the above activities, impacts associated with remediation works will be of "medium" significance.

Mitigation measures proposed during the remediation works of the effluent lake are as follows:

1. Standard protection to the workers during the overall remediation activities
2. Special tools for handling the dangerous wildlife found
3. On site sanitation should be established for the workers
4. Avoid the disturbance of the existing plants and wildlife as much as possible during the site preparation
5. Handle with care found wildlife (catchment dangerous wildlife). It is recommended to seek the assistance of the Ministry of Health and Ministry of Agriculture for the best practice of handling the catch of dangerous wildlife
6. Minimize the soil contamination by site management plan (place for temporary storage, handling, transportation and disposal)
7. Replanting the affected plant that has to be displaced. If the replacement is not feasible, planting 2 trees to compensate 1 removed tree has to be done by the contractor
8. Notification to the designated landfill should be done prior to the soil disposal.

5.2.1.6. Changes in Hydrology and Groundwater Quantity and Quality

During the construction of the recovery scheme and decommissioning of BLWWTP there will be no impact on groundwater since groundwater is about 30 to 70 m below the earth surface. Therefore, there will be no mitigation measures.

Concerning the changes in hydrology and groundwater quantity and quality at the effluent recovery sites, it is not expected to have an impact during construction activities of the water distribution network. The depth of the excavation will not significantly impact the groundwater but the wells construction. It is recommended to hire a highly qualified contractor for wells establishment. Therefore, the impact is negligible for decommissioning and remediation activities and low impact on the water distribution networks (only for wells construction).

The mitigation measure to avoid the changes on hydrology of groundwater quantity and quality is similar to the general wells construction. To reduce the impact on 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 fall down to the wells.

5.2.1.7. Health and Safety

During the construction phase, as the proposed project are at a large distance from the nearest population or residential area (around 300-400 m BLWWTP, 100-150 m from Effluent Lake and on the agriculture land on the water distribution network site), the temporary impact due to exhaust gas emission, dust and noise that could affect the health of the population is not expected to be significant. These impacts are considered minimal.

In addition, the remediation works of the effluent lake will be concentrated only in some wet area. The soil replacement will be done manually with the equipment (mainly vehicles) are standby at the internal access road only (with some additional soil pavement to be used for internal access inside the lake's bed).

Negative impacts will mainly concern the works for construction of new facilities (booster pumps building and the storage tanks), the laying of pipes and the pipe connection (for water collections and distributions); assembly and testing of equipment which will produce impacts inherent to worksites. These activities, which are mainly within water distribution networks, will have few limited negative impacts such as temporary discomfort and localized pollution to the communities caused by worksites (noise, exhaust fumes, dust and vibration, risk of accidents due to increased traffic in the project impact area, the presence of workers, very limited disruption of wildlife and vegetation, poor management of handled products: fuels and lubricants as well as worksite waste, etc.).

The effluent lake, during remediation will not have any heavy machinery to be counted. The proposed remediation will have only vehicles to transport the waste to the landfill and few numbers of workers' vehicles going to and from the site. Similarly, the construction of the water pipeline network will not create much dust emission as the pipe network's installation will use mostly conventional machineries. For the decommissioning activities of BLWWTP, only the small numbers of equipment will be applied and the emission will be considered temporary, localized and short term.

However, although the impact is considered low and temporary for the communities, the mitigation measures are developed to minimize the impact. In addition, due to the health and safety of the workers, which accidents might occur on site in various construction project activities, mitigation measures are as well developed to mitigate the risk of health and injuries to the workers.

Mitigation measures developed to minimize the risk related to health and safety, both for community and workers are:

1. Campaigns to raise awareness of workers and community members to promote safety, and health and safety monitor should be appointed. The monitor can be chosen from among community members who accepted to work in the project.
2. Workers should wear standard protection especially due to the dangerous wildlife on BLWWTP and effluent lake sites.
3. Workers should be trained to cover the completed parts and keep their work areas safe. In case of causing an accidents, the workers should be penalized either by deduction of salaries or dismissal.

4. Existing utilities (especially at BLWWTP and water distribution network), if exist, would be located and staked before construction begins, including and at intersections of other pipes and crossings. This would confirm the location and depth to ensure new construction does not impact the existing utilities.
5. Following the measures above, the identification of the existing infrastructure (other pipelines, cables, etc.) have to be identified prior to the construction phase.
6. Heavy equipment should not normally be operating above the existing utilities during construction of the new line. If heavy equipment or trucks must cross the existing utilities, additional soil cover will be needed to protect the existing pipe.
7. Onsite inspectors should be present during construction to verify that the construction contractor is following engineering specifications and meeting regulatory requirements. The inspectors could be from PWA – PMU or from selected inspection consultant selected by PWA – PMU.
8. Workers should take the following steps to protect themselves from falls during high construction:
    a) Use 100% fall protection when working on higher construction sites
    b) Participate in all training programs offered by the employer (contractor).
    c) Follow safe work practices identified by worker training programs.
    d) Inspect equipment daily and report any damage or deficiencies

As a mitigation measure, safety measures should be taken into consideration and addressed with the workers. The contractor is the main responsible actor for any safety procedures to be applied and the PMU is the main responsible for monitoring the health and safety performance of the contractors. In addition, the contractors should be responsible to provide such standard protection for health and safety to the workers.

5.2.1.8. Archaeological Disturbance

This section was developed by reviewing the ESIA developed for NGESTP in 2006 and the site visits paid to the project areas and different reports related to the antiquities in the project areas.

The conclusion of the surveys in the area of the BLWWTP is that no archaeological sites were identified so far. The confirmation letter was sent to the Archeological Authority for assurance and clarification of the assessment. The reply indicated the non-existence of the archeological site at the project component (the correspondences between the Consultant and the Antiquities Authority are presented in Annex 10).

The nearest archaeological remains in the area is Tell al-Khirb. It is situated in the eastern part of Beit Lahia, 500 m south of the BLWWTP. In the area archaeological remains such as mosaic fragments and pottery shards can be found over the whole of the mound. They date back to the Roman Byzantine period.

Strategically, the NGESTP project site for irrigation lands and water distribution networks are located in a relatively remote, agricultural area, which was neither important for military purposes nor for settlements. These facts may be the explanation for the absence of relevant archaeological sites in the project area. All available data (literature, maps, and photos) do not mention any archaeological remains or historical buildings in the area.

The archaeological investigation of the site, which was conducted in 1999 in connection with the previous EA, showed the following results:

- Presence of some pottery shards of the Roman-Byzantine type and locally made. These movable archaeological surface remains are not an absolute indication for structures or dwellings existing under the surface of the project area. The surface of the area does not reflect any structural remains or building material.
- An investigation of one-meter deep dug area and a dug for cultivation purposes (70 cm deep) shows that there are no visible archaeological remains and – beside agricultural activities - the soil has a natural structure. Also a soil test was conducted in the middle of the project area. The excavated soil down to 10 meter depth was checked. The excavated soil is muddy and clean. There is no indication for any archaeological remains.
- The field survey identifies a small mound about 10 meters high located 150 meters east of the project area, namely behind the green line, inside the Israeli territories. Some similar mounds in the country reflect in different cases archaeological structures.

Concerning the project area surrounding NGWWTP site, the nearest known archaeological site is located approximately 2,000 meters away from the infiltration basins (NGWWTP). The remains are water cisterns and pottery shards scattered in some places. No archaeological excavations were carried out in these areas. The most important structure of cultural value in the area is the Al Shuhada Islamic Cemetery (EA Study NGESTP Project Chapter 3, Environmental Impacts and Benefits).

The Jordanian Antiquities Law of 1966 is still applicable in the Palestinian Territories, and stipulates that in situations where any culturally valuable object/monument is discovered during excavation works, the works should be stopped by the contractor and the nearest administrative authority must be informed within 48 hours. An inspector shall then supervise any excavation on the site following any evidence of artifacts or antiquities.

A chance find procedure should be drawn-up prior to the start of construction that addresses and protects cultural heritage finds made during the construction phase. The procedure should outline the chain of events put in motion if previously unknown heritage resources, particularly archaeological resources, are encountered during the project's construction phase.

The procedure should include provisions for:

- Record keeping
- Expert verification procedures
- Chain of custody instructions for movable finds
- Clear criteria for potential temporary work stoppages that could be required for rapid disposition of issues related to the finds.

The procedure should also outline the roles and responsibilities and the response times required on the part of project staff and any relevant heritage authority, as well as any agreed consultation procedures.

5.2.1.9. Ecological Disturbance

Wetland ecosystem and vertebrates living at the area surrounding the BLWWTP and the effluent lake might be affected during the decommissioning of the treatment plant and the remediation works of the effluent lake. The remediation activities and the removal of the existing pipelines (for decommissioning of BLWWTP) as well as the backfilling activities will involve the temporary or permanently displacement, both on existing flora and fauna.

Although the biodiversity, especially fauna identified within the vicinity of the project sites (effluent lake and BLWWTP), are commonly found, they do not belong to endangered wildlife and in fact could cause a vertebrate pest outbreak or other health impacts, the mitigation measures have to be developed to avoid the ecological disturbance and provide safe and adequate relocation for found wildlife and re-plantation of the fauna. Based on the ecological disturbance impact assessment, the project at BLWWTP and effluent lake will have medium impacts.

However, due to the decommissioning activity and the remediation of the effluent lake; which caused deadfall accidents to the nearby community, floods, vertebrate pest outbreak, mosquito proliferation and other health impacts associated to the operation of the treatment plant and effluent; after the finalization of the works activities, the site will provide a permanent positive impact. The biodiversity disturbance of the site due to the remediation works and decommissioning activities, either by relocation or re-plantation to another site or still within the project site area, will be compensated with the long term positive impact. In addition, as the fauna and flora found in the project site are local and do not belong to the endangered flora or fauna, they will easily adapt and continue their life cycle.

Mitigation measures to reduce and minimize the impact of the existing wildlife and plantation within the BLWWTP and effluent lake are as follows:

1. Standard procedure for health and safety of the workers at the site, especially the equipment that protect them from the wildlife.
2. Equipment to handle the vertebrates should be prepared (this includes cages, snake sticks, net, etc.) in case of the found vertebrate during the activities.
3. Assistance from the staff of the Ministry of Health and Ministry of Agriculture is needed to advise the contractor on the procedure of temporary relocation of the found wildlife. Please note, the detailed measures to handle the vertebrates are inserted in Annex 6.
4. Re-plantation of the trees, if needed, should be done by the contractor, if it is needed. The re-plantation can be done within the area of the effluent lake.
5. Avoid the disturbance of the nesting, breeding site. The found nesting place or breeding of the fauna found has to be handled with care and replace it to the safe site.

Regarding the water distribution network site, there is an opportunity that the networks will be laid in agricultural land, and impose on the existing crops and local 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.

Mitigation measures developed to avoid the ecological disturbances in the vicinity of the water distribution network project site are as follows:

1. Temporary construction fences have to be installed prior to the construction of the water networks and other components for recovery water distribution to avoid the fall of the local animal and to localize the site from the local animals.
2. In case the destruction of the crops or plants at the farms near the construction site of the recovery water distribution network, compensation has to be settled. The compensation measures shall be developed prior to construction. The

compensation shall be developed based on the compensation framework of the Ministry of Agriculture.

3. If it is needed, the replanting or relocation of the trees (temporary or permanently) has to be done (for the trees or plantation that are un-avoided to be removed).
4. If the relocation or replanting of the existing trees is not feasible, the compensation of planting 2 trees (for removal of one tree) has to be done in another area. It is advisable to plant local trees.

5.2.1.10. Land Use and Accessibility

During the decommissioning and remediation activities, the land use and accessibility the impact is considered “low”. The equipment will be placed within the project area and the movement of the vehicles, etc. will be also be minimized. The project area is already isolated from the surrounding residential area and there is only one access road with one gate already in place around the site. The movement of the vehicles and equipment is expected only during the transportation of equipment and commuting of the labors. It is worth noting that the access road is already established in the project area with low traffic intensity.

Regarding the land use and accessibility of the water distribution networks for the recovery reuse scheme, the main impact on traffic will be during possible lying of water distribution networks along or across the main roads. Longitudinal excavation will cause narrowing of the excavated road for a relatively long period, while the lateral crossing of roads may cause blocking of the road, but for a relatively short period, possibly only a few hours.

Excavation on village roads will cause minimum impact to vehicle related traffic, as most of the village roads are mainly used for pedestrian and field animal related traffic. Therefore, the blockage of village roads through excavation will cause access problems to pedestrians, and possibly to riders of animals and agricultural tractors. 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. This possible impact is limited during construction. However, in case of applying the mitigation measures proposed, the impact will be further limited.

Mitigation measures proposed during the construction of water distribution (mainly for the site of the storage tank and booster pumps) and other project components (remediation works) are as follows:

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. All the temporary storage materials and the place for equipment standby have to avoid the side of the road. The temporary site should be appointed and approved by the PMU prior to the construction activities.
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 in the 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 the daytime, a clear sign (by light or fluorescence lights) has to be considered to determine and identify the site.
8. When the land use and accessibility is disturbed and the safety of the communities or people passing by the project location is affected (especially to the children, handicapped or the elderly who might use the access road), a temporary access road has to be considered. The assistance of the traffic department is needed to identify the temporary access road and to divert the traffic.
9. Temporary resettlement that might occur during the preparation and the construction phase has to be defined and accordingly has to be prepared and compensated.

Table 5.2 below presents the environmental potential impacts and their significant and mitigation measures.

Table 5.2 Assessment of Significance of Expected Environmental Impact during Construction Phase

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
Decommissioning of BLWWTP				
Affecting air quality by dust and gaseous emissions	- Temporary and localized	Likely to rise dust and gaseous emissions due to the vehicles movement	Low	Minimize the impact with spraying the location, management of vehicles and regular vehicles maintenance
Noise impacts	- Temporary	Impacts of construction is less likely to the resident but likely for the workers on site	Low for the resident and sensitive receptors Medium at project sites	Minimize the impacts to the workers by using the standard ear protection and maintain their control for intensity nearby the noise source and exposure to duration
Odor Impacts	+	The positive impact at the BLWWTP as the pond, especially anaerobic ponds will be dried up.	Positive impact at BLWWTP	No mitigation measures is required
Vibration due to the equipment movement	- Temporary and localized	Low impact is predicted at the BLWWTP and Effluent lake as the closest residential area is between 300-400m	Low impacts at the BLWWTP	No mitigation measures is required
Risks of hazardous wastes	-	Likely to have workers exposure to sanitary and hazardous waste if no hazardous waste facility is established before the project preparation	Medium	Minimize the impacts by wastes management plan (non-hazardous and hazardous wastes) prepared by the contractor (separation, storage, transportation and disposal) and sanitation facilities for the workers

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
Soil contamination of the decommissioning of BLWWTP	-	Likely to have significant impacts due to oil spillage, decanting wastewater, removing sludge and unearthing pipelines networks	Medium	Minimize the impacts by care and sufficient pipe length during decanting, maintain vehicles, monitor the vehicle movement out from the site
Health and Safety	-	Likely to have impact to the workers due to populations of insects and rodents but not necessarily in conditions worse than the existing condition	Medium	Minimize the impacts with standard protection for the workers and adequate tools to handle the dangerous wildlife Awareness to the communities and workers for health and safety risks
Archaeological disturbance		Likely to have no significant impacts at the project areas	No significant impacts	Standard recording and reporting of the found valuable archeological and cultural object
Ecological disturbance	- Temporary or Permanent	Likely to have impact due to the displacement of the flora and fauna Permanent positive impacts due to the disappearance of vertebrate outbreak and mosquito's proliferation for the communities	Medium impacts	Minimizing the impacts by using standard procedure for workers protection, handle the vertebrates and replanting the trees (with avoiding the disturbance to nesting, breeding sites)
Land use impacts and accessibility	-	Likely to have impacts as the project site is already localized. The little disturbance will occur due to the vehicles movement in and out to the project.	Low impact	Minimizing the impact with clear signs of the project and management of vehicles movement

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
Reduce of sewage water that some of the farmers relied upon to water their plants	-	Potential impacts on the economic status of the farmers due to depriving them from this source of water. However the project will provide them with the recovered water	Medium impacts of economic status in Beit Lahia	Provision of recovered water of a competitive price to minimize the potential impacts Due to the fact that the sewage untreated water should be banned, the legislators should develop appropriate laws that criminalize the use of untreated water
Remediation of Effluent Lake				
Affecting air quality by dust and gaseous emissions	- Temporary and localized	Likely to rise dust and gaseous emissions due to the vehicles movement	Low	Minimize the impact with spraying the location, management of vehicles and regular vehicles maintenance
Noise impacts	- Temporary	Impacts of construction is less likely to the resident but likely for the workers on site	Low for the resident and sensitive receptors Medium at project sites	Minimize the impacts to the workers by using the standard ear protection and maintain their control for intensity nearby the noise source and exposure to duration
Odor Impacts	+	The positive impact at the BLWWTP as the pond, especially anaerobic ponds will be dried up.	Positive impact at BLWWTP	No mitigation measures is required
Vibration due to the equipment movement	- Temporary and localized	Low impact is predicted at the BLWWTP and Effluent lake as the closest residential area is between 300-400m	Low impacts at the BLWWTP	No mitigation measures is required

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
Risks of hazardous wastes	-	Likely to have workers exposure to sanitary and hazardous waste if no hazardous waste facility is established before the project preparation	Medium	Minimize the impacts by wastes management plan (non-hazardous and hazardous wastes) prepared by the contractor (separation, storage, transportation and disposal) and sanitation facilities for the workers
Remediation activities	- During the remediation period only	Likely to have impacts on health and safety to workers, ecological disturbance, waste management and soil contamination	Medium	Minimize the impact by implementing the mitigation measures for health and safety, handling with care for the wildlife found, replanting trees, and site waste management plan (temporary storage, handle, transportation and disposal to the designated landfill)
Health and Safety	-	Likely to have impact to the workers due to populations of insects and rodents but not necessarily in conditions worse than the existing condition	Medium	Minimize the impacts with standard protection for the workers and adequate tools to handle the dangerous wildlife Awareness to the communities and workers for health and safety risks
Archaeological disturbance	-	Likely to have no significant impacts at the project areas	No significant impacts	Standard recording and reporting of the found valuable archeological and cultural object

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
Ecological disturbance	- Temporary or Permanent	Likely to have impact due to the displacement of the flora and fauna Permanent positive impacts due to the disappearance of vertebrate outbreak and mosquito's proliferation for the communities	Medium impacts	Minimizing the impacts by using standard procedure for workers protection, handle the vertebrates and replanting the trees (with avoiding the disturbance to nesting, breeding sites)
Land use impacts and accessibility	-	Likely to have impacts as the project site is already localized. The little disturbance will occur due to the vehicles movement in and out to the project.	Low impact	Minimizing the impact with clear signs of the project and management of vehicles movement
Recovered water distribution networks				
Affecting air quality by dust and gaseous emissions	- Temporary and localized	Likely to rise dust and gaseous emissions due to the vehicles movement	Low	Minimize the impact with spraying the location, management of vehicles and regular vehicles maintenance
Noise impacts	- Temporary	Impacts of construction is less likely to the resident but likely for the workers on site	Low for the resident and sensitive receptors Medium at project sites	Minimize the impacts to the workers by using the standard ear protection and maintain their control for intensity nearby the noise source and exposure to duration
Vibration due to the equipment movement and construction	- Temporary	Low impact is predicted at the collection pipes and irrigation networks.	Low impacts	No mitigation measures is required

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
activities	and localized	Likely to rise the disturbance to the el Shuhada Cemetery during the construction storage tanks and booster pumps	Medium impact due to existence of El Shuhada graveyard	Minimize the impact by concentrating all activities at the future storage tanks location, time management for heavy machineries and ready mix concrete (preferable transported with mix tanker with pump)
		Likely to have impact on wells construction	Medium impacts due to groundwater quality sensitivity	Minimized the impact by localize the site and fenced the well construction site, at least for 100 m distance
Risks of hazardous wastes	-	Likely to have workers exposure to sanitary and hazardous waste if no hazardous waste facility is established before the project preparation	Medium	Minimize the impacts by wastes management plan (non-hazardous and hazardous wastes) prepared by the contractor (separation, storage, transportation and disposal) and sanitation facilities for the workers
Changes in hydrology and groundwater quantity and quality	-	Likely to have significant impacts due to oil spillage, decanting wastewater, removing sludge and unearthing pipelines networks	Medium	Minimized the impact by localize the site and fenced the well construction site, at least for 100 m distance in addition to hiring the highly qualified contractor
Health and Safety	-	Likely to have impact to the workers at water collection network and water distribution network	Medium	Minimize the impacts with standard protection for the workers and adequate tools to handle the dangerous wildlife Awareness to the communities and workers for health and safety risks

Potential Impact	(+/-)	Likelihood and severity	Significance	Mitigation Measures Effects
		Likely to have impact to the workers for construction of storage tank and booster pumps	medium	Besides the measures mentioned above, avoid the cross section with existing networks, following the design specifications and protection from falling
Archaeological disturbance	-	Likely to have no significant impacts at the project areas	No significant impacts	Standard recording and reporting of the found valuable archeological and cultural object
Ecological disturbance	- Temporary or Permanent	Likely to have impact due to the displacement of the flora and fauna	Medium impacts	Minimizing the impacts by using standard procedure for workers protection
Land use impacts and accessibility	-	Likely to have impacts as the project site for water collection and storage tanks	Low impact	Minimizing the impact with clear signs of the project and management of vehicles movement and activities during day time
		Likely to have significant impact on disturbance to community and limit the access	Medium impact	To avoid the impact and minimizing it, the measures implemented is, beside the mentioned above measurements, the soil, when there is disturbance or narrowing street due to the project, and safety measures

5.2.2. Negative Environmental Impacts and Mitigation during Operation Phase

5.2.2.1. Air Emissions and Noise Pollution

After finalizing the remediation works, the effluent lake will be ready to be handed over to el Awqaf for future use, depending on the urban planning or the requested use by the owner. The site can then be used for agricultural uses or as a residential area as no adverse impacts are expected from the remediated land.

After finalization of the decommissioning activities at BLWWTP, the only other source of air emissions during the remaining pond at BLWWTP (pond #7) are the diesel generators in PS adjacent to Pond #7. The impact of such air emissions are considered minor, because the diesel generators are only expected to operate temporarily during power cut-offs. The compliance of generator emissions with Palestinian Standard for Ambient Air will be sufficient to safeguard against unacceptable air emissions impacts to the neighboring areas. In addition, the generators are isolated in the building, therefore the impact is considered minor.

Noise generating sources in the project site after the decommissioning activities are pump rooms and generators in the Pumping Station room at BLWWTP. However, the impacts are expected to be minor, or even negligible, on the neighboring sites because those pumps are contained inside buildings. A relatively higher impact will be on 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. In addition, as the PS and generators remain for the emergency; the operation of the PS and generators are temporary and during a short period only.

Similar to the operation of the PS and generators BLWWTP, the booster pumps and generator of the water distribution networks will have a similar impact (minor impact) and will have similar mitigation measures. The PS and the generators are located inside the building and the site is considered far from the residential area.

5.2.2.2. Odor

There is no impact expected after the completion of the remediation works. The site should be rehabilitated and returned back to the original conditions before being used as an overflow (effluent lake). Similarly, the operation of the water distribution network system is not expected to have significant impacts from odor. Therefore, the impact is considered negligible.

However, due to the remaining Pond #7 that will be used as the emergency sewage pond, the operation of the pond (whenever there is a discharge or overflow of raw sewage) will have a significant impact associated with generation of odors and vectors.

The odors are generated from wastewater handling facilities due to decomposition of organic matter. The most effective contributor of unacceptable odor is H_2S, because it is normally included in wastewater in relatively high concentration, while H_2S smell can be detected and recognized by the normal human olfactory system at very low concentration as indicated in Table 5.3.

Table 5.3 Thresholds for Odor detection and recognition associated with wastewater

Odorous compound	Detection threshold (ppm volume)	Recognition threshold (ppm volume)
Ammonia	17	37
Chlorine	0.08	0.314
Dimethyl Sulphide	0.001	0.001
DiphenylSulphide	0.0001	0.0021
Ethyl Mercaptan	0.0003	0.001
Hydrogen Suphide	<0.00021*	0.00047
Indole	0.0001	-
Methyl Amine	4.7	-
Methyl Mercaptan	0.0005	0.001
Skatole	0.001	0.019

Source: George Tchobanoglous, Franklin L. Burton, Wastewater Engineering, Treatment, Disposal and Reuse, Third Edition, McGraw-Hill, Inc.
*The WHO guidelines for detection of H_2S is 0.2-2 μg/m^3 (about 0.0002 to 0.002 ppm)), for recognition is 0.6-6 μg/m^3 (about 0.0006-0.006 ppm) while the guideline value to protect against substantial annoyance is 7 μg/m^3 (about 0.007 ppm)

The exposure to Odors could cause psychological stress that can develop poor appetite, lowered consumption of water, impaired respiration, nausea and vomiting. In addition to that there are socio-economic impacts associated with places with strong odors, which may lead to an impact on peoples' dignity and real estate prices.

The impact of odor is subjective; it could vary from one person to another according to the background odors in the area. Also people's tolerance for odors differs according to their exposure to similar odors. For example in WWTPs, the staffs working at the plant are normally more tolerant towards odors than inhabitants of neighboring residential areas. Even odor measurements are done through applying different folds of dilution to the odorous material, and checking the odor detection by a number of people, which is a subjective means of measurement. Therefore the best impact evaluation of unsatisfactory odors generated from pond #7 is complaints from neighboring areas.

The mitigation measures proposed for Pond #7 to reduce mainly H_2S generated from the untreated storage raw sewage are as follows:

1. As the pond #7 will be used only during the emergency situation, it is advisable to set a minimum standard to consider it an emergency. However, the monitoring plan and analysis during the emergency of Pond #7 is presented in Chapter 6 section 6.6. Monitoring Plan
2. Maintaining high performance of biological treatment of wastewater. Other means of mitigation is to be as far as possible from Odor recipients, and keeping buffer zones between odorous units and neighbors.
3. As the Pond #7 will not have a treatment process, the aerator from the aeration tank can be installed on the pond to maintain reasonable dissolved oxygen in the water to avoid anaerobic conditions, if needed.
4. As it is mentioned in the point above, to keep the aerobic condition, maximum permissible level of the overflow or raw wastewater discharge in the pond is a height of 2 m.

5.2.2.3. Vibration

Concerning the vibration at the effluent lake and the decommissioning site (including pond #7 and the PS adjacent to pond #7), the impact is considered negligible.

The main impact (medium impact) expected during the operation of the water distribution network is on the site of the booster pump. Although the pumps and the generator will be installed in the room, special attention has to be applied to reduce the vibration impact at the pumping station and the generator to minimize the impact due to the close distance to the El Shuhada Cemetery.

It is expected, that the installation area of pumps and generators for the water distribution network will have a "medium" impact. The mitigation measures to be developed to minimize the vibration impact of the machines are:

1. Tree plantation, heavy leaf trees to reduce the vibration by significantly absorbing the vibration and noise generated; it is recommended to plant these close to 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 maximized and if less is required then the standard period required for maintenance and spare parts changes.

5.2.2.4. Water Resource Contamination

The impacts on groundwater is one of the most important issues that is being associated with the project, as part of the project has been designed to prevent impacts on the groundwater from infiltrating partially treated sewage.

The EA of the NGEST Project estimated the water mound caused by infiltration of the partially treated sewage at the end of the emergency phase will extend 700 m towards the sea, 300 m inland, 250 m North and south of the infiltration basin, the EA has further assessed the impact on chlorides, nitrates and pathogenic bacteria.

The groundwater modeling prepared in the original EA of the project will result in an improvement of the groundwater quality after the operation of Part B, as the new infiltrated plume will wash out the old plume of partially treated water. Nonetheless, the EA has simulated a worst case scenario where the operation of Part B of the project is delayed and the EA thus recommended construction of remediation wells to pump out the effluent.

For the current work, the existing groundwater modeling provided during the design project and EA of the original NGESTP study is assessed and used as a reference. Visual Modflow (VMF) version 4.2 and its integrated modules are used in the current study. Therefore, the conceptual model in the design report (CEP&FCG, 2010) is considered valid; however, normally our approach consists of updating the conceptual model to schematize the most actual hydro geological context.

The developed numerical model, which consists of dividing the modeled domain in meshes (space elements) where hydrogeological properties are constant, and in dividing the simulation period into time intervals if required, is assessed. The most updated data provided by the client is used where the design project model used the input data until

2010 for the groundwater flow model and until 2012 for the transport model. Annex 5 shows the details of the groundwater modeling procedures carried out to reach a quantifiable assessment of the groundwater quality impacts, and of groundwater movements. In addition, the current water quality measurements done under this study were used as comparison with a set of available data provided by the client.

The assessment of the impact on the groundwater considered the abstraction rates of the recovery wells, the possible recharge in the agricultural lands and different scenarios for project implementation. Two scenarios are considered in the current impact assessment 1: without implementation of the recovery scheme and 2: with implementation of the recovery scheme and construction of the new WWTP.

In addition, the impact of the groundwater quality with the implementation of the recovery system discussed three different scenarios, 1: where the 12 recovery wells need to be constructed in year 2013 (according to the design criteria), 2: where the 12 recovery wells need to be constructed but postponed to year 2015 and 3: where the 25 wells need to be constructed to recover the infiltrated water with the maximum capacity of 35,600 m^3 water that is infiltrated to the infiltration ponds.

Please note, the 12 recovery wells are a must to be implemented (with current capacity or full capacity). In addition, according to the designer, 27 wells need to be constructed when the full capacity from NGWWTP is implemented. However, according to the groundwater modeling under this study, 25 wells are sufficient to be implemented instead of 25 wells.

It is important to note that the modeling estimation has a certain degree of uncertainty based on the proposed dispersivity values and could be different according to actual conditions. In this modeling approach the dispersivity values were fairly estimated based on the calibration results using the available monitoring data provided that the amount of leachate and its concentration are determined accurately.

a. Modeling Results without Recovery Scheme

As stated in CEP&FCG, 2010, there were several scenarios recommended. The current study considered the most two realistic scenarios as follows:

1. If the quality of the pumped wastewater from the existing BWWTP was not improved or worsened, then the allowable quantity of water to be infiltrated would be 15,000 m^3/d up to year 2025. This scenario is the pessimistic one (12 recovery wells shall be needed). This scenario is pessimistic from a water quality stand point as the quality of the dumped water is bad and hence the quality of the water in the recovery wells is also bad.
2. If NGEST is implemented in year 2014 (planned year for operation), the quality of the pumped wastewater will be good (NO3-N is 10 mg/l). Then the allowable quantity of partially treated wastewater to be infiltrated with current quality will be 15,000 m^3/d up to year 2014 and 35,600 m^3/d of fully treated wastewater from year 2014 to year 2025. For the increased amount of the water infiltrated, the number of 25 wells shall be needed, not 27 wells.

However, for the two scenarios, the 12 wells are a compulsory requirement for the recovery scheme. When the good quality of the wastewater from the NGWWTP is infiltrated to the infiltration basin, thus the 25 recovery wells are needed to be implemented to recover the infiltrated water. The result of the above mentioned scenarios are discussed in the following section; Modeling result with recovery scheme. The design of the reuse scheme identified that 27 recovery wells need to be implemented. However, based on the assessment on the groundwater quality (4 round data) and current water quality conducted with groundwater modeling run using the most recent water quality, it is concluded that 25 recovery wells are sufficient to capture the infiltrated water to be recovered during the full capacity designed.

Figure 5.5 shows that the pollution extension to a distance of around 600 m (nitrate concentration contour line is 80 mg/l) in the west and North-west direction of the basin in year 2012 where bad quality of water; untreated wastewater; (15,000 m^3/day) is being infiltrated in the basin starting from year 2009. As mentioned previously in Chapter 4, an increase in NO_3 in well Q53 is encountered where the well is around 250 m from the basin.

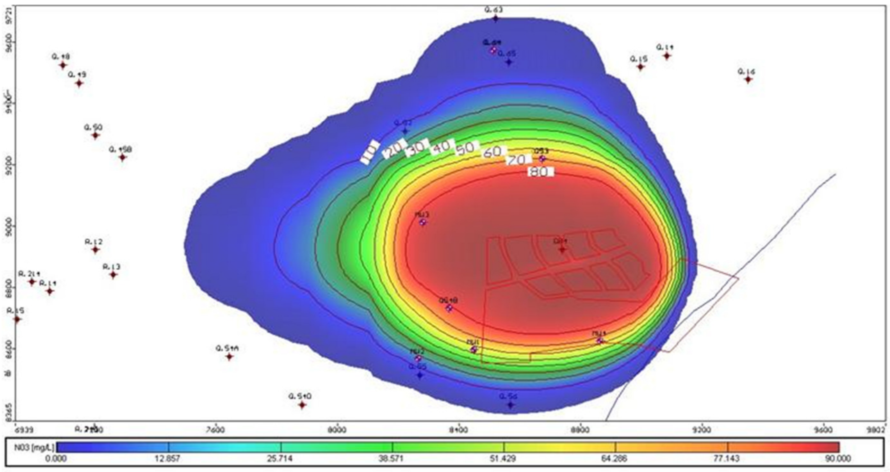


Figure 5.4 the Pollution Plume in Year 2012 (current infiltration, no recovery)

Figure 5.5 shows that the pollution (nitrate concentration will be increased by 80 mg/l) will be extended to a distance of around 500 m in the North-west direction of the basin in year 2015 if bad quality of water; untreated wastewater; (15,000 m^3/day) is infiltrated into the basin starting from year 2009. In addition, around 25 agricultural wells will be negatively influenced. Please note that the fact situation of the 15,000 m^3/day of the infiltrated rate for the infiltration basin is based on the design capacity of the basin. However, the current capacity of the basin is only 8,000 m^3/day.

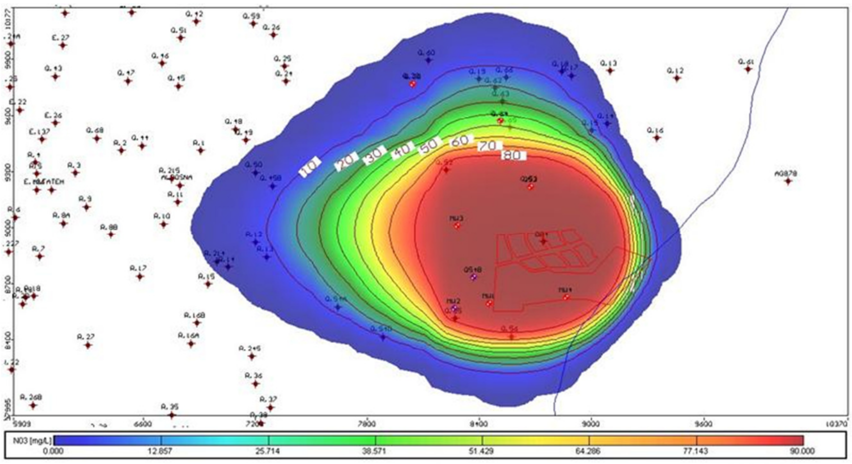


Figure 5.5 the Pollution Plume in Year 2015 (current infiltration, no recovery)

Figure 5.6 shows that pollution plume will be extended to a distance of around 1,200 m (nitrate concentration contour line is 80 mg/l) in the West and the North-West directions of the basin in year 2025 if bad quality of water (untreated wastewater; 35,600 m^3/day) is infiltrated in the basin starting from year 2014. In addition, a high number of agricultural wells and some of municipal wells will be negatively influenced.

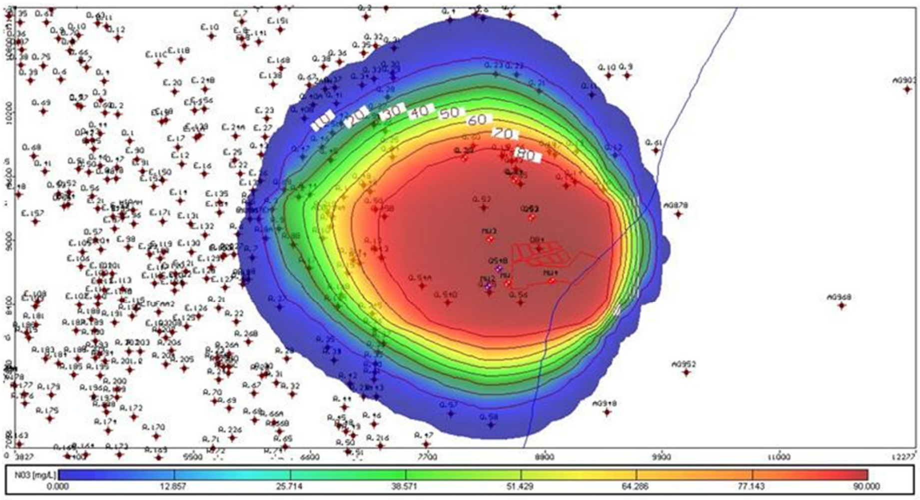


Figure 5.6 the Pollution Plume for Year 2025 if 35,600 m^3/d untreated wastewater is infiltrated starting from 2014

Figure 5.7 shows the groundwater quality expectations (NO_3-N) in year 2015 after the operation of the NGESTP. Concentration of the infiltrated treated wastewater will be 10 mg/l. It can be seen that there will still be polluted zones and some agricultural wells will be affected. Figure 5.8 shows the same scenario for year 2025 where the groundwater quality is highly improved. However, large a polluted zone is still valid in the North-West direction. In this zone municipal and agricultural wells are available.

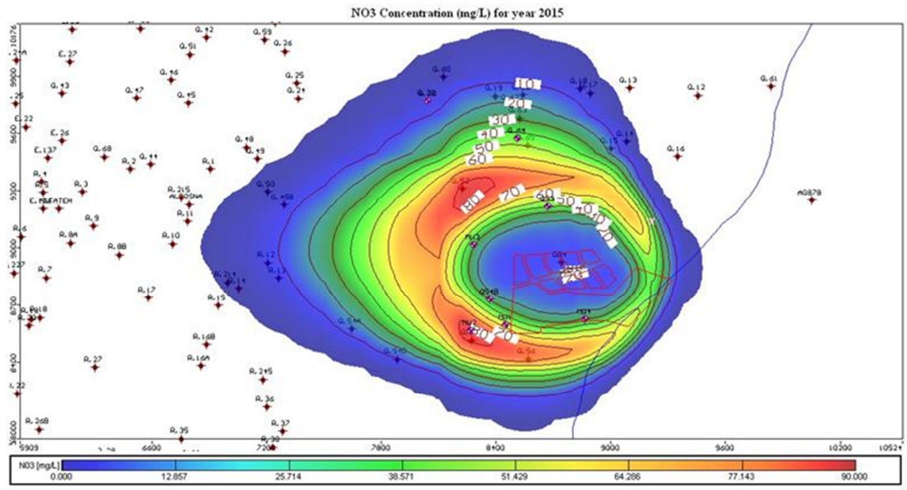


Figure 5.7 the Pollution Plume for Year 2015 if 35,600 m^3/day treated wastewater is infiltrated starting from 2014

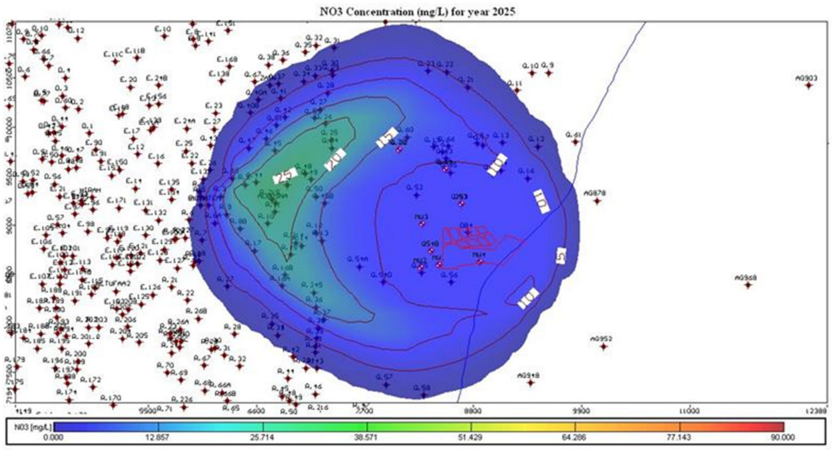


Figure 5.8 the Pollution Plume for Year 2025 if 35,600 m^3/day treated wastewater is infiltrated starting from 2014

b. Modeling Results with Recovery Scheme

For this case three scenarios were considered:

1. As per the design project report (CEP&FCG, 2010) 12 wells were required to recover 16,500 m^3/d; starting from year 2013.
2. If the construction and operation of the 12 wells is postponed to year 2015.
3. If 25 recovery wells that should be drilled around the infiltration basin to recover the infiltrated treated wastewater for 35,600 m^3/d; as infiltrated water, and 39,100 m^3/d as recovered water starting from 2014.

In order to check and specify the location of these wells, Modpath module and MT3D were run under steady state conditions. Figure 5.9 shows the pollution path lines with the operation of 12 recovery wells under a steady state. Figure 5.10 shows infiltrated water that is fully captured by the 12 wells. As mentioned in the design of the report the location of the wells was selected after several runs of the model on the basis that they should be able to capture all pollution. Therefore, the wells will be from the first row and the second row which are concentrated in the direction of flow. The wells will be located in the first row with a distance of 550 m from the infiltration basin and the second row will be around 750 m from the basin. Figure 5.8 shows the pollution plume that is restricted to pass the 12 recovery wells

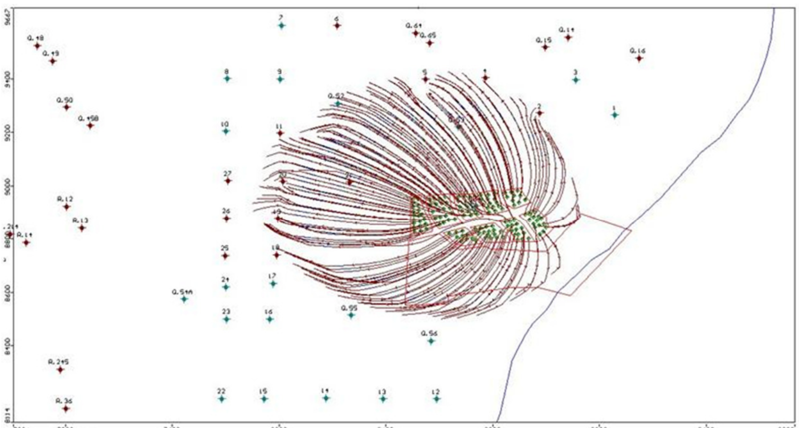


Figure 5.9 Pollution Captured by the 12 Recovery Wells in year 2014

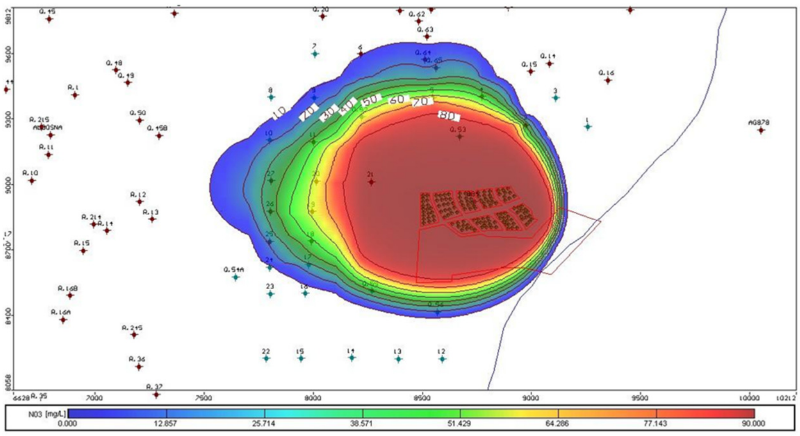


Figure 5.10 Pollution Plume Captured by the 12 Recovery Wells in year 2014

The second scenario concerns the postponing of the operation of the 12 wells to year 2015. Figure 5.11 shows that the pollution plume will be extended to 600 m from the IB. It means many other agricultural wells will be at Risk. If only 12 wells continue for operation, the pollution will be extended to a distance of around 800 in year 2020 as shown in Figure 5.12. The pollution will exceed the recovery wells and it will be difficult to capture the pollution.

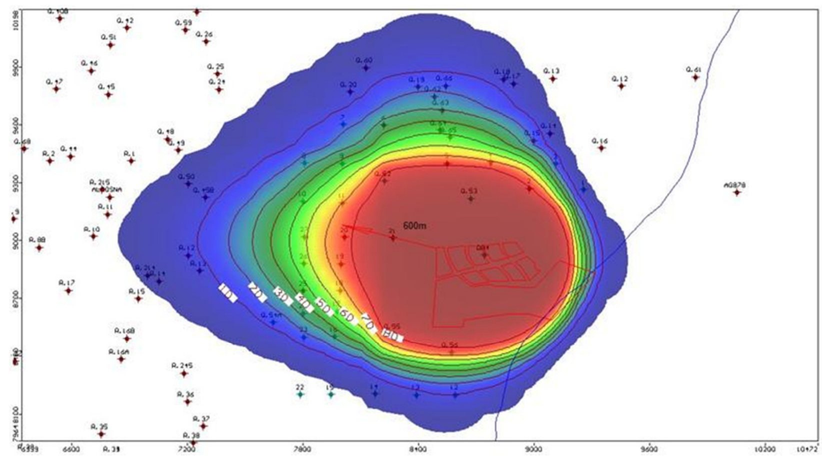


Figure 5.11 Pollution Plume in Year 2015 when Recovery Well Start in Year 2015

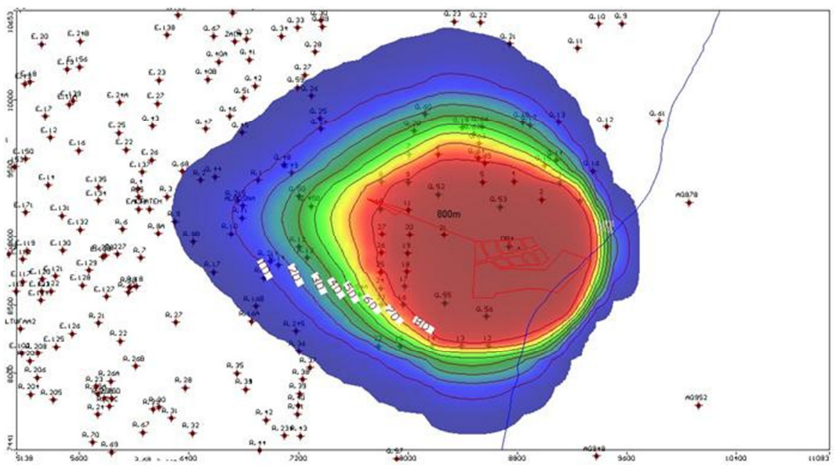


Figure 5.12 Pollution Plume in Year 2020 when Recovery Well Start in Year 2015

In the design report (CEP&FCG, 2010) it was recommended that 27 recovery wells should be drilled around the infiltration basin to recover the infiltrated treated wastewater for 35,600 m^3/d as infiltrated water and 39,100 m^3/d as recovered water starting from 2014. The infiltration quality will be good with a concentration of 10 mg/l. The increment of the recovery will start in 2015. However, during the groundwater modeling run, the 25 wells are already sufficient for successfully capturing the pollution path lines.

Figure 5.13 shows the pollution path lines that could be successfully recovered by 25 wells. As mentioned in the design report the recovery wells are distributed in the first row with a distance equal to 550 m from the basin and in the second row with a distance of 750 m from the basin. Figure 5.14 shows the location of the wells that are optimal since they are selected based on capturing all pollution. Figure 5.14 shows the pollution plume that is restricted to pass the 25 recovery wells.

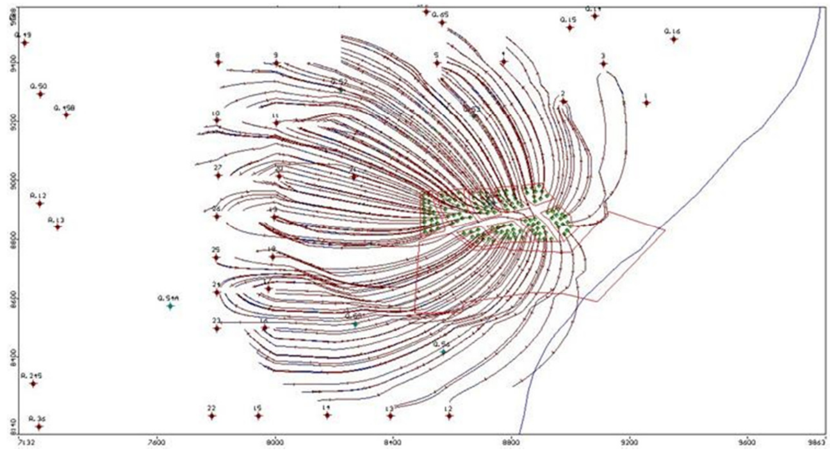


Figure 5.13 Pollution that Captured by the 25 Recovery Wells at 2025

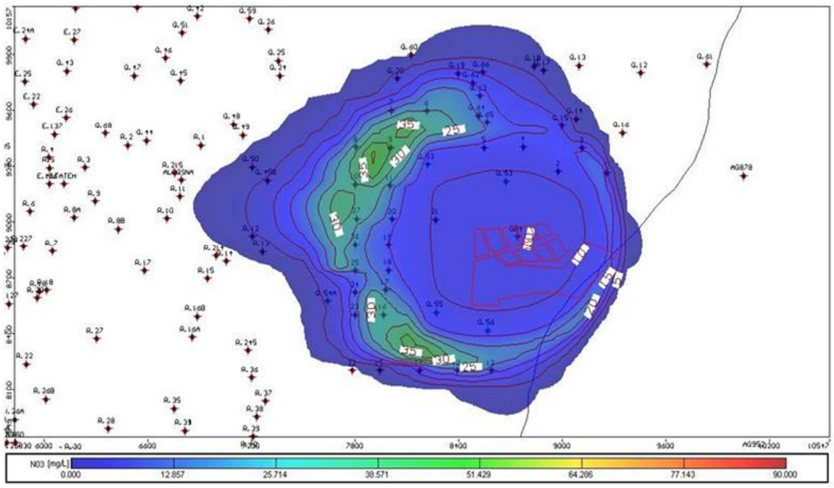


Figure 5.14 Pollution that Captured by the 25 Recovery Wells

Based on the groundwater modeling and analysis, a monitoring plan is developed in the following chapter; Chapter 6, section 6.6 to include the mitigation measures that need to be considered during the operation of the effluent recovery scheme. The monitoring plan includes the provision of the monitoring wells location, monitoring indicators (parameters to be monitored) and monitoring frequency.

5.2.2.5. Impacts on Local Agriculture, Public Health and Water Resources

Based on the design project report three scenarios that consider 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 border. The profiles of the soils in the area are deep enough to cultivate tree crops. Based on crops water requirements, the available reclaimed water (16,500 m^3 daily) is just enough to irrigate 5,375 dunums divided into citrus (1,613 dunums), olives (1,344 dunums), fruit trees (806 dunums), alfalfa (806 dunums) and grains (806 dunums). 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^3 daily. This reclaimed water will be used to irrigate additional land amounting to 7,525 dunums in total. The citrus area will increase to 2,258 dunums; olives to 1,881 dunums, fruits to 1,129 dunums, alfalfa to 1,129 dunums and grains to 1,129 dunums.
- 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 (39,160 m^3/d which equals 35,600 m^3/d plus 10% extra) is expected for unrestricted use as mentioned in the following table, Table 5.3. The quantity of reclaimed water will be enough to irrigate about 12,577 dunums. The citrus area will increase to 3,773 dunums, area for olives to 3,144 dunums, fruit trees to 1,887 dunums and alfalfa and grains each will increase to 1,258 dunums. In this scenario vegetable crops (it is not advisable to plant the uncooked vegetables crops, at least for the first year of implementation; although according to the water quality, the standard is allowed) will be introduced with an area of 1,258 dunums, as it is difficult to convince the farmers to accept the recovered water for cultivation of vegetables (not uncooked vegetables) at the beginning of the project.

During the Public Consultation (scoping phase and the Public Consultation), the governorate is requested to benefit from the recovered water for tree planting along the main street. The agreement between PWA (PMU) can be done prior to the operation of the recovery scheme for the trees plantation for public purposes.

Table 5.4 Criteria Recommended by PWA for Effluent Standards (PS 742, 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 liter	Less than 0.1 ova per liter

Notes:

1. Restricted crops: Cereal crops, industrial crops, fodder crops, crops normally eaten cooked and trees, etc.
2. Unrestricted crops: Crops normally eaten uncooked (vegetables), Sport fields, and parks.

The expected water quality from the recovery wells through the groundwater modeling, as indicated in the previous task, and through reviewing of the water analysis of samples taken from existing monitoring wells is shown in Table 5.4. The parameters presented in the table are the maximum and the minimum values recorded by PWA in year 2012. It is concluded that the groundwater quality is suitable for Unrestricted Use since BOD in the groundwater is less than 30 (as per limit value according to the Palestinian limit for unrestricted groundwater use and F. Coliform and Helminthes Eggs are not available. Only the restriction is for the Total-N which is higher than 15 mg/l; this could be considered as an advantage for agricultural use.

The recovered water will be prohibited for drinking water use since it could have negative impacts on public health and farmers due to the Total-N higher than the drinking water standards that recommends a minimum value of 50 mg/l. In addition, the recovered water might include some other contaminants which are not yet recorded and have negative impacts on public health and farmers.

The expected water quality can be used as unrestrictive crops or vegetables, however, due to the possibility of adverse health impacts and remaining contaminants which are not yet recorded, it is preferable not to be used the water to irrigate the uncooked crops or vegetables.

As indicated above the expected groundwater quality will not have significant number of F Coliform and Helminthes Eggs (not available), the epidemiology constraint of using the recovery water is not expected. However, as a general precaution, the epidemiology mitigation measures are provided and detailed in Annex 8, Public health concern related to using treated wastewater. The impact on the recovered water use for the public health is highly significant; therefore the monitoring plan including the indicators has been developed and presented in detail in the following chapter, Chapter 6

5.2.2.6. Impacts of decommissioning of BLWWTP on Groundwater Quality

After decommissioning the lake and BWWTP, a positive impact will be clearly found on the groundwater quality in the aquifer under the lake. This was found from the analyses of NO_3 concentration in two groundwater wells close to the lake A/180 and A/185. As mentioned in the evaluation of the existing groundwater statues in BWWTP, the NO_3 concentration is around 79 mg/l which indicates an improvement of the groundwater quality after drying the lake.

5.2.2.7. Recovery Water Quantity and Quality

Based on the groundwater modeling and analyses, mentioned in previous sections, the expected recovery water quantity and quality is summarized in Table 5.5. The recovery water quality is expected to be acceptable for agricultural irrigation for unrestricted crops, but unacceptable to be used for drinking water. However, it is recommended not to irrigate the uncooked vegetables at least for the first year.

Table 5.5 Expected Recovery Water Quantity and Quality

Year	Infiltration Quantity (m^3/d)	Recovered Water (m^3/d)	Expected Water Quality			
			BOD (mg/l)	Total-N	F.C	Helminthes Eggs
2009-2014*	15,000	16500	<5	125	Nil	Nil
2014-2025**	35,600	39160	<5	10	Nil	Nil

*resource: analytical results (grab and composite) sample result of wastewater effluent from BLWWTP and NGWWTP
**the Criteria Recommended by PWA for Effluent Standards (PS742, 2003) as provided in Table 5.3

Beside the recovery water quality and quantity, it is also important to identify the dumped water quality and quantity at different phases or periods, similar to the recovery water, the phases are divided into two; 2009-2014 when the effluent recovery scheme is not yet implemented and during 2014-2025 when the effluent recovery is under operation. Table 5.6 below presents the quality and quantity of dumped water at different phases.

Table 5.6 Quantity and Quality of Dumped Water

Year	Dumped Quantity (m3/d)	Water Quality			
		BOD (mg/l)	Total-N	F.C	Helminthes Eggs
2009-2014*	15,000	90	91.6	>1000	Nil
2014-2025**	35,600	20	10-15	<200	<1

*resource: analytical results (grab and composite) sample result of wastewater effluent from BLWWTP and NGWWTP
**the Criteria Recommended by PWA for Effluent Standards (PS742, 2003) as provided in Table 5.3

As is shown in Table 5.5 and Table 5.6, the recovered water quality is expected to be acceptable for agricultural irrigation for unrestricted crops, but unacceptable to be used as drinking water. However, it is advisable both by EQA and the Consultant not to introduce the recovered water for the uncooked or raw eaten vegetables for the first year.

As is indicated in Chapter 3, the recovery and reuse system might trigger WB OP 7.50 related to International Waterways. Although the NGWWTP is located nearby the Israeli border, due to the topographical nature of the area; the treatment plant and the infiltration basins, the risk of the flood will not cross the fence to the Israeli site.

In addition, as a result of the groundwater modeling (from different scenarios), it was shown that the plume will slightly cross the Israeli border (at the nearby the NGESTP site). However, this crossing is unlikely to happen as the infiltration basins are located more than 300 m downstream of the border. Finally, with the implementation of the NGEST in year 2014 and the recovery wells in year 2013, this possibility will not take place as the groundwater modeling result demonstrated that the recovery wells will accelerate the flow; in the downstream direction away from the Israeli border.

It is worth noting, that the implementation of the 12 recovery wells shall be done and operated before the year of 2015. As it is demonstrated in the groundwater modeling, the pollution will not be captured by the recovery wells and might affect the existing wells. Therefore, the measures or the correction measures to avoid the spread of the pollution plume cross the boundary (including the Israeli border) is the implementation of the 12 recovery wells and operate before 2015.

5.2.2.8. Land Use of remediated Effluent Lake and Decommission of Beit Lahia Wastewater Treatment Plant (BLWWTP

During the operation of the remediated Effluent Lake, it is proposed that in one year the remediation activities will be finalized. Afterwards, the remediated effluent lake can be used for agricultural purposes or as a residential area, depending on the Urban Planning of the area.

At a nearby location, a new landfill will be built to replace the existing landfill (Johr Eldeek site). The excavation of the landfill will generate a huge volume of soil. Based on sampling analysis results, the good excavated soil can be transported for filling the site and used for agricultural purposes, if needed. If the site will be used as a residential area, the soil can still be transported to the site for filling and leveling.

After the completion of the remediation works, depending on the urban planning of the area and the future plan of Ministry El Awqaf, the land use of the effluent lake will be mitigated. Based on the soil assessment prior to the completion of the remediation works, there are two options of land use which can be applied:

5. Option 1 to be used as agricultural land. Although the area will not need additional filling or leveling, but due to the huge amount of the soil excavated at the nearby landfill site (Johr Eldeek) that will be implemented during 2018, if needed, the excavated soil can be transported to the effluent lake site as far as the soil is considered good. However, the quality of the soil has to be determined (soil analysis done at the landfill site, by the landfill management), before transporting it to another area.
   The agreement between the Ministry of Awqaf and the Land Authority or the Ministry of Economic and Land Authority in addition to the agreement of the Landfill management shall be reached prior to transferring the soil to the effluent lake. According to the capacity analysis during the EA of NGESTP, a maximum of 1.5 million m^3 of soil can be transferred to fill the effluent lake
6. Option 2 to be used for residential purposes. Additional soil for leveling and soil conditioning if needed at the effluent lake site when the urban planning of the area is dedicated for a residential area. The soil analysis will not be as crucial as in option 1 and the agreement shall be reached only between the Ministry El Awqaf and the Ministry of Economic and Land Authority in addition to the agreement of the landfill management.

To transport the huge amount of soil to the effluent lake, if needed, the route of the trucks is proposed on the Figure 5.15, using the existing main roads.

Figure 5.15 Proposed Route to Transport the Soil from Johr Eldeek Landfill to Effluent Lake Adjacent to BLWWTP (if needed)

Backfilling of the decommissioning of the ponds at BLWWTP, if needed, would use the soil transported from the excavation of the closest landfill (Johr Eldeek) is found feasible.

Due to the remaining pond # 7, the mitigation measures have to be developed to minimize the impacts due to the operation of pond # 7. Based on the land use impacts, the land use and accessibility of the decommissioning land is of "medium" significance.

Mitigation measures developed to reduce the impacts are:

1. Fences surrounding pond # 7 have to be constructed to reduce the accessibility of the community to the pond area.
   During the Public consultation, Beit Lahia Mayor announced that there is a budget to be allocated to build the permanent fence around pond #7. The agreement between PWA and Beit Lahia Municipality can be reached with regards to the construction procedures.
2. There should be between 10-15 m distance between the pond area and the fences to be constructed.
3. The trees shall be planted nearby the fences, in order to reduce the odor or nuisance and separate the pond site from the surrounding neighboring area and future land use of the other decommissioning ponds. Planted trees will also bring positive impact on the visual impact.
4. The site is only connected to one main gate and the access road to the neighboring site. In addition the pond site should be connected with the pumping station at the vicinity for ease of access.

5.2.2.9. Public Health related to Using Recovery Water for Irrigation

The measures and the analysis of the impact, as detailed in Annex 8, is based on the comparison of the different standards and procedures of the treated wastewater reuse standard in Jordan, Egypt and Israel, besides the International (WHO and FAO) guidelines. In addition, the analysis of the treated wastewater reuse was assessed based on the Egyptian laws, guidelines and practices of treated wastewater reuse.

Health protection measures (general measures) which can be applied to the agricultural use of treated water include the following, either separately or in combination (NAWQAM, 2004):

- Crop restriction
- Human exposure control and promotion of hygiene
- Contamination of Reuse of treated wastewater for irrigation
- Treatment of drainage water

Based on the characteristic of the recovered water, the treatment of drainage water is not considered and will not be discussed in this ESIA report.

a. 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:

- an irrigation project has a strong central management;
- there is adequate demand for the crops allowed under crop restriction, and they fetch a reasonable price;
- 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.

b. Human Exposure Control

The objective of this approach is to prevent the population groups at risk from coming into direct contact with pathogens in the wastewater or to prevent any contact with pathogens leading to disease. Four groups are at risk in agricultural use of marginal quality water (NAWQAM, 2004):

- agricultural workers and their families
- crop handlers
- consumers of crops, meat and milk
- those living near the areas irrigated with marginal quality water

Control measures aimed at protecting agricultural field workers and crop handlers include:

- The provision (and insistence on wearing) of protective clothing, the maintenance of high levels of hygiene and immunization against (or chemotherapeutic control) selected infections.
- Risks to consumers can be reduced through cooking the agricultural products before consumption and by high standards of food hygiene, which should be emphasized in the health education associated with irrigation schemes.
- Local residents should be kept fully informed on the use of recovered water in agriculture so that they, and their children, can avoid these areas.
- Special care must always be taken to ensure that agricultural workers or the public do not use irrigation water for drinking or domestic purposes by accident or for lack of an alternative.

All measures should be coordinated with the awareness campaign of using treated wastewater and pilot projects of using treated wastewater for irrigation. According to the clarification from the PWA team responsible for the effluent reuse study and pilot projects in Gaza, currently, there are ongoing projects related to the awareness and the pilot projects, i.e. awareness workshops carried out for farmers, operators and managers of recovered wastewater and more awareness will be carried out during the operationalization of the pilot projects.

Concerning the epidemiology due to the reuse of the recovered water and sludge reuse for irrigation and soil at the irrigated land, based on the expected water quality, there will be no bacteria, viruses and other related pathogens that lead to the waterborne diseases, i.e. cholera, hookworm, diarrheal diseases or other helminthic infections is not feasible. However, 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 a patient with symptoms 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.

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.

c. Contamination from Reuse of Recovered Water in Irrigation

This section pays attention to highlighting the potential contamination of reusing recovered water in irrigation. The discussion was based on scientific background information (according to the research paper presented in the fourth environmental conference in Yemen, by Ahmed Gadallah Aboud, May 2008) and the data collected (from potential customers (consumers and traders) and the farmers). The reuse of recovered water might result in the following impacts on health:

- The previous literature showed that the untreated 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 people of younger ages.
- Those who do the maintenance for irrigation systems might get infected. Irrigation systems play a role in the magnitude of impact of the recovery water (Sprinkle Irrigation Systems have worse repetition than Flood and Furrowing irrigation systems). However, localized irrigation systems like bubbler and drip irrigation are of better impact due to the limitation of hazards on the worker's 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.

Moreover, the awareness and workshops related to the practices of using the treated wastewater as well as the crops restrictions and other subjects related to the workers restriction and protections have to be considered during the operation of the reuse scheme.

5.2.2.10. Contamination from Reuse and Disposal of Sludge

If the sewage sludge fails to meet Rule 503 Class- A on sludge use requirements, it will pose hazardous health and environmental impacts if applied to the lands for agricultural use since it contains toxic metals and pathogenic microorganisms. The potential contamination will affect soil, air, groundwater and crops. Moreover, this contamination will in turn pose serious disease risks to humans (farmers, crop consumers, sludge transporters, etc.) and to farm animals (cows, sheep, birds, etc.).

Sludge contains heavy metals like arsenic, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, and zinc. These metals are persistent (i.e., they do not break down in the environment and therefore build up over time). Most heavy metals remain in the soil for long periods of time, ranging from several decades to many centuries. The heavy metals in land spread sludge therefore become permanent additions to the total quantity in the soil (Aktar & Sengupta, 2008).

High levels of arsenic in food or water can be fatal. Cadmium, chromium, nickel, and selenium have been linked to cancer. Cadmium has also been linked to kidney problems, miscarriages, and stillbirths. Copper, nickel, and zinc are known to cause growth problems in crops. Children exposed to Lead can develop behavioral and learning problems. Mercury exposure at key moments in fatal development can cause learning disabilities and neurological disorders. Molybdenum bio-accumulates in grass eating livestock; ingested in excess, it can cause anaemia, diarrhoea, and growth problem (Aktar&Sengupta, 2008).

These metals can be taken up by the plants that are grown on sludge and re-enter the human food chain via livestock feed. These metals can also leach into groundwater. Highly acidic soils can exacerbate heavy metal leaching.

Sludge contains human pathogens: germs such as bacteria, viruses, and parasites. Whereas exposure to heavy metals can cause problems over time, exposure to these germs is more acute and can cause health problems almost immediately. Because of the extremely large numbers of pathogens, it is impossible to test sludge for all types of pathogens. Some common pathogens in sludge include the bacteria E-coli and Salmonella, the virus Hepatitis A, and parasitic worms.

Humans can be exposed to sludge pathogens in a number of ways. They might consume vegetables that have pathogens on them and children might accidentally gain access to a sludge field and become exposed to the germs. A principal route for transport of pathogens is through vector transmission. Vectors are any living organism capable of transmitting a pathogen from one organism to another either mechanically (by simply transporting the pathogen) or biologically by playing a specific role in the life cycle of the pathogen. Vectors for sewage sludge pathogens would most likely include insects, rodents, birds, cats and dogs.

Sludge not meeting Class-A requirements will also contaminate air by releasing odorous gases into the air. Bad odor will be produced due to the incomplete stabilization of the sludge in the treatment plant since anaerobic digestion continues to occur during sludge storage, transport, and spreading on land.

Contamination may also occur during transportation of sludge from the storage facility at the NGESTP to the farms for agricultural use or for disposal to landfills if sludge is spilled along the transport route. Contamination may reach to soil, air, crops and water resources along the route.

If for some reason the sludge fails to meet Class-A requirements, it will be disposed of in a landfill. The most probable impact is high concentration of pathogens (over 1000 cells/100 ml). High concentrations of heavy metals (higher than those in Class- A standards are not expected as verified by the sludge analysis results). In this case the sludge transporters and the workers in the landfill may be at risk of infection if they come in direct contact with this sludge.

After the sludge treatment technology in the NGWWTP (thickening, anaerobic digestion, mechanical dewatering, and 100 days storage), and accounting for the typically low content of heavy metals in North Gaza sewage sludge as detected by lab analysis, it is predicted that the produced sludge will meet Rule 503 Class-A of sludge use. However, care should be taken under emergency cases when the treatment plant fails to achieve the required sludge quality by following the mitigation measures illustrated hereafter.

Concerning the reuse of the recovered water and the reuse of the sludge at the same area proposed, according to the groundwater analysis and current measurement, the recovered water does not contain any possible health risk as well as heavy metal that could have a significant effect on crops. In addition, based on the sludge analysis and the treatment technology at NGWWTP and low content of heavy metal found, the sludge is already stabilized and predicted to meet the Class A rules for sludge reuse.

However, the importance parameter for recovered water is the pH and for the sludge; the stability of the sludge has to be ensured. Using the combination of the recovered water and the sludge are not expected to have high significant negative impacts on crop and soil. In addition, with the sludge reuse implementation schedule and monitoring plan and the groundwater monitoring plan implemented during the operation phase, the impact associated is considered low. The importance of the monitoring plan for sludge and recovered water are highly significant. Accordingly, with the possibility of lack of enforcement, the trained qualified personnel for management and monitoring plan has to be taken into consideration. The good management monitoring practice, documentations and reporting has to be well defined and prepared accordingly.

Proposed mitigation measures to reduce the significant impact due to sludge reuse include:

1. Adhering to the requirements of Rule 503 Class A sludge and the sludge treatment levels. Sludge not meeting these requirements should not be used for agricultural purposes and should be disposed to landfills.
2. As a protection measure in this project, to avoid the sludge application for vegetables that are eaten uncooked despite the fact that Rule 503 Class A sludge allows sludge application for all types of vegetables.
3. Adhering to the monitoring and testing requirements
4. Adhering to the requirements of vector attraction minimization. If the sludge does not meet the Class-A requirements especially with respect to pathogen concentration it should be mixed with lime (the same way that floating sludge is treated) and disposed to landfills to minimize the pathogen concentration.
5. Training and guidance for farmers and sludge transporters regarding healthy handling and usage of sludge in agriculture. Sludge application requires detailed instructions to the user and education of the consumer. Some of the precautions to protect farmers are to wear suitable clothes, gloves and boots; washing before eating; and using a facemask if the sludge is dusty.
6. Vehicles should be carefully selected for their local suitability and transport routes chosen so as to minimize inconvenience to the public. Movement of sludge by trucks from the sewage treatment plant to agricultural land or to landfills can create traffic problems and give rise to noise and odor nuisances. Special care must be ensured to prevent vehicles carrying mud onto the highway.
7. Enclosed trucks should be used for transporting treated sludge to prevent sludge spill and to avoid any Odor release.
8. Sludge storage on farms can optimize the transport and application operations but every effort must be made to ensure that storage facilities are secure.
9. Appropriate use of land by controlling rates of sludge application, nutrients addition, crop types, waiting periods, and sowing and harvesting constraints.
10. Keeping good communication between customer, regulator, public and stakeholders including landowners and retailers.

As the expected amount of contaminated sludge is not expected to be large enough to be transported to the landfill, the impact is considered of medium significance. As the capacity is considered small (only around maximum of 1-2% of the sludge generated) the agreement shall be reached only between PMU (as the responsible entity for sludge monitoring at the NGWWTP) and the landfill management (Join Council Committee).

The mitigation measures to be implemented besides monitoring the sludge quality at the laboratory of NGWWTP, the route of the transported sludge shall be defined to avoid the traffic disturbance. The route proposed for transportation of the contaminated sludge from NGWWTP to the closest and better capacity, Johr Eldeek is presented in figure 5.14.

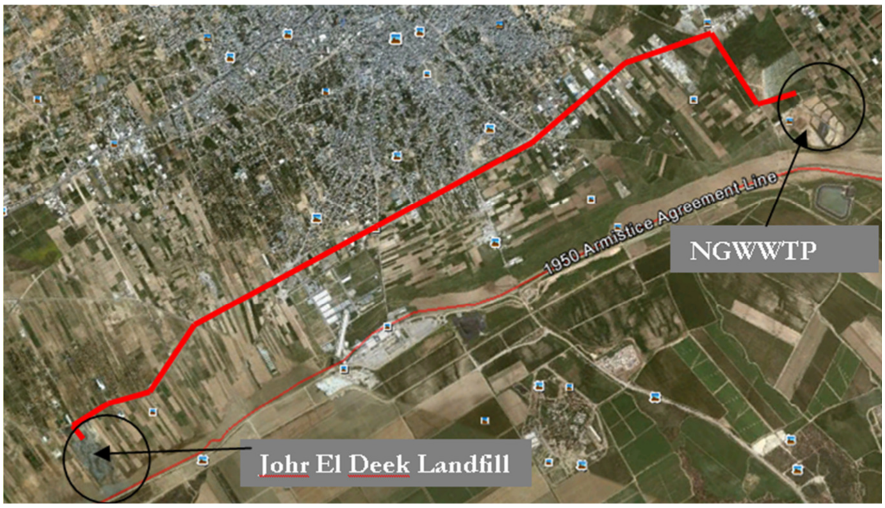


Figure 5.14 Proposed Route for Transporting Contaminated Sludge from NGWWTP to Johr Eldeek Landfill

The following table presents the summary of potential impacts and their mitigation measures.

Table 5.6 Assessment of Significance of Expected Environmental Impacts during Operation Phase

Impact	(+/-)	Likelihood and Severity	Significant	Mitigation Measures Effects
Decommissioning of BLWWTP				
Ambient Air quality and Noise Pollution	+	Positive likelihood for decommissioning of the BLWWTP	Positive permanent impact of high significance	Standard protection of the workers of existing PS sites.
Odor	-	Medium likelihood for the pond # 7	Negative impact of medium significant for the remaining pond # 7 site	Minimize the impacts by maintaining aerobic performance of the pond and limit retention time for max 2 -3 days
Vibration	-	no significant impact	No significant impacts as the land will be handle over to El Awqaf	No mitigation is developed
Groundwater quality	+	Positive likelihood	Positive permanent and long term impact due to due to the reduce infiltrated partially treated wastewater into the groundwater	No mitigation is developed
Land use	- / +	Negative likelihood impact and permanent Positive likelihood due to increasing land availability	Medium negative impact due to the remaining pond #7 Positive permanent impact due to land availability	Minimize the impacts by securing the site of pond #7 with fences, limited access, trees plantation surrounding the fences and keep distance between the pond and the access and fences
Remediation of the Effluent Lake				
No significant impacts related to the after remediation phase as the land will be handle over to the Ministry of Awqaf. The impact will depend on the future plan or proposed use of the land proposed by the owner (Ministry of Awqaf). However the handover of the lake will bring positive permanent impact as the land availability is increase				

Impact	(+/-)	Likelihood and Severity	Significant	Mitigation Measures Effects
Effluent Recovery Reuse Scheme				
Recovered Water Reuse				
Water resource contamination	- / +	Medium likelihood	Combination of positive and negative impact of moderate significance	Reduce the severity of the impact by implementing the monitoring, operation and maintenance of the wells as specified in the monitoring plan
Impact on Local Agriculture, Public Health and irrigation	-	Medium to High likelihood	Negative impact of moderate to high significance	Reduce the severity of the impact by implementing scenarios for different crop identification and not to use it as drinking water or irrigation for uncooked vegetables (at least for the first year) Awareness and campaign for recovery reuse system
Recovery water quantity and quality	- / +	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
Public health concern related to the recovery water reuse	-	Medium likelihood of negative impacts	Negative impact of low to medium significance	Reduce the severity of the impact by implementing the monitoring plan, awareness and workshops for farmers related to treated wastewater, standard procedure, method of crop selection and crop irrigation system, etc.

Impact	(+/-)	Likelihood and Severity	Significant	Mitigation Measures Effects
Contamination of the sludge reuse	-	Medium likelihood for negative impacts	Negative impact of moderate significance and permanent	Reduce the severity of the impact
Contamination of the sludge reuse	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact by implementing the monitoring plan, disposal to the landfill when the standard is not achieved and the sludge application limitation, vehicles selection In addition, training and awareness for the farmers for sludge reuse

5.3. Socio-economic Impacts and Their Mitigation Measures

The analysis of social impacts for any developmental project is the core process to address the factors which might work for the benefit or against the project. This discussion relied upon previous ESIA reports for BLWWTP and NGESTP. The combination of the previous studies and the current one enriched the data presented in this report. The various types of socio-economic impacts are discussed in the following sections.

5.3.1. Type of Impact According to Project Components

The project is expected to have four main components with the following rationale:

1. Decommission BLWWTP and adequately develop the site for subsequent use, after the operation of NGWWTP, expected in 2013.
2. Remediate the land of the evacuated effluent lake at BLWWTP and use the land as a location for a suitable development project;
3. Pumping out quantities of the infiltrated partially treated effluent from the groundwater to avoid potential long term irreversible impacts to the groundwater and surrounding areas;
4. Reuse the abstracted water from the groundwater in irrigation according to sound environmental and public health practices;
   The impacts will be discussed as follows:
   - Type of Impact According to Its Main Theme
   - Type of Impact According to Its Nature
   - Type of Impact According to Hosting Communities
   - Impact According to Time of Occurrence

5.3.2. Area Descriptions

The discussion of impacts necessitates a brief description of the project areas in Beit Lahia and Jabalia, provided in the following sections.

<u>Beit Lahia</u>

The existing wastewater treatment plant is located in the Beit Lahia area in the Northern Gaza Strip, characterized by being dependent mainly on agriculture with some small industries.

<u>NGWWTP Site</u>

The project area is located east of Jabalia, neighboring the Shuhada Cemetery. This is an area that has not been significantly used for any economic activities in the past. However, its proximity to the Cemetery might have some social consequences if used for wastewater treatment.

5.3.2.1. Socio-economic Impact for Decommissioning of BLWWTP

The current wastewater treatment plant is located in Beit Lahia and serves the residents of Beit Lahia, Beit Hanoun, Jabalia, and Um Al Nasr. Due to the increasing transfer of sewage from newly connected areas to this WWTP, effluent has been flooding the surrounding areas.

The size of the area of the BLWWTP is around 140 dunums. The soil of the plant site and the adjacent area is mainly sand without a marked profile. Textures in the top few meters are usually uniform (sedimentary sandy soil), consisting of fine to medium quartz sand with a low water-holding capacity. From Part A on all wastewater from the old site will be collected and pumped directly to the new NGWWTP. Only Pond No. 7 will be left as an emergency retention basin.

The following tables illustrate the potential impacts of the decommissioning of Beit Lahia treatment plant (Table 5.7 and Table 5.8 for positive impacts and negative impacts respectively).

Table 5.7 Positive socio-economic impacts of decommissioning of BLWWTP

Potential positive impact	Type of impact	Description
The potential change in source of income through having new lands	Permanent	The lowering of the water level reduces the risk for a breaking of the sand dams and the consequent flooding of living quarters and agricultural land. When the lake has dried completely and has been rehabilitated the health situation for the local residents will have improved significantly. Transferring treated wastewater from the BeitLahia WWTP will provide additional land due to the removal of the effluent lake. This land can in the short term be used for recreational purpose but may also be suitable for construction of new residential projects. When the soil of the lake bottom has achieved an advantageous soil structure, due to the natural rehabilitation, it could be either used as green land or also for agricultural purposes, because it is rich in nutrients and it is not necessary to use huge amounts of chemical fertilizers there. The prices of the surrounding lands might be increased due to the close of the TP. The farmers will use the recovery water or partially treated water to increase their income "*We will rely upon Pond 7 in order to gain money, the farmers will lose money if they relied upon municipality water only*" reported a farmer in Um El Nasser Village
Impact on health status and health seeking behaviors	Permanent	The removal of the effluent pond will have a positive health impact, as this will reduce risks of diseases. Not only that, the accidents took place in 2007 affected the psychological conditions of people "Now *the situation is better but after the decommissioning it will be much better*" reported a farmer in Beit Lahia. Therefore the decommissioning will stop any potential flooding.
Enhancement of the underground water quality	Permanent	The quality of water was better before BLWWTP, and then it was completely polluted. After decommissioning of the TP, the underground water will be enhanced "We *used to drink water from our wells laying less than 500 m² from the TP but after having the TP it was complete catastrophe for us as the drinking water got contaminated. We don't do measurements but we rely upon the smell and colour of water to make sure if it is potable or not*" reported a farmer in Ezbt Abd Rabouh.
Religious relief	Permanent	For some of the sample surveyed, they felt relaxed as their religious beliefs stated the potential hazards of recovery water.

Table 5.8 Negative socioeconomic impacts of decommissioned treatment in Beit Lahia

Potential negative impact	Type of impact	Description
The potential change in source of income	Permanent	Based on the FGD conducted in Beit Lahia, the farmers noted that they rely upon sewage water to irrigate their lands as this might reduce the cost of using water. The decommissioning of the WWTP will cause a reduction in water and increase the cost of watering their fields
Job availability	Permanent	There will be no job reduction due to the decommissioning as the employee will continue working
Impact on health status and health seeking behaviors	Permanent	The present situation constitutes a permanent risk for human health because: - The open wastewater bodies (WWTP ponds and the lake) are not fenced and allow direct access and dangerous for children. A week before the study implementation a child fell dead in the dried pond which still contain the sludge forming a surface that child thinks he might walk on. There is an increasing risk that the sand dams holding back 1.5 million m^3 of partly treated wastewater may breaking the neighboring settlement areas of Beit Lahia may be flooded. A flooding most probably causes casualties (drowning, collapse of houses) and indirect dangers for human health - The unfenced WWTP bears a high infection risk. - Open, polluted water bodies are potential breeding grounds for pathogen vectors like mosquitoes.
Disruption for community	Temporary	The wastewater pipe will mainly follow roads connecting the existing and the proposed site. The construction of the pipeline might temporarily cause some disruptions The construction of the carrier pipe will have some negative impact due to noise and obstruction of traffic and use of agricultural land during the construction stages but these are minimal negative impacts compared to the positive impacts discussed above.
Impact on land use	Permanent	There will be possibility to reduce the prices of lands adjacent to Pond #7, as neighboring lands suffer due to the pond form mosquitoes, odor. Based on the FGDs and in-depth interviews conducted in the area as well as the comments raised during the second public consultation, the farmers noted that they have already purchased their lands for 25.000 $ /dunum (10 years ago) now it worth 75.000 $ in similar areas. The buyers offer to buy the lands adjacent pond 7 for only 25.000 $. The land owners were not satisfied with that. They reported that there should be a mechanism to limit the odor, mosquitoes resulted from the pond
Impact on health status and lives of surrounding population	Permanent	The effluent lake will continue to cause high risk on human life till it is completely dry. During the drying process, the partly filled lake with steep sand dams and the deep sludge at the bottom of the lake will be a potential danger for anybody who falls into the lake. In the dry season playing children may break through dry crusts over deep sludge. It may be very difficult to rescue them.

5.3.2.2. Socio-economic Impact of Remaining Pond #7 as an emergency pond.

Besides the new pumping station, the inlet works, the infiltration and the emergency Basin No. 7, all existing technical structures will be dismantled. In a worst-case scenario, when the wastewater cannot be pumped to the NGWWTP - for whatever reasons - Pond # 7 will be used as an emergency basin. The retention volume of Basin No. 7 is about 180,000 m^3. With a daily inflow of about 26,500 m^3 in 2008 the maximum retention time would be 6.5 days.

In 2015, at a daily inflow of 45,000 m^3 the maximum retention time would be reduced to four days. In 2025 (completion of NGESTP) the daily inflow volume is estimated at 65,000 m^3 and the maximum retention time would be 2.8 days. It is quite risky to rely on these short retention times. If there are substantial problems at the new plant site or a severe damage of the pipeline, maybe due to military activities, there is the possibility that repair works would take more time.

When the completed NGESTP starts to operate in 2013, all the raw wastewater will be transferred out from the old BLWWTP. After screening and sedimentation, which will be done in an almost closed system with biological gas filters, no significant odor problems must be expected under normal operation conditions. In emergency cases pond No. 7 will be used as a retention basin for wastewater.

Following tables (table 5.9 and table 5.10) illustrate the positive and negative impacts, respectively, for remaining Pond #7 as an emergency pond (BLWWTP).

Table 5.9 Positive Socioeconomic Impacts of Remaining Pond# 7 as an Emergency Pond

Potential positive impact	Type of impact	Description
1. The potential impact on livelihood status	Permanent	The retention capacity for this basin in 2013 would be sufficient to store all incoming wastewater for slightly more than 6 days. This will work for not affecting the livelihood of people during emergency status However, as it is mitigated at the environmental section, although the pond can accommodate the all wastewater capacity, but it is mitigated to maintain aerobic condition of the pond, maximum of 2 days retention time shall be allowed for the wastewater to be store untreated. Having this pond will not affect the provision of partially treated water to the farmers in the adjacent area. Thus the income of farmers will not change
2. Job availability	Permanent	The same job opportunities available now will be remained and not affected

Table 5.10 Negative Socioeconomic Impacts of Remaining Pond# 7 as an Emergency Pond

Potential negative impact	Type of impact	Description
1. The potential change in source of income	Permanent	The pond might result in minor unfavorable impact on the surrounding areas due to the impact on the prices of lands in the adjacent areas. As the prices might be reduced to having such pond. Not only the prices of lands but also the prices of residential houses and shops
2. Access to basic services and utilities	Permanent	The pond puts limitations on access to services and utilities, particularly, in case of not constructing the fence to keep children away from the pond. Families will not feel comfortable to leave their children unwatched close to the pond
3. Impact on health status	Permanent	Due to the unfavorable odor, mesquites and flies might affect the health of the adjacent communities. Allergic people might suffer due to the flies
4. Impact on land use	Permanent	The use of lands might be limited due to the pond as having recreational activities; especially in case of not having a fence that surrounds the pond. The construction of residential compounds in decommission area will be limited due to the existence of the pond.

5.3.2.3. Socio-economic Impact for Infiltration Pond adjacent to NGWWTP

The total area of the overall NGWWTP (including infiltration ponds) is around 300 dunums located east of Jabalia Town adjacent to the eastern border with Israel. The North western boundary is adjacent to the Shuhada Cemetery.

The soil cover of the proposed new WWTP site is dark brown loamy clay of 7-23 m^2 in depth with a well-developed structure laying over marine Kurkar Formation (Calcareous sandstone).

The site selected was used for the cultivation of grain crops, which is considered to be rain-fed agriculture. Farming practices have modified the natural soil and increased organic matter content and nutrient levels. The site is far away from industrial sites and landfill areas and therefore there are no direct or indirect impacts from those areas. The tables below (Table 5.11 and table 5.12) illustrate the positive and negative impacts, respectively, of the establishment of the infiltration pond (NGWWTP). Although the treatment plant is under construction and the infiltration pond is already in operation, but the impact to the communities are assessed

Table 5.11.Positive Socioeconomic Impacts of Infiltration Pond Adjacent to NGWWTP

Potential positive impact	Type of impact	Description
Enhancement of water quality	Permanent	As soon as the completed WWTP starts its operation in 2013 the infiltration of a high quality effluent in the infiltration ponds will begin to compensate the negative effects on groundwater. In the long term (15 to 20 years) the infiltration of fully treated wastewater with a high effluent quality will improve the ground water quality in the whole area. From an environmental point of view it would be useful to irrigate at least a part of the treated wastewater effluent in agricultural areas and to use treated sludge, especially composted sludge, as a fertilizer.
The potential change in source of income	Permanent	A positive social effect is that the proposed site is far from any neighborhoods, thus will cause the least disruption to the quality of life of local residents. The provision of good quality water (treated wastewater) will reduce the cost of water needed for irrigation in the area. Sludge is one of the outputs of the project that will increase income for those who work in sludge trading
Job availability	Permanent	The construction of the new site will have positive economic effects through employment generation and use of Palestinian contractors for construction activities. The construction phase had positive effects on employment. During the construction phase, services of local subcontractors will be used which will generate job opportunities for skilled and unskilled workers in addition to professional services of engineers and others. The majority of workers are from the adjacent areas which suffer from high unemployment rate. They were up to 200 workers in the site (construction, plastering, and digging). The workers are temporary labourers. They work during the construction phase. In addition, some fixed employment opportunities were created to maintain the new site.
Access to basic services and utilities	Permanent	The construction of the site and the carrier line will improve the road network connecting the existing and the emergency area.
Impact on health status and health seeking behaviors	Permanent	The removal of the ponds will lead to a great social and health improvement as this will reduce health risks and provide a better and cleaner living environment for people in the old area BeitLahia but for the new area the impact is different.
Impact on land use	Permanent	Pumping of wastewater from Beit Lahia to the new NGWWTP will make new lands available due after rehabilitation of the lake and the WWTP area. The new empty areas can be used, if no sanitary and health hazards exist for commercial, agricultural and residential purposes.

Table 5.12 Negative socioeconomic impacts of Infiltration Pond Adjacent to NGWWTP

Potential negative impact	Type of impact	Description
Access to basic services and utilities	Permanent	The construction of the pond near the Shuhada Cemetery will cause some discomfort to the families of the deceased during the burial ceremonies. Odor and mosquitoes can be a problem if not properly mitigated for. A long-term impact for the construction of the new affluent pond near the Cemetery is that it will prevent any future expansion of the Cemetery to the east.
Impact on health status and health seeking behaviours	Permanent	In densely settled areas sewage treatment is a necessary part of the civil infrastructure that allows the population to remain healthy and to prevent ground water pollution. Therefore the driving force for the proposed development is public safety. However, the fumes and dust affected the health of people in the adjacent area during the construction phase. One of the major problems concerning wastewater is the broad spectrum of pathogenic microorganisms - bacteria, viruses, protozoa and helminthes (intestinal worms) which can be found in the raw wastewater stream. Many of the pathogens are present in high concentrations, and can survive for days, weeks and some for months in wastewater, in wetted soil or on crops irrigated with raw wastewater. These pathogens may pose potential health risks to the workers or adjacent residents who may have direct contact to wastewater recycling activities, and also to the public who may consume wastewater irrigated crops or recreate on wastewater irrigated lawns or lakes.
Impact on land use	Permanent	The project will result many unfavorable impacts on land use in the areas adjacent the Infiltration pond: 1- Expropriation for the areas of lands needed to construct the recovery well and lands needed for the project. The 27 well and the expansion of the treatment plant need about 18175 m^2 2- Put limitation to any potential expansion for the Cemeteries Based on different FGDs conducted in the areas adjacent the infiltration pond, the community people reported that the project will expropriate their lands. Regardless to the fact that the majority of lands belong to the Ministry of Endowment (*Awqaf*), the small strata of people own the lands that will be affected expressed their worries that they might not be compensated for their lands. These worries were raised during the second public consultation. The PWA reported that land acquisition will be applied amicably with the least disturbance to people. As well, they try to find out the appropriate mechanism to expropriate lands with fair compensation. As a conclusion for this discussion, community people are fully aware about the project, in the meantime, the PWA is completely aware about land acquisition problems. Thus the PWA started to find alternative solutions to get lands through applying the following procedures: - Negotiate with the Ministry of Endowment for lands needed for the project - Consult with the municipalities regarding the needed lands

		- Consult with the PAPs who might be expropriated
Psychological problems	Permanent	The Shuhada Cemetery is regarded by Palestinians as a symbol of their struggle against occupation, constructing a wastewater pond in the area of the Cemetery could cause some psychological problems to the families of the deceased or Shuhada. The FGDs and municipality in-depth interviews reported that the Odor results from the pond might disturb the visitors. As well as, any deficit takes place during the operation phase might have negative impacts on the Cemetery. Therefore, it is essential to apply the needed mitigation measures in order to put limitation to the discussed impact.
Disturbance to community	Temporary	The construction of the carrier pipe will have a small negative impact in the construction phase due to noise and traffic disruptions.

5.3.2.4. Socio-economic Impact for the Reuse of Recovered Water and Sludge

The project will create a new market in the Gaza Strip. That market will create job opportunities, income generation, and enhancement of the living conditions of the potential beneficiaries. The following subsection will illustrate the results of the discussion of the potential project impacts on the people of the community and other relevant institutions, taking into consideration the quality of water recovered.

Although more positive impacts will be expected due to the reuse of recovered water and sludge, there are positive and negative impacts associated with the reuse scheme. Table 5.13 and Table 5.14 below illustrate the positive and negative impacts, respectively, due to the reuse scheme.

Table 5.13 Positive socioeconomic impacts of Reuse of Recovered Water and Sludge

Potential positive impact	Type of impact	Description
The potential change in source of income	Permanent	The market of recovery water reuse and sludge is a big market, if it is appropriately managed. Sludge reuse 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 Water reuse The utilization of the recovered water of high quality and of less price might work for the benefit of the farmers, increasing their profits
Job availability	Permanent	The sector will result a wide range of job opportunities for: • Sales persons working in sludge • Workers in sludge sites • Administrative employee i.e. accountants, clerks…etc • Drivers working on moving sludge • Operators of the recovery water sites • Accountant for treated water
Impact on health status and health seeking behaviors	Permanent	Sludge reuse The sludge reuse will work for reduction of chemical fertilizers that affect the health of people, however people were concerned that the sludge might contain heavy metal Water reuse 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

Table 5.14. Negative socioeconomic impacts of Reuse of Recovered Water and Sludge

Potential negative impact	Type of impact	Description
The potential change in source of income	Permanent	Sludge reuse The use of the sludge as fertilizer might affect those who work in the chemical fertilizers sector in Gaza Strip, especially, those who import fertilizers from abroad. Water reuse Irrigating with recovery water might affect those who use the municipality water, as fresh water is more expensive than the recovered water. Potential loss of income for those who own and operate the six wells that will be closed due to the project implementation. Put limitation to cultivating vegetables and green plants in the areas watered by the recovered water
Impact on health status and health seeking behaviours	Permanent	Impact of sludge use Potential pollution of the raw eaten crops. Children are often present on the farms and fallen fruit may be picked off the ground. Laborers and farmers at farms that are irrigated by treated wastewater or fertilized by sludge may be subjected to some danger of Ascaris. Bad Odor might affect the health of surrounding areas Impact of water reuse Potential pollution of the raw eaten crops in case of not appropriately treatment of water Impact on the health of farmers. This is in case of using dripping irrigation and does not use the protective clothes Impact on those who work on irrigation system Laborers who work on harvesting and crop collecting
Odor	Permanent	Sludge and water reuse Any wastewater facility has the potential to create Odor problems. Odor from wastewater is usually caused by gases produced by the decomposition of organic matter and is especially problematic when the decomposition has occurred in the absence of oxygen (anaerobic decomposition) and with available sulphur. In general, offensive Odor can reduce the appetite, lower water consumption, impair respiration, and in extreme cases may cause vomiting and mental perturbation

5.3.3. Socioeconomic Impact Summary and Their mitigations

Generally speaking, the project components will result in many favorable and negative impacts, summarized in the following sections.

5.3.3.1. Positive Socioeconomic Impacts

- Solving the problem of water scarcity especially during summer time, as a source of water will be continuously available
- Solving the problem of the disposal of wastewater, as it will be treated and injected for agricultural use,
- The provision of good quality water (treated wastewater of good quality) will reduce the cost of water needed for irrigation in the area. The utilization of the recovered water of high quality and of a lesser price might work for the benefit of the farmers, increasing their profits
- Sludge is one of the outputs of the project, and will increase the income for those who work in sludge trading
- Sludge reuse will work for reduction of chemical fertilizers that affect the health of people.
- The new lands gained due to the decommissioning of BLWWTP will be used in agricultural activities or as a recreational place.
- Potential increase of the price of lands and dwellings due to the implementation of the project,
- The provision of partially treated water for the adjacent areas in Beit Lahia from Pond 7,
- Provision of jobs due to the implementation of the project components,
- Enhancement of the underground water due to the treating of waste water,
- Protect the livelihood status of people who suffered due to the flooding of BLWWTP and were dramatically affected ,
- Reduction of the Odor, mosquitoes and flies resulting from BLWWTP. People were much in favor of putting limitations to their agony,
- As soon as the completed WWTP starts its operation in 2013 the infiltration of a high quality effluent in the infiltration ponds will begin to compensate the negative effects on groundwater,
- The construction of the site and the carrier line will improve the road network connecting the existing and the emergency area,
- Put limitation to importing sludge from abroad. Relying on the sludge might save money needed to import chemical fertilizers.

5.3.3.2. Negative impacts and mitigation measures

- Decommission of the BLWWTP will reduce water that some of the farmers relied upon to water their plants. Indicating that their income might be affected this will be mitigated through: i) Provision of recovered water at a competitive price to minimize the potential impacts. Ii) Due to the fact that the sewage untreated water should be banned, the legislators should develop appropriate laws that criminalize the use of untreated water
- Potential risk for the people in the adjacent areas due to having no fence around Pond 7 that might affect children. Mitigation measures will be implemented through construction of a fence

- The use of lands might be limited due to the pond as having recreational activities; especially in case of not having a fence that surrounds the pond. In addition, the construction of residential compounds in the decommissioned area will be limited due to the existence of the pond. Again the fence will be the most appropriate mitigation.
- The construction of the carrier pipe will have some negative impact due to noise and obstruction of traffic and use of agricultural land during the construction stages. In order to apply mitigations. The project should try to reduce the disturbance to community using most appropriate environmental mitigation measures. In addition to information sharing
- Due to the unfavorable odor, mosquitoes and flies might affect the health of the adjacent communities. The flies should be combated using hygienic and environmentally friendly procedures.
- The use of the sludge as fertilizer might affect those who work in the chemical fertilizers sector in Gaza Strip, especially, those who import fertilizers from abroad. Integrating laborers into the new market might be an appropriate mitigation measure.
- Negative impact on the livelihood status of those who operate wells. Potential loss of income for those who own and operate the wells that will be closed due to project implementation. The laborers and the well owners might be affected severely. Provision of appropriate compensation i.e. jobs or monetary compensation.
- Put limitation to the plantation of certain crops by the beneficiaries who will use the recovered water. Orientation sessions should be presented to raise farmers awareness regarding the type of crops that should be planted using recovered water
- During the construction of the infiltration ponds there was temporary and minor local nuisance for visitors of the Cemetery caused by exhaust fumes from transport vehicles moving to and from the construction site. This should be mitigated by reducing odor.
- Expropriation for the areas of lands needed to construct the recovery well and lands needed for the project. The 27 wells and the expansion of the treatment plant need about 18,175 m^2. Protective procedures should be applied to limit the resettlements. Avoiding small plots in order not to raise poverty. Compensation should be paid on the basis of the full market price. Please note the 27 wells investigated are based on the designed report.

5.3.4. Vulnerable groups

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 paid to 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.

According to the ranking of the most affected groups who have no alternative livelihood approach were ranked a recognized as follows:

A. **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
B. **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
C. **Those who rent lands from *Awqaf*** for a few amount of money that includes the cost of water. They will be affected in sense of losing their lands and paying for water.
D. The **owners of small plots of lands** who will be expropriated during the construction of the recovery 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.
E. **Poor people with respiratory allergy** will be severely affected due to the NGWWTP and the infiltration ponds. In case if they suffer due to poverty they will not be able to ask for medical support

According to the design model simulation, nearly 63 agriculture wells and 5 municipal wells around the infiltration basins will be affected by the pollution path lines without the recovery system. After the operation of the recovery system, nearly 25 agriculture wells close to the infiltration basin pond will be affected and municipal domestic wells will be fare from pollution path lines. Please note that most (if not all) agriculture well are licensed wells.

This phenomenon is also verified during the groundwater modeling run under this study. However, the detailed study will be conducted during the RAP preparation to detail the affected wells and the type and nature of the impact.

In order to reduce the impacts of the project vulnerable groups, it is recommended to apply the mitigation measures that can be summarized as follows:

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 follows:

1- **The operators of wells** should be provided with alternative job opportunities in the project itself or assessed by the agricultural entities to reduce their suffering.
2- **The owners of wells** should be provided with recovered water free of charge. In addition in cooperation with the municipality they should be provided with fresh water at a lower subsidized cost. The cost of digging their wells should be paid on the basis on the full market price.
3- **Those who rent lands from Awqaf** should be compensated by having alternative land in nearby areas (this should be coordinated with Awqaf)

4- The **owners of small plots** should be completely avoided as they will be badly affected.
5- **Poor people with respiratory allergy** should be provided with health care free of charge in cooperation with governmental health providers

5.3.5. Residual Impacts and Costs of applying mitigation measure

Major if mitigation measures and site management practices are applied. This discussion will cover the whole potential impacts resulted due to land acquisition and expropriation during the preparation of the project, during the construction and during the operation phase.

The estimated cost for applying the different activities related to the potential expropriation and land acquisition will be mainly based on:

- Cooperation with the municipalities and other organizations
- Negotiation with the Awqaf
- Negotiation with the affected people

Therefore, any estimations of the budget for such activities will not be based on a solid rationale

5.4. Willingness to pay, cost analysis and tariff survey

Surveys have been conducted for willingness to pay for the wastewater and sludge reuse, water distribution network and cost analysis including proposed tariffs for the effluent recovery. The result is a stand-alone report that is presented in Annex 8.

Regarding the increment cost of the reuse system, the draft vision toward the reuse system is under developed. The tariff including the cost analysis for water reuse as well as the sludge reuse is studied. However, the tariff survey and willingness to pay conducted under this study should be taken into consideration.

5.5. Resettlement Policy Framework and Resettlement Action Plan

According to the ToR of the Consultant, the ToR for the RPF has to be prepared when the involuntary resettlement might trigger with regards to the implementation of the water distribution network of effluent recovery scheme. The ToR of RPF has been prepared and presented in Annex 11. However, based on findings and the consultant's recommendation in addition to the WB approval, the RAP should be prepared as a document instead of the RPF due to the certainty of the OP 4.12 triggered. Therefore, PWA is recommended to appoint the consultant to prepare the ToR for RAP (ToR for RAP is presented in Annex 11 as well).

The Bank will be reviewing drafts of the RAP. Once the RAP TOR is cleared and work towards the RAP is underway. Specifically, the RAP should provide details on how the affected parties are identified, consulted on the project and the adverse impacts they will experience, the compensation, and the modes of grievance redress that is available to them. More specifically, detailed information on the operators of the wells (license or unlicensed), owners of wells, those who rent lands from the Awqaf should be developed, and owners of small plots of lands who will be affected /expropriated. If these categories of people are not affected based on subsequent research, then we would need definitive information to this effect.

In addition to the above, the RAP should also cover areas of temporary impacts or disturbances (land use and accessibility of the water distribution networks) and its impacts on traffic, especially to pedestrians. The SESIA notes in one place that access difficulty will be greater for elderly, handicapped etc.; so it must be determined how the impact on these groups will be mitigated. Several of the permanent impacts (on jobs etc.) would also have implications for the RAP study.

5.6. Analysis of Alternatives

The analysis of alternatives is meant to investigate the feasibility of different design alternatives, which have been presented in the final impact assessment in terms of environmental and social impacts. The analysis of alternatives has considered the environmental and social advantages and disadvantages of the available project alternatives. In the previous Chapter some project alternatives were assessed against specific impacts and this assessment was presented under the correspondent impact analysis, this assessment is also presented in this chapter but with a wider scope through comparing the degree of relevant environmental and social impacts for each alternative and hence reaching a conclusion about the environmental and social preferred alternative.

5.6.1. No Project Alternative

The objectives of this SESIA are to reuse (recover water for irrigation and sludge for fertilizer and soil condition), decommissioning of BLLWTP and remediation works of Effluent Lake adjacent to BLWWTP. Basically the project components goals are to improve the environmental, socio economic and public health conditions in Gaza strip, especially at the project areas. Accordingly it is expected, by definition, that the environmental and social benefits will overweigh the negative impacts.

The main benefits that are expected by the projects include:

- Decommissioning of BLWWTP upgrade the environmental and public health conditions in their surrounding areas, in addition to the land availability for different land use purposes in the future.
- Remediation of effluent lake adjacent to BLWWTP increases the land availability for land use purposes in the future.
- Better water effluent reuse for unrestricted use for irrigation. The project will have many positive impacts on water resources by definition. The recovered effluent from the groundwater will be an important source of irrigation water as the water resources in the Gaza Strip are scarce.
- Better and more efficient use of scarce water resources. The expected recovery water quantity and quality will have additional recovered water for irrigation purposes.
- The recovery will limit the horizontal dispersion and the vertical building up of the water table which without recovery will have negative impact on current land use. Horizontal dispersion of the contamination will be captured by the recovery schemes. Without a recovery scheme, vertical building up of infiltrated water will reach the water table and in some extend, at the certain area, depending on the topographical and contour, the surface water will appear in the very near future and will negatively impact the land use that is already limited in the Gaza Strip.
- The recovery also has to be implemented during year 2013 and to be operated during year 2014. When the implementation start is the year 2015, the recovery scheme cannot catch the pollution and the irrigation wells will be at risk.

- Benefits of the sludge reuse. The sludge generated from the NGWWTP that meets the standard requirements for agricultural use has many benefits as it has high content of organic matter that can help conserving soil organic matter and sludge stimulates biological activity in the soil, reduction in cost for nitrogen and phosphorus mineral fertilizers may improve crop yield on sludge treated fields; sludge availability compared to imported fertilizers, which are subject to importing difficulties due to the political instability and the imposed siege on Gaza; and sustainable management for sludge recycling rather than transporting it to already limited landfills or an incinerator facility.
- Socio economic aspects for recovery effluent and reuse:
- The acceptance of farmers to use recovered water and sludge were relatively high.
- The potential change in source of income due to the provision of good quality water (treated wastewater with good quality) will reduce the cost of water needed for irrigation in the area. Sludge is one of the outputs of the project that will increase the income for those who work in sludge trading
- Job availability, especially during the construction period, for skilled and unskilled labor.
- Better access for the community due to the construction of NGWWTP and Infiltration basins.

The negative environmental and social impacts of the project were discussed in the previous chapter. All these impacts are mainly site-specific and could be managed / minimized through implementing the proposed mitigation measures as described earlier in this ESIA. When comparing the benefits to the impacts on a strategic level, it could be concluded that the “no project alternative” is not supported from the environmental and social perspective, given that the project negative impacts will be controlled as recommended in this ESIA.

In addition, the implementation shall start and be operated before 2015, otherwise the recovery scheme will not be able to catch the pollution and they will affect the irrigation wells around the recovery wells.

CHAPTER 6 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP) AND MONITORING PLAN

6.1 Introduction

This chapter presents Environmental and Social Management Plan (ESMP) developed for NGESTP Effluent recovery, remediation of effluent lake, and decommissioning of BLWWTP. 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

6.2 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 is 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.

In addition, according to the ToR, it is required to provide the monitoring indicators, measurable and the frequency and parameters to be monitor for effluent recovery scheme. The monitoring plans are prepared at following section, section 6.6 to detail the monitoring plan including indicators, monitoring frequency and parameter to be measured. Besides, the emergency plan and risk plans due to the power failure and the security risk (due to the site of the water distribution network is within the buffer zone to the Israeli border) is presented in the same section, section 6.6.

6.3 Environmental and Social Management Plan (ESMP) and Monitoring Plan

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 in Chapter 5. The

ESMP assigns certain tasks for different stakeholders according to their roles and responsibilities in the project.

Based on the Institutional Capacity Assessment for effluent recovery (presented in Annex 11), the proposed institutional set up for project management is comprised of the following main features:

6.3.1. During Construction Phase

- Decommissioning of BLWWTP and Remediation Works
  - PMU is responsible for the implementation of the decommissioning of BLWWTP and remediation works of effluent lake
  - Contractor will be selected by PMU to implement the project
  - ESMP will be implemented by the contractor and the monitoring of the ESMP will be done by PMU or independent consultant supervision selected by PMU.
  - Cooperation with MoH and MoA shall be established to monitor the wildlife and dangerous pets (wildlife) and fauna surrounding the sites to avoid the disturbance of the surrounding communities.
  - For the removing the soil cap from the places that indicate to have Cd, the implementation will be done by PMU by selecting contractor for soil removal.
  - The notification has to be sent prior to the remediation activities to the landfill (preferable Johr Eldeek or other landfill that has capacity to receive the contaminated soil).
- Construction of Water distribution networks
  The institutional set up of activities during the construction of the water distribution networks including purchasing machinery and equipment, involuntary resettlement, if any, and compensation, are as follows:
  - PMU is responsible for the implementation of the overall activities of the construction. If needed, the independent consultant will be selected to provide the preparation of tenders, evaluation of tender and implementation of the purchasing and construction works.
  - Contractor will be selected by PMU to implement the project
  - ESMP will be implemented by the contractor and the monitoring of the ESMP will be done by PMU or independent consultant supervision selected by PMU.

6.3.2. During Operation Phase

During the operation phase, there are two categories related to the project components:

- Effluent Lake Remediated land and Decommissioned of BLWWTP land
  - After the completion of remediation works and handled over to the El Awqaf, if needed by the Awqaf to have soil conditioning or landscaping purpose, due to the huge amount needed, the agreement between El Awqaf and the Ministry of Economic and Land Authority shall established to transfer the soil from the future landfill of Johr Eldeek to the site. In addition, the agreement shall be approved by North Gaza Join Service Council (NJSC).
  - After the completion of decommissioned of BLWWTP and handled over to the El Awqaf, the similar approach, if needed, for soil conditioning or

landscaping purpose, the soil from the future Johr Eldeek landfill can be transported to the site. However, due to relatively small amount of soil needed, the agreement can be achieved only between El Awqaf and the landfill management and approved by NJSC.
Please note that if the land will be used for agriculture purposes, the assurance that the soil will be transferred is a good soil and can be used for agriculture purposes (soil conditioning).
- For transportation of the soil to the site, a traffic route has to be identified and approved by the Traffic Authority.

- Effluent Recovery Reuse system; (collection, treatment, discharge to the infiltration basin, monitoring and reuse system awareness)
  - Wastewater collection, treatment and discharge to the infiltration basins)
    Effluent Recovery and Reuse system is a new entity that are not belong to the CMWU responsibility, neither by practice nor by law. The CMWU responsibility is for the water collection and distribution network.
    In addition, according to the Palestinian Water Strategy and the consensus among the concerned parties (PWA, MOLG, Municipalities and CMWU), regarding the water distribution network, CMWU will be responsible for the operation and maintenance of the treatment plant (NGWWTP). The water distribution network accordingly will be under the responsibility of the new entity, namely, Wastewater Reuse Distribution and Reuse Utility (WWDRU). Please note that under the preparation of the SESIA and during the discussion and clarifications with the PWA and CMWU, the new entity is still undergo and is under the study.
    Regarding the operation and maintenance of the new treatment plant (NGWWTP) that is fallen under the responsibility of the CMWU, the capacity and capability of the CMWU is adequate to overcome with the responsibility of the operation and maintenance of the treatment plant (including sludge generated from the treatment plant). This responsibility includes the operation and maintenance of the sludge treatment. In addition, as the financial constrain of the CMWU, to overcome with the additional budget, currently, there is an ongoing negotiation among the stakeholders (PWA, Municipalities, CMWU and MOLG) for operation and maintenance coverage by endorsing the new tariff system and by improving the collection and government subsidy.
    The study to overcome the additional cost of CMWU will include the financial analysis to ensure the utility will be able to absorb the operation and maintenance cost.
  - For monitoring and control of the effluent recovery quality, cooperation between MENA, CMWU, PWA (PMU), MoA and MoH will be established.
  - Non-Governmental Organization (NGOs) related to the irrigation system(i.e. Union for Agriculture and Palestinian Agricultural Relief Committee (PARC)),wastewater reuse or the environment in general will be responsible for public awareness campaigns for recovery water reuse and sludge management and reuse. However, the campaigns and public awareness activities should be in close coordination with PWA/PMU.

In addition, it is recommended that mandates of the CMWU staff as operators of the effluent recovery reuse system (wastewater collection, wastewater treatment and treated wastewater discharge to the infiltration basins) have to be modified, and capacity building should be proposed.

Detailed analysis of the Institutional Setup, including the CMWU new Institutional Structure modified at 2012 to overcome with operation and maintenance of the reuse system is presented in Annex 11; Institutional Capacity Assessment and Regulatory Needs.

- Effluent Recovery reuses system; Recovered Water Reuse (Treated Wastewater Reuse) and Sludge Management and Reuse
  - Wastewater Reuse Distribution Utility (WWDU) will be responsible for operation and maintenance of the reuse system (recovered water distribution) Similar to the wastewater collection, treatment and discharge to the infiltration basins, the Recovered water reuses and sludge management Reuse is a new system that according to the consensus of the PWA (PMU) the new entity will be responsible for operation and maintenance of the Recovered water distribution network and sludge reuse management.
    Currently, there is undergo study from PWA to overcome with the operation and maintenance cost of the recovered water distribution. There are some scenarios proposed for this subject. However, the result of the willingness to pay for the recovered water reuse and sludge reuse done by Consultant should take into consideration developing the new tariff and fees system for the reuse system.
    Accordingly, as indicated above, the new entity proposed (WWDU) is still undergoes and under study, thus the proposal is still the preliminary proposal. However, PWA, temporarily, will be the main responsible for water distribution network until the institutional setup in established. The responsibility will be in partnership with MoA, MoEA and MoH.
  - PWA / PMU is a responsible authority for monitoring the quality of the sludge in coordination with MoA
  - Farmer Association or privates entities interested in marketing and distribution of the sludge will be responsible for marketing and distribution of sludge
  - MENA in cooperation with MoA and MoH is the responsible authority to approve the usage of the sludge for different purposes, either for soil fertilizer or soil conditioning.
  - MoA and Ministry of Economic shall be responsible for setting the price of the sludge and financial mechanisms for marketing and distributing the sludge for different purposes.
  - The fees shall be approved by the Farmer Association who will be responsible for marketing and distribution

  In addition, capacity building for PWA (PMU) staff as an operator of sludge management is recommended, along with amendment of the legal framework related to the PWA.

  Detailed analysis of the Institutional Setup for the new entity (WWDU), including the PWA new Institutional Structure modified at 2012 to overcome with operation and maintenance of the reuse distribution system and vision toward sustainability of WWDU is presented in Annex 11; Institutional Capacity Assessment and Regulatory Needs.

The institutional set up of the reuse system, as stated above is still under the preliminary consensus and the study is still undergoes. This study includes the cost increment, sustainability of the system, as well as, the additional subsidy when the new water tariff system proposed does cover the operation and maintenance cost. In addition, the willingness to pay of the farmers as well as the water tariff were conducted by the

Consultant to indicate the appropriate pricing of recovered water and sludge reuse (presented in Annex 9; Social Impact Assessment). The result of the surveys will be taken into consideration during the negotiation processes and the completion of the wastewater reuse institutional set up study.

6.3.3. Grievances and Compensation

The creation of "Committees" under Promoters Company to address grievances originating from misunderstandings of project policy, or resulting from conflicts among neighbors is one of the most fundamental procedures that warrantee smooth and amicable implementation for the project activities. Law No 2 for year 1953 for land expropriation for Public Benefit allows one month objecting to the decision of resettlement after publishing it in the national Gazette for 15 days and informing the affected persons.

The World Bank's OP 4.12 advances a "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.

6.3.3.1 Proposed Grievance 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

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:

1. The petitioner has to be informed of the proposed corrective measure.

2. In case if a corrective action is not required, the petitioner has also to be informed accordingly.
3. 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

a. 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, NGOs, 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.

b. Grievances tiers

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 will assign a Social Development Officer (might be more than one) who will be responsible of receiving all grievances from all different stakeholders.
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, he will follow 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.

2. A regular meeting should be assigned by the Compensation Committee. The complainants can attend these meetings

c. 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. NGOs 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

d. 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

e. 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)
2. Type of grievance received (according to the topic of the complaint)
3. Number of grievances solved
4. Dissemination activities done
5. Satisfaction with solutions
6. Documentation efficiency
7. Efficiency of response to grievance provided

f. Disclosure of grievances

All grievances activities should be disclosed in the municipalities, NGOs 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, NGOs, municipalities.

6.4 ESMP Institutional Set Up

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.

6.5 Roles and Responsibilities for Implementation and Supervision

The mitigation measures and monitoring activities that were recommended in Chapter 5 of the SESIA report shall be implemented according to the above-mentioned institutional set-up. Tables 6-1 to 6-3 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 (and WWDU[7]) depending on their project components.

The specific roles and responsibilities of the SDO planned to be appointed under the PMU are presented in Box 6.1 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.

Following tables, Table 6.1 and 6.2 present the Environmental Management Plan and Monitoring Plan, respectively. In addition, Table 6.3 presents the Social Management and Monitoring Plan.

[7] Please note that during the operational of the reuse system, when the WWDU is not yet amended and fully operated for the system, the distribution of the reuse system will be done by PWA (PMU).

Box 6.1 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 profile of 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 (e.g. the model of …. Project for wastewater reuse and sludge management and recycling) to benefit from the experience and lesson learnt

Box 6.2 Proposed Capacity Building Programmes for the SDO

- OP 4.12 and Palestinian laws related to land ownership
- Communication Skills
- Community Participation Tools
- Consensus Building Techniques
- Participatory Monitoring and Evaluation (PM&E)
- Promotion of Awareness Raising Activities

Table 6.1 Environmental Management Plan

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
During Pre-Construction / Preparation					
Site clearance prior to water distribution network	Health and safety of the workers	standard procedure for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender process	
		Portable construction fences have to be prepared prior to the construction	Contractor (through tendering activity	None as a part of tender process	
		In case of potential destruction of crop or plants, the compensation has to be settled.	PWA (PMU-EM) in coordination with MoA	150.000	Compensation framework has to be developed accordingly
Biodiversity and site clearance prior to remediation of Effluent Lake	Health and safety of the workers due to the wetland ecosystem and vertebrate living at the area	Strictly standard procedures for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender process	
		Equipment to handle the vertebrates has to be prepared	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	
		Fauna found to be dangerous has to be isolated and handled with care	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	Procedures of handling of fauna found to be dangerous is presented in the annex 6, Soil Remediation Assessment for Effluent Lake
Biodiversity and site clearance prior to	Health and safety of the workers due to the	Strictly standard procedures for health and safety of the workers	Contractor (through tendering activity)	None as a part of tender	The decommissioning activities will start

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
decommissioning of the BLWWTP	wetland ecosystem and vertebrate living at the area			process	after the start up of NGWWTP. Therefore, the proposed mitigation measures proposed in these activities can be combined with the measures of the remediation of effluent lake, that is assumed the site remediation has been completed.
		Equipment to handle the vertebrates has to be prepared	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	
		Fauna found to be dangerous has to be isolated and handled with care	Contractor (through tendering activity) in assistance from MoH and MoA	None as a part of tender process	
Base camp preparation for the workers (for all project components)	Ambient air, noise and community disturbance	Base camp and storage of the equipment has to be defined to avoid the disturbances	Contractor	As a part of their financial budget during the bidding activities	
During Construction					
Ambient Air Quality by dust emission of construction works (for all project components)	Health impact associated with fugitive dust generated due to the vehicles movements	Localize the vehicle movements	Contractor As a part of their financial budget during the bidding activities		Low impact and temporary
	Potential nuisance to the population in the vicinity to the construction site	Pavement of access roads prior to usage in construction of the project components			
	Vegetation survival, especially on the agricultural land	Keep the site nearby the agriculture land and plantation wet, especially during the hot and	Contractor As a part of their financial budget during the bidding activities		

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		dry season			
Noise impacts (for all project component)	Construction activities associated with heavy machineries and generators	Noisy equipment, especially those that will be used in the construction works including generators should be supplied with adequate silencers	Supplier	None, as a part of the supplier offers	Short term duration
		Standard noise protection equipment for the construction workers			
	Psychological impacts among the neighboring area	Optimize the use of noisy machines	Contractor	None	Low impact as there is no major noise sensitive receptor is located in close proximity of the project
		Use acoustic barriers as necessary if complaints from neighbors were received	Contractor	None	Secondary impacts. It is apply when the mitigation measure is not properly managed.
	Traffic congestion due to the heavy equipment movement and transportation of raw materials	Construction activities confined during day time	Contractor	None	
		Management of the main routing of construction vehicles	Contractor	None	Routing management shall be presented to the traffic department for approval.
Sludge drying during decommissioning of BLWWTP and during	Odor impacts due to the exposure to active sludge during the	Apply fresh soil from the effluent lake to cover the fresh sludge to reduce the release of H_2S.	Contractor	None, as a part of the contractor's	

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
remediation works	decommissioning or drying of the ponds at BLWWTP and wet areas of the effluent lake			offers	
Vehicles movement during the Construction work (concrete work) of the facility of water distribution network.	Vibration at the location nearby El Shuhada Cemetery area.	Base camp and the storage of the equipment has to be on placed far from the Cemetery area (on the future land dedicated for the future location of the booster pumps and storage tank).	Contractor	None, as a part of the contractor's offers	
		Time management plan to reduce the overlapped heavy equipment	Contractor	None	
		Ready mix concrete is preferred instead of on site concrete mixing.	Contractor	None	
Handling of construction wastes and hazardous wastes	Impacts on soil, groundwater, air quality, as well as aesthetic impacts due to mishandling of construction wastes.	Provision of onsite sewage collection for the workers.	Contractor	None	Coordination with the landfill management for receiving the unusable construction waste.
		Site waste management including storage, collection and disposal.			
		Maximize the reuse and recycle of construction materials.			
		Notify the sanitary landfill of receiving the unusable construction wastes or damaged construction materials.			
	Impacts on soil, groundwater, air quality, and health due to mishandling of hazardous wastes.	Site waste management including separate and safe storage of hazardous wastes.			
		Arrange for collection and disposal in licensed landfills.			

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		Proper identification of hazardous wastes.			
Decommissioning of BLWWTP	Soil contamination due to oil or fuel spill from construction vehicles	Preventive maintenance for construction vehicle	Contractor	None	
		Fuel or oil change station shall be prepared		None	
		Containment system to avoid the spill of broken machine onsite		None	
	Impacts on air quality resulting from sludge removal from the lagoon to the selected drying area	Considering the prevailing wind is not directed from temporary drying area to the nearby community	Contractor	As a part of contractor's financial offer for decommission ing plan	
	Impacts on air quality due to transportation of backfilling materials.	Time plan for transporting of soil for backfilling	Contractor	None	Secondary impact. Coordination between contractor and traffic department
Remediation works at the effluent lake	Residual hazardous contaminants in the effluent lake	Soil replacement / removal of the wet area of the effluent lake	PWA	235,000	The cost is estimated for the soil cutting only (overall cost including workers, equipment and truck for transportation When the sand or soil need to be replaced, additional 105,000 will be

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
					needed to purchase the sand / soil and another 175,000 for sand / soil placement (workers, equipment and vehicles)
Construction works of effluent recovery network	Potential leaks or spill chemical / fuel	Proper waste management and spill prevention measures	Contractor	None	
	Potential leaks from temporary sewage storage tank	Spill prevention measures			
Construction Works of the project components	Risk of injury or accident to the construction workers	Safety measures and standard safety protection of the workers	Contractor	As a part of the contractor's financial offer	
Excavation works	Impacts related to archeological disturbance such as risk of unknown discovery of culturally valuable object / monument during excavation	When there a culturally valuable object/monument is discovered, the work should be stopped.	Contractor	None	Secondary impact. The antiquities authority needs to be notify prior to the construction works.
		The discovery should be informed to the administrative authority within 48 hours.			
		Excavations should be supervised by an inspector.			
		Record keeping, expert verification, chain of custody and criteria for potential temporary work stoppage			
All stages of excavation and	Potential disturbance to the crops and animals,	Installation of fences prior to the construction of the recovery	Contractor	As a part of the	

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
construction-related works	especially at the water distribution network site	water distribution networks		contractor's financial offer	
		Compensation for destructed crops or plant.	Contractor in coordination with MoA	This section will be defined prior to the construction phase.	
	Risks to the workers from dangerous vertebrate, pets and fauna.	Strictly standard procedure especially at the wetland site	Contractor in coordination with the PWA (PMU)	Contractor in coordination with the PWA (PMU)	On the preparation stage, the tendering has been done to purchase the standard procedure for site clearance. However, the contractor shall put into consideration on their budget proposal
		Equipment to handle the vertebrates such as cages should be provided.			
		Dangerous fauna must be isolated and handled with care.			
Construction works for water distribution networks	Land use and accessibility such as road traffic impacts due to the laying of water distribution networks along or across main roads	Selection of temporary storage areas of construction materials, equipment, tools and machineries prior to the beginning of construction activities.	Contractor in coordination with PWA for site selection	None	
		Training on safe utilization for the machineries drivers	Contractor	As a part of the contractor's financial offer	On Job training as a standard training activities
		Clear signing for the project site and fences installation prior to the beginning of construction activities	Contractor		
		All activities shall be performed during daytime and have to be	Contractor	None	

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		scheduled to avoid conjunction			
		Inform Traffic Department for traffic management during congested time			
		Temporary resettlement has to be defined, prepared and compensated for.	Contractor in coordination with Land Authority for resettlement		RAP has to be developed accordingly in coordination with independent consultant
During Operation / Maintenance					
Operation of the PS at the remaining BLWWTP and water distribution networks	Noise impact especially for the PS staff at the water distribution network PS and the remaining BLWWTP	Standard protection for the workers including the ear muffs.	CMWU as the authority for collection and storing the recovery water and municipality of BLWWTP as the responsible entity for operation and maintenance of the plant	10,000 for initial purchase of equipment and 10,000 for monitoring programme annually	
Storage of raw sewage during emergency at the remaining pond#7 at BLWWTP	H_2S release due to raw sewage storage at the remaining BLWWTP	Maintaining high performance of biological treatment at the remaining pond	Municipality of BLWWTP	5,000	Operation cost is depending on the average annual budget for aerators maintenance and operations and energy consumption
		Installation of existing aerator at pond #7	Operators at BLWWTP in coordination with PWA (PMU)		Installation activities, there is not cost estimate for

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
					purchasing the aerator
Operation of machineries	Vibration impacts especially nearby the El Shuhada Cemetery of the installation of pumping station and generators	Heavy leafy tree plantation at the Cemetery area to absorb the vibration and noise associated with the PS and generators	CMWU in coordination with MoA	10,000	MoA provide the suitable plantation can be sufficient for vibration and noise absorption
		Maintenance of the machines and equipment has to be maximized.	CMWU	-	Cost estimation is depending on the average annual budget for pumping, generators and pipelines connections
		Maintenance of the trees planted at the Cemetery area	Contractor for trees maintenance (selected and supervised by CMWU)	7,500	Cost estimation is based on yearly maintenance. Cost includes the watering, plant observation and trimming of the trees done every 6 months. Please note that the water is collected from the treated wastewater.
Operation of recovery water scheme	Captured contaminant by the 25 recovery water wells installed as designed	The maintenance of the recovery well to meet the design criteria to captured the contaminant	PWA	-	Cost estimation is depending on the local materials availability
Water recovery for reuse in irrigation	Impact on local agriculture, public health and water resources.	Prohibition of using recovery water for drinking purposes (higher total N and possible other	PWA in coordination with MoA and MoH through private communities, NGOs and	40,000	The cost estimates will be used for workshops, training,

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
	Risk of using the recovered water for the cultivation of unrestricted crops	contaminations which are not recorded) Recommend the reuse of recovered water not for uncooked vegetables (especially during the first year of implementation	farmer's associations		etc.
Preparation of the use of the former effluent lake and decommissioning of BLWWTP site	Impacts due to soil transportation for filling of the effluent lake and decommissioning, if needed	Agreement for soil transportation to the effluent lake and decommissioning land	El Awqaf in coordination with North Gaza Joint Service Council (NJSC) of Johr Eldeek landfill	-	The activities will be done after the handing over of the land. Soil placement will be considered, if needed for leveling, landscaping or soil conditioning
		Traffic route management for transferring the soil from John Eldeek to the effluent lake	PWA in coordination with traffic authority	None	Prior to the agreement between PWA and the NJSC, the PWA in coordination with traffic authority to identify the route
Operation of pond #7 for emergency purposes.	Limiting access for neighboring residential area and visual impacts due to the operation of pond#7 as the emergency pond	Construction of fences around the pond to reduce the accessibility to the pond and access road	Municipality of BLWWTP through tendering procedure	40,000	This cost estimated should be discussed with the municipality as it is mentioned that the fund is already available
		Keep distance of 10-15 m between the pond and the fences			
		Plantation around the fences (to reduce odor, facility separation and for visual / aesthetic)			

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		One gate and access road to be connected to the pumping station			
Water recovery for reuse in irrigation (related to public health)	Health impact for agricultural workers for using treated water and general public for consuming unrestricted crops	Institutional framework for monitor and control compliance with regulations and enforce them	PWA in coordination with MoA, MoH, farmers association and water usage and distribution, under PWA	Undefined	
		Farmer's awareness for crop restriction and assistance in development of a balanced mix of crops	MoH in coordination with MoA through private sectors or NGOs	20,000	This activities belong to the awareness campaign and training
	Public health impact for agriculture workers and families, crop handlers and inhabitant nearby the irrigated area	Provision of protection clothing, the maintenance of high levels of hygiene and immunization against selected infections	MoH in coordination with MoA through private sectors or NGOs	20,000	This activities belong to the awareness campaign and training
		Cooking the agriculture product before consumption and high standard of food hygiene	MoH in coordination with MoA through private sectors or NGOs	20,000	As a part of public awareness
		Health education associated with irrigation scheme			
		Special care for assurance of not using the irrigation water for drinking water or domestic purposes by accident or by lack of an alternative	MoH in coordination with MoA through private sectors or NGOs	20,000	As a part of public awareness
Reuse and disposal of Sludge	Risk of sludge not meeting the standards for reuse (sludge is contaminated with substances that cannot be used as fertilizers or	The sludge has to be dispose to the landfill	NGWWTP management with coordination of PMU	Undefined	NGWWTP in coordination with the NJSC for arrangement of disposal of contaminated sludge
		Traffic management for sludge	NGWWTP management in	None	Discussion between

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
	soil conditioning)	transport to the landfill	coordination with the traffic authority		NGWWTP management to define the approved route for sludge transportation
	Sludge reuse application for irrigation	Limiting the sludge application for uncooked vegetables	MoH in coordination with MoA through private sectors or NGOs	-	As a part of public awareness
		Monitoring and testing of the sludge before sending it to for reuse	NGWWTP (based on the assumption that the sludge testing and monitoring equipment is available at the NGWWTP laboratory) in coordination with CMWU	None	The equipment area already included in the budget of NGWWTP. The budget of chemical and spare part purchasing base on annual demand.
	Risks of sludge not meeting the standards due to pathogen concentration	Treated with the lime and transported into landfill	NGWWTP management with coordination with CMWU and NJSC	None	The budget of chemical and spare part purchasing base on annual demand. The budget is already included for O&M of NGWWTP
		Traffic management for sludge transportation	NGWWTP management in coordination with the traffic authority	None	
	Health and handling sludge in agriculture	Training and guidance for farmers and sludge transporter regarding health and handling sludge in agriculture	MoA	20,000	Cost estimation is based for each training session
		Health and safety protection shall			

Project Activities	Potential Impacts	Proposed Mitigation Measures	Institutional Responsibilities (enforcement and coordination)	Cost Estimates ($)*	Comments
		be introduced to the farmers and the transporters			
	Inconvenience to the public due to sludge transportation	Vehicle selection to reduce public inconvenience	NGWWTP management	20,000	Cost estimation for operation and maintenance of the vehicle annually
		Transport route selections to minimize the public inconvenience and the raise Odor and noise nuisance	NGWWTP in coordination with traffic authority	None	
		Traffic route selected shall avoid the highway			
	Sludge spillage and Odor nuisance resulting from the sludge	Enclose sludge trucks	NGWWTP management	None	
		For transport optimization the sludge can be stored on farm with assurance of secure storage facilities			
	Risk due to uncontrolled sludge application on land	Controlling sludge rate of sludge application, nutrient addition, crop types, waiting period and sowing and harvesting constraint	MoA in coordination with farmers association (Union for Agriculture and PARC)	5,000	Cost estimates based on the annual operational cost
		Good communication between costumers, regulator, public and stakeholders	Palestinian Water Council	Undefined	
Using recovered water for irrigation purpose	climate change and crop management impact	Crops selections, irrigation method, water distribution management	MoA	25,000	Cost estimate is based on every two year study for climate change impact on irrigation

***The costs are based on the Estimation and Current Condition**

Table 6.2 Environmental Monitoring Plan

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
During Pre-Construction / Preparation						
Site clearance prior to water distribution network	Worker's injuries	Construction site location	Preparation of recording form of workers injure during the construction	Monthly	None	Contractor On the preparation stage, the tendering has been done to purchase the standard procedure for site clearance. However, the contractor shall put into consideration on their budget proposal
Site clearance prior to decommissioning of the BLWWTP and remediation work of effluent lake	Health and safety equipment, equipment for handling vertebrate	Project site for remediation and decommissioning sites	Purchasing equipment for the workers, equipment for handling vertebrates Preparation form of recording the number of vertebrate and fauna	Once during the preparation and prior to start the construction phase	None	
Base camp preparation for the workers	Neighbors' complaints	Project construction sites	Recording of complaint and type of complaint	Once during the preparation and prior to start the construction phase	None	
During Construction						
Monitoring ambient Air Quality during construction works	Ambient air (gas emissions) PM, dust complaint	Ambient air (gaseous emissions), PM at the closest farm of pumping station location, water distribution network and	Sampling collection and laboratory analysis Recording and documentation of complaints	Once during the most activities at each location	As a part of contractor's financial offer for decommissioning plan	Contractor

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
		nearby community at the BLWWTP and effluent lake				
Monitoring Noise Impacts at the project sites	Ambient noise levels, noise complaints 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	As a part of contractor's financial offer for decommissioning plan	Contractor
Monitoring of Odor Impacts during the construction activities	Odor complaints from neighbors	Site location	Recording and documentation of complaints	Monthly	None This monitoring activities is already established with the odor scrub at the BLWWTP PS	PMU-EM
Monitoring 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	As a part of contractor's financial offer for water distribution During the operation, the price for equipment is included on the ESMP table above	Contractor during construction and CMWU during operation

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
Management of construction waste and handling of hazardous waste	Amount of hazardous and nonhazardous waste generated	Project site locations	Estimation of the hazardous waste and non-hazardous waste in relation to the handling and transporting to the landfill	Weekly or monthly depending on the volume of waste	As a part of contractor's financial offer for wastes handling	Contractor
Monitoring soil contamination during decommissioning of BLWWTP	Area of spillage	Project sites	Visual observation Recording and documentation of spillage	weekly	As a part of contractor's financial offer for environmental monitoring	contractor
Remediation works at the effluent lake	Replantation due to the soil removal from the top layers of contaminated soil Volume of the soil to be removed from the site and transported to the landfill	Project sites	Recording and documentation during the preparation of remediation and during the plantation period	monthly	As a part of contractor's financial offer for environmental monitoring	contractor
Monitoring health and safety of the workers during the construction of the project components	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	The cost is undefined, depending on the cases	Occupational health clinic / hospital
Monitoring archeological disturbance during construction of the	Record of any artifact or antiquities found during construction	Project site	Recording and documenting and reporting to the relevant authority	On findings	-	contractor

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
project components						
Monitoring of ecological disturbance during construction of the project components	Records about biodiversity found, removed, handle over to relevant authority, damaged or replanted	Project sites	Recording and documenting and reporting to the relevant authority	monthly	-	contractor
Storage of the machines and construction materials of the project components	Complaints from neighboring communities and records and documentation of the temporary area for storage of materials or machineries	Project sites	Recording and documentation	monthly	-	contractor
During Operation / Maintenance						
Groundwater monitoring plan for recovery water and reuse scheme	Presented below at separate subsection				22,400 The cost based on the identified monitoring wells monitored for four times a year and yearly water level monitoring presented in the monitoring plan section below	PWA
Recovered water reuse for irrigation purposes	Recording and documentation of agriculture production,	Nearby community and farms connected	Sampling collection or survey, recording and documentations	Annually	18,000 The cost based on annual survey and	MoA in coordination with MoH The irrigation

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
	endemic or health related diseases due to recovery water usage on agriculture	with recovery water distributions			documentation purposes but excluding the emergency response for the endemic emergency plan or health related disease related to the recovered water reuse (that is not expected) In addition the cost include the analysis samples of crops and soil at the pilot areas (please note, the water for irrigation is excluding as it is monitored from the groundwater monitoring done by PWA)	water monitoring is done by PWA; MoA and MoH will be responsible for reviewing the results
Monitoring of public health due to recovered water effluent reuse	Presented below at separate subsection				8,000 The cost is related to the recording from different hospitals and	MoH in cooperation with MoA

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
					agricultural centers and random survey for public health conditions on the area of reuse	
Monitoring sludge quality for reuse purposes	Presented below at separate subsection				Cost estimates is including on the operation and maintenance of the NGWWTP. It is estimated that the cost estimation will be around 10,500 as the 5 times sludge monitoring for two weeks period for 6 times a year	NGWWTP sludge management in cooperation with PWA (PMU)
Operation of Pond # 7 of BLWWTP (related to the emergency response plan due to failure)	Presented below at separate subsection				Cost estimated to be allocated during the Emergency plan should be discussed between PWA and CMWU. However,	CMWU

Project activities	Parameters to be monitored	Locations	Measurements (methods and equipment)	Frequency of measurements	Cost Estimates ($)**	Responsibilities
					allocated budget should be kept at CMWU will be around 30,000 USD (under CMWU) to cover the mentioned activities during the Emergency.	

Table 6.3 Social Management and Monitoring Plan

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
During construction						
Reduction of sewage water that some of the farmers relied upon to water their plants.	• Provision of recovered water of a competitive price to minimize the potential impacts • Awareness raising programs to be provided to the adjacent communities in Beit Lahia	PWA Legislation Entities	PWA internal monitoring MENA external monitoring Ministry of Agriculture	1- Site visits observation show that no farmers use sewage water 2- Increase the number of participants in the awareness raising activities 3- Photos for awareness events 4- No Grievances received related to this impacts	Monthly monitoring checklist Monthly monitoring checklist Monthly monitoring checklist	No additional cost as all activities lie under the direct supervision of each entity
Involuntary resettlement	• Apply strict avoidance mechanism in order to reduce resettlement activities to only necessary ones, and avoid small plots of land • Develop Resettlement Policy Framework to be the foundation for a Resettlement Action Plan • Provide appropriate compensation strategy through the RAP • Develop and enforce efficient consultation strategy with the	PWA In cooperation with the municipalities, Awqaf and Land Authority	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	1- Documentation of all procedures applied to minimize the PAPs show that the affected people were appropriately considered 2- Grievances received and how they were responded to 3- Lists of affected people 4- Lists of consulted affected people 5- Photos for different activities implemented with the PAPs 6- Documents related to affected people identification and how they were compensated 7- Post impact report results	Documentation for all mitigation and relocation Reports developed (Resettlement Policy Framework and/or Resettlement Action Plan)	No cost as all activities are part of PWA activities

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
	community people in order to reach the appropriate compensation that will be based on Laws and the desire of people • Providing compensation to the land owners, tenants, house owners, tenants, or provision of alternative lands					
Potential risk for the communities in the adjacent areas due to having no fence around pond 7	A fence should be constructed around the pond with protective wire at the top of fence in order to keep children away	PWA & Contractor	The PWA in cooperation with the local municipalities should monitor the guards in the areas until the completion of the fence construction	1- Site visits should be paid in order to warrantee that the fence is well established 2- Grievances received from the communities adjacent the fence will be reduced 3- Reduction in number of accidents resulted due to the construction of fence	Documentation of the site visits. Grievances from community people and municipalities	No cost
Community Disturbance impact during the construction of the carrier pipe. The fumes	• Provide the needed information to the community • Follow all mitigations mentioned under	Contractor PWA (HSE supervisor)	PMU in the PWA	1-Grievances received from the adjacent communities related to this impact are reduced 2-Intervention reports to minimize the impacts declared that they are mild	Site visits to be paid to the sites Documentation for site visits results Grievances from the community	No cost

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
and dust affect the health of people in the adjacent area	environmental management plan			3-environmental measurements and analysis are under the acceptable ranges 4-Reports developed by the supervisor showed that the impacts are in compliance with the environmental standards of the EQA and the WB		
During operation						
Due to the unfavorable Odor, mosquitoes and flies might affect the health of communities adjacent to the infiltration ponds	• The flies should be combated by using environmentally hygienic procedures • Awareness raising programs should be developed to reduce the impacts due to having such insects	PWA in cooperation with the Ministry of Health	MENA in cooperation with the PMU in the PWA should monitor the implementation of mitigation measure	1- MENAs surveillance reports show no impact 2- Increase the number of combating campaigns 3- Enhancement in the health of communities adjacent the infiltration pond 4- Site visits show that no flies in the area	Monthly reports Health centers reports	No cost
Negative impact on the livelihood of the chemical fertilizers' traders.	• Try to integrate the labor force working in this sector in newly developed sludge trading. In addition, awareness raising programs about the benefits of sludge should be provided	PWA with traders	MENA in cooperation with the Ministry of Agriculture and the PMU in the PWA should monitor the	1-No grievances to be received from their side 2-How many of them were included in the project 3-No impact on their source of income reported 4-Increase in the awareness activities provided 5-List of participants for those	Monthly reports	No cost

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
			implementation of mitigation measure	who attended awareness session 6-High demand for the sludge		
Negative impact on the livelihood of the operators of wells and owners of wells	• The operators should be provided with job opportunities in the project • Well owners should be provided with subsidized water from the project and from the fresh water provided by the municipality • Full compensation for the cost of well digging	PWA Municipality	PWA and the municipalities	1- No grievances to be received from their side 2- Number of well operators employed 3- Their level of satisfaction with their new job 4- Site visits to the affected people	1- Compensation identification sheets 2- List of job opportunities provided to well operators 3- Receipt for the well owners that he got his full compensation	No cost
Put limitation to the plantation of certain crops in the beneficiaries who will use the recovered water	• Orientation sessions should be presented to raise farmers awareness regarding the type of crops that should be planted using recovered water	PWA Ministry of agriculture	PWA	1- Increase the number of the farmers received awareness sessions 2- Registration sheets 3- Orientation sessions materials to be provided and published on the PWA website 4- Well documentation for all activities 5- Decrease the number of grievances received	1- List of participants 2- Photos 3- Minutes of sessions	No cost
The construction of	• As the main disturbance will be from the Odor, all	PWA	PMU within the PWA	1- No grievances received 2- Site visits show no rejection	1- Site visits to be paid to the sites	No cost

Impact	Mitigation measures	Responsibility of mitigation	Responsibility of direct supervision	Monitoring Indicators	Means of supervision	Estimated Cost of supervision
the pond near the El Shuhada Cemetery will cause some discomfort to the families of the deceased during the burial ceremonies.	procedures should be taken (environmental procedures) to minimize the Odor			to have the project close to the cemeteries	2- Documentation for site visits results 3- Grievances from the community	
Potential health hazards on the people eating the raw crops from fields	• Orientation sessions should be presented to raise people awareness regarding the type of crops that should be planted using recovered water	PWA in cooperation with the Ministry of Agriculture and NGOs	PWA	1- Reduction of the number of affected people 2-Orientation materials prepared and presented to people 3-No grievances reported related to this impact	1- List of participants 2- Photos 3- Minutes of sessions	No cost

6.6 Monitoring Plan and their indicators and Emergency / Risk Plan

There are indicators related to the environmental and social monitoring plan and guidelines. To avoid the negative impacts, groundwater, sludge reuse, public health indicators' concerns is prepared. In addition, the emergency plan related to the emergency situation when the sludge does not meet the standard required for reuse, the emergency response plan and failure of Pond # 7 at BLWWTP, failure due to the energy of the NGWWTP resulted on the quality of the sludge as well as the security risks of the storage tanks' due to sabotaged because of the site is within the buffer zone of Israeli border were assessed.

6.6.1. Groundwater Monitoring Plan

A comprehensive groundwater monitoring plan is prepared to maximize the expected positive impacts on the groundwater and monitor these impacts with adequate frequency. The plan is prepared to safeguard against unexpected delays during construction of the wastewater treatment plant and the recovery scheme. EIA, 2006 study proposed a groundwater monitoring plan consisting of 5 monitoring wells surrounding the infiltration basin.

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.

6.6.1.1. 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 hydro geologic conditions and anticipated contaminant pathways. Figure 8.1 shows the recommended locations of the monitoring wells which were set up based on the location of the recovery wells.

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 should be 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 and used to monitor the infiltration basin. In addition, the recovery wells will be part of the monitoring network as shown in Figure 6.1. Notice that the monitoring network proposed in the design of recovery scheme project was found appropriate.

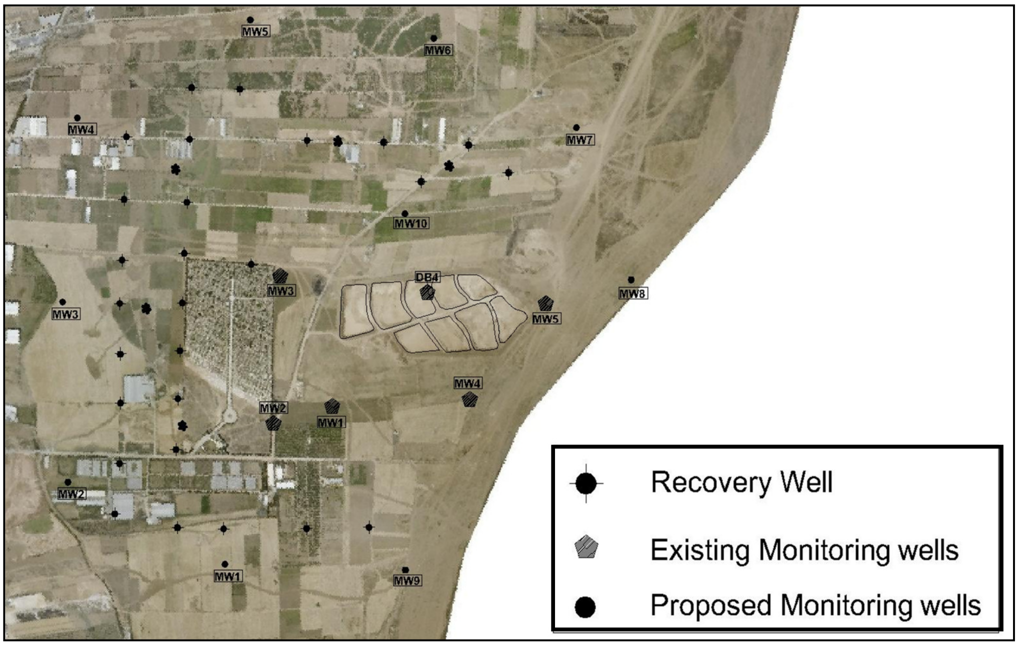


Figure 6.1 Monitoring wells locations

6.6.1.2. 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. The consultant made extensive reviews of similar projects such as the Gosh Dan Project where several parameters are monitored. Among these parameters, the consultant proposed in Table 6.5 some parameters which could reflect the status of groundwater after infiltration of partially treated wastewater and could be analyzed in Gaza Strip laboratories.

Table 6.5 Monitored Parameters and Frequency of Monitoring

Parameters	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

Parameters	Frequency of Monitoring
Ammonia as N	Four Times a year
NO3	Four Times a year
T.N	Four Times a year
Cl	Four Times a year
Detergent	Four Times a year
F.C	Four Times a year
Phosphorus	Four Times a year
Heavy Metals	Four Times a year
Mg	Four Times a year

6.6.2. Sludge Monitoring Plan

6.6.2.1. Sludge sampling location

Sewage sludge samples must be representative of the final sewage sludge that is land applied. To achieve this goal, samples must be representative of the entire amount of sewage sludge being sampled, collected after the last treatment process, and taken from the same, correct location each time monitoring is performed.

Sampling locations should be as close as possible to the stage before final land application. In the NGWWTP, the sewage sludge should be sampled at the storage area from the sludge that has completed the 100 days storage period. For the sample to be representative, it should be a composite of samples from many locations within the storage area and at different depths. This sampling location is essential since a decision should be made at this point either to send the sludge for land application for agricultural use or to landfill disposal.

6.6.2.2. Sludge Monitoring Plan

The produced sludge from the NGWWTP shall comply with USEPA Rule 503 Class A sludge. Consequently, it is recommended to follow the monitoring requirements stated by the same rule. According to Rule 503, monitoring of sewage sludge that is applied to land should focus primarily on sludge characterization to determine heavy metals concentration, pathogen density, and vector attraction reduction. Required monitoring includes:

1. Monitoring of sewage sludge for 10 heavy metals (As, Cd, Cr, Hg, Mo, Ni, Se, and Zn) to determine heavy metals levels in the sludge compared to Class A maximum permissible limits as given in Table 8.5.
2. Monitoring to determine pathogen concentrations (Fecal coliforms, Salmonella**,** Viable nematode eggs, Intestinal viruses) compared to Class A maximum permissible limits as given in Table 8.5.
3. Monitoring to ensure that conditions for vector attraction reduction (VAR) are maintained. VAR is met by reducing volatile solids by over 38 percent. Five samples of sewage sludge are analyzed for volatile solids content over a period of two weeks.

Minimum frequency of monitoring for heavy metals, pathogen requirement and vector attraction depends on the amount of sewage sludge used or disposed annually. The monitoring frequency according to USEPA Rule 503 is given in Table 6.6.

Table 6.6 Frequency of monitoring for Heavy metals, pathogens, and vector attraction reduction according to USEPA Rule 503

Amount of sludge t ds/year	Monitoring Frequency
0< sludge amount <290	Once per year
290≤ sludge amount <1500	4 times per year
1500 ≤ sludge amount <15000	6 times per year
15000 ≤ sludge amount	12 times per year

According to the design report, the NGWWTP will produce 3100 t ds/year at the starting year and 7665 t ds/year at its full capacity. This means that the sludge production in NGWWTP lies in the interval that requires a monitoring frequency of 6 times per year according to USEPA Rule 503 (Table 6.5), for its entire lifespan. It is worth mentioning that the Palestinian draft standards for sludge use adapt the same monitoring frequency requirements in accordance with USEPA Rule 503.

Regarding vector attraction reduction (VAR): Anaerobic systems (such as the system used in NGWWTP) reduce volatile solids by 35% to 60%, depending on the nature of the sewage sludge and the system's operating conditions. Sewage sludge produced by systems that meet the operating conditions specified under Part 503 will typically have volatile solids reduced by at least 38%, which satisfies vector attraction reduction requirements. Five samples of sewage sludge should be analyzed for volatile solids content over a period of two weeks to guarantee that the minimum reduction volatile solids are 38%.

6.6.3. Energy Demand, Plan of Energy Source Sustainability and Response Plan of Energy Shortage

Operation and maintenance of the treatment plant and the distribution network need a sustainable and reliable energy source as the power failure can degrade the quality and quantity of the network. In regards of the unreliability of the energy source in Gaza Strip, the PWA and CMWU as the main responsible entity for operation of NGEST and NGWWTP are preparing the plan for sustaining the energy sources and secure the reliability of the demand of the system. In addition, the emergency plan concerning the power failure are also prepared and planned[8] for:

a. Terminal Pumping Station (currently operated to transport the wastewater from BLWWTP to the infiltration basins)
b. NGWWTP
c. Recovery and Reuse

Currently, at the terminal PS of BLWWTP, to pump the wastewater to the infiltration pond, with daily rate of maximum 15,000 m^3/d, there are 5 available pumps with capacity of 314 kVA each. To safeguard the future operation of the basin, since May 2009 till December 2012, it is recorded the average daily energy consumption is 2200 kWh

[8] The detailed energy demand estimation are presented in the design report of NGESTP (for the recovery and reuse) and the design report of NGWWTP as well as EIA for NGWWTP

It is expected that the treatment plant will need 2 MVA for its energy consumption. In addition, for the overall recovery and reuse system, 6 MVA will be needed during the operation. The recovery system, as designed, will be divided into 2 phase that need 2.4 MVA for phase 1 and 3.6 MVA for phase 2. The energy demand estimation is presented in detailed on the designer report for NGESTP recovery and reuse system and NGWWTP.

Energy sources and emergency plan related to the power failure are developed to maintain the operational of the reuse system. Currently for the PS at BLWWTP, the required energy is provided through existing transformer that is connected to the local electricity network (1.6 MVA). For NGWWTP, up to 0.8 MVA (around 40% of the total energy demand) is reserved via one gas generator based on the gas from 2 digesters within NGESTP. In addition, around 2 MVA will be reserved through 2 transformers (1.6 each) from GEDCO network. Concerning the effluent recovery and reuse, up to 2.4 MVA will be reserved from GEDCO network.

Currently, there are discussions among the donors (WB and other NGEST donors) for possibility from Israeli side to provide NGEST project with the electricity through separate deed coming directly from Israeli side with total of 12 MVA.

Power outages and power breakdown is consider a norm for some part of Gaza Strip. Accordingly, as the power sustainability is an important role for operational of the reuse system, to secure the power demand and sustainability, the emergency plan has been developed by PWA:

- For existing PS at BLWWTP; In case of electricity failure from local network, there are existing 2 standby diesel generators with capacity of 900 kVA. However, one generator is already sufficient to maintain operational load required. The second generator is reserved for the full load capacity.
- For NGWWTP; In case of electricity failure from local network, 3 standby diesel generators with capacity of 800 kVA each will be operated at NGWWTP. This power generation is sufficient to maintain operation load of the entire plant.
- For Recovery and Reuse System; In case of electricity failure from local network, 2 standby diesel generators with capacity of 500 kVA each will be operated for phase 1 while 3 others with 500 kVA to be used during phase 2. This power generation is sufficient to maintain operational load of the entire system.

6.6.4. Emergency Response Plan (ERP) for Operation of Pond # 7

During the operation of NGESTP, Pond # 7 at existing BLWWTP will be remained as the emergency pond during the overflow. The original lagoon, concerning the pond structure, it can be preserved as it is without any measures. However, additional structure (the replacement of the aerator pumps from the existing aeration lagoon to the pond #7), fences and trees around the remaining BLWWTP, as mentioned at the previous chapter, Chapter 5, will be installed to reduce the odor, mosquitoes, safety and the aesthetic impacts. However, the emergency response plan is developed to mitigate the emergency case due to the failure of the Pond # 7.

An emergency is generally defined as a situation that arises suddenly and that can have considerable negative consequences, if fast and effective corrective measures are not taken.

The Emergency Response Plan (ERP) is a document that provides a step-by-step response to, and recovery from, incidents related to situations of emergency. The ability of wastewater utility staff to respond rapidly in an emergency will help prevent unnecessary complications and protect the people's health and safety. It may also save money by preventing damage to the wastewater systems.

The expected emergency situation that may be encountered under the scope of this study is related to the sudden failure of pond # 7, as it will be used as an overflow pond for the North central pumping station after the decommissioning of the BLWWTP. The following is an illustration of the response plan for the anticipated emergency situation.

6.6.4.1. Emergency Response Plan for Pond #7 Failure

The emergency plan consists of the following components:

1. Facility description.
2. Definition of the emergency situation
3. Risk assessment
4. Crises management center and assigning emergency personnel
5. Emergency response actions
6. Testing the emergency response plan
7. Emergency budget availability.
8. Incident investigation and documentation

The following is description of the emergency plan components.

a. Facility Description

According to the plans, the existing pond # 7 will be kept after the decommissioning of the BLWWTP to be used as an overflow pond for the North central pump station. The area of this pond is 28,820 m^2; its water depth is 5 m and has an approximate storage volume of 145,000 m^3. The pond will be empty under normal situations. Since the recent daily wastewater inflow to the treatment plant is 26,000 m^3/d, the emergency storage capacity of pond #7 is 5.5 days when the central pumping station is completely broken. However, at the design year of the pumping station the flow will increase to 35,000 m^3/d and the storage capacity will decrease to 4 days.

b. Definition of the Emergency Situation

1. Failure of embankments due to heavy rains event.
2. Failure of embankments due to increase of the wastewater level in the pond during the failure of the North central pumping station.
3. Failure of embankments due to possible air strikes during military clashes that usually occur in the BLWWTP vicinity.

c. Risk Assessment

The main expected risks that will be created due to the failure of pond #7 are:

1. Loss of lives of some of the workers in the North central pump station.
2. Loss of lives of farmers and residents in the vicinity especially at the western side of the pond.
3. Destruction of the crops and killing livestock in the farms west of the pond.
4. Soil pollution and possible groundwater pollution since the full storage of the pond is 145000 m^3 which is a considerable amount.
5. Public health deterioration in the vicinity of the pond.

d. Crises Management Center and Personnel

A crises management center (CMC) should be prepared and equipped with all the necessary communication means to be used for the management of the emergency situation. It is proposed to establish this center in the building of the North central pumping station. A stand by generator should be available in the CMC and wireless communication devices since during emergency the CMC will not rely on the existing systems in the pump station. The CMC should contain the following documents:

- Hard copy of the ERP.
- Hard copy of "Emergency Call Lists" (proposed list illustrated in Table 3)
- Hard copy of "Building and Site Maps" (effluent pond # 7 and the detailed pumping station plans including power control plans)
- Hard copy of "Resource Lists" (equipment available and there location, contractors, suppliers,..)

The proposed Crises management unit personnel are as follows:

1. Crises Manager.
2. Communication officer.
3. The pumping station manager.
4. The pumping station operator.
5. CMWU wastewater chief officer.

The crises manger should be a well experienced person who is involved in the water and wastewater sector and should be selected by PWA and CMWU. The communications officer can be selected from the public relations officers already working in PWA or CMWU. The other members of the crises management unit are already working in the wastewater system and occupying the mentioned titles. Table 6.7 indicates the sample of the emergency call list for Pond#7 during the crises.

The responsibility of the crises management unit is to activate the ERP and to implement the emergency response procedures as stated in the next item.

Table 6.7 Emergency Call List for Pond # 7 Crises

Agency to be called	Person to call	Phone numbers
Civil defense	Person name to be filled and regularly updated	Phone # To be filled and regularly updated
Ambulance station	//	//
Ministry of health	//	//
Environmental Quality Authority	//	//
Police department	//	//
Mayors of North municipalities	//	//
Ministry of local government	//	//
Neighbors of the pond	//	//
Media (TV and Radio stations)	//	//
Pre-qualified contractors	//	//

e. Failure Emergency Response Procedure

The following is a brief description of the emergency procedures to be followed:

1. The CMU manager activates the crises management center and calls the CMU members to the center. A situation assessment is to be conducted to see the crises magnitude and to figure out the needed assistant and the parties to call to the site.
2. The communication officer should communicate with all the related parties especially the population in the vicinity to alert them so that they can help in avoiding any risk that my reach them.
3. The first priority should be given to the evacuation of any injured or trapped population.
4. After saving the population or any trapped workers, the priority should be to contain the spill and isolate the spill site in an effort to avoid any human contact that may result in health hazards.
5. A public relation campaign should start immediately to calm the population who may lose their properties or even lose family members or get injured. This campaign should be directed by the CMU and implemented by the public communication officer with the help of community leaders and selected government officials.
6. The next step should be to eliminate the cause of the failure of the pond's embankment. If the failure was due to heavy rain, the rebuild work will start when the weather conditions gets better. If the failure is due to military actions, a coordination with the international organizations to help in reaching the site and manage the crises. If the failure is due to a technical problem in the North central pump station, all required technical staff and resources should be mobilized to get the station working again.
7. Spill clean should then start by evacuating the wastewater and the sludge using vacuum tankers, portable pumps, trucks and front loaders. The evacuated wastewater can be transferred by vacuum tankers and emptied at the inlet works of the NGWWTP.
8. Rebuilding the embankment by supplying the required soil and the construction equipment. Pre-qualified contractors trained for emergency conditions should be employed to repair the embankments.

f. Testing the Emergency Response Plan (drill)

Regular testing of the ERP is very important. The purpose of conducting the exercise (drills) is to ensure that the ERP is functional and to train the crises management unit and the employees and all related bodies.

The main goals and objectives of the exercises are:

- To reveal weaknesses in the plan
- To identify shortages in material and personnel
- To improve coordination between various people and organizations
- To gain confidence in the organization's leadership and stability
- To improve knowledge, skills, abilities, and confidence of employees
- To ensure that personnel understand roles and responsibilities
- To improve the relationship between the organization and the local government
- To enhance overall emergency response capabilities

It is recommended to make at least one drill per year to guarantee the preparedness of all the involved persons and agencies and to assure the reliability of the ERP.

g. Emergency Budget Availability

An emergency budget should be allocated and kept in the account of the CMWU so that the crises manager can respond rapidly to the crises financial needs. The budget should be estimated based on the expected resources that will be needed during the crises such as fuel, emergency contractors, first aid and shelters to the population, etc… Moreover, the support of relief agencies may be used but needs preset agreements and memorandums of understanding (MOUs) to grantee the commitment of these agencies during the crisis.

h. Incident Documentation and Investigation

The emergency situation should be documented by the CMU. All reports, photos, video tapes, and communications during the crises should be properly filed and kept. An investigation should immediately start after the recovery from the crises to draw conclusions and to minimize future similar incidents. The investigation team should be formed by PWA in coordination with the related governmental bodies such as the Ministry of local government, Civil defense, Ministry of public works and ministry of Justice.

6.6.5. Risks to the treatment plant structures and its operation related to the sludge quality

6.6.5.1. Power failure

Power failure may occur during the operation of the NGWWTP either partially or completely leading to the deterioration of the quality of both treated water and sludge.

In case of complete power failure it is expected that wastewater will not be pumped (from the North central pumping station) to NGWWTP and the overflow pond at the BLWWTP (pond #7) will be used to store the sewage until the power failure problem is fixed. In this case no sludge (nor water) will be produced in out of the treatment plant.

Partial power failure may occur when the main power supply is cut and the treatment plant can use the gas storage available in the gas holder. The estimated power (according to the design report of NGWWTP) storage in the gas holder is 9750 kWh/day (6.5 kWh/Nm^3 X 1500 m^3) which will not be sufficient to cover the daily power consumption of 25360 kWh/day at the startup year (only 38% of daily power demand). This gas storage will be enough to operate the treatment plant at full capacity for 9 hours only then a complete power failure will occur. So, the treatment plant management should have an emergency plan in this case to fix the power problem in this available time. The sludge quality during the partial power failure will not be affected since the treatment plant will be operating at its normal conditions in terms of treatment processes.

Another option that may be adapted during partial power failure is reducing the air supply to the oxidation ditches (by 50% for example) since the air blowers are the main power consumer (16317 kWh/day; 64% of the power). This option will give the opportunity of increasing the time of the treatment plant operation to around 13 hours.

However, this option may negatively affect the quality of the secondary sludge due to the low oxygen supply. Nevertheless, since the time of power shortage is relatively short, and the sludge will be dewatered and digested anaerobically, the sludge quality will not be significant. In all cases, the sludge quality following the power shortage should be carefully monitored as illustrated in section 7 of this report and to dispose it to landfill in case it does not meet the standards of sludge use for agriculture.

6.6.6. Public Health Related Monitoring Plan for Using Recovery Water (treated wastewater)

6.6.6.1. Objectives

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

6.6.6.2. Parameters to be measured

- **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, NO3, SO4, Cl, TDS, BOD, COD, Fecal Coliform, Oil and Grease, Benzene, Organic Compound (Trichloroacetaldehyde, Propionaldehyde, Phenol, AtrazineDimethoate, Chlorpyrifos).

- **Soil**

The following parameters should be measured in the soil once a year:

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

- **Crops**

The following parameters should be measured in crops at the harvesting period: Arsenic, Cadmium, Chromium, Lead, Nickel, Copper, Zinc, and Atrazine

- **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.

6.6.6.3. Data Base Management

The collected data has to be stored in a data-base for further analysis, interpretation and development of information packages for the different stakeholders.

6.6.7. Security Risk (especially for the Storage Tanks and Booster Pumps)

The location of the storage tanks and booster pump is within the buffer zone of the Israeli borders. The location has a high security risk in addition to the height of the tanks; there is possibility to be sabotaged by the Israeli Military. This sabotage might damage partially or overall infrastructure.

For the prevention of the misperception of the infrastructure, the clear sign that can be seen from above need to be written above the storage tanks with the colorful phosphoric paints to be able to differentiate between other infrastructures surrounding. In addition, the phosphoric paint can be seen during the dark or in the night.

The concrete wall with no leakage is recommended to be built around the storage tank to avoid the spillage that can cause flooding to the surrounding areas. In addition, the stones can be place from the tank to around 2-3 meters to allow the water to be infiltrated to the groundwater. To avoid the water running to the Cemetery, the sloop to the direction of the North West of the site is recommended. In addition, if there is land availability, the open channel (earthen channel) can be built to accommodate the overflow. This channel is to be connected with other drains (at nearest drain with sufficient capacity)[9].

6.6.8. 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 is implemented by the Project Management Unit.

In order to achieve this monitoring system the following personnel are needed:

- The Compensation Committee is responsible for the valuation of the compensation, and should be assessed by the governorates during the process of compensation.

[9] Please note, some of the parameters should be monitored especially for the groundwater quality for irrigation is already included in the groundwater monitoring. However, the coordination between PWA and MoA are needed to determine the monitoring responsibility.

- In addition to that, a social officer should be hired in order to do the following tasks as part of the monitoring system.

6.7. Required Human Resources and Training

PMU-EM and SDO is 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 in socio-economic issues, with a strong background in involuntary resettlement and public awareness campaigns.

Site supervision is also needed. For back to back activities, it is recommended to have 2 staff under supervision. In addition, site supervision helps in documentation and recording during the project phases.

After completion of the construction phase, another staff is needed for follow up operation and maintenance including recording and documentation for the effluent recovery system. For the operation of the effluent lake, after complete removal of residual contaminant from the soil, the land returns back to El Awqaf for future use, and the remaining pond is similar to the existing set up. The table below summarizes the training needed for human resources of the effluent recovery system.

Table 6.8 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, MoH and WWDU (new entity for water distribution of reuse system – still under development)	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
Training on Emergency Plan (due to the risk of operation of Pond 7 for overflow and due to the Security Risk of the storage tank)	Description of Emergency Response Plan and the training and exercise of emergency plan	Once before implementation and annual training	PWA (PMU) and CMWU	25,000 annually	Classroom and On Job Training
Social assessment, community communications and community survey and inspections	Communication skills, mass communications, social survey, sampling, analysis and reporting	Once before implementation and once every two years	PWA (PMU), CMWU, Private organizations, NGO and farmer's associations (Union for Agriculture and PARC)	25,000 per sessions	Classroom with field visits and exercises.

6.8. ESMP Budget

The ESMP matrices presented in Tables 6-1 and Monitoring matrices presented in Table 6.2 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 has 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 6-1 to 6-9 are included in the project budget.

It is worth nothing that it has been assumed that NGWWTP has an equipment laboratory to carry out wastewater analysis and sludge analysis. In addition, as the design of the treatment plant has an odor treatment, the air emission monitoring activities especially for H_2S recommended in the ESMP as a part of the project budget.

CHAPTER 7 THE PUBLIC CONSULTATIONS

The project is characterized by the importance and considerable weight given to socio-economic dimensions. The SESIA, thus, was produced in a highly participatory manner that managed to fully engage stakeholders groups. The SESIA is particularly sensitive to the interests of the primarily affected vulnerable groups like land owners and farmers who is restricted from access to their source of livelihoods, using the effluent recovery for reuse in their agricultural land and the local population near the project sites.

Consultation and participatory techniques were employed during the process of the SESIA preparation. As indicted under Chapter 2 of the SESIA, the methodology of the preparation of the SESIA involved a bottom-up approach that depended on a diverse range of tools to serve the objectives of the various parts of the SESIA. The Consultant accessed large amounts of quantitative and qualitative information from various primary and secondary sources.

The key consultation activities during the course of the project could be divided into the following:

7.1 The Scoping and Preparation of the SESIA

As a part of the project introduction and the understanding of its components and methodologies during the study process of the Supplementary ESIA for North Gaza Emergency Sewage Treatment Project (NGESTP), a scoping session was conducted in Gaza on Tuesday, July 10, 2012.

The scoping phase was attended by a wide range of stakeholders including various municipalities, International Organization in Gaza Strip (representative of UNICEF and the local representative of UNICEF), Academic, NGOs, local communities, Palestinian Water Authority, Ministries, Consultants (The German Consultant was attended besides the local partner) and Contractors of the new wastewater treatment plant; North Gaza Wastewater Treatment Plant (NGWWTP).

The Consultation started with registration at 9:00 AM as scheduled. During the registration, besides filling the registration form, the Consultant distributed a handout of the presentation in Arabic and the comment sheet to be filled for the public consultation general remarks and the feedback to the Consultant.

The session was initiated by the Moderator (Dr. Abu Shaban) where the highlights, objectives and the aim of the public consultation were addressed.

The Introduction and the objectives of the project details were explained by Eng. Sadi Ali, head of PMU from PWA. The initial background of the project and ESIA findings of NGESTP including cost estimates were also explained. In addition to that, the study initiation for supplementary Environmental and Social Impact Assessment were explained.

Furthermore, the SESIA objectives and methodology were presented by Eng. Dewi Rimayani Hanoum and Ms. Zaenab Hafez, the wastewater treatment expert and socio economy expert, respectively. After finalizing the detailed methodology for ESIA, before opening the discussion, the workshop of the stakeholders that were held on Sunday and Monday, 15 and 16 of July were discussed by the moderator. The workshop is a part of the stakeholders' consultation to receive the comments and inputs for completion the ESIA study. The workshop findings are incorporated as a part of community participations during the ESIA study.

Participants' analysis as well as key conclusions during open discussion is presented in details in the following sections.

7.1.1. Description of participants

Consultations with various groups of stakeholders have started at the earliest of the SESIA processes. Besides the scoping session (public consultation) different scoping periods were conducted through a comprehensive structured survey, in-depth interview, Semi Structured Interviews (SSIs) and Focus Group Discussions (FGDs) with various types of stakeholders. The attendees were asked to fill in a comment sheet in addition to active participation during the discussion.

Table 7.1 Main Stakeholders attended the first PC

Stakeholder	Role
Palestinian Water Authority	Responsible for protection of water resources and the responsible authority for the project implementation
Farmers Community	Farmers are at the center of this project, as the main beneficiaries of the reuse scheme
Palestinian Land Authority (PLA)	Responsible for land ownership/ usage and responsible for applying eminent domain principle
Ministry of Agriculture	Responsible for providing guidelines and expertise on cropping patterns
Ministry of Health	Protection of public health
Environmental Quality Authority EQA	Responsible for, provision of expertise and ensuring environmental protection and providing guidelines and regulations for the cultivation using treated wastewater.
Coastal Municipal Water Utility	Responsible for protection of costal water within Palestinian territory
Donors or International organization (UNICEF)	Responsible for, providing some guidance to enhance study methodology and data collection if needed
NGOs (Agricultural Relief Committee (PARC), Union of Agriculture Work Committee (UAWC)	Two of the major NGOs working in agriculture related issues
Contractor and supervisors of NGWWTP (the German Consultant and their local partner)	General description of the treatment plant enhancement (if needed)
Local community members/ and municipalities	Those whose land will be taken (purchased or otherwise) for the project and nearby communities close to BLWWTP (the existing station)

70 people were invited among different institutes and stakeholder. 46 were responsive to the meeting, among which 19.6% were females (9 persons) and 80.4% were males (37 people).

Municipalities were the main responsive to the invitation as their communities might be at risk due to the implementation of the project. As the study should be modified according to this meeting, consultation firms attended including the contractor and the consultant supervisor for NGWWTP. 10.9% of the participants were among universities with 4.3% among environmental institutes who might provide the needed guidance for the study team. Funding organizations, banks and International support entities were invited to enrich the social study aspect (the representative from UNICEF was among the attendees).

The invitations were organized by the Consultant and facilitated by PWA by sending the individual invitations through electronic mails. In addition, the Consultant invited neighboring communities to the project sites through individual invitations. Copy of the first public consultation invitation and agenda, the list of the session participants and scanned copy of the comments' sheets and minutes of the meeting (in Arabic) are presented in Annex 12.

As it is mentioned above, the aim of the scoping session (first public consultation) is to present the project, scope of work and methodology of the ESIA as well as obtain participants' feedbacks on the issues that the Consultant should pay attention to during the course of ESIA.

7.1.2. Key Conclusions from the Scoping Session

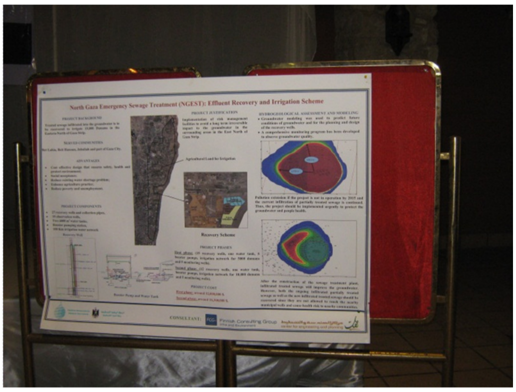
The following wraps up the main issues, comments and recommendations raised by the participants during the discussions. These conclusions were considered in preparing the ESIA:

- The sludge is planned to move to the landfill has to be informed and the reported to the relevant authority
- The project is a promising water experience for water recovery and the municipality of Gaza will benefit from the project.
- Monitoring system of the groundwater is included in the project and the results is submitted to the Ministry of Agriculture (MoA) and Ministry of Environment (MENA)
- More comprehensive institutional study for reuse scheme is being develop and the ESIA the management and monitoring plan including the responsibilities of different activities shall be included as a part of SESIA
- The project is developing with energy sustainability. The new wastewater treatment plant, NGWWTP will benefiting from the self sustains energy consumption by using the methane gas produced by the sludge.
- Certainly there will be a probability for land acquisition, therefore; land acquisition will be mentioned in the ESIA but the ESIA detailed study for Resettlement Action Plan (RAP) will be prepared later on that containing 7 main elements (description for the project, effected group and vulnerability, the impact of the project and mitigation measures, graveness mechanism and corresponding to it, cost estimation for the compensation, legal and institutional framework for land acquisition). The responsibility of ESIA study is responsible to develop the ToR for RAP further study will be developed if needed.
- For the continuation of the project, the fund is completely available for the treatment plant for phase A and the recovery scheme and we received many promises for phase B from AFD and WB and other international donors. There is an international interest to revive the agriculture sector there is no worry about the funding.
- Part of the ESIA's task is to analyze both positive and negative impacts for the decommissioning of BLWWTP and measure this impact on the livelihood of the communities. In case of finding the negative impact,

mitigation measures will be develop and implemented to reduce such unfavorable impact.

- The lands focusing on Awqaf and governmental property have been reviewed. However, around 2 dunums are needed to the private land (it is relatively a limited area) and this will be applied with maximum mitigation measures in order to compromise with the land owners.
- The treatment plant will produce a huge quantity of sludge and gas according to the first study sample from sludge and soil which was analyzed and no indication of heavy metal occurred. Nevertheless,, the sludge shall be re investigated during this study.
- All technical assistance will be provided for the staff and the operators during the first couple of years as well as a lab inside the treatment plant to analyze all parameters. Currently PWA tries to analyze the capacity in order to identify the gap.
- It is a pleasure as PWA to coordinate with the PARC and the Agriculture Union as part of the active players for the reuse scheme and it will defiantly cooperate with.
- The time plan is explained in details. It is estimated that the draft study will be presented by the end of September by another Public Consultation for presenting the findings, management and monitoring plan as well as the cost estimation for the management and the monitoring plan.

Scoping Session Preparation



Displays at the Scoping Session Hall

Scoping Session Participants

Scoping Session Participants

Figure 9.3. Public Consultation (scoping session)

7.2. Consultation through surveying and participatory tools

Consultation with various groups of stakeholders has been carried out during the scoping period through a comprehensive structured survey, in-depth interviews and FGDs with various types of stakeholders as explained in more details under Chapter 2 on the ESIA methodology.

The information describing the current situation of wastewater networks, irrigation practices, crops at the irrigation land to be irrigated with the recovery water as well as the predictions of the negative and positive impacts of the project were gleaned from active contributions of different stakeholders. The findings of the survey, FGDs and SSIs are presented in details in Chapter 5. In addition, the willingness surveys and the tariff cost surveys were conducted during the preparation of SESIA and presented in detailed in the Annex 9; Detailed of Socio Economic Methodology, Baseline Environment and survey tools and Willingness to pay survey results, cost analysis and tariff results.

Although the water distribution network planned to be installed on El Awqaf land, however, there is indication that the involuntary resettlement will be triggered. Therefore, the involuntary resettlement were identified during the preparation of the study and presented in detailed in Chapter 12, ToR for RAP. In addition, the ToR has been prepared as well as the involuntary resettlement is triggered and confirmed.

The main findings from the consultation activities are briefly summarized below

1- The community people were much in favor for the New Project due to the solving of water problems in Gaza Strip. Water problem for the majority of participants include the disposing of sewage, the quality of the underground water and scarcity of water,
2- The most important finding is that the community people is not reluctant to use the recovered water or the sludge, however, they have some concerns regarding the quality of water and its impact on their health,
3- Regardless of water quality the community were not reluctant to irrigate vegetables and fruits with the recovered water, as this might be more profitable to them,
4- The well owners and land owners affected by the project were opponent to land acquisition and termination of their wells. Restriction to use wells was one of the motives to raise the negative response against the project,
5- There was no foreseen any religious motives that might hinder people from using the recovered water. However, the need of awareness raising sessions regarding the Islamic Religion point of view regarding the utilization of recovered water and sludge

7.3. Public Consultation of the SESIA (Second Public Consultation)

The Consultation started with registration at 9:00 AM as scheduled. During the registration, besides filling the registration form, the Consultant distributed a comment sheet to be filled for the public consultation general remarks and the feedback to the Consultant.

The session was initiated by the Moderator (Eng. Zohair, head of UG Gaza, the Local Team Leader) where the highlights, objectives and the aim of the public consultation were addressed.

The Introduction and the objectives of the project details were explained by Eng. Sadi Ali, head of PMU (PWA). The initial background of the project and ESIA findings of NGESTP including cost estimates were explained.

Furthermore, the SESIA results were presented by the following experts:

Dr. Tarek Genena	Team Leader
Eng. Dewi Rimayani	Wastewater Expert
Dr. Fahd Rabah	Sludge Management and Reuse Expert
Dr. Ayman George A.	Groundwater and Modeling Expert (via video)
Ms. Amal Faltas	Resettlement Expert
Ms. Zeinab Hafez	Socioeconomic Expert

The presentation, in Arabic and in English is presented in Annex 13 as well as the copy of the registration forms, minutes and other related documentations.

After the presentations, the short break was held and afterward an open discussion was held with the stakeholders. Participants' analysis as well as key conclusions during open discussion will be presented in details in the following sections.
Consultations with various groups of stakeholders have started at the earliest of the SESIA processes. Besides the scoping session (first public consultation), different scoping periods were conducted through a comprehensive structured survey, in-depth interview, Semi Structured Interviews (SSIs) and Focus Group Discussions (FGDs) with various types of stakeholders. The attendees were asked to fill in a comment sheet in addition to active participation during the discussion. The following table, table 7.2 present the stakeholders attended the second public consultation.

Table 7.2 Main stakeholders attended the Second Public Consultation

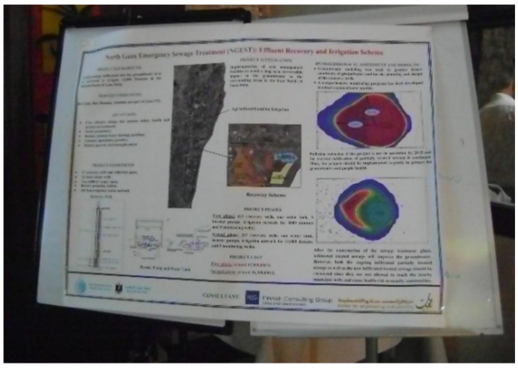
Stakeholder	Role
Palestinian Water Authority	Responsible for protection of water resources and the responsible authority for the project implementation
Farmers Community (PAPS)	Farmers are at the center of this project, as the main beneficiaries of the reuse scheme
Ministry of Agriculture	Responsible for providing guidelines and expertise on cropping patterns
Ministry of Health	Protection of public health
Environmental Quality Authority EQA	Responsible for, provision of expertise and ensuring environmental protection and providing guidelines and regulations for the cultivation using treated wastewater.
Coastal Municipal Water Utility	Responsible for protection of costal water within Palestinian territory
Donors or International organization (representatives from UNDP and UNRWA)	Responsible for, providing some guidance to enhance study methodology and data collection if needed
NGOs (Agricultural Relief Committee (PARC), Union of Agriculture Work Committee (UAWC)	Two of the major NGOs working in agriculture related issues
Contractor Union	Support the contractors in Gaza
Local community members/ and municipalities	Those whose land will be taken (purchased or otherwise) for the project and nearby communities close to BLWWTP (the existing station)

Up to 80 people were invited among different institutes and stakeholders. 53 of them were responsive to the meeting, among which 17% were females (9 persons) and 83% were males (44 persons). It is worth noting that the enthusiasm of the international agency (UNDP and UNRWA) toward the project, including the public consultation process is positive. The farmers and community's involvement and participation through the study process were appreciated.

The distribution of the participants and their main objectives is as follows:

- Municipalities (15.1%) were the main responsive to the invitation as their communities might be affected due to the implementation of the project.
- 17.0% of the participants were from the PWA as they will response to people worries and comments.
- Many farmers and well owners attended the meetings in order to inform the PWA about their worries and complain due to the termination of their wells and the expropriation of their lands. NGOs were represented by three people.
- Awqaf sent one representative.
- The Coastal Municipalities, Electricity Company Environmental Quality Affair, and Ministry of Agriculture and Ministry of Local Government were the representative of governmental institutes.
- Universities also were represented by 4 people (3 of them were students).
- Press people attended the meeting.
- It was noted that the International Institutes were represented as WHO and UNDP sent 3 people.
- Young people attended the meeting as representative from different institutes, especially universities and NGOs.

The invitations were organized by the Consultant and facilitated by PWA by sending the individual invitations through electronic mails. In addition, the Consultant invited neighboring communities to the project sites through individual invitations. Copy of the public consultation invitation and agenda is attached in the Annex 13 as well as the list of the session participants, presentations and the comments sheets.



Information poster by the PWA

Banner of the Second PC

Introduction by Eng. Sadi Ali PWA | **Introduction About the Study by Eng. Zohair (Consultation Firms)**

Participants | **Environmental Results by Dr. Tarek Genena**

Sludge management by Eng. Fahd Rabah | **Socioeconomic impacts by Ms. Amal Fatlas**

Project impacts and vulnerability by Ms. Zeinab Hafez | **International Agencies**

Discussion and comments | **one of the participants' comments**

Figure 9.4 Second Public Consultation

Based on the consultation processes; especially during the public consultation, both scoping phase and the second public consultation, the table below, Table 7.3 presents the summary of the stakeholders concerns raised during the public consultations.

Table 7.3 Summary of the Stakeholders and consultations results

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
The first Public Consultation			
Effluent recovery and reuse			
Water recovery	The model was planned and implemented for the recovery well that was used to irrigate the trees in 10 streets. We wish to have a share for Gaza city in the 27 wells (based on the design of the recovery) that belong to the project.	The project is a promising water experience for water recovery and the municipality of Gaza will benefit from the project.	
	Is there any type of monitoring of the infiltration and the quality of groundwater?	There will be a complete monitoring system and there is a study for the groundwater before the injection during 2008 and afterwards the basins started operating and it is analyzed 5 times annually and the results were provided to the Ministry of Agriculture and Ministry of Environment.	
	To operate the treatment plant (NGWWTP) the energy consumption is high and we have a shortage in electricity. Is there any consideration for the energy consumption?	The treatment plant needs around 3 MW and it is independent (60% of the energy consumption coming from the methane gas produced by the sludge). In addition, there are 4 standby generators that equally operate the treatment plant with full capacity that will be available. In the meantime, PWA still negotiating with the Israeli government to provide the treatment plant with the electricity, in addition, a funding agency (Islamic Bank) tried to provide the electricity from the Egyptian side.	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	The treated water is of excellent quality. Why is recovering underground water needed with it adding up extra costs?		
	Some experiments for the reuse of treated water were applied on different crops and produced good results but there is potential drawback if any increase or decrease in nutrient containment occurs. There is an ongoing study on this precise issue. Also, the PWA's plan to cultivate 5,000 different crops using treated water, recommends cooperating together in order to share the experience.	It is a pleasure as PWA to coordinate with the PARC and the Agriculture Union as part of the active players and it will defiantly cooperate with you through the Consultant.	
	Some of the wells are located at the east of Gaza (Israeli site), this issue should be taken in account	Some of those wells will be addressed and investigated.	
	Who will cover the operation costs in the future?	The operation cost was estimated during the study and the stakeholders will be contacted to define the mechanism needed for the operation cost; it is a project of high importance in Palestine. The water project is of a lot of significance , therefore , the desalination of sea water and the reuse of treated water is to be reconsidered	
Sludge reuse	The sludge is planned to move to the landfill and there is no information about sending it to the landfill.	The vast majority of the sludge is usable thus; the consultant during the impact assessment will address this issue through predicting the quantity of sludge that should be sent to the landfill. After that the draft report of the ESIA would be sent to	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
		the Municipality and stakeholders.	
	It is assumed that sludge produced is not much. Have you studied the land to use the sludge and the quality of the land and to what extend is it needed for the sludge land.		The treatment plant will produce huge quantity of sludge and gas according to the first study sample from sludge and soil which was analyzed and no indication of heavy metal occurred. Nevertheless,, the sludge shall be re investigated during this study.
Decommissioning of BLWWTP			
	The BOD resulted from the treatment plant might be used in agriculture. Is there any possibility for direct reuse or not?	Direct use is a bit costly. It is needed to add more ingredients. Therefore, the water injection to the groundwater is more acceptable to people as it is now considered as groundwater not the treated wastewater. In addition, the direct reuse needs bigger tanks to store the water. The second option will be even more costly.	
	Having the basin in BLWWTP attracted the attention to the people surrounding the site, moving the basin will reduce the attention paid to the community in Beit Lahia. The funding agency will pay less attention to the surrounding area		Part of the ESIA's task is to analyze both positive and negative impacts for the decommissioning of BLWWTP and measure this impact on the livelihood of the communities. In case of finding the negative impact, mitigation measures will be develop and implemented to reduce such unfavorable impact.
Remediation works			
	The issue of mosquitoes and its impacts of the	There will be no water services produce	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	treatment plant shall be put into consideration.	mosquitoes. Infiltration basins will not remain in more than a 2-3 day retention time.	
Institutional framework			
	What is the institutional framework for the reuse of treated water and what is the difference between this project with NGESTP and BLWWTP. Will the authority be for the management of treated water?	The current study for institutional framework is not agreed upon. We requested a more comprehensive study from the Consultant. Furthermore, regarding the ESIA there will be a clear institution.	
Other issues raised			
	Will it be continuity for the funding project implementation entirely	The fund is completely available for the treatment plant for phase A and the recovery scheme and we received many promises for phase B from AFD and WB and other international donors. There is an international interest to revive the agriculture sector there is no worry about the funding.	
	Did you develop and prepare the capacity building and the resources to run this project?	All technical assistance will be provided for the staff and the operators during the first couple of years as well as a lab inside the treatment plant to analyze all parameters. Currently PWA tries to analyze the capacity in order to identify the gap.	
	The time plan is not clear	The time plan is explained in details. It is estimated that the draft study will be presented by the end of August or the beginning of September by another Public Consultation for presenting the findings, management and monitoring plan as well as the cost estimation for the management and the monitoring plan.	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
Land acquisition			
	Will people be consulted for the land acquisition issue?		Certainly there will be a probability for land acquisition, therefore; land acquisition will be mentioned in the ESIA but the ESIA detailed study for Resettlement Action Plan (RAP) will be prepared later on that containing 7 main elements (description for the project, effected group and vulnerability, the impact of the project and mitigation measures, graveness mechanism and corresponding to it, cost estimation for the compensation, legal and institutional framework for land acquisition). The responsibility of ESIA study is responsible to develop the ToR for RAP further study will be developed if needed.
	Land acquisition is not acceptable. The focus is to have the government land or Awqaf owned land.	The lands focusing on Awqaf and governmental property have been reviewed. However, around 2 dunums are needed to the private land (it is relatively a limited area) and this will be applied with maximum mitigation measures in order to compromise with the land owners.	
The Second Public Consultation			
Effluent recovery and reuse			
Water	Was there a study for the Cd?	Moving Nitrate is part of the national strategy to	The SESIA covered the Cd

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
recovery	The average of Nitrate in the North Plant, Was there a study on the Nitrate?	enhance water quality. In addition we have a desalination station for sea water that will provide 110 million cubic meters during the second phase.	There is no specific study for Nitrate
	Methane Gas will provide only 60% of the electricity needed for the new plant. How will you find the rest of 40% of electricity	In order to have enough electricity we still negotiate with the WB, AFD, Israel and Egypt.	
	Recovered water should be distributed free of charge	I don't accept to distribute water for free in order to sustain the project. Cost recovery is essential for the project. It will be impossible to maintain and operate the project unless we have sustainable source of income	
	Cd is not a problem in North Gaza due to the nature of the soil		
	Did you consider similar projects i.e. North Gaza project that cares about tree irrigation using the recovered water	This should be taken into consideration	
	Will the recovered water be useful to irrigate strawberry?	Recovered water is suitable to irrigate vegetables as it will be injected to the underground water	
	Can you tell us about the groups of people approved to use recovered water and sludge?		The study covered the following groups: farmers (consumer of water) wholesalers (consumer of vegetables and fruits) and customers (end consumer of vegetables and fruits) In addition to applying questionnaire with them some FGDs were conducted with them for further detailed information

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	What is the source of the Cd?	Cd is a heavy metal resulted of fossil fuel combustion, phosphate fertilizers, natural sources, iron and steel production, cement production and related activities, nonferrous metals production, and municipal solid waste incineration. Bread, root crops, and vegetables also contribute to the cadmium in modern populations.	
	We need some detailed information about the quality of water		All measurements are included in the study
	We need to have a feasibility study about the potential revenue	We developed a feasibility study for the project	
Sludge reuse	Can the sludge be mixed with the composting? It will be more comfortable to people if you mix the sludge with compost Will the sludge be sufficient to fertilize the soil or other substances will be needed		Mixing sludge with composting will be considered in this study
	We (EQA) will recommend not to use the sludge for uncooked food during the first year		
Decommissioning of BLWWTP			
	One of the negative impacts is the Asbestos, Is the landfill prepared to dispose Asbestos in?		The landfill in Johr Eldeek is prepared to dumb Asbestos in
	I don't think we have Asbestos, it is just the old pipelines		
	Please consider the importance of the Emergency Basin	We will consider it	
	Kindly consider the aerator of pond 7, the fence and the pipeline.	We will coordinate with Beit Lahia Municipality to build the fence and rehabilitate the pond	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	We signed an agreement with the Red Crescent to build a fence around pond 7		
Remediation works			
	What is the cost of moving the harvested plants that will be used to remediate the soil to Johr Eldeek landfill and what is the cost of moving the surface soil	The cost of moving the harvested plants versus the cost of moving the soil will be considered	
	The basins in Beit Lahia should be stopped working, especially basin number one	The pumping of water to the basin is essential to secure the new project during emergency.	
Institutional framework			
	Regarding institutional framework we need detailed one on how to collect the sewage water, how to recover and distribute it.	We have a full study about the institutional framework, (still draft)	
	Will the municipalities be able to operate the project	We still revise the institutional study	
Other issues raised			
	There should be a training and guidance to the farmers on how to use recovered water Farmers should work under organizations or NGOs in order to provide them with the guidance through such institutes		Training is essential to the farmers. This is part of health and safety plan Integration of the farmers in unions will be more viable to provide the training through such organization.
	For the ESMP you mentioned consultation with the governmental agencies what about the civil society?		The NGOs and CPOs will play an important role in the project due to awareness raising and training activities
	What about the emergency plan The implementation of the project was delayed do you have an emergency plan?	We have developed an emergency plan. Thus pond 7 was retained	

Project component	Brief Description Question raised	Response of the PWA - PMU	Response of the ESIA consultant
	We ask the PWA to check my well that is located nearby the new TP. Foams cover the surface of water	We will send someone from the PWA to investigate your well immediately	
	Can we compare the same project with similar ones in the Middle East?		The SESIA contained comparison between Egypt, Jordan and Israel
Land acquisition and resettlement activities			
	Our lands will be affected due to the project how will we be compensated? The prices of lands were reduced due to having the project The operators of wells who used to work for over 20 years now, what will they do?		All lands that will be affected due to the project will be clearly investigated, in addition to other project affected people. A Resettlement Action Plan (RAP) should be prepared. All affected people will be addressed; valuation of their affected assets, appropriate strategies of compensation will be highlighted. That will include the wells owners and operators
	According to the agreement between Awqaf department and the PWA the lands of the remediated plant should have been handed to the Awqaf in 2008, until now we received no lands. What will happen afterwards? The recovery wells are about 6 in Awqaf lands, what will you do to take the lands needed for the wells, will you rent or buy the lands?	We had an agreement with Awqaf, but as you know the delay in implementation resulted due to the political situation was the main problem we faced. In addition, we have a good relation with the Awqaf who are so supportive to the project. I had several meetings with HE the Minister of Awqaf.	

Annex 1

The Consultancy Term of References

The Consultancy Term of Reference

The Consultancy Term of Reference (ToR)s identify the objective of the study as to "undertake an independent Supplementary Environmental and Social Impact Assessment (SESIA) of the proposed Reuse system, Remediation Works and Decommissioning of Beit Lahia Wastewater Treatment Plant (BLWWTP)". Eight tasks have been identified in the ToRs, in addition to a special task concerning sludge management, as follows:

Task 1. Description of the Proposed Project: Provide a full description of the project location; general layout; unit process description and diagram for rehabilitation/new components; population served, present and projected; number and types of connected households; water supply characteristics, adjacent facilities and communities, natural, or cultural facilities close to project site; existing/new road or other supportive infrastructure.

Task 2. Description of the Environment: Assemble, evaluate and present relevant baseline data on the environmental characteristics of the study area.

(a) *Physical environment*: geology (general description for overall study area and details for land application sites); topography; soils (general description for overall study area and details for land application sites); monthly average temperatures, rainfall and runoff characteristics; description of waters bodies (identity of streams, springs, wadis, groundwater, water quality; existing discharges or withdrawals).

(b)Biological environment: identify and describe any terrestrial communities, rare or endangered species; sensitive habitats, including parks or reserves, significant natural habitats, in areas affected by construction, facility sitting, land application or disposal;

(c)*Socio-cultural environment*: present and projected population; present land use/ownership; planned development activities; community structure; public health as it relates to water use; tourism; cultural properties.

Task 3. Legislative and Regulatory Considerations: Describe pertinent Palestinian national, municipal, and local laws, regulations and standards governing environmental quality, pollutant discharges to surface waters and land, industrial discharges to public sewers, water reclamation and reuse, agricultural and landscape use of sludge, health and safety, land use control, etc.

Task 4. Determination of the Potential Impacts of the Proposed Project: In this analysis distinguish between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts that are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental and/or social costs and benefits. The environmental and social impacts should be classified for both the construction and operational phases of the project. Although not exhaustive, the main impacts to be investigated are:

(i) Impacts on water supply and water quality;

(ii) Impacts on the local agriculture industry;

(iii) Impacts on vehicle, donkey, foot traffic, and commerce in the project areas during the construction period;

(iv) Construction-related impacts (noise, dust, debris, increased accidents) during the construction phase;

(v) Impacts related to construction of the effluent reuse pipeline, well field, and pumping of the effluent from beneath the infiltration ponds. Specific attention should be given to the possible impact on existing wells of groundwater level drawdown that may be caused by the effluent recovery wells;

(vi) For the decommissioned site, explore consequences of keeping the site open including examination of safety issues for children;

(vii) Public health benefits anticipated.

Task 5. Clarify the project social impacts including on issues related to involuntary resettlement:

- Briefly describe who are the affected communities;
- Summarize positive and adverse social impacts that will be accrued by community members;
- Clarify what the permanent and temporary land requirements of the project are in specific relation to land ownership, land use, access to properties, or livelihood as it relates to access to properties, most notably in and around the path of the construction including lands for access roads and reservoirs in the recovery well areas;
- Summarize both positive and adverse effects of various land taking scenarios including PWA rental of private lands, willing-buyer, willing-seller option, or voluntary land donations in exchange for specific project benefits (i.e, municipality employment);
- For each project intervention (e.g. pipelines, wells, pumping stations, reservoirs) clarify all direct economic and social impacts caused by the involuntary taking of land (if any) resulting in: relocation or loss of shelter; loss of assets or access to assets; loss of income sources or means of livelihoods (regardless of whether the affected persons must move to a new location)
- Summarize Palestinian legislation on the acquisition of land through eminent domain principle.
- Conduct a rapid assessment of community's willingness and ability to pay for services, with special attention to more vulnerable households (poorer families, widows, disabled persons). This would include detailing social impacts of the effluent reuse scheme, subsequent tariff collection, and system efficiency;
- Examine the institutional arrangements for the reuse scheme including how water will be allocated at individual household/farm levels, with specific attention to the equitable distribution of water, including the community understanding of these resources will be presented;
- Examine potential livelihood issues arising from a change in hydrology caused in the water regime. Attention will be given to whether farmers will be negatively impacted

by the draw down resulting from the 27 wells. How does this compare to the overall benefits accrued?

- Assessment of the demand for reused water (a rapid assessment of the willingness and ability to pay is included in the ToR but the demand should be assessed as well);
- Current type of crops on the 1,500 ha targeted by the Project;
- Forecasted type of crops on the 1,500 ha targeted by the Project, which are dependent on the below questions:
    1. What are the sanitary regulations related to this use?
    2. If the expected quality of the treated water might restrict the type of crops to be irrigated, an analysis of the social and economic impacts should be done (since some farmers might be affected).
- Methodology of follow-up of the physical-chemical quality of the treated effluent (after treatment and before reuse);
- Methodology of follow-up of the healthy conditions of the stakeholders (operators and farmers). An epidemiologic comparison should be put in place to detect a potential impact of the Project;
- Emergency plan if a technical problem is faced on the WWTP (implying a low quality of the treated water);
- Awareness campaign on sanitary issues for workers and population who will consume the products grown on the 1,500 ha.

Task 6. Development of an Environmental and Social Management Plan (ESMP)

Prepare a detailed plan to monitor the implementation of each mitigating measurement that corresponds to a negative impact of the project during rehabilitation/construction as well as operations. Include in the plan an estimate of capital and operating costs and a description of other inputs (such as training and institutional strengthening) needed to implement the plan. Review the authority and capability of institutions at local, provincial/regional, and national levels and recommend steps to strengthen or expand them so that the EMP may be effectively implemented. Assess compensation to affected parties for impacts that cannot be mitigated.

The ESMP should include (but is not limited to):

- Construction management mitigation to manage the disposal of construction waste generated in an environmentally-friendly manner. Likewise, 'lifecycle management' recommendations for materials being replaced should be included, as Gaza has a serious solid waste management problem;
- A fugitive dust control mitigation plan should be prepared to control fugitive dust emissions during construction activities;
- A noise control mitigation plan to control noise impacts on the surrounding communities during construction activities;

- Traffic control mitigation plan to minimize the disruption of daytime traffic flows along important access roads;

In summary, the ESMP should include the following: a proposed work program, budget estimates, schedules, staffing and training requirements, and other necessary support services to implement the mitigating measures, as well as a detailed monitoring plan. This monitoring plan will include for each mitigation measure who is the responsible party for mitigating the impact, how often the mitigating measure should be assessed, as well as a monitoring indicator and parameters.

The ESMP should identify one or two "key indicators" from the monitoring plan that may be used as overall "safeguard indicators" in the project-level Results Framework as a measure of general environmental and social safeguard performance.

An outline of the contents of the ESMP to be included in the project's Operational Manual should be provided along with environmental/social protection clauses for contracts and specifications.

Task 7. Assist in conducting Stakeholder Consultations: Following the identification of key project stakeholders (affected communities and farmers, relevant NGOs, among others), the consulting firm will assist PWA in coordinating ESIA-specific consultations with relevant stakeholders likely to be affected, both positively and negatively, by the proposed project. As this project has been assessed as a World Bank environmental category A, these stakeholders should be consulted once a draft ESIA has been prepared and an executive summary of the ESIA will be publicized both prior to and after these consultations. The draft ESIA should also be available in a public place accessible to affected groups and local NGOs.

Relevant materials will be provided to affected groups in a timely manner prior to consultation and in a form and language that is understandable and accessible to the groups being consulted. The consultant should maintain a record of the public consultation and the records should indicate: means other than consultations e.g. surveys used to seek the views of affected stakeholders; the date and location of the consultation meetings; a list of the attendees and their affiliation and contact address; and summary minutes.

At least two public hearing workshops shall be arranged; the first one shall be EA scoping before the inception report. The program should describe approach, frequency, and substantive issues to be discussed with concerned stakeholders. A public hearing should be held for presenting the findings and recommendations of the consultant at the end of the EA process.

Special Task: Sludge Management:

Sludge management resulting from the North Gaza Wastewater Treatment Plant and intended to be used in the agricultural land as detailed in the effluent recovery and reuse scheme or in emergency cases to be dumped to landfill should be incorporated into Tasks 3-7.

Potential concerns might include:

(i) various environmental (soil, land, water, and air) impacts relating to disposal and/or agricultural use options;

(ii) environmental health concerns, including the composition and extent of heavy metals exposure during disposal and/or transport and potential agricultural use;

(iii) social and distributional impacts, whereas, if there is agricultural demand for the sludge, how will the sludge be distributed i.e. will be given away freely, or rather sold, at what price, to whom, and to whom will the proceeds accrue?

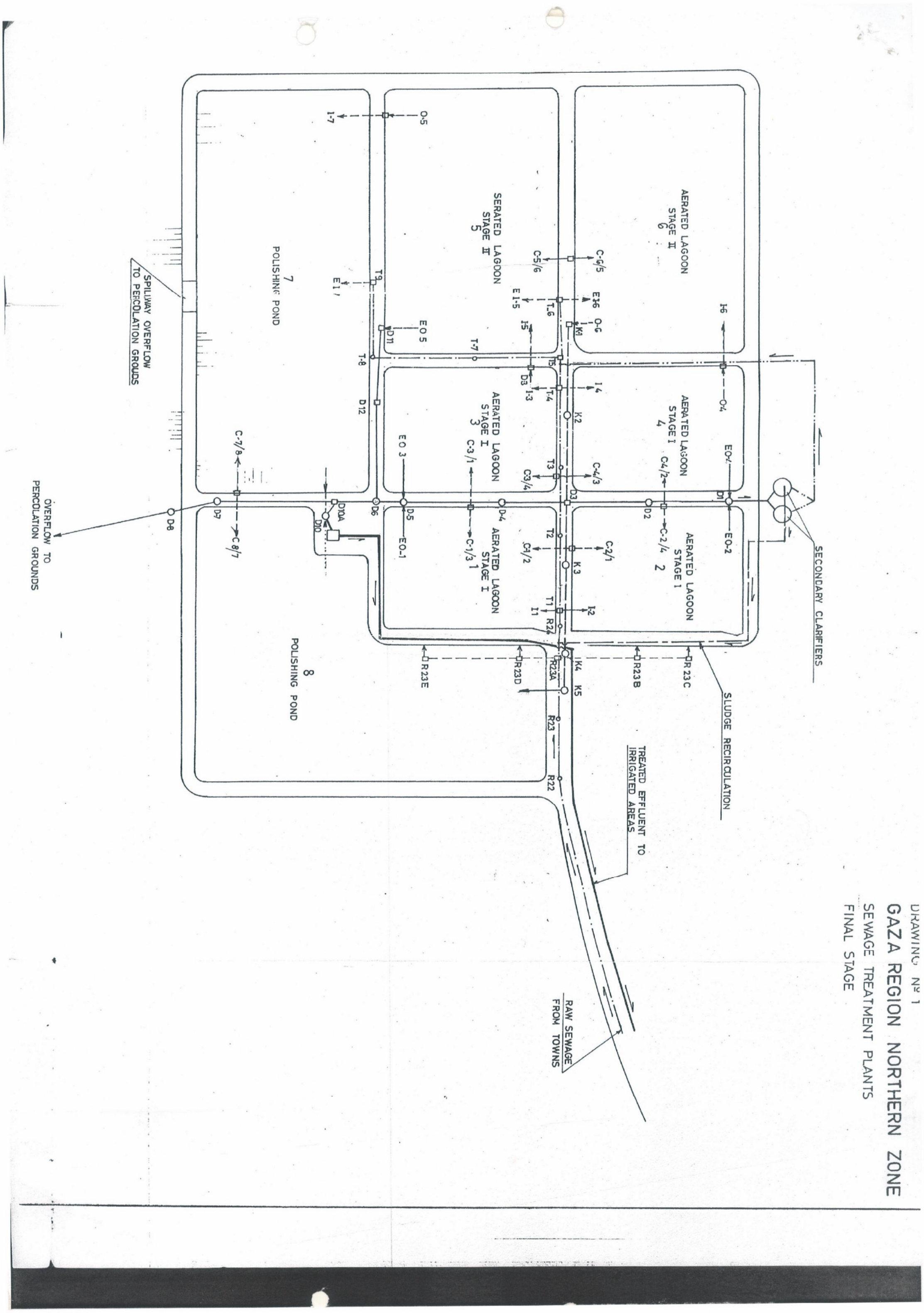
(iv) Public awareness concerning sludge use: if the sludge is indeed given away and/or sold, how will the consumers be made aware of the composition of the sludge and suggested rules for its application.

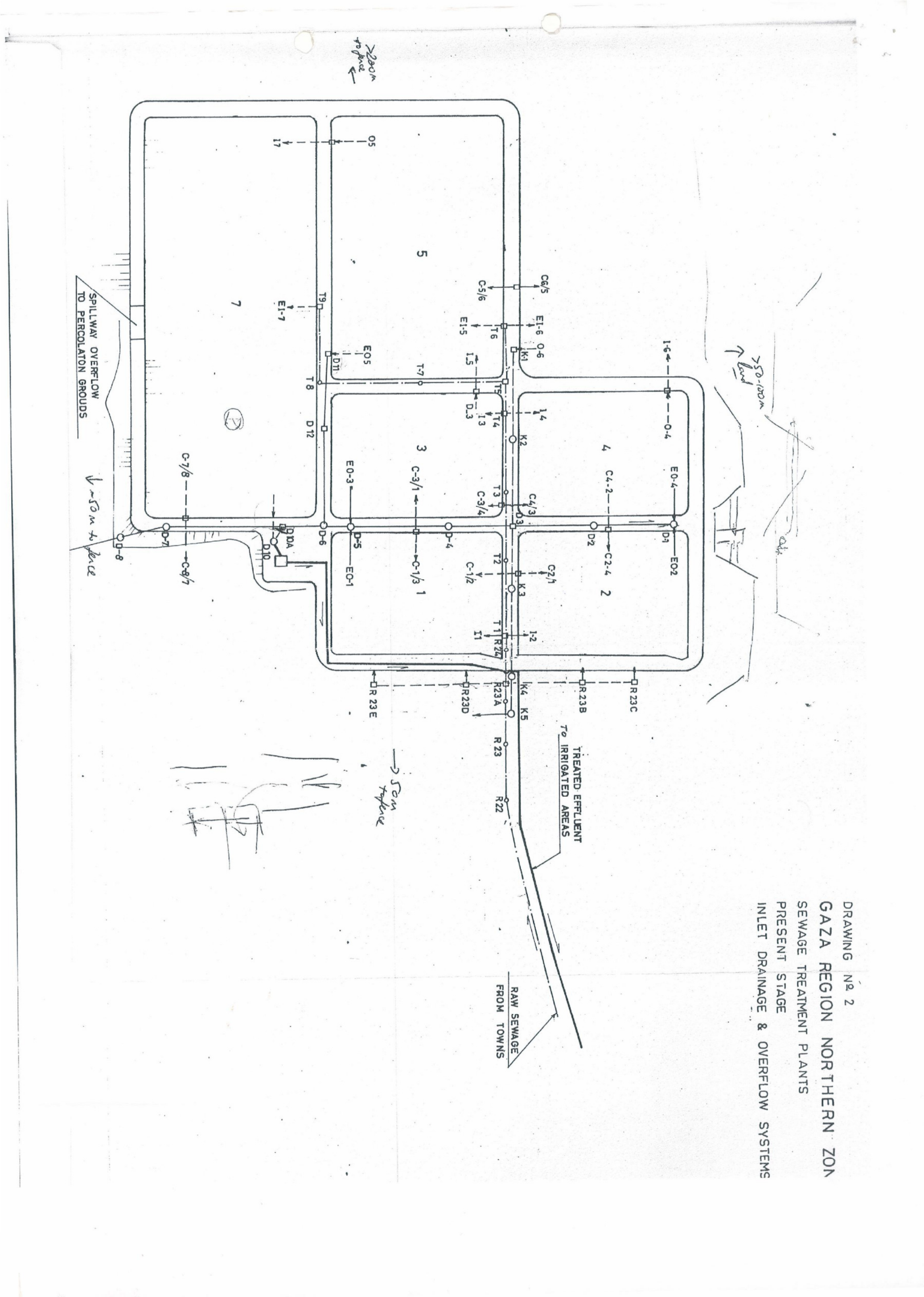
Task 8. Development of draft terms of reference for preparing a Resettlement Policy Framework (RPF) / Resettlement Action Plan (RAP), if required: If the firm's analysis of the temporary or permanent land acquisition that is anticipated to occur determines that OP/BP 4.12 is triggered, the firm will develop and provide draft terms of reference for preparing a RPF / RAP.

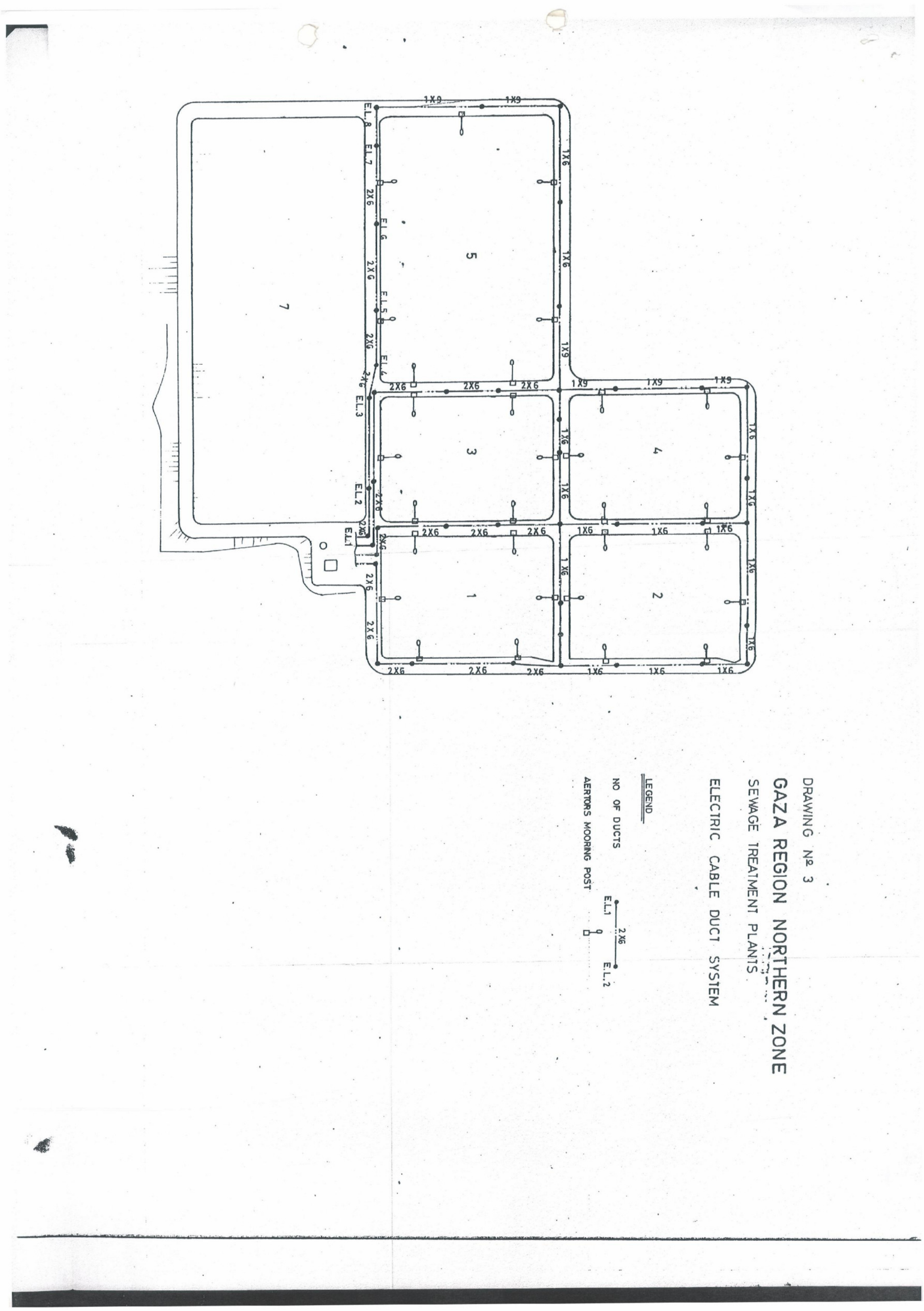
Annex 2

Layout plan of BLWWTP and Water Distribution Networks

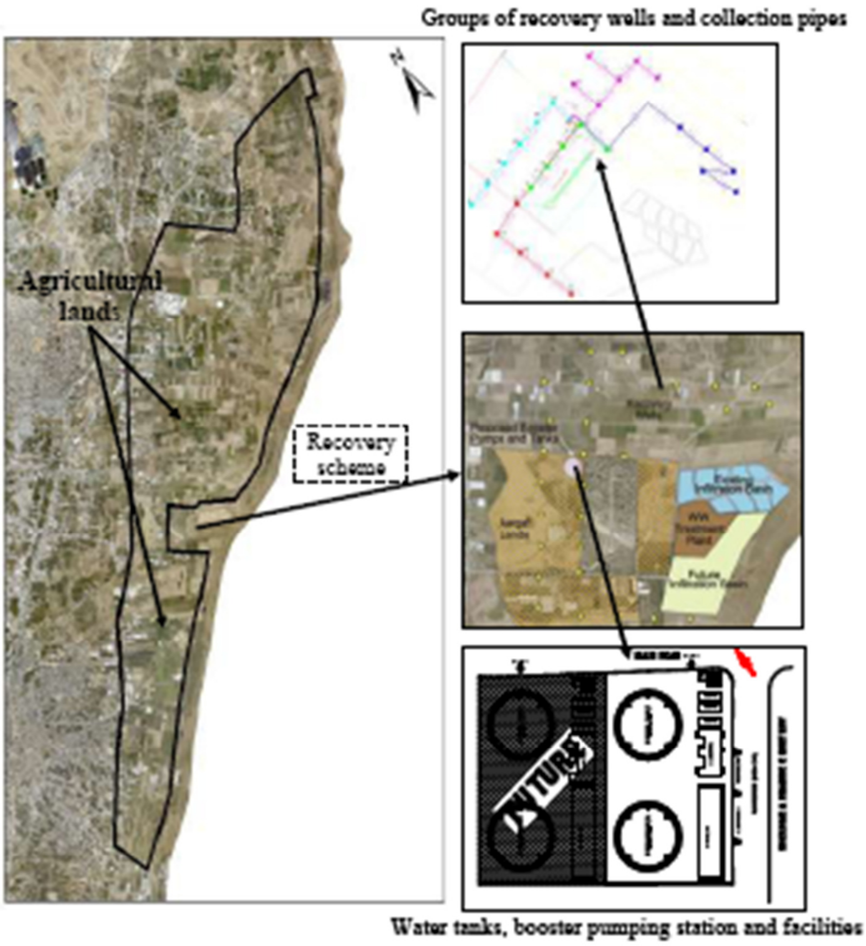
Beit Lahia Wastewater Treatment Plant


DRAWING Nº 1
GAZA REGION NORTHERN ZONE
SEWAGE TREATMENT PLANTS
FINAL STAGE
AERATED LAGOON STAGE II 6
SERATED LAGOON STAGE II 5
7 POLISHING POND
AERATED LAGOON STAGE I 4
AERATED LAGOON STAGE I 3
AERATED LAGOON STAGE I 2
AERATED LAGOON STAGE I 1
8 POLISHING POND
SECONDARY CLARIFIERS
SLUDGE RECIRCULATION
TREATED EFFLUENT TO IRRIGATED AREAS
RAW SEWAGE FROM TOWNS
SPILLWAY OVERFLOW TO PERCOLATION GROUDS
OVERFLOW TO PERCOLATION GROUNDS


DRAWING Nº 2
GAZA REGION NORTHERN ZON
SEWAGE TREATMENT PLANTS
PRESENT STAGE
INLET DRAINAGE & OVERFLOW SYSTEMS
TREATED EFFLUENT
TO IRRIGATED AREAS
RAW SEWAGE
FROM TOWNS
SPILLWAY OVERFLOW
TO PERCOLATON GROUDS


DRAWING № 3
GAZA REGION NORTHERN ZONE
SEWAGE TREATMENT PLANTS
ELECTRIC CABLE DUCT SYSTEM
LEGEND
NO OF DUCTS
AERTORS MOORING POST

Effluent Recovery and Reuse Scheme



Location of the physical components of the recovery and reuse scheme

CLIENT

PALESTINIAN NATIONAL AUTHORITY

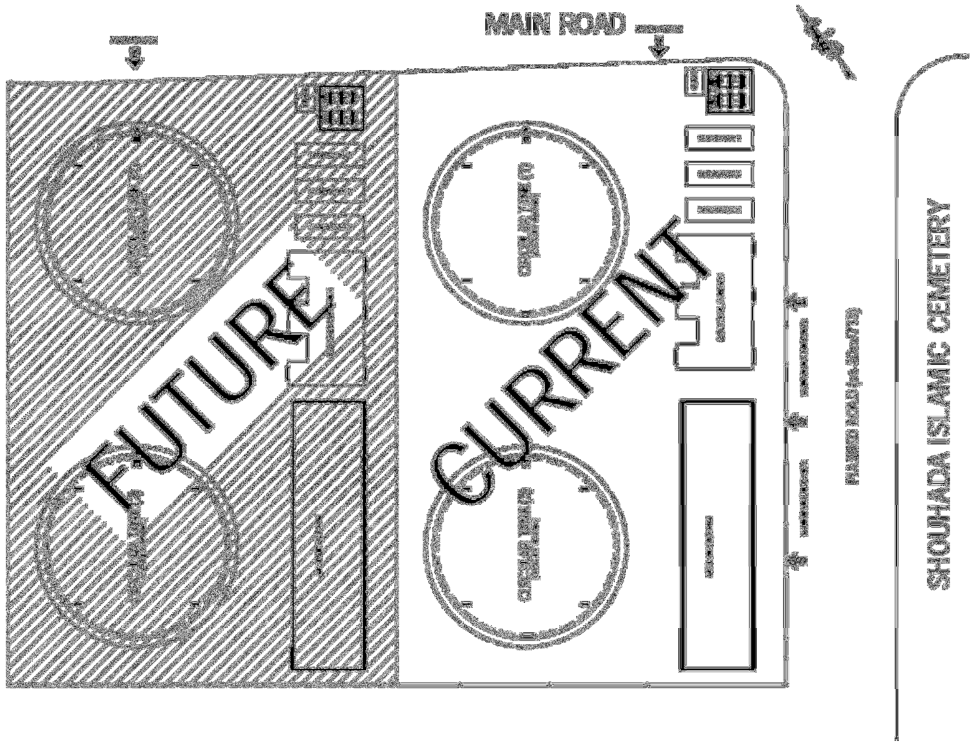
PALESTINIAN WATER AUTHORITY

EFFLUENT RECOVERY AND
IRRIGATION SCHEME

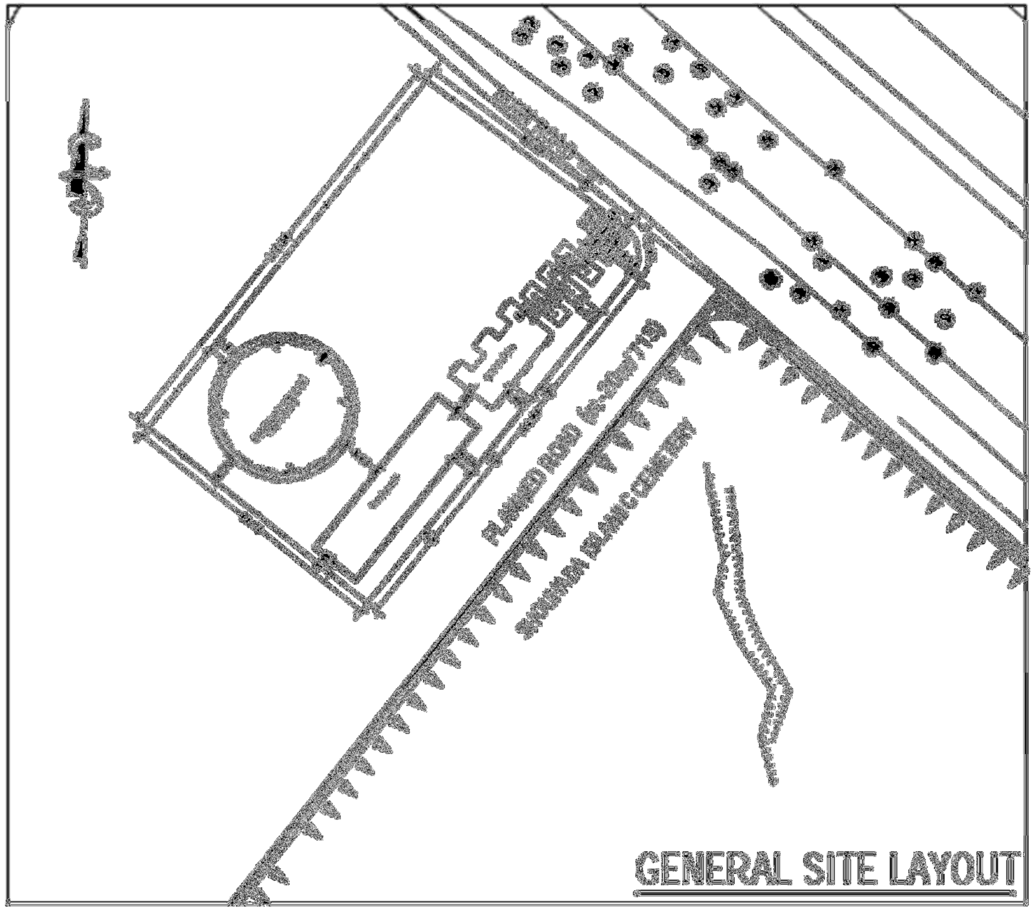
CONSULTANT

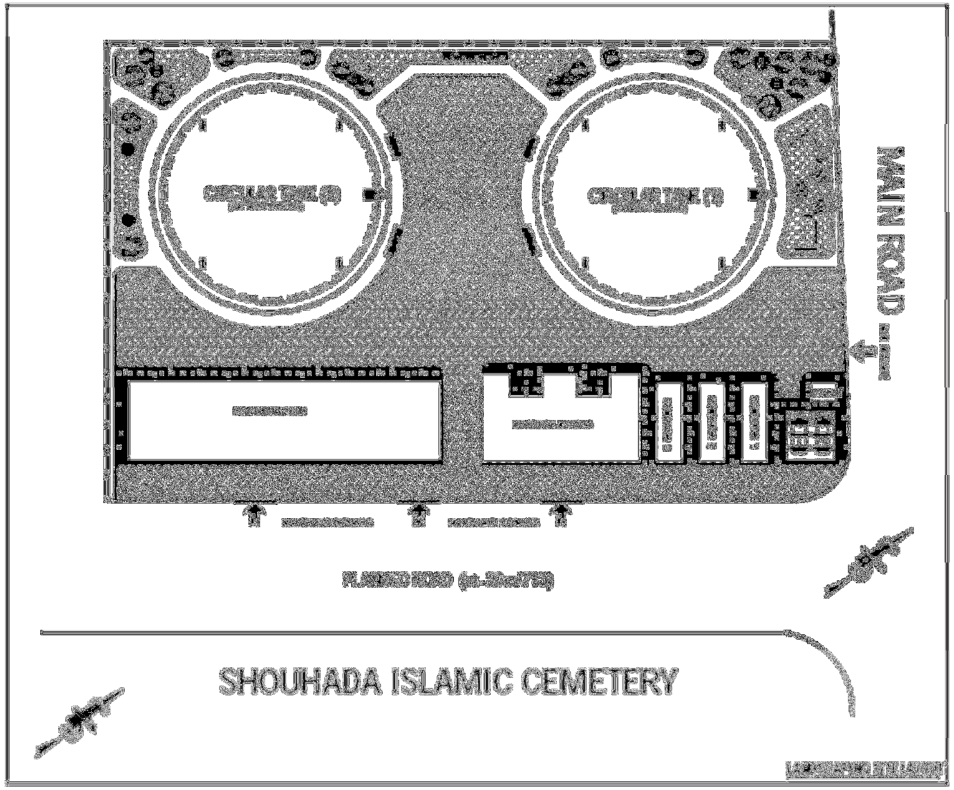
Finnish Consulting Group

BOOSTER SITE LAYOUT

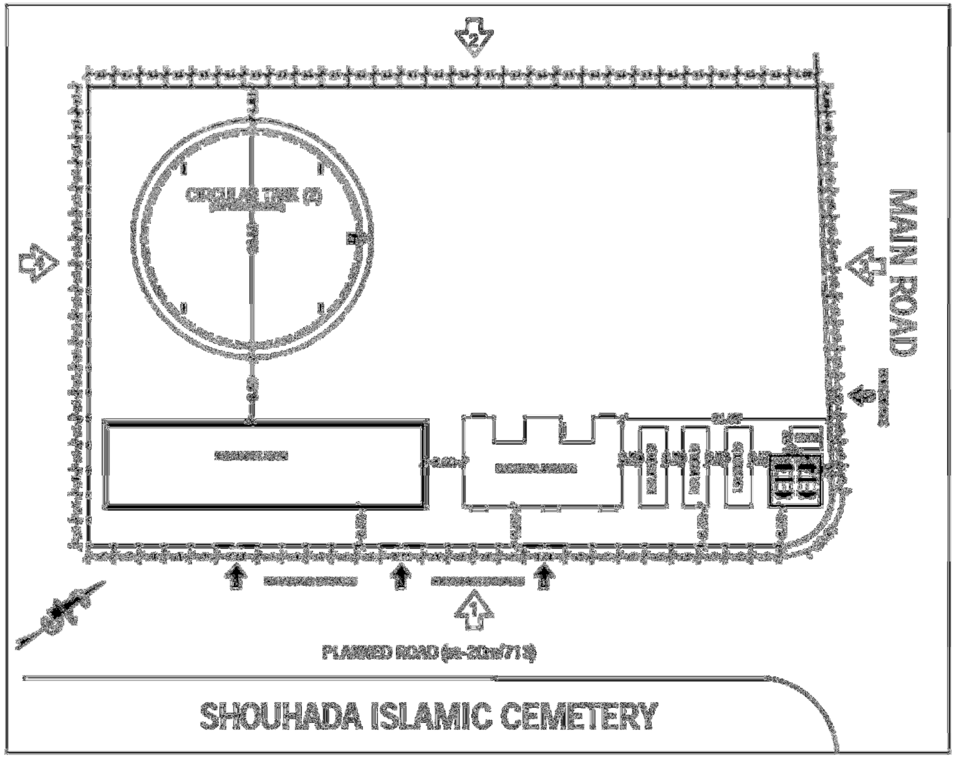


PROPOSED SITE LAYOUT (CURRENT & FUTURE)

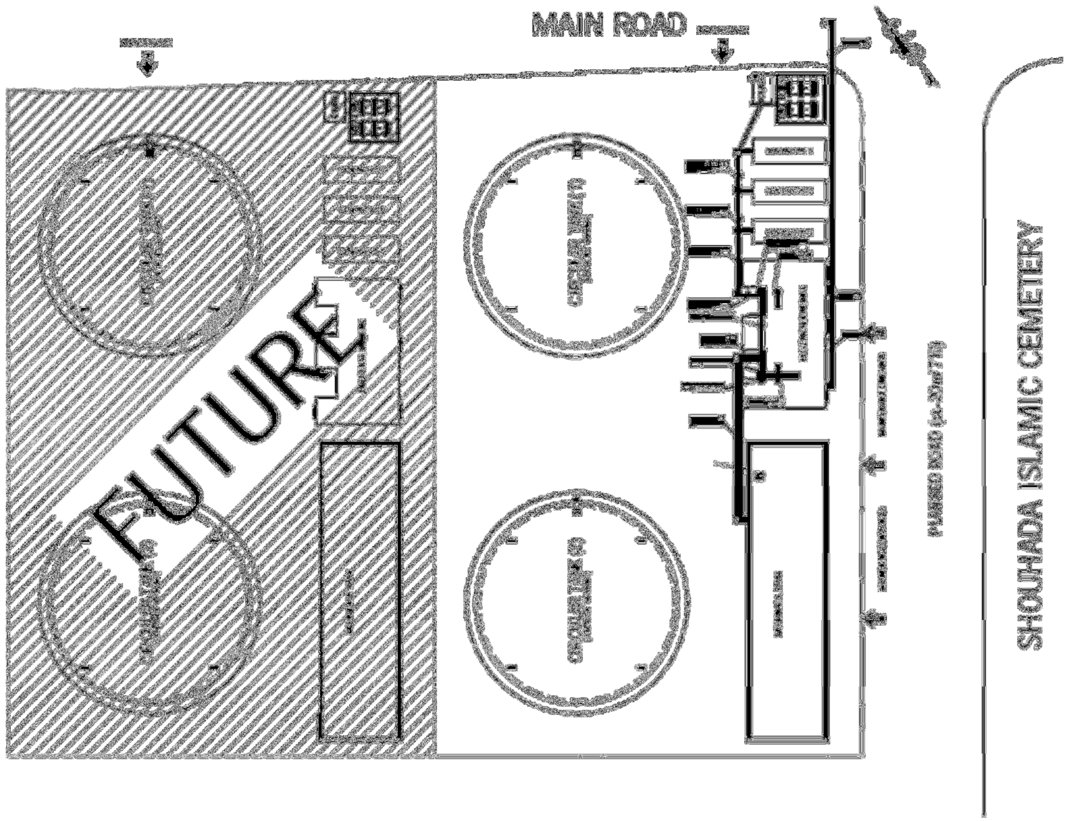

GENERAL SITE LAYOUT



LANDSCAPING SITE LAYOUT



SPECIAL SITE LAYOUT WITH DIMENSIONS



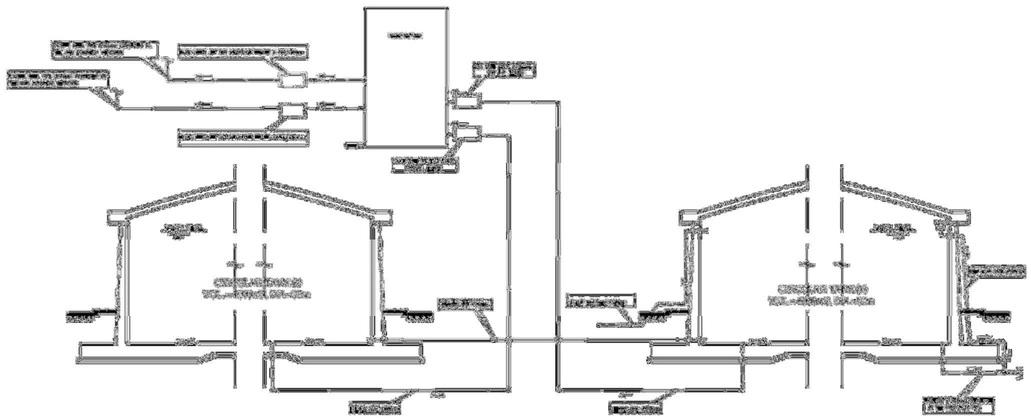
PROPOSED SITE LAYOUT (CURRENT & FUTURE)

CLIENT
PALESTINIAN NATIONAL AUTHORITY
PALESTINIAN WATER AUTHORITY

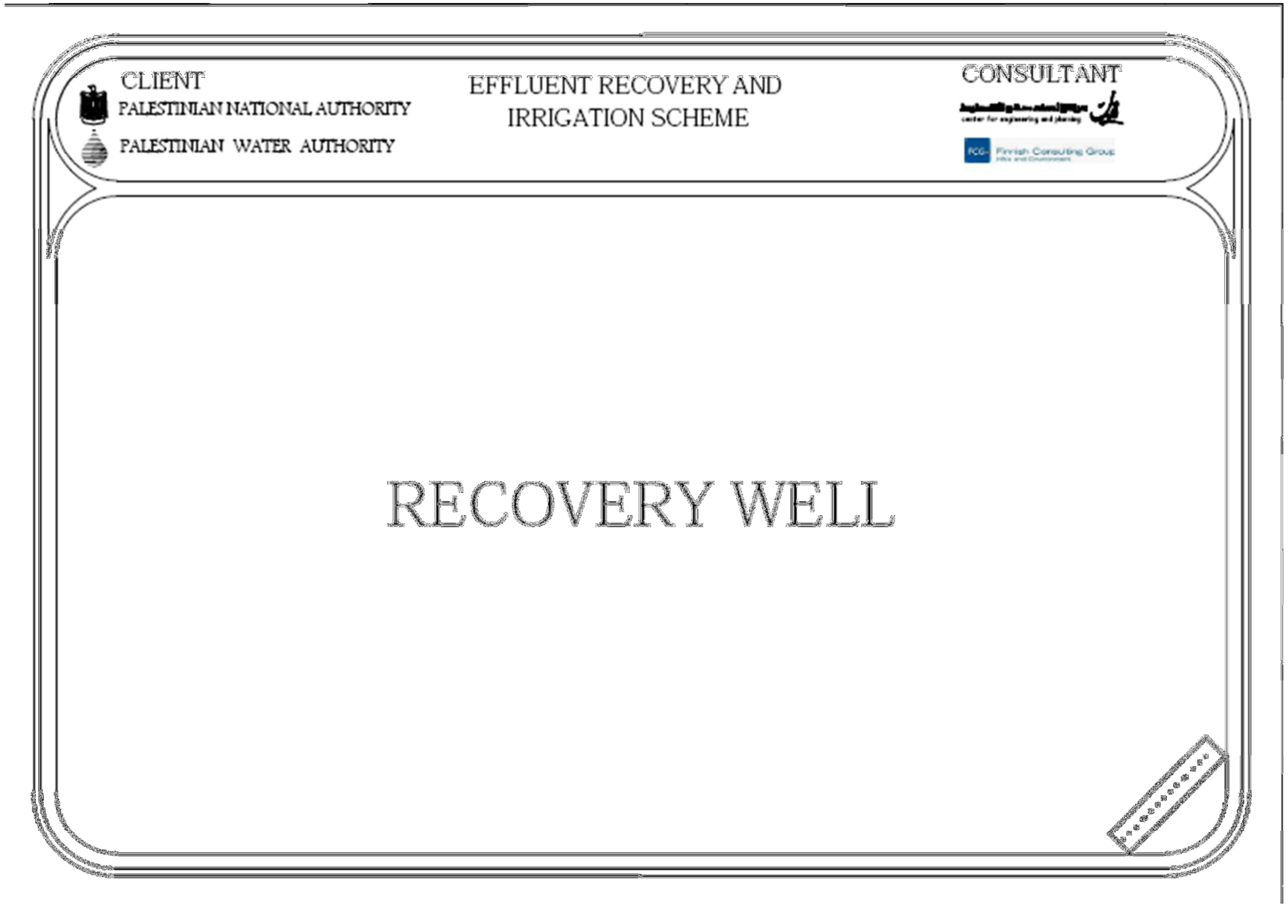
EFFLUENT RECOVERY AND IRRIGATION SCHEME

CONSULTANT

CIRCULAR TANKS



GENERAL SKETCH DIAGRAM OF CONNECTIONS FOR
4000 m3 WATER TANK


CLIENT
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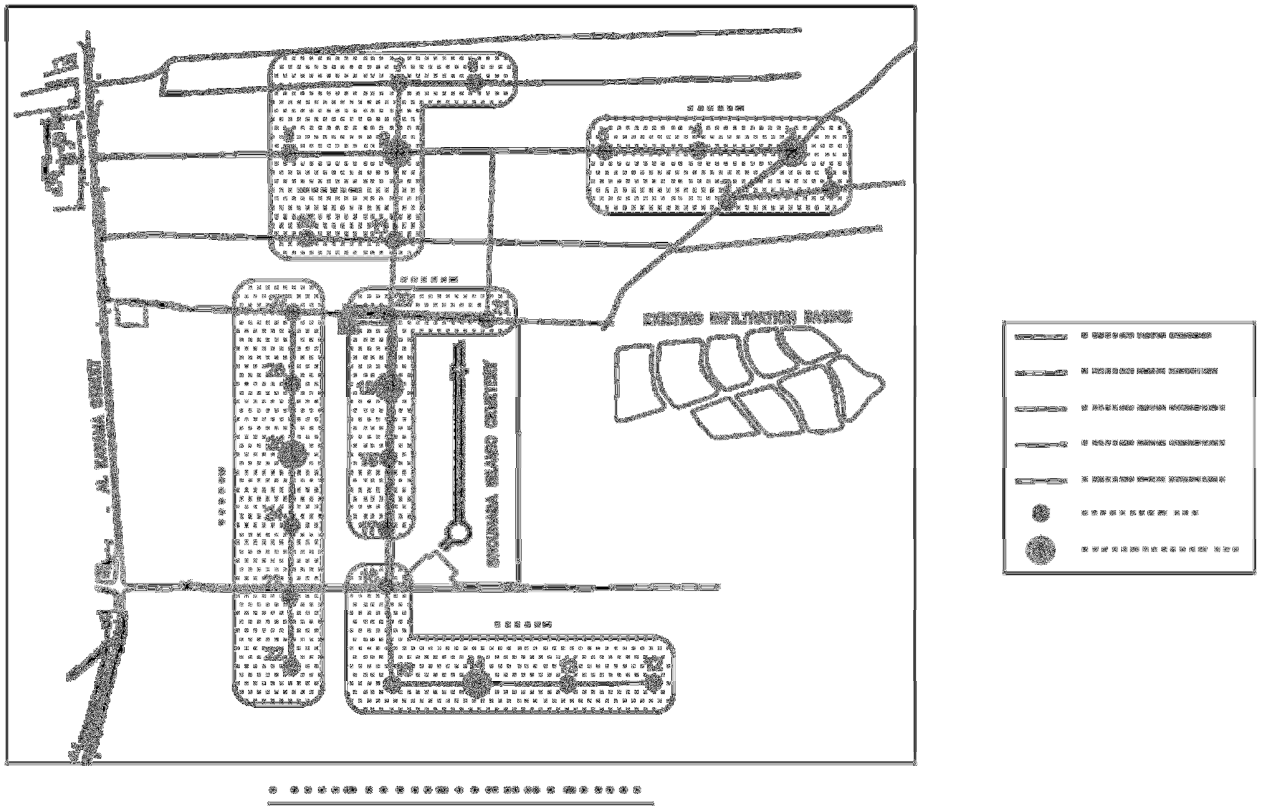
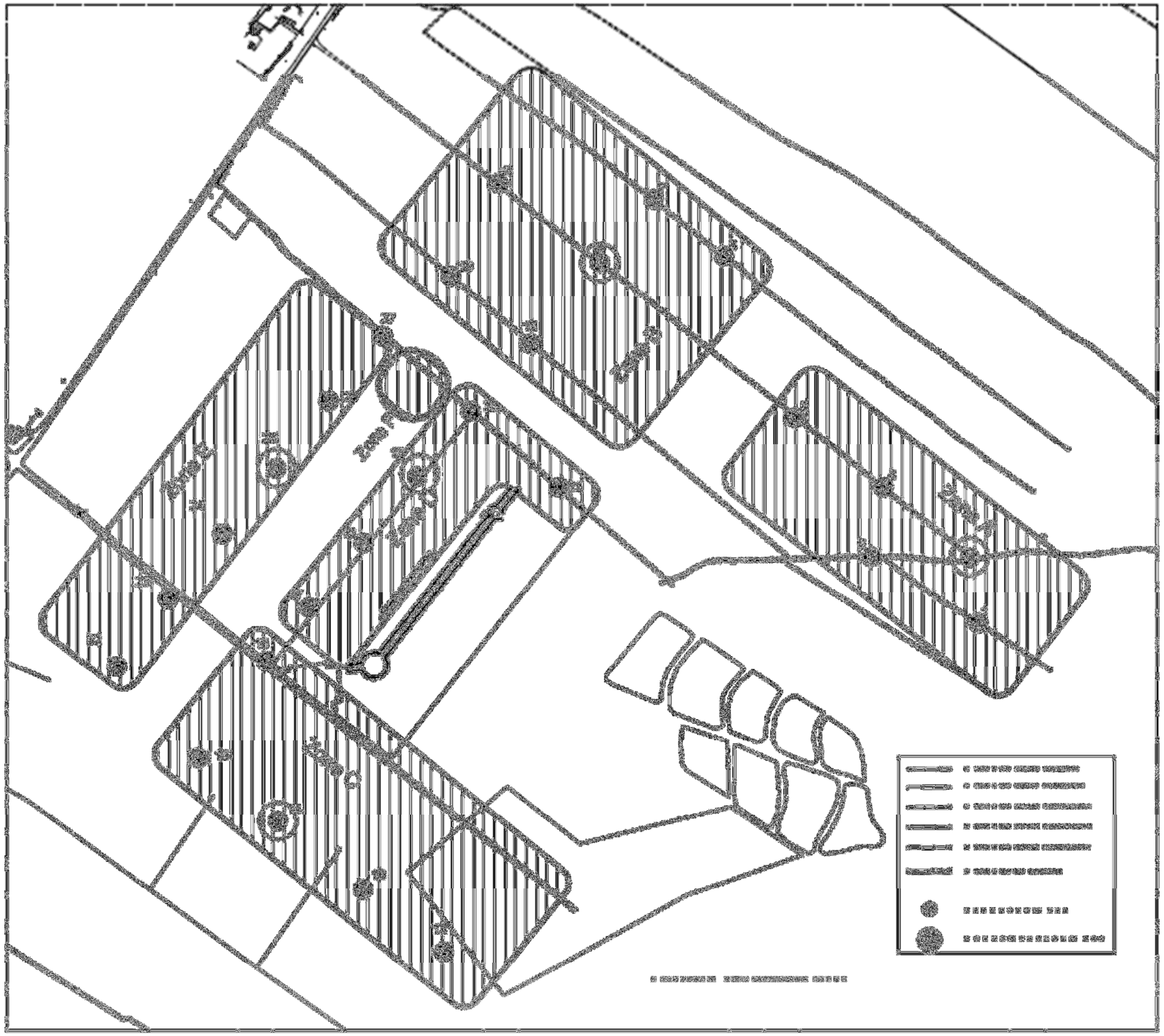
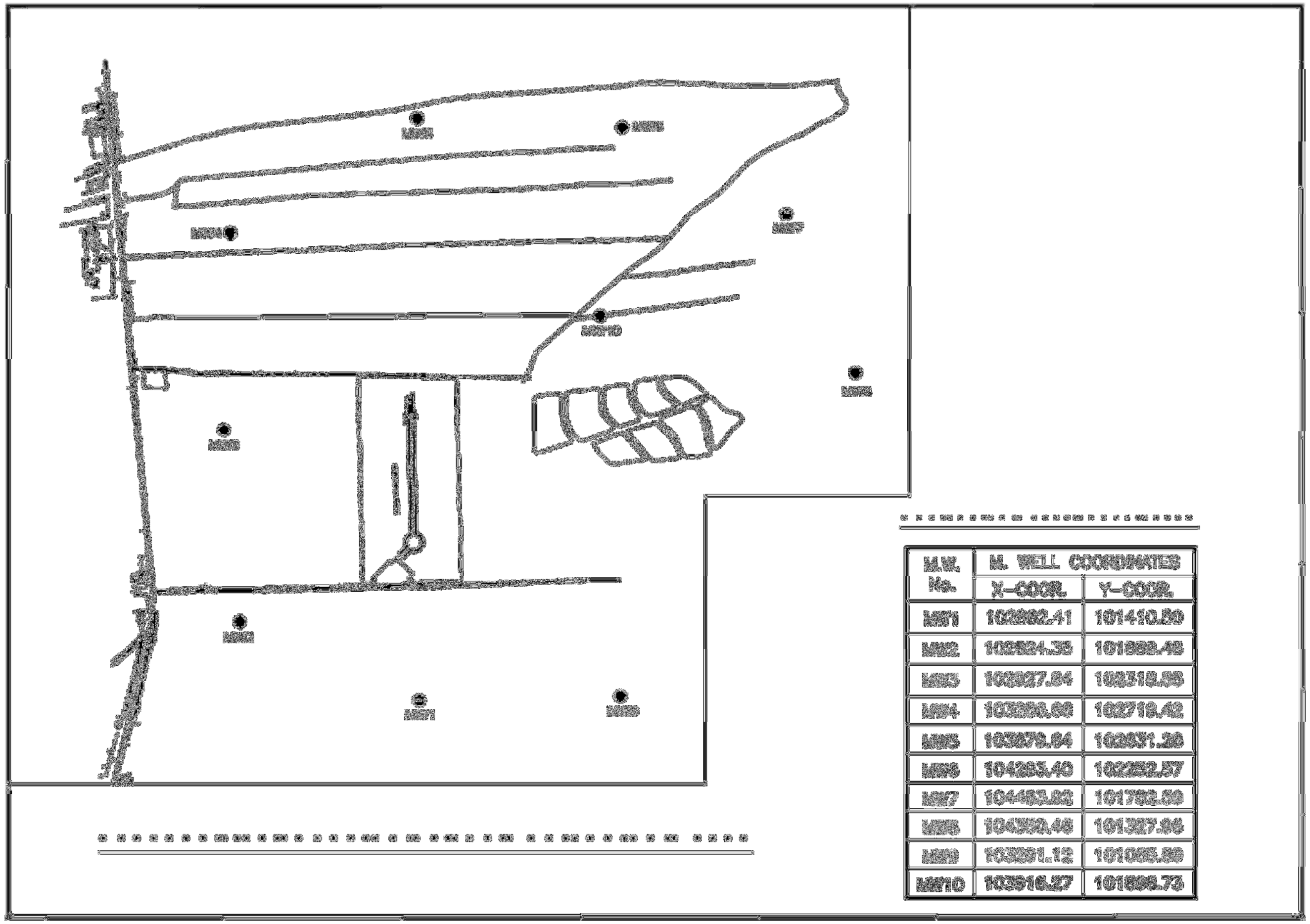
PALESTINIAN WATER AUTHORITY
EFFLUENT RECOVERY AND
IRRIGATION SCHEME
CONSULTANT
RECOVERY WELL







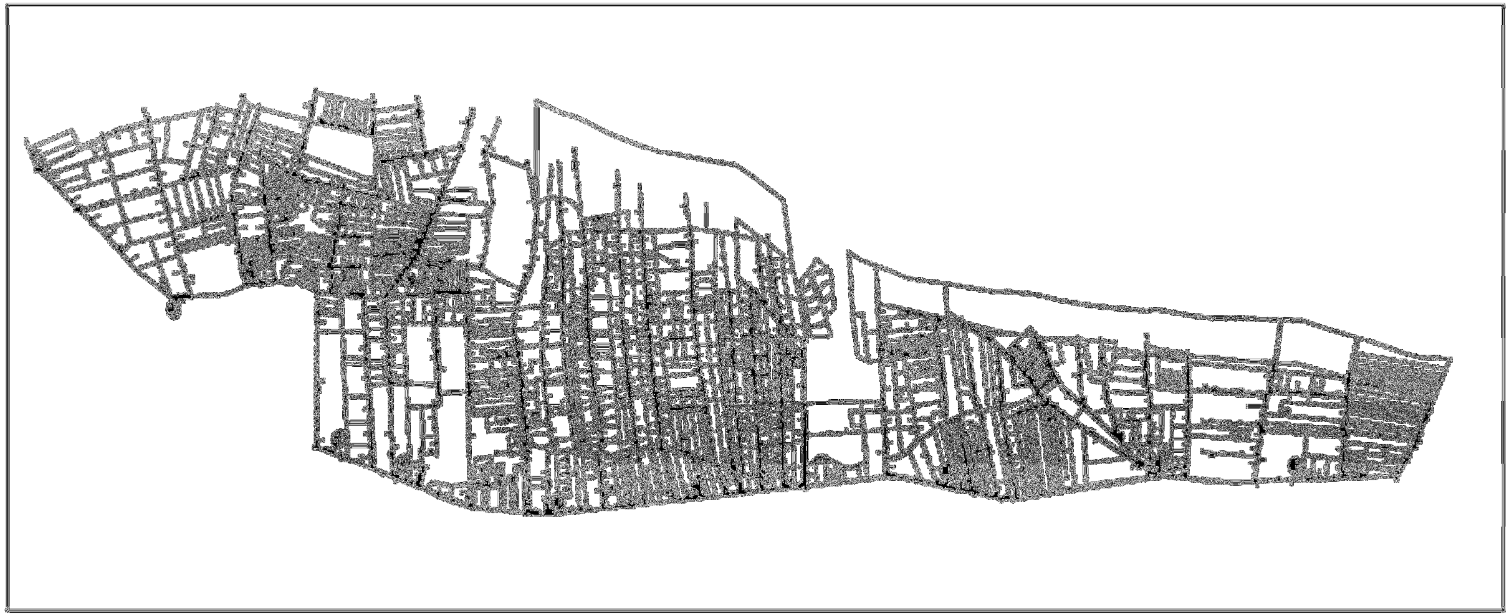
M.W. No.	M. WELL COORDINATES	
	X-COOR.	Y-COOR.
MW1	102892.41	101410.80
MW2	102524.35	101888.48
MW3	103027.84	102318.98
MW4	103298.66	102718.42
MW5	103879.64	102831.26
MW6	104293.40	102252.57
MW7	104483.82	101782.59
MW8	104350.46	101327.94
MW9	103891.12	101085.89
MW10	103916.27	101898.73

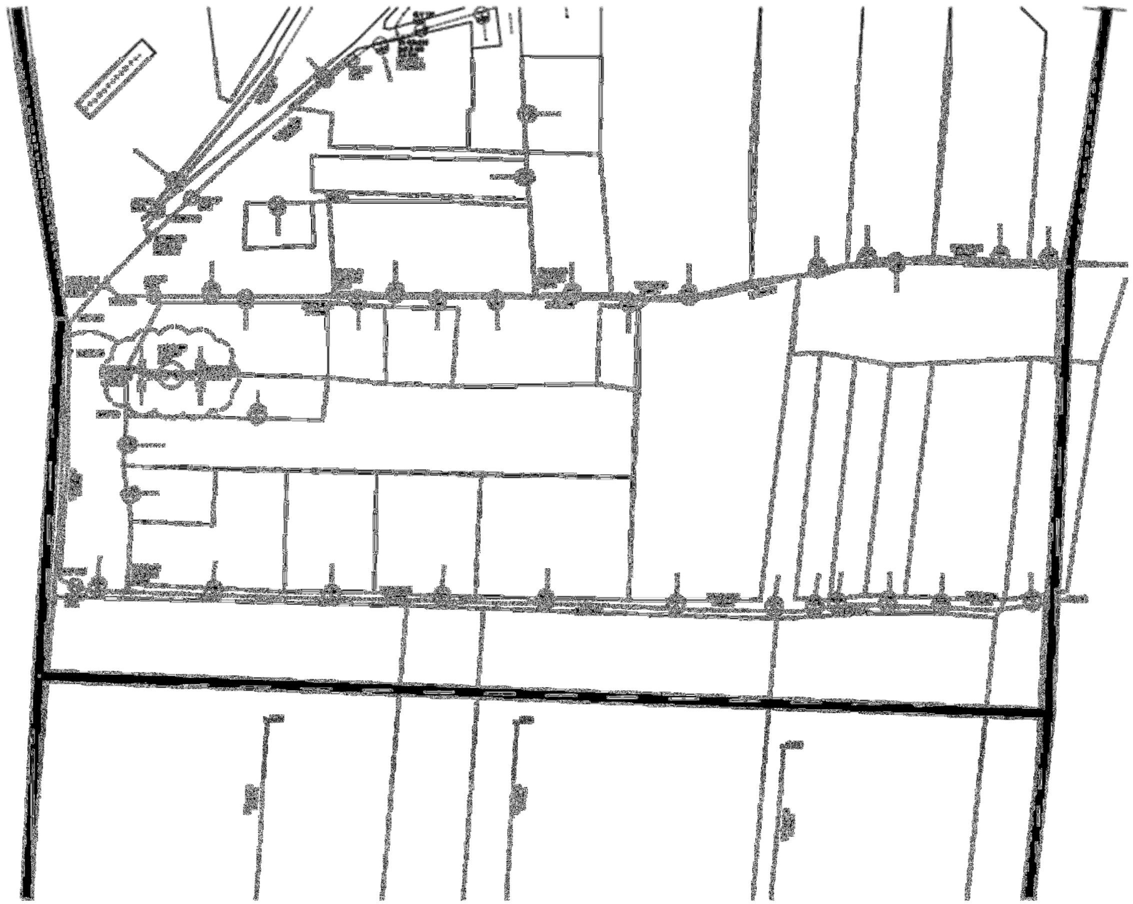
CLIENT
PALESTINIAN NATIONAL AUTHORITY
PALESTINIAN WATER AUTHORITY

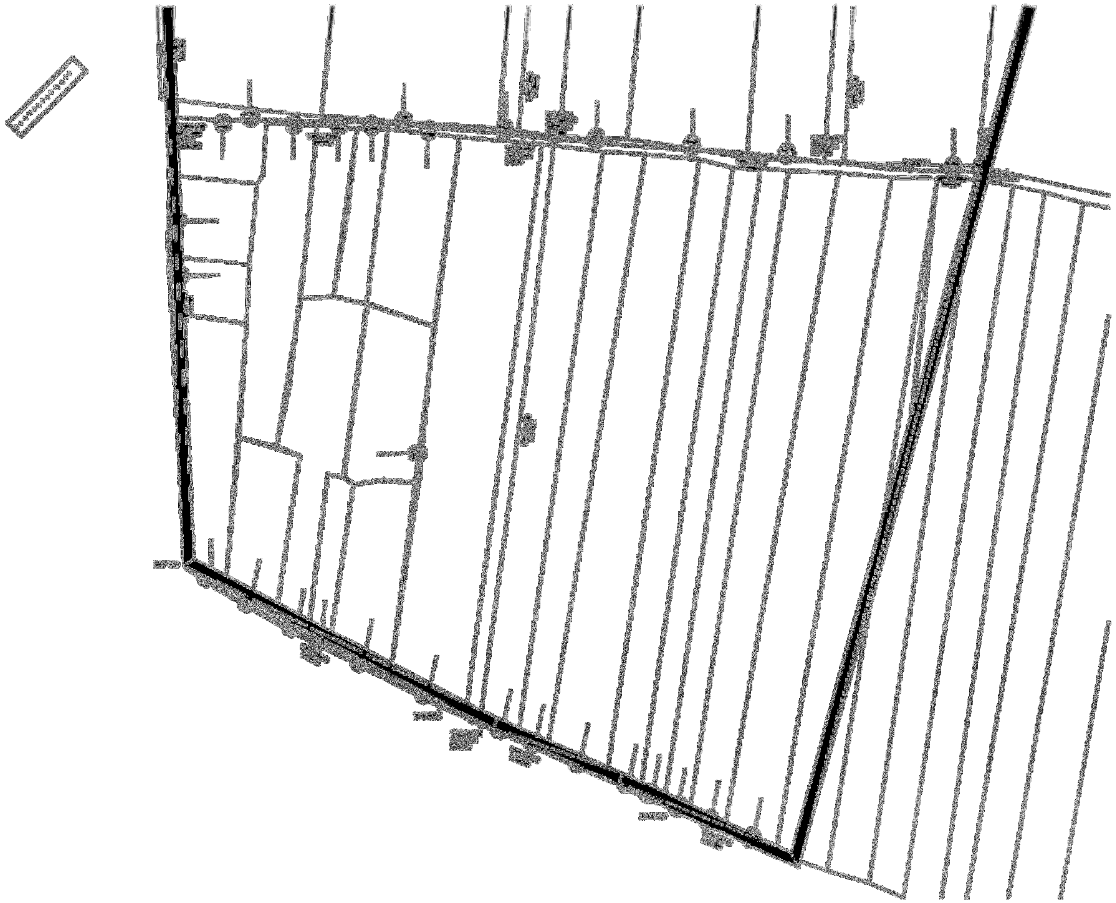
EFFLUENT RECOVERY AND
IRRIGATION SCHEME

CONSULTANT

IRRIGATION NETWORK







Annex 3
Environmental Field Measurements Report

(Methodology, Standard Equipment Used and Measurement Results)

Environmental Field Measurements

Methodology and Standard Equipment Used

Environmental Methodology

A. Field Measurements

Field measurements for ambient air quality and noise are important in order to assess the current environmental conditions at the project's site. In addition, to run the groundwater modeling, water quality has to be conducted, besides assessing current water quality and quantity at the recovery system.

To indentify the contamination level of the effluent lake due to the remaining sludge generated from the wastewater (in this case, most of the sludge has been stabilized for a long period due to the climate and dryness of the lake), the sludge and soil sample is also an important to be assessed.

In addition, to predict the sludge generated from the NGWWTP, wet sludge has to be collected and assessed to identify the heavy metals contain. This sludge assessment was important indication to determine the future sludge generated from NGWWTP was suitable for irrigation reuse or has to be dumped to the sanitary landfill.

Besides assessing the soil, water and sludge, the ambient air as well as the noise has to be conducted for baseline environmental conditions onsite. Based on the results, the predictions of the expected impacts due to preparation, construction and operation of the project component will be identified.

The Consultant has performed the field measurements based on the side investigations and site characteristics. The soil, water, sludge, ambient air and noise measurements were conducted by the local laboratory. The measurements have been conducted on August 7 and August 8, 2012 by Islamic University Lab. However, due to the doubt result on one of the soil sample, the soil, sludge and water samples were conducted again by Al Azhar Laboratory on September 4, 2012.

The field measurements were conducted based on a following:

A.1. Soil Analysis

Soil sampling points has to be determined based on a grid pattern and should be taken in areas which are identified as "hot spots" (in this regards, the hot spot of the effluent lake was at nearby the overflow of the polishing pond (pond #7) and nearby the overflow of the aerated pond[1]; pond # 1. In addition at the end of the effluent lake was measured to indicate the contamination pattern.

It is indicated during the site investigation that the stabilized sludge is occurred on the thin layers and some area is mixed already with the sand. These characteristics indicated that the contaminant do not spread vertically, therefore, samples was taken at 2 various depths (top layer that contain stabilized sludge and 0.5 depth that contain sand (might mixed with) sludge to indicate and develop the penetration profiles along the effluent lake.

[1]According to the original design, pond #1 designed as an aerated lagoon. However, the lagoon since the beginning is implemented as anaerobic lagoon without any aeration. Currently, as poor operation and maintenance, the pond turns to have a layer of solid particles (waste and sewage floating sludge) that cover almost half of pond's surface (especially at pond #1)

Analysis was conducted in accordance with international standard methods wherever practicable and applicable. Parameter considered for soil / stabilized sludge sample was concentrated on heavy metals and in organic contaminations.

A.2. Sludge Analysis

Sludge analysis is the basic for calculating heavy metal contamination (metal additions) when sludge is spread on farm yard. Sludge analysis from the existing BLWWTP was conducted to predict the metals contamination when the wastewater is transferred fully to the new NGWWTP.

The influent wastewater flow rate is assumed to be similar as the wastewater network mainly connected to the households. The influent characteristic of the wastewater received at BLWWTP mainly from the household processes.

Although metal concentrations will vary considerably between samples, but there is general relationship between metal and sludge dry solid (but considerably not stabilized yet) content. Thus the accurate assessment of metal contamination or metal addition to land requires collection of a representative sludge sample for dry solid analysis (according to standard sludge analysis of EPA)

Sampling of liquid sludge is generally undertaken from first treatment process or first anaerobic pond (see foot note 1 for the current condition of the pond). Settled solid (sludge) was taken at representative depth of the pond. The normal practice to analyze sludge sample is after it is turned to be dry solid content (reference made to the EPA standard for sludge analysis).

Analyses were conducted in accordance with international standard methods wherever practicable and applicable. Parameters considered for wet or liquid sludge sample was concentrated on heavy metals.

A.3. Water Analysis

Water samplings were taken at the effluent of BLWWTP, before entering the infiltration basin and from groundwater wells (MW2, MW3 and Q52).Table 1 shows the parameters that were analyzed. Similar to the soil and sludge analysis, the analysis was done according to the standard method and of using similar equipment done for the water sampling during the preparation of the original EA of NGESTP of 2006 and for the design project.

Groundwater assessment results provided by PWA were verified and water samples taken at different points were used as the baseline water quality environmental condition.

Table 1. Proposed sampling parameters and locations

Well No. / Tested Parameters	Groundwater (MW2, MW3, Q52)	Influent to infiltration Basin
pH	x	
TDS	x	
BOD	x	x
COD	x	x
NO3	x	x

Tested Parameters \ Well No.	Groundwater (MW2, MW3, Q52)	Influent to infiltration Basin
T.N &P	x	x
Cl	x	x
Detergent	x	x
F.C	x	x

A.4. Ambient air and Noise Analysis

The impact on ambient air quality and noise disturbance associated to this project will be determined during the construction of project components; decommissioning of BLWWTP, remediation works at the effluent lake as well as during operation of the project component; reuse schemes, post decommissioning works (pumping station and polishing pond (pond #7) will remain as an emergency overflow and the reuse scheme network (in this study the project component as a part of the reuse scheme will be concentrated at the infiltration ponds and reuse pipe distribution networks).

As the site characteristics of the project components vary, therefore the parameters and the sampling duration (especially for the noise and H_2S as a specific characteristic of odor generated at the treatment plant only) will be defined according to the specific site characteristic and condition and based on scientific explanation.

Ambient air quality and Noise sampling and their parameters and durations measured for the preparation of the environmental baseline conditions are as follows:

- Close to the Cemetery area (nearby the storage tank and booster pumping station (for the reuse scheme) will be constructed)

  Ambient air:

  SO_2, NO_x, CO and SPM (and PM_{10}) parameters were measured to identify the current air quality

  Noise

  An 8 hour duration for the noise measurement was conducted from 08.00 – 16.00 (represent the working hour duration during the construction Based on the proposed measurements conducted for the noise, an hour measurement during the night was identified. However, due to the restriction area (close to the border to Israel) the night hour measurement could not be performed.

- Infiltration Pond site

  At the infiltration ponds area, ambient air and noise are not expected to be generated during the operation. Moreover, the noise expected during the construction phase has been predicted and analyzed during the original ESIA study for NGESTP and the construction has been finalized and currently it is under operation (but not in a full capacity). Therefore, the ambient air and noise measurement were not conducted in this site.

- Beit Lahiya WWTP site and Effluent Lake

  Ambient air

  Similar to the cemetery site, CO, CO_2, PM_5 and PM $_{2.5}$ at representative point at the effluent lake and at the nearby the existing pumping station (between pumping station and the aerated ponds that will be decommissioned) were measured to identify the current quality for representative points for remediation works activities and decommissioning activities.

  Noise

  Similar to the ambient air point's measurements, representative point at the effluent lake and the BLWWTP were based on an 8 hour duration (working hour between 8:00 – 16:00).

The 8 working hours are selected to represent the activities during the construction. During the operation phase, the management and monitoring will be prepared in accordance to their sensitivity as the project components will run for 24 hours. 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.

The international standard methods were applied for both ambient air and noise measurements whenever it is applicable and practicable. The method and equipment used to measure for ambient air quality and noise is discussed in detail at the following appendix; measurement report. Table 2 .presents the Testing procedures and name of used instrument to measures the wastewater and soil for preparation of this ESIA study.

Table 2. Testing procedures & name of used instrument

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	Digital titration unit
11.		NO3	colorimetric method	Spectrophotometer
12.		Na	Flam photometry	Flam photometer
13.		Ca	Titration method	Digital titration unit
14.		K	Flam photometry	Flam photometer
15.		Mg	Titration method	Digital titration unit
17.		CO3	Titration method	Digital titration unit

Ser.	Parameter	Procedure	Name of instrument
18.	Detergent (mg/l)	Absorption (UV-249 nm)	Spectrophotometer
Soil analysis			
1.	ECe (µS/cm)	Soil extraction method	EC meter
2.	SAR	By calculation method	Flam photometer
3.	Organic matter (%)	Ignition method	Furnaces
4.	CaCO3 (%)	Titration method	Digital titration unit
5.	PO--4	Ascorbic acid	Spectrophotometer

B. Groundwater Analyses Verification and Modeling[2]

Perhaps the impacts on groundwater was one of the most important issues that will be associated with the project, as part of the project has been designed to prevent infiltration into the ground water by partially treated sewage. The EA of the NGEST Project estimated the water mound 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 has 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 practice the locations of the 27 wells were identified along with their correspondent discharge rates and depths.

The team carefully reviewed the available data from the groundwater modeling carried out by the project designer, verified the expected achievements and positive impacts on the groundwater and assessed the impact on abstraction wells in the region. In addition, the Consultant reviewed and verified the 4 sets of readily available data of groundwater samples and results provided by the PWA (namely water quality results, first to fourth round conducted between March 2011 and February 2012 and the baseline groundwater quality report).

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 was taken 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 with the verification data measured during the preparation of this SESIA.

For the current work, the existing groundwater modeling provided during the design project and EA of the original NGESTP study will be assessed and will be used as a reference. The

[2] Groundwater modeling methodology is presented in detailed at Annex 5

design consultant used Visual Modflow (VMF) version 4.2 and its integrated modules which will be also used in the current study. Therefore, the conceptual model in the design report is considered valid; however, the Consultant approached consists of updating the conceptual model to schematize the most actual hydro geological context.

The developed numerical model consists of dividing the modeled domain in meshes (space elements) where hydro geological properties are constant, and in dividing the simulation period in time intervals was assessed. The most up-to-date data provided by the Client was used where the design project model used the input data until 2008 (the present water quality from different sources conducted by the Consultant was used to verify and compare with the available water quality data provided by the Client).

C. Secondary Data

Secondary activities involved collection of different national reports through reviewing available sources of secondary data and assess requirements for primary data collection. In addition, due to the gaps within the Palestinian standard and technical specification; especially regarding the sludge management and reuse, required lesson learned and comparison of the standard limit from regional countries around Gaza Strip, the wastewater reuse and sludge management and reuse from Jordan, Israel and Egypt were assessed.

A list of all reviewed data was prepared:

1- Palestinian Environmental Law .7, 1999
2- Health and Safety Law 3/2011
3- Palestinian Reform and Development Plan PRDP (2008 -2010)
4- Palestinian Environmental Assessment Policy
5- Basic Information about Beit Lahia- Wikipedia
6- Standards for the re- use of treated wastewater for irrigation, www.arriyadhenv.com
7- Palestine Water Authority, organization and tasks, PWA website
8- Coastal Municipal Water Utilities, organization and tasks, CMWU website
9- The North Gaza Emergency Sewage Treatment project, World Bank website
10- Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan
11- Environmental Assessment North Gaza Emergency Sewage Treatment Plant Project
12- Literature review of factors influencing public perceptions of water reuse
13- Technical proposal for the Supplementary Environmental and Social Assessment North Gaza Emergency Treatment Project
14- Climate change and agriculture water demand: Impact and adaptation, Ziad A Mimi and Sireen Abu Jamous, African Journal of Environmental Science and Technology, 2010
15- Guidelines for municipal water reuse in the Mediterranean region, UNEP, 2005
16- Users Manual for Irrigation with treated wastewater, FAO Regional office for Near East, 2003
17- Health Risks in wastewater irrigation: Comparing estimates from quantitative microbial risk analyses epidemiological studies, D.D. Mara, P.A. Sleigh, U.J. Blumenthal and R.M. Carr, 2007
18- Guidelines for wastewater reuse in the Gaza Strip, Palestine, Part 1 – Legal and Institutional Issues
19- The Palestinian Central Bureau of Statistics (http://www.pcbs.org/populati/est_n1.aspx)

Measurement Result

Project : Supplementary Environmental and Social Impact Assessment (SESIA)

Clint : PWA

Consultant : JV of Ecoconserv & UG

The results of sampling tests

Environmental and Rural Research Center, IUG-Gaza.

September 2012

The Islamic University-Gaza **الجامعة الإسلامية – غزة**

Environ. & Rural Research Center **مركز الدراسات البيئية و الريفية**

Ref ……………………. الرقم ………………………………

Soil Samples Analysis Results

Place : BeitLahiya – The effluent lake (Old Basin)

Parameters	Unit	Result South Basin		Result At the meddle of the Basin		Result North Basin	
		0-15cm	50cm	0-15cm	50cm	0-15cm	50cm
PH		6.97	6,97	6.96	6.99	7.02	6.97
EC	µS	821	854	800	820	531	571
OM	%	0.98	0.86	2.2	1.2	0.98	0.37
TN	%	0.11	0.06	0.08	0.08	0.086	0.05
TP	%	0. 43	0. 34	0.49	0.32	0.47	0.36
Pb	mg /kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cu	mg /kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cd	mg /kg	0.008	0.008	0.17	0.047	0.061	0.005
Zn	mg /kg	0.1	0.061	0.008	0.008	0.008	0.007

Sludge samples Analysis Results

Place : BeitLahiya – WW basin

Parameters	Unit	Result
PH	-	6.78
EC	µS	**2400**
OM	%	2.6
TN	%	0.25
TP	%	0.21
Pb	mg /kg	< 0.01
Cu	mg /kg	< 0.01
Cd	mg /kg	0.17
Zn	mg /kg	0.01

2/12/9/13

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The Islamic University-Gaza
Environ. & Rural Research Center

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Ref ……………………..	الرقم ………………………………

Results of the air test analysis

Parameters	Unit	Result BeitLahiya- WWTP Site	Result At the effluent lake	Result Close to the Cemetery
CO	ppm.	1.3	0.1	0.1
CO2	pmm.	442	380	344
Noise 8hours	dB.	54.1	40.5	43.3
PM5	Microgram/m3.	397	306	345
PM2.5	Microgram/m3.	69	53	60

Close to the Cemetery

Time	Noise/dB
09:00	43.3
11:00	43.3
01:00	43.3
03:00	43.3
05:00	43.3
Noise (AVG) :	43.3 dB

12/9/17

BeitLahiya- WWTP Site

Time	Noise/dB
09:00	64
11:00	63
01:00	60.5
03:00	41.5
05:00	41.5
Noise (AVG) :	54.1 dB

At the effluent lake

Time	Noise/dB
09:00	42.7
11:00	42
01:00	40
03:00	39
05:00	39
Noise (AVG) :	40.5 dB

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Appendices

Appendix A: Testing procedures & name of used instrument

Ser.	Parameter	Procedure	Name of instrument
	Seawater & wastewater analysis		
1	pH	Probe method	pH meter
2	TDS	Probe method	TDS meter
3	BOD	Oxitop method	Oxitop
4	COD	Closed reflux method	Spectrophotometer & COD reactor
5	Fecal Coliform	Filtration technique	Incubator
9.	Heavy metal	ICP method	ICP
10.	Cl	Argenometric method	Digital titration unit
11.	NO_3	colorimetric method	Spectrophotometer
12	Detergent (mg/l)	Absorption (UV-249 nm)	Spectrophotometer
13	**Soil analysis**		
14.	ECe (µS/cm)	Soil extraction method	EC meter
16.	Organic matter (%)	Ignition method	Furnaces
17.	PO^{-}_{4}	Ascorbic acid	Spectrophotometer
18	pH	Probe method	pH meter
	Heavy metal	ICP method	ICP

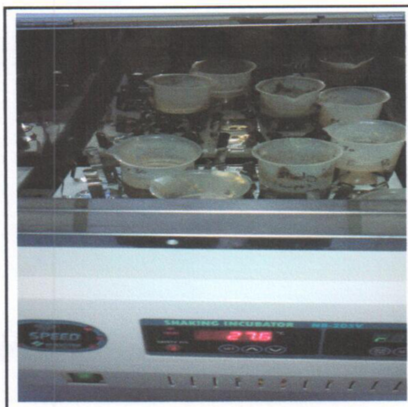
Appendix B: Names of Sampling collector and testing technicians

	Sampling collection team
1.	Mr. Azmu Abu-dagga
2.	Mr. Alaa Al-jubb
3.	Mr. Adelkareem Abu-hatab
4.	Mr. Rafat Sh Mortaja
	Testing technicians
3.	Mr. Azmu Abu-dagga
4.	**Mr. Alaa Al-jubb**
	Miss. Samah Abu-samra
	Miss Zynab S. Ei- sersawy

Time schedule of samples collection:

Ser.	Collection (Day-Date)	Activity
1.	11/8/2012	Soil-sludge-Air
2.	14/8/2012,	Soil-sludge-Air

Appendix B: Photos for sampling at site and analyze it in the lab



Vibrate device for mixing samples

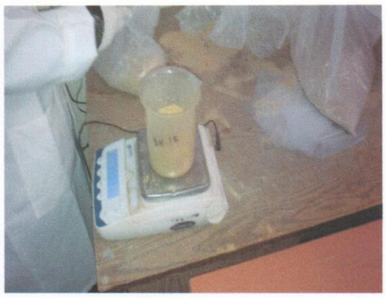
Samples inside the oven

Samples after burning in the oven

During soil sampling

Depth of excavation

Sludge sampling



Weight of the soil

Sludge sampling

ICP Device for testing minerals

TN testing

Measuring air pollution
Place : close to the Cemetery area

Measuring air pollution
Place : BeitLahiya WWTP site

Quotation for Soil, Sludge and water analysis

Institute of Water and Environment
Al Azhar University, Gaza

September, 2012

Analytical Methods

Groundwater and wastewater effluent samples were analyzed according to the WHO recommended methods, that is the Standard Methods for the Examination of Water and Wastewater, 20^{th} edition 1998.

Methods used are presented in the following table:

Table (1): Analytical methods used in water and wastewater analysis.

Parameter	Method
pH	St. Method 20^{TH}, 1998, 4500-H^+ B. Electrometric Method; p (4-87)
Electrical Conductivity.	St. Method 20^{TH}, 1998, 2510 B. Laboratory Method; p (2-46)
TDS	St. Method 20^{TH}, 1998, 2540C. Total Dissolved Solids Dried at 180Ċ; p(2-56)
Nitrate	St. Method 20^{TH}, 1998, 4500-NO_3^- B. Ultraviolet Spect. Screening Method; p (4-115)
Chloride	St. Method 20^{TH}, 1998, 4500-Cl^- B. Argenotometric Method; p (4-67)
Phosphorus	St. Method 20^{TH}, 1998 4500-P-B: Ascorbic Acid Method.
Ammonia	St. Method 20^{TH} . 1998, 4500-NH_3 F. Phonate Method; p (4-108).
Kjeldahl-N	St. Method 20^{TH}, 1998 4500-N_{org} C: Kjeldahl Method.
Biochemical Oxygen Demand	St. Method 20TH, 1998 5210-B: 5 Respirometric method, OXI TOP, FTD250 refrigerator(incubator)
Chemical Oxygen Demand	St. Method 20^{TH}, 19985220-D: Close Reflux, Colorimetric Method.
Total Coliform	St. Method 20^{TH}, 1998 9222: Membrane Technique.

Water and wastewater results

Table (2): Chemical analysis of groundwater and wastewater samples.

Well no.	pH	TDS mg/L	BOD5 mg O_2/L	COD mg O_2/L	Nitrate mg/L	TN mg/L	Chloride mg/L	P mg/L	Faecal coliform cfu /100mL
MW2	7.13	1310	< 5	6	48	11.5	653	<1	6
MW3	7.19	1125	< 5	5	78	17.01	370	<1	4
Q52	7.34	990	< 5	8	72	16.30	320	<1	12
Wastewater	7.36	1420	85	195	60	23.26	340	5.2	>1000

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Soil and sludge samples were analyzed according to the hand book of soil analysis.

Methods used are presented in the following table.

Table (3): Analytical methods used in soil analysis

Parameter	**Method**
pH	Handbook of Soil Analysis, 2006. Soil solution ratio 1/1. Measurement on Aqueous Soil Suspensions; pH Meters; p (565-567)
Electrical Conductivity.	Handbook of Soil Analysis, 2006. Soil solution ratio 1/1, Electrical Conductivity of the Extracts; p (610-614).
Organic Matter	Handbook of Soil Analysis, 2006. Organic Carbon by Wet Oxidation at the Temperature of Reaction; p (335-340).
Total Nitrogen	Handbook of Soil Analysis, 2006. Total Nitrogen by Kjeldahl Method and Titrimetric; p (344 – 348).
Total Coliform	St. Method 20TH, 1998 9222: Membrane Technique.

Soil and sludge samples analysis

No	pH	EC µs/cm	O.M g/Kg	T.N g/Kg	Faecal coliform cfu /1 gm
Soil (1)	7.04	565	9.91	0.33	$1*10^3$
Soil (2	7.57	1476	12.94	0.73	Neg.
Soil (3)	8.07	351	11.11	0.51	Neg.
Soil (4)	7.31	377	12.25	0.72	Neg.
Sludge	7.91	2540	420	-	-

For quality control, analytical blanks prepared and analyzed using the same procedures and reagents. Standard reference materials were used for determination of element in ground water, wastewater and soil samples.

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Annex 4

Policy, Legal and Institutional Framework

Policy, Legal and Institutional Framework

This annex includes a summary of the laws, regulations and institutional setup relevant to environmental and social management in the Gaza Strip, with particular focus on sludge management, water reuse and social rights. National and international guidelines for environmental assessment, treatment plants and technical design requirements were reviewed and key points are presented. . A review of the most pertinent regulations and standards governing health and safety has been included. In addition, analysis for the gaps between Palestinian Laws and International Laws were presented in order to develop some mechanisms to fill in the gaps. The section also includes a review of environmental quality standards for ambient air, drinking water, and limited values for liquid and gaseous emissions.

1. PALESTINIAN LEGAL FRAMEWORK

Palestinian Legal Framework includes the laws, regulations and guidelines related to the preparation of the project (EIA), the standard for ambient air, water quality for groundwater and drinking water as well as the sludge reuse (is not yet endorsed). The Consultant reviewed the available laws, regulations and guidelines ensure that the procedure for the implementation process is done according to the relevant laws applied in Gaza Strip. In addition, the Consultant, based on the task assigned for each authority related to the water, sludge and water collection and distribution identified the relevant authority to implement the project components, both during construction and operation phase.

Concerning the land acquisition, the Consultant reviewed the relevant laws related to the land ownership, compensation and the involuntary resettlement applied in Gaza Strip. Based on the available laws, the Consultant compared it with the International guidelines (in this regard the WB Operational Procedure concerning the involuntary resettlement as the project is financed by the WB).

As to the Palestinian Environmental Assessment Policy (PEAP), the EIA is a perquisite for the approval of any project in Palestine. The EIA is the project document informing the relevant permitting authorities and the Environmental Quality Authority (EQA) that a project is being considered. It is the document used by the EQA to screen the project for its disposition under the EA Policy, and to consider permitting conditions. The EIA should list what environmental and other permits must be obtained and complied, it indicates how the expected conditions of these permits will be fulfilled, and it includes a signed statement by the proponent that these conditions will be fulfilled.

Each project is subject to a screening process in which the level of required Environmental Assessment (EA) is determined. The list of the projects that require a full detailed EA includes WWTP and its processes. In this study, as the recovery water resulted from partially treated wastewater, decommissioning of WWTP and remediation of effluent lake is a part of WWTP management, therefore the project "NGESTP, Effluent Recovery and Reuse System and Remediation works" will require an EIA.

In order to determine what environmental and social issues should be covered by an EIA, a scoping process is done in which the stakeholders and impacted entities and locals are invited. The scoping sessions are then to address the project and get feedback on the concerns and subjects to be addressed. The EQA issues the Terms of References (ToR) based on the scoping and the experiences gained. Nevertheless, scoping is essential as it will inform about the project and enhance the acceptance and the understanding of the environmental and social impacts.

The Palestinian Ministerial Council approves the Palestinian Environmental Assessment Policy, through resolution No: 27-23/4/2000. This Policy shall be interpreted and implemented to support the sustainable economic and social development of the Palestinian people through assisting in meeting the following goals:

- Ensuring an adequate standard of life in all its aspects, and not negatively affecting the basic needs, and the social, cultural and historical values of people as a result of development activities.
- Preserving the capacity of the natural environment to self-clean and sustain.
- Conserving biodiversity, landscapes and the sustainable use of natural resources.
- Avoiding irreversible environmental damage, and minimizing reversible environmental damage, from development activities.

There are three types of EA documents that represent sequential stages in the project life cycle and the EA review process. These are Application for Environmental Approval, Initial Environmental Evaluation (IEE), and Environmental Impact Assessment (EIA). The EQA shall provide guidance on the content and preparation of the EA reports. The Initial Environmental Evaluation (IEE) is for projects where significant environmental impacts are uncertain, or where compliance with environmental regulations must be ensured; whereas An Environmental Impact Assessment (EIA) is required for projects, which are likely to have significant environmental impacts. An EIA may be carried out as a result of an IEE.

A determination of whether or not IEE or EIA must be conducted is based on a screening criterion. The screening process will be based on requirements of relevant land use plans, and on whether the project is likely to:

- Use a natural resource in a way that pre-empts other uses of that resource,
- Displace people or communities,
- Be located in or near environmentally sensitive areas such as natural reserves, wetlands, or registered archeological and cultural sites,
- Generate unacceptable levels of environmental impact,
- Create a state of public concern, or
- Require further, related development activities that may cause significant environmental impacts.

Based on the Application for Environmental Approval, screening criteria are used to determine whether an Initial Environmental Evaluation or an Environmental Impact Assessment is required for a project. An EIA shall be conducted for the different types of major development projects. Among which are Wastewater treatment plants including main sewers.

Without limiting its content, an Environmental Approval may specify:

- Required measures to mitigate adverse environmental impacts or capture potential environmental benefits, including a compliance schedule,

- Measures that the proponent must implement in order to comply with relevant standards and requirements; and
- Monitoring and reporting duties of the proponent.

The following is a summary of the laws and regulations reviewed by the Consultant in the course of conducting the ESIA:

Table 1 Summary of the reviewed Palestinian Laws

Name of Law	Law Summary	Year
Environmental laws and regulations		
Law 7/1999	Palestinian Environmental Law	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 No. 90/1995	Regarding The establishment of Palestinian Water Authority (PWA)	1995
Decree No. 6/2002	The Environment Quality Authority was established by Presidential decree No 6/2002	2002
TS 34/2012	The Palestinian Treated Wastewater Standard (Technical Specification)	2012
Solid Waste regulations	Solid Waste Management Regulations	2004
Social laws and regulations		
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
Other laws and regulations		
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

1.1 Palestinian Environmental law 7, 1999

The Environmental Law of Palestine (PEL) includes a framework for environmental protection including reused treated water and sets roles and responsibilities for the EQA as follows:

- **Chapter 1 (Article 4):** To promote environmental awareness in schools, universities and clubs and encourages volunteer work aiming to protect the environment
- **Chapter 1 (Article 5**): To ensure the right of every individual to live in a sound and clean environment and stress on resource conservation and sustainable development including the protection of water resources, soil quality, flora and fauna
- **Chapter 1 (Article 6)**The different entities should cooperate with the EQA regarding the policy of land use in order to protect the natural resources that have particular nature and preserve environment and ensures the protection of natural resources and areas with special habitats
- **Chapter 1(Articles 11 to 13)** To ensure a safe disposal of hazardous wastes and to prohibit the import of such waste to Palestine
- **Chapter 1 (Article 14)**: the EQA is responsible, with other entities, for addressing the environmental conditions for manufacturing, distributing, and storage of the pesticides, chemical fertilizers that might be hazardous to the environment
- **Chapter 2 (Article 20):** The owner of the project is responsible for health and safety of all workers against any type of pollutants inside the working environment
- **Chapter 3 (Articles 28):** The EQA addresses with other ministries the quality of accepted potable water.
- **Chapter 3 (Articles 29**): It is the responsibility of EQA to address the standards of water collection, treatment and disposing in environmentally sound way that preserve the environment
- **Chapter 3 (Article 30):** To prohibit the discharge of any solid or liquid or other substance unless conforming to the regulations.
- **Chapter 3 Environmental Impact Assessment (Articles from 45-57):** that includes some subsections regarding EIA requirements, licenses and inspections (monitoring). Part IV of the law gives the authority to EQA to periodically inspect and to acquire all needed information and collect all necessary samples. EQA has the authority to apply penalties on projects not complying with the laws/regulations.

1.2 Palestinian Water Law 3/2002

The Water Law No. 3 of 2002 has to be considered as the basic legislation for any activities related to water sector. This law comprises of all regulations that govern water in the Palestinian territory and Gaza Strip. The following are some of the important articles that will regulate the project:

- **Chapter 2 (Article 6)** According to this law an organization should be established under the auspices of the Palestinian Authority in order to be responsible for water sector and should be named as Water Authority.
- **Chapter 2 (Article 7)** discusses the responsibility of water authority which is as follow: 1)assume full responsibility for the management of water resources and sanitation in Palestine.2) the preparation of water policy and public action to implement them in cooperation and coordination with the concerned authorities and submit periodic reports on the water situation for the Council.30 survey of

water sources and propose various aspects of water allocation and priorities for their use.4) the establishment of protection zones of the risk of contamination and to exercise control and supervision and approval of the transfer of water between geographical areas.5) permit the usage of water resources including the establishment of public and private wells, organizing and drilling water wells and the drilling of exploratory and experimental, productivity, and any matters or activities related to water and sanitation in cooperation and coordination with the concerned authorities.6) study of water projects, sanitation or supplementing it, and the development of design standards, quality control, technical specifications and to monitor their application.7) the rehabilitation and development of water services to provide water all over the country as a national water facilities and determine the responsibilities and functions under the regulation issued by the Cabinet for this purpose.8) coordination and cooperation with relevant agencies to develop plans and programs for regulating water use and prevent waste and rationalizing consumption and awareness-raising campaigns in this area.9) supervision of the profession of well drilling and rehabilitation contractors in the establishment of water facilities in accordance with procedures prescribed by law. 10) developing plans and programs for the training of technical personnel working in the field of water for the development of water resources management and supervision of the implementation and development.11) work towards equitable distribution and optimum utilization of water resources to ensure the sustainability of groundwater and surface and in cooperation and coordination with the relevant authorities and to find solutions and appropriate alternatives in case of emergency.12) regulation and supervision of research and studies related to water and sanitation and follow-up with the specialized and relevant.13) rehabilitation centers, research, studies and training working in the field of water in accordance with procedures specified by the regulation .14) participate in the development of the approved specifications of the quality of water to various aspects of their use with the competent authorities and mainstream application.15) work on the development and coordination of technical cooperation programs of international, regional and bilateral cooperation in the field of water resources and the holding of conferences, seminars and representation of Palestine in the regional and international meetings in this area.16) the preparation of draft laws, regulations and instructions relating to water resources, implementation and provision of technical opinion in disputes concerning the sources of water.17) Any other tasks entrusted to them under the provisions of laws and regulations in force.

- **Chapter 5 (Article 18-20)** discussed the licenses and tariff mechanisms
- **Chapter 7 (Articles 25-27)** that discusses the water utilities roles and responsibilities, which can be summarized as follow: A25) a regional water facilities shall be established at the behest of local authorities and water users associations to provide water services, sanitation and define its functions and powers, composition and management, and resolution of financial resources and all matters relating to its work under a regulation issued for this purpose. A26) Facilities and regional associations of water users determine the price of water for different queries according to the tariff system headquarters.A27) Authority may contract with regional facilities for the operation of alternative water systems. A 28) the power of supervision and control of regional facilities and water users associations in cooperation and coordination with the relevant authorities and to take all necessary actions right inconsistent with the provisions of this Act or the

regulations or instructions issued there. the Council, upon the recommendation, of the relevant authorities decides that the decision to stop or cause the dissolution of the management services of any of the facilities or regional associations of water users and this decision be appealed to the competent court

- **Chapter 8 (Articles 29-32)** environmental protection for the water sources. However, the most crucial item is article 30 that indicated: The Authority is able to issue a decision to stop production or supply of water if they determine that pollution source, the supply system and has a closed source system, or if the pollution and shall notify the competent authorities that, and get rid of pollutants.
- **Chapter 9 (Article 33-35)** related to inspection and monitoring for water quality

1.3 Regulations for Groundwater Pollution Control

The Water Law No. 3 of 2002 has to be considered as the basic legislation for these Regulations. In addition, the Environmental Law No. 7 of 1999 prescribes development of relevant regulations and standards, contributes to clarification of the division of roles and responsibilities between different relevant authorities within this field, and constitutes also a part of the legal basis for these Regulations.

PWA has in its mandate set out in Article 7.4 of the Water Law No. 3 of 2002 the task to create reservation areas for protection from the danger of pollution, exercising oversight and supervision over such areas, and approval of transfer of water between the different geographic areas.

Article 31 of the Water Law No. 3 of 2002 states that any area contains groundwater is considered a protected area if the quality or quantity is in danger.

These Regulations aim to regulate groundwater pollution control to prevent contamination of groundwater, or restore polluted groundwater, to obtain an acceptable water quality in accordance with prevailing standards. In addition, these Regulations aim to contribute to a sustainable integrated water resources management in the Palestinian Territories to the best for the society as a whole.

Following are the main regulations:

- **Chapter Two: Prevention of pollution of groundwater** discusses in four articles (5-8) the regulations related to prevention of pollution
  Article 5 declared that "The Authority shall, to as large extent reasonable in relation to its capacity and need for prioritising, determine a well head protection area applying to the entire surface and subsurface area surrounding a well or a well field, supplying a public or private water system, through which contaminants are likely to reach such a well or well field after a period varying from at least 50 days to up most 10 years."
  Article 6 (Zoning) "The Authority shall divide a well head protection area into three different zones, taking into consideration the ToT and associated need for protection against pollution. The zoning shall be related to the following criteria:
  a. Zone I: 50 days ToT or 50 meters radius, whichever indicates the largest area;
  b. Zone II: 2 years ToT; and
  c. Zone III: 10 years ToT.

The criteria described under subsection (1) are indicative. Based on all relevant factors and the extent of available information, the Authority shall make an individual decision seeking an optimal solution for zoning of each well head protection area.

Article 7 (Restriction of activities): (1) In order to prevent or reduce the risk of pollution of groundwater, EQA shall develop one or more lists of activities which may be restricted within the different zones of a well head protection area. The reason to restrict activities is the connection between those activities and regulated substances. This list, or those lists, shall be incorporated as an annex to these Regulations. (2) The Authority may decide that some activities specified in the annex shall be prohibited within one or more of the zones as described under Article 5. Other specified activities may only provide guidance to the Authorities' decisions to be made in conjunction with licensing. The Authority may differ between existing activities and establishment of new activities of the same type.

Article 8 (Regulated substances): EQA shall develop one or more lists of substances applicable in relation to the Authority's considerations of restriction or licensing of activities, discharge, disposal or storage. The involvement of listed substances may make it mandatory for the Authority to reject applications, or the list or those lists, may only give guidance for the Authority's considerations and decisions. Such list, or lists, shall be incorporated as an annex to these Regulations.

- **Chapter Three – Licensing and licenses :**
  Article 9 License requirements)

  The most important items mentioned under this article are as follow:
  1. No person may execute any activity involving discharge, disposal or storage of substances listed in an annex to these Regulations, or to construct, alternate, own or operate a disposal system, within any zones of a well head protection area, without a licence granted by the Authority. This licence requirement applies to both existing and intended activities.
  2. Subsection (1) does not apply to:
     a) drilling fluids and additives associated with drilling of new wells; and
     b) Application of fertilisers, pesticides or other agriculture chemicals approved for that purpose by EQA or any other empowered authority, and in compliance with prevailing standards regulating such activities in particular.
  3. The Authority may exempt activities regulated under subsection (1) from licensing if the quantity or adverse impacts of the discharge or disposal is considered to be insignificant.
  4. A person who executes an activity regulated under subsection (1) prior to these Regulations becoming effective, shall submit an application for a licence to the Authority within a timeframe from the effective date, to be determined by the Authority by a decision applying to groups of prospective licensees, or to individual prospective licensees. The Authority is responsible for notifying all prospective licensees in a way ensuring them attainment of knowledge about the licensing requirement.

- **Chapter Four – Well head protection plans. Article 22 (Well head protection plans)**
  1. Each existing or prospective owner of a well with an abstraction capacity larger than [determine volume] or of a well-intended for public water supply, shall fence zone I surrounding their well and all activities shall be prohibited within this zone.

2. The Authority, in cooperation with EQA and other relevant stakeholders, may prepare well head protection plans for protected areas outside zone I of any well regulated under subsection (1).

- **Chapter Five – Reporting, records and inspections Article 23(Reporting)**
  A licensee shall report to the Authority on its findings of state of activity facilities and volume and contents of its discharge and disposal obtained by own inspection and monitoring in accordance with Article 14, and specified in its licence conditions. The samples of discharge and disposal shall be analysed only by laboratories approved by the Environment Quality Authority.
- **Chapter Seven – Disputes, offences, penalties and appeals Article 26 (An offence)**
  A licensee violating these Regulations, conditions imposed by licences granted under these Regulations, or the Authority's individual decisions made according to those legal instruments, commits an offence and shall be liable to a fine imposed by the Authority.
  Article 28 (Appeals)
  1. All decisions made by the Authority directly affecting rights or duties of non-governmental parties may be appealed to the Authority within 20 days after the directly affected parties are informed about the decision.
  2. Other parties than the appellant also directly affected by the decision, shall receive a copy of the appeal and from the Authority and be requested to lodge their representations within 20 days of receipt of the appeal.
  3. Based on all available information, the grounds set out in the appeal and received representations; the Authority shall make a final decision.
  4. The Authority's final decision may be appealed to the Court.

1.4 Guidelines for Wastewater Reuse in the Gaza Strip, Palestine

This guideline is for reuse of treated wastewater from housing, municipality, industry and commercial enterprises in the Gaza Strip and to provide information for collection, additional treatment, and storage of treated effluent in such manner that the use of groundwater can be replaced, the aquifer can be enriched and the inflow of saline water into coastal aquifer can be reduced. (Article 1 and 2)

- **Chapter I Article 6: Principles of the Water Reuse**

1. Economic and financial principles

Water is not a usual commercial product but a scarce natural resource which must be protected, defended and treated correspondingly and must be provided as a basic need by supplying safe water to all consumers. One of the important components for wastewater reuse is wastewater tariff charge and the incentives must be given to promote the widespread reuse. In addition, demand and supply management for treated wastewater has to be considered.

2. Environmental Principles

Activities related to the reuse of wastewater need to be planned and implemented with due regard for all their environmental implications, including the protection of aquifer from pollution and over exploitation. In addition, the short- and long-term effects of the reuse of wastewater should be monitored so that the improvements can be encouraged and detrimental impacts minimized.

3. Institutional and management principles

The role of the responsible authorities and all official bodies at all levels should be clearly defined and the areas of responsibility officially established. The structure and system of the wastewater reuse management should be designed in such a way as to facilitate the involvement by the responsible authorities at different levels with encouragement of private sector involvement. In addition, capacity building for all institutions for treated wastewater reuse has to be envisaged and intermediary bodies such as association, NGP and local councils has to be enhanced.

- **Chapter II: Article 7: Technical Principles**

1. General Technical Principles

All wastewater shall be collected, treated and used according to these guidelines to minimize the deficit in the water balance. The treated wastewater reuse should comply with the standards and has to be transported in accordance to the guidelines (closed pipes). Dilution of the wastewater to reach the compliance standard and direct injection to the aquifer without treatment is forbidden. In addition, wastewater treatment operator shall provide information and test results of quality of wastewater or any other information as requested.

2. Technical Principles for Irrigation and Recharge

Industrial and commercial wastewater is allowed to be used for irrigation and groundwater enrichment, only if the compliance with the standards is durably guaranteed during operation. The use of wastewater for irrigation and ground water enrichment is forbidden in drinking water protection zones. The ground water enrichment by wastewater is only allowed in facilities that are operated with a license from the competent authorities.

The reuse of wastewater for irrigation is only allowed if it follows the regulations and standards according to the relevant type of cultivation and irrigation technique. The use of sprinklers is not allowed for irrigation.

All kinds of vegetables are not allowed to be irrigated by treated wastewater. Irrigation with treated wastewater has to be stopped two weeks before harvest. Fruits on the ground from trees that have been irrigated with treated wastewater are forbidden to eat, to process or to sell.

- **Chapter III: Competent Authorities and Responsible Areas**

This chapter includes responsibilities of National water council (NWC), Palestinian Water Authority (PWA), The Ministry of Environmental Affairs (MEnA), Ministry of Health (MoH), Ministry of Agriculture (MoA), Coastal Municipal Eater Utility (CMWU) and formation of Committee for the reuse of wastewater (that consisting of representative from NWC, PWA, MEnA, MoH, MoA, Palestine Institute for Standardization and Measurement (PSI), Gaza Municipality, Rafah Municipality, Khanyounis Municipality, Islamic University of Gaza, El Azhar University, and Birzeit University.

Application and approval for wastewater reuse process is following EA administrative procedure (that describes in the Palestinian Environmental Assessment Policy (See Chapter 2). Licenses and permission is prepared by PWA with coordination with MoA. (Article 9)

Regarding wastewater reuse, PWA is responsible for technical, financial and operational issues, including compliances (chemical, microbial, samples, groundwater measures, and wells). MEnA is responsible for environmental issues supervision. MoH is responsible for the public health supervision in regards to the consumption of food products that are irrigated by wastewater reuse and employees working on the reuse system. (Article 10)

Monitoring of groundwater, wastewater quality, soil quality of product and human health is required to ensure proper treatment, avoiding environmental degradation, minimizing adverse health impacts and increasing the agriculture production in a sustainable manner. The monitoring of facilities and operation includes self-monitoring, compliance with regulations of facilities and operations and required control facilities and documentations. In addition, sampling analysis and conservation shall follow Annex 1 of this guideline (Article 11, 12 and 13)

- **Article 8: Competent Authorities and Responsibility Areas**

1. National Water Council (NWC)

NWC is responsible for:

a. Setting the policy for reuse of wastewater for Palestine and submitting it to the Council of the Palestinian National Authority for approval.

b. Reinforcing regional and international co-operation in reuse of treated wastewater.

c. Determining the budget required for investment in reuse of wastewater.

2. Palestinian Water Authority (PWA)

PWA is responsible for:

The strategic planning for the reuse of treated wastewater, e.g., for setting up the water management plan

a. Issuing licenses related to the operation of facilities for the groundwater recharge

b. Giving permission for the use of ground water and irrigation with treated wastewater.

c. Monitoring the quality and quantity of treated wastewater.

d. For the reuse of treated wastewater PWA is working in close cooperation with other stakeholders mainly the Ministry of Environmental Affairs, the Ministry of Health and the Ministry of Agriculture.

e. Instruct the Coastal Municipal Water Utility with special design tasks.

1.5 Technical Specification (TS) 34 / 2012

This Technical specification divide the quality of treated wastewater into 4 categories, high quality (A), Good quality (B), Moderate quality (C) and Poor quality (D). In addition, this specification regulate that the effluent quality of the treated wastewater for irrigation has to be approved by the Ministry of Irrigation and Ministry of Agriculture to use of the treated wastewater for irrigation in accordance to their standards and specification.

1.6 Solid Waste Management Regulations 2004

Solid Waste Management Regulations (2004)

The Solid Waste Management Regulations, issued by the EQA in 2004, are the first trial to develop regulations that aims to complement the Environmental Law. These include the following key guidelines related to waste collection:

- MSW collection is the responsibility of municipalities and village councils, as well as ensuring that this the process does not have health and/or environmental implications.
- It is prohibited to dispose of waste outside the street containers designated for this purpose. These containers should be closed and manufactured out of a metallic or similar material. The number of these containers should be sufficient and waste has to be collected at least three times per week in urban areas.
- It is the responsibility of industrial, commercial and agricultural waste generators to arrange for the collection and transport of their wastes to the designated treatment/disposal areas. This has to be pre-arranged with the authorities.

The regulations also include an article about classification of the different waste streams into MSW, construction and demolition waste, and other waste streams depending on the generating industry

Key guidelines for landfills included in the regulations

In general, the construction of a waste landfill is subjected to an environmental approval according to the conditions and instructions of Environmental Impact Assessment Policy. The co-mixing of hazardous and non-hazardous wastes is prohibited. And the different cells of the landfill should be classified according to one of the following types:

- Inert landfills;
- Non-hazardous landfills;
- Hazardous landfills.

The landfill operator shall be responsible for the landfill for a period of 20 years following its closure. Additional technical considerations related to the site selection and landfill design include the following:

- The site should be fenced, and located at a considerable distance from residential or commercial areas – no distance has been indicated.
- The landfill site should be lined with a protective insulation layer in order to protect groundwater.
- A leachate collection system should be constructed.
- The site should have sufficient quantity of soil which will be needed for daily covering the waste.
- Regular inspection of the monitoring wells.
- The landfill operator should prepare a waste register.

1.7 National Strategy for Solid Waste Management in the Palestinian Territory, 2010

The National Strategy for Solid Management in the Palestinian Territory was endorsed by the Cabinet in May 2010 and represents the first cross-sectoral strategy for solid waste in Palestine. The strategy aims at establishing the framework to all decisions, programs, activities, and mid-term investment plans to develop the solid waste sector in Palestine.

At institutional level, the strategy confirmed the urgent need to address major issues like:

- Ineffective legislative framework
- Lack of standards for various stages of SWM
- No division of tasks and responsibilities among various stakeholders
- Lack of resources (human, financial, organizational capacity) in the instates involving in SWM
- No unified system to manage data related to SWM
- Limited participation of the private sector
- Insufficient public awareness in SWM issues and weakness of participation.

Among the strategy's policies are the following:

Policy (1) Strategic Objective 1: Development and update of the legislative framework supporting integrated SWM

Policy (2) Strategic Objective 1: Strengthen the organizational framework of national institutions and supporting their complementary roles in SWM.

Policy (3) Strategic Objective 2: Establishing an integrated, coordinated, and sustainable institutional approach to support institutional capacity building in the SWM sector.

Policy (4) Strategic Objective 3: Developing the current management systems for SW collection and transport, in order to improve the quality and effectiveness of services and its availability to all citizens

Policy (5) Strategic Objective 3: Safe and efficient disposal of SW in regional sanitary landfills servicing all communities

Policy (6) is concerned with diverting waste from landfills through waste minimization, reuse and recycling. The MoLG shall play a vital role as the key executing party for achieving most of the strategic objectives. This shall be considered in any new institutional set-up for SWM in GS. The municipalities in GS are the main parties responsible for the SWM at all stages including primary collection, secondary collection, and landfill management.

Policy (7) – Strategic Objective 3: Prohibiting the use of random dump sites and closing or rehabilitating the existing sites to limit their environmental and health risks.

Monitoring the implementation of the solid waste management strategy has been assigned to the national team for solid waste management by a Ministerial Council Cabinet Decision in 16 May 2010. This is the steering committee which develops the solid waste management strategy and is chaired by the Minister of Local Government.

Policy (14) of the strategy promotes private sector participation in SWM projects

1.8 Palestinian Labor Law 7/2000 and supplementary bylaws

This law governs the whole labor activities and arranges the relation between laborers and employers.

- **Chapter 2 Article 34** indicates the importance of applying health and safety procedures

- **Chapter 4: health and safety. Article 90** indicates the importance of using protective clothes to rescue the workers from any danger. Health and safety inside work place. Needed medical supplies inside work. Periodical examine for all of the workers.
- **Chapter 4 Article 91** discussed the regulations according to which the organization can set its own health and safety procedures and penalties that should be indorsed by the Ministry and disclosed in a visible place
- **Chapter 4 Article 92** indicated that the worker should not pay for health and safety arrangement
- **Chapter 4 Article 93** banned any employment for the children less than 15 years old.

1.9 Land Ownership Law 3, 2011

Law 3 Year 2011 concerns with land ownership, acquisition and compensations. This law comes to amend Law 2 Year 1953. The law stipulates all the regulations and procedures related to the acquisition of private land for the purpose of public interest projects. It defines the meaning of public interest projects and presents the entitlement requirements including land registries and ownership documents needed to prove the affected person entitlement to compensation. It also regulates the cases where disputes over ownership may occur.

1.10 Land Expropriation Law2/1953

Land expropriation is one of the key issues of relevance to the project. The most important articles related to this law are as follow:

- **Article 3:** Initiation of the expropriation
    1. the beneficiary should publish an advertisement in the Official Gazette for a period of fifteen days after declaring his intention to precede to the Cabinet a request for expropriation of the land described for Public Benefit
    2. The transactions related to Secretion[1] (*Ifrath*) that takes place after publication of the notice mentioned in paragraph (1) above, shall not affect the right of the government or the municipal council or the local council to expropriate 25% of an area of land before secretion without compensation, which is similar to the provisions of **Article (21)** of this law.
- **Article 4** presents the types of expropriation including: 1) permanent 2) temporarily 3) Not allowing full use of land 4) forcing certain use of land
- **Article 5** is related to the disclosure of expropriation activities and inventory for the affected groups
- **Article 6** is about the informing of land owners
- **Article 8; after the declaration of land expropriation. The land registration officer should ban** any action or activities to be applied through putting a reference number. The Ref. No of the land should be attained from Land Authority to stop any action on this land if it is registered
- **Article 9** is about the negotiations with the affected persons

[1] According to law the government has the right to expropriate 25% of the owned lands for roads and any other projects without paying any compensation

- **The articles from 10-21** discuss the entitlement of compensation and strategies to pay it. As well, the different cases that enable the affected people to stop the expropriation actions and retain their lands
- **Article 22** discussed the taxes needed due to any change of the value of land due to the implementation of the project

1.11 Antiquities Law of 1966

Since the establishment of the Palestinian Ministry of Tourism and Antiquities in 1994, the Ministry, in cooperation with governmental and non-governmental institutions, academics and intellectuals, has drafted its own version of a National Antiquities Law. However, this draft has never been enacted as law, and therefore the Jordanian Antiquities Law of 1966 is still applicable in the Palestinian Territories today.

There is no unified legal regime in the Palestinian Territories. In fact, there are different laws that are applicable in these territories. This is because Palestine was subject to different rulers since the end of nineteenth century. The British Mandate, Jordan, Egypt, and the Israeli Occupation issued large amounts of legislation, some of which is still applicable in the West Bank and the Gaza Strip.[2]

The Palestinian Legislative Council (PLC) that was inaugurated in March 1996 also issued legislation on different fields of life in the Palestinian Territories. However, the different scopes of sovereignty of the Palestinian Authority in the West Bank and the Gaza Strip (areas A, B, and C), the continuing application of the Israeli military orders in area C, the continuation of the Israeli occupation to East Jerusalem and application of the Israeli law there, and the reoccupation by Israeli troops of the PA areas (since 2002) put serious constraints on the legislative role of the PLC, the role of the judiciary, and the executive role of the PA to enforce this legislation.

The existing legal regime concerning cultural and natural heritage in the Palestinian Territories are the British Mandate Law of Antiquities of 1929 (applicable in Gaza Strip only), the Jordanian Law of Antiquities of1966 (applicable in the West Bank) and the Israeli laws of 1978 in East Jerusalem.

The Palestinian Basic Law of 2003 contained a paragraph of relevance to heritage protection. Under this paragraph, the President swears, "…to be faithful to the homeland and holy places, to the people and its national heritage…" This is currently the only reference to "heritage", and it is limited, in the draft constitution.

Since there is not yet an approved Palestinian constitution, the protection of cultural and natural heritage remains, until today, without a solid constitutional basis. As it stands today the Constitution is in its fourth reading. The major Deficit of the 1966 Law of antiquities is the Definition, which reads:

"Antiquities are any movable or immovable remains or any part of it that was constructed, or formulated, or decorated, or inscribed or built in any form or any addition by a human being before 1700 AD. Antiquities also include human or animal remains prior to the year 600 AD. It also includes any structure built after 1700 AD, which is declared by the Director of the Department of Antiquities to be ancient antiquities".

The definition clearly excludes any archaeological sites (including historic buildings) and artifacts (movable objects), which postdate 1700 AD. The definition also excludes

[2] Cultural Heritage in Palestine, RIWAQ New Experience and Approaches, Nazmi Ju'beh Ramallah-Palestine, June 2009

religious buildings, as well as natural heritage sites. Neither architecture (groups of buildings, monuments) nor movable objects are defined or included as separate categories in these two laws.

1.12 Basic Laws

Within the framework of the provisional period, resulting in the Declaration of Principles Agreement, the establishment of the Palestinian National Authority with its three pillars – the legislative, executive and judicial branches – became among the most urgent of national missions. The establishment of the Palestinian Legislative Council, through free and direct general elections, made the adoption of a Basic Law suitable for the interim period a necessary foundation upon which to organize the mutual relationship between the government and the people.

Title Two – Public Rights and Liberties

- **Article 9:** Palestinians shall be equal before the law and the judiciary, without distinction based upon race, sex, color, religion, political views or disability.

- **Article 10: Basic** human rights and liberties shall be protected and respected. The Palestinian National Authority shall work without delay to become a party to regional and international declarations and covenants that protect human

- **Article 31:** An independent commission for human rights shall be established pursuant to a law that will specify its formation, duties and jurisdiction. The commission shall submit its reports to the President of the National Authority and to the Palestinian Legislative Council.

1.13 Consumer protection law 21/2005

This law discusses intensely the consumer rights which might be trigged during the implementation of the project. The most relevant articles related to the project are as follow:

- **Chapter Two: Consumer rights Article (3)** The consumer has the following rights: 1 - Maintain his health and safety when using any type of good or service in terms of quality

- **Chapter three. Article (4):** Formation of the Palestinian Council for consumer protection and consumer protection associations. "Established under the provisions of this law advisory board called "the Palestinian Council for Consumer Protection" and consists of the following entities: - Member of the Ministry of National Economy - Member of the Ministry of Finance. - Member of the Ministry of Health - Member of the Ministry of Agriculture - Member for Environment Authority - Member of the Institution for Standards and Metrology Palestinian - Member of the Chamber of Commerce - Member of the industry associations - Member of the Federation of Contractors - Member of the Business Association - five members of associations of consumer protection

- **Chapter three .Article (5):** The Council aims at protecting consumer rights and ensures that he is not exposed to any risks or damages resulting from using any types of goods and services provided through the following: 1 - Participation in the formulation of the relationship and coordination between all relevant agencies to protect the consumer. 2 - Support and strengthen the role of consumers in the national economy.

- **Chapter four. Product safety Article (9)** "Each product that might result any dangerous must be signed by the warning showing the type of risk.

- **Chapter four. Article (11).** If the provider observed that the good or service that is purchased has a defect or more would be detrimental to the safety of consumer or health or that they may pose a threat to it, for the supplier to take and immediately the following procedures: 1 - to inform the competent authorities and inform the public by the media about these defects and warned of the risks that may result from them. 2 - Item withdrawn from the market. 3 - To recover the goods that were sold or leased and re-paid the price. 4 - Replace the goods at provider's expense and re-paid the price in case they could not fix it. 5 - Get rid of them, in ways that are correct and not harmful to the environment, and at his expense.

- **Chapter V. Integrity of the economic transactions**, **Article (15)** The promotion should apply advertising of products that takes into account the consensus is to be announced and the reality of the advertised product specifications, and must not imply that declaration to deceive or mislead the consumer

1.14 Joint Service Council (JSC) Regulations, 2006

The JSC regulations were issued by the MoLG in 2006; they set the managerial system and authorities for the JSCs. The work of the JSC shall be organized by the Minister of Local Government in coordination with the councils of concern.

1.15 Palestinian Reform and Development Plan (2008-2010)

The Palestinian Reform and Development Plan 2008 - 2010 (PRDP) is a national plan which sets out Palestinian Authority medium term agenda for Palestinian reform and development. Among the primary objectives set out in the PRDP is "strengthen public institutions" which is of support to "good governance" as one of PA national goals. This is to increase the capacity of the public sector organizations in delivering basic health services which will have a direct positive effect on the daily life of the citizens as has been stated by PRDP. This is also in line with "strengthening the local government" policy and objective set out in PRDP. That is work with local government unit to empower and increase the accountability and effectiveness through intensive capacity building.

The Palestinian National Policy Agenda (PNPA) has conservation and recycling of natural resources including SW as one of its objectives. This is under the "development of physical capital" objective and is stated as "Equitable, efficient and environmentally friendly management of solid waste". The other PNPA objective of developing affordable and regional SWM is listed in the development budget resources. The main two objectives and targets in this regard stated in PRDP are complete construction of a new sanitary landfill in the West Bank and increase number of SW tons disposed of in regional sanitary landfills.

1.16 Local Council Law, 1/ 1997

The local council law issued in 1997 has replaced the old law and is currently the prevailing council law. After perusal of the Municipalities Law No. 29 of 1955 in force in the provinces of the West Bank, and the Municipalities Law No. 1 of 1934 in force in the Gaza Strip, and the Law on Management of villages No. 5 of 1954 applicable in the provinces of the West Bank, and the Law on Management of villages No. 23 of 1944, in force in the Gaza Strip, and the draft law submitted by the Council of Ministers, the Legislative Council after the adoption of the bill, we have issued the following law. According to the new law, water collection and disposal are the responsibility of local councils, which was clearly stated as follows:

- Provision of potable water and other types of water. Addressing specification of water equipments i.e. pipes and water meter. Arrange for the distribution of water, the tariff and prevention of pollution to the wells, basins and springs

- Planning the town and roads including, road development planning and closing of roads, modification, set the length and width, paving, construction and resurfaced, cleaning, lighting, maintenance, naming or numbering and numbering its buildings, beautification, plantation and monitoring of street conditions.

- Protection measures for safe public health shall also be taken by the council; this includes the implementation of an efficient waste collection system.

The law provides for municipalities the possibility to form JSCs through which they can join forces and collaborate onto the delivery of municipal services including water tariff. Regulations to give effect to this law were adopted the following year.

1.17 Project Approval Requirements

- **Article 45 of the PEL;** "The Ministry (EQA), in coordination with the competent agencies, shall set standards to determine which projects and fields shall be subject to the environmental impact assessment studies. It shall also prepare lists of these projects and set the rules and procedures of the environmental impact assessment".

- **Article 47 of the PEL states that;** "The Ministry (EQA), in coordination with the competent agencies, shall determine the activities and projects that have to obtain an environmental approval before being licensed. This includes the projects that are allowed to be established in the restricted areas".

According to the PEL and the Palestinian Environmental Assessment Policy (PEAP), was approved through resolution No: 27-23/4/2000, the project proponent must first obtain an initial approval from the appropriate ministry or local planning committee. The proponent then submits an application for environmental approval to the EQA. The EQA notifies the appropriate permitting authorities that an application for environmental approval has been received. The application should also list what environmental and other permits must be obtained and complied with, indicate how the expected conditions of these permits will be fulfilled, and include a signed statement by the proponent that these conditions will be fulfilled.

An Environmental Approval may specify:

- Required measures to mitigate adverse environmental impacts or capture potential environmental benefits, including a compliance schedule. This may include land compensation measures issued by the Higher Planning Council after reviewing the project. The procedures involve the Ministry of Finance, the MoLG and municipalities of concern.

- Measures that the proponent must implement in order to comply with relevant standards and requirements.

- Monitoring and reporting duties of the proponent.

The project proponent shall express the commitment to the standards and requirements for the protection of the environment and to apply all the required mitigation measures addressed in the EIA. The proponent shall express the legal commitment towards the EIA.

2. 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 (OP 17.50)
- Natural Habitats (OP 4.04)
- Cultural Property (OPN 11.03)
- Project on International Waterways (OP 7.50)

2.1. 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.

Based on the survey conducted by the Consultant, the OP. 4.12 related to the involuntary resettlement is trigger. Therefore, the ToR of RPF and RAP were prepared and presented as an Annex in the SESIA study to be reviewed by the donors. Afterward, the donor will approve the ToR and the Client will prepared the tender for performing RAP.

2.2. 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.

The Consultant conducted the disclosure procedures in accordance to the WB procedures. The activities were done as early as possible to ensure the disclosure processes takes place in a manner that the project affected people as well as the stakeholders were fully informed and involved during report preparation. The detailed processes conducted by the Consultant regarding the disclosure processes are presented at different chapters and Annexes of the SESIA report.

2.3. 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.

Concerning the remediation works and the decommissioning of the BLWWTP, the OP 4.04 is triggered. Therefore, the degree of the impacts and the mitigation measures has to be presented to reduce the impacts. However, the habitats expected to be disturbed during the project implementation are not consider endanger. In addition, after the activities (rehabilitation and the decommissioning), the health and the disturbance of the neighboring community due to the outbreak (as a result of the operation of BLWWTP and Effluent Lake) will be eliminated.

2.4. 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.

The Consultant conducted the review of the cultural resources within the project component. In addition, the clarification and confirmation from the Antiquities Authority was obtained to ensure the project components do not trigger the cultural property.

2.5. OP 7.50 - Project on International Waterways

The core requirement for this Safeguard Policy include investigation of the Project that might affect the International or shared waterways or water bodies. Impact on the international shared waterways or water bodies could be tolerate only if no alternatives are available and if acceptable mitigation measures are in place.

The project component of reuse system is nearby the Israeli border. The Consultant reviewed the groundwater characteristics at the surrounding site. In addition, based on the groundwater modeling, the expected impact is presented. The detailed explanation of the impacts on the groundwater might affect the neighboring country (Israel) due to the reuse system is presented in detailed at Chapter 5. In addition, as the storage tanks is located nearby the Israeli border, due to security, the emergency plan in case the storage tanks is damage or not functioned is presented as well on the SESIA report, Chapter 6.

3. 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 tributes 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.

The Consultant reviewed the design of the reuse system and ensures that the articles mentioned above are followed. In addition, the standard of the effluent reuse and sludge reuse is following the available limit by Israeli laws and standard. Please note, according to the design criteria, the sludge limit guideline is following the EPA standard (according to the design criteria) and the effluent reuse, beside the Israeli guidelines, the guideline according to the Egyptian standard was compared.

4. REGIONAL LEGAL FRAMEWORKS (JORDAN, ISRAEL AND EGYPT) CONCERNING WASTEWATER REUSE AND SLUDGE MANAGEMENT AND REUSE

Palestine by law has a standard and guideline for recovered water (groundwater) quality standard to be used for irrigation. However, the regional legal framework as well as the standard guidelines from the region (especially Jordan, Israel and Egypt) and the International standard for wastewater reuse were reviewed and compared. The Consultant reviewed the available frameworks and guidelines to ensure that the recovered water proposed within this project is according to the framework and guidelines applied in the region and according to the acceptable international guidelines.

In addition, as the guidelines for sludge management and reuse in Palestine is not yet endorsed the frameworks, including guidelines, and practices from countries within the region and international guideline for sludge reuse were reviewed by the Consultant. The Consultant ensures that the guideline provided by the Palestine is in accordance to the practice and in comparison with the regional and international standards.

4.1. Wastewater Reuse Policy in Jordan, Israel in comparison with the FAO standards for irrigation

Authority of Jordan has established the standard of wastewater reuse for irrigation purposes in 2006. These standards are currently applied to all municipal wastewater treatment systems. The standards establish a variable standard for wastewater quality for

7 categories of discharge or direct reuse. The direct use of treated wastewater for the irrigation of crops normally consumed raw was explicitly forbidden by the Standard.

The 1995 Standard # 893 includes the following categories of wastewater reuse standards depending on the fate of domestic wastewater after it is released from the wastewater treatment facility:

- Recycling of water for irrigation of vegetables that are normally cooked,
- Recycling of water used for tree crops, forestry and industrial processes,
- Discharges to receiving water such as wadis and catchment areas,
- Use in artificial recharge to aquifers,
- Discharge to water bodies containing fish,
- Discharge to public parks or recreational areas,
- Use in irrigation of animal fodder.

The 1995 standard enabled design engineers and concerned health officials to adjust the level of treatment and, hence, the cost of treatment to the actual conditions of treated effluent reuse. Standards for BOD were limited to 150 mg/l for most forms of agricultural reuse and a more stringent standard was created for amenity irrigation in areas that can be accessed by the public.

Similarly, Israeli has similar policy of reusing treated wastewater for irrigation with different quality standard. Table 1 and 2 below present the comparisons of quality standards of Jordan, Israel, Palestine and the standard comparison with FAO.

4.2. Wastewater Reuse Policy in Egypt

Law 48/1982 concerning protection of the river Nile from pollution that restrict the discharge of the wastewater on different water bodies (groundwater and surface water) and Ministry of Water Resource and Irrigation (MWRI) whereas, the Ministry of Health and Population (MoHP) are responsible for monitoring effluent. In addition, only discharge of treated municipal wastewater can only discharge to brackish water bodies. Moreover, the reuse of drainage water is also regulated.

Law 12/1982 is the legal basis for irrigation and drainage is set out in Law 12/1982 and its supplementary Law 213/1994, which define the use and management of public and private sector irrigation and drainage systems including main canals, feeders, and drains.

Law 12/1982 defines inter alia public properties related to irrigation and drainage: the River Nile, the main canals, public feeders, and public drains and their embankments. The law regulates the use of groundwater and drainage water (construction of wells or the use of drainage water and water pumps). It provides regulations for the development of new land and the price that has to be paid for the irrigation and drainage of land.

Law 93/1962—Wastewater disposal and reuse; Decree No. 649/1962 of the Minister of Housing issued the executive regulations for Law 93/1962. It specifies regulatory standards for wastewater disposal. It was updated in 1989 by Decree No. 9/1989, in which a distinction was made between wastewater disposal on sandy soils and clay silt soils.

In 1995, an amendment was made by both the Ministry of Irrigation and the Ministry of Agriculture and approved by the Ministry of Health. In 2005, new standards for the reuse of wastewater were set in the Egyptian Code for the Use of Treated Wastewater in Agriculture.

 Annex 4

Table 1 Comparisons of quality standards of Jordan, Israel, Palestine and the standard comparison with FAO

		Jordan JS 893/2006				Palestine TS 34-2012				Israel[1]	FAO[2]		
Parameter	**UM**	**A**	**B**	**C**	**D**	**A**	**B**	**C**	**D**		**Degree of restriction on use**		
		Cooked vegetables Parks Playgrounds Roadsides	Fruit tress Landscaped roadsides of highways	Industrial crops Forest trees	Collecting flowers	High quality	Good quality	Medium quality	Low quality	unrestricted irrigation	none	slight to moderate	severe
Physico-chemical characteristics													
BOD_5	mg/l	30	200	300	15	20	20	40	60	10			
TSS		50	200	300	15	30	30	50	90	10			
COD		100	500	500	50	50	50	100	150	100			
pH		6-9				6-9				6.5-8.5	6.5 - 8		
Turbidity	NTU	10			5								
EC	dS/m									1.4			
- salt sensitive		(EC: ~ 2.34)									< 0.7	0.7 - 3.0	> 3.0
- medium salt tolerant													
- salt tolerant													
- higly salt tolerant													
TDS	mg/l	1500				1200	1500	1500	1500		< 450	450 - 2000	> 2000
Ammonium as NH_4-N	mg/l					5	5	10	15	10			
Nitrate as NO_3 / NO_3-N		30 / 6.8	45 / 10.4	70 / 16.1	45 / 10.4	- / 20	- / 20	- / 30	- / 40		< 5	5 - 30 / 1.2 - 6.8	> 30 / > 6.8
Total Kjeldahl N		45	< 70	100	70	30	30	45	60	25			
PO_4-P		30				30							
Chloride		400				400				250	~ < 400	~ 400 - 1000	~ > 1000
residual Chlorine										1			
Bi-carbonate (HCO_3)		400			400						< 1.5 (me/l)	1.5 - 8.5 (me/l)	> 8.5 (me/l)
Microbiological characteristics													
Escherichia coli	MPN/100 ml	100	1000		< 1.1	100	1000	1000	1000	12			
Feacal coli						200	1000	1000	1000	10	1000 F. coli (irrigation of crops likely to be eaten uncooked; otherwise no standard recommended)		
Intestinal Nematodes	viable eggs/l					< 1	< 1	< 1	< 1				
Intestinal Helminthes		< 1	< 1	< 1	< 1						1 (irrigation of crops likely to be eaten uncooked)		

Table 2 Comparisons of quality standards of Jordan, Israel, Palestine and the standard comparison with FAO (continued)

		Jordan JS 893/2006	Palestine TS 34-2012	Israel[1]	FAO[2]		
Parameter	UM	A - D	A - D		Degree of restriction on use		
					none	slight to moderate	severe
Heavy metals / trace elements							
Arsenic	mg/l	0.1		0.1	0.1		
Cadmium		0.01	0.01	0.01	0.01		
Chromium		0.1	0.1	0.1	0.1		
Copper		0.2	0.2	0.2	0.2		
Lead		0.2	0.2	0.1	5.0		
Mercury		0.002	0.001	0.002			
Nichel		0.2	0.2	0.2	0.2		
Zinc		5.0	2.0	2.0	2.0		
Aluminium		5.0	5.0	5.0	5.0		
Boron		1.0	0.7	0.4	< 0.7	0.7 - 3.0	> 3.0
Lithium		2.0 (0.075 for citrus)		2.5	2.5 (0.075 for citrus)		
Iron		5.0	5.0	2.0	5.0		

4.3. Sludge Management and Reuse Policy in Jordan and Israel

- **Jordanian Standard # 1145/1996 -- The Uses of Sludge in Agriculture**

According to (JS-1145) 1996, this standard is concerned with the conditions that must be available in the sludge resulting from the stations for the treatment of sewage water intended to be used in agricultural land.

The "Wastewater Management Policy" of Jordan was prepared in 1998 and consisted of 67 main points that were listed under 13 subtitles. The following key policy issues were included in the wastewater management policy:

- Wastewater shall not be treated as waste and therefore disposed. Wastewater shall be part of the national water budget.
- Adequate wastewater collection and treatment facilities should be available for all the major cities and towns in Jordan to protect the environment and public health.
- Priority of reuse of treated effluents should be directed as a source for irrigation.
- Treatment of wastewater shall be targeted towards producing an effluent fit for reuse in irrigation that complies with the WHO and FAO guidelines.
- A high importance should be given for the establishment of a section in the Water Authority to be responsible for the development and management of wastewater systems, wastewater treatment and reuse.

- A basin management approach shall be adopted where possible. The use of treated wastewater in irrigation shall be given the highest priority and pursued with care.

- Effluent quality standards shall be set based on the best attainable treatment technologies, and calibrated to support or improve ambient receiving conditions, and to meet public health standards for end users.

- Wastewater intended for irrigated agriculture shall be regulated based on the soil characteristics of the irrigated land, the type of crops grown, the irrigation methods, and whether other waters are mixed with the treated wastewater.

- Industries shall be encouraged to recycle part of its wastewater and to treat the remainder to meet standards set for ultimate wastewater reuse or disposal.

- Wastewater from industries with significant pollution should be treated separately to standards allowing its reuse for purposes other than irrigation or to allow its safe disposal.

- Consideration shall be given to isolating treated wastewater from surface and ground waters used for drinking purposes, and to the blending of treated effluent with relatively fresher water for suitable reuse.

- Priority shall be given to protecting public health and water resources from chemical and microbiological pollutants.

- The transfer of advanced wastewater treatment technologies shall be endorsed and encouraged. However, appropriate wastewater treatment technologies shall be selected with due consideration to operation and maintenance costs and energy savings, in addition to their efficiency in attaining and sustaining quality standards.

- Treated wastewater effluent is considered a water resource and is added to the water stock for reuse. Priority shall be given to agricultural reuse of treated effluent for unrestricted irrigation. Blending of treated wastewater with fresh water shall be made to improve quality where possible. Crops to be irrigated by the treated effluent or blend thereof with freshwater resources shall be selected to suit the irrigation water, soil type and chemistry, and the economics of the reuse operations.

- Farmers shall be encouraged to use modern and efficient irrigation technologies. Protection of on farm workers and of crops against pollution with wastewater shall be ensured.

- Treated effluent quality should be monitored and users are alerted to any emergency causing deterioration of the quality so that they will not use such water unless corrective measures are taken.

- Sludge produced from the treatment process would be processed so it may be used as fertilizer and soil conditioner. Care shall be taken to conform to the regulations of public health and environment protection norms.

- Wastewater charges, connection fees, sewerage taxes and treatment fees shall be set to cover at least the operation and maintenance costs. It is also highly desirable that part of the capital cost of the services shall be recovered. The ultimate aim is for a full cost recovery.

- Appropriate criteria in order to apply the "polluter pays" principle shall be established.

- Treated effluent shall be priced and sold to end users at a price covering at least the operation and maintenance costs of delivery.

- All crops irrigated with treated or mixed waters shall be analyzed and monitored periodically.

- The role of the private sector will expand with management contracts, concessions and other forms of private sector participation in wastewater management such as BOO / BOT.

- The role of private sector in reuse of treated wastewater shall be expanded.

- **Israeli Standard 5764 – 2004; sludge stabilization and sludge treatment generated from WWTP to be used as a condition for agriculture use or soil conditioning.**

The standard establishes maximum limits for heavy metal and pathogen concentrations and odor limits on sludge designated for agricultural use, set recording and laboratory testing requirements, define specific uses for different classes of sludge (A and B), set imitations on areas of sludge use, and prescribe requirements for warning signs, transport and storage. Requirements for class A sludge, which is virtually pasteurized and highly stabilized, came into force in 2008.

U Directive 86/278 EEC: The purpose of Directive 86/278 EEC is to regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil, vegetation, animals and man, thereby encouraging the correct use of such sewage sludge as in common with other EU directives, the Sludge Directive is presenting a framework'. EU member states are obliged to derive its one national regulation.

Being introduced in 1986 the EU Sludge Directive is far from being up-to-date.

Most relevant parameter such as heavy metals and sanitary requirements are presented in the following table.

It becomes clear, that the Israeli standard is by far more rigid than the current EU standard and for some parameter (copper, nickel, lead, chrome) even stronger than the EU concentrations proposed to be introduced in the year 2015.

Table 3.Israel standard of sludge reuse in agriculture comparison with EU Directive

	EU		Israel	
	Directive 86/278 EEC	medium-term (ca. 2015)[1]	Class A	Class B
Heavy Metals (mg/kg DS)				
Cadmium	20 - 40	5	20	
Copper	1.000 – 1.750	800	600	
Mercury	16 - 25	5	5	
Nickel	300 - 400	200	90	
Lead	750-1.200	500	200	
Zinc	2.500 – 4.000	2.000	2500	
Chrome	(1.000 – 1.500)	800	400	
Sanitary requirements				
Feacal coliforms (MPN/1g DS)			1.000	2.000.000
Echerichia coliforms (MPN/g)		at least $2\log_{10}$ reduction[2]	-	-
		at least $6\log_{10}$ reduction[3]	-	-
Salmonella (MPN/4g DS)		non	3	
Enteric viruses (PFU/1g DS)			1	
Helminthes eggs (number/g)			1	

4.4. Wastewater Reuse Policy in Egypt

Law 276/1994—Use of Sewage Sludge

Law 276/1994 is the most specific law on reuse of wastewater sludge. It was amended by Decree No. 214/1997 and Decree No. 222/2002, which deal with the requirements for use of sewage sludge in agriculture. The standard of sludge reuse according to Egyptian Standard Decree 214/1997 is presented at the table 4 below.

Table 4 Composition of Sludge reuse according to Egyptian Standard

Determinant	Standard requirements	
	Limit Value	Units
Volatile solids	-	%
Dry solids	-	%
Nitrogen	-	%
Phosphorus	-	%
Potassium	-	%
Magnesium	-	%
Magnesium	-	%
Calcium	-	%
Iron	-	%
Copper	1,500	mg kg^{-1} DS
Cadmium	39	mg kg^{-1} DS
Chromium	1,00	mg kg^{-1} DS
Nickel	420	mg kg^{-1} DS
Lead	300	mg kg^{-1} DS
Zinc	2,800	mg kg^{-1} DS
Molybdenum	18	mg kg^{-1} DS
Arsenic	41	mg kg^{-1} DS
Selenium	36	mg kg^{-1} DS

Determinant	Standard requirements	
Mercury	17	mg kg^{-1} DS
Coliforms count	10^3	count g^{-1} DS
Salmonella count	3 per 4 g DS	count g^{-1} DS
Helminth	1 per 5 g DS	count g^{-1} DS
Virus	1 per 5 g DS	count g^{-1} DS

5. 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. These agreements may have had an influence of the development of Palestinian National Environmental Quality Standards.

6. Standards/Guidelines

The following national and international standards and guidelines were reviewed during the course of conducting the current ESIA:

- IFC Occupational Health and Safety Guidelines.
- World Health Organization (WHO) Guidelines for Air and Water Quality.
- WHO Guidelines for the wastewater reuse in agriculture 1989
- WB Guidelines Effluent Discharge Requirements.
- European Commission Environmental Standards.
- Israeli Environmental Standards.
- Jordanian Environmental Standards
- Egyptian Environmental Standards
- Palestinian Environmental Law Limit Values for Ambient Air Quality.

7. Relevant Ministries and Institutions

The Consultant reviewed the relevant ministries and institutions relevant to reuse system. Based on this assessment, the institution responsible for construction and operation phase of the project components (for management and monitoring) we developed.

As this project is mainly related to water, wastewater and sludge management, more than one entity is responsible for the implementation of the project. However, the main actor is the Palestinian Water Authority. Through cooperation with other Ministries and institutions, the project might be implemented in an easier way. The following figure presents some relations of the PWA with other entities

Source: PWA website

Figure 1. Some organizations that play a role in the project

7.1. The Palestinian Water Authority

PWA is responsible for management of the available water resources in Palestine to achieve the balance between available water quantities and qualities, and the needs of the Palestinian people in the present and the future. Law No.2 for 1996 identified the role of PWA in the following areas:

1. *Strategic planning for the water resources:* In this context, PWA has the authority to develop, enhance and allocate the water resources among the various demand sectors in order to achieve its goals which are:

    - Find the optimal way to manage, protect, and conserve the limited national water resources.

    - Guarantee the right of access to water of a good quality for both present population and future generations at cost that they can afford.

2. *Monitoring and protection of water resources: PWA has developed a comprehensive* monitoring program. The program identified the needs, the number of

monitoring wells and their locations. Also vulnerable areas by different sources of pollution like wastewater treatment plant, industrial estates, ports and intensive farms were considered carefully [PWA Monitoring, 1998].

3. *Regulation: Aiming at maximization of the benefit from the water resources and due to* existing conflict of interests, it is necessary to have a mature regulator for the water sector in general. Regulations should organize the relationship between service providers, the and the service users of environment and water resources. The role of PWA will be:

   Environmental Regulation: aims at controlling the utilization of water resources and wastewater disposal and/or reuse in such a manner that enables the environment and optimizes the benefit.

   Water Quality Regulation: aims at controlling the drinking water quality. In this context the PWA will be responsible for imposing a set of regulations on the service provider. These regulations should satisfy the requirement of the various stakeholders and mainly the Ministry of Health (MOH).

   Economic Regulation: aims at reviewing the prices of water in order to protect the customer from the service provider, which is normally working in a monopolistic environment. Also the regulator should ensure that all cost related activities are performed adequately by the utility.

7.2. Environmental Quality Authority (EQA)

Presidential Decree No. 6 in June 2002 established the Environment Quality Authority as the successor body to the Ministry of Environmental Affairs during the administrative reforms.

The responsibility of EQA is to promote a sustainable environmental development of the Palestinian society. Its main task is the protection of the environment, including its water, soil, air, natural resources, nature and Biodiversity, and the prevention of public health risks related to environmental issues. The main responsibilities of EQA are in the field of planning, monitoring, licensing and enforcement. EQA is responsible for the development of the environmental policy, legislation and environmental planning. It is also responsible for developing standards, norms and guidelines for creating environmentally sustainable Engineering and Management Consulting Center Annex II conditions. For a number of standards EQA has primary responsibility. The Agency, EQA, plays a complementary role to the MOH in setting standards related to the conservation and protection of the environment such as:

- Minimum water requirement to preserve the environment.
- Disposal of treated sewage in wadis, streams, rivers, lakes and seas.
- Disposal of treated sewage in environments, which affects the bio-diversity.
- Regulation of the industrial wastewater which is not treated by the utility.
- Disposal of brine from the desalination plants.

- Monitoring of the physical environment is an important task of EQA. It also includes the monitoring of the compliance with the environmental laws and regulations, as well as the enforcement by means of putting sanction on violations and transgressions.

7.3. Ministry of Agriculture

The Ministry of Agriculture plays an important role in managing the agricultural resources in Palestine. Its responsibilities are summarized as follows:

- Achieving food security.
- Establishing cooperation with the Palestinian Water Authority
- Rehabilitation of water sources, their protection from pollution, and promotion of their rational and economic use for agricultural production.
- Achieving the legislation that controls the extension of urban areas at the expense of agricultural areas and ensure sustainable development.
- Establishing methodologies for conservation of biological diversity and for sustainable use of resources by utilizing legislation, rules, procedures, budgetary allocations and other regulatory measures.
- Advancing public awareness concerning the advantages of Biodiversity conservation and sustainable development.
- Indicating the types of crops that can be irrigated by treated wastewater using the international standards.

7.4. Ministry of Local Government

Historically, local governments have been the cornerstone of Palestinian governance and the key providers of public goods and services in the West Bank and Gaza. Municipalities, in particular, have a well-established service delivery and regulatory functions including electricity, water supply, sanitation, solid waste management, local roads, libraries, parks and recreation, slaughterhouses, markets, land use planning, building and development approval, and business and professional licensing. Until November 1996 the governmental organization basically consists of two levels: central and local levels. In November 1996 a new intermediate level was introduced as Governorate, thus; three levels were established: central, regional and local governments. MOLG is responsible for the following activities:

1. To work towards an inclusive and unified local administration and establish local and municipal councils.
2. To provide the infrastructure services to all areas, both within and outside municipal boundaries.
3. To develop the organizational structure and public administration at local levels based on studies and a close dialogue with concerned localities.

7.5. The Ministry of Health

Environmental Health Department (EHD) is a central department in the Ministry of Health.

One of the main objectives of EHD is to promote research and information exchange related to health and environment (water, air, hazardous waste, vectors, and toxic materials). The Preventive Medicine Department (PMD) is responsible for monitoring the water quality. The MOH pays an important role in the water industry regulation. This covers setting the standards, which are related to the public health such as:

- Drinking water quality.
- Disposal of treated sewage in bathing waters.
- Disposal of treated sewage in environments which affects the quality of some products like fish.
- Treated wastewater reuse for irrigation, which may affect the agricultural products.
- Disinfection and drinking water storage.

7.6. Ministry of Planning (MOP)

MOP also took the initiative to develop an Emergency Natural Resources Protection Plan through their former Environmental Protection Directorate (EPD) and the Regional Development Plans through their Directorate for Urban and Rural Planning (DURP). MOP objectives are matching with the current objectives of EQA, which aim at the distribution of responsibilities and tasks among the ministries, institutions and agencies for the sake of achieving or working towards sustainable development. The development objectives of MOP are to:

- Institutionalize the strategic planning process at the national level;
- Support the participation of the all ministries and agencies of the PNA in the preparation and implementation of the three - five years plans "Palestinian Development Plan (PDP)".
- Coordinate the development at the national level between environment, socio-economic and physical sectors in a sustainable manner.

7.7. Ministry of Public Works and Housing (MPWH):

The main responsibilities of the Ministry of Housing and Public Works are:

1. To improve the standard of housing to safeguard the health of the inhabitants; which comprises improvement of the housing conditions and services such as sanitary facilities and ventilation.

2. To complete and upgrade the infrastructure required for economic development and social activities and to improve the quality of public buildings.
3. To ensure the use of high-quality construction materials to improve safety standards.
4. To concentrate on issues that has a direct impact on the environment such as air pollution and wastewater treatment and disposal.

3.6.2. Ministry of labor

The Department of Occupational Safety is responsible for:

- Performing periodical visits to work places and giving instruction regarding workers and equipment safety,
- Monitoring chemical, physical and biological impacts on workers, and
- Keeping records and monthly reports on work places.

7.8. Ministry of Energy and Natural Resources (MENR)

The objectives of the Ministry of Energy and Natural Resources are to develop current electricity sources and develop sustainable and cost-effective new sources and to minimize the emission of air pollutants. This can be achieved by full adoption of the actions specified in the National Environmental Action Plan (NEAP) to protect health and the environment from the effects of air pollution.

7.9. Ministry of Tourism and Antiquities (MoTA):

The ministry in general has the following responsibilities:

1. To protect antiquities.
2. To develop internal and external tourism,
3. To bring Palestinian history to the world's fingertips,
4. To work with other institutions in establishing specialized department/programs that is specialized in protecting ancient sites, cemeteries and monuments.

7.10. Ministry of Religious Affairs

The ministry is responsible for management the religious issues in the West Bank and Gaza Strip. The ministry manages the Waqf lands. Some of these lands may be rented to other ministries to implement a public facility.

7.11. United Nations Relief and Works Agency (UNRWA)

UNRWA has a monitoring program for drinking water in refugee camps.

7.12. North Gaza Joint Service Council

The North Gaza JSC is responsible for the waste collection in Gaza North Governorate which includes the municipalities of Beit Hanoun, Jabalia, Beit Lahia and Um Al Nasser Village. The population of Gaza North Governorate is around 300,000. The JSC was established in August, 2002 by a statue endorsed by the MoLG as a non-profitable public enterprise and started functioning since April 2004. The North Gaza JSC operates the following facilities:

a) The council headquarters and office at the service yard in Beit Lahia; and

b) Garage and workshop at the service yard in Beit Lahia.

Primary collection is performed using street containers, donkey-carts and small tractors with trailers the council contracts private firms to transfer solid wastes to Johr al Deek Landfill.

The North Gaza JSC Board includes the mayors of the municipalities and a supervisor from the MoLG, The organizational chart of the JSC is shown in Figure 2. In total, there are 222 workers in North Gaza JSC.

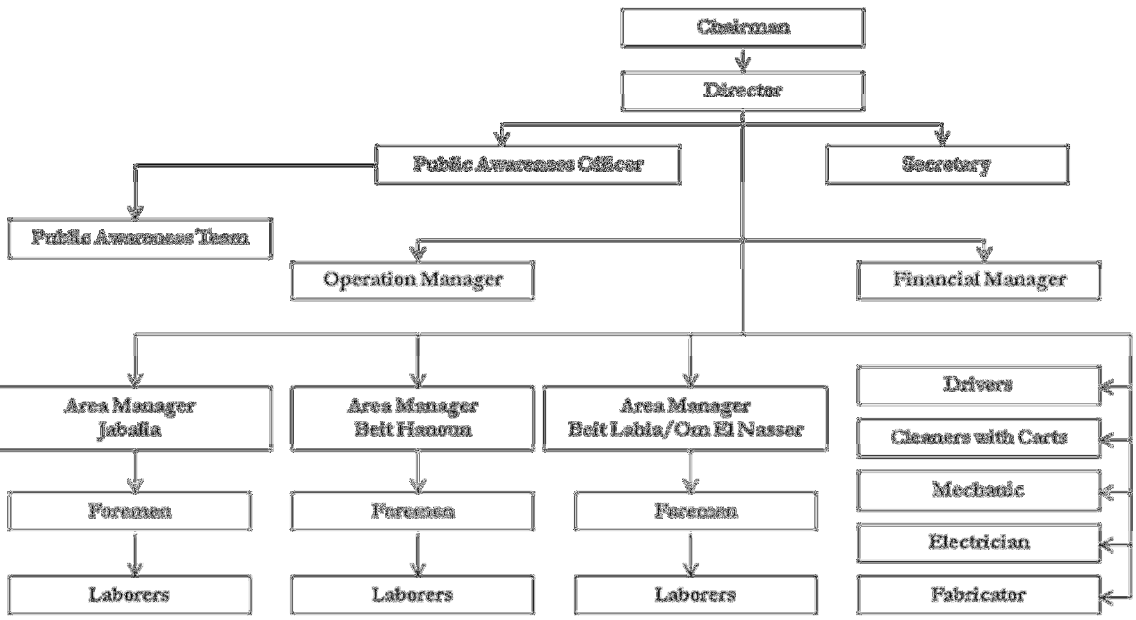


Figure 2. Organization Chart – North Gaza Joint Service Council (UNDP/PAPP 2011)

7.13. Municipalities

The main two municipalities working closely with the projects are Gaza and Jabalia municipalities who are responsible for land planning and acquisition. They address the plans for land to be expropriated under the 25% for public benefits in order to construct roads, etc. They are responsible also for any compensation to be paid to the affected groups entitled to be mitigated. As well the municipalities might get money from the expropriated lands in case of the value of lands raised due to the implementation of roads.

Annex 5

Groundwater Model Methodology

Table of Contents

1. Background Information

1.1 General Geology of the Coastal Aquifer

Gaza aquifer is part of the regional coastal aquifer which lies along the south eastern edge of the Mediterranean Sea and extends from the foothills of Mt. Carmel southward to Gaza and Northern Sinai. It is composed of Pliocene-Pleistocene age calcareous sandstone, unconsolidated sands, and layers of clays. In the Gaza Strip, the aquifer extends about 15–20 km inland, where it overlies Eocene age chalks and limestone or the Miocene-Pliocene age Saqiye Group. The Saqiye Group is a 400–1000 meter thick sequence of marls, marine shales, and clay stones. Approximately 10 to 15 km inland from the coast, the Saqiye Group pinches out, and the coastal aquifer rests directly on Eocene chalks and clastic sediments of Neogene age. Figure 1 presents a generalized geological cross-section of the coastal aquifer.

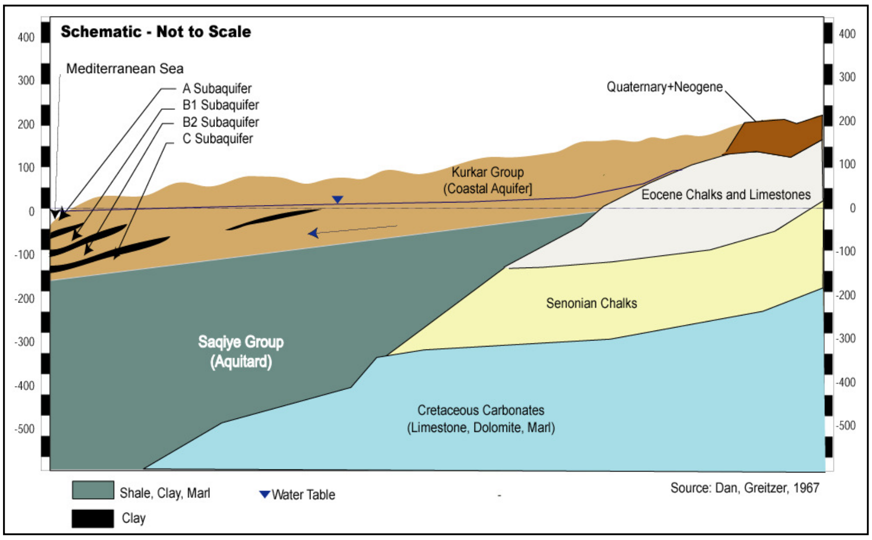


Figure 1: Generalized geological cross section of the coastal aquifer.

Near the coast in the Gaza Strip, clay layers subdivide the coastal aquifer into four separate sub-aquifers (Figure 1). They extend inland about 2 to 5 km, depending on location and depth. Further east, the marine clays pinch out and the coastal aquifer can be regarded as one hydro-geological unit.

Within the Gaza Strip, the thickness of the Kurkar Group increases from east to west, and ranges from about 70 m near the Gaza border to approximately 200 m the coast. Low permeable layers are found in the Kurkar group. These layers are more predominant closer to the coast.

1.2 Geotechnical Information in the Infiltration Basin

Field investigations had been carried out on the proposed infiltration site by SWECO, 2003, in addition, in 2010; PWA had finished the construction of 5 monitoring wells of the infiltration basin. Based on the information collected from the past investigations in the project area, five boreholes were drilled in a distance of 500 to 1000 m from the basin to complete the design of the recovery scheme.

All information collected from SWECO, PWA investigation, the past design project served as a fundamental source of information for the evaluations and conclusions of the current groundwater model and the SESIA report. A summary of the most important results is given in this section.

2. Groundwater Model

2.1. Software Description

Previously, there have been three modelling exercises related to the study area:

1) A regional groundwater model has been constructed for the southern part of the coastal aquifer focusing on Gaza strip and using the DYN software. This was a MS-DOS based software manufactured by CDM-consultants and is limited to the use of PWA and CAMP project.

2) A local groundwater model has been constructed for the hydrogeological evaluation of the infiltration system. The consultant (VA-Project AB, Sweco Viak AB and an under consultant at Tyréns, all in Sweden) has used MODFLOW. Modflow with its connected modules is a commercial product and operates in a Windows environment. It has been on the market for about 10 years and is well established. It is fully available for PWA and consultants.

3) Groundwater model of the Northern area for NGEST project under EA 2006 study. Visual Modflow (VMF) version 4.2 and its integrated modules were chosen. VMF is based on the finite-difference code MODFLOW (Harbaug & McDonald 1988) and contains four integrated modules: MODFLOW – Groundwater flow model, ZONE BUDGET – Water balance within user defined zones, MODPATH – Particle tracing and MT3D (Model Tracking 3D) – Substance or solute transport.

4) In the design of the recovery scheme 2010, the model used by EA is considered as the base of further modeling activities in that project. The conceptual model was considered valid, however, the modeling procedures were repeated for further calibration and verification of the model by input of new data from year 2004 until 2008.

5) In the current project for preparing the SESIA report, the same conceptual model used for the design of the recovery scheme is considered valid. The input data was updated for the last two years and up to year 2010. The groundwater level of 2011 was not considered since after review the raw data from PWA/Gaza office, the data was unrealistic in comparison with groundwater level data in year 2010. In general, the value of year 2011 data are greater than that in year 2010 which are not correct.

2.2. Conceptual Model

2.2.1. Model domain and boundaries

Based on the previous modelling efforts and the simulated water level contours for the year 2004, the model domain was chosen to fit stable boundary conditions. The Model Domain encloses an area of 17 x 23 km in the northern part of the Gaza Strip. Figure 2 shows the selected model domain as part of the coastal aquifer.

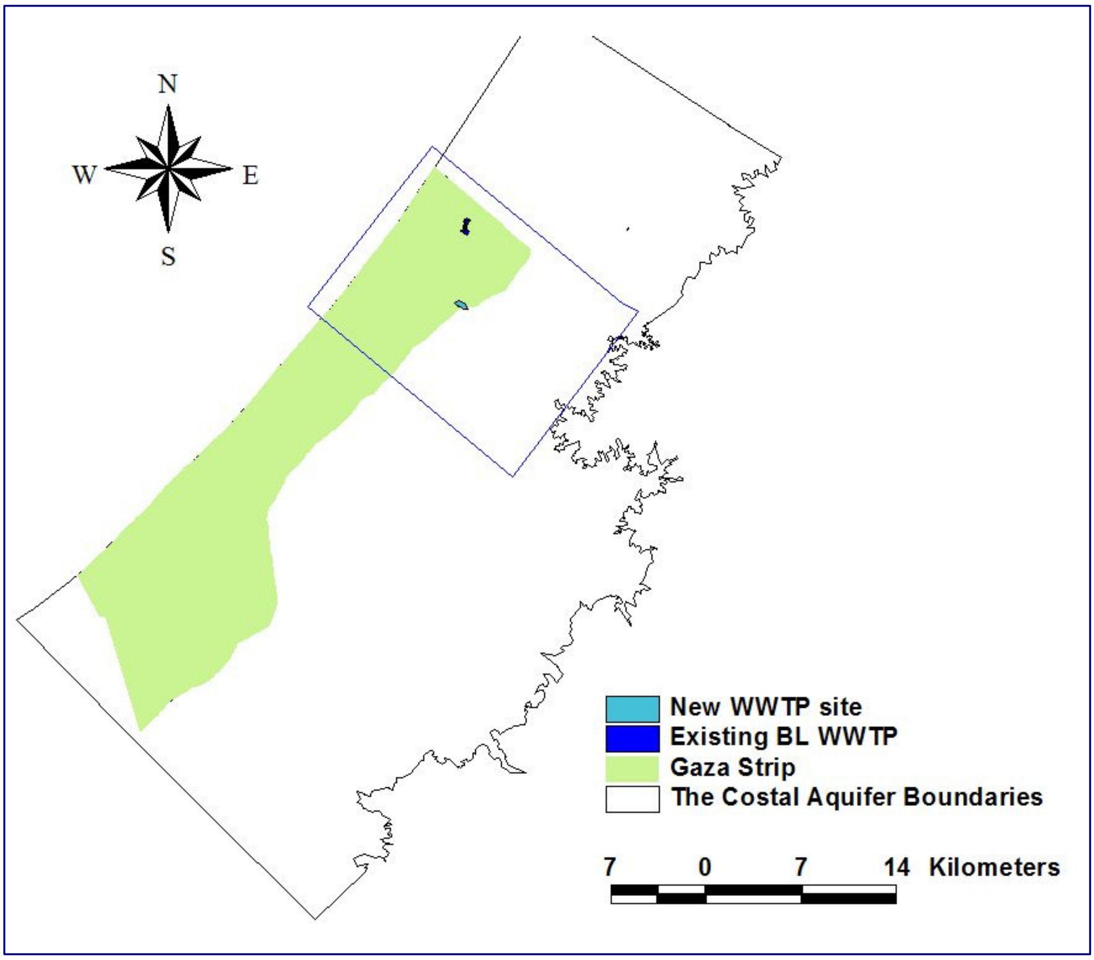


Figure 2: Model domain and boundaries

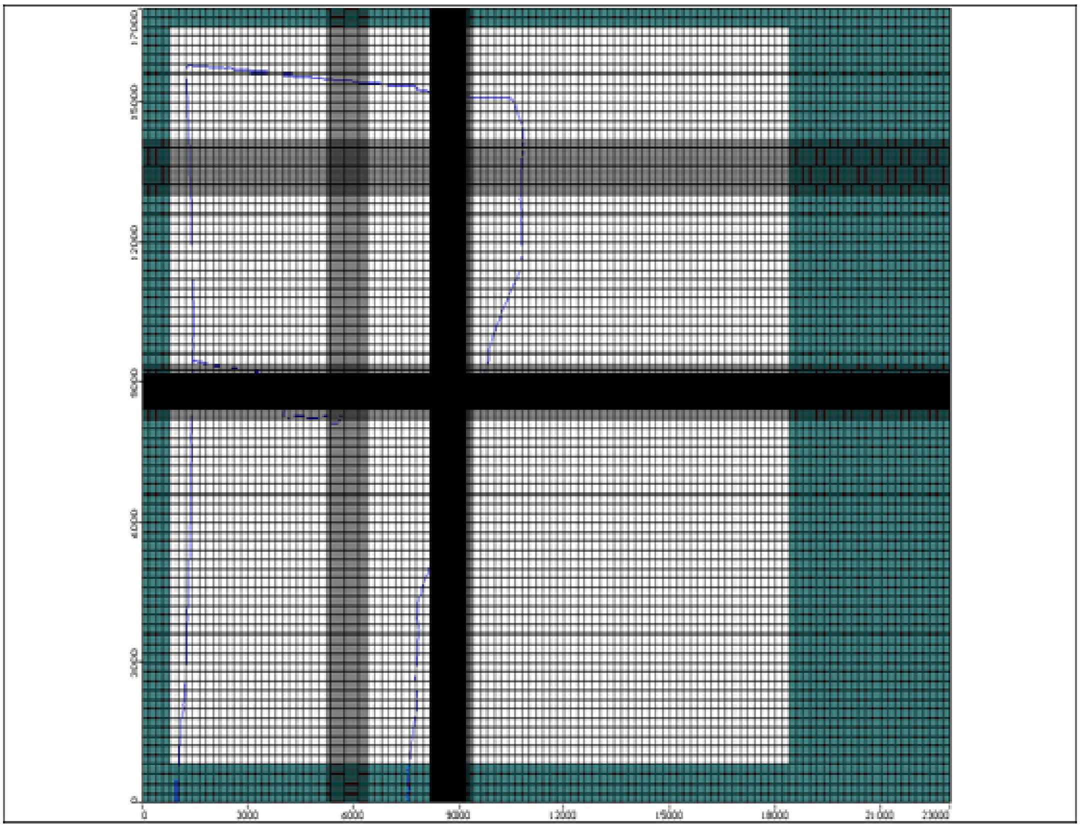


Figure 3: Model grid and the grid of the Infiltration Basin

Hydro-geologically there is not sufficient information available for the entire model domain. Therefore primary effort has been made finding data for the central part of the Model Domain. This is the area that will be affected by the infiltration water within a time of a few decades. The reason for expanding the Model Domain beyond the Data Area is to minimize the effects of Model Boundaries in the central part of the Model, the area of interest.

The model domain is divided into a horizontal grid with cell size 50x50 m at the BLWWTP site and 20 x 20 m at the new NGWWTP site and the cell size then increases gradually towards the model boundaries (Figure 3).

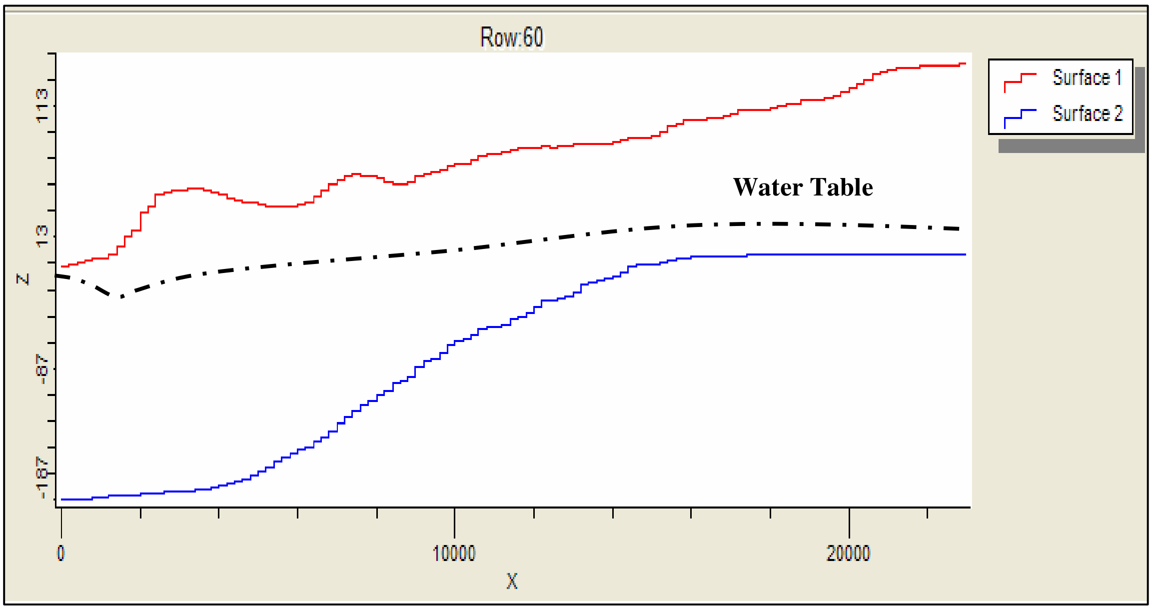


Figure 4: Bottom of the aquifer and the ground surface elevation

The model boundaries can be described as follows (Figure 3):

- East: General Head Boundary
- West: Constant Head Boundary
- North and South: No Flow Boundary

The lower boundary of the model consists of Saqiye's surface (see Figure 4). This has been adopted based on the regional DYN model consideration and the results from geophysical investigations, and borehole investigation at the site (DB4).

2.2.2. Stratigraphy

Although the greater part of the Gaza strip has a topsoil of stiff clay, the pumping test at the site (August 2002 in well DB4) clearly indicates that the aquifer is an unconfined, phreatic aquifer. Furthermore, clayey and silty layers have been found on the site during soil investigations by drilling. The layers are found both in the unsaturated and saturated zone. The arial continuity and hydraulic permeability of these layers do, however, not lead up to the conclusion that the aquifer is divided into several hydraulically separate sub aquifers. Instead, the **one aquifer approach is supported**.

The CAMP model final report indicates that the top clay layer extends up to 2 km inland. The second clay layer extends up to 1.5 km and the third deep clay layer extends up to 3.5 km inland. The average depths of those layers are -60, -100, and -130 to -60 respectively. Most, if not all, of the wells, screens are located above the deep clay layer. SWECO INT. in the previous modelling effort has indicated that the extent of infiltration influence is about 3 km in 20 years. In other words, the influence area is far from the coastal area where the thin clay layers separates the aquifer into three sub-aquifers. **Hence a single layer model will serve the purpose of the study.**

2.2.3. Recharge Components

A GIS module is designed to calculate the net recharge to the aquifer in winter days and in summer days. The net recharge comprises of; recharge from rain, irrigation return flow, water networks losses, wastewater leakages, existing treatment plants and recharge basins, and recharge from treated wastewater irrigation in the Israeli side of the model. The details are illustrated below:

2.2.3.1. Recharge from rain:

Recharge from rainfall was quantified as the average seasonal rainfall multiplied by an infiltration factor. Based on the rainfall records from 15 rainfall stations, Thiessen polygons interpolation method was used to calculate the aerial rainfall distribution over the model domain cells. The value of the rainfall in each cell is then multiplied by the infiltration factor based on the soil type. Infiltration coefficient 0.6, 0.25, 0.2 for clay, Loess, and Sand soil types (M&E, 2000 and OALS/IALC, 2001). Infiltration factor for impervious surfaces was considered zero.

2.2.3.2. Recharge from irrigation:

In the CAMP model report, it was assumed that 0.25 of water pumped for irrigation return to the aquifer in Gaza area. The same assumption was considered in the Israeli side for irrigated agriculture.

For Israel since we do not have the exact land use map, 80% of the land where we have irrigation wells is assumed to be irrigated (See the land use map of Israel, http://www.1uptravel.com/worldmaps/israel8.htm, for crop information). For Israeli part of the model, three water sources were considered: 1) irrigation directly from rainfall, the recharge from that is taken into consideration while calculating recharge from rain. 2) Irrigation from wells, 0.25 of the pumped water is assumed to return to the aquifer. 3) Recharge from wastewater reuse network at the far east of the model domain which was estimated at 35 MCM.

2.2.3.3. Recharge from un-piped wastewater:

In areas not connected to wastewater networks, people use septic tanks or cess/percolation pits to dispose their sewage. From 70% to 75% of the Northern Governorate population are connected to wastewater networks (Boliden Contech and Montgomery Watson, 1999; LEKA, 2003). Most of the produced un-piped sewage seeps to the aquifer through the percolation pits. The rest is transported to the wastewater treatment plant via tanker trucks. 80% of the water consumption is assumed to be a non-consumptive use and thus turns into wastewater. In each area the produced wastewater is multiplied by a seepage factor (1-network connection percentage) to estimate the leakage into the aquifer from the un-piped sewage (M&E, 2000).

2.2.3.4. Recharge from piped wastewater:

Piped wastewater is assumed to reach the treatment plants in the model domain area. The quantity recharged from each treatment plant is taken as recorded by other studies (M&E, 2000).

From Gaza wastewater treatment plant = 6,000 – 10,000 m^3/day

From Beit Lahia wastewater treatment plant and the pond = 6,000 – 8,000 m^3/day

2.2.3.5. Water supply network losses recharge:

This was calculated based on water consumption and the physical water supply network losses in each area in the model domain. Records indicate that the total annual water supply in the Gaza and the Northern Governorate is about 40.5 MCM (PWA, 2004). Physical losses are estimated at 30% in these areas (PWA, 2004).

Figures 4 and 5 show the GIS distribution of the 2002-2003 hydrologic year total recharge rate in winter and summer respectively. Figure 6 shows the recharge rate in year 2004 where all changes due urbanization in the northern area was considered in the map.

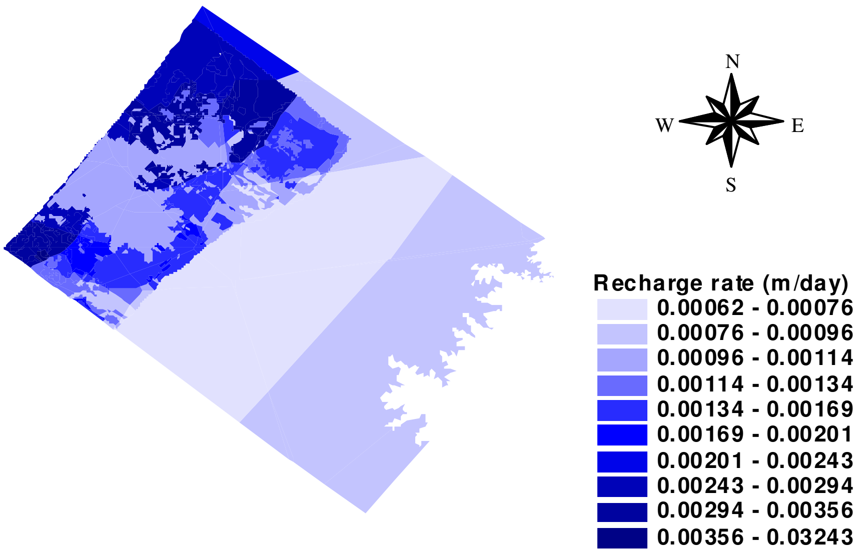


Figure 4: Recharge rate grid during winter 2002-2003 (EA, 2006)

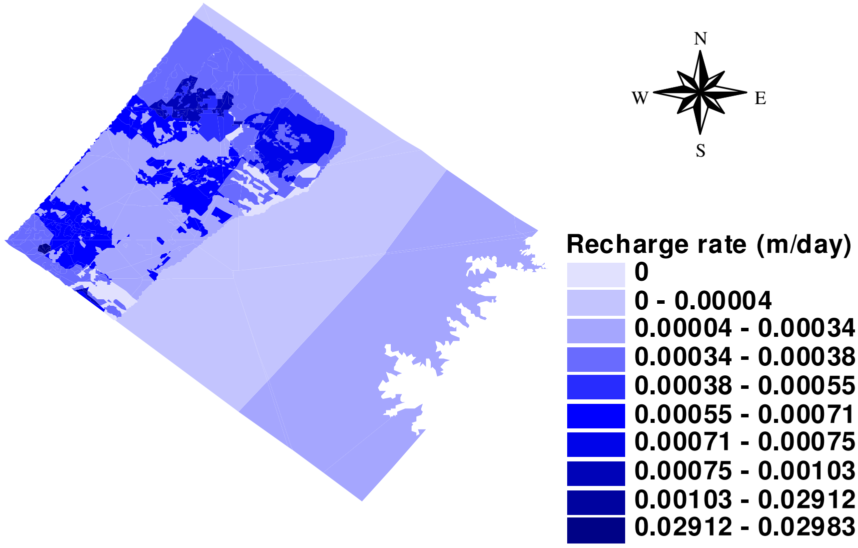


Figure 5: Recharge rate grid during summer 2002-2003 (EA, 2006)

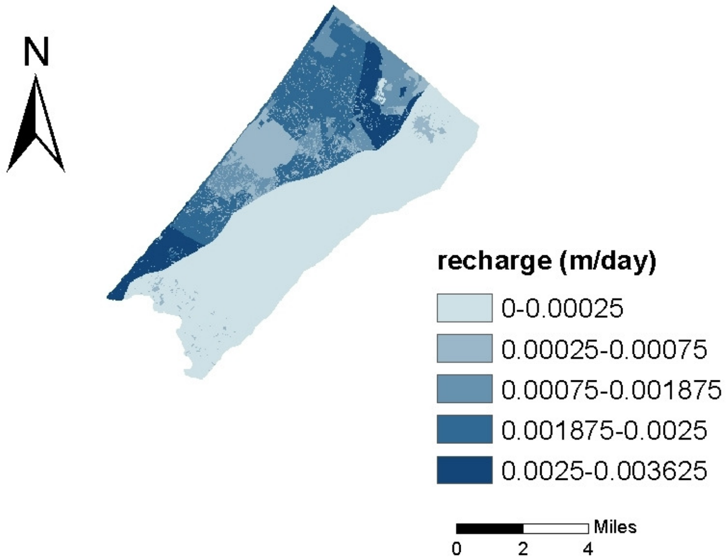


Figure 6: Recharge rate during year 2005 (m/day).

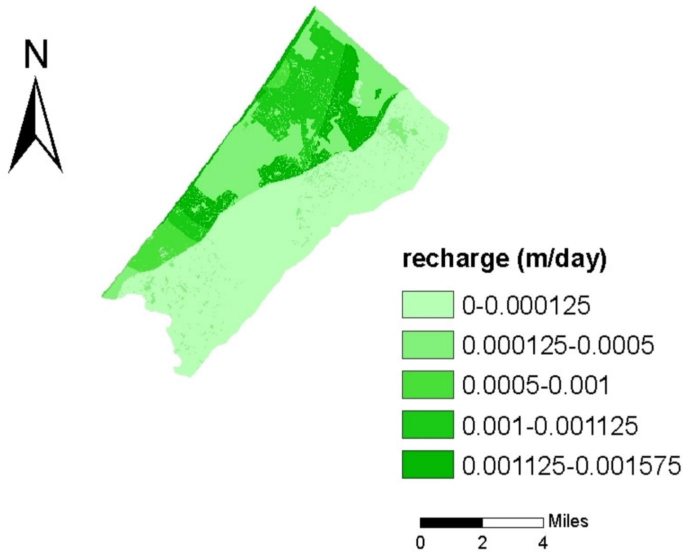


Figure 7: Recharge rate during year 2010 (m/day).

Based on the GIS recharge grid distribution, 24 recharge zones (Figure 7) were considered for the MODFLOW input. Each zone carry different values based on annual and seasonal recharge values.

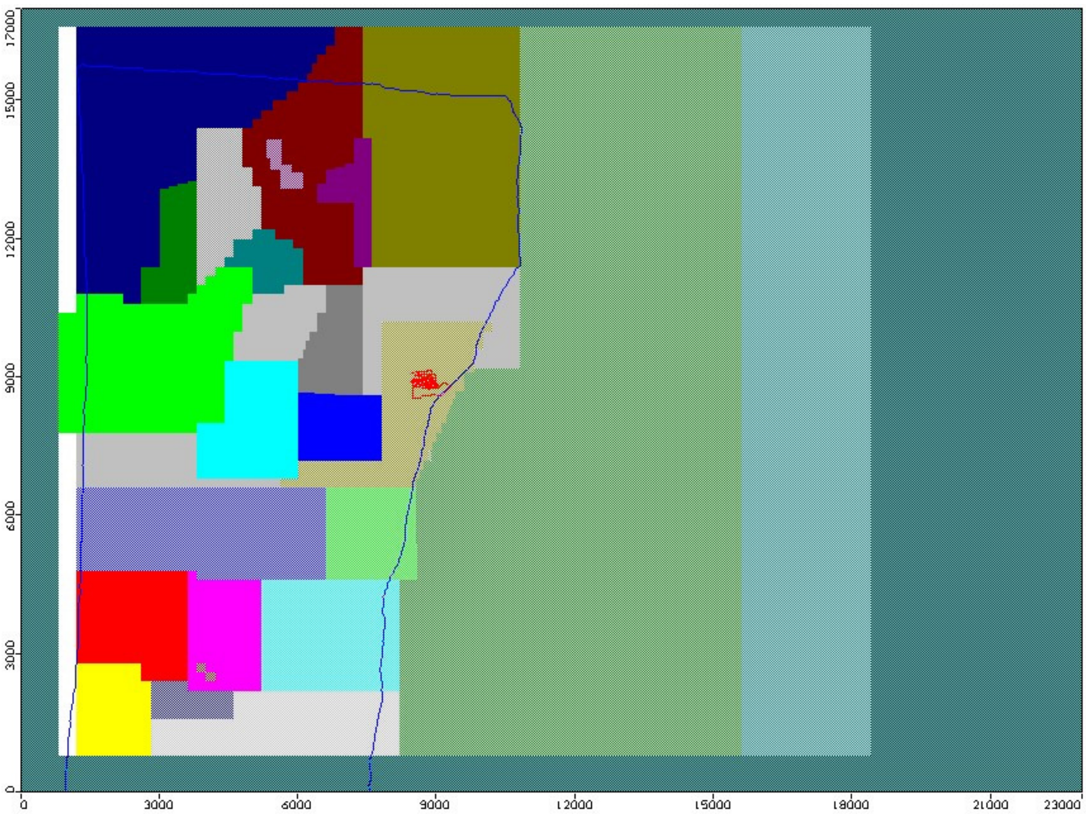


Figure 8: MODFLOW recharge zones for year 2010

2.2.4. Abstraction Components

Within the model area, 1185 agricultural wells have been defined and parameterized with a given average discharge based on available data (data from PWA and Ministry of Agriculture). In addition 100 domestic wells were also recorded based on data from Coastal Municipality Water Utility (CMWU). The abstraction from domestic wells is recorded monthly. Table 1 shows the average yearly abstraction rate from domestic wells. Very limited data is available about agricultural wells abstraction. In most of agricultural wells the abstraction rates were estimated based on information from Ministry of Agriculture about irrigated areas, crop patterns, and crop water requirements.

The 34 wells which were selected as head observation wells for the model regional calibration in the previous model is still used in the following calibration procedures (Figure 9). The selection was based on the availability of good hydrograph for these wells. More details are presented in the calibration section. It is important to note that the abstraction rate was kept as in year 2011 for the years up to 2025 since the reply on the aquifer will either be kept as in year 2011 due the fact that quality of the aquifer becomes highly deteriorated, or decrease since the resources for drinking water will be from desalination plants. The recharge rate was kept as year 2010 for prediction which is shown in Figure 7. The assumption used gives more safety factor the results of the model with concern to the extent of the pollution plume.

Table 1: Yearly Abstraction Municipal Wells

	Yearly Total Abstraction (m^3/year)							
	2004	2005	2006	2007	2008	2009	2010	2011
100 wells	44,857,962	42,337,345	46,783,858	45,348,932	43,757,892	46,054,107	60,101,764	57,009,902

Table 2: Municipal wells average abstraction rate

No.	Well Name	Yearly Average Abstraction (m^3/day)							
		2004	2005	2006	2007	2008	2009	2010	2011
1	F.191	-2639	-947	-1355	-2639	-79	-1218	-1200	-1200
2	A.180	-1748	-2076	-2456	-1810	-1786	-1786	-2466	-1854
3	A.185	-4489	-4647	-3437	-3040	-3812	-3812	-3435	-3041
4	C.127	-1169	-1502	-1149	-2124	-1358	-1358	-3049	-3278
5	C.128	-1706	-2235	-2234	-2100	-1981	-1981	-1449	-1760
6	C.76	-315	-425	-330	-427	-397	-397	-484	-471
7	C.79	-6	-221	-962	-1112	-1378	-1378	-1613	-1608
8	D.60	-1700	-1659	-2111	-2474	-2919	-2919	-2078	-1828
9	D.67	-4068	-1614	-3897	-1438	-1287	-1287	-1346	-1425
10	D.68	-4238	-3866	-5287	-4614	-3866	-6040	-1563	-1563
11	D.69	-3841	-3529	-3394	-3841	-3529	-3394	-1535	-1535
12	D.70	-2533	-3011	-3490	-2533	-3011	-3490	-3603	-3603

No.	Well Name	Yearly Average Abstraction (m^3/day)							
		2004	2005	2006	2007	2008	2009	2010	2011
13	D.71	-5130	-4349	-3707	-5130	-4349	-3707	-3620	-3620
14	D.72	-4309	-4245	-3908	-4309	-4245	-3908	-3568	-3568
15	D.73	-2887	-1458	-3144	-2579	-2407	-2407	-2885	-2677
16	D.74	-4068	-1614	-3897	-4354	-3223	-3223	-3882	-2823
17	E.1	-1393	-1414	-1591	-1672	-3488	-3488	-2231	-1575
18	E.11A	-490	-490	-466	-362	-337	-337	-407	-305
19	E.11B	-1381	-1381	-691	-1167	-1193	-1193	-1374	-1223
20	E.11C	-724	-724	-826	-871	-931	-931	-1188	-1124
21	E.154	-3052	-2998	-2623	-3246	-2998	-2623	-3	-3
22	E.156	-3382	-4298	-4564	-4941	-3536	-3536	-4038	-2867
23	E.157	-3625	-4728	-4686	-4728	-4686	-4728	-4386	-4386
24	E.4	-2375	-2516	-2640	-2837	-2804	-2804	-2670	-2048
25	E.6	-1660	-1660	-1597	-1660	-1597	-1597	-1739	-1739
26	E.90	-4617	-4132	-4115	-4013	-3198	-3198	-3581	-2520
27	Q.40B	-2823	-2919	-2919	-2823	-2919	-2919	-2919	-2919
28	Q.68	-3919	-5595	-5498	-3919	-5595	-5498	-4962	-4962
29	R.162D	-837	-596	-1370	-837	-596	-1370	-988	-988
30	R.162E	-1628	-957	-1156	-1628	-957	-1156	-1031	-1031
31	R.162G	-4819	-4686	-4603	-4819	-4686	-4603	-4334	-4334
32	R.162H	-3309	-1560	-2005	-3309	-1560	-2005	-3309	-3659
33	R.162HA	-2830	-2389	-2648	-2830	-2389	-2648	-2094	-2094
34	R.25A	-2765	-2802	-2953	-2765	-2802	-2953	-3443	-3443
35	R.25B	-4445	-4445	-4198	-4445	-4445	-4198	-5027	-5027
36	R.25C	-1402	-2202	-2577	-1402	-2220	-2577	-1077	-1077
37	R.25D	-869	-2900	-4201	-869	-2900	-4201	-4008	-4008
38	R.74	-150	-100	-265	-150	-100	-265	-184	-184
39	D.20	-1965	-2401	-1981	-1981	-1981	-1981	-2654	-1777
40	R.112	-1670	-1732	-2011	-1670	-1732	-2011	0	0
41	R.254	-1620	-1555	-1789	-1620	-1555	-1789	-1527	-1527
42	R.265	-1328	-1006	-1184	-1328	-1006	-1184	-1430	-1430
43	R.113	-1921	-1687	-1713	-1921	-1687	-1713	-2099	-2099
44	F.192	-761	-583	-862	-761	-426	-426	-375	-375
45	R.75	-1744	-1421	-1786	-1421	-1786	-1786	-4071	-4071
46	R/162CA	-1427	-728	-1065	-728	-1065	-1065	-688	-688
47	R/162BA	-1164	-459	-1148	-459	-1148	-1148	-900	-900
48	C.137	-2699	-2699	-2885	-2885	-2885	-2885	-1963	-1963
49	C.155	0	0	0	-253	-253	-253	-664	-664
50	C.20	-849	-1025	-1025	-1025	-1025	-1025	-2174	-2174
51	A.211	-1420	-1420	-1350	-1350	-1350	-1350	-3440	-3440
52	A.205	-1823	-1823	1713	1713	1713	1713	-2585	-2585
53	D.75	-2834	-2834	-2988	-2988	-2988	-2988	-2849	-1822

No.	Well Name	Yearly Average Abstraction (m^3/day)							
		2004	2005	2006	2007	2008	2009	2010	2011
54	E.142.A	1424	1424	-1164	-1164	-1164	-1164	-2332	-1726
55	Q.72	-1755	-1755	-2584	-2584	-2584	-2584	-3288	-3288
56	E.164	-651	-308	-308	-651	-308	-308	-577	-304
57	E.168	-900	-643	-643	-900	-643	-643	-945	-658
58	A.210	-450	-450	-450	-450	-450	-450	-479	-479

Source: CMWU and PWA Data

No.	Well ID	Yearly Average Abstraction (m^3/day)		No.	Well ID	Yearly Average Abstraction (m^3/day)	
		2010	2011			2010	2011
59	D.77	-1573	-1573	80	R/306	-264	-264
60	E.171	-1670	-1670	81	R/307	-873	-873
61	Aslan	-438	-438	82	R/308	-513	-513
62	Zain	-1169	-1169	83	Sabra4	-82	-82
63	AlFateh	-978	-978	84	R/310	-695	-695
64	Hirah	-1364	-1364	85	R/305	-836	-836
65	AlBosna	-320	-320	86	Zaitoun3	-540	-540
66	R/162LA	-2922	-2922	87	Zaitoun4	-783	-783
67	R/162LB	-2757	-2757	88	R/313	-1224	-1224
68	E/154A	-1403	-1403	89	R/314	-1059	-1059
69	Sh.R.17	-1262	-1262	90	Remal3	-441	-441
70	R/66B	-273	-273	91	R/317	-1041	-1041
71	R/309	-770	-770	92	R/316	-1014	-1014
72	R/312	-809	-809	93	Remal7	-1013	-1013
73	Shijaia7	-1343	-1343	94	R/315	-432	-432
74	Shijaia8	-320	-320	95	AlTufaa2	-7	-7
75	Shijaia9	-773	-773	96	R/311	-592	-592
76	R/277	-1773	-1773	97	R/270	-415	-415
77	R/280	-395	-395	98	R/161	-488	-488
78	R/293	-793	-793	99	R/299	-651	-651
79	ShiekhEgleen8	-1046	-1046	100	R/300	-814	-814

2.3. Groundwater Model Update

2.3.1. Aquifer Properties

The default model parameters were set based on the calibrated parameters from the design project and from EA 2006 study. The pumping tests carried out in the design project indicated the following parameters based on which the model was recalibrated. Kxy has been initially set with a general value of 60 m/day in the proximity of the proposed infiltration site and 35 m/d else where in the model domain. Little adjustments have been made thereafter in specific zones in connection to model calibration. In the same way, Kz has been set for 3 m/day, Sy for 0.15, Ss for 0.00002 m-1, ne for 0.25, and total porosity for 0.35.

2.3.2. Steady State Model Calibration

Data from year 2004 was used for the steady state calibration at year 2004. The recharge and abstraction rates were estimated based on year 2004 data. The modeled water level was then calibrated based on level records for 34 observation wells distributed throughout the model domain (**Figure 9**). The steady sate model shows 95% agreement with the observed value (Correlation Coefficient = 0.95) as shown in Figure 10.

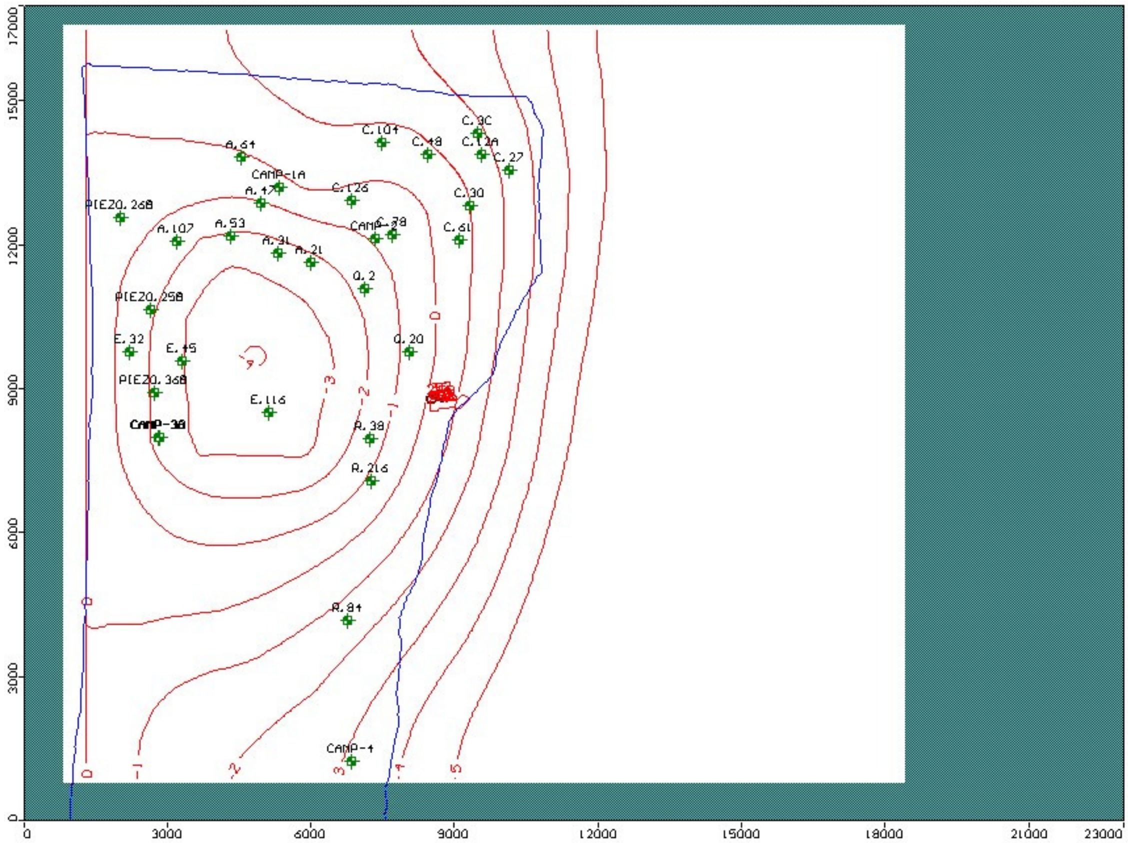


Figure 9: Steady state calibrated groundwater level contor map

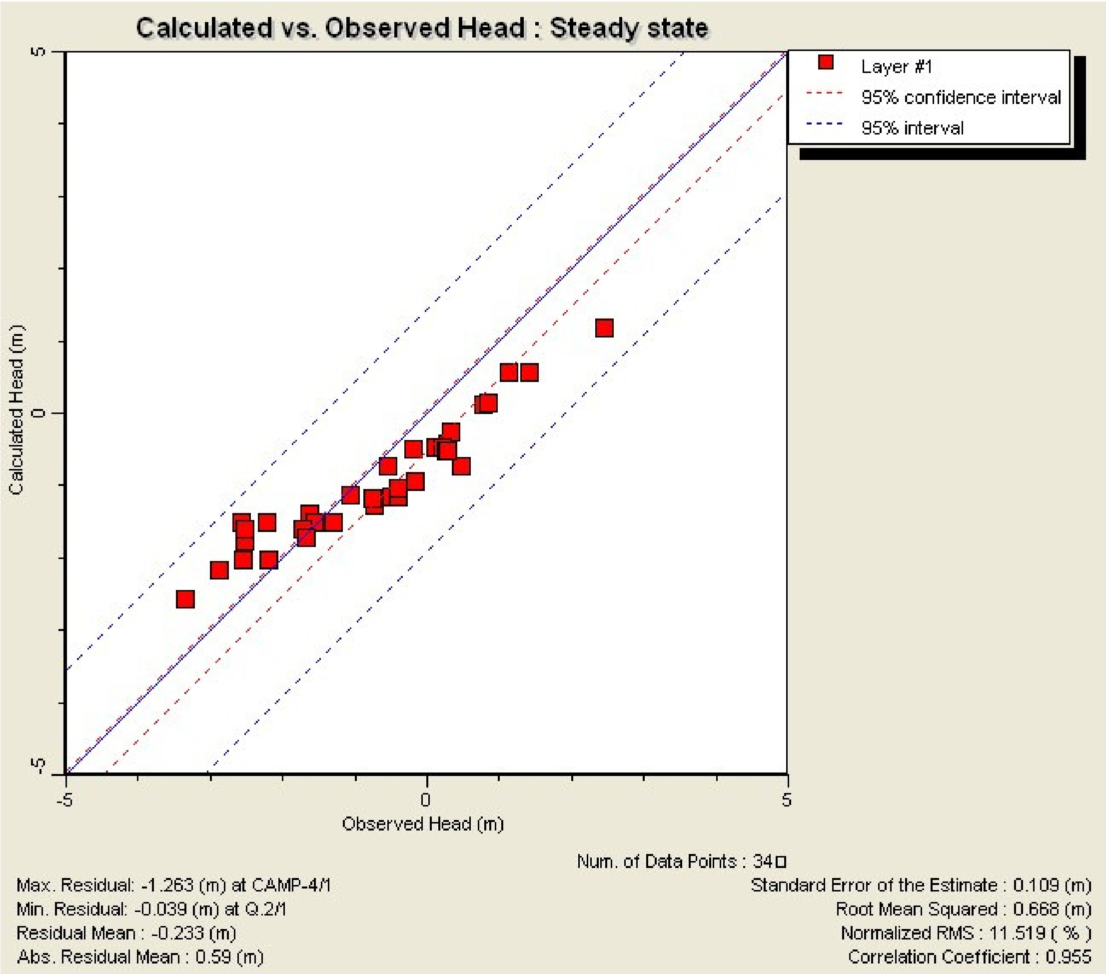
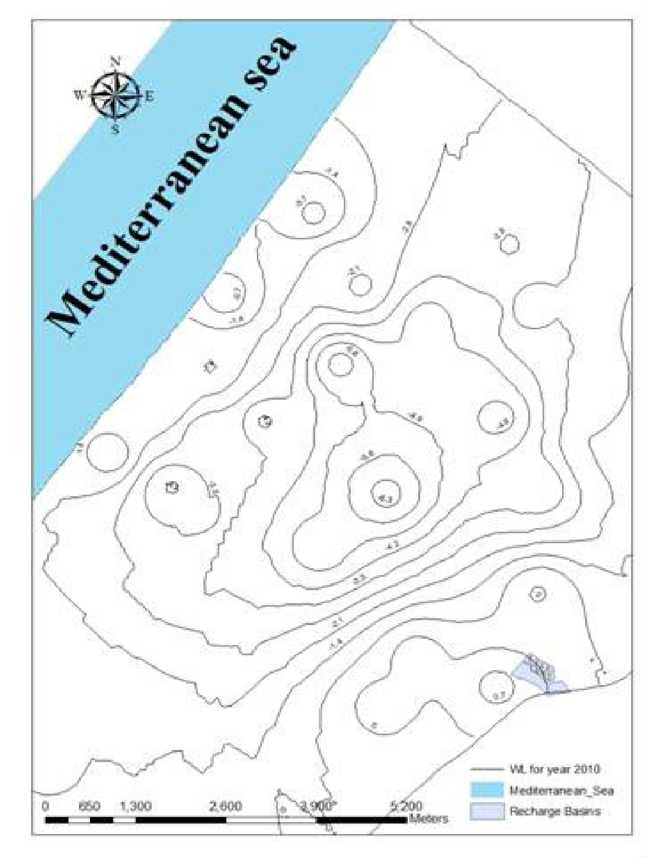


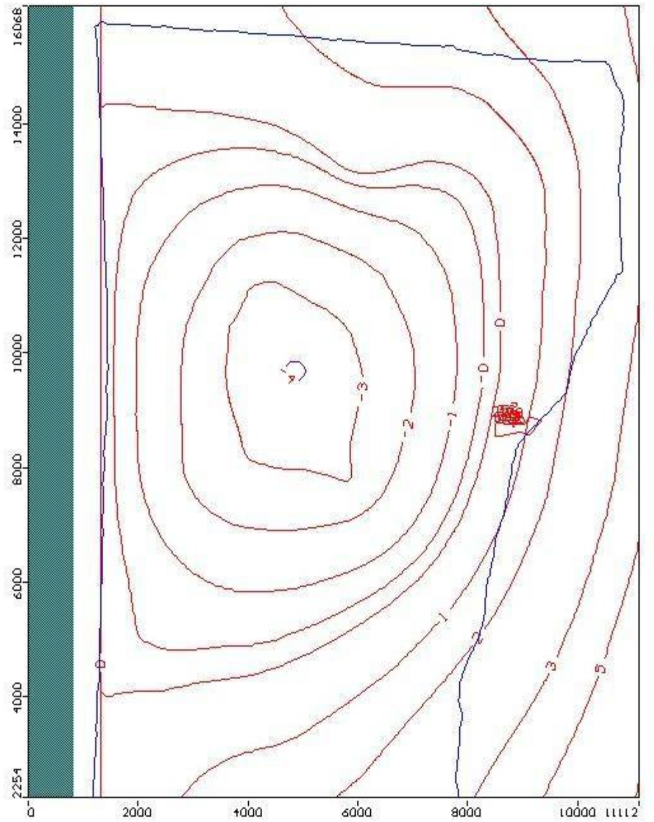
Figure 10: Steady State Calibration Results

2.3.3. Transient Flow Model Verification

Data from the period 2004 to year 2010 was also used for the transient model calibration. The abstraction and recharge components were earlier discussed. The same graph of the distribution of recharge rate used in the steady state is used in the current transient model. Since the aquifer properties were set based on the CAMP DYN model and the model developed by SWECO INT, the EA model and the design project model, the calibration was mainly performed based on the change of the abstraction of the wells which mainly highly influence the groundwater water level regime. The time step for the transient model was set daily. Figure 11 shows the modeled groundwater level contours at the end of year 2010 and the observed water level in the same year.



(a): Observed Groundwater level in year 2010



(b): Modeled Groundwater level contours in year 2010

Figure 11: Observed and (b) Modeled Groundwater Level Contours in Year 2010

Figures 12, 13 and 14 show the observed versus modeled water level hydrograph for wells A/47, Q/2 and R/38. Notice the summer and winter fluctuation of water level. Similar graphs are available for other wells in the model domain. The modeled water level showed good agreement with the observed water level both in the trend and in the value. The transient model shows 94% agreement with the observed value (Correlation Coefficient = 0.94) as shown in Figure 15.

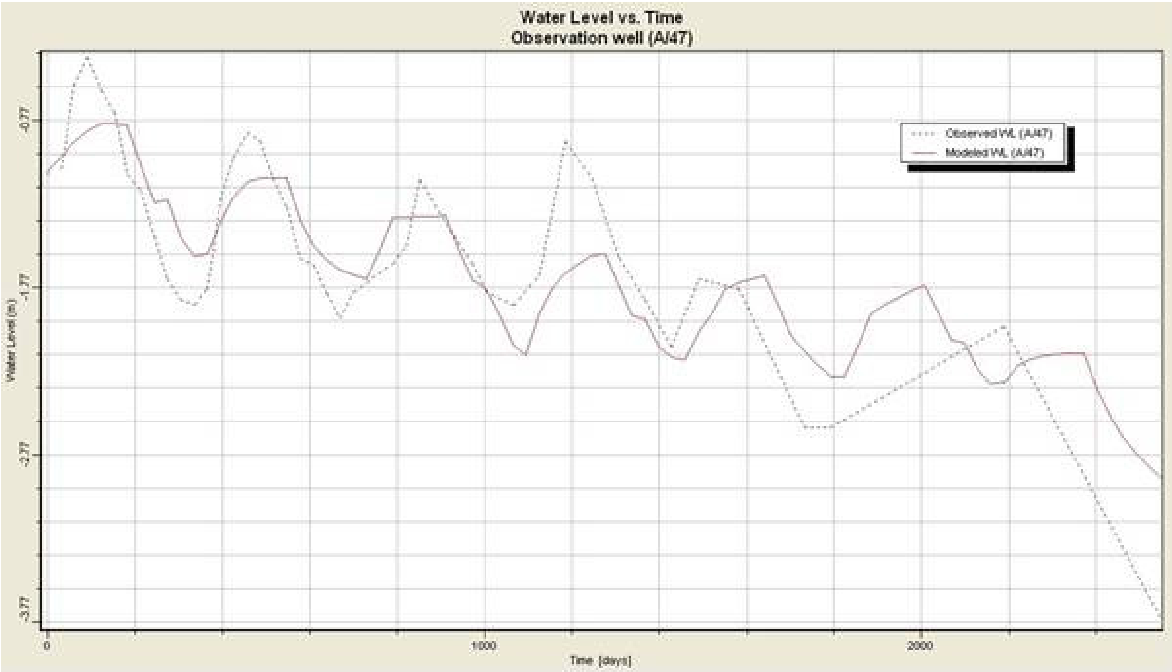


Figure 12: Observed vs. modeled water level for well A/47. Category axis shows days since 2004

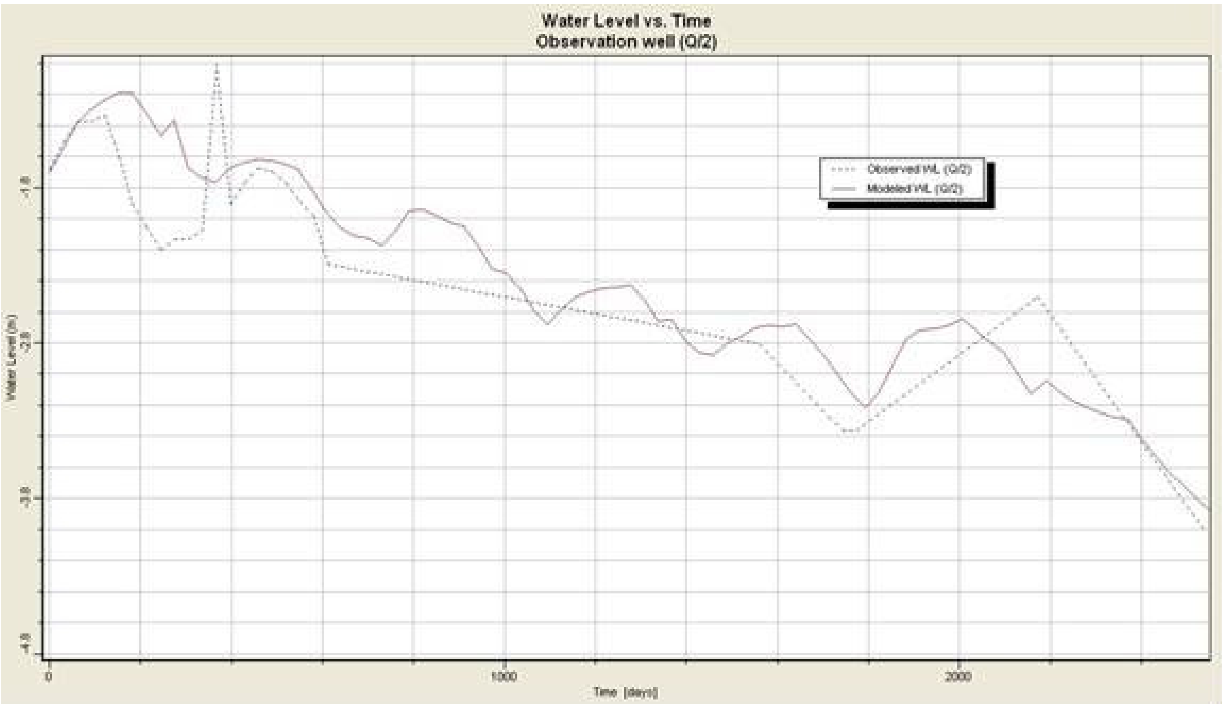


Figure 13: Observed vs. modeled water level for well Q/2. Category axis shows days since 2004

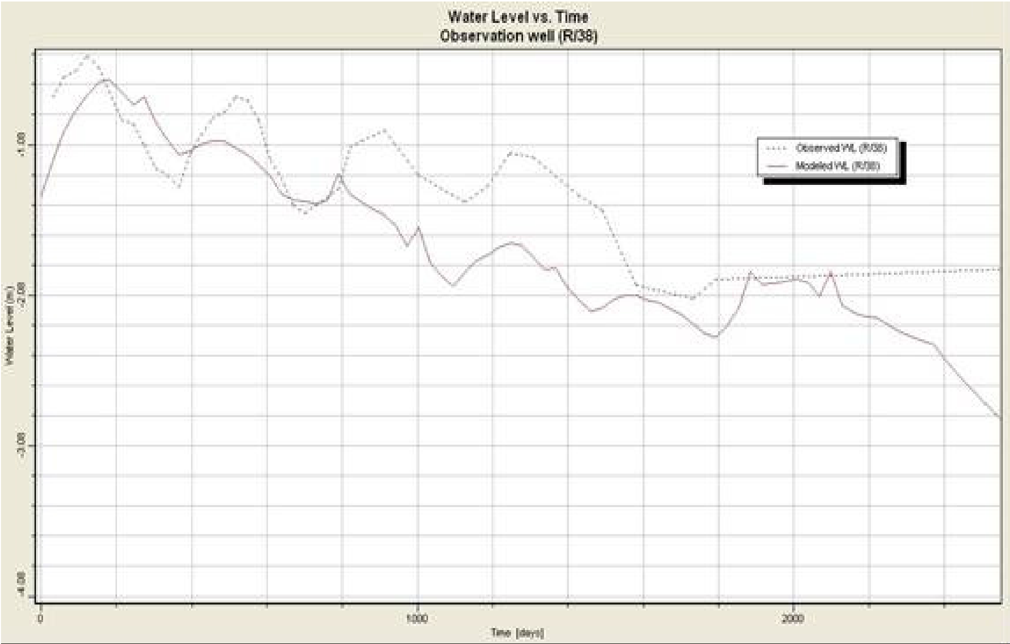


Figure 14: Observed vs. modeled water level for well R/38. Category axis shows days since 2004

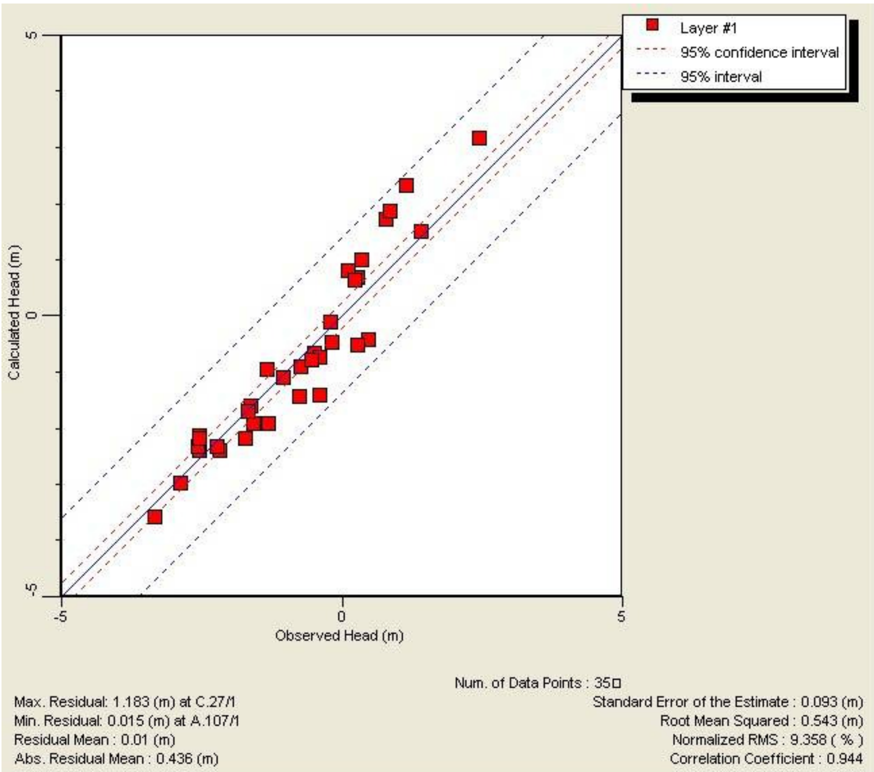


Figure 15: Transient Model Calibration Results

2.3.4. Transport Model

In order to study which part of the aquifer that will be directly influenced by the infiltration, the module Modpath was used to simulate the adjective transport. Thereafter the dispersion was examined by simulation of pollution in the infiltration water using the MT3D module for labeled water containing soluble, non-reactive contaminant.

The parameters that principally influence mass transport in the flow model are effective porosity and dispersivity. The effective porosity, ne, has been set to 25 %. The uncertainty for the parameter is considered to be small, approx. 5 % (CEP&FCG, 2010). Reducing ne will result in increased particle velocity which affects the time aspect in advective transport.

Dispersivity has been set to values ranging from 3 m to 12 m calculated by the following equation (SWECO INT, 2003):

$$\mathbf{D_L = 0.83 \log L2.414}$$

where D_L= concerns longitudinal dispersivity and L is the length of the mass transport plume considered. Comparison of simulations shows that this difference in dispersivity does not result in any measurable changes of the diffusion plume.

In order to study the transport due to advection-dispersion, MT3D module simulation has been performed using a pollution tracer which could be Chloride, NO3-N or any chemical. However the NO3-N was considered as indicator for the influent which has a range of 10 to 100 mg/l which indicated the good quality and bad quality of water. The pollution initial concentration in the aquifer was set to 0 mg/l. This simulation allowed for a clear picture of the spreading of the labeled water, since, any deviations from the zero level is a direct effect of the infiltration. For example partially treated wastewater from BLWWTP is characterized by high N-content in all forms. Lacks of aeration in the aerated lagoon hinder the formation of nitrate and degradation of the organic matter. Moreover the lagoon system is unfit for denitrification process. Using large area infiltration basins with good management system will enhance the nitrification process in the soil top layers and de-nitrification in the deeper layers. The partially treated wastewater will supply Carbon to the soil deeper layers enhances the de-nitrification process, but this may not go further than few meters. Hence there will not be effective de-nitrification process during the emergency phase treatment or passage through the unsaturated and saturated zones.

Consecutive drying of the flooded basins will supply enough oxygen that will enhance the nitrification process. As a result it is assumed that 90% of the Kjeldal nitrogen will end up as nitrate in the aquifer. The transport model considered the infiltration of partially treated wastewater with total NO3-N as 80 mg/l starting in April 2009 infiltration rate equal 15000 m^3/day. Data from year 2009 to 2012 was used for the transport calibration at year 2012. The modeled Nitrate concentration model was then calibrated based on year 2012 Nitrate records for 8 groundwater quality observation wells distributed around the infiltration basins (Figure 16). The transport model shows 97% agreement with the observed value (Correlation Coefficient = 0.97) as shown in Figure 17.

Figure 18 and 19 show the observed versus modeled nitrate time series for wells Q/64 and Q/20 The figure shows a good agreement despite the number of measurements are small. The assumption behind that initial concentration under the infiltration basin was set zero can be acceptable since in year 2004 the groundwater quality was very good in term of nitrate concentration. Figure 20 shows the results of model in year 2010 for nitrate concentration.

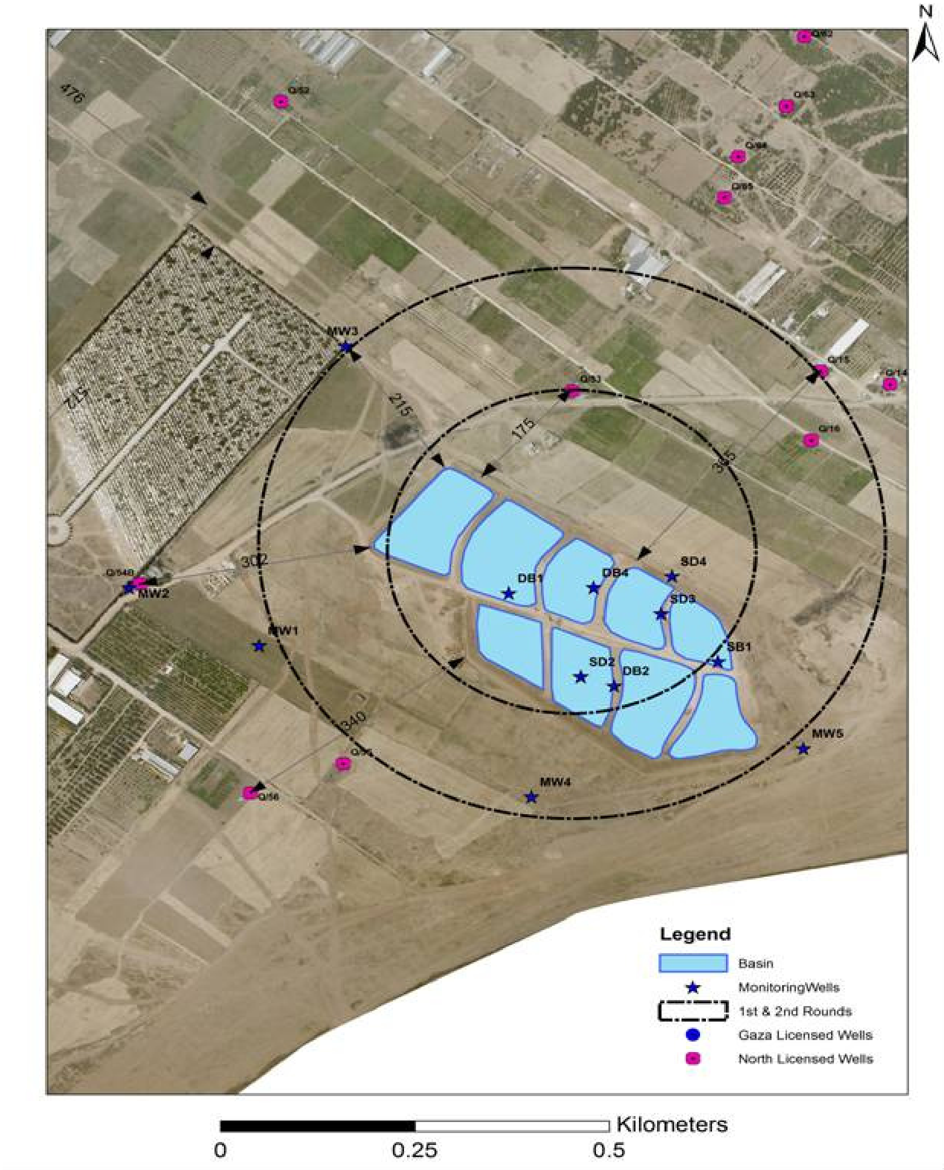


Figure 16: groundwater observation wells used for transport model calibration

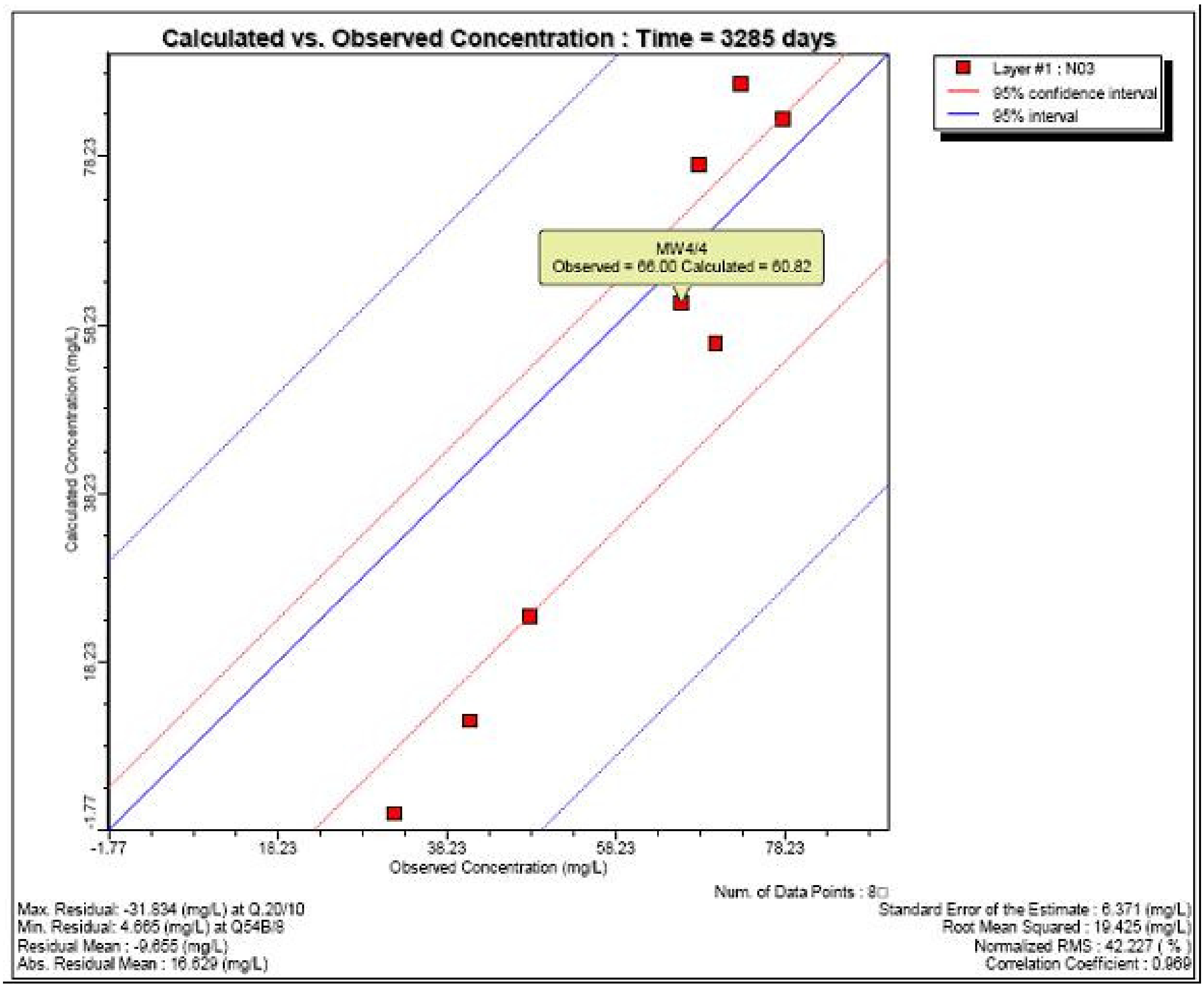


Figure 17: Transport Model Calibration Results

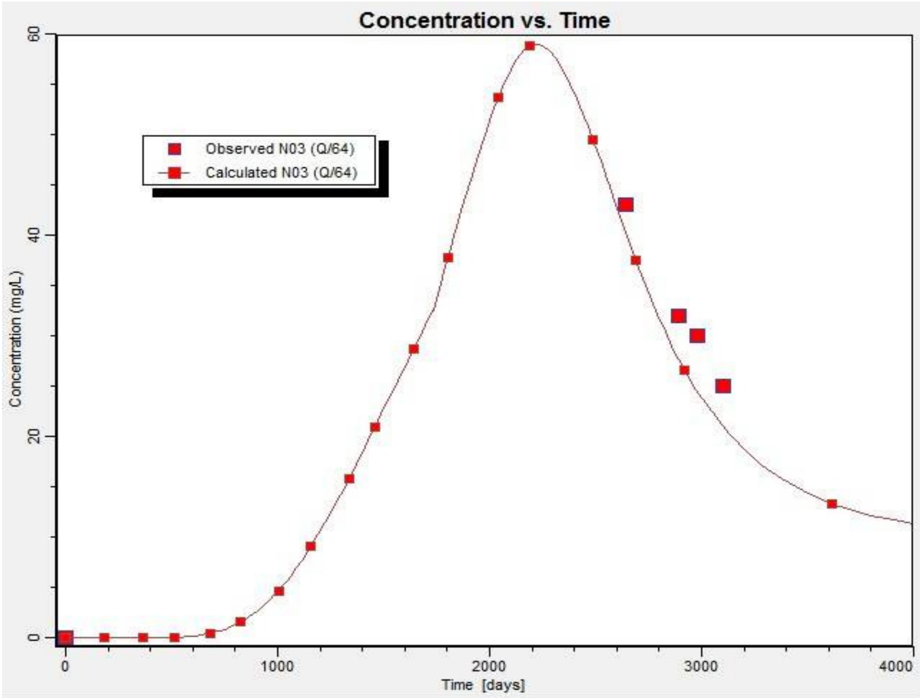


Figure 18: Model and observed nitrate concentration in well Q64

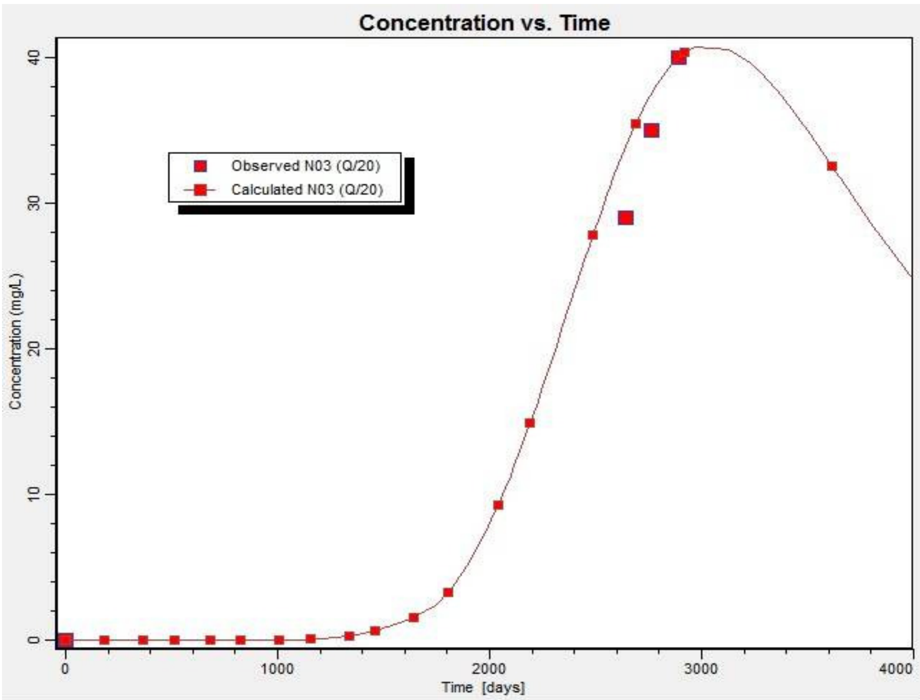


Figure 19: Model and observed nitrate concentration in well Q20

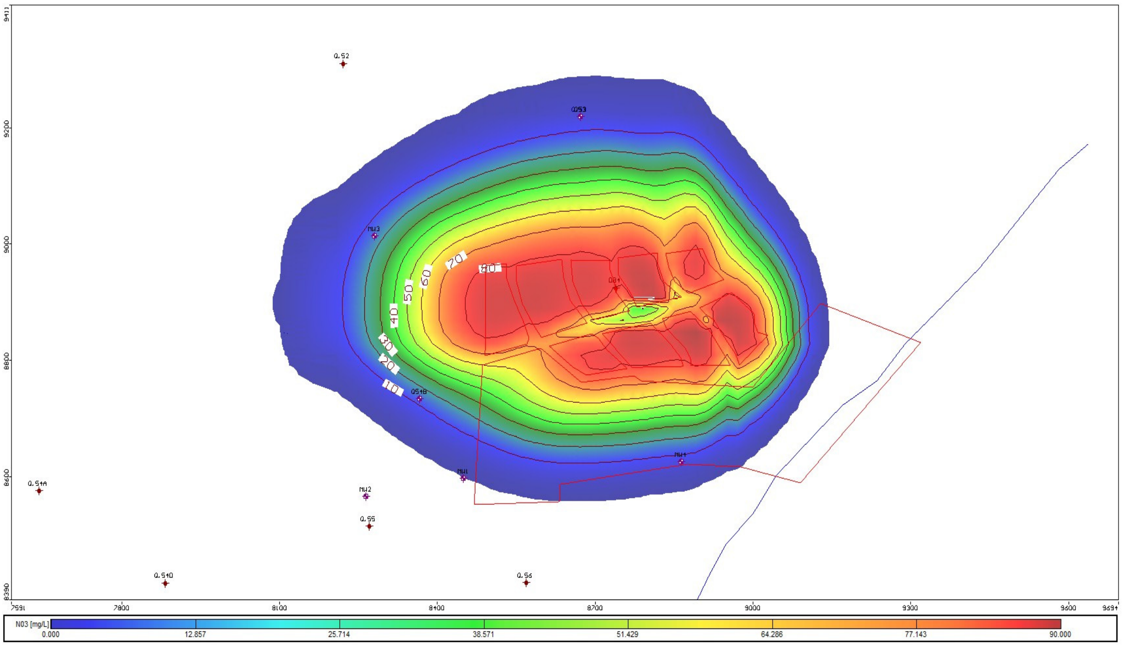


Figure 20: the Modelled NO_3 concentration for year 2010

Annex 6
Soil Remediation Assessment of Effluent Lake

Soil Remediation of Effluent Lake

1. Site description and history

- The site subject to remediation (around 43 ha in total) used to be used as an overflow lake of Beit Lahia Wastewater treatment Plant
- The site is surrounded from the Western side predominantly by agriculture land, and from the Eastern side predominantly by the residential area and urban development area.

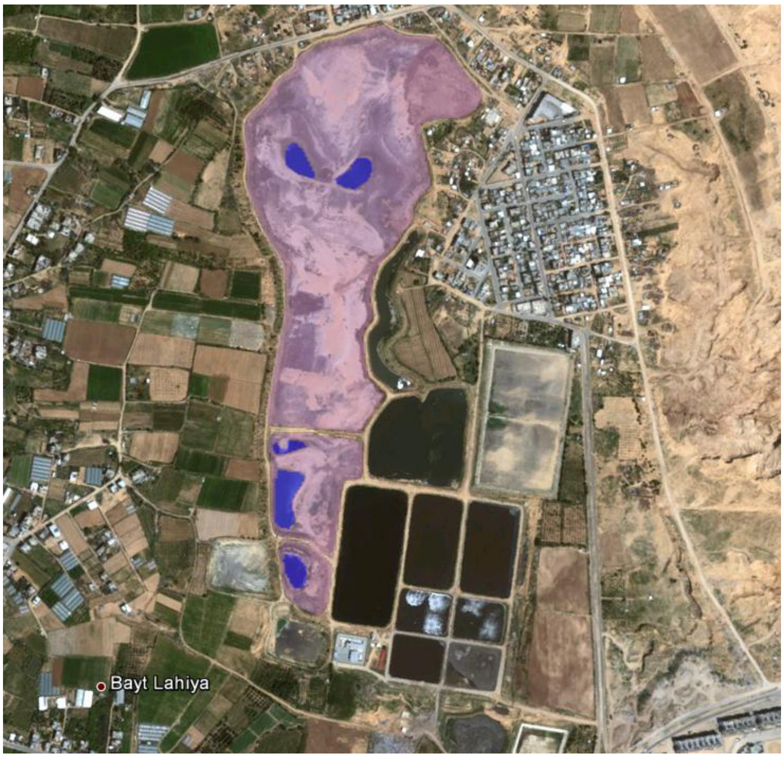


Figure 1 Remediation area

- The lake received effluents and sludge from the treatment plant. The sludge accumulated over the full surface with thickness that varies between 5 and 15 cm. The thickness reaches almost 50 cm in a limited area in and close to the still wet surfaces, which are the deepest surfaces of the lake.
- When this practice was stopped starting in 2007, when the emergency sewage project started to be implemented, the water started to be transferred to the new infiltration ponds located at the adjacent of the NGESTP.
- Currently, from the satellite image, around 90% of the surface area of the lake disappeared by percolating in the soil or evaporating. Only less than 10% of the area is still wet and split into five isolated small ponds, two in the North and three in the

South. These small remaining "lakes" are located in the relatively deepest points of the pond. The thickness of the deposited sludge is higher in, and immediately around, these lakes and it might reach 50 cm (Figure 1).

2. Soil and Sludge Measurement results and Analysis

2.1. Soil analysis

- The soil analysis, of soil samples taken in July 2012, show in general that soil does not suffer from neither heavy metals nor pathogenic contamination. This can be attributed to the possibility that the treatment plant didn't receive industrial waste, the main source of heavy metals, and the long period of 5 years since 2007 stabilized the deposited sludge and the top part of the soil.

- Samples were collected at different points and at two levels, the surface part (0-15 cm) and the top part (50 cm). Samples were analyzed for organic matter (OM) as a general indicator for organic contamination, nutrients (Nitrogen, and Phosphorus), as well as heavy metals (Lead, Copper, Cadmium, and Zink) as indicators for non-organic contamination.

2.2. Heavy metals:

- The soil humidity pH is fairly neutral and varies between 6.96 to 7.02. At this pH level, most of the heavy metals, if exist, will be adsorbed to the soil particles at the top part of it, and will not travel with seeping water to the groundwater aquifer.

Table 1 Heavy metal concentration at the effluent lake

mg/kg	Dry area		Wet area	
cm *	0-15	50	0-15	50
Pb	<0.010	<0.010	<0.010	<0.010
Cu	<0.010	<0.010	<0.010	<0.010
Cd	0.061	0.005	0.170	0.047
Zn	0.008	0.007	0.008	0.008

* below surface level

- The analysis of the samples of both surface and top levels shows neither untraceable levels of neither Lead (Pb) nor Copper (Cu). Except of Cadmium (Cd) concentration in the surface samples in the areas of thick deposition of sludge (0.17 mg/kg), concentrations of Cd and Zink (Zn) are very low.

2.3. Organic matter:

- In general, organic matter decays to its main compounds when deposits on land surfaces for relatively long time. The deposited sludge were subject to two different processes that helped decomposing; anaerobic process when the pond was full of water (2004 – 2007) and aerobic process (2007 – 2012) (Table 2).

Table 2 Organic matter concentration at the effluent lake

%	Dry area		Wet area	
cm *	0-15	50	0-15	50
OM	0.98	0.37	2.20	1.20
TN	0.09	0.05	0.08	0.08
TP	0.47	0.36	0.49	0.32

* below surface level

- The analysis of the samples of both surface and top levels shows very low levels of total Nitrogen (TN), which is expected due to the de-nitrification process that took place in the first period (2004 – 2007). The organic matter (OM) is less than 1% in the dry areas, because the sludge layer deposited in these areas is very thin, that helped an aeration / oxidation of most of the Carbon in the sludge during the second period (2007 – 2012).

3. Remediation options

Remediation possible options depend on a number of factors, two of them are highly decisive: (A) type and extent of the contamination, and (B) the future planned land use.

(A) The type and extent of the contamination

The soil analysis show that the contamination is limited to relatively higher level of Cadmium in a spatially limited area, under and immediately around the wet areas, which represents 15-20% of the total pond area. Cadmium oxide and sulfide are relatively insoluble while the chloride and sulfate salts are soluble. The adsorption of cadmium onto soils and silicon or aluminum oxides is strongly pH-dependent, increasing as conditions become more alkaline. When the pH is below 6-7, cadmium is desorbed from these materials. Cadmium has considerably less affinity for the absorbents tested than do copper, zinc, and lead and might be expected to be more mobile in the environment than these materials. Studies have indicated that cadmium concentrations in bed sediments are generally at least an order of magnitude higher than in the overlying water.

Addition of anions, such as humate or tartrate, to dissolved cadmium causes an increase in adsorption. The mode by which cadmium is adsorbed to the sediments is important in determining its disposition towards remobilization. Cadmium found in association with carbonate minerals, precipitated as stale solid compounds, or co-precipitated with hydrous iron oxides would be less likely to be mobilized by re-suspension of sediments or biological activity. Cadmium absorbed to mineral surfaces (e.g., clay) or organic materials would be more easily bio-accumulated or released in the dissolved state when sediments are disturbed, such as during flooding.

(B) The future planned land use

The area is owned by the Palestinian Endowment Authority. After proper remediation, it is expected that he land will be returned back to the Authority. From the surrounding area in Bait-Lahia, the site can be used as agricultural or residential area. In the absence of a clear land use plan for the site, both options will remain valid. However, according to the Master Plan of the surrounding site it will be used as an urban or residential area (kindly refer to Appendix 3).

3.1. Options analysis and recommendation

3.1.1. Technical options – overview

A special and well developed tool (FRTR Screening matrix[1]) is used to identify the best remediation option. The following table 3 shows only a relevant extract of the overall matrix of options.

The following section, presents various options that could be used in steps in remediating the site. For the purpose of the remediation options, a model was prepared by the consultant to compare between the different options. Table 3 below presents the technically possible options that can be used to remediate the effluent lake at BLWWTP.

Table 3 Technically possible remediation options

N/A - Not Applicable I/D - "Insufficient Data" ◇ - Level of Effectiveness highly dependent upon specific contaminant and its application	Developme	Treatment	O&M	Capital	System Rel Maintainabi	Relative Co	Time	Availability
Soil, Sediment, Bedrock, and Sludge								
3.1 In Situ Biological Treatment								
4.1 Bioventing	●	●	●	●	●	●	◑	●
4.2 Enhanced Bioremediation	●	●	○	◑	◑	●	◑	●
4.3 Phytoremediation	●	●	●	●	○	●	○	◑
3.2 In Situ Physical/Chemical Treatment								
4.4 Chemical Oxidation	●	●	○	◑	◑	◑	●	●
4.5 Electrokinetic Separation	●	○	○	◑	◑	○	◑	◑
4.6 Fracturing	●	◑	◑	○	◑	◑	◑	●
4.7 Soil Flushing	●	●	○	◑	◑	◑	◑	●
4.8 Soil Vapor Extraction	●	○	○	◑	●	●	◑	●
4.9 Solidification/Stabilization	●	●	◑	○	●	●	●	●
3.3 In Situ Thermal Treatment								
4.10 Thermal Treatment	●	○	○	○	●	◑	●	●
3.4 Ex Situ Biological Treatment (assuming excavation)								
4.11 Biopiles	●	●	●	●	●	●	◑	●
4.12 Composting	●	●	●	●	●	●	◑	●
4.13 Landfarming	●	●	●	●	●	●	◑	●
4.14 Slurry Phase Biological Treatment	●	○	○	○	◑	◑	◑	●
3.5 Ex Situ Physical/Chemical Treatment (assuming excavation)								
4.15 Chemical Extraction	●	○	○	○	◑	◑	◑	●
4.16 Chemical Reduction /Oxidation	●	◑	◑	○	●	◑	●	●
4.17 Dehalogenation	●	◑	○	○	○	○	◑	◑
4.18 Separation	●	◑	○	◑	●	◑	●	●
4.19 Soil Washing	●	○	○	○	●	◑	●	●
4.20 Solidification/Stabilization	●	●	◑	○	●	●	●	●
3.6 Ex Situ Thermal Treatment (assuming excavation)								
4.21 Hot Gas Decontamination	○	●	○	○	●	●	●	◑
4.22 Incineration	●	●	○	○	◑	○	●	●
4.23 Open Burn/Open Detonation	●	●	○	○	●	●	●	●
4.24 Pyrolysis	●	●	○	○	○	○	●	●
4.25 Thermal Desorption	●	●	○	○	◑	◑	●	●

[1]Federal Remediation Technologies Roundtable, 2007 (www.frtr.gov/matrix2/top_page.html)

4. Cost of Potential Remedial Technologies

The subject remediation program may be used as a model for future similar programs. Because this process is relatively new in Gaza, it is important to develop a program that is designed to reduce risks to human health and the environment at the same time is implementable in Gaza. For that reason, a simple financial model is designed to help in this evaluation.

Table 4 presents preliminary cost estimates for each of the alternatives presented above. These costs were developed by the consultant. It should be noted that these costs should be used primarily for comparison purposes.

Table 5: Estimated Costs for Remediation Alternatives

		Duration (yrs)	Total cost (mio. USD)
1	Doing nothing – limiting access to the site	6.0	9.31
2	Phytoremediation	3.0	5.23
3	Placement of clay cap	1.0	3.59
4	Placement of three-layer cap.	1.5	5.50
5	Encapsulation of the site	2.5	11.28
6	Rinsing of soil	6.0	24.75

The total cost is a sum of different cost items as shown in the following chart[2].

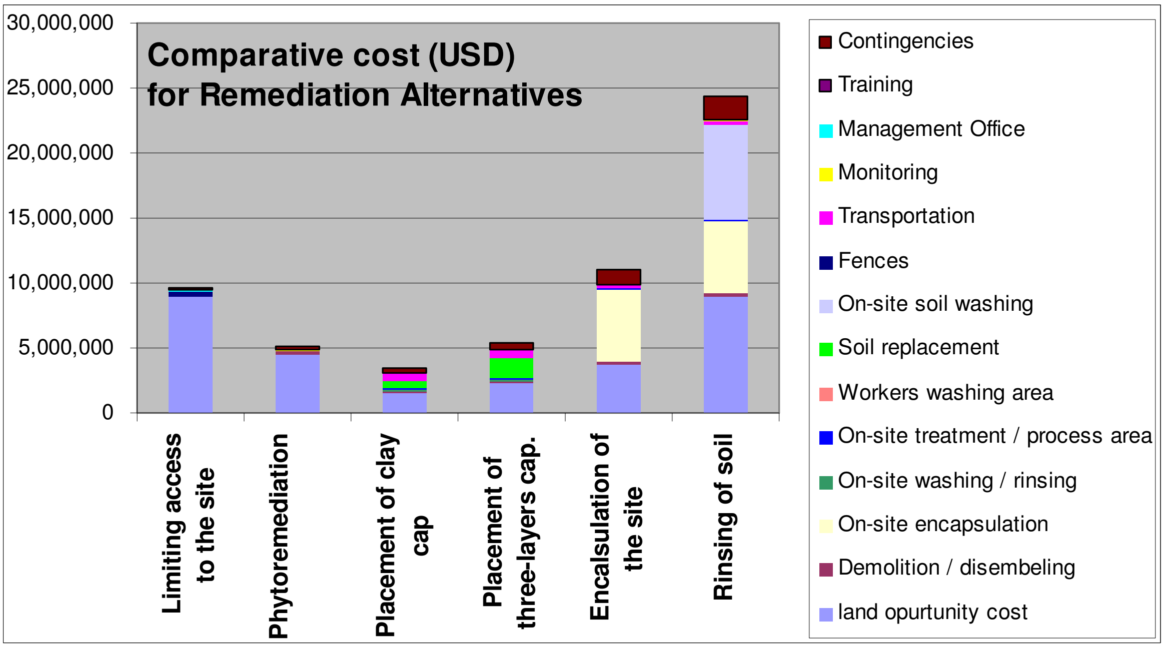


Chart 1 Different Cost assumption for different remediation options

[2] The model output of different cost and alternatives are presented at Appendix

5. Conclusions

- It should be noticed that the cost is very sensitive to the Land opportunity cost, which is directly affected by the remediation duration period. The consultant's estimated value is 35,000 USD/ha/yr.
- Based on the outcome of the cost analysis model, it is recommended to replace the top layer (average 50 cm) of the contaminated part of the soil (around 4.3 ha), with cleaner sand from the adjacent area. The total cost is estimated at 3.6 million USD, and can be maximum one year.
- If the land opportunity cost drops to 30% of the consultant's estimated value, i.e. to 10,000 USD/ha/yr, both options 2 and 3 will have almost the same total cost (around 2.3 million USD), however, option 3 (top soil replacement) still takes 1/3rd of the required time.
- Comparative cost for different options is presented at the chart below.

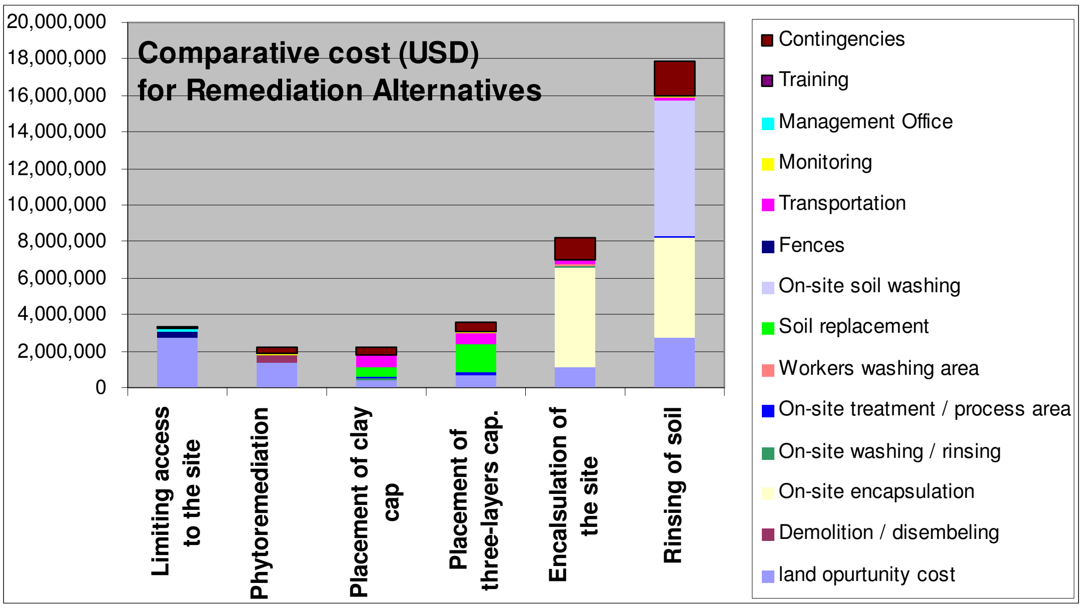


Chart 2 Comparative costs for different remediation alternatives

Appendix
Model output

Generic Costs

1					Years ------->	6.0	3.0		1.0	1.5		2.5	6.0
						Alternative cost factors							
		Unit	**Qty**	**USD/Unit**	**USD**	**F1**	F2	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
999	**Land compensation**	**ha p.a.**	**43**	**35,000**	1,505,000	**6.0**	**3.0**	**0.0**	**1.0**	**1.5**	**0.0**	**2.5**	**6.0**
1000	**Phyto remediation**				408,000	0.0	1.0	1.0	0.0	0.0	1.0	0.0	0.0
1100	leveling	ha	8.0	2,500	20,000								
1200	plants	ha	8.0	3,000	24,000								
1300	plantation	ha	8.0	2,500	20,000								
1400	maintainance				344,000								
1410	irrigation	ha	8.0	1,000	8,000								
1420	cleaning	ha	8.0	1,000	8,000								
1430	final removal	ha	8.0	6,000	48,000								
1440	disposal	ton	160.0	500	80,000								
1450	Other salvage parts	ton	400.0	500	200,000								
					-								
2000	**On-site encapsulation**				5,461,687							1.0	1.0
	Cement	ton	19,511	250	4,877,813								
	Sand	ton	19,511	12	232,672								
	Mixing and placing	ton	23,414	15	351,203								
3000	**On-site washing / rinsing**				44,000	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0
	Set-up	L.S.	1	8,000	8,000								
	Running	wk	12	3,000	36,000								
	Pretreatment	m^3	-	10.0	-								
4000	**On-site treatment / process area (for trucks and equipment)**				121,265	0.0	0.4	0.4	1.0	1.0	0.4	0.6	0.6
	Set-up	L.S.	1	8,000	8,000								
	Running	wk	12	3,000	36,000								
	Pretreatment	m^3	7,726	10.0	77,265		0.0	0.0	1.0	1.0	0.0	0.4	0.4
5000	**Workers washing area**				**21,240**	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Set-up	L.S.	1	6,000	6,000								
	Running	wk	12	1,000	12,000								
	Pretreatment	m^3	648	5.0	3,240								
6000	**Soil replacement**				**515,097**	0.0			1.0	3.0			
	Soil Cutting	m^3	23,414	10	234,135								
	Sand	m^3	23,414	4.5	105,361								
	Sand placement	m^3	23,414	7.5	175,601								
7000	**On-site soil washing**				**7,381,253**	0.0							1.0
	Soil Cutting	m^3	23,414	10	234,135								
	Washing basin	num	1	6,000	6,000								
	Chemicals	ton	5,151	250	1,287,743								
	Treatment				5,853,375								
8000	**Fences**				**375,000**	1.0	0.0	1.0					
	Material	m^2	15,000	15	225,000				0.0				
	Construction	m^2	15,000	10	150,000								
9000	**Transportation**				608,751	0.0	0.0	0.0	1.0	1.0	0.0	0.4	0.4
9100	Loading				46,827								
9110	Soil	m^3	23,414	2.0	46,827								
9120	Brick / concrete	ton	-	3.0	-								
9130	Metal pieces	ton	-	4.0	-								
9200	Tavel	trip	5,151	100	515,097		0.0					0.4	0.4
9300	Unloading				46,827								
10000	**Monitoring**				**28,830**	0.4	0.5	0.6	1.0	1.0	1.0	1.0	1.0
10100	Equipment				750								
10110	Soil Sampler	No	1	50	50								
10120	Air Sampler	No	1	700	700								
10200	Analysis	Sample	432	65	28,080								
11000	**Management Office**				**146,400**	0.9	0.1	0.1	0.1	0.1	0.1	0.1	0.1
11100	Set-up	L.S.	1	6,000	6,000								
11200	Running	wk			140,400								
12000	**Training**				**21,500**	0.2	0.7	0.8	0.9	1.0	1.0	1.0	1.0
12100	Training subjects				8,000								
12200	General Health and Safety	Trainee	20	250	5,000								
12300	Specific	Trainee	30	100	3,000								
12200	Workers allowance	Trainee.day	50	30	1,500								
12300	Trainer	Day	8	1,500	12,000								
13000	**Remediation consultant**				376,000	0.1	0.2	0.3	0.3	0.4	0.3	0.6	1.0
	Fixed costs	L.S.	1	40,000	40,000								
	Running costs	wk	12	28,000	336,000								

Generic Costs

1					Years ------->	6.0	3.0		1.0	1.5		2.5	6.0
						Alternative cost factors							
		Unit	**Qty**	**USD/Unit**	**USD**	**F1**	F2	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**
20000	**Contengincies**				2,786,492	0.0	0.1	0.1	0.1	0.2	0.1	0.4	0.7
999	**Land compensation**	%	5.0%	1,505,000	75,250								
1000	**Phyto remediation**	%	10.0%	408,000	40,800								
2000	**On-site encapsulation**	%	15.0%	5,461,687	819,253								
3000	**On-site washing / rinsing**	%	10.0%	44,000	4,400								
4000	**On-site treatment / process are**	%	15.0%	121,265	18,190								
5000	**Workers washing area**	%	10.0%	21,240	2,124								
6000	**Soil replacement**	%	10.0%	515,097	51,510								
7000	**On-site soil washing**	%	20.0%	7,381,253	1,476,251								
8000	**Fences**	%	10.0%	375,000	37,500								
9000	**Transportation**	%	30.0%	608,751	182,625								
10000	**Monitoring**	%	15.0%	28,830	4,325								
11000	**Management Office**	%	10.0%	146,400	14,640								
12000	**Training**	%	15.0%	21,500	3,225								
13000	**Remediation consultant**	%	15.0%	376,000	56,400								

Dimensions

total area	43	ha		
contaminated area	43,000	m^2	10%	
Area for clay removed at 0.15 m depth:	12,900	m^2	30%	0.15
Area for clay removed at 0.50 m depth:	12,900	m^2	30%	0.5
Area for clay removed at 0.75 m depth:	17,200	m^2	40%	0.75
Volume of clay (steped removal):	23,414	m^3		
Weight of clay (steped removal):	51,510	ton		
Volume of clay (1.0 m removal):	35,475	m^3	100%	0.75
Weight of clay (1.0 m removal):	78,045	ton		

Prices

Item	Unit	$/Unit
Clay	m^3	5.50
Sand	m^3	4.50
Salvage steel	ton	5,000.00
Transportation	1.0 km.trip	20.00
	10 km.trip	35.00
	50 km.trip	100.00
	100 km.trip	140.00
Soil cutting	m^3	10.00
Cement	ton	250.00
Guard	p.m.shift	700.00
Three layers cap / clay cap factor	ratio	3.00
land value (rent)	yr	35,000.00

		Limiting access to the site	Phytoremediation	Placement of clay cap	Placement of three-layers cap.	Encalsulation of the site	Rinsing of soil
999	land opurtunity cost	9,030,000	4,515,000	1,505,000	2,257,500	3,762,500	9,030,000
1000	**Demolition / disembeling**	0	408,000	0	0	0	0
2000	**On-site encapsulation**	0	0	0	0	5,461,687	5,461,687
3000	**On-site washing / rinsing**	0	0	44,000	44,000	44,000	44,000
4000	**On-site treatment / process area**	0	44,000	121,265	121,265	74,906	74,906
5000	**Workers washing area**	0	21,240	21,240	21,240	21,240	21,240
6000	**Soil replacement**	0	0	515,097	1,545,291	0	0
7000	**On-site soil washing**	0	0	0	0	0	7,381,253
8000	**Fences**	375,000	0	0	0	0	0
9000	**Transportation**	0	0	608,751	608,751	243,500	243,500
10000	**Monitoring**	11,532	14,740	28,830	28,830	28,830	28,830
11000	**Management Office**	126,000	16,085	16,085	16,085	16,085	16,085
12000	**Training**	4,300	16,100	19,481	21,429	21,500	21,500
13000	**Remediation consultant**	54,842	72,384	128,528	151,926	209,513	376,000
20000	**Contingencies**	78,590	359,828	378,238	481,258	1,197,491	1,854,489
	USD	**9,680,263**	**5,467,377**	**3,386,514**	**5,297,574**	**11,081,252**	**24,553,489**

Appendix – 2

MITIGATION AND PREVENTIONS MEASURES FOR THE FAUNA DURING THE REMEDIATION LAKE OR DECOMMISIONING ACTIVITIES
(Especially snakes and mice or rats)

MITIGATION AND PREVENTIONS MEASURES FOR THE FAUNA DURING THE REMEDIATION LAKE OR DECOMMISIONING ACTIVITIES (Especially snakes and mice or rats)

Unwanted snakes, especially common snakes, may appear during the remediation activities or the decommissioning the BLWWTP, especially if the activities held during the spring. Often, they've been hiding (or overwintering) in spaces or underground. They enter through cracks or holes surrounding the existing trees or underground soil. These spaces provide shelter and warm places for a snake to spend the winter. When spring returns or when they are disturbed by the remediation or decommissioning activities, the snakes reappear outside.

Following is the measures proposed by the Consultant (besides the close coordination with the Ministry of Health and Ministry of Agriculture related to the reported cases and found wildlife, if any, during the activities). These measures includes, as well, the preventions to be considered by the contractor of the remediation works and the decommissioning for protection of workers and wildlife (fauna)

Measures and protection of the snakes on the site area for remediation works or decommissioning activities:

a. **Seal the cracks;** Deter snakes by sealing the cracks and filling holes or cracks on the ground or between the trees roots. Most snakes can fit through a 1/2-inch-wide crack. It is advisable to fill the crack when snakes determined not inside the crack or hole (during the summer, it is determined that the snake will not be in the crack or hole), otherwise, it would die inside the hole and cause odor problems.

b. **Eliminate their food source – Mice;** Snakes may also appear when they are looking for a place to overwinter, or may be searching for food -- specifically mice. By eradicating rodents from the area.

Mice can be controlled by removing their food sources, nesting sites, or by trapping them. To prevent the entry to the area, wastes (i.e. soil piles, pipe piles, sanitary wastes) should be removed regularly to reduce the piles on site.

c. **Landscaping;** Certain types of landscaping may be appealing to snakes. Avoid having piled wastes on site (as mentioned above). In addition, keeping the site dry may also reduce the attraction prey items (worms, slugs, or frogs) that some species of snake feed on.

d. **Remove hiding spots;** Snakes seek out sites that provide cover for both them and their prey. The easiest way to discourage snakes is to remove these hiding spots. Move any debris or dispose it in a frequent period in which rodents might reside away from site. Trim shrubs and trees to create a space of at least 6 inches between the ground and the first branches. The larger the mowed area, the lower the chance of having snakes near the site area in addition, it is also makes it easier to see a snake on site.

e. Fencing; The only way to absolutely keep snakes to escape from the site area is with fencing. Snake-proof fencing can be made by modifying a normal chain-link, picket, or split-rail fence. Attach 24-inch-high hardware cloth (1/4-inch weave) or aluminum flashing to the outside bottom of the fence. Bury the bottom of the hardware cloth or flashing 2 to 4 inches into the soil. Gates should have the same snake-proofing and be kept closed to be effective.

The fence has to go all the way around the specific site area to be remediated or decommissioned. Snakes tend to travel along a fence rather than go over it. If the fence ends or has an opening, the snakes will enter the outside site area at this point and might cause the disturbance to the inhabitant nearby. Fill any mammal burrows that appear near the fence.

If there is no existing fence, aluminum flashing could be used to encircle the site. The flashing should be 24-inches high and buried 2 to 4 inches into the soil.

f. Removing unwanted snakes; If the contractor encounters an unwanted snake in a site area, there are a number of humane, nonlethal methods of removing them. The method includes using the snack catcher sticks and put in inside the cage (prepared onsite by the contractor). However, the close coordination and the guidance from the Ministry of Agriculture might be needed to assist the common ways of removing the unwanted snakes according to their dangerous levels.

g. Trapping; There are several types of snake traps available. The best are one of the various styles of funnel traps. Traps work best inside closed area, but can be used outside along a snake-proof fence. They should be placed length-wise, so that when a snake moves along the fence it will enter the trap. Traps should be used to remove a specific snake that you know is present.

h. Relocating; Once you have trapped or found the snake, you will need to relocate it. This means picking it up and putting it in a container for transport to the new habitat or temporarily relocation before return it back to the natural habitat after the activities are completed. Nonvenomous snakes can be lifted with a garden rake or shovel. If the snake is small, the workers can use a gloved hand. Transport the container to an appropriate site (new habitat) for release. However, the relocation of the found fauna or temporary relocation has to be discussed and agreed between the contractor and the Ministry of Agriculture.

In urban and suburban areas, cage or box traps are generally the most practical removal devices. Foot traps may be used in some areas, especially if they can be set in water. Some cities have ordinances prohibiting the use of certain types of traps, so local authorities should be contacted before any removal efforts are begun.

Measures and protection of the rats or rodent on the site area for remediation works or decommissioning activities:

In general, as the rats or rodent are belong to the normal and common wildlife and not considered as endanger animals and might cause damage or injury to the workers and the surrounding populations if it is not controlled and released outside the project site. In general, it is allowed to control rats or rodents that are causing damage or injury. They may control these animals without permit from any authority. Following is the standard procedure for caring the rats or rodent found during the activities:

a. **Live trap;** A normal live trap will work to trap the animals. It can be baited with fish, chicken, fish flavored cat food or canned tuna. The mesh must be small enough so the animals cannot reach through the wire and get the bait--one-half inch or smaller will be adequate. Most of the bait should be placed inside the trap near the back, but a few morsels should be placed in front of and just inside the trap. Live traps are available for rent or loan from rental companies and some animal shelters and nature centers, or they can be purchased or made. Coordination between the contractor and the Ministry of Agriculture might help to identify the local practice to trap the animals.

b. **Shooting;** Although shooting is often an effective control technique in rural areas, however, it is prohibited in towns and cities. This approach is not recommended by the Consultant as the more common technique is available on the project site.

c. **Unprotected picked;** Rats or rodents are wild animals and no attempt should be made to pick them up or pet them, even if they appear tame. Although rabies is quite rare in the project area, no bite by a wild carnivore should be ignored. These animals are normally not aggressive, but will defend themselves if captured or cornered. If the workers are bitten, every attempt should be made to capture or kill it (without damage to the head) so that it can be tested for rabies by the Ministry of Health. Medical treatment and advice should also be sought.

d. **Prevention from the infectious disease caused by the parasite;** It might be possibility to have worm or parasite of rats or rodent that can cause human health problems under certain circumstances. These parasites live in the animal's intestine and shed microscopic eggs which are passed in the feces. These eggs can become infective to people or other animals after about 30 days. The greatest potential for problems is for people who may come into close contact with areas contaminated with fecal material, particularly small children who may place dirty hands or objects in their mouths. Therefore, isolation of the area is necessary and the use of standard protection of the workers during the site activities is compulsory.

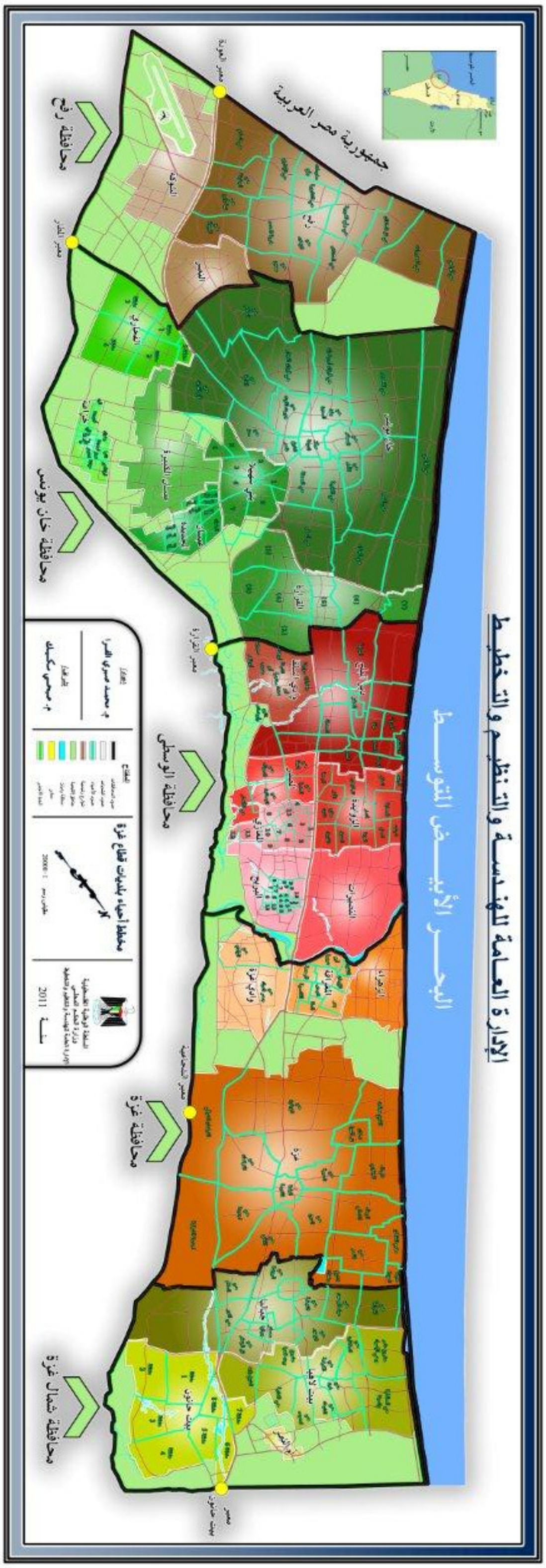
Photo logs below presents the example of locally and temporarily made cages that can be utilize during the remediation works and during the decommissioning of the treatment plant (BLWWTP).

Figure 1 Photo logs of temporary site shelter for snake and rats / rodent

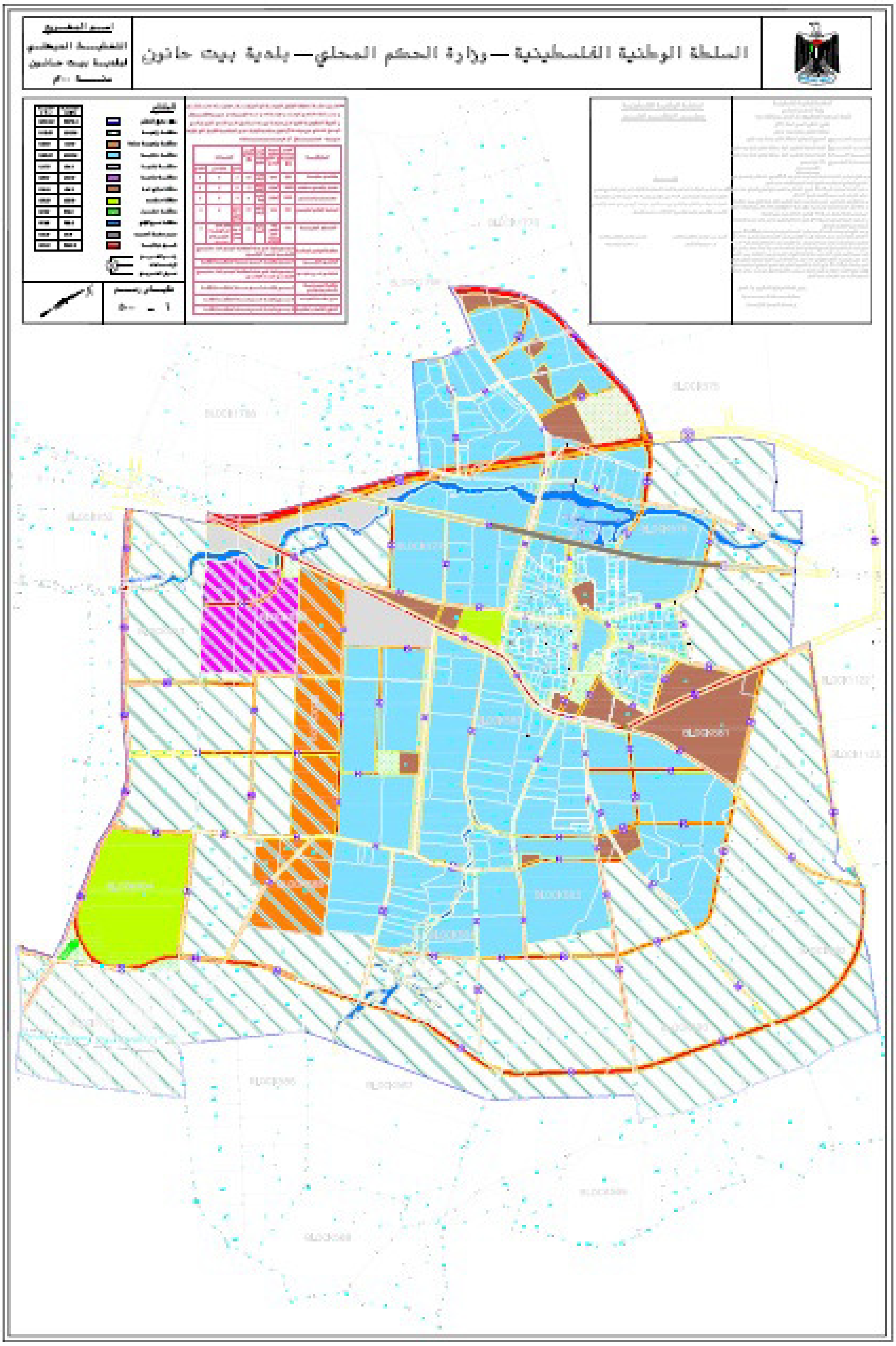
Appendix – 3

Urban Planning of surrounding Effluent Lake – BLWWTP

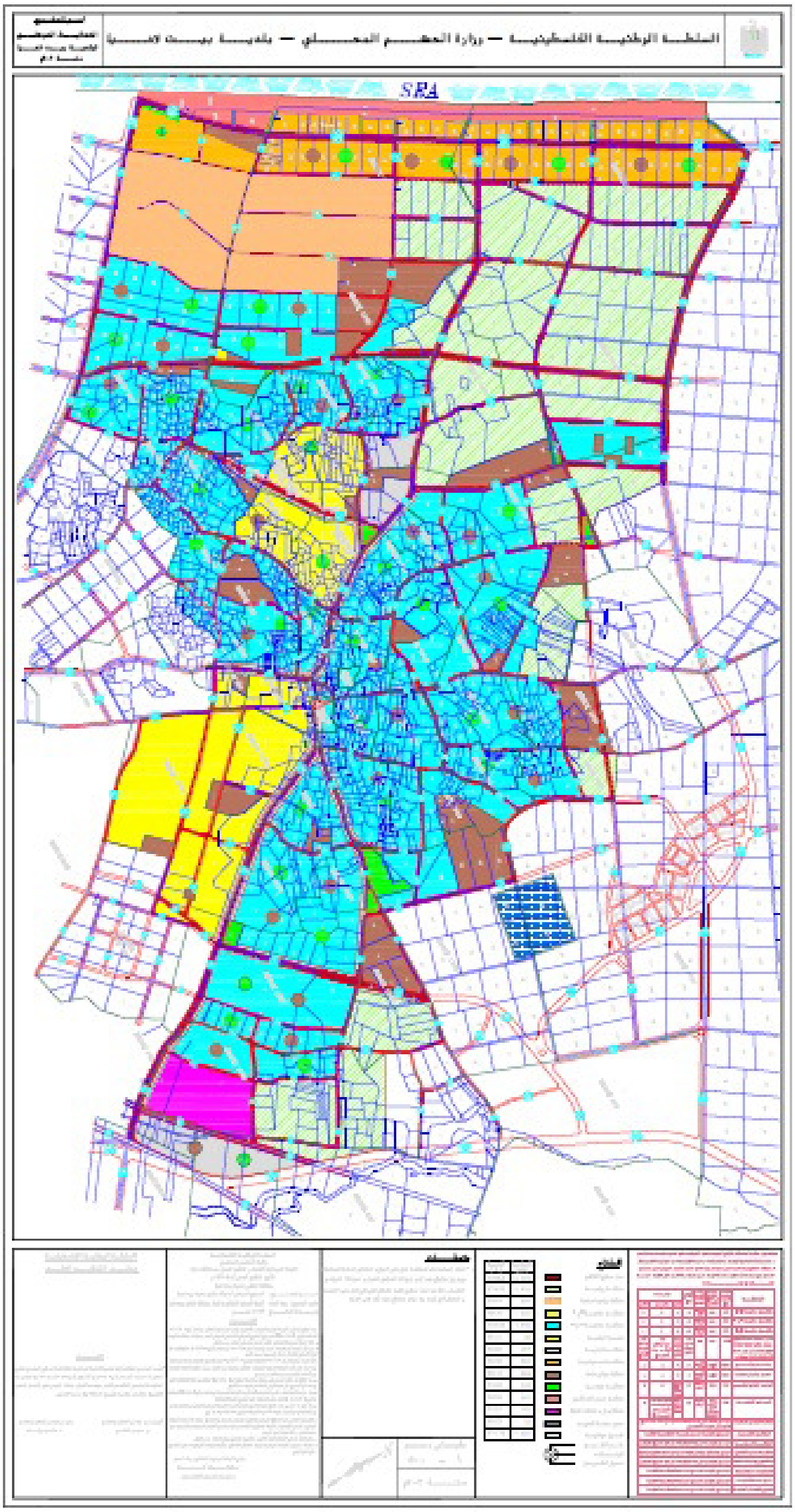
Urban Planning of Gaza Strip



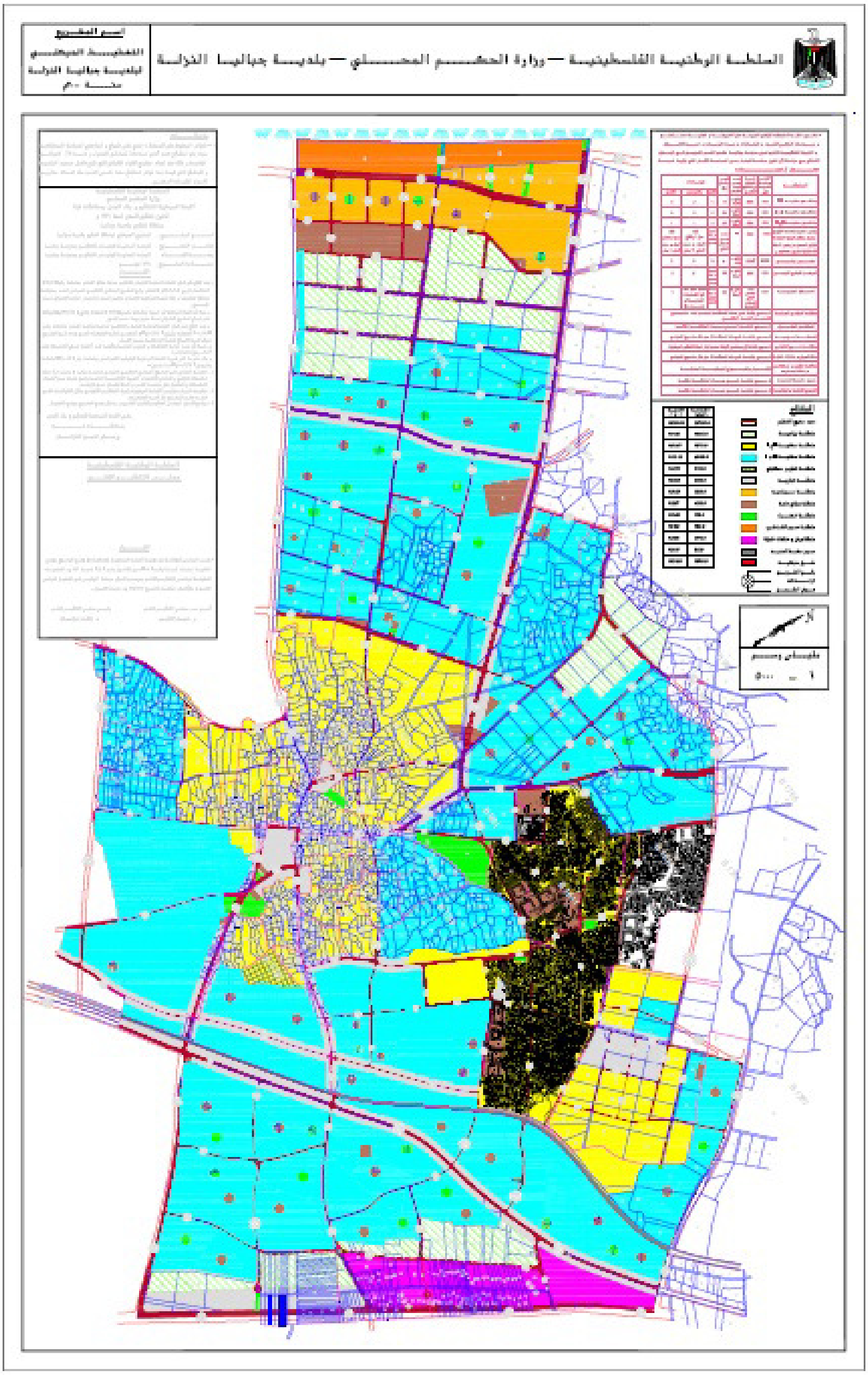
Urban Planning of Beit Hanoun



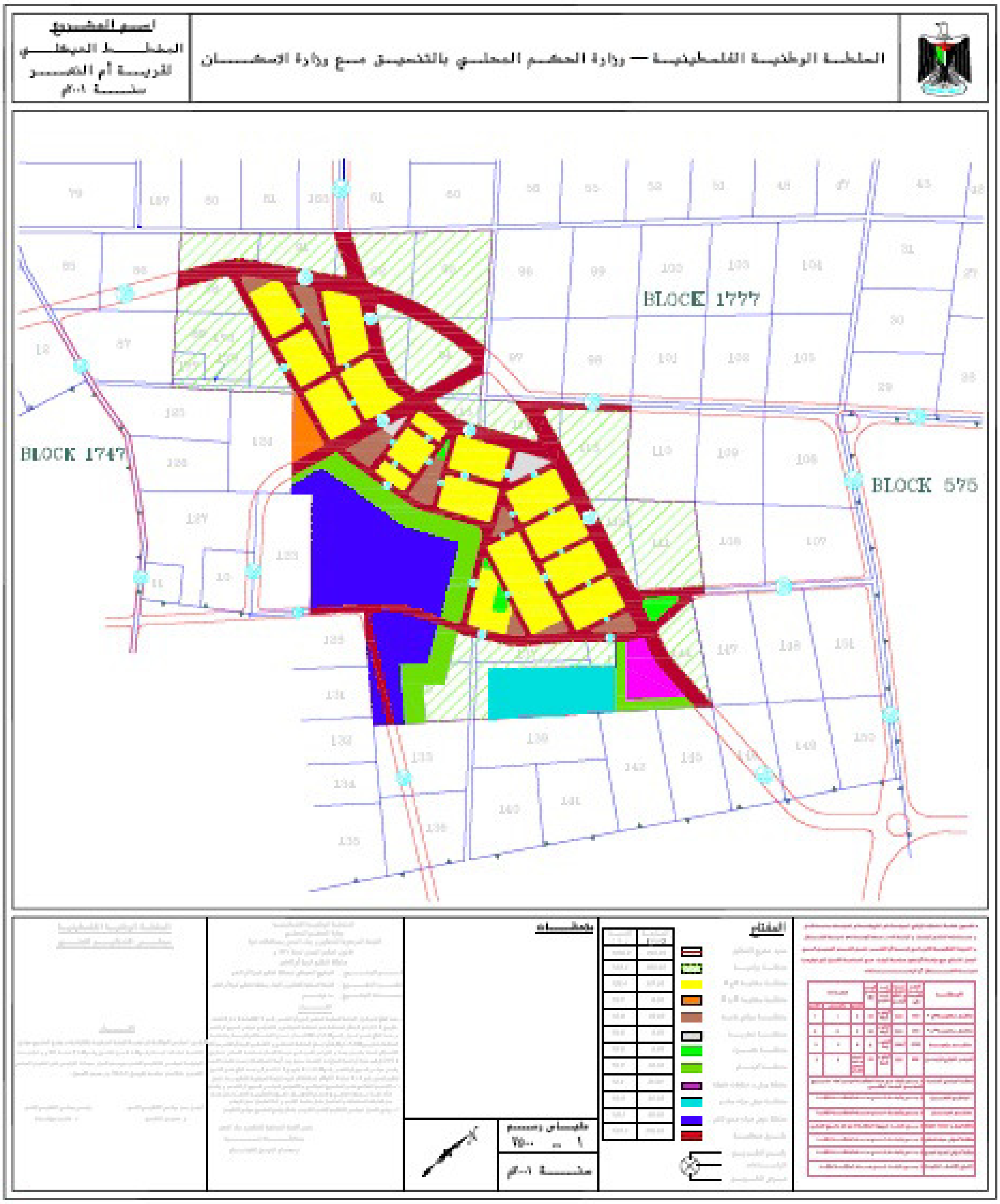
Urban Planning of Beit Lahia



Urban Planning of Jabalia

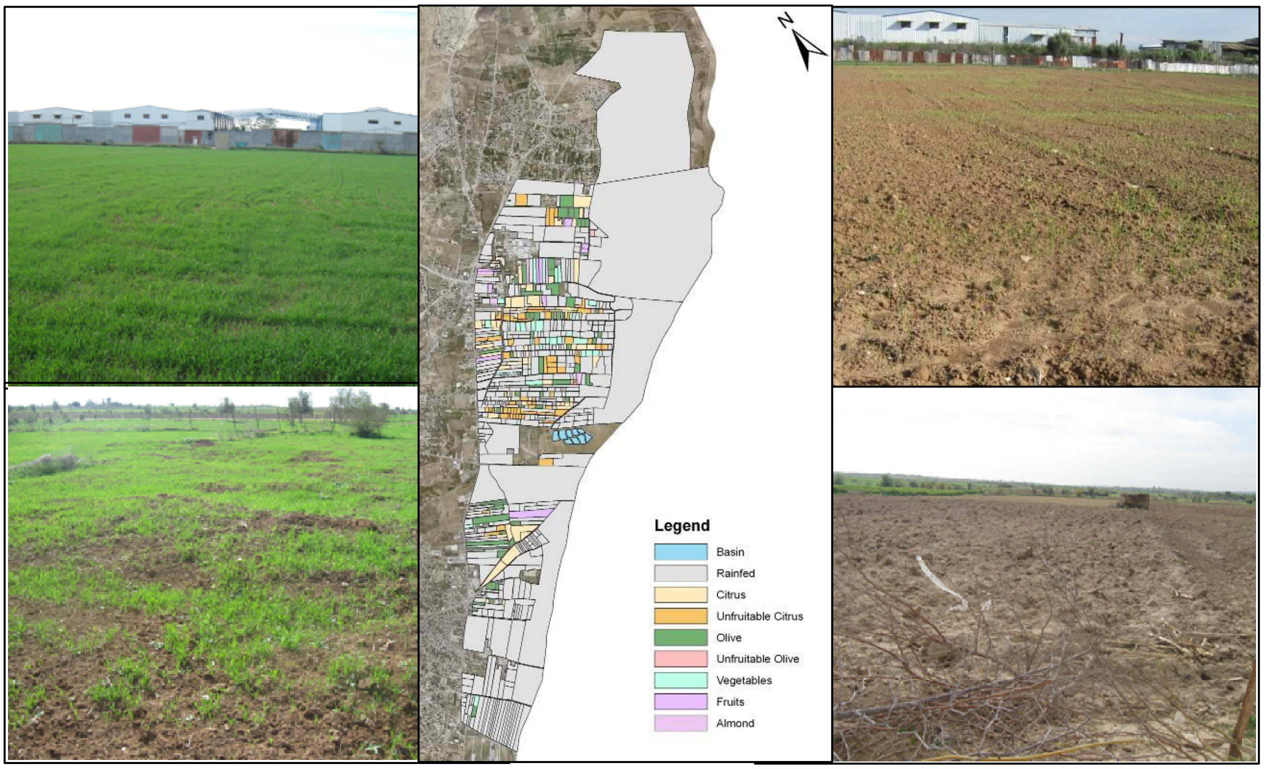


Urban Planning of Um Nasser



Consulting Services for Detailed Design and Tender Documents of Effluent Recovery and Irrigation Scheme of North Gaza Emergency Sewage Treatment (NGEST)

Contract Number: NGEST/AF-QCBS01-08/DD



Special Report Concerning Irrigation Scheme

Consultant

Joint Venture Association of the Center for Engineering and Planning (CEP) and the FCG International Ltd.

مركز الهندسة والتخطيط
center for engineering and planning

FCG Finnish Consulting Group
Infra and Environment

June 2010

Special Report Concerning Irrigation Scheme

1. Project Background and Objectives:

The main objective of the current project is to design recovery wells, water storage tanks, pump station and irrigation networks which should account for possible infiltrated wastewater, recovery scheme, and the demand for crops up to year 2025 or 2030 (based on consultant prediction) which could reach the identified capacities of treated wastewater (69,000 m^3/day).

Two phases based on generated wastewater quantity (35,600 m^3/d and 69,000 m^3/d) regardless of the target year (around 2012 and 2025) will be considered. Detail design of the recovery scheme is for 35,600 m^3/day as infiltrated treated wastewater. Future extension of infiltration basins and recovery scheme to accommodate 69,000 m^3/day of treated wastewater will be suggested.

The main factors influencing the design scheme are:

i. The quality of treated wastewater (treated and partially treated) diverted to the infiltration basin depends on the efficiency of the treatment in the existing Basin Wastewater Treatment Plant (BWWTP) and/or the construction of the North Gaza Emergency Sewage Treatment (NGEST).
ii. The cropping patterns water demand.

To ensure the capturing of all infiltrated water quantity, an addition 10% extra over the infiltrated amount should be abstracted. Yearly infiltrated treated wastewater should be recovered and used at the same year. The recovered 35,600 m^3/day, with 10% extra, should be used for irrigation in the vicinity or nearby area of the recovery wells (Figure 1), therefore, the current document should specify:

- land availability (total area required),
- cropping patterns,
- daily and monthly crop water requirement, and
- irrigation methods

2. Agriculture Background for Project Area:

The total project area is around 15,700 dunum located on North East of Gaza Strip adjacent to the eastern border with Israel as shown in Figure (1). The agricultural area is about 12,600 dunum whereas the industrial and residential area account for 3000 dunum. The proposed area is divided into two zones (A and B) according to its location from infiltration basins. Zone A is the part located north of infiltration basins with about 10,100 dunum whereas, Zone B is located south of proposed WWTP with about 5,000 dunum (Figure 1).

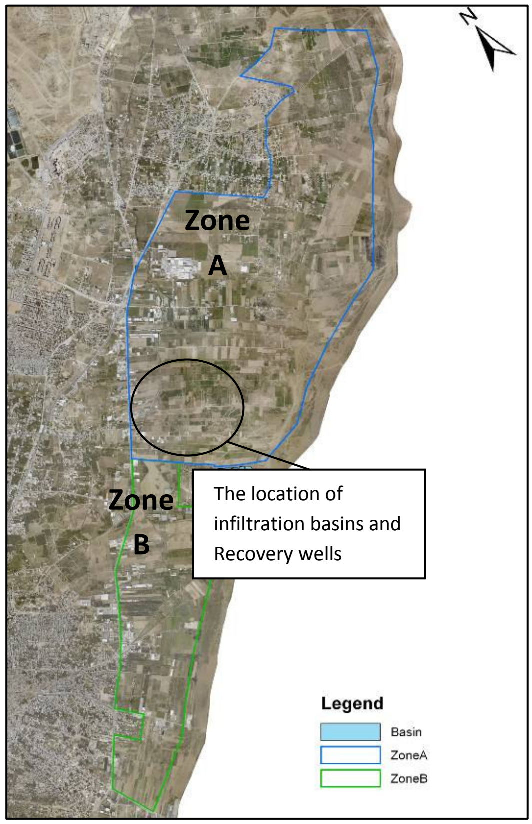


Figure (1): Project Site Map.

3. Climate Data for Project Area:

Gaza Strip is located at the east shore of the Mediterranean Sea. It is considered as a semi-arid region with an annual rainfall ranging from 200 to 450 mm.

The meteorological factors determining evapotranspiration are weather parameters which provide energy for vaporization and remove water vapour from the evaporating surface. The principal weather parameters to consider are: solar radiation, wind speed, air humidity and air temperature.

- **Rainfall:** The main rainfall season in the proposed area is from October to March. The average rainfall rates range from 0 mm in summer months to its maximum in December and January, however it differs from year to year (Table 1).

- **Sunshine hours:** Solar radiation is the largest energy source available and is the main driving force for the vaporization of water which determine the evapotranspiration process. Actual sunshine hours are relatively high in summer months being about 11 hours daily. While, potential sunshine hours around 8 hours daily.
- **Air temperature:** The solar radiation absorbed by the atmosphere increases the air temperature which transfers energy to the crop and exerts as such a controlling influence on the rate of evapotranspiration. In sunny, warm weather the loss of water by evapotranspiration is greater than in cloudy and cool weather. The project area is considered as temperate region so the average minimum temperature around 10°C in January to maximum temperature around 30°C in August taking in to account the climate change through the mentioned ten years (1.5°C/year).
- **Relative humidity:** While the energy supply from the sun and surrounding air is the main driving force for the vaporization of water, the difference between the water vapour pressure at the evapotranspiring surface and the surrounding air is the determining factor for the vapour removal. The project area is far from Gaza shore and therefore the relative humidity is relatively medium ranging from 60 to 75 %.
- **Wind speed:** The process of vapour removal depends to a large extent on wind and air turbulence which transfers large quantities of air over the evaporating surface. When vaporizing water, the air above the evaporating surface becomes gradually saturated with water vapour. If this air is not continuously replaced with drier air, the driving force for water vapour removal and the evapotranspiration rate decreases. The wind speed is about the same during the year with an average 10.4 km/hr.

→ The evaporation power of the atmosphere is expressed by the reference crop evapotranspiration (ET_o). The reference crop evapotranspiration represents the evapotranspiration from a standardized vegetated surface.

Table 2 illustrates rainfall, temperature, relative humidity, wind and sunshine hour's for ten years (1997-2006) average values for the project area.

Table (1): Monthly Rainfall Average for Gaza Station (mm) (2000-2007)

Season Rainfall	2000-2001	2001-2002	2002-2003	2004-2005	2005-2006	2006-2007	AVG
JAN	130.4	17.8	98.1	53.5	106.6	159.5	94.3
FEB	60.6	11.8	239.4	46.1	16.8	98.8	78.9
MAR	10.5	12.1	67.9	33.2	21.7	68.5	35.7
APR	3.2	6.6	9.2	0.2	42.5	1.7	10.6
MAY	0	0	0	0	0	0.8	0.1
JUN	0	0	0	0	0	0	0.00
JUL	0	0	0	0	0	0	0.00
AUG	0	0	0	0	0	0	0.00
SEP	1.2	75.6	0	0	0	2.2	13.2
OCT	132.3	23.7	38.8	0.1	19.7	40.8	42.6
NOV	17.6	198.3	6.7	104	56.4	27.8	68.5
DEC	132.5	202.4	163.2	52.1	51.4	84.9	114.4

Table (2): Climatic Data of Project Area in Average (1997-2006) (Meteorological Gaza Office, 2006)

Month	Rainfall (mm)	Min Temp °C	Max Temp °C	Relative Humidity %	Wind (km/hr)	Sunshine (hours)
Jan	94.3	10.8	18.1	65	11.3	4.8
Feb	78.9	11	18.2	67	12.3	6.1
Mar	35.7	12.9	19.8	67	11.5	7.6
Apr	10.6	16.3	22.9	67	11.0	8.4
May	0.1	19	24.6	72	10.2	9.7
Jun	0	21.7	27.2	74	9.8	9.8
Jul	0	23.8	29.6	74	9.7	10.7
Aug	0	24.5	30.2	72	10.1	10.6
Sep	13.2	23	29	68	10.5	9.7
Oct	42.6	20.3	26.7	67	10.5	8.3
Nov	68.5	16.3	23.5	62	10.6	6.2
Dec	114.4	12.6	19.6	64	10.9	4
Average	38.2	17.7	24.1	68	10.7	8

4. Soil Type of the Project Area:

In general, the dominate soil type in the area can be considered as heavy soil with 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 roots penetration for deep rooted crops. Detailed soil characteristics (physical and chemical) will be investigated in the second phase of the project.

Zone A Loamy clay textured soils with dark brown to reddish brown color are dominated in the area (Figure 2). The calcium carbonate content ranges from 15 to 20% (MOA, 1994).

Zone B The north part of this area is loamy clay textured soil and the south part is loess textured soil and is yellow brown in color as shown in Figure (2).

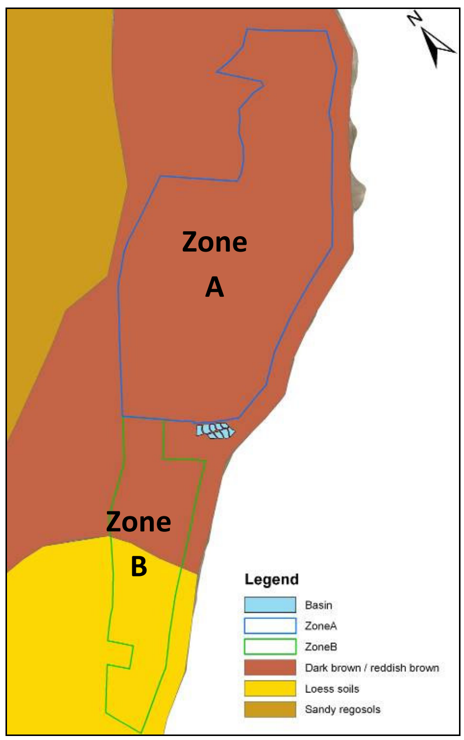


Figure (2): Gaza strip soil map and project area (MOA, 1994)

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.

5. Existing Agricultural Situation in Project Area

The data about the existing agricultural situation in the proposed project area was collected during site visits. The proposed area is actually 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, (Table 3). Surface irrigation is common and irrigation system is predominated in the grooves.

Table (3): Land survey (December, 2009).

Crop	Total Areas (du)	No. Of Farms	Property	
			Private	Awqaf
Rainfed	12055	398	379	19
Citrus	688	68	68	0
Olives	600	58	57	1
Unfruitable Citrus	510	69	69	0
Unfruitable Olives	14	3	3	0
Vegetables	280	32	30	2
Fruits	184	11	10	1
Almond	53	5	5	0
Total	14384	644	621	23

Distribution of cultivated crops in the project area

Table (4) shows the distributions of cultivated crops in both zones (A & B). 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 rainfed farming to irrigated land.

Table (4): Distribution of cultivated crops in zone (A & B) (Dec. 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

Citrus is a crop grown in the project area with an area of 1198 dunum (fruitable and none-fruitable). However, citrus is sensitive to poor groundwater quality (mainly salinity) resulting in reduced yields and quality with some plantations being abandoned.
Olives represent 614 dunum (fruitable and none-fruitable). Vegetables represent 280 dunum. The area of fruit trees is 120 dunum, whereas, the rainfed area includes the grains and the demolished area occupying the most of the project area being 12,055 dunum as shown in Figure(3).

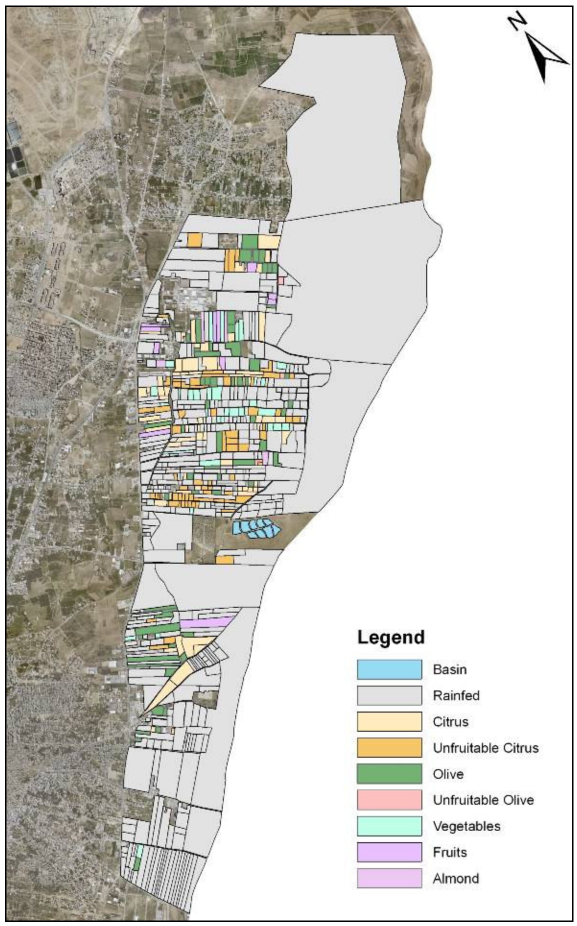


Figure (3): Existing crops in project area.

The water requirements for the different crops were calculated using local climatic parameters. Crop coefficients were obtained from FAO Irrigation and Drainage Paper No. 33. The net irrigation requirement for crops was calculated using crop evapotranspiration (ET) and effective rainfall according to Cropwat V.8, 2009. Leaching requirement will be discussed in the section of cropping pattern design.

6. Criteria for crop selection

- *Self Sufficiency:* Gaza Strip is actually in bad need to citrus, olives and fodder crops.
- *Policy of Ministry of Agriculture*
- *Dominant crops:* These lands -especially the north part- was previously cultivated with citrus.
- *Farmers' acceptance:* The farmers are familiar with citrus and vegetables cultivation.
- *Reclaimed Water quality:* The infiltrated water is actually partially treated, and its quality is expected to improve through soil filtration.
- *Climate and land suitability.*
- *Crop value and market availability.*

7. Irrigation Water Demand

The irrigation water demand has been determined based on the following factors:

- 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 characteristics as given in the attached agricultural soil testing report.
- Irrigation methods.

Table (5) illustrates the monthly crops water requirements calculated using (Cropwat V. 8, 2009) software. Considering effective precipitation calculated as 80% of total precipitation (Cropwat V. 8, 2009)

Table(5): Monthly Crops Water Requirements (mm) (Cropwat V.8, 2009)

Month	Citrus	Olives	Fruit	Alfalfa	Vegetables	Grains
Jan.	12.1	1.3	0.6	40.7	8.2	48.5
Feb.	17.2	4.8	1.4	11.0	16.8	19.4
Mar.	35.0	8.5	12.8	29.8	56.1	10.1
Apr.	67.0	35.5	40.5	60.7	111.2	108.2
May	89.8	53.3	60.9	87.9	140.0	166.3
June	98.8	60.5	71.6	115.0	145.1	123.0
July	115.6	72.9	88.6	154.8	132.3	6.1
Aug.	117.6	74.6	91.8	180.8	77.1	0.0
Sept.	92.2	54.8	69.8	157.1	67.4	0.0
Oct.	68.2	37.2	49.6	122.3	80.8	0.0
Nov.	38.8	15.2	24.2	80.8	57.1	13.6
Dec.	7.7	0.0	0.2	43.4	9.9	40.0
Total	**760.0**	**418.6**	**512.0**	**1084.3**	**902.0**	**535.2**

8. Calculation of leaching requirements

The leaching requirement is the ratio of the net depth of leaching water to the net depth of water which must be applied for consumptive use. Calculating the leaching requirement for trickle irrigation is greatly simplified by:

$$LR = \frac{ECw}{ECd}$$

Where:

ECw = Irrigation water salinity, dS/m
ECd = Drainage water salinity, dS/m

ECd can equal 2 (max ECe) Then LR can be calculated for trickle irrigation percent as:

$$LR = \frac{ECw}{2 \max ECe}$$

Where:

Max ECe = electrical conductivity of the saturated soil extract that will reduce crop yield, to zero, dS/m. (Sprinkler and Trickle Irrigation by Bliesner and Keller, 2001)

However, for sprinkler and surface irrigation systems, leaching requirement calculated using the following equation:

$$LR = \frac{ECw}{5ECe - ECw}$$

Where ECe is estimated electrical conductivity of the average saturation extract of the soil root zone profile for an approximate yields reduction, dS/m.

ECe values which will give 10% yield reduction is recommended (Annex 1)

Table (6) illustrates Leaching requirement (ratio, %) Drip, sprinkler and surface irrigation systems.

Table (6): Calculation of leaching requirements.

Crop	Citrus and Fruit tress	Olive trees	Alfalfa	Grains	Weighted Average
ECw, dS/m[(1)]	2.925	2.925	2.925	2.925	2.925
ECe, dS/m[(2)]	2.3	3.8	3.4	7.4	-
Sprinkler and surface irrigation systems, LR, %	34.1	18.2	20.8	8.6	45
Relative proposed area for scenario III	45	25	15	15	100
LR calculated on weighted value %[(3)]	15.35	4.55	3.12	1.29	24.30

[(1)] Source: analysis of local wells.
[(2)] Source: FAO and presented in Annex 1
[(3)] Numbers in the shaded cells represent applicable leaching requirement.

Based on recommended cropping pattern, recommended irrigation system for each crop, and expected reclaimed water quality (Wells Q53 and Q56, water quality report) weighted average leaching requirement will be 25% at average.

For the purpose of estimating the gross water requirement for each crop, irrigation efficiency (Ei) of 80% was assumed for good irrigation system management. Since leaching fraction more than 10% then gross irrigation is calculated using the following equation:

$$\text{Gross Irrigation} = \frac{0.9 \text{ Net Irrigation}}{(1 - \text{LR})(\text{Ei}/100)}$$

The (0.9) in the above equation is included to account for the unavoidable deep percolation losses which normally will satisfy approximately 10% of the leaching need. Table (7) shows the gross irrigation water demand for the proposed calculated crops.

Table (7): Gross Irrigation Water Demand of Crops (m^3/dunum).

Crop	Net Irrigation	Gross Irrigation
Citrus	760.0	1140
Olives	418.6	627.9
Fruits	512.0	768.0
Alfalfa	1084.3	1626.5
Grains	535.2	802.8
Vegetables	902.0	1353.0

9. <u>Reuse Scenarios</u>

In general, the components of the irrigation demands include: crop evapotranspiration, irrigation efficiency, leaching requirement, and irrigation losses in the irrigation system. In this study, crop water demand was estimated using crops actual evapotranspiration, 80% on farm irrigation efficiency, and 25% leaching fraction. Leaching requirements were calculated for each crop, along with its suitable on farm management based on the cropping pattern design and the time of application.

It is necessary to know how much water a crop will use, not only over the entire growing season, but also during the part of the season when water use is at its peak, - the rate of water use during peak consumptive period- which is the basis for determining the rate at which irrigation water must delivered to the field.

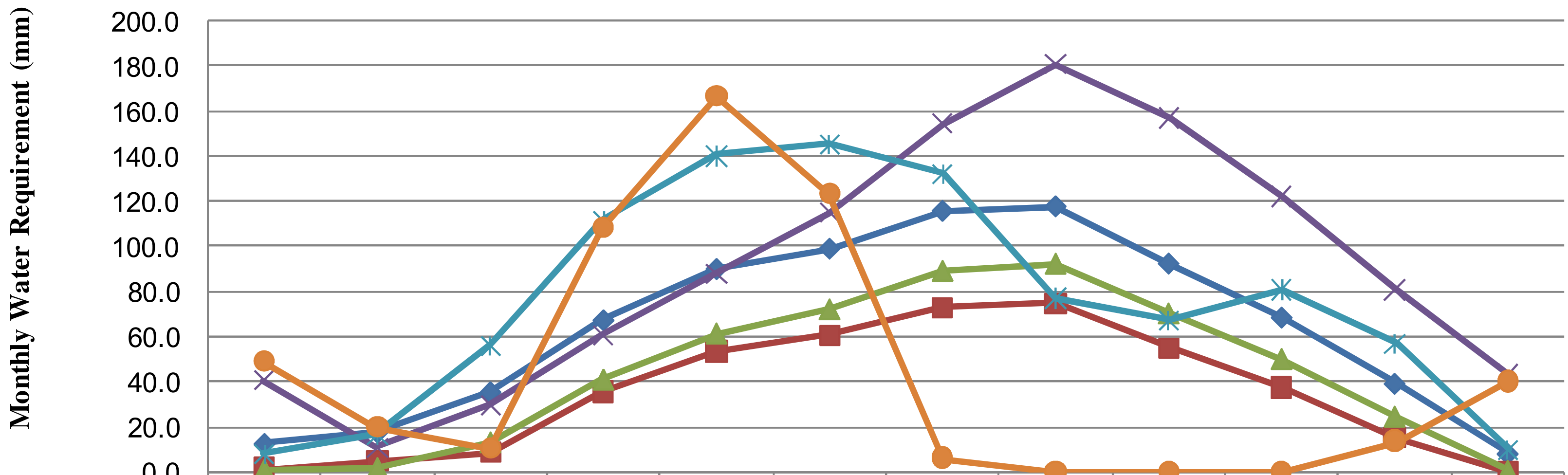
Figure 4 indicates that citrus, olive, fruit trees and alfalfa have continued demand pattern with a summer peak 5.06 mm/day, 3.13 mm/day, 3.90 mm/day and 7.78 mm/day during the month of August, respectively. While for vegetable and grain crops peak demands occur during the months of June and May being 6.45 mm/day and 7.15 mm/day, respectively.

For cropping pattern selection flexibility and based on crops water requirements during the peak period, an equivalent area for the different crops in the cropping pattern was estimated based on one dunum of a certain crop, as illustrated in Table (8).

Table (8): Equivalent area for the different crops in the cropping pattern calculated based on one dunum of a certain crop, according to crop water requirement.

Crop	Citrus	Olives	Fruits	Alfalfa	Grains	Vegetables
Citrus	1.00	0.55	0.67	1.43	0.70	1.19
Olives	1.82	1.00	1.22	2.59	1.28	2.15
Fruits	1.48	0.82	1.00	2.12	1.05	1.76
Alfalfa	0.70	0.39	0.47	1.00	0.49	0.83
Grains	1.42	0.78	0.96	2.03	1.00	1.69
Vegetables	0.84	0.46	0.57	1.20	0.59	1.00

The selection from this table is started from the top row to the left column of crops. For example, if citrus area increased by 100 dunum, olives area should be reduced by 182 dunum, or to reduce fruit trees area by 148 dunum, or to reduce alfalfa area by 70 dunum, or to reduce grains area by 142 dunum, or vegetables area by 84 dunum, and so on.



	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Citrus	12.1	17.2	35.0	67.0	89.8	98.8	115.6	117.6	92.2	68.2	38.8	7.7
Olives	1.3	4.8	8.5	35.5	53.3	60.5	72.9	74.6	54.8	37.2	15.2	0.0
Fruit	0.6	1.4	12.8	40.5	60.9	71.6	88.6	91.8	69.8	49.6	24.2	0.2
Alfalfa	40.7	11.0	29.8	60.7	87.9	115.0	154.8	180.8	157.1	122.3	80.8	43.4
Vegetables	8.2	16.8	56.1	111.2	140.0	145.1	132.3	77.1	67.4	80.8	57.1	9.9
Grains	48.5	19.4	10.1	108.2	166.3	123.0	6.1	0.0	0.0	0.0	13.6	40.0

Citrus Olives Fruit Alfalfa Vegetables Grains

Figure (4): Mean monthly crop water demand (mm) for citrus, olives, fruit trees, alfalfa, vegetables and grains crops.

Based on comprehensive analysis considering the criteria used for crop selection and to balancing water demand all over the year, Three scenarios were investigated and discussed in this report using the recommended cropping pattern, which are citrus 30%, olives 25%, fruit trees 15%, alfalfa 15% and grains 15% for scenarios I and II and citrus 30%, olives 25%, fruit trees 15%, alfalfa 10%, grains 10% and vegetables 10% in scenario III. At the same time, data in table 7 can be used to select any cropping pattern without affecting yearly water requirement demand and/or yearly water recovered. Adjustment of operating hours (pumping) may be needed in some cases but will remain in the range of 10 hours or less in winter months and 12 hours or less in the summer months.

Scenario I: On 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^3 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).

Scenario II: It is proposed that on the time when using Scenario II the wastewater will be treated more effectively and consequently the effluent will be of better quality in general. Consequently, the quantity of effluent diverted to the infiltration basin will increase to approximately 23,100 m3 daily. This reclaimed water will be used to irrigate addition land being 7525 dunum in total. The citrus area will increase to 2258 dunum, whereas, olives to 1881 dunum, fruits to 1129 dunum, alfalfa to 1129 dunum and grains to 1129 dunum.

Scenario III: Assuming that the planned WWTP in East of Jabalia will work with its full capacity on year 2025. The produced effluent must be totally infiltrated through the infiltration basins. The quality of reclaimed water (39,160m^3/day which equal 35,600 plus 10% extra) is expected for unrestricted use (Table 9). The quantity of reclaimed water will be enough to irrigation about 12,577 dunum. The citrus area will increase to 3773 dunum, whereas, olives to 3144 dunum, fruit trees to 1887 dunum, and alfalfa and grains each will increase to 1258 dunum. At this scenario vegetable crops will be introduced with an area of 1258 dunum (Table 10), as it is difficult to convince the farmers to accept the recovered water for cultivation of vegetables at the beginning of project.

Planting tree crops adjacent to the political boarder should be avoided as much as possible due to the specific political issues in the region. By using the reclaimed water, more irrigation wells on the area will be closed and consequently the original groundwater will be increased and improved through yearly addition of rain water (Figure 5).

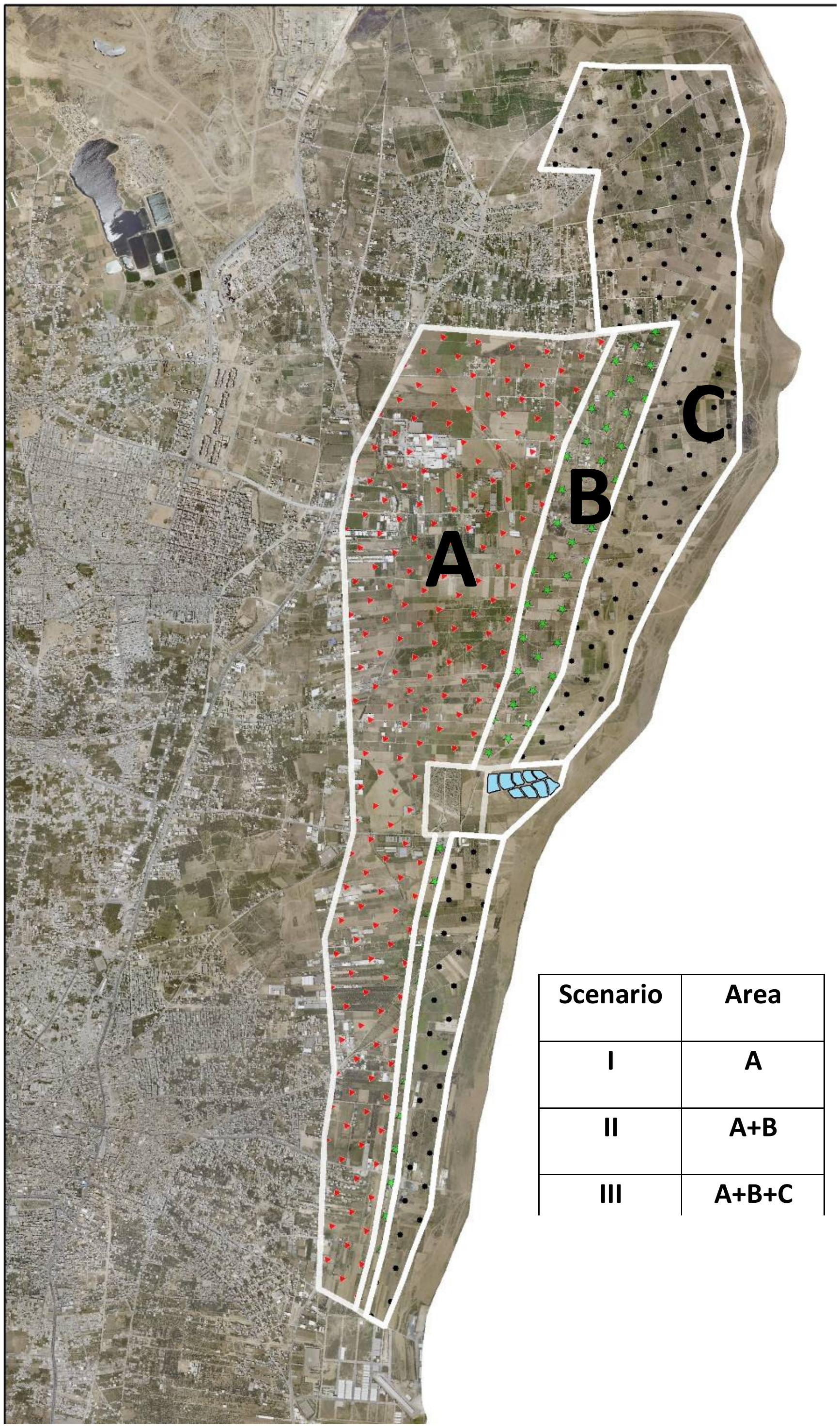


Figure (5): Map for Different Scenarios.

Table (9): Criteria Recommended by PWA for Effluent Standards (PS742, 2003)

Criteria	Restricted Use[1]	Unrestricted Use[2]
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 liter	Less than **0.1** ova per liter

Notes:

1. Restricted crops: Cereal crops, industrial crops, fodder crops, crops normally eaten cooked and trees, etc.
2. Unrestricted crops: Crops normally eaten uncooked (vegetables), Sport fields, and parks.

Table (10): Areas of Crops (dunum) Irrigated at the Three Scenarios.

Crop	Scenario I (16,500m^3/day)		Scenario II (23,100m^3/day)		Scenario III (39,160m^3/day)	
	%	Area (dunum)	%	Area (dunum)	%	Area (dunum)
Citrus	30	1613	30	2258	30	3773
Olives	25	1344	25	1881	25	3144
Fruits	15	806	15	1129	15	1887
Alfalfa	15	806	15	1129	10	1258
Grains	15	806	15	1129	10	1258
Vegetables	0	0	0	0	10	1258
Total area	100	5375	100	7525	100	12577
Total Infiltrated	**5,460,000 m^3**		**7,644,000 m^3**		**12,958,400 m^3**	
Total Recovered	**6,006,000 m^3**		**8408400 m^3**		**14254240 m^3**	
Balance	**-546,000 m^3**		**-764,400 m^3**		**-1,295,840 m^3**	

10. Calculation of total water requirements

For non-farming activities and may be due to expected climatic change, (15%) is added to the gross irrigation demand for the three scenarios as shown in Tables (11), (12) and (13).

Table (11): Water Requirements for Scenario I.

Crop	% of Area	Area (du)	Gross Irrigation (m^3/du)	Total Irrigation demand (m^3/area)	Total water requirement (m^3/area)
Citrus	30	1613	1140	1838250	2113988
Olives	25	1344	627.9	843741	970302
Fruit trees	15	806	768	619200	712080
Alfalfa	15	806	1626.5	1311366	1508070
Grains	15	806	802.8	647258	744346
Total	100	5375		5259814	**6048786**

Table (12): Water Requirements for Scenario II.

Crop	% of Area	Area (du)	Gross Irrigation. (m^3/du)	Total Irrigation demand (m^3/area)	Total water requirement (m^3/area)
Citrus	30	2258	1140	2573550	2959583
Olives	25	1881	627.9	1181237	1358422
Fruit trees	15	1129	768	866880	996912
Alfalfa	15	1129	1626.5	1835912	2111299
Grains	15	1129	802.8	906161	1042085
Total	100	7525		7363739	**8468300**

Table (13): Water Requirements for Scenario III.

Crop	% of Area	Area (du)	Gross Irrigation (m^3/du)	Total Irrigation demand (m^3/area)	Total water requirement (m^3/area)
Citrus	30	3773	1140	4301334	4946534
Olives	25	3144	627.9	1974275	2270416
Fruits	15	1887	768	1448870	1666201
Alfalfa	10	1258	1626.5	2045649	2352496
Grains	10	1258	802.8	1009682	1161134
Vegetables	10	1258	1353	1701668	1956918
Total	100	12577		12481478	**14353699**

Since crop water demands varies through out the year with minimum demands in winter months and peak demands occur during summer months, it is recommended to apply leaching requirement during the months of low demands. Such a practice has many advantages in balancing pumping flow rate, effective salt leaching, and preventing the hazardous salts at the peripheral of the wetting front from entering the root zone vicinity. Twenty two percent (22%) of the total leaching requirement should be applied in the month of January, followed by 25% in February, 19% in March, 11% in November, and 23% in December.

The average daily irrigation water requirements for each month are given in Table (14). The irrigation demand during the summer months (June, July and August) accounts for about one third of the yearly crops water demands. Thus, in addition to managing timing of leaching requirement application cropping patterns for the three scenarios were designed to optimize and balance pumping flow rate all over the year. The irrigation demand flow rates vary from a minimum of 1083, 1517, and 2738 m^3/hr to a maximum of 1531, 2149 and 3922 m^3/hr , with an average of 1541, 2158, and 3687 m^3/hr for scenarios I, II, and III, respectively (Table 15).

Table (14): Net Daily Water Requirements for Irrigation (m^3/day)

Scenario	I	II	III
Jan.	12868	18016	28766
Feb.	13122	18371	31144
Mar.	12183	17056	30431
Apr.	12171	17039	29743
May	17073	23902	40541
June	18383	25736	44248
July	17619	24667	43597
Aug.	18495	25893	42673
Sept.	15196	21275	35034
Oct.	10834	15168	26250
Nov.	11432	16005	27377
Dec.	12797	17915	28823
Average	**14348**	**20087**	**34052**

The low daily water requirements in the month of July (17619, 24667 and 43597 m^3), as compared to that in the months of June (18383, 25736 and 44248m^3) for scenarios I, II, and III, respectively, is because grain crops harvested in the month of July and consequently its crop water requirements reduced significantly from 123.0 m^3/dunum in the month of June to 6.1 m^3/dunum in the month of July. Also, alfalfa and grain crops cultivated area reduced from 15% in scenarios I and II to 10% in scenario III (In addition to the 10% vegetable crops introduced in scenario III).

Table (15): Hourly Water Requirements m^3/hour

Month	Scenario I (m^3/hr)	Scenario II (m^3/hr)	Scenario III (m^3/hr)
Jan.	1287(*)	1802	2877
Feb.	1312	1837	3114
Mar.	1218	1706	3043
Apr.	1217	1704	2974
May	1423(**)	1992	3378
June	1532	2145	3687
July	1468	2056	3633
Aug.	1541	2158	3556
Sept.	1266	1773	2920
Oct.	1083	1517	2625
Nov.	1143	1601	2738
Dec.	1280	1792	2882
Average	**1435**	**2009**	**3405**

(*) Numbers in white cells calculated based on 10 hours pumping daily in low water demand months.
(**) Numbers in shaded cells calculated based on 12 hours pumping daily in high water demand months.

11. Recovered Water

Table (16) shows the daily recovered water quantities which should be extracted by the recovery wells and pumped through the irrigation networks. The values presented in Table 16 considered the values of Table (14) multiplied by 1.15 (15% extra) to account for non-farming activities and potential climatic change. Table (17) shows the hourly recovered water in each month.

Table (16): Daily Recovered (m^3/day)

Scenario	I	II	III
Recovered	16500m^3	23100m^3	39160m^3
Jan.	14799	20718	33081
Feb.	15091	21127	35816
Mar.	14010	19614	34995
Apr.	13997	19595	34204
May	19634	27488	46622
June	21140	29596	**50885**
July	20262	28367	50136
Aug.	21269	29777	49073
Sept.	17476	24466	40290
Oct.	12459	17443	30187
Nov.	13147	18406	31484
Dec.	14716	20602	33146
Average	**16500**	**23100**	**39160**

Table (17): Water recovered m^3 per hour

Month	Scenario I (m^3/hr)	Scenario II (m^3/hr)	Scenario III (m^3/hr)
Jan.	1480(*)	2072	3308
Feb.	1509	2113	3582
Mar.	1401	1961	3500
Apr.	1400	1960	3420
May	1636(**)	2291	3885
June	1762	2466	4240
July	1689	2364	4178
Aug.	1772	2481	4089
Sept.	1456	2039	3357
Oct.	1246	1744	3019
Nov.	1315	1841	3148
Dec.	1472	2060	3315
Average	**1650**	**2310**	**3916**

(*) Numbers in white cells calculated based on 10 hours pumping daily in low water demand months.

(**) Numbers in shaded cells calculated based on 12 hours pumping daily in high water demand months.

An alternate recommendation for maintaining the pump operating at its design capacity throughout the year, pumping hours should be adjusted monthly, with maximum 12 hours operating in the month of June (Table 18).

Table (18): Pumping hours for scenarios I, II and III, with the pump operates at its design capacity.

Month	Scenario I with 1623 m^3/hr pumping rate	Scenario II with 2282 m^3/hr pumping rate	Scenario III with 4163 m^3/hr pumping rate
Jan.	10	10	8
Feb.	10	10	8
Mar.	10	10	8
Apr.	10	10	10
May	11	11	11
June	12	12	12
July	11	11	12
Aug.	12	12	12
Sept.	12	12	11
Oct.	9	8	9
Nov.	9	9	8
Dec.	10	10	8
Average	10	10	10

Figures (6), (7) and (8) show the crop water requirements demand pattern (m^3/day) for the three scenarios.

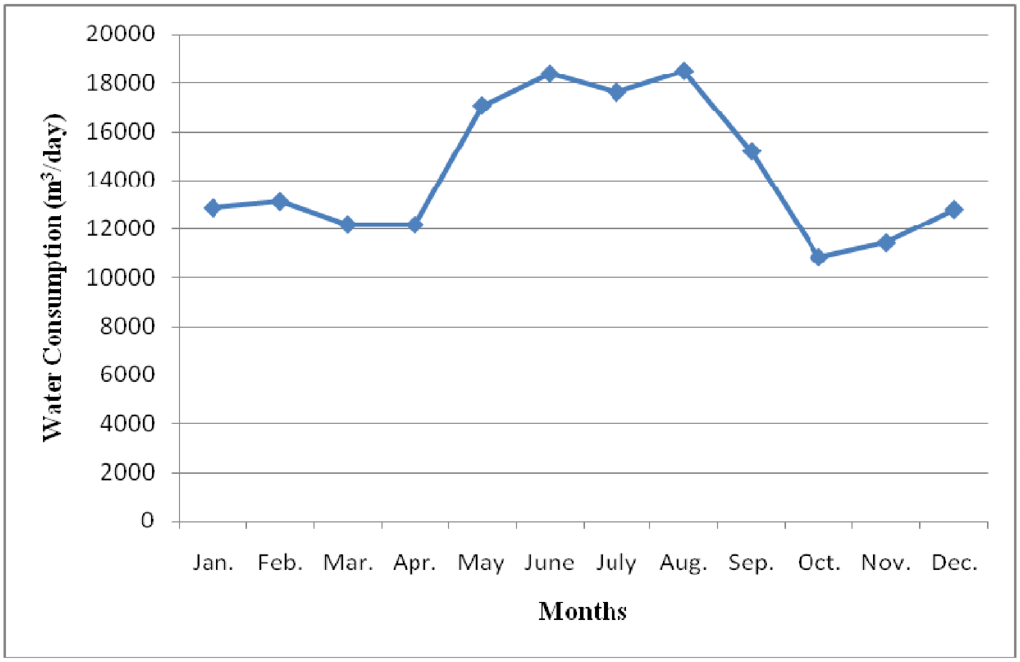


Figure (6): Crop Water Requirements (m^3/day) for Scenario I.

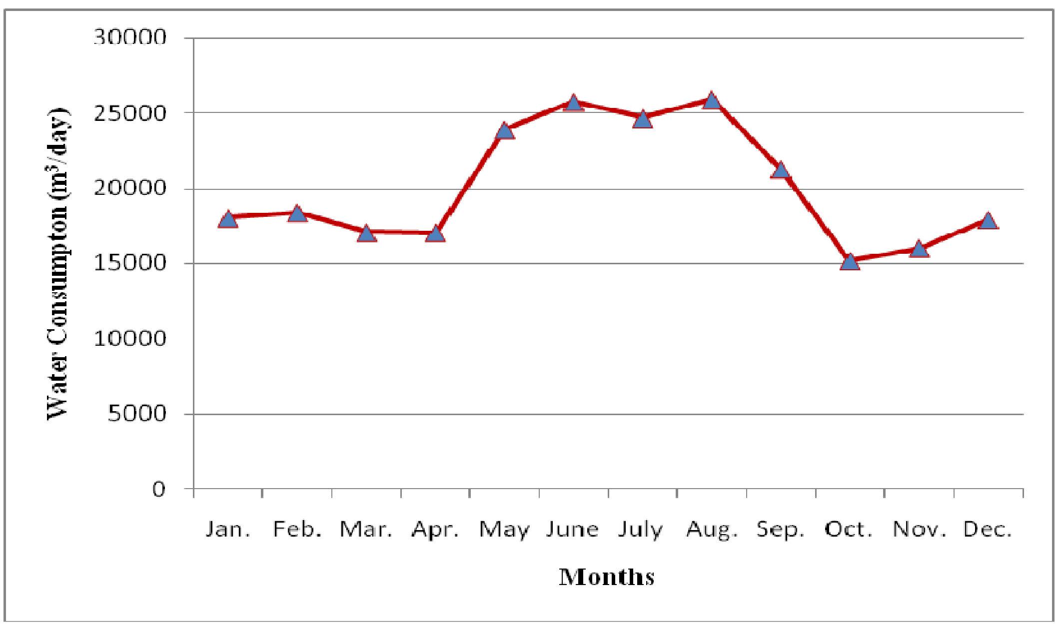


Figure (7): Crop Water Requirements (m^3/day) for Scenario II

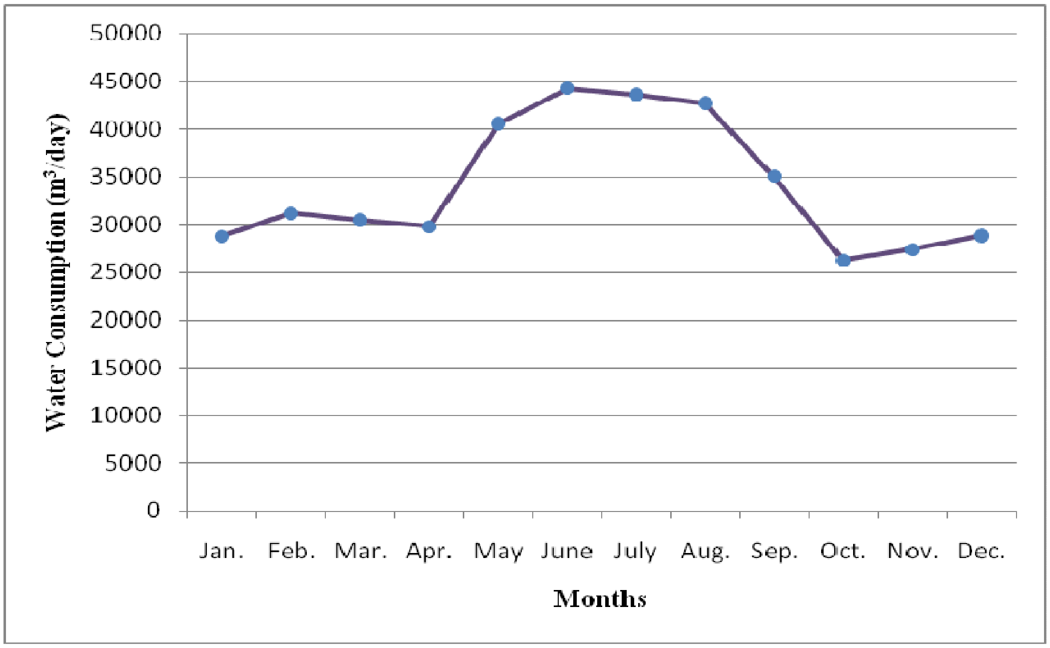


Figure (8): Crop Water Requirements (m^3/day) for Scenario III

12. Irrigation schedule

Based on the calculation of the irrigation scheduling in Annex 3 which considered the field water holding capacity obtained from the soil test results, the total area is divided into 6 equal main plots (A1+A2, B1+B2, C1+C2, D, E, and F) (Figure 9). Table (19) illustrates the area of each plot.

Table (19): Area of plots. (m^2).

Plot	A=A1+A2	B=B1+B2	C=C1+C2	D	E	F
Area (m^2)	2551	2542	2706	2615	2607	2734

Figure (9): Project Area Divided into 6 Main Plots

Two plots can be irrigated in one day such as A1 and A2 at the same time to take into account the farthest plot and the most near plot at the same time so the pumping will be equal in every day for each two sub area (Table 19).

Table (19): Pumping Schedule

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7
Sat	A1+ A2	B1+ B2	C1+ C2	D	E	F	A1+ A2
Sun	B1+ B2	C1+ C2	D	E	F	A1+ A2	B1+ B2
Mon	C1+ C2	D	E	F	A1+ A2	B1+ B2	C1+ C2
Tue	D	E	F	A1+ A2	B1+ B2	C1+ C2	D
Wed	E	F	A1+ A2	B1+ B2	C1+ C2	D	E
Thu	F	A1+ A2	B1+ B2	C1+ C2	D	E	F
Fri	A1+ A2	B1+ B2	C1+ C2	D	E	F	A1+ A2

13. Irrigation methods:

The type of irrigation method selected depends on:

1. Crop type,
2. Soil characteristics,
3. Investment costs of system.
4. Ability of farmers to manage the system.

The common method of irrigation used actually by farmers in the Gaza Strip is surface irrigation which involves complete coverage of soil surface around the tree (small basin) with water. In the recent years using of more efficient irrigation method, like drip irrigation which is relatively expensive, has increased particularly for high price vegetables. The most appropriate efficient methods to be recommended under our conditions are sprinkler and localized irrigation system, which includes bubbler and drippers.

1. ***Sprinkler systems:*** Applying of irrigation water in the form of a spray reaching the soil as rain. There are a variety of sprinkler systems including mini-sprinkler (30-80 l per hr.) which is used actually for irrigation of most citrus, olive and fruit trees. Macro-sprinklers can be used to irrigate cereals, fodder crops and industrial crops. Efficiency ranges from 70 to 80%.
2. ***Localized systems:*** Water is applied more efficiently in the vicinity of the plant root zone, so that only the root zone gets wet and avoiding overlapping problems. These systems have low energy requirements (1-3 bar) but require high quality of irrigation water in order to prevent clogging problems. Thus good filtration (90-120 mesh screen or disc filter) unit is required.
   - 2.1. ***Drip (Trickle) irrigation****:* Applying water (4-8 l per hr.) continuously through drippers to each individual plant at limited rates. Its efficiency is high (up to 90%) and used for high value crops (vegetables and citrus). Drip irrigation requires clean water without any particles or algae on it. Hazard categories include sand grains, precipitation of carbonates and algae.

   - 2.2. ***Bubbler irrigation****:* This system is more recommended as irrigation method for reclaimed water because exit openings are wider than of a dripper and thus less clogging problems. It can be used to irrigate citrus trees under our conditions. The irrigation efficiency is slightly lower than drip irrigation.

3. ***Sub-surface drip irrigation (SDI):*** This system is still not enough evaluated through trials under Gaza conditions.

Appropriate irrigation systems for proposed crops:

- *Citrus and fruit trees:* bubblers, drippers and mini-sprinklers.
- *Fodder and grains:* macro-sprinklers
- *Vegetables and row crops:* In-line drippers

The rate of irrigation can be controlled accurately and nutrients can be also added with irrigation water (fertigation).

Annexes

Annex 1: Crop tolerance and yield potential of selected crops as influenced by irrigation water salinity (ECw) and soil salinity (ECe)
YIELD POTENTIAL2

FIELD CROPS	100%		90%		75%		50%		0% “maximum”3	
	ECe	ECw	ECe	ECw	ECe	ECw	ECe	ECw	ECe	ECw
Barley (Hordeum vulgare)4	8.0	5.3	10	6.7	13	8.7	18	12	28	19
Wheat (Triticum aestivum)4,6	6.0	4.0	7.4	4.9	9.5	6.3	13	8.7	20	13
Cowpea (Vigna unguiculata)	4.9	3.3	5.7	3.8	7.0	4.7	9.1	6.0	13	8.8
Sugarcane	1.7	1.1	3.4	2.3	5.9	4.0	10	6.8	19	12
Corn (maize) (Zea mays)	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10	6.7
Bean (Phaseolus vulgaris)	1.0	0.7	1.5	1.0	2.3	1.5	3.6	2.4	6.3	4.2
VEGETABLE CROPS										
Broccoli	2.8	1.9	3.9	2.6	5.5	3.7	8.2	5.5	14	9.1
Tomato	2.5	1.7	3.5	2.3	5.0	3.4	7.6	5.0	13	8.4
Cucumber (Cucumis sativus)	2.5	1.7	3.3	2.2	4.4	2.9	6.3	4.2	10	6.8
Spinach (Spinacia oleracea)	2.0	1.3	3.3	2.2	5.3	3.5	8.6	5.7	15	10
Cabbage (Brassica oleracea	1.8	1.2	2.8	1.9	4.4	2.9	7.0	4.6	12	8.1
Potato (Solanum tuberosum)	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10	6.7
Corn, sweet (maize) (Zea	1.7	1.1	2.5	1.7	3.8	2.5	5.9	3.9	10	6.7
Sweet potato (Ipomoea batatas)	1.5	1.0	2.4	1.6	3.8	2.5	6.0	4.0	11	7.1
Pepper (Capsicum annuum)	1.5	1.0	2.2	1.5	3.3	2.2	5.1	3.4	8.6	5.8
Lettuce (Lactuca sativa)	1.3	0.9	2.1	1.4	3.2	2.1	5.1	3.4	9.0	6.0
Carrot (Daucus carota)	1.0	0.7	1.7	1.1	2.8	1.9	4.6	3.0	8.1	5.4
Bean (Phaseolus vulgaris)	1.0	0.7	1.5	1.0	2.3	1.5	3.6	2.4	6.3	4.2
Alfalfa (Medicago sativa)	2.0	1.3	3.4	2.2	5.4	3.6	8.8	5.9	16	10
Corn (forage) (maize) (Zea	1.8	1.2	3.2	2.1	5.2	3.5	8.6	5.7	15	10
FRUIT CROPS10										
Date palm	4.0	2.7	6.8	4.5	11	7.3	18	12	32	21
Grapefruit (Citrus paradisi)11	1.8	1.2	2.4	1.6	3.4	2.2	4.9	3.3	8.0	5.4
Orange (Citrus sinensis)	1.7	1.1	2.3	1.6	3.3	2.2	4.8	3.2	8.0	5.3

Peach (Prunus persica)	1.7	1.1	2.2	1.5	2.9	1.9	4.1	2.7	6.5	4.3
Apricot (Prunus armeniaca)11	1.6	1.1	2.0	1.3	2.6	1.8	3.7	2.5	5.8	3.8
Grape (Vitus sp.)11	1.5	1.0	2.5	1.7	4.1	2.7	6.7	4.5	12	7.9
Almond (Prunus dulcis)11	1.5	1.0	2.0	1.4	2.8	1.9	4.1	2.8	6.8	4.5

[1] Adapted from Maas and Hoffman (1977) and Maas (1984).
[2] ECe means average root zone salinity of the saturation extract of the soil, (dS/m) at 25°C. ECw means electrical conductivity of the irrigation water in (dS/m). Source: FAO irrigation and Drainage paper No. 29 (Ayers and Westcott, 1976).
[3] The zero yield potential or maximum ECe indicates the theoretical soil salinity (ECe) atwhich crop growth ceases.
[4] Tolerance evaluation is based on tree growth and not on yield.

Annex 2: Guidelines for interpretation of water quality for irrigation (FAO 1985)

Potential irrigation problem	Units	Degree of restriction on use		
		None	Slight to moderate	Severe
Salinity				
EC_w[1]	dS/m	<0.7	0.7-3.0	>3.0
or				
TDS	mg/l	<450	450-2000	>2000
Infiltration				
SAR[2]=0-3 and EC_w		>0.7	0.7-0.2	<0.2
3 - 6		>1.2	1.2-0.3	<0.3
6 - 12		>1.9	1.9-0.5	<0.5
12 - 20		>2.9	2.9-1.3	<1.3
20 - 40		>5.0	5.0-2.9	<2.9
Specific ion toxicity				
Sodium (Na)				
Surface irrigation	SAR	<3	3-9	>9
Sprinkler irrigation	me/l	<3	>3	
Chloride (CL)				
Surface irrigation	me/l	<4	4-10	>10
Sprinkler irrigation	m^3/l	<3	>3	
Boron (B)	mg/l	<0.7	0.7-3.0	>3.0
Miscellaneous effects				
Nitrogen (NO_3-N)[3]	mg/l	<5	5-30	>30
Bicarbonate (HCO_3)	me/l	<1.5	1.5-8.5	>8.5
pH		Normal range 6.5-8.4		

1 EC_w means electrical conductivity in deciSiemens per metre at 25°C

2 SAR means sodium adsorption ratio

NO_3-N means nitrate nitrogen reported in terms of elemental nitrogen

Annex 3: Computation of Irrigation scheduling

The following calculation is made for Alfalfa. The parameters used for calculation are collected based on the soil investigations carried out by the consultant.

FC = 18 %,

WP = FC / 1.85 = 9.7 %,

Sa = FC – WP

Sa = 18-9.7 = 8.3 %;

Bulk density = 1.4 g/cm^3;

Sa (mm/m) = 8.3 *x* 1.4 *x* 10 = 116.2 mm/m depth

Net depth of irrigation dose (d) (mm) = (Sa × p) D,

Where:

Sa: is the available water in mm/m depth.

p: is the permissible depletion (fraction), and the recommended p values are: 0.40–0.60 = 0.5 for deep rooted field crops and mature trees.

D: is the root depth (m).

Location*	FC % (w/w)	WP = FC/1.85	Available Water = FC-WP	mm water/m Depth	Net Irrig. Depth (50%)	Irrig. Interval
WH 15	6.4	3.5	2.9	40.6	20.3	3 days
WH 14	10.7	5.8	4.9	68.6	34.3	5 days
WH 1	11.7					
WH 2	12.9	7	5.9	82.6	41.3	6 days
WH 3	17.3	9.3	8	112	56	8 days
WH 17	17.5					
WH 5	19.6					
WH 10	18.4	9.9	8.5	119	59.5	8 days
WH 13	22.8					
WH 19	22.4					
WH 7	22.5					
WH 4	23.1					
WH 18	23.8	12.8	11	154	77	11 days
WH 11	23.8					

WH 9	25.1					
WH 12	25.1	13.6	11.5	161	80.5	12 days
WH 6	25.9					
WH 16	31.5	17	14.5	203	101.5	14 day

* The location of testing FC and presented in the soil report

Annex 8

Public Health Concern of Using Treated Wastewater

Public Health Concern of Using Treated Wastewater

Reuse of treated wastewater for agriculture use are very close related to the public health concern, either to the farmers, the consumers, as well as the indirect contact i.e. the family, neighboring area, etc. Although, as mentioned at the groundwater analysis section, the recovered water will not contain bacteria that can affect the public health, as the water will be self-cleansed by the infiltration, however, this annex explain the public health concern of using treated wastewater as well as the parameters has to be taken into consideration for reuse purpose of treated wastewater for agriculture.

The recovered water in this study is considered as a groundwater which already has both wastewater treatment and Self Aquifer Treatment (SAT) which accordingly will have minimum impact on the public concern. As it is confirmed from the groundwater water quality measurement result as well as groundwater modeling, the public health in this regard has less significant impact for reuse purpose. However, public health concern of using treated wastewater, including the standard and guidelines and the epidemiological concern were assessed during the preparation of the SESIA.

The standards and guidelines used in this assessment, beside the Palestinian standard for wastewater reuse for agriculture is mainly Egyptian standard in comparison with Israeli and FAO and WHO standards and guidelines.

1. Parameters of Importance in Agricultural Use of Marginal Quality Water

1.1. Parameters of Health Significance

1.1.1. Microbiological Parameters

Pathogenic organisms give rise to the greatest health concern in agricultural use of marginal quality water. The major source of water contamination with or effective on-site disposal has led to widespread contamination of drainage channels, particularly in those areas where piped water is available through house connections. The situation is especially critical in the area where high population densities, impervious soils and high ground water table make the application of low cost on-site sanitation options difficult.

The major pathways of pathogens are to groundwater, internal or external contamination of crops and translocation to grazing animals. The risk of groundwater contamination by pathogens involves movement of bacteria or viruses to aquifers that are then used for drinking purposes without further treatment.

Concerns with respect to crop-contamination focus mainly on surface contamination and then persistence of pathogens until consumed by man or animals or the internal infection of the plant via the roots. The survival of pathogenic organisms in soil or on crops is highly variable and depends on many factors such as moisture, shade, ambient temperature and the organic content of the immediate environment as summarized in Table 1.

Table 1 Survival of excreted pathogens (at 20-30°C)

Type of pathogen	Survival times in days			
	In feces, night soil and sludge	In fresh water and sewage	In the soil	On crops
Viruses				
Enteroviruses	<100 (<20)	<120 (<50)	<100 (<20)	<60 (<15)*
Bacteria				
Faecal Coliforms	<90 (<50)	<60 (<30)	<70 (<20)	<30 (<15)
Salmonella spp.	<60 (<30)	<60 (<30)	<70 (<20)	<30 (<15)
Shigella spp.	<30 (<10)	<30 (<10)	-	<10 (<5)
Vibrio cholerae	<30 (<5)	<30 (<10)	<20 (<10)	< 5 (<2)
Protozoa	<30 (<15)	<30 (<15)	<20 (<10)	<10 (< 2)
Entamoebahistolytica cysts	<30 (<15)	<30 (<15)	<20 (<10)	<10 (< 2)
Helminths	Many	Many	Many	<60 (<30)
Ascarislunbricoides eggs	Months	Months	Months	

*** Figures in brackets show the usual survival time.**
Source: Feachem et al. (1983)

Under favorable conditions, viruses may survive for several months in soil and perhaps 2 or 3 weeks on crops (WHO, 1989). Pathogenic protozoa are less persistent in the environment where survival beyond 2 weeks is unusual. These organisms are particularly sensitive to elevated temperatures (Feachem et al, 1938). Fecal bacteria generally have limited survival expectancy in water but may persist in most organic rich soils for months. (WHO, 1981)

On crops, the limited availability of water and effects of the ultra violet component of sunlight rapidly reduces the number of viable bacteria. Helminth ova represent probably the most serious problem since their prolonged survival within the environment is well documented. The most persistent are Ascarisova which may survive for a year or more in moist organic environments (Feachem et al, 1978).

It is also known that many viruses and bacteria that are pathogenic to man are more infectious when inhaled than when ingested (WHO, 1989). This led to concern with regard to aerosol transfer of disease where sewage effluents were employed in spray irrigation. Research sponsored by the USEPA which measured the aerosol transfer of viruses and bacteria around an activated sludge wastewater treatment plant, found that the zone of influence is limited to 250 meters in that case. Other research has come up with a distance of 1.2 km (WHO 1973). Nevertheless it is now commonly accepted that spray irrigation with biologically contaminated water should be prohibited in order to minimize the threat of disease transmission by this route .In general, the health impact of pathogens in irrigation water has been ranked in the order of priority shown in Table 2. (Shuval et al. 1986).

Table 2 Relative Health Impact of Pathogenic Agents

High Risk (high incidence of excess infection)	Helminthes (*Ancylostoma*, *Ascaris*, *Trichuris* and *Taenia*)
Medium Risk (low incidence of excess infection)	Enteric Bacteria *(Cholera vibrio, Salmonella typhosa, Shigella* and possibly others)
Low Risk (low incidence of excess infection)	Enteric viruses

The following microbiological parameters are particularly important from the health point of view:

1.1.2. Indicator Organisms

Coliforms and Faecal Coliforms

The Coliform group of bacteria comprises mainly species of the genera *Citrobacter, Enterobacter, Escherichia* and *Klebsiella* and includes Faecal Coliforms, of which *Escherichia coli* is the predominant species. Several of the Coliforms are able to grow outside of the intestine, especially in hot climates; hence their enumeration is unsuitable as a parameter for monitoring wastewater reuse systems. The Faecal Coliform test may also include some non-fecal organisms which can grow at 44°C, so the *E. coli* count is the most satisfactory indicator parameter for marginal quality water use in agriculture.

Faecal Streptococci

This group of organisms includes species mainly associated with animals *(Streptococcus bovis* and *S. equinus),* other species with a wider distribution (e.g. *S.faecalis* and *S. faecium,* which occur both in man and in other animals) as well as two biotypes *(S. faecalis var liquefaciens* and an a typical *S. faecalis* that hydrolyzes starch) which appear to be ubiquitous, occurring in both polluted and non-polluted environments. The enumeration of Faecal Streptococci in effluents is a simple routine procedure but has the following limitations: the possible presence of the non-faecal biotypes as part of the natural micro flora on crops may detract from their utility in assessing the bacterial quality of wastewater irrigated crops; and the poorer survival of Faecal Streptococci at high than at low temperatures. Further studies are still warranted on the use of Faecal Streptococci as an indicator in tropical conditions and especially to compare survival with that of Salmonellae.

Clostridium perfringens

This bacterium is an exclusively faecal spore-forming anaerobe normally used to detect intermittent or previous pollution of water, due to the prolonged survival of its spores. Although this extended survival is usually considered to be a disadvantage for normal purposes, it may prove to be very useful in wastewater reuse studies, as *Clostridium perfringens* may be found to have survival characteristics similar to those of viruses or even helminth eggs.

Pathogens

The following pathogenic parameters can only be considered if suitable laboratory facilities and suitably trained staff are available

a. *Salmonella* spp. Several species of *Salmonellae* may be present in raw sewage from an urban community in a tropical developing country, including *S.typhi* (causative agent for typhoid) and many others. It is estimated (Doran et al. 1977) that a count of 7000 *Salmonellae*/litre is typical in a tropical urban sewage with similar numbers of Shigellae, and perhaps 1000 *Vibrio cholera*/litre.Both Shigellaspp and V. *cholera* are more rapidly killed in the environment, so if removal of *Salmonellae* can be achieved, then the majority of other bacterial pathogens will also have been removed.

b. *Enteroviruses.* May give rise to severe diseases, such as Poliomyelitis and Meningitis, or to a range of minor illnesses such as respiratory infections. Although there is no strong epidemiological evidence for the spread of these diseases via sewage irrigation systems, there is some risk and it is desirable to know to what extent viruses are removed by existing and new treatment processes, especially under tropical conditions. Virus counts can only be undertaken in a dedicated laboratory, as the cell culture techniques required are very susceptible to bacterial and fungal contamination.

c. *Rotaviruses.* These viruses are known to cause gastro-intestinal problems and, though usually present in lower numbers than *enteroviruses* in sewage, they are known to be more persistent, so it is necessary to establish their survival characteristics relative to *enteroviruses* and relative to the indicator organisms in wastewaters. It has been claimed that the removal of viruses in wastewater treatment occurs in parallel with the removal of suspended solids, as most virus particles are solids-associated. Hence, the measurement of suspended solids in treated effluents should be carried out as a matter of routine.

d. *Intestinal Nematodes.*It is known that nematode infections, in particular from the roundworm *Ascaris lumbricoides,* can be spread by effluent reuse practices.

1.1.3. Chemical Pollutants

Until recently, concerns about the quality of water used for irrigation have focused largely on salinity (Environment Council of Alberta, 1982). In addition, concern over the potential impacts of specific variables such as selenium, boron, chloride, and a number of metals and other trace ions (which may originate in irrigation waters) on agricultural crops has resulted in the development of irrigation water guidelines for these elements by the Saskatchewan Water Corporation (1988). The potential health and environmental effects of pesticides, industrial pollutants, and other environmental contaminants in irrigation waters, have not been adequately addressed.

The potential impact of organic contaminants such as pesticides is of obvious immediate concern to the farmers (and the consumers) since the use and re-use of irrigation water containing pesticide residues may adversely affect sensitive crop species. For those contaminants that are persistent and do not degrade (e.g., heavy metals), concentrations causing adverse effects to crops may be reached due to accumulation in the soil environment. Since It is impractical to include chemicals of every body's choice and to establish maximum permissible levels for hundreds of organic chemicals that could sometimes be present in marginal quality water only in minute quantities, the WHO (1995) selected substances that appeared frequently in irrigation water (Table 4A.18). Many of these chemicals are of industrial origin. Since partially treated and untreated wastewater are frequently discharged into agricultural drains they have to be considered in the development of the guidelines.

Table 3 Chemicals Frequently Suggested for Regulations

Inorganic Substance	Organic Compound	
As	Aldrin	Hexachloroethane
Ba	Benzene	Pyrenes
Be	Benzo(a) pytene	Lindane
Cd	Carbon Tetrachloride	Methoxychlor
Cr	Chlorodane	Pentachlorophenol
Cyanide	Chlorobenzene	PCBs
F	Chloroform (THMs)	Tetrachloroethane
Pb	Dichlorodethanes	Tetrachloroethylene
Hg	Dichlorophenols	Toluene
Ni	2,4-D	Toxaphene
Se	Dieldrin	2,4,5-T
Ag	Heptachlor	Trichloroethane
	Hexachlorobenzene	Trichlorophenol

1.1.4. Heavy Metals Fate and Transport

Understanding the distribution of toxic metals in aquatic ecosystems is important to the assessment of environmental and human health risks from irrigation water.

It is important to know whether the trace metals are (i) in solution or adsorbed on solids; (ii) in organo-metallic or hydroxide forms; or (iii) in the crystal structure of suspended materials. Without such precise distribution data, techniques for removing and development of guidelines for these harmful elements cannot be designed effectively.

Particulate matter has been recognized to be the major means of transport of metals through aquatic ecosystems and one of the major pathways of pollutants to biota. It has been indicated that the highest concentrations (mg/kg metal in solid) occur in the colloids and, the lowest in the dissolved solids. The metal content of coarse particles occupies an intermediate position, with the dissolved material having a lower concentration. Except for iron and manganese, the metals are about 2 to 10 time more enriched in the course particles relative to the dissolved solids. The capacity of minerals to hold dissolved metals is different for each type of clay mineral. For example the cation exchange capacity (determined by the number of negatively charged sites on clay mineral surfaces) ranges from a few milli equivalents per hundred grams (me/100g) of mineral for kaolinite clay to more than 100 me/100g for montmorillonite clay. Typical estuaries sediments, which are mixtures of clay, silt and sand minerals, have exchange capacities ranging from 15 to 60 me/100g (Krone, 1963).

The various chemical and biochemical transformations that metals may undergo in the aquatic environment deserve attention. Chemical changes may affect their biological availability or toxicity, which may be either enhanced or reduced. Knowledge of such processes is often essential for the understanding of health effects of these substances, whether physical, chemical or microbial transformations.

It is becoming increasingly apparent that microbial processes may be important and even dominating factors in the distribution of specific metals (Ford et al, 1992). Interactions between microorganisms and metals can be conveniently divided into three distinct processes, all of which may be important with respect to metal distribution in natural waters: a) intracellular interactions, (b) cell surface interactions, and (c) extracellular interactions (Ford et al, 1995).

Probably the most widely recognized microbial interaction with toxic metals in the aquatic environment is the microbial methylation of mercury. Although receiving less attention than mercury, methylation of other toxic metals, with subsequent volatilization, may also occur in the aquatic environment. Methylation has been shown for tin, arsenic, lead, selenium, tellurium, thallium, and antimony (Thayer et al, 1982).

A number of authors have shown that metal binding to cell surfaces is an important factor in the distribution of metals in natural waters (Sigg, 1987 and Xue, 1988). Algal surfaces contain functional groups (e.g. carboxylix, amino, thio, hydroxo, and hydroxy-carboxylix groups) that can interact with metal ions (Xue, et al. 1988).

Extracellular interactions with toxic metals range from the potential to leach metals from sediments by production of acidic metabolites to the formation of colloidal sized extracellular polysaccharide metal complexes implicated in mobilization and transport of toxic metals in soils (Black et al, 1986 and Chammga thus et al, 1988). Indirectly, toxic metals closely associated with iron oxide (Cd and Zn) have been shown to be solubilized by enzymatic reduction of the ferric iron (Francis et al, 1990).

Synergism is a phenomenon in which the combined effects of two agents are greater than that of each taken independently. Two metals mixed in water may have a lethal effect, while either alone would be relatively innocuous. Because of the variety in effluents discharged into receiving water bodies, the potential for synergistic effects is large.

Competition between essential and non-essential metals having similar chemical properties may take place. At low levels of the competing metals, the essential metal will win in the competition for binding sites. However, as levels of the nonessential metals rise, it will begin to interfere with the normal function of the essential metals. Thus, the essential metals have a capacity to protect the cells against low levels of metals contaminants, but at higher levels the protection fails. Interference with the normal function of the essential metal results in a toxic outcome.

Lead and calcium ions are sufficiently similar that some degree of competition occurs. Hexavalent chromium, in the form of the oxy-anion, gains entrance to the cell on the sulfate carrier. Once inside the cell, the chromate oxy-anion undergoes reduction, with the production of highly reactive toxic intermediates believed to be ultimately responsible for the carcinogenic action of hexavalent chromium (Wetterhahn, et al. 1993).

1.1.5. Uptake by Crops

Cadmium
Although Cadmium (Cd) is considered to be a nonessential element for plants, it is effectively absorbed by both root and leaf systems. In most cases a linear relationship between Cd in plant material and growth medium has been reported. Nevertheless several soil and plant factors affect the uptake of Cd.

In nearly all publications on the subject, soil pH is the major influence controlling both total and relative uptake of Cd. Kabata-Pendias (1984) reported results indicating that the relative uptakes of Cd by rice seedlings was the greatest within the pH range of 4.5 to 5.5. However, there are contradictory results which show that when Cd becomes more mobile in alkaline soil due to the formation of complexes or metal chelates, the plant uptake of Cd may be independent of pH. The accumulation of cadmium in Maize is dependent on soil pH. The higher the soil pH, the less cadmium was taken up by the plants (Street et al. 1977). Addition of $CdCl_2$ to elevate soil concentrations to between 20 and 30 ppm resulted in decreased germination and yield of some plants (Kabata-Pendias et al. 1984).

The most important biochemical characteristic of Cd ions is their affinity for sulfhydryl groups of several compounds. In addition, Cd shows an affinity for other side chains of proteins and for phosphate groups.

Dabin et al. (1978) and Braude et al. (1980) has reported that cadmium will most likely be concentrated in the protein fractions of plants.

There are no known enzymes that require Cd for their normal activity. Cadmium has been shown to induce cysteine and methionine synthesis (Roucoux and Dabin 1977). Cadmium has been implicated in the inhibition of the formation of anthocyanin and chlorophyll in plants (Cunningham et al. 1975, and Baszynski et al., 1980). This in turn may lead to the interference with metabolism of micronutrients, inhibition of photosynthesis, disturbance of transpiration and CO2 fixation, and alteration of the permeability of cell membranes.

In general, symptoms induced by elevated Cd content are growth retardation, root damage, chlorosis of leaves, and red-brown coloration of leaf margins or veins. The maximum permissible rate of cadmium addition to soil should depend strongly on the soil pH (Kabata-Pendias and Pendias 1984). USEPA (1979) guidelines regulating cadmium lifetime application rates state that a total of 20 kg of cadmium per hectare can safely be applied to soils with cation exchange capacity of 0.20 mol (+) kg^{-1}.

Crops grown on cadmium contaminated soils may accumulate cadmium in amounts sufficiently large to be of public health concern (Kabata-Pendias and Pendias, 1984). A soil to plant accumulation ratio of 0.15 for the fruit/seed of the crop and 0.55 in the vegetative plant parts has been reported by Baes et al. (1984).

Copper
The literature has reported that there is a relationship between the concentration of the metal measured in the growth medium and in the plant. The copper mobility in the plant tissues strongly depends on the level of copper supply. Copper when absorbed through root systems is transported into the xylem and phloem saps for distribution in the plant (Tiffin, 1972). There appears to be a correlation with concentrations of amino acids. A considerable portion of copper in green tissues appears to be bound to platocyanin and in some protein fractions.

The biochemical functions of copper indicate a potential role in disease resistance. Copper is generally complexes with organic compounds of low molecular weight and with proteins. Copper occurs in the compounds with no known functions as well as in enzymes having vital functions in plant metabolism. Copper plays an important role in photosynthesis, respiration, carbohydrate distribution, nitrogen reduction and fixation, protein metabolism, and cell wall metabolism. Copper influences water permeability of xylem vessels and thus controls water relationships. Copper controls the production of DNA and RNA, and its deficiency greatly inhibits the reproduction of plants.

Finally Copper is involved in the mechanisms of disease resistance (Kabata-Pendias and Pendias, 1984).

Prediction of the copper content of soil that results in toxic effects on plants is difficult. Generally, before phytotoxic symptoms are evident the level of copper accumulation in the palnt will pose a human health risk. Baes et al. (1984) reported a soil to plant accumulation ratio in the fruit/seed of the plant of 0.25 and 0.40 in the vegetative plant parts.

Iron

Iron uptake by plants is metabolically controlled and can be absorbed as Fe^{3+}. Fe^{2+} or as iron chelates. At normal pH levels iron organic complexes apparently play an important role in plant nutrition. Generally roots adsorb Fe^{2+}cation (Kabata-Pendias and Pendias, 1984). In plant tissues iron has been identified as citrates and soluble ferro-dioxine. Iron uptake is generally dependent on soil pH, concentrations of calcium and phosphorus and the ratios of several heavy metals.

The metabolic function of iron is key to energy transformation needed for several cell processes, including: organic iron complexes are involved in the mechanism of photosynthetic electron transfer, non-heme proteins are involved in the reduction of nitrites and sulfates, chlorophyll formation seems to be influenced by iron concentrations, iron is implicated in nucleic acid metabolism, and catalytic and structural roles of iron are also known. Iron occurs in heme and nonheme chloroplasts. A soil to plant absorption factor of 0.001 has been reported for the fruit/seed of the plant and 0.004 for the plant parts by Baes et al. (1984).

High soil concentrations of iron can cause phytotoxic effects when soils are acidic, low in phosphorus, acid sulfate soils, and flooded soils. A 500 ppm soil concentration in a paddy soil solution has been reported to kill rice seedlings.

Lead

Airborne lead is readily taken up by plants through foliage. A number of studies have shown that lead deposited on the leaf surface is absorbed by these cells with a significant translocation into plant tissues (Kabata-Pendias and Pendias, 1984). Lead from soil is not easily translocated into edible portions of plants.

There is no evidence that lead is essential for the growth of any plant species. Some data suggest that some lead salts have a stimulation effect on plant growth while other reports have shown an inhibitory effect (Kabata-Pendiasand Pendias, 1984). Subcellular effects include the inhibition of respiration and photosynthesis due to the disturbance of the electron transfer reactions.

A relatively minor effect on lead concentrations in plants has been reported for the contamination of soil due to agricultural processes. Vegetables grown in areas of high lead concentrations such as urban and industrial areas may present a health risk to humans who consume them (Kabata-Pendias and Pendias, 1984). Baes et al. (1984) reported a soil to plant accumulation ratio in the fruit/seed of the plant of 0.009 and 0.045 in the vegetative plant parts.

Zinc

Soluble forms of zinc are readily available to plants with a linear uptake from both solution and soils. The presence of high calcium to zinc ratios in soil greatly reduces zinc uptake. Although Zn, Zn^{2+} and Zn-organic chelates are the primarily absorbed forms.Kabaa-Pendias and Pendias (1984) reported that only Zn2+ was absorbed by Maize roots. Zinc is generally bound to soluble low molecular weight proteins. Zinc bound to xylem fluids and other tissue extracts may indicate high mobility in the plant. However, some literature regards zinc as highly mobile while other data suggest intermediate mobility. Baese et al. (1984) reported a soil to plant accumulation ratio in the fruit/seed of the plant of 0.90 and 1.50 in the vegetative plant parts.

1.2. Parameters of Agricultural Significance

The quality of irrigation water is of particular importance in arid zones where extremes of temperature and low relative humidity result in high rates of evaporation, with consequent deposition of salt, which tends to accumulate in the soil profile. The physical and mechanical properties of the soil, such as dispersion of particles, stability of aggregates, soil structure and permeability, are very sensitive to the type of exchangeable ions present in irrigation water.

Traditionally, irrigation water is grouped into various quality classes in order to guide the user to the potential advantages as well as problems associated with its use and to achieve optimum crop production. The water quality classifications are only indicative guidelines and their application will have to be adjusted to conditions that prevail in the field. This is so because the conditions of water use in irrigation are very complex and difficult to predict.

The suitability of water for irrigation will greatly depend on the climatic conditions, physical and chemical properties of the soil, the salt tolerance of the crop grown and the management practices. Thus, classification of water for irrigation will always be general in nature and applicable under average use conditions.

Many schemes of classification for irrigation water have been proposed. Ayers and Westcot (FAO, 1985) classified irrigation water into three groups based on salinity, sodicity, toxicity and miscellaneous hazards. These general water quality classification guidelines help to identify potential crop production problems associated with the use of conventional water sources. *The guidelines are equally applicable to evaluate Marginal quality water for irrigation purposes in terms of their chemical constituents, such as dissolved salts, relative sodium content and toxic ions.* Several basic assumptions were used to define the range of values in the guidelines and more detailed information on this is reported by Ayers and Westcot (FAO 1985).

The effect of sodium ions in irrigation water in reducing infiltration rate and soil permeability is dependent on the sodium ion concentration relative to the concentration of calcium and magnesium ions (as indicated by SAR) and the total salt concentration, as shown in the guidelines. This emphasize the fact that soil permeability (including infiltration rate and surface crusting) hazards caused by sodium in irrigation water cannot be predicted independently of the dissolved salt content of the irrigation water or that of the surface layer of the soil.

Many of the ions which are harmless or even beneficial at relatively low concentrations may become toxic to plants at high concentration, either through direct interference with metabolic processes or through indirect effects on other nutrients, which might be rendered inaccessible. They are not normally included in routine analysis of regular irrigation water, but attention should be paid to them when using marginal quality water, particularly if contamination with industrial wastewater discharges is suspected. These include Aluminium (A1), Beryllium (Be), Cobalt (Co), Fluoride (F), Iron (Fe), Lithium

(Li), Manganese (Mn), Molybdenum (Mo), Selenium (Se), Tin (Sn), Titanium (Ti), Tungsten (W) and Vanadium (V). Heavy metals are a special group of trace elements which have been shown to create definite health hazards when taken up by plants. Under this group are included, Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg) and Zinc (Zn).

Morishita (1985) has reported that irrigation with nitrogen-enriched polluted water can supply a considerable excess of nutrient nitrogen to growing rice plants and can result in a significant yield loss of rice through lodging, failure to ripen and increased susceptibility to pests and diseases as a result of over-luxuriant growth. He further reported that non-polluted soil, having around 0.4 and 0.5 ppm cadmium, may produce about 0.08 ppm Cd in brown rice, while only a little increase up to 0.82, 1.25 or 2.1 ppm of soil Cd has the potential to produce heavily polluted brown rice with 1.0 ppm Cd. Table 4A.19 presents phytotoxic threshold levels of some selected trace elements.

Table 4 Guidelines for Interpretation of Water Quality for Irrigation

Potential irrigation problem		Units	Degree of restriction on use		
			None	Slight to moderate	Severe
Salinity					
Ec_w[1]		dS/m	< 0.7	0.7 - 3.0	> 3.0
or					
TDS		mg/l	< 450	450 - 2000	> 2000
Infiltration					
SAR[2] = 0 - 3 and EC_w			> 0.7	0.7 - 0.2	> 0.2
	3 -6		> 1.2	1.2 - 0.3	>0.3
	6-12		> 1.9	1.9 - 0.5	> 0.5
	12-20		> 2.9	2.9 - 1.3	> 1.3
	20-40		> 5.0	5.0 - 2.9	> 2.9
Specific ion toxicity					
Sodium (Na)					
	Surface irrigation	SAR	< 3	3 - 9	> 9
	Sprinkler irrigation	me/I	< 3	> 3	
Chloride (Cl)					
	Surface irrigation	me/I	< 4	4 - 10	> 10
	Sprinkler irrigation	me/l	< 3	> 3	
Boron (B)		mg/l	< 0.7	0.7 - 3.0	> 3.0
Trace Elements					
Miscellaneous effects					
Nitrogen (NO_3-N)[3]		mg/l	< 5	5 - 30	> 30
Bicarbonate (HCO_3)		me/I	< 1.5	1.5 - 8.5	> 8.5
pH		Normal range 6.5-8			

Source: FAO (1985).

[1]*EC_w means electrical conductivity in deci-Siemens per metre at 25°C*
[2] *SAR means sodium adsorption ratio*
[3] *NO_3-N means nitrate nitrogen reported in terms of elemental nitrogen*

Table 5 Threshold Levels of Trace Elements for Crop Production

	Element	Recommended maximum concentration (mg/l)	Remarks
Al	(aluminium)	5.0	Can cause non-productivity in acid soils (pH < 5.5), but more alkaline soils at pH > 7.0 will precipitate the ion and eliminate any toxicity.
As	(arsenic)	0.10	Toxicity to plants varies widely, ranging from 12 mg/l for Sudan grass to less than 0.05 mg/l for rice.
Be	(beryllium)	0.10	Toxicity to plants varies widely, ranging from 5 mg/l for kale to 0.5 mg/l for bush beans.
Cd	(cadmium)	0.01	Toxic to beans, beets and turnips at concentrations as low as 0.1 mg/l in nutrient solutions. Conservative limits recommended due to its potential for accumulation in plants and soils to concentrations that may be harmful to humans.
Co	(cobalt)	0.05	Toxic to tomato plants at 0.1 mg/l in nutrient solution. Tends to be inactivated by neutral and alkaline soils.
Cr	(chromium)	0.10	Not generally recognized as an essential growth element. Conservative limits recommended due to lack of knowledge on its toxicity to plants.
Cu	(copper)	0.20	Toxic to a number of plants at 0.1 to 1.0 mg/l in nutrient solutions.
F	(fluoride)	1.0	Inactivated by neutral and alkaline soils.
Fe	(iron)	5.0	Not toxic to plants in aerated soils, but can contribute to soil acidification and loss of availability of essential phosphorus and molybdenum. Overhead sprinkling may result in unsightly deposits on plants, equipment and buildings.
Li	(lithium)	2.5	Tolerated by most crops up to 5 mg/l; mobile in soil. Toxic to citrus at low concentrations (<0.075 mg/l). Acts similarly to boron.
Mn	(manganese)	0.20	Toxic to a number of crops at few-tenths to a few mg/l, but usually only in acid soils.
Mo	(molybdenum)	0.01	Not toxic to plants at normal concentrations in soil and water. Can be toxic to livestock if forage is grown in soils with high concentrations of available molybdenum.
Ni	(nickel)	0.20	Toxic to a number of plants at 0.5 mg/l to 1.0 mg/l; reduced toxicity at neutral or alkaline pH.
Pd	(lead)	5.0	Can inhibit plant cell growth at very high concentrations.
Se	(selenium)	0.02	Toxic to plants at concentrations as low as 0.025 mg/l and toxic to livestock if forage is grown in soils with relatively high levels of added selenium. As essential element to animals but in very low concentrations.

	Element	Recommended maximum concentration (mg/l)	Remarks
Sn	(tin)		
Ti	(titanium)	-	Effectively excluded by plants; specific tolerance unknown.
W	(tungsten)		
C	(vanadium)	0.10	Toxic to many plants at relatively low concentrations.
Zn	(zinc)	2.0	Toxic to many plants at widely varying concentrations; reduced toxicity at pH > 6.0 and in fine textured or organic soils.

Source: Adopted from National Academy of Sciences (1972) and Pratt (1972)

The maximum concentration is based on a water application rate which is consistent with good irrigation practices (10 000 m^3 per hectare per year). If the water application rate greatly exceeds this, the maximum concentrations should be adjusted downward accordingly. No adjustment should be made for application rates less than 10 000 m^3 per hectare per year. The values given are for water used on a continuous basis at one site. (Source : Adopted from National Academy of Sciences (1972) and Pratt (1972))

2. Evaluation of National and International Irrigation Water Quality regulations and Guidelines

2.1. Chemical Guidelines

Based on the analysis of available guidelines, it was determined that two general approaches have been used to establish human health-related chemical limits for land application of marginal quality water. The two approaches are (NAWQAM, 2004):

First Approach: Preventing Pollutant Accumulation in Soil.

This approach equates pollutant input to pollutant output. Conceptually, no net accumulation of pollutants is permitted in the receiving soil; therefore, numerical limits are set to prevent the pollutant concentration of the soil from rising during the course of land application, which maintains the soil's original ecological and chemical integrity. When these requirements are met, the sustainability of the soil to maintain any future land uses is guaranteed, and the transfer of pollutants up the food chain is kept to a minimum. Implementation of this approach requires enforcement of the following measures:

(i) Pre-treatment of industrial wastewater to prevent pollutants from entering the wastewater collection and treatment system, then receiving water bodies.

(ii) Requiring municipal wastewater to undergo complete treatment to remove pollutants prior to discharge into agricultural drains.

(iii) Setting very stringent pollutant loading limits for soils.

An advantage of using this approach to develop regulations is that detailed knowledge of exposure pathways and the dose-response relationships are not needed. The numerical limits for pollutants may be calculated by simple mass balances by matching pollutant input from irrigation water with pollutant outputs and the results tend to be universally applicable. The net cost of mitigation measures and disposal, however, will be high because more advanced technologies must be employed in treating point sources of pollution prior to discharge into agricultural drains, or a large land area is required to accommodate the treatment of irrigation water.

Second Approach: Taking Maximum advantage of the Soil's Capacity to assimilate, and Detoxify Pollutants

The primary principle underlying the second approach in setting numerical limits is that the capacity of soil to attenuate pollutants should be utilized fully. Guidelines based on this approach set the maximum permissible pollutants loading and provide users the flexibility to develop suitable management practices for using marginal quality water. Under this scenario, pollutants concentrations in the soil, however, will rise eventually to levels considerably higher than the background levels, and future land uses may be restricted if accumulation of pollutants in soil is not managed.

The most comprehensive method of deriving the numerical limits for pollutant input is to establish first the acceptable daily human intake (ADI) for a particular pollutant and then quantitatively back track the pollutant transport through various environmental exposure routes and arrive at an acceptable pollutant concentration for the receiving soil. It has been determined that at least seven exposure pathways are involved, and each pathway requires a mathematical model. More importantly, each exposure pathway requires an exposure scenario to define the model parameters and to select input data for the computation. As globally representative exposure scenarios are almost impossible to define, this method has little practical utility.

According to WHO (1995), the pollutants concentrations in soil is a more suitable global reference point than the pollutant mass loading rate for assessing potential negative impacts of pollutants in soil, primarily because crop uptake of pollutants is a function of pollutant concentration in soil and because soil properties and environmental conditions are variable around the world. The same pollutant mass loading to soils with different background concentrations may result in different soil pollutant concentrations. After a detailed study, the WHO recommended the numerical values given in Table (6).

These guidelines, for maximum pollutant concentration in soils have been computed based on:

(i) acceptable daily dietary intake (ADI) of pollutants obtained from the literature,

(ii) an assumed global diet

(iii) pollutant exposure derived mainly from the consumption of those food groups that make up the major portion of the global diet (grain, vegetable, root/tuber, and fruit), and (iv) a limit on daily intake of pollutants from consumption of those food groups to 50% of the ADI.

It is worth mentioning that the maximum permissible concentrations of potentially toxic elements vary according to the pH of the soil. The department of the environment (1989) recommended the values presented in Table (7).

Table 6 Maximum Allowable Concentrations in Soil (mg/kg DW)

Inorganic Elements			
Constituent	**WHO Standards***	**DWIP**	**Canadian. 1999****
Arsenic	9		12
Barium	2900		750
Beryllium	20		
Cadmium	7	3	1.4
Chromium	3200		64
Fluorine	2600		
Lead	150	150	70
Mercury	5		6.6
Nickel	850		50
Selenium	140		
Silver	3		
Copper		140	63
Zinc		300	200
Vanadium			130
Organic Compounds			
Atrazine		2.9	
Aldrin	0.2		
Benzene	0.03		0.05
Benzo (a) pyrene	3		0.1
Chlorodane	0.3		
Chlorobenzene	ND		
Chloroform	2		
Dichlorophenols	ND		
2,4-D	10		
DDT (total)	ND		0.7
Dieldrin	0.03		
Hexachlorobenzene	40		
Hexachloroethane	2		
Pyrene	480		
Lindane	0.6		
Methoxychlor	20		
Pentachlorophenol	320		7.6
PCBs	30		0.5
Tetrachloroethane	4		
Tetrachloroethylene	250		0.1
Toluene	50		0.1
Toxapjene	9		
2,4,5-T***	ND		
2,3,7.8 TCDD ****	30		
Trichloroethylene			0.1
Ethy/benzene			0.1
Ethylene glycol			960
Phenol			3.8

*** 1995 ** 1999 *** Trichloro phenoxy acetic acid **** Tetrachloro-dibenzo-dioxine**

Table 7 Maximum Permissible Concentrations of Potentially Toxic Elements (PTE) in Soil After Application of Sewage Sludge and Maximum Annual Rates of PTE Addition over a 10 year period (kg/ha)[3]

Potentially toxic element (PTE)	Maximum permissible concentration of PTE in soil (mg/kg dry solids)				Maximum permissible average annual rate of PTE addition over a 10 year period (kg/ha)[3]
	pH				
	5.0 <5.5[1]	5.5<6.0	6.0-7.0	> 7.0[2]	
Zinc	200	250	300	450	15
Copper	80	100	135	200	7.5
Nickel	50	60	75	110	3
Cadmium	3[5]				0.15
Lead	300				15
Mercury	1				0.1
Chromium	400 (prov.)				15 (provisional)
*Molybdenum[4]	4				0.2
*Selenium	3				0.15
*Arsenic	50				0.7
*Fluoride	500				20

Source: Department of the Environment – Egypt (1989)

** These parameters are not subject to the provisions of Directive 86/278/EEC.*
[1] *For soils of pH in the ranges of 5.0 < 5.5 and 5.5 < 6.0 the permitted concentrations of zinc, copper, nickel and cadmium are provisional and will be reviewed when current research into their effects on certain crops and livestock is completed.*
[2] *The increased permissible PTE concentrations in soils of pH greater than 7.0 apply only to soils containing more than 5 % calcium carbonate.*
[3] *The annual rate of application of PTE shall be determined by averaging over the 10-year period ending with the year of calculation.*
[4] *The accepted safe level of molybdenum in agricultural soils is 4 mg/kg. However, there are some areas in the UK where, for geological reasons, the natural concentration of this element in the soil exceeds this level. In such cases there may be no additional problems as a result of applying sludge, but this should not be done except in accordance with expert advice. This advice will take account of existing soil molybdenum levels and current arrangements to provide copper supplements to livestock.*
[5] *For pH 5.0 and above*

The European Union (1999) adopted the values presented in Table 8 for soils and those presented in Table (9) for annual heavy metals loads which may be added to the soil. Most European countries have adopted values which are comparable to the EU limits or even stricter (Tables 10 & 11).

Table 8 Limit values for concentrations of heavy metals in soil (mg/kg dm)

Elements	**EU 86/278 6<pH<7**	**5<pH<6**	**6<pH<7**	**PH>7**
Cd	1-3	0.5	1	1.5
Cu	50 – 140	20	50	100
Hg	1 – 1.5	0.1	0.5	1
Ni	30 – 75	15	50	70
Pb	50 – 300	70	70	100
Zn	150 - 300	60	150	200

Source EU (1999)

Table 9 Limit values for amounts of heavy metals which may be added annually to soil, based on a ten year average

Elements				
	Directive 86/278/EEC	**Until 31/12/2005**	**From 1/1/2005 until 31/12/2010**	**From 1/1/2010**
Cd	150	50	25	10
Cu	12000	5000	2500	1000
Hg	100	50	10	5
Ni	3000	1500	500	300
Pb	15000	10000	5000	1500
Zn	30000	15000	5000	3000

Source: European Union (1999)

Table 10 Limit values for concentrations of heavy metals in soil in EU Directive and some European countries (mg/kg DW)

Elements	**EU Directive 86/278**	**Greece**	**UK**	**Germany**	**Finland**	**Belgium**	**France**	**Italy**	**Sweden**	**The Netherlands**
Cadmium (Cd)	1-3	1-3	3	1-1.5	0.5	1-3	2	1.5	0.4	0.8
Chromium (Cr)	-	-	400	100	200	100-150	150	-	30	100
Copper (Cu)	50-140	50-140	80-200	60	100	50-140	100	100	40	36
Mercury (Hg)	1-1.5	1-1.5	1-1.5	1	0.2	1-1.5	1	1	0.3	35
Nickel (Ni)	30-75	30-75	50-100	50	30	30-70	50	75	75	0.3
Lead (Pb)	50-300	50-300	300	100	60	50-100	100	100	40	85
Zinc (Zn)	150-300	150-300	200-450	150-200	150	150-300	300	300	75	140
Arsenic (As)	-	-	50	-	-	-	-	-	-	29
Fluorine (F)	-	-	500	-	-	-	-	-	-	-
Molybdenum (Mo)	-	-	4	-	-	-	-	-	-	-
Selinium (Se)	-	-	4	-	-	-	-	-	-	-

Source: IAWQ (1996)

DW "Dry weight "

Table 11 Limit values for annual loads of heavy metals in EU Directive and some European countries (kg/ha/y)

Element	**EU Directive 86/278**	**Greece**	**UK**	**Germany**	**France**	**Austria**
Cadmium (Cd)	0.15	0.15	0.15	0.016	0.06	0.025
Chromium (Cr)	-	-	15	1.5	3	1.25
Copper (Cu)	12	12	7.5	1.3	3	1.25
Mercury (Hg)	0.1	0.1	0.1	0.013	0.03	0.025
Nickel (Ni)	3	3	3	3	0.6	0.25
Lead (Pb)	15	15	15	1.5	2.4	1.25
Zinc (Zn)	30	30	15	2.5	9	5
Arsenic (As)	-	-	0.7	-	-	0.05
Fluorine (F)	-	-	20	-	-	-
Cobalt (Co)	-	-	-	-	-	0.25
Molybdenum (Mo)	-	-	0.2	-	-	0.05
Selinium (Se)	-	-	0.15	-	0.3	-

Source: IAWQ (1996)

2.2. Irrigation Water

Table (12) summarizes the numerical limits of the guidelines developed by several nations for irrigation water. It should however be mentioned that most of these criteria were developed specifically for wastewater irrigation, (Taiwan, Hungary, People's Republic of China, Saudi Arabia, Tunisia and Egypt).

As can be seen, the numerical limits in many parameters are identical, but in other cases they varied by one to two order of magnitude.

Table 12 National and International Guidelines for Irrigation Water Quality

Parameter	Unit	Canada	USA	Taiwan	Hungary	Peoples Republic of China			Saudi Arabia	Tunisia	FAO	DWIP	Egypt	Egypt Decree
		All Soils 1999	Sandy Soils 1973	All Soils 1978	All Soils 1991	Rice Paddy Undated	Dry land Undated	Vegetable Undated	All Soils Undated	All Soils Undated	1992	1997	Law 48/1982 Article "65"	No.44/2000
pH				6.0-9.0	6.5-8.5	5.5-8.5	5.5-8.5	5.5-8.5	6-8.4	6.5-8.5			7-8.5	
TDS	mg/L	500-3500				1000-2000	1000-2000	1000-2000						2000
E.C.	umho/cm 25 °C			750						700				
S. S	mg/L			100		150	200	100	10	30				20
Chloride	mg/L	100-700[a]		175		250		250	280	2000				300
Sulfate	mg/l			200										
T. K. N	mg/l			1		12	30	30						
BOD	mg/l					80	150	80	10				10	20
COD	mg/l					200	300	150		90			6	40
Temperature	°C			35		35	35	35						
Al	mg/l	5	5	5	5				5		5			
As	mg/l	0.1	0.1	1	0.2	0.05	0.1	0.05	0.1	0.1	0.1		0.05	0.1
Ba	mg/l				4									
Be	mg/l	0.1	0.1	0.5	0.1				0.1					
B	mg/l	0.5-6.0[b]	0.75	0.75	0.7	10.0 - 30.0	7.0 - 3.0	1.0 - 3.0	0.5	3				3
Cd	mg/l	0.005	0.01	0.01	0.02	0.005	0.005	0.005	0.01	0.01	0.01	0.01	0.01	0.01

Parameter	Unit	Canada	USA	Taiwan	Hungary	Peoples Republic of China			Saudi Arabia	Tunisia	FAO	DWIP	Egypt	Egypt Decree
		All Soils	Sandy Soils	All Soils	All Soils	Rice Paddy	Dry land	Vegetable	All Soils	All Soils	1992	1997	Law 48/1982	No.44/2000
		1999	1973	1978	1991	Undated	Undated	Undated	Undated	Undated			Article "65"	
Cr (Total)	mg/l	0.01	0.1	0.1	5	0.1	0.1	0.1	0.1	0.1	0.1		0.01	0.1
Co	mg/l	0.05	0.05	0.05	0.05				0.05	0.1	0.05		1	0.05
Cu	mg/l	0.2-1.0	0.2	0.2	2	1	1	1	0.4	0.5	0.2	1		0.2
F (Total)	mg/l	1			1	2.0-3.0	2.0 - 3.0	2.0 - 3.0	2	3	1		0.5	
Fe	mg/l	5			0.1				5	5	5	5	1	5
Pb	mg/l	0.2	5	0.1	1	0.1	0.1	0.1	0.1	1		5		5
Li	mg/l	2.5	2.5	2.5	2.5				0.07		2.5			
Mn	mg/l	0.2	0.2	2	5				0.2	0.5	0.2		1.5	0.2
Hg	mg/l			0.005	0.01	0.001	0.001	0.001	0.001	0.001				
Mo	mg/l	0.01 - 0.05[c]	1.01	0.01					0.1		0.01			0.01
Ni	mg/l	0.2	0.2	0.5	1				0.02	0.2	0.2			0.2
Se	mg/l	0.02-0.05[d]	0.02	0.02		0.02	0.02	0.02	0.02	0.05	0.02			
Ag	mg/l				0.1									
V	mg/l	0.1	0.1	10	5						0.1			
Zn	mg/	1.0 - 5.0[e]	2	2	5	2	2	2	4	5	2	1	1	2
CN(Total)	mg/l				10	0.5	0.5	0.5	0.05				0.1	
Surfact (ABS)	mg/l			5	50	5	3	5					0.5	

Parameter	Unit	Canada	USA	Taiwan	Hungary	Peoples Republic of China			Saudi Arabia	Tunisia	FAO	DWIP	Egypt	Egypt Decree
		All Soils	**Sandy Soils**	**All Soils**	**All Soils**	**Rice Paddy**	**Dry land**	**Vegetable**	**All Soils**	**All Soils**	**1992**	1997	**Law 48/1982**	**No.44/2000**
		1999	**1973**	**1978**	**1991**	**Undated**	**Undated**	**Undated**	**Undated**	**Undated**			**Article "65"**	
Oil and Grease	mg/l			5	8								1	5
Benzene	mg/l				2.5	2.5	2.5	2.5						
Tar	mg/l				30									
Petroleum	mg/l				0.5	1	0.5	0.5						
Methanol	mg/l				0.1									
Trichloroacetylaldehyde	mg/l					1	0.5	0.5						
Propionaldehyde	mg/l					0.5	0.5	0.5						
Phenol	mg/l								2				0.02	
Atrazine	mg/l	0.01												
Hydrocarbons													1.5	
Coliforms fecal	cfu/100	100/100												
Coliform total	cfu/100	1000/100												

(a) Chloride guideline = 100-175 mg/l for almond apricots and plums
= 178-355 mg/l for grapes, peppers, potatoes and tomatoes
= 355-710 mg/l for alfalfa, barley, corn and cucumbers
> 710 mg/l for cotton, sorghum, sugar beets and sunflowers
= 180-600 mg/l for stone fruit (peaches, plums, etc.)
= 710-900 mg/l for grapes

(b) Boron guidelines = 0.5 mg/l for blackberries
= 0.5 – 1.0 mg/l for grapes, onions, garlic, sweet potatoes, sunflowers wheat, barely
= 1.0 – 2.0 mg/l for red peppers, potatoes, cucumbers
= 2.0 – 4.0 mg/l for lettuce, cabbage,
= 4.0 – 6.0 mg/l for sugar beets
= 6.0 mg/l for asparagus

(c)Molybdenum guideline= 0.05 mg/l for short-term use on acidic soils

(d) Selenium guideline = 0.02 mg/l for continuous use
= 0.05 mg/l for intermittent use

(e) Zinc guideline = 1.0 mg/l when soil pH < 6.5
= 5.0 mg/l when soil pH > 6.5

2.3. Microbiological quality guidelines for health protection

Following several meetings of environmental specialists and epidemiologists, a WHO Scientific Group on Health Aspects of Use of Treated Wastewater for Agriculture and Aquaculture arrived at the microbiological quality guidelines for wastewater use in agriculture shown in Table (13). These guidelines were based on the consensus view that the actual risk associated with irrigation with treated wastewater is much lower than previously thought and that earlier standards and guidelines for effluent quality, such as the WHO (1973) recommended standards, were unjustifiably restrictive, particularly in respect of bacterial pathogens (NAWQAM, 2004).

The new WHO guidelines (1989) are stricter than previous standards with respect to the requirement to reduce the numbers of helminthes eggs (Ascaris and Trichuris species and hookworms) in effluents for Category A and B conditions to a level of not more than one per litter. Also implied by the guidelines is the expectation that protozoa cysts will be reduced to the same level as helminthes eggs. Although no bacterial pathogen limit is imposed for Category C conditions where farm workers are the only exposed people, on the premise that there is little or no evidence indicating a risk to such workers from bacteria, some degree of reduction in bacterial concentration is recommended for irrigation water.

The WHO Scientific Group considered that the new approach to effluent quality would increase public health protection for the large numbers of people who were subjected to infection in areas where crops eaten uncooked are being irrigated in an unregulated and often illegal manner with raw wastewater. It was felt that the recommended guidelines, if adopted, would achieve an improvement and set targets which are both technologically and economically feasible. However, the need to interpret the guidelines carefully and modify them in the light of local epidemiological, socio-cultural and environmental factors was also pointed out.

Recent evidence of enteric infections in farming families in direct contact with irrigation water containing more than 106 FC /100 ml, suggests that a fecal coliform guideline should now be added for restricted irrigation (Ursula et al., 2000). A guideline level of 103 FC/100 ml has been recommended where adults are involved in flood/furrow irrigation and children are regularly exposed (through farm work or play).

The nematode egg guideline of £1 egg per liter is adequate if no children are exposed, but a revised guideline of ≤0.1 egg per liter is recommended if children are in contact with the wastewater through irrigation or play.

Table 13 Recommended Microbiological Quality Guidelines for Drainage Water Use in Agriculture [(a)]

Category	Irrigation Conditions	Exposed Group	Intestinal nematodes[(b)]	Fecal coliforms	
		Workers	(arithmatic mean no	(geometric mean	
	Irrigation of crops likely to be eaten uncooked, sports fields, public parks	consumers,	of eggs per liter [(c)]	per 100 ml)	
A		public	≤ 1	≤ 1000 [(d)]	
	Irrigation of cereal crops,	Workers	≤ 1	No standard recommended	
B	industrial crops, fodder crops				
	and pasture and trees (e)				
	Localized irrigation of crops	None	Not applicable	Not applicable	
C	in category B if exposure of				
	workers and the public does not occur				

[a] *In specific cases, local epidemiological, socio-cultural and environmental factors should be taken into account, and the guidelines modified accordingly.*

[b] *Ascaris and Trichuris species and hookworms.*

[c] *During the irrigation period.*

[d] *A more stringent guideline (<200 faecal coliforms per 100 ml) is appropriate for public lawns, such as hotel lawns, with which the public may come into direct contact.*

[e] *In the case of fruit trees, irrigation should cease two weeks before fruit is picked, and no fruit should be picked off the ground. Sprinkler irrigation should not be used.*

Source: WHO (1989)

3. Recommended Health Protection Measures

Health protection measures which can be applied in agricultural use of drainage water include the following, either singly or in combination (NAWQAM, 2004):

- Crop restriction
- Human exposure control and promotion of hygiene
- Treatment of drainage water. Although the drainage water is not within the scope of work of this ESIA, however, the general protection measures is included for reference.

3.1. 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 of the public. Crops can be categorized according to the exposed group and the degree to which health protection measures are required, as follows:

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 belonging to 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:

- an irrigation project has a strong central management;
- there is adequate demand for the crops allowed under crop restriction, and they fetch a reasonable price;
- there is little market pressure in favour 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.

3.2. Human exposure control

The objective of this approach is to prevent the population groups at risk from coming into direct contact with pathogens in the wastewater or to prevent any contact with the pathogens leading to disease. Four groups are at risk in agricultural use of marginal quality water (NAWQAM, 2004):

- agricultural workers and their families
- crop handlers
- consumers of crops, meat and milk
- those living near the areas irrigated with marginal quality water

Different methods of exposure control might be applied for each group.

Control measures aimed at protecting agricultural field workers and crop handlers include the provision (and insistence on the wearing) of protective clothing, the maintenance of high levels of hygiene and immunization against (or chemotherapeutic control) selected infections. Risks to consumers can be reduced through cooking the agricultural products before consumption and by high standards of food hygiene, which should be emphasized in the health education associated with irrigation schemes.

Local residents should be kept fully informed on the use of drainage water in agriculture so that they, and their children, can avoid these areas.

Special care must always be taken to ensure that agricultural workers or the public do not use irrigation water for drinking or domestic purposes by accident or for lack of an alternative.

3.3. Treatment of Drainage Water

This can be carried out using oxidation ponds at a hydraulic retention time of 8-10 days or wetlands, provided land is available at the project area at a reasonable cost.

3.4. Institutional Framework

The incorporation of the use of drainage water into national water resources and agricultural planning is important, to obtain the maximum agricultural and aqua cultural benefits from the nutrients which wastewater contains. However, to safeguard public health and the environment and to ensure long-term sustainability, sufficient attention must be given to the social, institutional and organizational aspects of drainage water use in agriculture and aquaculture.

Since the use of drainage water touches on the responsibilities of several ministries and government agencies, the active involvement of the ministries of health, agriculture and public works (or their equivalents) is essential at the national level, if the potential benefits are to be achieved without endangering health and the environment. The responsibilities of this Committee should cover the following:

- developing a coherent national policy for drainage water use and monitoring the environmental and health impact of its implementation;

- defining the division of responsibilities between the respective ministries and agencies involved and the arrangements for collaboration between them;
- The responsible agency will generally deal with farmers through users associations, to which will be delegated the task of enforcing regulations. The agency will also have the important task of providing services to the users, including advice on and assistance with farm machinery, the supply of materials and equipment, agricultural credit, agricultural advisory services and training, marketing services and primary health care.

In general, the sustainability of this project will depend to a large extent on the administrative skills, responsibility and financial resources applied.

4. Development of a Monitoring Program

4.1. Objectives

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 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

4.2. Parameters to be measured

Irrigation Water

All parameters presented in Table 14 should be measured twice a year, during the minimum and maximum flows in February & August respectively

Soil

The following parameters should be measured in the soil once a year:

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

Crops

The following parameters should be measured in crops at the harvesting period:

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

The collected data has to be stored in a data-base for further analysis, interpretation and development of information packages for the different stakeholders.

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Annex 9
Social Assessment Methodology
Socio Economic Baseline Assessment
Willingness Survey Results
Cost Analysis and Tariff Surveys Results

Social Impact Assessment Methodology

Social Impact Assessment Methodology

This section will highlight the different objectives of the ESIA study, due to the fact that this is not a customary Social Impact Assessment study as it has more than one component that might need to be addressed using different tools that are not likely to fall under standard ESIA procedures i.e. measuring the willingness to pay for the water and sludge.

1. Study objectives

The interventions of the Effluent Recovery, Irrigation Scheme and Remediation Works Project were not previously identified during the preparation of the original ESIA for the NGEST project, therefore; the justification for the Supplementary Environmental and Social Assessment (ESIA) is clear as the environmental and social benefits/impacts were not addressed in the original ESIA. The objective of the study in the following statement: "The supplementary Environmental and Social Impact Assessment (ESIA) is in anticipation of restructuring the project to include expanded effluent recovery and reuse and to assess the impacts of the specific plans for remediation of the land formerly covered by the Beit Lahia effluent lake." The study team identified five specific objectives for the ESIA, which we understand to be the following:

The objective of the study in the following statement: "The supplementary Environmental and Social Impact Assessment (ESIA) is in anticipation of restructuring the project to include expanded effluent recovery and reuse and to assess the impacts of the specific plans for remediation of the land formerly covered by the Beit Lahia effluent lake." The study team identified specific objectives for the ESIA, which are:

1. Identification of the possible social impacts of the proposed effluent recovery and reuse scheme and the rehabilitation plan for the former Beit Lahia effluent lake and the decommissioning of the existing BLWWTP after opening of the new WWTP
2. Identification of any potential temporary or permanent land acquisition requirements associated with civil works
3. 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. Moreover, a capacity assessment of the implementing party to implement the ESMP and recommendations for any capacity-building needs
4. Identify positive and negative impacts on the local market in change in demand for local services, as well as access to social infrastructure
5. Highlight the legislations under which the project will be implemented
6. Outline the vulnerable groups that might be affected by the project and identify the appropriate mitigation measures,
7. Identify the methods of quality assurance and monitoring system needed during the construction and operation phases, Finally, try to propose a Social Management Plan that might be responsible for any potential social problems
8. Try to investigate the different potential alternatives of the current project. Provide various option to minimize the need for involuntary resettlement

2. Social Study Methodology

2.1. Primary Data

Primary data collection involves collecting data primarily from different potential stakeholders and project target groups.

Due to having more than one component under this project, the study will rely upon different sources of data using multi-levels of tools that will enable the project authority to apply proper mechanisms and decisions related to the project. In order to fulfill the requirements of this project, it is crucial to collect detailed information during short period. Therefore, applying a Participatory Rapid Appraisal (PRA) survey will 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 during three surveying phases that might be summarized as follow:

1) ***Data collection scoping phase***:

During this phase the study team has done 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 for the project introduction as well as the relevant project background for starting the assignment
- The first site visit and data collection was done during the negotiation session on May 6 and 8, 2012. 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 two sites (old and new sites).

Figure 1 Meeting conducted during the site visit to treatment plant

Figure 2. Site visit to the project area

2) Pilot phase and tools testing:

During this phase the survey team tried to dig deeper in order to collect the preliminary data that might work for enhancing the data collection tools as well as enable the study team to collect data from different sources. During this phase the following activities have been done:

a) Site visits have been paid in order to identify the current status of the workers inside each treatment plant,

b) The first public consultation that aimed at bringing the project forward to community people in order to get their perceptions, worries and comments on the methodologies,

c) Applying in-depth meetings with the key players in order to investigate their main contribution to the project, potential impacts and mitigations, barriers and how to overcome, and community participation

d) Two opinion pool workshops to be applied with different stakeholder in order to discuss different issues related to the project: following is detailed table about topics to be discussed.

Table 1.Discussed topics during the Opinion Pool Workshops

Main topic	Discussion points
The Social and Institutional Workshop	
1- Institutional framework	1. Actual institutional frames 2. Suggested institutional frames different views 3. Available capacities and needed capacities (human resources and equipment's) 4. Suggestions on other related issues.
2- Water pricing and cost coverage	1. The actual costs of 1. Collection 2. Treatment 3. Conveyance system 4 institutional 2. Competition with water pumping from privet wells vs (PWA wells) 3. Water use profitability in different cropping activities 4. Selling water to neighbors. 5. Current water pricing policies 6. Plans for future water pricing suggestions. 7. Pricing of sludge 8. Other related issues
3- Land acquisition	1. Total land needed to the project and potential extension 2. How can this land be accessed 3. Different entities participating in this process 4. Land prices, cost, cash flow, and procedures 5. Potential effect on the livelihood status of the expropriated people (PAPS)

Main topic	Discussion points
	6. Potential problems results from the expropriation, grievances and remedies 7. Monitoring and follow up for such activities 8. Legal barriers that might face the process
The Technical Workshop	
1-Public health and environment	1. Effect of using recovery water and sludge on public health either directly or indirectly. 2. Effect on Soil 3. Effect on aquifer 4. Monitoring on environment 5. Monitoring on public health 6. Mitigation measures 7. Cost of mitigation measures 8. Suggestions on other related issues.
2- Agriculture technical potentialities	1. Expected water quality 2. The actual land use activities in the project area 3. Technical restrictions such as irrigation systems restrictions 4. Optimal cropping patterns and other production restrictions 5. Sludge use as fertilizers (technical restriction, suitable crops, competition with other fertilizers and costs) 6. Potential effects on farm income 7. Other related issues

e) Two focus group discussions were implemented in the BLWWTP site and NGWWTP. The main objective of these two workshops was to investigate people's perception towards their willingness to use the treated water and sludge and their perception on the new treatment plant and the decommissioning of the old one

Laborer camps in the NGWWTP

Electrical supply station in BLWWTP

First Public Consultation

Social and Institutional Workshops

FGD in BLWWTP Bedouin Village

FGD in NGWWTP in Ezbeit Abd Raboh

Figure 3. Activities during data collection during scoping phase and Pilot phase and tools testing

3) ***Data collection and analysis phase***

The data collection process was planned to start from 11th of July till the 25th of July. Nevertheless, due to having Ramadan (Fasting month for Muslim people) the data collection lasted till the beginning of August.

The primary data collection relied upon the following tools to collect the needed data:

a) ***Quantitative tools***

The qualitative tools are divided into the following types based on the target group to be investigated:

1. Consumer structured questionnaire

That is mainly tailored for potential customers who might purchase the crops irrigated by treated water, or fertilized by sludge. This tool covered the following indicators:

- Basic socioeconomic characteristics
- Purchasing attitudes and behaviors
- Bases to purchase the crops
- Quality of water
- Perception towards the proposed project
- Willingness to reuse treated water and sludge in agriculture
- Willingness to trade in vegetables irrigated by treated water
- Willingness to trade in labeled products
- Media strategies to be applied to encourage community people to purchase products irrigated by treated water

2. Wholesalers and retailers structured questionnaire

That is mainly tailored for potential wholesalers and retailers who might sell the crops irrigated by treated water, or fertilized by sludge. This tool covered the following indicators:

- Basic socioeconomic characteristics
- Purchasing attitudes and behaviors for customers according to traders perception
- Bases to trade in certain crop
- Quality of water as basis for the willingness to trade in a crop
- Perception towards the proposed project
- Willingness to reuse treated water and sludge in agriculture
- Willingness to trade in vegetables irrigated by treated water
- Willingness to trade in labeled products
- Media strategies to be applied to encourage community people to purchase

products irrigated by treated water

3. Beneficiaries farmer who will use the reused water

This tool is modified according to comments raised during the public consultation and the site visits during the second phase of this study. The main indicators covered were:

- Basic socioeconomic characteristics for the farmers
- Agriculture status and most faced problems
- Perception towards the project
- Their willingness to use reused water and sludge in planting products
- Project impacts on the sector and water reused
- Their willingness to pay for reused and sludge. In addition their proposed tariff

b) Qualitative tools

Due to the diversity of the groups that should be covered by the qualitative tools, namely, in- depth and FGDs, the study team developed different guidelines to suit each groups which mainly cover the following generic indicators

- Basic information about the project
- How treated water might be disposed off
- Cost of using pure water in irrigation
- Feasibility to use treated water
- Potential incentives to be given to the farmers to use treated water
- Using of sludge benefits and drawbacks
- Awareness strategies to apply
- Gap analysis for the organizational capacity
- Monitoring for different activities
- Total lands to be expropriated
- Prices of lands
- Mechanism for expropriation
- Grievances and redress
- Budgeting and time plan
- Organizational responsibilities
- Plans for decommissioning
- Obstacles and barriers facing the decommission and how to overcome
- Site monitoring
  However some indicators might be used with certain group i.e. the guideline of Awqaf covers lands that might be expropriated from their assets.

Regarding the qualitative tools used, they were as follow:

1. **Focus Group Discussion**

That was applied with the residents in Om El Nasr village close to Beit Lahia Waste Water Treatment Plant and Ezbet Abd Rabouh. In addition to one with the owners of wells who might be affected due to the implementation of the project. The main topics discussed in these FGDs were:

- Basic socioeconomic characteristics
- Ever heard about the project
- Perception towards the proposed project
- Willingness to reuse treated water and sludge
- Willingness to buy vegetables irrigated by treated water
- Proposed prices of vegetables and fruits irrigated by treated water
- Proposed prices for water treated and sludge reuse
- In case of not reusing treated water and sludge how they can be final disposed
- Prices of lands in areas by dunum
- Awareness about expropriation laws
- Acceptance to be expropriated
- Proposed compensation (Highest- least)
- Awareness about the implementing agencies
- Ever was expropriated
- Strategies to apply expropriation activities with no disputes
- Perception concerning the current site
- Perception towards decommissioning
- Proposed plans to use the site after decommissioning

2. **In-depth Interviews**

They were implemented with the stakeholders. The main topics discussed are:

- Basic information about the areas
- Health conditions in the area
- Role of organization in the project (pre-during- post construction) and how they cooperate with PWA
- Potential unfavorable impacts of the project and how to mitigate
- Perception towards sludge and treated water reuse
- Willingness to apply the reuse of treated water and sludge
- In case of not reusing treated water and sludge how they can be final disposed
- Role of organization in the decommissioning and land acquisition
- Potential unfavorable impacts of the decommissioning
- Auditing for the project
- Most urgent environmental hazards in the project areas

- Quality of underground water

3. Workshops for opinion pooling

In the aformentioned , two workshops were applied in order to collect the needed information related to five main topics, which are:

1- Institutional framework
2- Water pricing and cost coverage
3- Land acquisition
4- Public health and environment
5- Agriculture technical potentialities

This type of opinion pooling provides a comprehensive amount of verified data due to the fact that the majority of stakeholder attended the workshops. Their contribution was active and the information provided was of a reliable status

2.2. Secondary data

Secondary activities involve collection of different national reports through reviewing available sources of secondary data and assess requirements for primary data collection; the above mentioned lists of reports were reviewed. A list of all reviewed data was prepared:

1- Human Development Report 2009/10 Investing in Human Security for a Future State- occupied Palestinian territory
2- Palestinian Environmental Law .7, 1999
3- Palestinian Laws
    - Palestinian Labor Laws 7/2000
    - Health and Safety Law 3/2011
    - Land Ownership Law 2/1953
    - Expropriation Law (Istmlak)
    - Antiquities Law 1966
    - Basic laws
    - Basic Laws declaration for Palestinian Human Right
    - Law 21Consumer protection laws
    - JSC Regulations
    - Joint Service Council (JSC) Regulations
    - Palestinian Reform and Development Plan PRDP (2008 -2010)
    - Local Council Law 1/1997
4- Palestinian Environmental Assessment Policy
5- World Bank OP.4. 12 concerning Involuntary Resettlement
6- Basic Information about Beit Lahia- Wikipedia
7- Standards for the re- use of treated wastewater for irrigation, www.arriyadhenv.com
8- Palestine Water Authority, organization and tasks, PWA website
9- The North Gaza Emergency Sewage Treatment project, World Bank website

10- Health conditions in the occupied Palestinian territory, including east Jerusalem, and in the occupied Syrian Golan
11- Environmental Assessment North Gaza Emergency Sewage Treatment Plant Project
12- Literature review of factors influencing public perceptions of water reuse
13- Treated water reuse in agriculture and the potential health impact, A.Gad Allah Aboud, Damascus University.
14- Goa, health at the front line, Real Health News • the magazine of real action and research • No. 9 • May 2008
15- Socio-economic Assessment of Using Treated Wastewater in Irrigated Agriculture – The Case of Northern Gaza, Dr. Ahmed A. Abu Shaban
16- Technical proposal for the Supplementary Environmental and Social Assessment North Gaza Emergency Treatment Project
17- The Palestinian Central Bureau of Statistics, (http://www.pcbs.org/populati/est_n1.aspx)

2.3. Data management and analysis

1- Data was reviewed, edited and entered
2- The quantitative data was analyzed using the SPSS 16 Statistical Package for the Social Science which enabled the study to have detailed analysis. As well, it enabled the team to enhance the quality of analysis for Data
3- Using different methods to analyze the contents of the qualitative data. Relying upon computerized techniques and manuals in order to have the rich text needed

Through applying different analysis techniques enriched the results of the data collected which enabled the study team to verify data collected. In case of having any discrepancy in data, the team tried to find the most reliable data from other sources either primary or secondary sources

3. Targeted Groups Identification and Sample Selection

3.1. Target Groups

Due to the nature of this project, the identification of the survey targeted groups will be based on different components. Some determinants took part in identifying the targeted groups i.e. area, gender and project component. Figure 4 below presents an initial identification for the targeted groups from the survey:

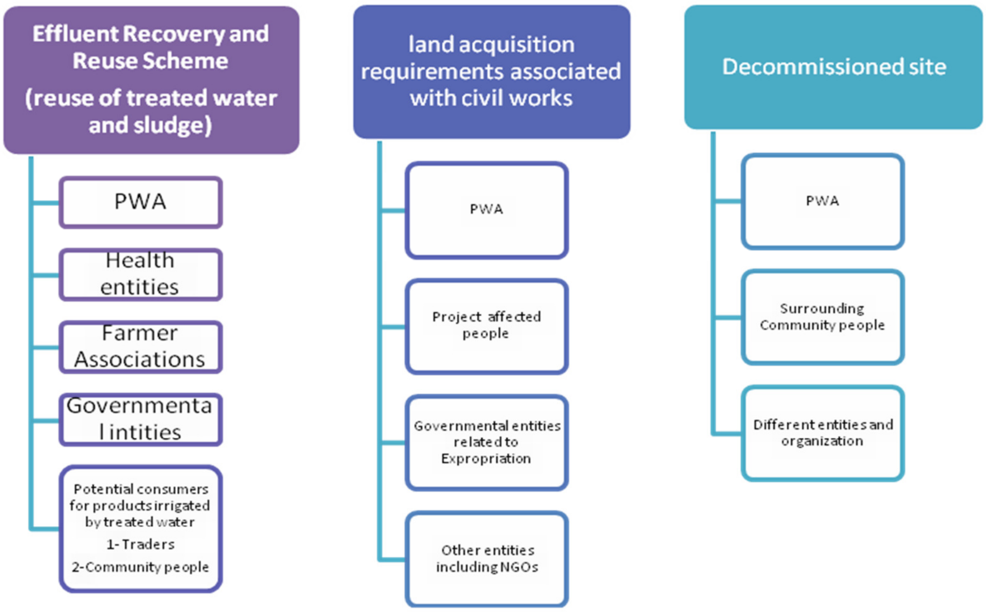


Figure 4. Key target groups

In addition to the above mentioned categories and target groups, the study will rely upon an observation checklist for the study areas.

3.2. Sample selection based on survey tools

Both qualitative and quantitative tools were applied to obtain the baseline information needed. However, the quantitative sample should be representative for the different components and the targeted households, the targeted population among different areas. The samples were selected as follows:

1- Quantitative Sample

This was covered using different structured questionnaires:

- The diversity of activities is suggesting that the research team will develop a stratified random sample. That is mainly due to having a list of farmers among which **34 farmers** were selected randomly. However, it is worth mentioning that the study team tried to interview more farmers but their refusal worked against the questionnaires' implementation
- Regarding the consumers of the agricultural products willingness to pay assessment, **51 dealers** (including retailers and wholesalers)

- **696 of the customers** in the different markets surrounding the project areas were selected conveniently,

2- ***Qualitative Sample***

Using FGDs, workshops opinion pool and in-depth interviews the following were investigated:

- **2 FGDs** with the surrounding communities to the decommissioning site, diversity regarding age categories and education should be put into consideration
- **1 FGD** with the owners of wells in Jabalia
- **1 FGD** with the farmers and well owners in Jabalia
- **In- depth interviews with the following:**
  - Al Mezan Center for Human Rights
  - Palestinian Water Authority
  - Ministry of Endowment (Awqaf)
  - Gaza Municipality
  - Jabalia Municipality
  - Palestinian Agriculture Relief PARC
- **Workshop was conducted to collect data attended by the following categories:**
  - 11 from Palestinian Water Authority
  - 2 with Environmental Quality Authority
  - 1 from Coastal Municipality of Water Authority
  - 2 from Palestinian Agricultural Relief Committee
  - 4 Gaza municipality
  - 1 Palestinian Contractor union
  - 1 Nasr NGO for Agricultural Development
  - 1 Human Rights Center
  - 1 Ministry of Endowment (Awqaf)
  - 2 UG consultation
  - 1 Ministry of Health
  - 2 Islamic University

In addition to the above mentioned sample, scoping sessions were applied with different stakeholders to collect basic data that were the bases for verification and developing surveying tools

Field observations were conducted to assess project areas, land use characteristics/ownership, community structure and planned development activities (including tourism and cultural properties). In-depth analysis of present and projected population, public health related to water use, gender issues as well as educational background were given. These analyses will implicate the willingness to pay and contribute to the improved effluent scheme as well as acceptance of the effluent reuse purposes.

4. Additional Consultation Activities

It is worth noting that the stakeholders' consultation activities were not limited to the activities mentioned above. Further public consultation through plenary event has been/ are planned to be conducted. This includes a scoping consultation session with the main objective of reviewing the ESIA scope of work and ToRs with stakeholders and obtaining their views on issues that need special attention during the field investigations and analysis.

Additionally a plenary public consultation session is also planned after drafting the ESIA in order to validate and review the study findings with the relevant stakeholders and potentially affected groups. The results of the public consultation were included in the final ESIA. The various consultation and participatory activities largely contributed to enriching and validating the findings of this ESIA.

4.1. Sample description of the social survey

4.1.1. Sample socioeconomic profile

Due to having different components of the project that might result different impacts and aspects the study team tried to have a representative sample for all project affected or target groups. Not only has that but also had an appropriate mixed sample from different stakeholder. Due to applying different survey tools that varied between qualitative and quantitative. The sample was also selected according to the tools. This section will present the detailed sampling of the project.

A. Quantitative Sample

This was covered using different structured questionnaires:

- Due to having a list of farmers, it was relatively easy to select 34 **farmers** which were selected randomly. However, it worth mentioning that the study team tried to investigate 110 farmers but their refusal worked against the questionnaires implementation. Thus, more FGDs were conducted to fill the gaps.
- Regarding the consumers of the agricultural products willingness to pay assessment, **51 dealers** (including retailers and wholesalers) were interviewed in three types of markets one day market, supermarket and permanent market. The sample was not selected randomly due not to having a list of traders. Therefore, the sample selected conveniently during the study and data collection time.
- **696 of the customers** in the different markets adjacent the project areas were selected conveniently during certain data collection period. Thus the sample was statistically acceptable.

A.1. Trader sample

The first group sampled was the traders who are up to 51 male traders among which 39.2% of them interviewed in El Wasta and 60.8% were from Gaza Governorate. Different types of markets were covered in order to have the diversity of all traders. 39.2% of the traders were in El Noseirat. Followed by Moasker El Sahtea market (The Beach Camp Market) 21.6% of the traders was from there, whereas, 17.6% were from El Remal.

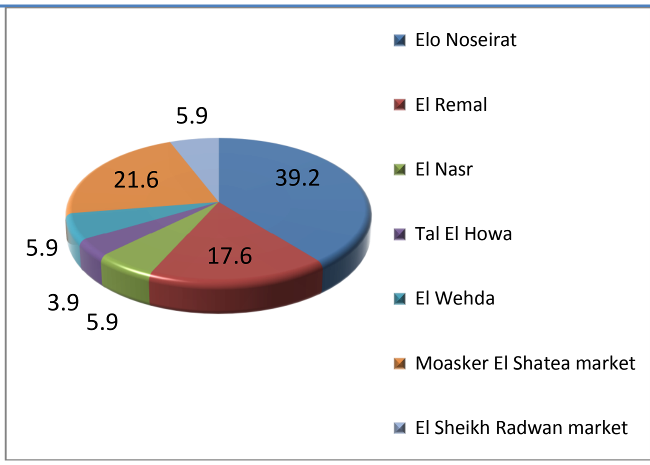


Figure5. % Distribution of the trader sample by area

The distribution of the trader sample by type of market revealed that 39.2% of the traders were from the one day market, followed by the supermarket 33.3% and the permanent market 27.5%.

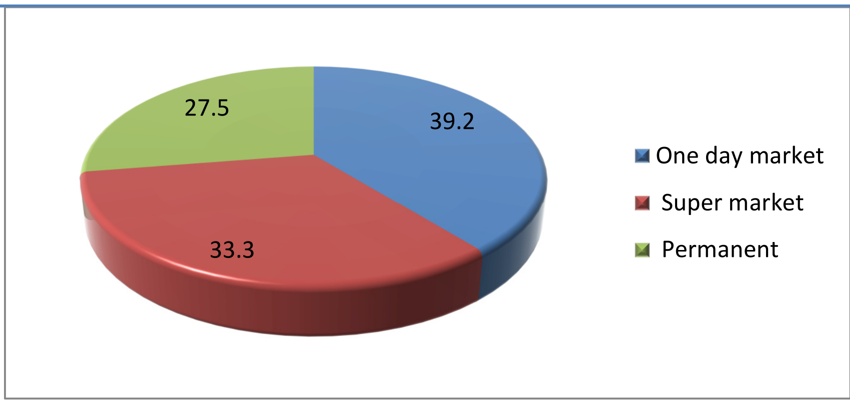


Figure 6.: % Distribution of the trader sample by market type

The distribution of the sample by age category revealed that about third of the sample surveyed were among the age category 40-49 years old. While a quarter of the sample surveyed were at the age category 30-39 years old. 15.7% were among the age category 50-59 years old. This diversity of age categories reflected on their responses and attitudes regarding the project.

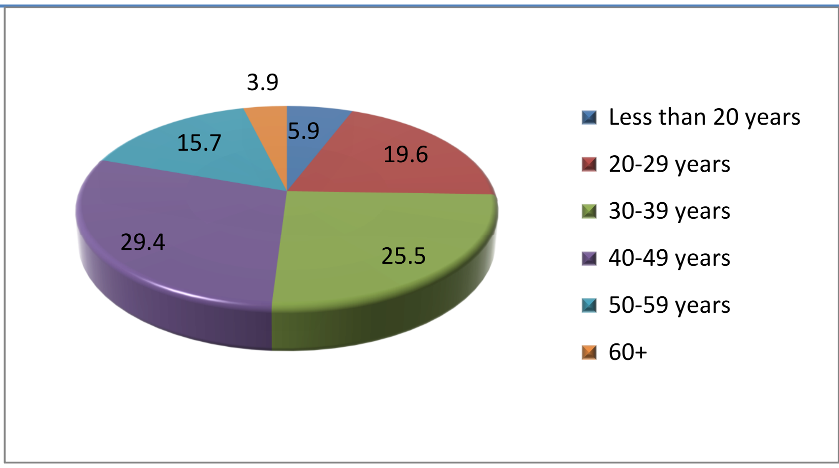


Figure 7.: % Distribution of the trader sample by age categories

The main level of education reached by the traders was secondary education 43.1%; while 33.3% reached the preparatory stage. 11.8% only were among university graduates. This is relatively consistent with the description of the population reported in the socioeconomic chapter. Due to the fact that part of this study deals with the attitudes and perception, the diversity according education was recommended to be achieved in order to have a wide range of attitudes and diversity in perceptions

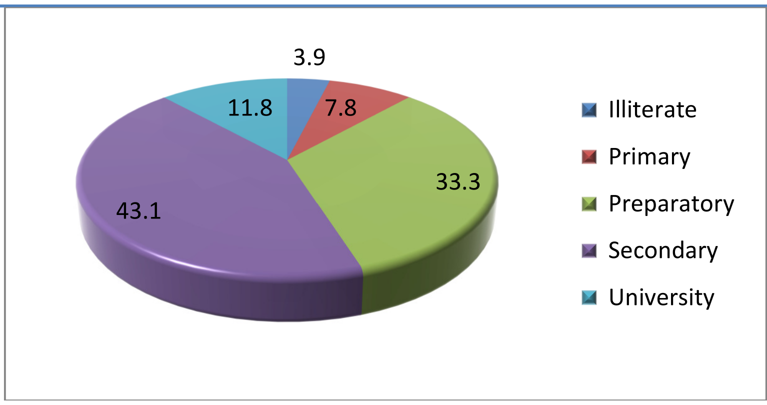


Figure 8.: % Distribution of the trader sample by educational status

Investigating the owners of shops was not the target of this study, therefore, the owners represnted only 17.6% of the sample surveyed in addition to 15.7% of the workers. The vast majority was among fruit and vegetable sellers among which half of them are vendors. They were mainly among those who work in the mobile one day market.

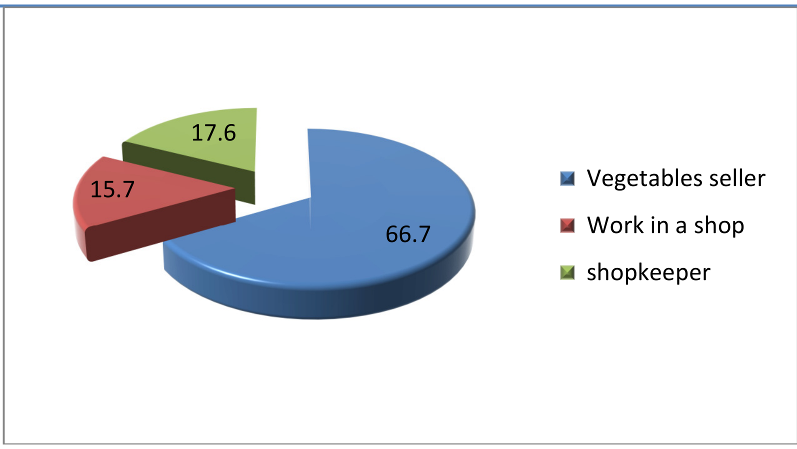


Figure 9.: % Distribution of the trader sample by occupation

A.2 Consumer sample

The second main target group interviewed was the consumers who were represented by 696 individuals among which 401 were from El Wasta, 203 from Gaza and 92 from Khan Younis. 82.9% of the sample was males versus only 17.1% females. That might reflect the types on potential customers that will be targeted in the advertising strategy.

The sample was selected 13 markets in different governorates; the following figure shows that El Noseirat, 22.7% followed by Deir El Balah 13.8%, Khan Younis 13.2%, El Moghazy 11.8% and El Berieg 9.3%. The markets were of different types and sizes 57.5% of them were among one day market, while, 18.2% were among permanent markets and14.4% from supermarkets. This mainly reflects the types of market according to their customers' size. The one day market was characterized with the most customers followed by permanent markets and supermarkets.

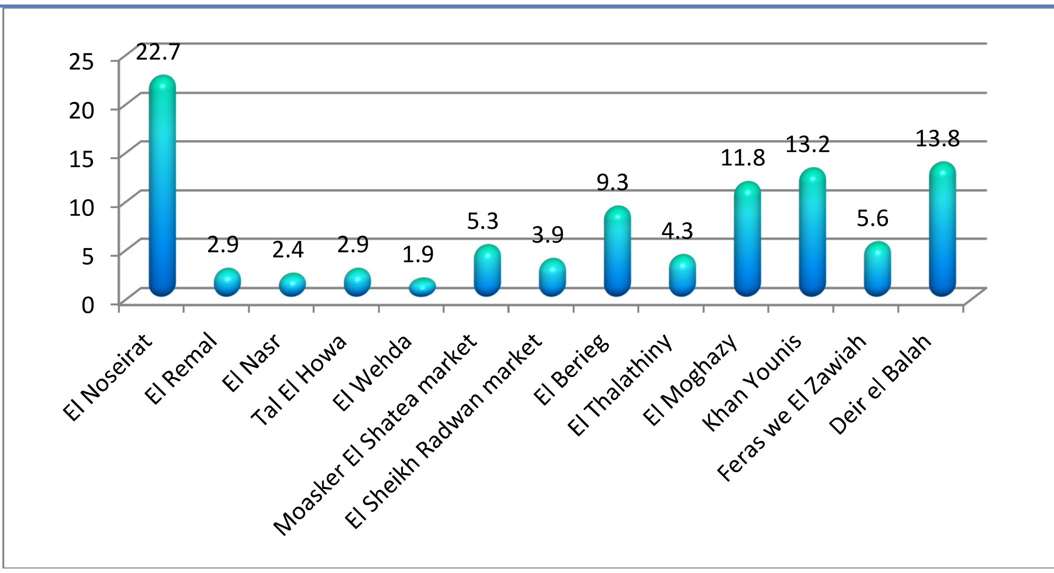


Figure 10: % Distribution of the consumer sample by area

According to age distribution it was notable that the customers' age ranged between 18 to 70 years old. The average value was 46.19 with mode value of 48 years. The third of the sample surveyed lied in the age category 40-49 years while 29% were 50-59 years. The younger age categories were the least as only 7.4% were less than 29 years old.

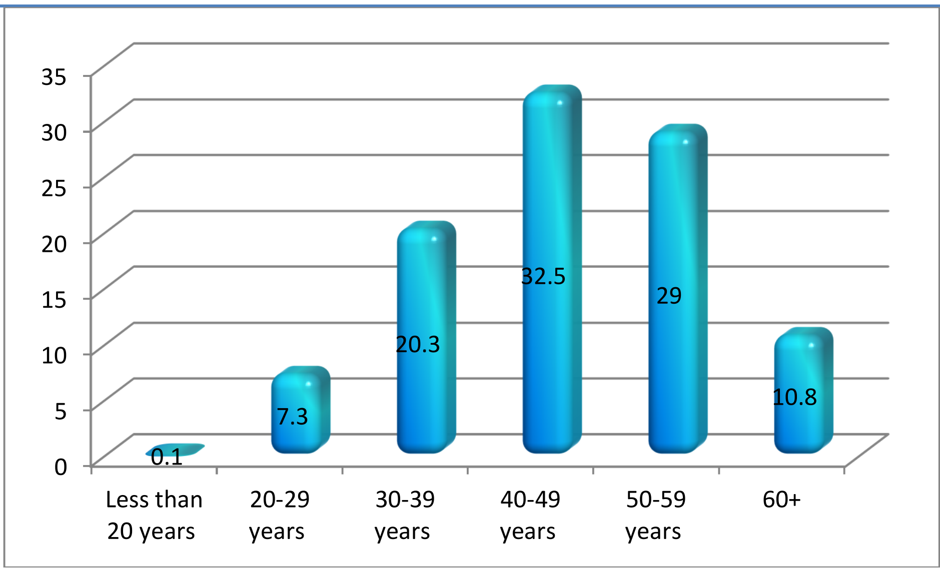


Figure 11. % Distribution of the consumer sample by age categories

The diversity of the sample according to the type of education in gender was notified as 30.3% of the female sample was of primary education versus 4.0% of the male sample. 21.8% of the females have completed their preparatory stage versus only 11.8% of the males. 53.9% of the males were university graduates, while only 28.6% continued their university education. That might reflect the gap between males and females regarding educational level.

Table 2. % Distribution of the consumer sample by educational status and gender

Educational status	Gender		Total
	Male	Female	
Illiterate	1.6%	4.2%	2.0%
Primary	4.0%	30.3%	8.5%
Preparatory	11.8%	21.8%	13.5%
Secondary	18.9%	10.1%	17.4%
Vocational education	5.9%		4.9%
University	53.9%	28.6%	49.6%
Above university	4.0%	5.0%	4.2%
Total	100.0%	100.0%	100.0%

The gender gap was not notified in the educational status but also reflected on occupation as the majority of females were housewives 59.7% followed by administration work 15.1% and educational sector 10.9%. Whereas, 36.2% of the male consumer sample surveyed was among clerks and administrative workers, 10.1% were among sales person. It is worth mentioning that 16.3% of the males were unemployed. This is another indication of the prevailing unemployment in the Strip.

Table 3. % Distribution of the consumer sample by occupation and gender

Occupation	Gender		Total
	Male	Female	
Specialist	3.6%	5.0%	3.9%
Technical and assistance	.2%		.1%
Clerks and related administrative workers	36.2%	15.1%	32.6%
Sale and service workers	10.1%		8.3%
Craftsman and related workers	5.5%	.8%	4.7%
Production workers and related workers	.5%		.4%
Common workers	9.2%	5.9%	8.6%
Teacher	4.7%	10.9%	5.7%
Police officer	6.9%		5.7%
Farmers/fishermen	.2%		.1%
Student	.3%		.3%
housewife		59.7%	10.2%
Pensioner	6.2%	.8%	5.3%
Unemployed	16.3%	1.7%	13.8%
Total	100.0%	100.0%	100.0%

Purchasing attitudes were covered under this study in order to have detailed information about their willingness to purchase. The data collected revealed that the majority of sample surveyed prefer the fixed shop or vendors. Mobile vendors are not welcomed in the communities.

Table 4. % Distribution of the consumer sample by purchasing attitudes and market type

Place where respondent purchase fruits and vegetables from		Market Type			Total
		One day market	Super market	Permanent	
Fixed shop	N	348	100	87	535
	%	87.00%	100.00%	44.40%	
Fixed vendor	N	348		171	519
	%	87.00%		87.20%	
Mobile vendor (using cart)	N	116		38	154

Place where respondent purchase fruits and vegetables from		Market Type			Total
		One day market	Super market	Permanent	
	%	29.00%		19.40%	
Total	N	400	100	196	696

Multiple responses

The motives to purchase from certain market were investigated as part of purchasing attitudes. The main two motives reported were the availability of all types of fruits and vegetables in addition to appropriate pricing. Regarding the supermarkets' customers the quality of products was the main reason followed by the place of the supermarket that should be adjacent to the house or work.

Table 5. % Distribution of the consumer sample by purchasing reasons and market type

Reasons for purchasing from this market		Market Type			Total
		One day market	Super market	Permanent	
Close to my house	N	36	48	100	184
	%	9.00%	48.00%	51.00%	
All fruits and vegetables are available	N	268	0	34	302
	%	67.00%	0.00%	17.30%	
Appropriate prices	N	268	0	43	311
	%	67.00%	0.00%	21.90%	
I trust the sales people	N	2	5	5	12
	%	0.50%	5.00%	2.60%	
Close to my work	N	22	8	18	48
	%	5.50%	8.00%	9.20%	
Good quality products	N	76	46	26	148
	%	19.00%	46.00%	13.30%	
Total	N	400	100	196	696

Multiple responses

A.3 Farmer sample

The third sample interviewed were the farmers who will be the potential beneficiaries for the recovered water. Originally they were 644 farmers among which 34 interviewed. All of them have source of water. They plant mainly citrus, olives and vegetable.

Table 6. Potential beneficiaries for the recovered water

No.	Crop	Total Areas (dunum)	No. of Farms	Farm property (Private)	Farm property (Awqaf)
1	Rainfed	12055	398	379	19
2	Citrus	688	68	68	0
3	Olives	600	58	57	1
4	Unfruitable Citrus	510	69	69	0
5	Unfruitable Olives	14	3	3	0
6	Vegetables	280	32	30	2
7	Fruits	184	11	10	1
8	Almond	53	5	5	0
	Total	**14385**	**644**	**621**	**23**

Source: PWA

About half of the sample surveyed was at the age 40-59 years old. A quarter of them were at the age category 60+. Few percentages lied under age category 20-29 years. 44.1% of them were among secondary education graduates while 20.6% were university graduates and the same sample was among preparatory graduates

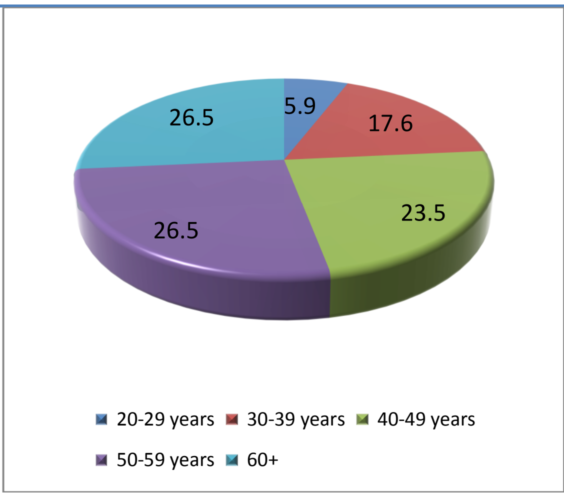


Figure 12 % Distribution of the farmer sample by age categories

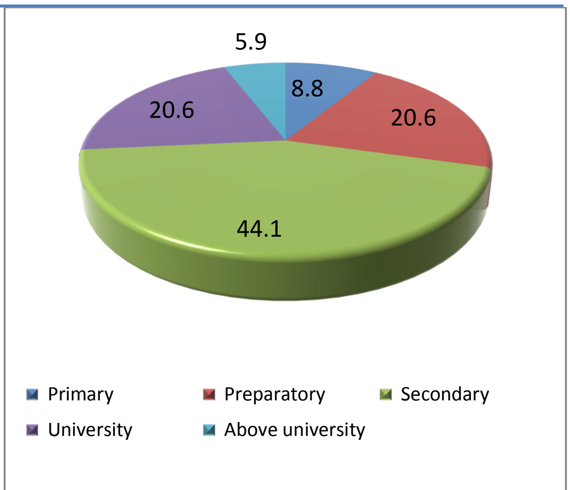


Figure 13.% Distribution of the farmer sample by educational status

It was notified that their main occupation was farming 55.8%, while few of them work as administrative staffs 8.8% and 8.8% were acting as unidentified workers.

Table 7. % Distribution of the farmers sample by occupation

Occupation	N	%
Legislators, high officials and managers	1	2.9
Clerks and related administrative workers	3	8.8
Sale and service workers	2	5.9
Craftsman and related workers	1	2.9
Common workers	1	2.9
Unidentified workers	3	8.8
Farmers	19	55.8
Student	1	2.9
Pensioner	3	8.8
Total	34	100

Regarding their socioeconomic characteristics, about half of them live in apartment building while 47.1% live in separate house. The majority of them 76.5% own their house while 17.6% are partially owners (brothers and sisters own the same unit). The small percentage reported was for those who live in a rented house 5.9%.

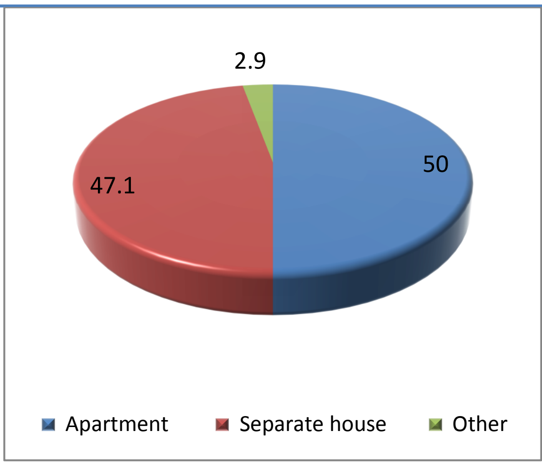


Figure 14.% Distribution of the farmer sample by type of dwelling

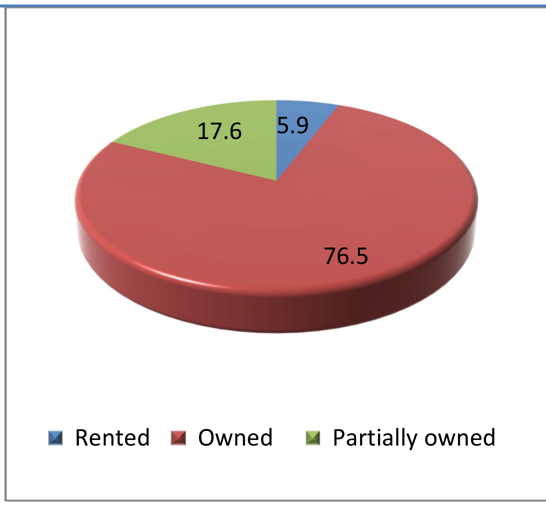


Figure 15. % Distribution of the farmer sample by type of dwelling ownership

Regarding the main source of drinking water was mainly from municipal water 82.4% while those who use their wells for drinking water represent 17.6%. The whole sample survey has access to electricity.

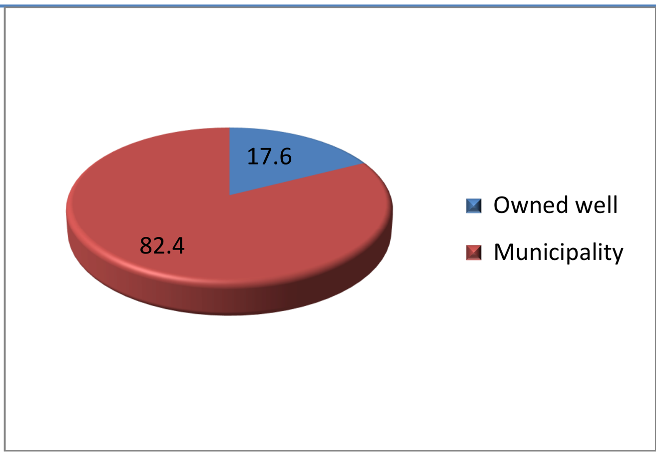


Figure 16.% distribution of the farmers sample by source of potable water

The total area of lands they own varied between 0.6 dunum to 23 dunum. The mode value was 2 dunum per each household while the average was 5.4955. The data collected revealed that almost a quarter of the sample surveyed own between 1-less than 3 dunums. While 18.2 own between 3 to less than 5 dunums. The same percentage of farmers own 9 and more dunums.

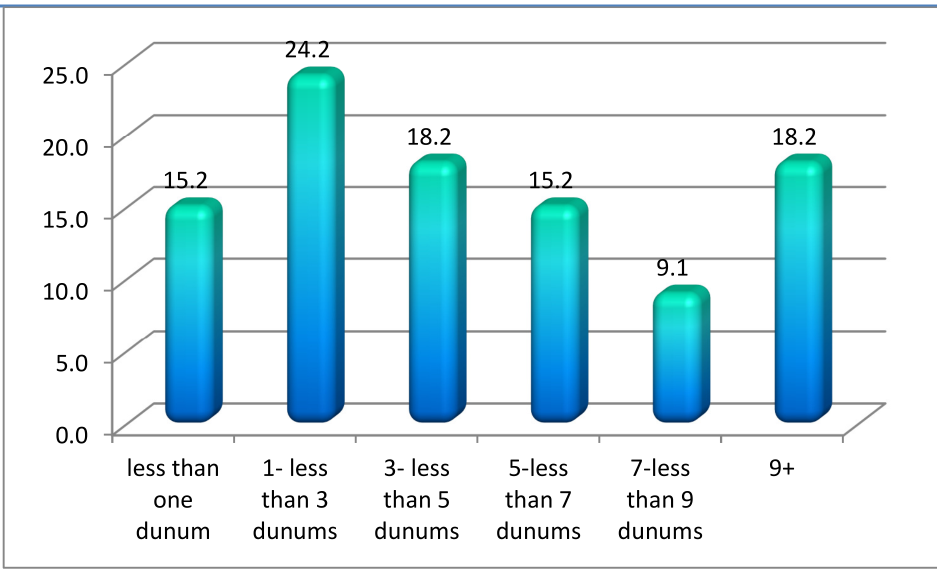


Figure 17 % distribution of the farmers sample by owned land areas

Regarding income and expenditure distribution, it was notable that the monthly income for a third of families was around 1001-1500 Shekel, followed by 26.5% who earns between 500-1000 shekel. Due to asking about expenditure first the reliability of data was relatively high and consistent with the income mentioned

Table 8. % Distribution of the farmers sample by monthly income and expenditure

Monthly income	N	%	Monthly expenditure	N	%
No income	1	2.9	**500**	3	8.8
Less than 500	2	5.9	**500: 1000**	5	14.7
500: 1000	9	26.5	**1001:1500**	7	20.6
1001:1500	11	32.4	**1501: 2000**	8	23.5
1501: 2000	5	14.7	**2001: 2500**	4	11.8
2001: 2500	4	11.8	**2501 : 3000**	3	8.8
More than 3000	2	5.9	**More than 3000**	4	11.8
Total	34	100	**Total**	34	100

Regarding the main problems facing the farmers was mainly the security conditions which affects their work severely especially the farming of trees. "*Whenever we plant trees the Israeli force invade our farms, destroying our trees. Therefore we are not much in favor for the plantation of trees any more*" reported one of the farmers in the FGD. The second problems ranked were the lake of water and lack of fuel. Problems related to the operation of wells were ranked as the fourth problems. Bad odor, dust and flies result during the construction of the infiltration pond reported as the fifth problem the farmers face. The FGD provided detailed information about problems they face.

Table 9: % Distribution of the farmers sample by problems facing the agriculture sector

Problems face farming	**Responses**		**% of Cases**
	N	%	
Security conditions	8	22.20%	23.50%
Lack of fuel	6	16.70%	17.60%
Scarcity of water	6	16.70%	17.60%
Problems related to the wells	4	11.10%	11.80%
Bad smelling from ponds- Dust-Smoke	3	8.30%	8.80%
Deterioration of vegetation	2	5.60%	5.90%
Lack of basic services	2	5.60%	5.90%
No problems	1	2.80%	2.90%
I don't do farming now	3	8.30%	8.80%
Doesn't know	1	2.80%	2.90%
Total	36	100.00%	105.90%

Multiple responses

The famers' strategies to overcome these problems are through the provision of fuel and electricity in addition to provision of subsidy to farmers. Having security and peaceful conditions might support to solve the faced problems. A long list of strategies suggested can be summarized in the following table.

Table 10: % Distribution of the farmers sample by suggested strategies to overcome farming problems

Strategies to overcome problems	Responses		% of Cases
	N	%	
Provision of fuel and electricity	7	21.90%	25.00%
Provision of subsidy to farmers	7	21.90%	25.00%
Security and peaceful conditions	5	15.60%	17.90%
Provision of services	3	9.40%	10.70%
Spraying the insects	2	6.20%	7.10%
Cooperative organizations	2	6.20%	7.10%
Digging wells close to land	1	3.10%	3.60%
Protect agricultural lands	1	3.10%	3.60%
Enhance the quality of plants	1	3.10%	3.60%
No solution	1	3.10%	3.60%
Doesn't know	2	6.20%	7.10%
Total	32	100.00%	114.30%

Multiple responses

Farmers' information about types of crops that should be planted to use the treated water was highlighted by the farmers. The main objective of this issue is to draw attention to any potential misconception related to the types of crops to be planted in order to include the accurate information in the awareness raising activities. Based on the responses provided it was notified that information is accurate and no misconceptions reported. Traditional crops and tree crops are the suitable ones to use recovered water for.

Table 11 % Distribution of the farmers sample by types of crops irrigated by treated water

Types of crops that can be irrigated by treated water	Responses		% of Cases
	N	%	
Traditional crops	13	37.10%	38.20%
Tree crops	13	37.10%	38.20%
Based on experts opinion	2	5.70%	5.90%
Based on the level of treatment	2	5.70%	5.90%
All crops but water should be well treated	2	5.70%	5.90%
No crops	2	5.70%	5.90%
Doesn't know	1	2.90%	2.90%
Total	34	100.00%	102.90%

Multiple responses

The last topic discussed with the famers was the sufficiency of water supply. The majority of farmers reported that water was sufficient particularly during winter time

Table 121 % Distribution of the farmers sample by sufficiency of water

Sufficiency of water	Sufficiency of water during summer		Sufficiency of water during winter	
	N	%	N	%
Sufficient	25	73.5	29	85.3
Sufficient to some extent	4	11.8	2	5.9
Not sufficient	4	11.8	3	8.8
Missing	1	2.9		
Total	34	100	34	100

B Qualitative Sample

1- ***Qualitative Sample***

Using FGDs, workshops opinion pool and in-depth interviews the following were investigated:

- **2 FGDs** with the surrounding communities to the decommissioning site, diversity regarding age categories and education should be put into consideration
- **1 FGD** with the owners of wells in Jabalia
- **1 FGD** with the farmers and well owners in Jabalia
- **In- depth interviews with the following:**
  - Al Mezan Center for Human Rights
  - Palestinian Water Authority
  - Ministry of Endowment (Awqaf)
  - Gaza Municipality
  - Jabalia Municipality
  - Palestinian Agriculture Relief PARC
- **Workshop was conducted to collect data attended by the following categories:**

B.1 FGDs sample

Table 13: Sample of the land and well owners

Well number	Participants	Total area of lands irrigated by wells	Total partners in the lands	Average land ownership	Total monthly salary of well operator
			FGD 1		
Q53	Male farmer	118	100	1.18	Dinar 200
Q56	Male farmer	140	40	3.5	Dinar 250
Q54	Male farmer	42	8	5.25	Dinar 200
Q52	Male farmer	60	40	1.5	Dinar 200

Well number	Participants	Total area of lands irrigated by wells	Total partners in the lands	Average land ownership	Total monthly salary of well operator
Q86	Male farmer	110	25	4.4	Dinar 200
Q14	Male farmer	120	30	4	Dinar 200
Q15	Male farmer	120	30	4	Dinar 200
Q16-A	Male farmer	148	40	3.7	Dinar 200

FGD 2

Participants	*Owned lands*	*Affected lands*
Male farmer	1000 m^2	400 m^2
Male farmer	5000 m^2	1300 m^2
Male farmer	10000 m^2	
Male farmer	850 m^2	42 m^2
Male farmer	8500m^2	
PWA representative		
PWA representative		
Jabalia Municipality representative		
Consultant		
Consultant		

*** Wells highlighted in red will be terminated**

In addition to the above mentioned sample 2 FGDs were conducted in Ezbet Abd Rabouh and Um El Nasr Village in order to identify the potential impacts of the decommissioning of BL treatment plant. 11 persons attended the discussions. Following are their characteristics:

1- Their age varied between 32-76 years old with mode age of 30-40 years old
2- About their education, four were university graduates, 4 were secondary graduates, 2 were preparatory graduates and one was illiterate.
3- All of them were married with at least one child to 9 children
4- Monthly expenditure ranged between 400-3500 Shekel monthly with mode value ranged 1000 -2000 shekel.
5- The average family size ranged between 3- 13 persons with economical dependency ratio of 0.08

B.2 In- depth sample

- Al Mezan Center for Human Rights
- Palestinian Water Authority
- Ministry of Endowment (Awqaf)
- Gaza Municipality
- Jabalia Municipality
- Palestinian Agriculture Relief PARC

B.3 Workshops sample

- 11 from Palestinian Water Authority
- 2 with Environmental Quality Authority
- 1 from Coastal Municipality of Water Authority
- 2 from Palestinian Agricultural Relief Committee

- 4 Gaza municipality
- 1 Palestinian Contractor union
- 1 Nasr NGO for Agricultural Development
- 1 Human Rights Center
- 1 Ministry of Endowment (Awqaf)
- 2 UG consultation
- 1 Ministry of Health
- 2 Islamic University

Socio Economic Baseline Conditions and Analysis

Socio Economic Baseline Conditions

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 Gaza Strip assists the 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:

1) Palestinian Statistical Year Book ,Volume 10, 2009, Palestinian Central Bureau for Statistics
2) PCBS Household Environmental Survey 2011
3) Palestinian Human Development Report 2009/10
4) 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
5) Environmental Assessment for North Gaza Emergency Sewage Treatment Plant Project

Generally speaking, the Gaza Strip is a small closed coastal area of a total surface area of 365 Km2. 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[1] per person in 2007.

The latest census conducted by the Palestinian Central Bureau of Statistics (PCBS) estimates the total population of the Palestinian Territories to be 3,825,512, of whom 2,385,180 live in the West Bank, and 1,440,332 live in the Gaza Strip.

[1] Land area used in the Ottoman Empire and representing the amount of land that can be plowed in a day; its value varied from 900–2500 m². In many formerly Ottoman regions, it is now defined as exactly one decare (1000 m²) (Wikipedia)

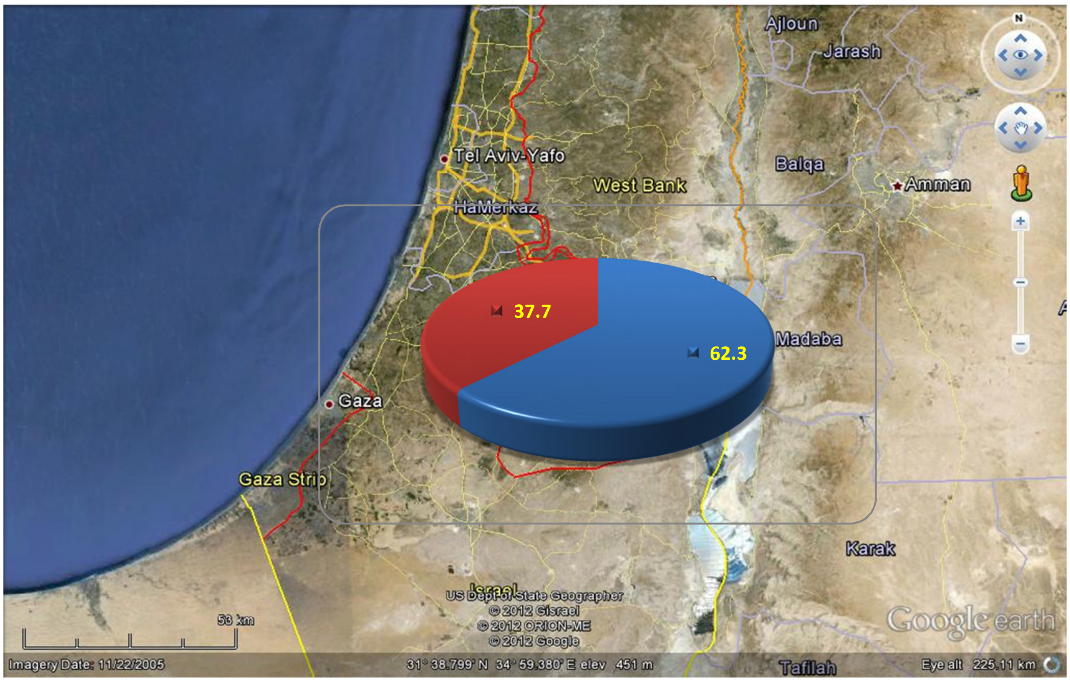


Figure 1. Population distribution in PalestinianTerritories

The population growth rate is approximately 2.82% per year; although this represents significant growth in population, the birth rates from 1997 to 2008 have actually declined.

1.1. Demographic Characteristics

In 1948, the Gaza Strip had a population of less than 100,000 people. By 2007, approximately 1.4 million Palestinians lived in the Gaza Strip, of whom almost one million were UN-registered refugees. The current population is estimated to be in excess of 1.5 million, distributed across five Governorates. Gaza City, which is the biggest governorate, has about 400,000 inhabitants. The two other main Governorates are Khan Younis (population 200,000) in central Gaza, and Rafah (population 150,000) in the South. The majority of people live in refugee camps[2].

Table 1. Population and density by area

Region/Governorate	Area (km2)	Population End of year 2009		Population Density (Person/Km2
		No	%	
North Gaza	61	291,758	19.3	4.783
Gaza	74	526,793	34.9	7.119

[2]Environmental Assessment of Gaza Strip, following the escalation of hostilities in December 2008 – January 2009 United Nations Environment Programme

Region/Governorate	Area (km2)	Population End of year 2009		Population Density (Person/Km2
Deir El Balah	58	219,336	14.5	3.782
Khan Yunis	108	287,511	19.0	2.662
Rafah	64	185,570	12.3	2.900
Total Strip	365	1,510,968	100.0	4.139

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

1.2. Population and gender distribution

The population of the Gaza Strip according to 2011 statistics is around 1,500,000[3]. As could be observed from the table below, the population growth in Gaza 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% by2040, after peaking at 3.5% in 2011.

Table 2. Population Distribution by Gender and year

Year	Male		Female		Total
	No	%	No	%	Number
Year 2007	708147	50.74	687573	49.3	1395720
Year 2008	730882	50.74	709450	49.3	1440332
Year 2009	754561	50.75	732255	49.2	1486816

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

The population distribution in the Gaza Strip shows that 13.2% of the total population of the Palestinian Territories lives in Gaza Governorate; followed by 7.3% living in North Gaza; 7.2% in Khan Younis; 5.5% in Deir El Balah;and 4.6% in Rafah.

Table 3 Percentage Distribution of Population in the PalestinianTerritories by Region and Governorate (Mid year 2007-2009)

Region/Governorate	Year		
	2007	2008	2009
Jenin	6.8	6.8	6.8
Tubas	1.3	1.3	1.3
Tulkarim	4.3	4.2	4.2
Nablus	8.5	8.5	8.4
Qalqiliya	2.4	2.4	2.4
Salfit	1.6	1.6	1.6
Ramallah & Al Bierah	7.4	7.4	7.4

3 PCBS, 2011

Region/Governorate	Year		
	2007	2008	2009
Jerico& El Aghwar	1.1	1.1	1.1
Jerusalem	9.8	9.6	9.5
Bethlehem	4.7	4.7	4.7
Hebron	14.6	14.7	14.8
West Bank	**62.5**	**62.3**	**62.2**
North Gaza	7.1	7.2	7.3
Gaza	13.2	13.2	13.2
Deir El Balah	5.4	5.5	5.5
Khan Yunis	7.2	7.2	7.2
Rafah	4.6	4.6	4.6
Gaza Strip	37.5	37.7	37.8
Total Palestinian Territories	100	100	100

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

1.3. 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[4]. Reviewing the age structure in the Palestinian Territories, it can beconcluded that the community has the potential for rapid, continuous growth.

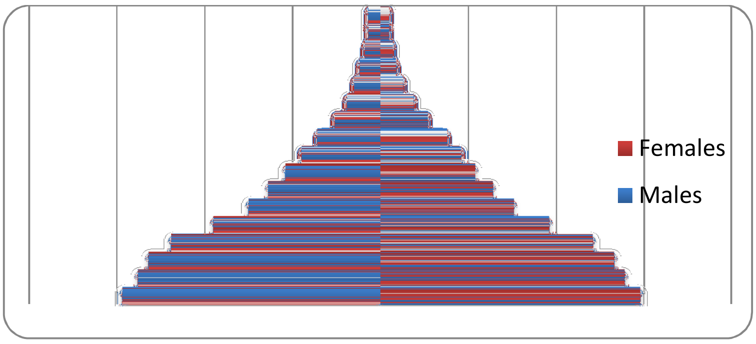


Figure 2 Population pyramids for PalestinianTerritories

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

The detailed distribution of the population by age category 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 recovery.

[4]http://en.wikipedia.org/wiki/Population_pyramid

Table 4. Percentage distribution for population in the PalestinianTerritories by Age groups and Gender (Mid year 2009)

Age Categories	Gender		
	Males	**Females**	**Total**
0-4	14.8	14.7	14.8
5-9	13.9	13.8	13.9
10-14	13.3	13.2	13.3
15-19	12.1	11.9	12
20-24	9.6	9.5	9.5
25-29	7.6	7.5	7.5
30-34	6.4	6.4	6.4
35-39	5.4	5.4	5.4
40-44	4.6	4.5	4.5
45-49	3.8	3.6	3.7
50-54	2.7	2.6	2.7
55-59	1.9	1.9	1.9
60-64	1.3	1.5	1.4
65-69	0.9	1.2	1.1
70-74	0.7	0.9	0.8
75-79	0.5	0.7	0.6
80+	0.5	0.7	0.5
Total Palestinian Territories	100	100	100

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

1.4. Birth Rate

The total fertility rate in the occupied Palestinian Territories was 4.6 in 2009 (4.1 in the West Bank and 5.3 in the Gaza Strip), 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.[5]

1.5. 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, colo-rectal 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

[5]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

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.4 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].

1.6. Rate of Natural Increase

The total fertility rate in the Palestinian Territories has declined with 4.6 births per thousand in 2007 compared to 6.0 births in 1997. Regional disaggregation indicates that the birth rate in the West Bank was 30.6 births compared to 35.6 births in the Gaza Strip in 2008. As Table 4 .4.illustrates, 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. The proposed project may serve a population as much as 10% higher than current numbers.

Table 5.Estimated annual growth rates in the Palestinian Territories (Mid-year 2007-2009)

Year	**Palestinian Territories**		
	West Bank	Gaza Strip	Total
Year 2007	2.66	3.2	2.86
Year 2008	2.65	3.23	2.87
Year 2009	2.65	3.25	2.88

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

2. Gaza Strip Living Conditions

2.1. 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 seven 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 5.8 in the Palestinian Territories, with the

[6]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

average household in the West Bank having 5.5 members, compared to6.5 in the Gaza Strip[7].

Table 6. Percentage distribution of households by household size average household size and region

Household size	Palestinian Territories		
	West Bank	Gaza Strip	Total
1 person	3.6	2.3	3.2
2 persons	8.5	7.2	8.1
3 persons	9.8	6.8	8.8
4 persons	12.3	10.9	11.8
5 persons	14.1	11.6	13.2
6 persons	16.8	12.6	15.4
7+ person	34.9	48.6	19.5
Average household size 2009	**5.6**	**6.3**	**5.8**

Source: Palestinian Statistical Year Book, Volume 10, 2009, 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 Gaza 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 represented11.0% of the Gaza Strip.

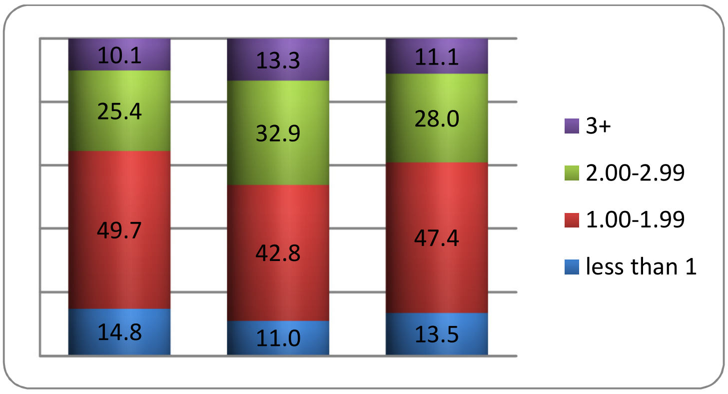


Figure 3.Percentage distribution of households by household density and region

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

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 80% of the family structure in the Gaze Strip (PCBS, 2010).

[7] Palestinian Human Development Report 2009/10

2.2. Type of Residence

One of the main indicators of living conditions and welfare of families is the type of dwelling. It is notified that the majority of the population (68.1%) in the Gaza Strip live in a house (that is a typical Palestinian type of residents), followed by 22.8% in larger residential buildings.

The majority of people use their units exclusively for living purposes (75.3%). 10.7% use the dwelling for both habitation and work, and 8.4% of the dwellings are used for work only.

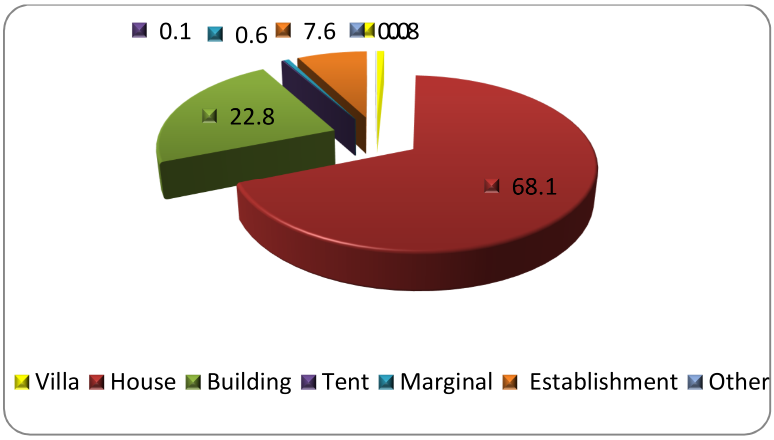


Figure 4.Percentage distribution of dwelling by type of building

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

Table 7. Dwelling by type of building, region and utilization 2007 in Gaza Strip

Type of building	Utilization of the building							
	Total	**Habitation**	**Habitation & work**	**Work**	**Closed**	**Vacant**	**Deserted**	**Not stated**
Villa	1088	916	31	0	88	52	1	0
House	97538	83388	6266	924	3498	2763	699	0
Building	32677	22845	8915	264	329	276	48	0
Tent	162	158	2	0	2	0	0	0
Marginal	801	453	29	284	35	0	0	0
Establishment	10858	0	16	10552	194	66	30	0
Other	67	31	1	14	21	0	0	0
Total	**143191**	**107791**	**15260**	**12038**	**4167**	**3157**	**778**	**15**
%	**100**	75.3	10.7	8.4	2.9	2.2	0.5	0.0

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

2.3. Ownership of Residence

The ownership of the house can be an important indicator of the socio-economic 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 socio-economic status of the community, but may instead reflect a custom and tradition of the community which encourages private ownership.

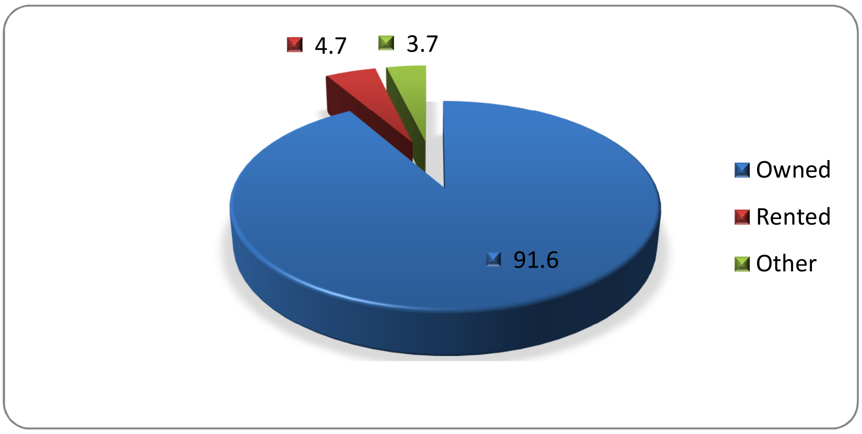


Figure 5. Percentage distribution of households by tenure of housing unit in Gaza Strip

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

3. 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 88% in 2008 and 2009.

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.

Only 52.1% of households 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.

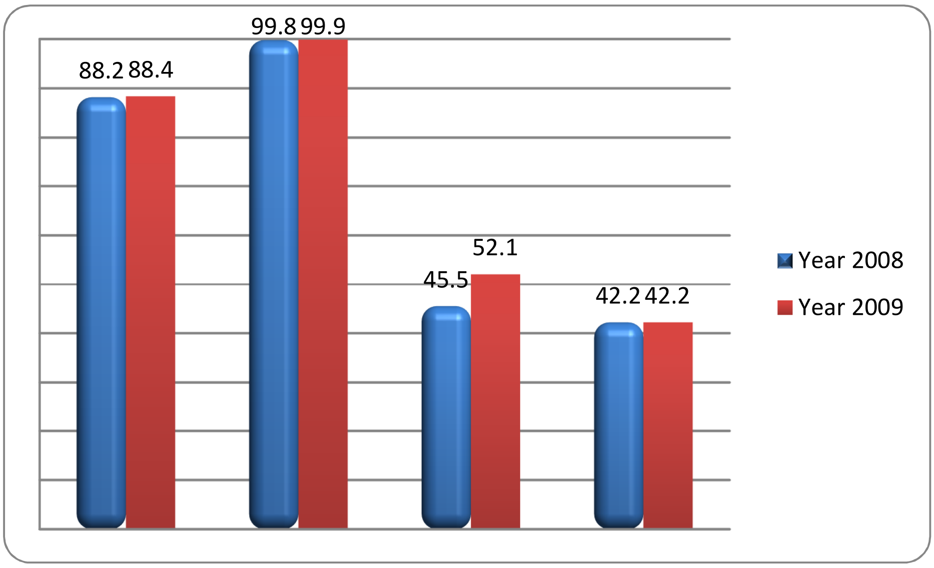


Figure 6. Percentage distribution for access to basic services in Palestinian Territories

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

The 2011 Household Environmental Survey (HES 2011) reported that 91.8% of the population of the Palestinian Territories has access to water supply. That proportion is higher in the Gaza Strip, at 96.3%. This is a good indication of the increasing installation of water supply in the Gaza Strip.

Water is one of the most challenging issues affecting environmental sustainability in the Palestinian Territories. The global Human Development Report2006 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 crisis', Human Development Report. The Water Crisis in the Occupied Territories and its Resolution in the Final-Status Agreement Position Paper', 10)

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 and96.3% 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 8. 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 %
Palestinian Territories	**91.8**	**3.4**	**2.0**	**2.8**	**100**
West Bank	**89.4**	**4.7**	**4.5**	**1.4**	**100**
North of West Bank	87.5	6.1	5.4	1.0	100
Middle of West Bank	97.8	0.5	0.6	1.1	100
South of west Bank	83.1	8.4	8.0	0.5	100
Gaza Strip	**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 9. Percentage distribution of households in the Palestinian Territories by the Household evaluation of water quality and region, 2011

	Household evaluation of water quality			
	Good %	Fairly good %	Bad %	Total
Palestinian Territories	**47.2**	**37.9**	**14.9**	**100**
West Bank	**70.9**	**23.9**	**5.2**	**100**
North of West Bank	60.9	32.5	6.6	100
Middle of West Bank	81.2	13.6	5.2	100
South of west Bank	72.7	24.0	3.3	100
Gaza Strip	**5.3**	**62.8**	**31.9**	**100**

Source: PCBS: Household Environmental Survey 2011

4. 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.

4.1. 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 resurgence of hostilities. As noted by a male Focus Group Discussion participant: *“…the most important concern to us as older people is the insecurity; every moment we expect another attack, we are afraid that our children will be killed…I am 62 years old and* *have lived through three wars during my life, yet I have not lived through such a war as this one. It is the worst – missiles fell on us like rain."*

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

4.2. 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 populations (12.7 beds in the West Bank and 13.5 beds in the Gaza Strip)[8].

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.

[8]Palestinian Ministry of Health, Health Annual Report Palestine.; Palestinian Health Information Centre, 2010

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).

Many 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[9].

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.

4.3. 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

[9] Palestinian Ministry of Health, Health Annual Report Palestine; Palestinian Health Information Centre, 2010

the health impacts of poor water and sanitation on children 5-year old or less, is $20 million, equivalent to 0.37% of GDP

5. Human Development Profile

5.1. Literacy Rate and Educational Attainment

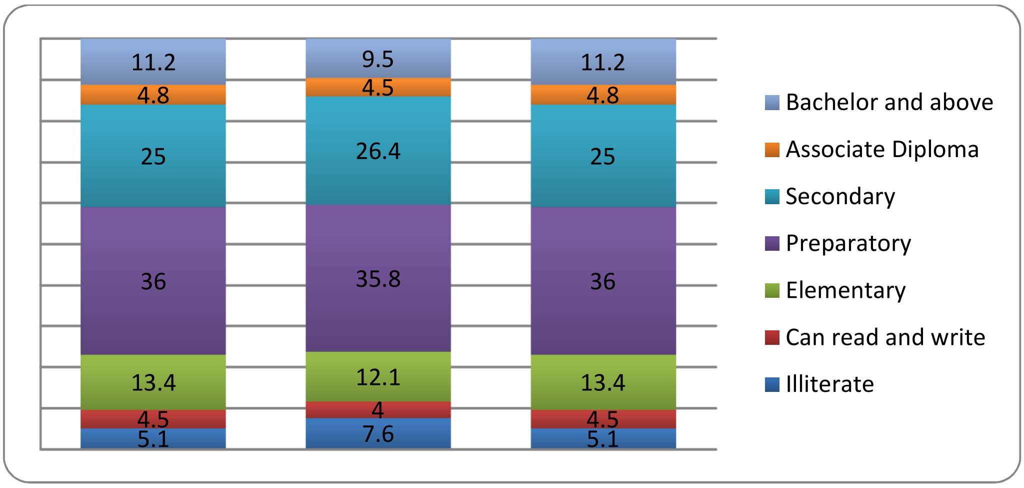
As could be observed from the table below, the literacy level is generally high in the Gaza Strip, reaching almost95% of the population above 15 years of age. Gender discrepancy is not significant, except in the groups above 45 years of age. This could be attributed to an increased level of awareness of the importance of girls' education.

Table 10. Literacy Rates of Gaza Strip Population (15 Years and Above) by Age Groups and Sex, 2009

Age group	% of literate persons from the population of the age group		
	Male	**Female**	Total
15 – 19	**99.3**	**99.2**	99.2
20 – 24	**99.1**	**98.6**	98.9
25 – 34	**98.5**	**98.3**	98.4
35 – 44	**98.7**	**96.4**	97.6
45+	**91.4**	**70.4**	80.6
Total	97.4	92.4	94.9

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

The level of attained education is shown in the figure below. As could be observed, the largest portion of literate population attained preparatory education 36.0%, followed by the secondary education certificate 25.0%. Here there is relatively high gender equity as well, with similar percentages of men and women attaining various educational degrees.



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

Figure 7. Percentage Distribution of Gaza Strip Population (15 years of age and above) by Educational Attainment and Sex, 2009 in Gaza Strip

5.2. Employment Status

The general unemployment rate in the Palestinian Territories is considered high, at 24.5% of the labor force. Unemployment in Gaza is double the rate in the West Bank (38.6% versus17.8% in 2010). Gaza City has the lowest unemployment rate in the Gaza Strip at 31%[10].

Unemployment is slightly higher for women than men in the Palestinian Territories (26.4% versus 24.1%). However, the gap is relatively high in the Gaza Strip as 37.3% of males are unemployed, whereas 45.8% of females are not working.

The various sources of literature and the field observations showed that temporary modes of employment are dominant in Gaza market. Most of the jobs are characterized by daily wages and short term contracts. The national statistics for the Palestinian Territories showed a rise in the daily wage rates for workers in 2010, most notably in the West Bank. It also showed a modest increase in Gaza; where daily wages average remain only about 70% of wages in the West Bank. In 2010, the average daily wage recorded was NIS 59.5 per day, with a low average wage of around NIS 55 per day in Khan Younis and a high average wage of NIS 71 per day in Rafah. Although this might be a relatively high wage rate compared to the case in other developing countries, the rate is still too low to allow families to meet the basic needs and daily demands given the relatively high prices as a result of the blockade and severe economic restrictions. More information about labor status is presented below.

Table 11. Percentage distribution of population (15 years and above) in the Palestinian Territories by gender and labor force status year 2007-2009

Labour force status and gender	Year		
	2007	2008	2009
Total Population			
In labor force	41.7	41.2	41.6
outside labor force	58.3	58.8	58.4
Total	100	100	100
Full employment	70.3	66.5	69.6
Under employment	8	6.9	5.9
Unemployment	21.7	26.6	24.5
Total	100	100	100
Males			
In labor force	67.1	66.6	67.1
outside labor force	32.9	33.4	32.9
Total	100	100	100
Full employment	68.5	64.9	69.1
Under employment	9.2	7.9	6.8
Unemployment	22.3	27.2	24.1
Total	100	100	100

[10] Socioeconomic Report, January 2011, UNSCO

Labour force status and gender	Year		
	2007	2008	2009
Females			
In labor force	15.7	15.3	15.5
outside labor force	84.3	84.7	84.5
Total	100	100	100
Full employment	78.6	73.7	71.3
Under employment	2.4	2.1	2.3
Unemployment	19	24.2	26.4
Total	100	100	100

Table 12. Percentage distribution of population (15 years and above) in the Palestinian Territories by gender and labor force status

Labour force status and gender	Palestinian Territories	Region	
		West Bank	Gaza Strip
Total Population			
In labor force	41.6	43.8	37.6
outside labor force	58.4	56.2	62.4
Total	100	100	100
Full employment	69.6	76	55.9
Under employment	5.9	6.2	5.5
Unemployment	24.5	17.8	38.6
Total	100	100	100
Males			
In labor force	67	69.5	62.5
outside labor force	33	30.5	37.5
Total	100	100	100
Full employment	69.1	75.1	57
Under employment	6.8	7.3	5.7
Unemployment	24.1	17.6	37.3
Total	100	100	100
Females			
In labor force	15.5	17.4	12.2
outside labor force	84.5	82.6	87.8
Total	100	100	100
Full employment	71.3	79.7	50
Under employment	2.3	1.5	4.2
Unemployment	26.4	18.8	45.8
Total	100	100	100

5.3. Economic Wellbeing

With a growing population and a shrinking economy, real GDP per capita is close to 30%below 1999 levels. 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 2008is slightly negative. Similarly, the International Monetary Fund 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 in the Palestinian Central Bureau of Statistics (2007) 'Economic forecasts for 2007'.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 but stressed 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, in2007 the estimated recurrent and developmental budget support added up to 5% of GDP. This, in part, 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 indictor 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 13 Proportion of population below national poverty line

	Year			
Year	**2004**	**2005**	**2006**	**2007**
Total	**25.6**	**29.5**	**30.8**	**34.5**
Male	26.0	29.8	30.3	34.5
Female	21.0	25.0	35.6	34.5
Urban	24.4	24.9	29.3	33.1
Rural	24.6	32.5	29.5	30.3
Camps	31.6	39.9	38.6	47.7
Gaza Strip	37.2	43.7	50.7	55.7
West Bank	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[11].

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.

5.4. Economic Activities

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 14 Percentage Distribution of Employed Persons from Gaza Strip by Economic Activity and Sex, 2009

Economic Activity	Percentage of the work force		
	Male	Female	Total
Agriculture, hunting and fishing	6.5	5.6	**6.4**
Mining, quarrying and manufacturing	5.9	2.0	**5.4**
Construction	1.0	-	**0.9**
Commerce, hotels and restaurants	20.7	4.1	**18.3**
Transportation, storage and communication	6.3	1.7	**5.7**
Services and other branches	59.6	86.6	**63.3**
Total	**100**	**100**	**100**

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

[11] Living Conditions in Gaza Strip, during and after Israel's military campaign in the winter of 2008/2009 Evidence from interviews with 2,000 households, UNFPA, 2009

6. Sewage Status in the Gaza Strip

6.1. 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 23m^3 in the Palestinian Territories: 23.6 m^3 in the West Bank and 24.3m^3 in the Gaza Strip

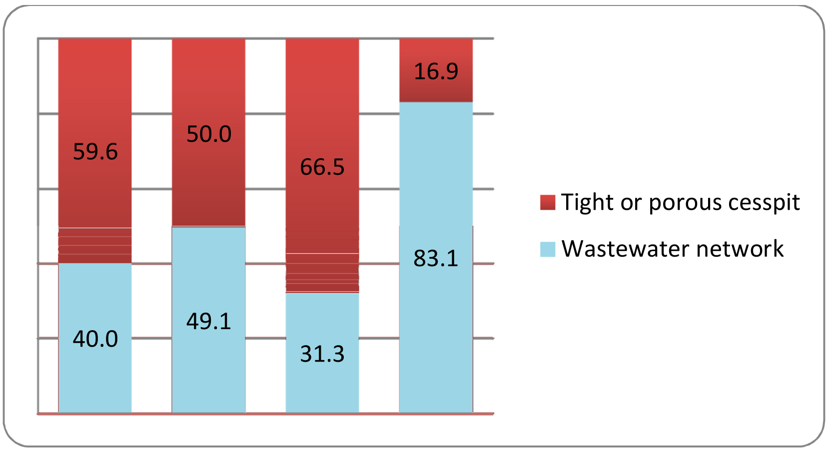
Table 15 Amount of consumed water in the household sector in Palestinian Territories (1000m^3) and household monthly average consumption of water (m^3) by region, 2011

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

Source: PCBS Household Environmental Survey 2011

6.2. 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.



Source: PCBS: Household Environmental Survey 2011

Figure 8. Wastewater disposal method

Table 16. Percentage distribution of households in the Palestinian Territories by the wastewater disposal method and region, 2011

	Disposal method of wastewater				
	Wastewater network %	Porous cesspit %	Tight cesspit %	Others %	Total
Palestinian Territories	55.0	39.0	5.3	0.7	**100**
West Bank	40.2	51.1	7.5	1.2	**100**
North of West Bank	40.0	49.8	9.8	0.4	100
Middle of West Bank	49.1	38.2	11.8	0.9	100
South of west Bank	31.3	66.5	0.0	2.2	100
Gaza Strip	83.1	15.8	1.1	0.0	100

Source: PCBS: Household Environmental Survey 2011

Table 17. Percentage distribution of households in the Palestinian Territories by the wastewater disposal method region, and locality type, 2011

	Disposal method of wastewater				
	Wastewater network %	Porous cesspit %	Tight cesspit %	Others %	Total
Palestinian Territories	**55.0**	**39.0**	**5.3**	**0.7**	**100**
Urban	60.9	34.7	3.8	0.6	100
Rural	10.3	74.0	14.5	1.2	100
Camps	90.9	8.4	0.6	0.1	100
West Bank	**40.2**	**51.1**	**7.5**	**1.2**	**100**
Urban	47.0	46.5	5.4	1.1	100
Rural	8.8	74.5	15.4	1.3	100
Camps	90.5	8.6	0.6	0.3	100
Gaza Strip	**83.1**	**15.8**	**1.1**	**0.0**	**100**
Urban	83.3	15.5	1.2	0.0	100
Rural	34.5	65.5	0.0	0.0	100
Camps	91.2	8.2	0.6	0.0	100

Source: PCBS: Household Environmental Survey 2011

Table 18. Selected indicators of the household environment in the Palestinian Territories during years 2004, 2006,2008,2009,2011

Indicator	**2004**	**2006**	**2008**	**2009**	**2011**
Percentage distribution of households by:					
Availability of public network water	**89.2**	**88.6**	**88.2**	**88.4**	**91.8**
Quality of households water					
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**

Indicator	2004	2006	2008	2009	2011
Wastewater disposal method					
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**
Exposure to smell					
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 19. Percentage distribution of households exposed to smell in the Palestinian Territories by time of exposure and region, 2011

	Time of exposure				
	6 AM- 12 PM %	12 PM-8 PM %	8 PM- 6 AM %	No specific time %	Total
Palestinian Territories	**7.4**	**6.0**	**21.1**	**65.5**	**100**
West Bank	**10.3**	**7.2**	**13.7**	**68.8**	**100**
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
Gaza Strip	**3.9**	**4.7**	**29.7**	**61.7**	**100**

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 20 Percentage distribution of households exposed to smell in the Palestinian Territories by the most important source of smell and region, 2011

	Source of smell					
	Waste water %	Dumping site %	Agricultural waste %	Traffic %	Others %	Total
Palestinian Territories	**37.1**	**30.0**	**26.0**	**3.0**	**3.9**	**100**
West Bank	**35.0**	**24.4**	**31.4**	**4.8**	**4.4**	**100**
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

	Source of smell					
	Waste water %	Dumping site %	Agricultural waste %	Traffic %	Others %	Total
South of west Bank	33.0	21.4	37.4	1.0	7.2	100
Gaza Strip	**39.6**	**36.5**	**19.7**	**0.8**	**3.4**	**100**

Source: PCBS: Household Environmental Survey 2011

6.3. 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/m3, 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.[12]

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

[12]West Bank and Gaza Assessment of restrictions on Palestinian Water Sector Development, sector note, World Bank April 2009

by a minimum of 60%, and a maximum of 300%. Water prices that before the Intifada were generally in the range 5-10 NIS/m3 were now typically in the range 10-20 NIS/m3. 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.43water tankers.

7. Agriculture sector in Gaza

7.1. Land Use, Communities Infrastructure and Services

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^2.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 21. Agricultural Land Use in Gaza Strip

Agricultural Land Use in Gaza Strip		Cultivation Type							
Region/ Governorate	**Total Agricultural land (Km^2)**	**Permanent Crops (Km^2)**				**Temporary Crops (Km^2)**			
		Irrigated		Rain-fed		Irrigated		Rain-fed	
		2007	2008	2007	2008	2007	2008	2007	2008
North Gaza	14.5	5.1	5.1	0.2	0.2	7.8	7.2	2.1	2.0
Gaza	16.7	22.0	13.4	0.6	3.1	1.3	1.1	1.4	1.1
Deir El Balah	21.8	12.6	12.6	1.6	1.6	6.5	5.0	2.7	2.6
Khan Yunis	37.5	14.5	14.5	2.5	2.5	12.3	10.5	12.4	10.0
Rafah	17.4	5.2	5.2	1.6	1.6	8.9	8.5	2.4	2.1
Total Strip	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 22. Production of field crops, fruit, trees and vegetables by region 2007/2008

Region/Governorate	Field crops	Fruit trees	Vegetables
North Gaza	18,619	5,496	29,662
Gaza	863	22,606	9,400
Deir El Balah	3,506	12,750	38,074

Region/Governorate	Field crops	Fruit trees	Vegetables
Khan Yunis	26,572	8,066	64,827
Rafah	22,956	5,013	73,288
Total Strip	**72,516**	**53,931**	**215,251**
Production in Ton			

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

8. Archaeology

The known history of Gaza spans 4,000 years[13]. 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

[13] http://en.wikipedia.org/wiki/History_of_Gaza

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.

8.1. Archaeological Conditions of Project Sites

During the Roman-Byzantine period Beit Lahia was a well-populated village possessing several temples, greatly venerated by the inhabitants for their antiquity and furnishing. The location of this village is identified with the site of Tell ad-dahab (the gold-mound), which was located to the west of the present day Beit Lahia and Tell al- Khirba (the ruins-mound) located in the eastern part of Beit Lahia. Many archaeological remains, such as pottery and glass fragments as well as coins were discovered in the soil of the two sites. Field surveys in the area of the BLWWTP did not identify any archaeological sites so far. The nearest archaeological remains in the area is Tell al-Khirb, situated in the eastern part of Beit Lahya, 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 Fatamid period and beginning of the Ayyubid Dynasty of Saladin, and two other mosques dating to the Ottoman period.

Willingness and Cost Analysis and Tariffs Surveys Results

Willingness Survey and Cost Analysis and Tariffs Survey Results

1. Willingness Survey Results

1.1. Introduction

One of the crucial issues to be investigated in the SESIA study is the willingness of people to use the recovered water and sludge. If the market is not ready for such products, this might be a problem for the project sustainability. Previous studies have covered issues of affordability, but with limited focus on people's willingness to pay. However, the current study paid more attention to measuring the willingness of farmers to use sludge and recovered water, as well as people's perceptions regarding the use of agricultural products irrigated by recovered water or fertilized by sludge. The willingness to pay survey aims to highlight the following items:

- Acceptance to use recovered water in irrigation and reasons behind actions (target groups are the farmers)
- Acceptance to use the sludge as fertilizer and justifications for the actions (target groups are the farmers)
- Acceptance to purchase products irrigated by recovered water and reasons for different actions. (target groups are the farmers, traders and consumers)
- Acceptance to purchase products fertilized by sludge and motives for that. (target groups are the farmers, traders and consumers)

The study team tried to have a representative sample that covered the most common types of markets existing in Gaza Strip. A preliminary screening for the types of markets revealed that there are three main types of markets in the Strip:

- **One day market:** this type of market is established for one day in the Refugee Camps. Consumers purchase their needs for the whole week in one day. This type of market is movable. For example, on Thursday it is moved to El Berig. While on Saturday it is in El Noseirat. Its prices are relatively lower than what can be found in permanent markets.
- **Permanents market:** this is a fixed market in the center of a town where agricultural products are traded. Based on observation, it is attractive to the consumers of low socio-economic conditions. There is no variation in the prices there.
- **Super markets:** The higher socio-economic groups target the supermarkets, which have the highest prices and better qualities, generally.

This discussion attempts to measure the factors that influence purchasing of vegetables and fruits. The data reveals that the type of water used was not on the focus of consumers or traders, and was actually one of the factors of lowest importance. They paid more attention to the shape, which reflects the quality of products, and the price. For the supermarkets, the traders paid less attention to the price. However, in the permanent market they paid more attention to the price. This should be put into consideration during the preparation of the advertising strategy, as people don't pay attention to water used.

Table 1. % sample distribution by the influence of price to buy agricultural products by the type of market

	One day market	Supermarket	Permanent	Total	One day market	Supermarket	Permanent	Total
High	45.00%	29.40%	71.40%	47.10%	55.50%		37.80%	42.50%
Intermediate	55.00%	70.60%	28.60%	52.90%	44.50%	96.00%	60.20%	56.30%
Low						4.00%	2.00%	1.10%

Table 2. % sample distribution by the influence of shape to buy agricultural products by the type of market

	One day market	Supermarket	Permanent	Total	One day market	Supermarket	Permanent	Total
High	55.00%	70.60%	28.60%	52.90%	44.50%	100.00%	59.70%	56.80%
Intermediate	45.00%	29.40%	71.40%	47.10%	55.50%		39.80%	43.10%
Low							0.50%	0.10%

1.2. Willingness to Re-use Scheme

The acceptance of farmers to use recovered water was relatively high, as 50% of the farmers sampled expressed their acceptance of it, with an additional32.4% who accepted under certain conditions. Those who accepted to use sludge represented about 64.0% of the farmer sample surveyed, with an additional 12.1% who would accept the sludge under conditions.

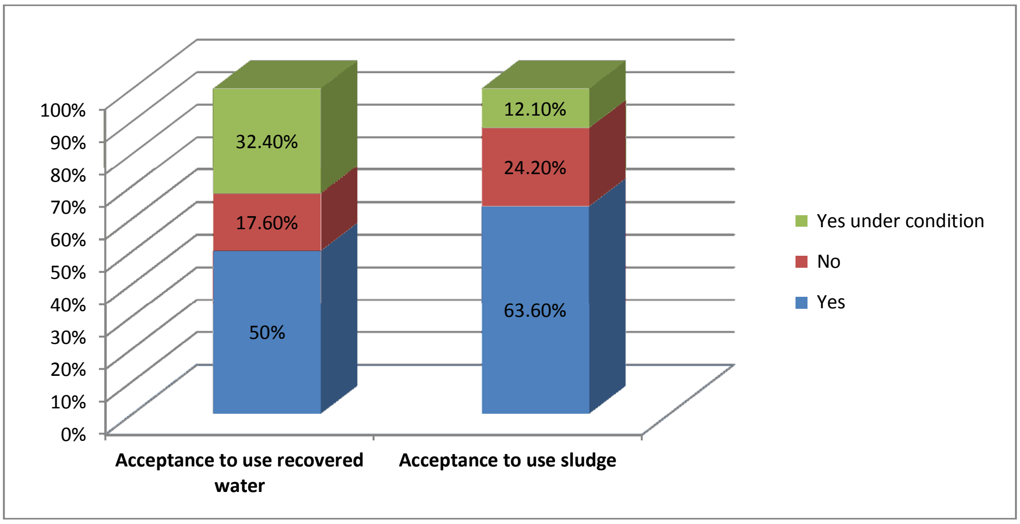


Figure 1: % Distribution of farmers perception to use sludge and recovered water

The acceptance of farmers to eat agricultural products irrigated by recovered water and fertilized by sludge was investigated. The percentage of farmers who would eat products which used recovered water or sludge was slightly lower than the percentage who would use the recovered water, indicating some slight aversion to consuming the end products.

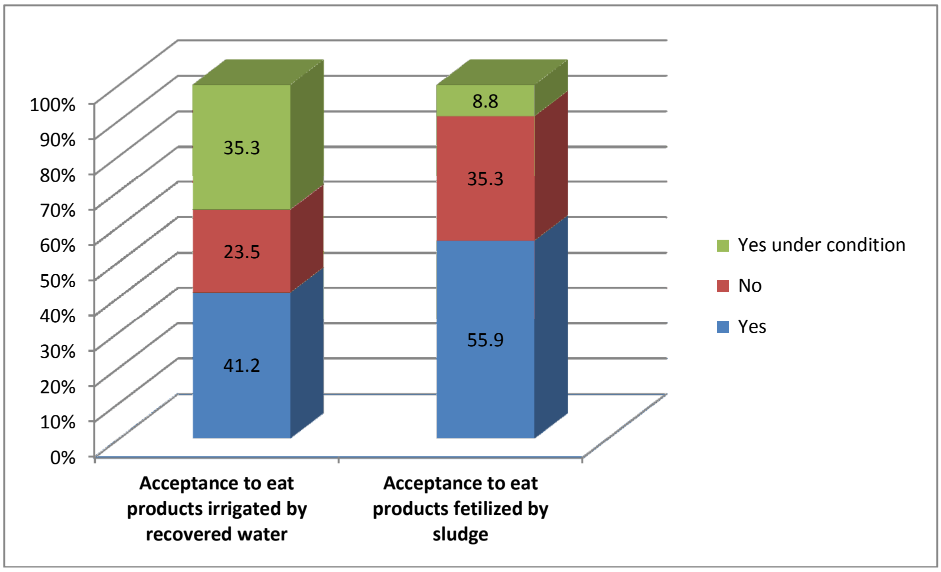


Figure 2 % Distribution of farmers perception to eat products sludge and recovered water

Regardless of the small sample size of farmers (34 individuals), due to the high rejection to be interviewed, the diversity of their perception reflected the motives behind such perceptions. The first reason mentioned was that the quality of crops is better than using recovered water. This is an important result since the farmers are capable of differentiating between the two choices. The second reason was that the trees and soils might absorb any parcels, indicating that no potential pollution is expected. The successful pilot project implemented by Israel encouraged the farmers to use recovered water. Contributing to solving the water problem was also one of the reasons reported.

Heath hazards were the main motive to reject using the recovered water, followed by psychological barriers. "*I can't imagine using sewage water to irrigate my plants*" reported one of the farmers in Ezbet Abd Rabouh. There was a lack of trust in the institute that will operate the project and manage it. Another reason reported during the FGD conducted in Um El Nasr village was that there is no need to use recovered water when fresh water is available. One of the participants reported that he rejected using the recovered water according to religious beliefs. This position was verified later on with the *Fatwa* Department in the Islamic University.

It was also noted that the owners of wells were more reluctant to use recovered water as they have fresh sources of water. However, those who do not have a source of water are more accepting of the recovered water. Moreover, some of them reported that they might use the partially recovered water in order to reduce the cost of irrigation water. "*We have to use recovered water, we can't rely upon the municipality water or well water because it might cost a lot, those who relied upon fresh water lost their money"* reported one of the farmers in Um El Nasr Village.

Another reason reported by one of the farmers in the FGD: "*Anything that might cause harm to people is banned according to religion (Islamic Religion) As well, I can't trust the farmers, and they might use recovered water to irrigate vegetables which is completely banned and not acceptable according to the restrictions… No one can guarantee a full monitoring on the farmers.*"

All worries related to the usage of recovered water should be highlighted in order to communicate them to the advertising team for future preparation of the awareness campaigns. Acceptance under conditions was limited to following the maximum safety procedures to ensure that the water is suitable to be used for agricultural products and doesn't cause diseases. The FGDs noted the importance of following the maximum monitoring procedures.

Table 3: Distribution of farmer sample by reasons for perception of eating agricultural products irrigated by recoveredwater

	Farmer sample	% Farmer sample
Reasons for accepting to eat agricultural products irrigated by recovered water		
The quality of crops is better than using recoveredwater	6	50
Trees and soil absorb any parcels	3	25
It was tried before in Israel	2	16.7
To solve water problems	1	8.3
Total	12	100
Reasons for not accepting to eat agricultural products irrigated by recovered water		
It has health hazards	4	50

	Farmer sample	% Farmer sample
Physiological barrier	1	12.5
I can't guarantee full treatment	1	12.5
Israeli use it for limited crops	1	12.5
Total	8	100
Reasons for accepting to eat agricultural products irrigated by recovered water under condition		
Safety should be guarantee	6	50
Water problem to be solved	2	16.7
Can be used for agricultural products	2	16.7
Not causing disease	1	8.3
Cost less	1	8.3
Total	12	100

Sludge use was more acceptable to the respondents, as it is better than using chemicals and has more nutrients for the soil. No potential hazards for both people and animals were one of the reasons for accepting using sludge.

Regarding those who were not willing to eat products fertilized by sludge, the main reason was psychological barriers. The second reason was being unhealthy and hazardous to people due to the heavy metals that might cause diseases. An additional reason was that it might change the taste of fruit.

For those who accept use the sludge with conditions, the reasons given were that it would not have any potential hazards and reduce consumption of chemicals, in addition to protecting from diseases. The FGD respondents were much in favor of sludge due to reduced usage of chemicals, as well as the reduction of importing chemical fertilizers from Israel. Based on in-depth interviews conducted with different stakeholders, the economic benefit of using the sludge is relatively high, as the new sector will develop job opportunities and reduce the importing of other fertilizers.

Table 4: Distribution of farmer sample by reasons for perception of eating agricultural products fertilized by sludge

	Farmer sample	% Farmer sample
Reasons for accepting to eat agricultural products fertilized by sludge		
Dissolved in the soil	3	21.4
Better than using chemicals	4	28.6
More nutrients to the soil	2	14.3
Has no hazards	4	28.6
Useful for the plant	1	7.1
Total	14	100
Reasons for not accepting to eat agricultural products fertilized by sludge		
Unhealthy and hazardous	1	16.7

	Farmer sample	% Farmer sample
Cause disease	1	16.7
Psychologicalbarrier	3	50
Change the taste of fruit	1	16.7
Total	6	100
Reasons for accepting to eat agricultural products fertilized by sludge under condition		
Has no hazards	5	45.5
Reduce the consumption of chemicals	5	45.5
Protect from diseases	1	9.1
Total	11	100

1.3. Willingness to Purchase Products

The second level of the market analysis concerns the traders and consumers. They were investigated in the markets as mentioned above. Their willingness to purchase the agricultural products irrigated by recovered water or fertilized by sludge was investigated. The farmers in (small hamlet) Ezbet Abd Rabouh reported that the consumers can't differentiate between the crops irrigated by recovered or fresh water, and they are not capable of knowing what crops were naturally grown or fertilized by hormones and chemicals. They noted that they, as farmers, know how to differentiate between such crops. Knowing this information might offer support in dealing with such types of crops.

64.7% of the traders of supermarkets refused to trade in products irrigated by recovered water versus52.9% of them refused trading in crops fertilized by sludge. The highest acceptance rate reported was in the permanent markets, with acceptances of 78.6% for water and sludge. In the one day market, recovered water irrigated and sludge fertilized crops were mostly accepted under conditions (40.0%). Those who accepted using the recovered water products under condition represented 55.0% of the purchasers in the one day market.

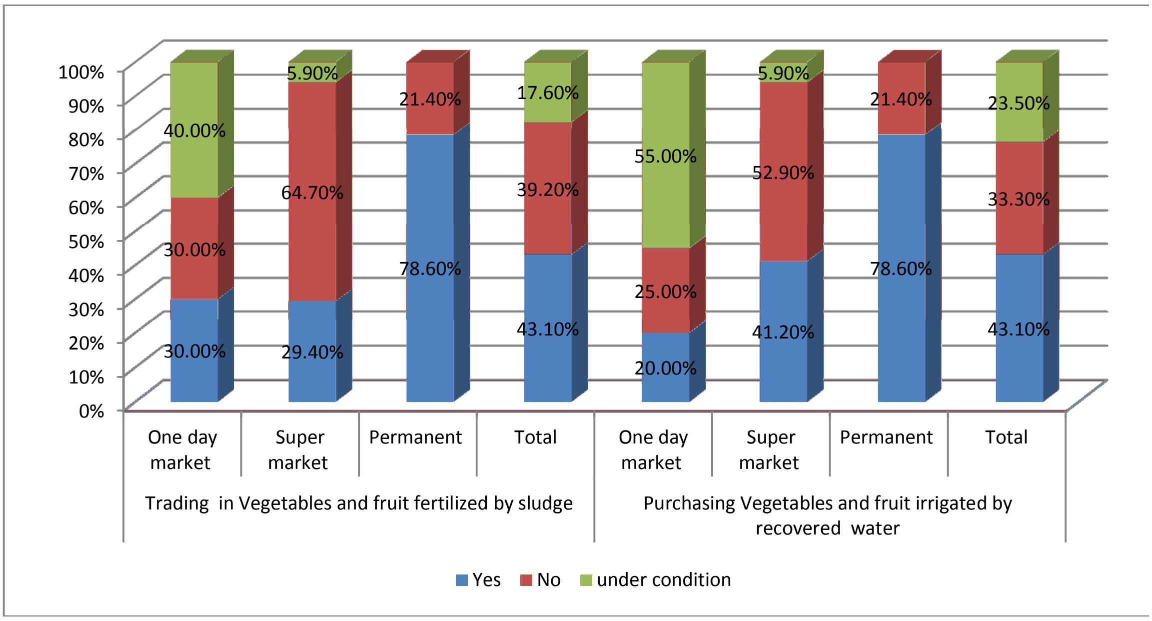


Figure 3: % Distribution of the traders willingness to trade in products irrigated by recoveredwater or fertilized by sludge according to market type

The reasons for accepting to use the products irrigated by recovered water was mainly that customers never pay attention to ask about the source of water used to irrigate the crops and they never ask about the fertilizers used. In the supermarkets, the traders were confident since these techniques have already been tested before. In comparison between water used now and recovered water the traders in the permanent markets were confident that the recovered water is better.

Investigating reasons of the reluctant traders who are not much in favor of using such type of water and sludge, the results were as follows: In the supermarkets, they were much in favor of their own shops repetition. While 80% of the traders in the one day market were worried about health, a high percentage of health worries was also reported in the permanent market.

Safety of people is the main worry of the traders. Therefore, accepting under condition was mainly linked with the assurance of health and safety measures. Traders in the one day market also reported that these products would be more profitable. The farmers in Ezbet Abd Rabouh reported that the customers pay attention to the price, whereas, the traders and farmers pay more attention to their profit "*The crops fertilized by hormones and watered by untreated water is more profitable to the farmers. They pay no attention to the health of people, regardless of the strict monitoring… but the farmers try to gain more and more money…When we go to the market we can identify the unhealthy crops …but other people will not pay attention for that they might care only for the shape and the price of the crops*"

Table 5: % Distribution of the traders sample by reasons for perception of dealing in crops irrigated by recoveredwaterby the market type

	Market Type			Total
	One day market	Super market	Permanent	
Reasons for acceptance dealing in crops irrigated by recovered water				
It has already been tried before		57.10%	9.10%	22.70%
Better water quality		14.30%	54.50%	31.80%
Customers don't care	75.00%	14.30%	27.30%	31.80%
Shopkeeper does not care	25.00%	14.30%	9.10%	13.60%
Reasons for rejecting dealing in crops irrigated by recovered water				
Caring for shop repetition	20.00%	55.60%	33.30%	41.20%
Health worries	80.00%	44.40%	66.70%	58.80%
Reasons for accepting (under condition) dealing in Crops irrigated by recovered water				
Under condition that safety is guarantee	63.60%	100.00%		66.70%
In case of customers accept it	27.30%			25.00%
If it were more profitable	9.10%			8.30%

Sludge means for the majority of sample surveyed a non-chemical substance which is better than chemical fertilizers that are relatively more hazardous and dangerous for health. The traders noted that the consumers don't pay attention to the fertilizers used as long as the product looks in a good shape. Traders also care less about fertilizers. They only pay attention to the consumers' willingness.

Caring for health was the first reason among different markets that might make them unwelcoming to the crops fertilized by sludge, followed by caring for shop reputation, especially in the supermarkets. Another reason for not accepting the crops is customers' willingness to purchase such crops.

Table 6: % Distribution of the traders sample by reasons for perceptionof dealing in cropsfertilized by sludge

	Market Type			Total
	One day market	Super market	Permanent	
Reasons for acceptance dealing in crops fertilized by sludge				
Better than fertilizers and chemicals		60.00%	54.50%	40.90%
Customers don't care	33.30%	20.00%	36.40%	31.80%

	Market Type			Total
	One day market	Super market	Permanent	
Sales person does not care	66.70%	20.00%	9.10%	27.30%
Reasons for not accepting dealing in Crops fertilized by sludge				
Caring for shop repetition	16.70%	45.50%	33.30%	35.00%
Health worries	50.00%	54.50%	66.70%	55.00%
Customers willingness	33.30%			10.00%

The most important pillar in merchandizing any product is the willingness of the final consumers to purchase the product. Investigating consumers' willingness in three markets it was notable that a high acceptance rate to purchase products irrigated by recovered water is reported in the one day market (82.0%) followed by permanent market (63.3%). While the lowest willingness reported was in the super market (43.0%). The acceptance to purchase crops fertilized by sludge was the highest in the one day market (83.5%) followed by the permanent and the supermarket. This result reflected that both traders and consumers adopted the same purchasing attitudes.

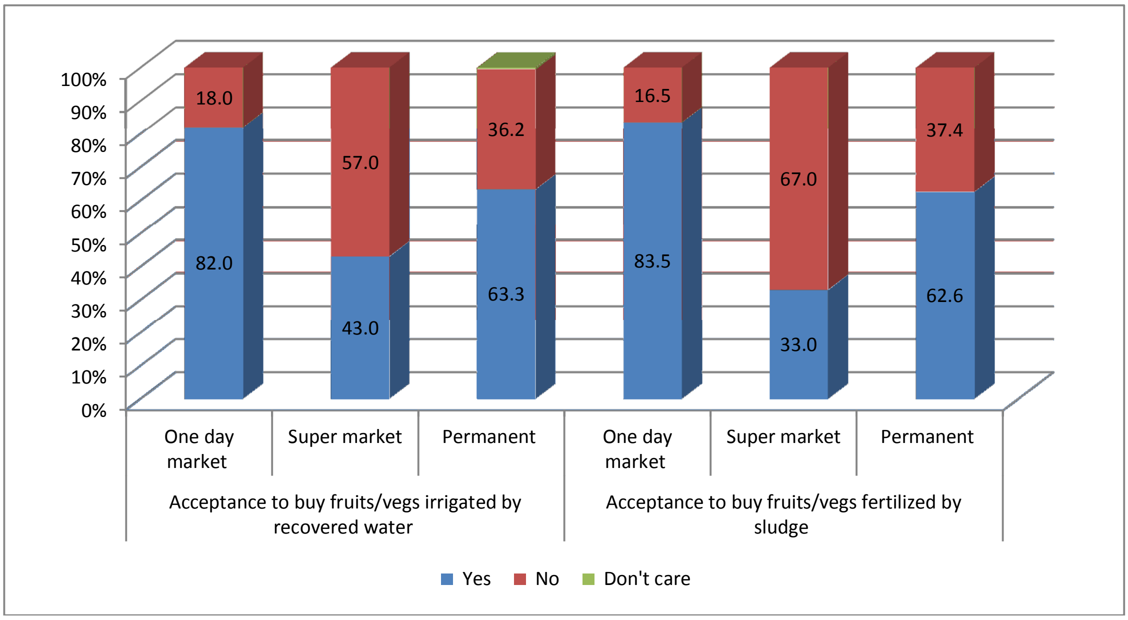


Figure 4.:% Distribution of the consumerswillingness to purchaseproducts irrigated by recoveredwater or fertilized by sludge according to market type

The motives reported regarding such attitudes were investigated to get a more detailed profile regarding the willingness of people to purchase such agricultural products. High acceptance rates were reported in the one day market (72.6%) as they don't care about type of water used. Meanwhile, almost 35.0% of the supermarket consumers reported acceptance under conditions of applying the maximum health and safety measures. A quarter of the sample surveyed in the permanent market reported they don't mind purchasing the products under conditions of applying safety measures. Solving the problem of water scarcity was the reason for about30.0% of the supermarket sample.

The small portion of sample who rejected purchasing crops irrigated by recovered water was mainly due to health concerns, followed by psychological barriers

The farmers investigated in the FGD reported the same reasons, adding to them that there was no necessity to use recovered water as long as they have their own wells that produce fresh water.

Looking at consumers according to gender, 66.8% of the females reported that they don't care about water used, while only 55.4% of the male sample reported the same reason. While almost a quarter of the male sample reported paying attention to applying the maximum safety procedures versus only 8.9% of the female sample.

Among the small quintile of the sample who reported that they are unwilling to purchase crops irrigated by recovered water, 60.9% of the males reasoned that it will cause disease, while only a third of them reported that they have psychological reasons for not accepting. The females who refused due to psychological reasons represent half of those who declared their rejection.

Table 7: Distribution of the consumer sample by reasons for perception ofdealing in cropsirrigated by recovered waterby market type

		Market Type			Total
		One day market	Super market	Permanent	
Acceptance crops irrigated by recovered water					
Don't care	N	238	4	44	286
	%	72.6%	9.3%	35.2%	
I trust the people in charge	N	6	3	9	18
	%	1.8%	7.0%	7.2%	
I trust the technique	N	10	8	8	26
	%	3.0%	18.6%	6.4%	
Safe	N	22	7	10	39
	%	6.7%	16.3%	8.0%	
Under condition of applying the maximum health and safety precautions	N	52	15	32	99
	%	15.9%	34.9%	25.6%	
In order to solve water problem	N	4	13	23	40
	%	1.2%	30.2%	18.4%	
Rejection crops irrigated by recovered water					
Definitely it will cause disease	N	44	30	43	117
	%	61.1%	52.6%	62.3%	
I don't trust the people in charge	N	6	1	4	11

		Market Type			Total
		One day market	Super market	Permanent	
	%	8.3%	1.8%	5.8%	
Psychological reasons	N	24	26	24	74
	%	33.3%	45.6%	34.8%	

Multiple responses

The reasons that lead to the acceptance of purchasing crops fertilized by sludge were mainly because it is better than chemical substances. However, the majority of the consumers in the one day market reported their acceptance due to not paying any attention to such issues. Being a healthier alternative to other fertilizers was one of the main reasons reported in the supermarkets. Females paid no attention to the type of fertilizers used. While males were much in favour of the sludge as it is better and healthier than the other types of fertilizers.

The rejection of using sludge was mainly due to related diseases. That was the prevailing reason reported in the three markets. The second factor reported was psychological reasons. That was the main reason reported in the one day market (51.5%), followed by the supermarket (43.3%). When divided by gender, 55.9% of males who rejected the crops did so due to causing diseases, followed by 40.1% due to psychological problems. The limited female sample who reported their rejection was mainly due to psychological reasons 65.5%, while 34.5% reported rejection due to causing disease.

Table 8.: Distribution of the consumer sample by reasons for accepting dealing in cropsfertilized by sludgeby market type

		Market Type			Total
		One day market	Super market	Permanent	
Acceptance crops fertilized by sludge					
Better than chemicals	N	46	17	30	93
	%	13.8%	51.5%	24.6%	
Don't care	N	210	3	42	255
	%	62.9%	9.1%	34.4%	
I trust the people in charge	N	4	1	7	12
	%	1.2%	3.0%	5.7%	
I trust the technique	N	4	2	3	9
	%	1.2%	6.1%	2.5%	
Safe	N	14	7	18	39
	%	4.2%	21.2%	14.8%	
Healthier	N	56	11	23	90
	%	16.8%	33.3%	18.9%	
Rejection of crops fertilized by sludge					
Cause disease	N	32	37	40	109

		Market Type			Total
		One day market	Super market	Permanent	
	%	48.5%	55.2%	54.8%	
Don't care	N	0	0	1	1
	%	.0%	.0%	1.4%	
I don't trust the people in charge	N	2	1	2	5
	%	3.0%	1.5%	2.7%	
Psychological reasons	N	34	29	27	90
	%	51.5%	43.3%	37.0%	
For health reasons	N	0	0	3	3
	%	.0%	.0%	4.1%	

Multiple responses

The conclusions of the above discussion are that:

1- High acceptance for using recovered water and sludge among different farmers. While those who own private wells are not much in favor of using such water.
2- Sludge is widely accepted due to no health problems and being more fertile for the plants
3- Consumers pay no attention to water used or type of fertilizers as the end result is a product of a good quality with appropriate pricing
4- The supermarkets are more reluctant to use such products as the typical consumer is of a higher socio-economic status and pays more attention to healthy products. As well, the supermarkets pay more attention to their own reputation.
5- The advertising plan should focus on the one day market and the permanent market as they attract more consumers, and recognize that the customers generally don't pay attention to the type of fertilizers or water used.

1.4. Willingness to Terminate Private Wells

The willingness to terminate the private wells was investigated as part of the willingness and perception section. About 59.0% of the sample would accept terminating their wells under conditions of having appropriate compensation for the cost of the well digging in addition to the provision of recovered water free of charge. Any additional support needed from the municipality should be applied in order to put limitations on the un-favorable impacts resulting from the termination of wells.

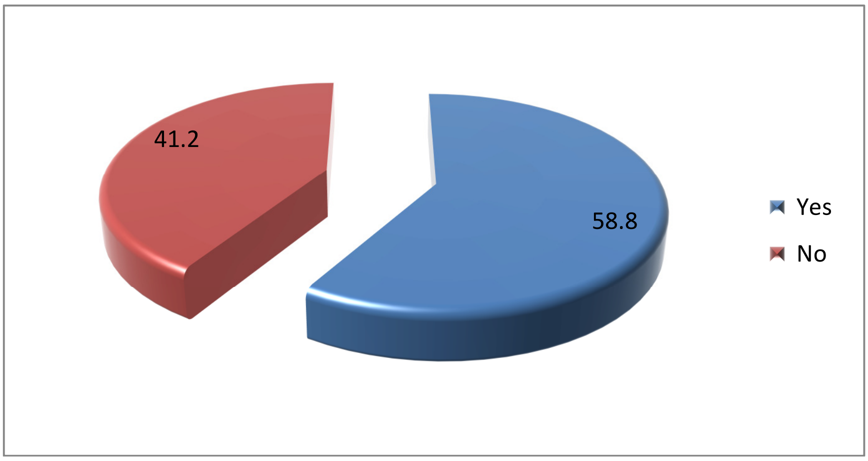


Figure 5: % distribution of farmers by their willingness to terminate their wells

Acceptances of having restrictions to use their private wells were highlighted due to the procedures that might ban certain activities that need the well water. The motives varied according to certain worries the people raised. A health worry was the motive for those who accept or reject the restrictions, since health problems could result from the injection of recovered water. Then the well will not be suitable to be used. However, the recovered water might be better than well water.

Regarding those who rejected having any restrictions, they were mainly the farmers who were worried due to health problems or pollution that might result. Some also expressed the desire to do whatever they want to their wells out of their own freedom. Planting vegetables that need fresh water created worried because of having water that might not be suitable for their type of crops. The project might not be continuous, and this might affect the wells in case of having any restrictions of use.

The third group was neutral, reporting that the wells are not their property as they might have partners (the well might cost $80,000).

Table 9: Perceptions of well restrictions

Perception of having restriction on well	Responses		% Farmer sample of Cases
	N	% Farmer sample	
Acceptance			
To avoid any harm to health of human	3	12.50%	12.50%
If water quality is bad	1	4.20%	4.20%
If the recovered water is good	2	8.30%	8.30%
Rejection			
The injection might cause pollution	2	8.30%	8.30%
Might cause economical problems	3	12.50%	12.50%

Perception of having restriction on well	**Responses**		**% Farmer sample of Cases**
	N	% Farmer sample	
The well is mine no one can do anything for me	3	12.50%	12.50%
I plant certain crops that need the well	1	4.20%	4.20%
I am free to plant whatever I want	2	8.30%	8.30%
I can't trust the quality of water	1	4.20%	4.20%
The project might not be continuous	1	4.20%	4.20%
Neutral			
The well is partially owned	1	4.20%	4.20%
I am helpless I should obey the laws	2	8.30%	8.30%
It is not applied on me as I don't plant vegetables	2	8.30%	8.30%
Total	24	100.00%	100.00%

2. Cost Analysis and Tariff

2.1. Introduction

The cost analysis of the sludge and water recovery was not a simple process for the study team, as calculating the costs should be based on detailed studies that are more suited to using a feasibility study technique. However, the team tried to develop a simple strategy to measure the cost of water and sludge that should be based on a multi-phase strategy.

Water tariffs are set based on a number of formal criteria defined by law, as well as informal criteria. Formal criteria typically include:

- Financial criteria (cost recovery),
- Economic criteria (efficiency pricing based on marginal cost) and sometimes
- Environmental criteria (incentives for water conservation).

Social and political considerations often are also important in setting tariffs. Tariff structure and levels are influenced in some cases by the desire to avoid an overly high burden for poor users. Political considerations in water pricing often lead to a delay in the approval of tariff increases in the run-up to elections. Another criterion for tariff setting is that water tariffs should be easy to understand for consumers. This is not always the case for the more complex types of tariffs, such as increasing-block tariffs and tariffs that differentiate between different categories of users.[14]

[14] http://en.wikipedia.org/wiki/Water_tariff

2.2. Tariff Structures

There are numerous different tariff structures. Their prevalence differs between countries, as shown by international tariff surveys.

Water and wastewater tariffs include at least one of the following components:

- a volumetric tariff, where water metering is applied, and
- a flat rate, where no water metering is applied.

Many utilities apply two-part tariffs where a volumetric tariff is combined with a fixed charge. The latter may include a minimum consumption or not. The level of the fixed charge often depends on the diameter of the connection.

Volumetric tariffs can

- be proportional to consumption (linear tariffs),
- increase with consumption (increasing-block tariffs, IBT), or
- decrease with consumption (decreasing-block tariffs, DBT).

The tariff for a first block on an IBT is usually set at a very low tariff with the objective to protect poor households that are assumed to consume less water than non-poor households. The size of the first block can vary from 5 cubic meters to 50 cubic meters per household and month.

Average monthly water consumption varies depending on household size and consumption habits between about 4 cubic meters for a single-person household in temperate climate with no outdoor water use and about 50 cubic meters for a four-person household in warm climate (e.g. in the Southern United States) including outdoor water use.

Wastewater tariffs typically follow the same structure as water tariffs. They are typically measured based on the volume of water supplied, sometimes after subtracting an allowance made for estimated or actual outdoor use. In the case of industries, wastewater tariffs are sometimes differentiated based on the pollutant load of the wastewater. In some cases wastewater tariffs are a fixed percentage of water tariffs, but usually they are set separately. In addition to regular bills, many utilities levy a one-time connection fee both for water and for sewer connections.

2.3. Tariff Adjustment Processes

The process of adjusting water tariffs differs greatly from one location to another. In many large countries (China, France, Germany, India, Mexico, South Africa and the United States) the process of price adjustment takes place at the municipal level. Rules for price adjustments vary greatly. In the case of public service provision, tariffs are typically adjusted through a decision by the municipal council after a request by the municipal utility. Some countries, such as Germany, stipulate by law that all the financial costs of service provision must be recovered through tariff revenues. Other countries define cost recovery as a long-term objective, such as in Mexico. In the case of private service providers tariff adjustment rules are often laid out in concession or lease contracts, often providing for indexation to inflation.

In some developing countries, water tariffs are set at the national level. Tariff increases are often considered a politically sensitive issue and have to be decided by the Cabinet of Ministers or a National Pricing Commission. This is the case in many countries of the Middle East and North Africa (Egypt, Jordan, Lebanon, Morocco, Syria, Tunisia), as well as in many countries in Sub-Saharan Africa. In many countries, there are no objective criteria for tariff adjustments. Adjustments tend to be infrequent and often lag behind inflation so that cost recovery remains elusive.

Some countries have created regulatory agencies at the national level that review requests for tariff adjustments submitted by service providers. The earliest and best-known example is the regulatory agency OFWAT, which was established for England and Wales in 1989. Some developing countries followed suit. They include Chile (1990), Colombia (1994), Honduras (2004), Kenya, Mozambique (1998), Peru (1994), Portugal (1997), and Zambia (2000). The review process is typically based on transparent and objective criteria set by law, in an attempt to move decision-making at least partly out of the realm of politics. The track record of these agencies has been diverse, usually mirroring the political and administrative traditions of each country.

3. Changes in Water Use in Response to Tariff Increases

The responsiveness of demand to a change in price is measured by the price elasticity of demand, which is defined as the percentage change in demand divided by the percentage change in price. The price elasticity of drinking water demand by urban households is typically low. In European countries it ranges between -0.1 and -0.25, i.e. the demand for water decreases by 0.1% to 0.25% for every 1% increase in tariffs. In Australia and the United States price elasticity is somewhat higher in the range of -0.1 and -0.4.[15]

3.1. Social Protection Measures

Social protection measures to ensure that piped water remains affordable can be broadly classified into income support measures and tariff-related measures. Income support measures address the individual customer's ability to pay from the income side (through income assistance, water services vouchers, tariff rebates and discounts, bill re-phasing and easier payment plans, arrears forgiveness). An example of income assistance to poor users is the subsidy system applied in Chile. Tariff-related measures keep the size of water bills low for certain groups (e.g. refinement of increasing-block tariffs, tariff choice, tariff capping). Examples of increasing block tariffs with a price of zero in the first block are found in Flanders and South Africa. Another measure is the cross-subsidization using different tariffs for different neighborhoods, as practiced in Colombia. A similar approach has been used at the national level in Portugal. The Portuguese economic water regulator carried out an affordability study that found out that 10.5% of the population paid more than 3% of their

[15] http://en.wikipedia.org/wiki/Water_tariff

income for water and wastewater services. As a result, the regulator showed flexibility concerning tariff increases and tariff solutions in municipalities where affordability was a particular issue.

3.2. Affordability and Social Protection Measures

Based on the ESIA report2006 it was reported that the affordability to pay for water and wastewater charges is difficult to judge, particularly in the absence of accurate data on per capita income by socio-economic category in various regions or settlements. It is well established that the design of any water tariff should take into account the basic human needs for water supply affordable to the poorest population segment.

Affordability to pay for water charges is normally based on the household ability to pay for the price of water consumed and the sewage disposal services. Willingness to pay for these services also stems from the customers' satisfaction of the level of services provided.

A certain minimum quantity of water is needed to meet the one-day human basic needs for personal hygiene and basic amenities. This has been estimated to range from a slow as 25 1/h/d; at the most arid region, to as high as 75 1/h/d for piped water supply in regions where potable water supply is considered relatively sufficient.

One of the key elements of the previous tariff studies was to define the poverty line, as this is considered to be relevant in established the first block of the tariff. Before Intefada, basic statistics indicated that an average monthly income for the low-income family was US$273 in the project area. This number has certainly decreased by more than35% in the project area. Agricultural sector which is the main source of income in the northern area has been considerably damaged in the last four years due to the political situation. Hence the average monthly income for the low-income family is less thanUS$180.

It is generally accepted that, to be affordable, water and wastewater charges should not exceed 4% of income. The expected average income within the project area isUS$270/month and therefore it is considered that the average family can afford to pay up to US$10.1/month for water related services. Assuming an average family size of 7 and consumption of 100 1/h/d, the water and wastewater charge can be up to approximately US$0.48 for each m3 of water supplied.

Based on the feasibility study conducted for the NGWWTP project, the required tariff for wastewater services would be 0.38 $/m3 for coverage of O&M cost only, while full cost recovery would require 0.55 $/m3. Additional 0.66 $/m3 to 0.89 $/m3 should be added to include water services for full recovery based on LEKA and CAMP studies. During the emergency phase the required O&M cost would be 0.24 $/m3.

The discussion of water and wastewater tariffs might be summarized on the following scheme:

- The community should be analyzed objecting to have a clear description for the communities, consumption rate, income, expenditure and to analyze the cost of irrigation and fertilization
- A poverty mapping should be developed for the community in order to know the area most in need of subsidized water
- Develop an inventory for the people who will lose their wells due to the project in order to establish another tariff for them (as part of the mitigation measures).
- Develop supportive laws which might be added as articles dealing with the sludge and treated water tariff
- The institutional framework should be developed to identify who will be responsible for recovered water and sludge.
- Support from other institutions should be integrated in the tariff process
- Multiple phases of proportional volumetric tariffs should be modified in sequence with the fresh water tariff (the size of lands, consumption rate, poverty level should be covered). In addition the governorate and municipality should adopt a tariff that will not affect their communities
- Sludge should be traded in at the same prices of composting fertilizers which is relatively of the similar acceptance and utilization in the community

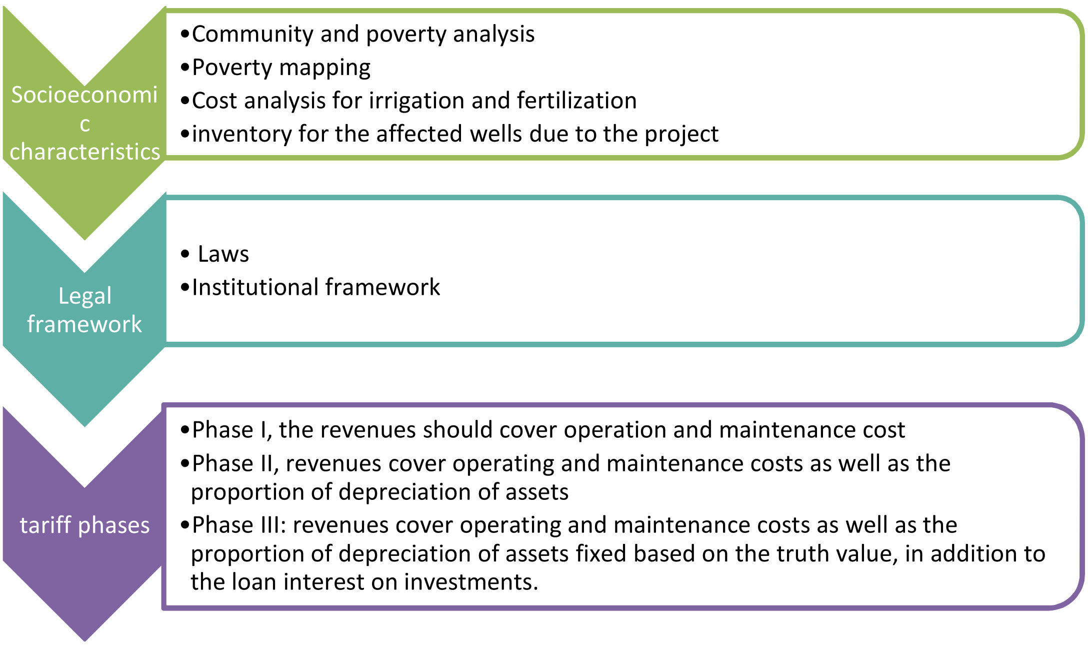


Figure 6: Recovered water and sludge tariff scheme

As a preliminary analysis for the cost, 34 farmers were interviewed in addition to having four FGDs and two opinion pool workshops regarding the prices of recovered water and sludge. The discussion revolved around the following topics:

- Cost of cubic meter of water
- Cost of irrigating one dunum of land annually

- The least expected price of recovered water to irrigate a dunum of land
- The most expected price of recovered water to irrigate a dunum of land
- Cost of fertilizing a dunum of land annually
- The least expected price of sludge to fertilize a dunum of land annually
- The most expected price of sludge to fertilize a dunum of land annually

The sample of farmers who don't own wells reported that the municipality water is relatively high priced. The farmers who relied upon that water were not able to make a good profit. The data collected revealed that about one third of the farmers pay 0.7 shekel for a cubic meter of water. Almost the same sample size reported paying between 0.5-0.6 shekel. The average cost reported was about 0.682 shekel while the mode value was 0.7 shekel.

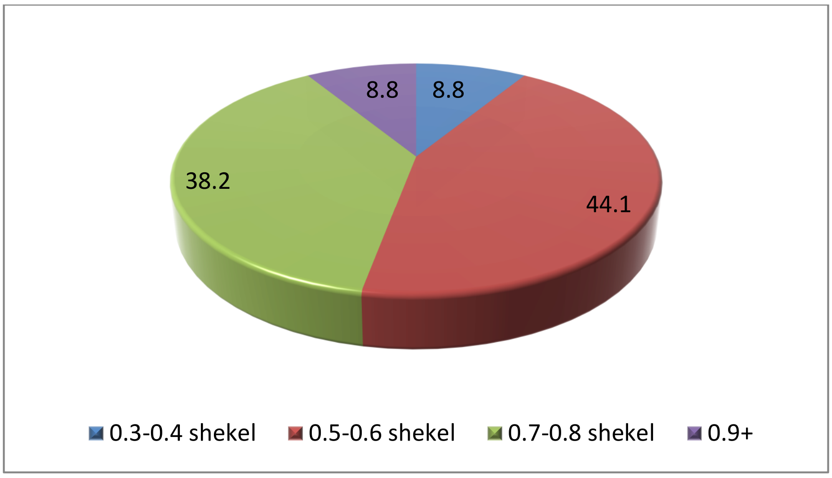


Figure 7: % Distribution of farmer sample by cost of cubic meter of water they pay

The cost of irrigation for one dunum of lands annually ranged between 105 shekel to 3500 shekel. That is mainly due the type of water used and the ownership of the source of water. The average cost reported was 583.82 shekel with a mode value of 400 shekel.

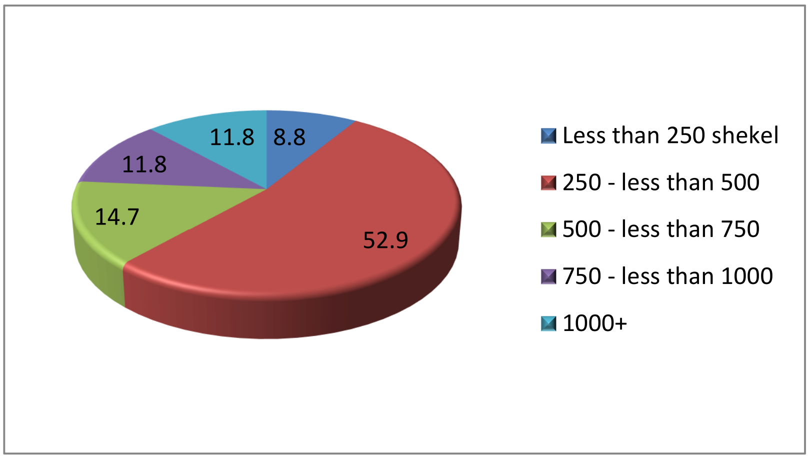


Figure 8: % distribution of the farmers sample by the cost of irrigating one dunum of land annually

The analysis for the least and the most expected price for the recovered water per dunum of land was highlighted and compared in order to reach the appropriate price that might be applied. About 30% of the farmers reported that they should pay nothing due to the fact that sewage water should be costless. However, those who reported the lowest prices varied between 5 shekel to 1500 shekel annually. While those who reported the highest value ranged between 10 shekel to 2000 shekel. The intersection point was the value of 100-200 shekel annually. This is the most accepted value for the farmers to pay. However, it is worth mentioning that 20.6% of the farmers are completely unwilling to pay a penny. The average least value reported was 180.52 shekel/annual. The average of the highest expected price was 208 shekel/ annually.

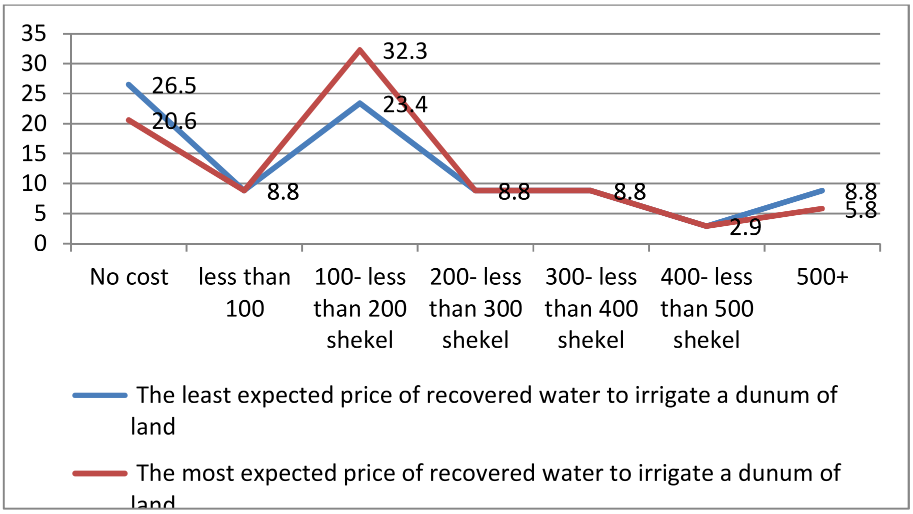


Figure 9: Comparison between the least and the most proposed recovered water price (farmer sample)

The reported cost of fertilizers per year varied between 100 to700 shekel, with an average of 403 shekel and a mode value of 400. The farmers reported paying the cost for fertilizers imported from Israel. That might add burden to the economy of the country. For this reason, they were much in favor of using the sludge.

The discussion of the lowest and the highest proposed prices for the sludge ended in the following results: 11.8% of the sample reported that they should pay nothing, while those who accepted to pay reported that they are willing to pay a maximum between 50 to 600 shekel with a mode value of 100 shekel. Regarding the lowest price accepted, they reported the price should be30-300 shekel annually; the average amount reported was 56.55 shekel. The interconnection value reported was about 100 shekel annually.

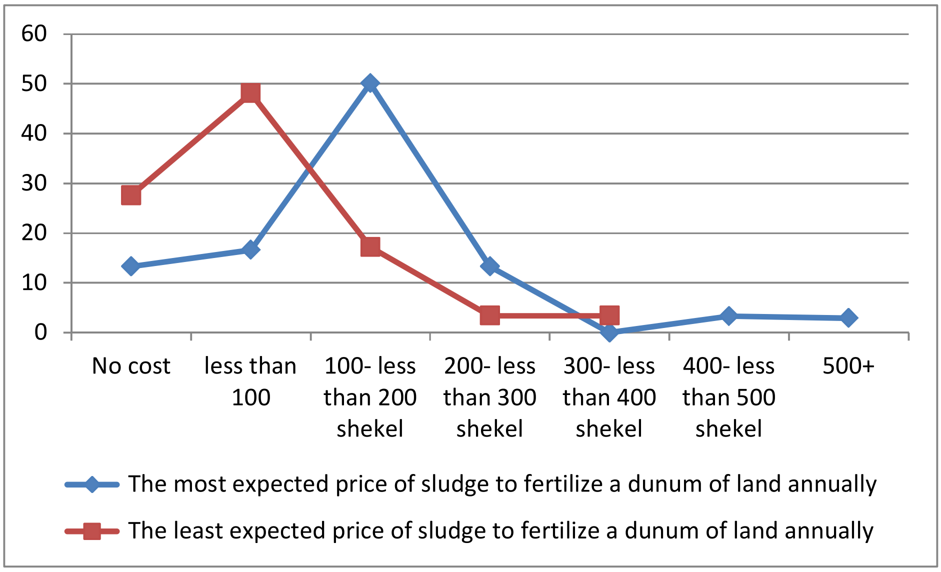


Figure 10 Comparison between the least and the most price for sludge (farmer sample)

The above discussion ended to the following results:

- The community is willing to use both recovered water and the sludge due to many rational reasons. The main reluctance reported was due to health problems
- The farmers were willing to use recovered water atan appropriate price. While the affected owners of wells reported that water should be provided to them free of charge as part of the compensation
- The multi-phases of sludge pricing and water tariff is the best mechanism to merchandize recovered water and sludge
- The appropriate pricing for the cubic water meter varies between 0.5-0.7 shekel. While the acceptable cost for sludge is 100 shekel annually. However, there should

be additional studies (such as a Market Analysis Study) to develop the appropriate techniques to trade in sludge and reused water

4. Public Awareness

4.1. Introduction

The public awareness is one of the main core issues to be highlighted under this project due to its nature that focus on awareness raising activities and marketing attitudes change. Therefore, the study team tried to set the objectives of the public awareness which might be summarized as follow:

1- Raise people awareness regarding the appropriate methods to combat flies that might result due the infiltration ponds;
2- Raise people awareness regarding the benefits of using sludge and recovered water, as well as, Do orientation sessions about the hazardous related to the use of the recovered water and sludge;
3- Raise community people awareness in the areas adjacent the project (NGWWTP) regarding the potential land use and expropriation;
4- Information sessions should be provided to the well owners who will be terminated or use restricted;
5- Provision of awareness raising campaigns regarding types of crops to be planted using the recovered water;

Awareness activities should be applied in cooperation with the Ministry of Health, Ministry of Agriculture, Land use Authority, Representative from Media people (Gazettes and TVs)

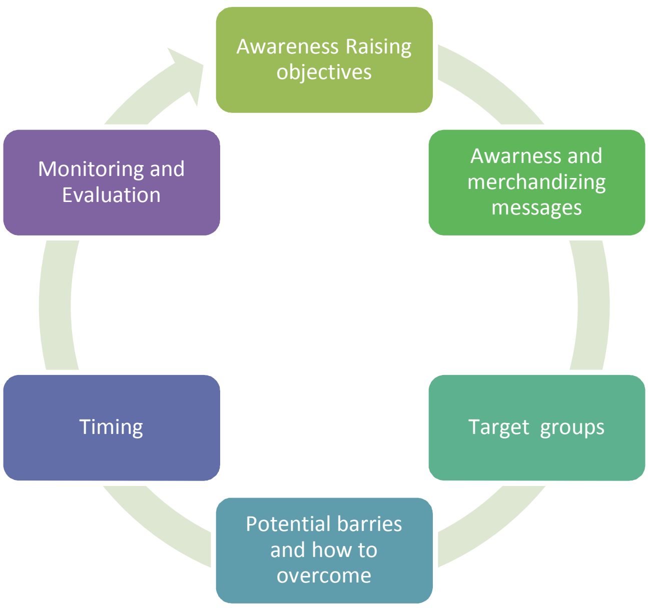


Figure 11. Awareness raising scheme

4.2. Sludge and recovered water awareness raising activities

Different consumers may have different beliefs about the same thing, and this belief will affect consumer attitudes. Some consumers may think that the brand-name quality of the product is much higher than the average product can provide a lot of additional benefits; some consumers insist that as the product matures, the production of different enterprises is not much difference in quality products, brand names provide the additional benefits are not as people imagine. Obviously, these different beliefs will lead to different attitudes to the brand-name products.[16]

It was generally agreed that the attitude is learned through experience. This means that the attitude and buying behavior is formed as a result of a direct experience of this direct experience, including product, oral information from others by the mass media the influence of advertising, the Internet and a variety of direct marketing situation. us is worth noting that, although the attitude may be the result of behavior, but it is not synonymous with behavior, it reflects an attitude object like or do not like the evaluation as the tendency of acquisition through learning or experience, the attitude of the nature of a motive, which is that they can drive consumers to the formation of a special kind of behavior, and also allows consumers to boycott a certain kind of behavior.

The data collected revealed that the community is in terribly needed for awareness raising strategy regarding all aspects related to the project. One of the main issues to be covered is the benefit of sludge and recovered water. The main channel of awareness raising recommended to be applied with traders was through media 45.10% of the total sample reported TV and Radio. The second main channel reported is through conferences and workshop. The third main strategy reported is through using brochures. The type of market reflected on the results

Table 10 % distribution of traders sample by Strategies to encourage traders to purchase crops irrigated by treated water by market type

Strategies to encourage traders to purchase crops irrigated by recovered water	Market Type			Total
	Daily market	Super market	Permanent	
Conferences and workshops	10.00%	23.50%	28.60%	19.60%
Media	70.00%	23.50%	35.70%	45.10%
Brochures	5.00%	23.50%	28.60%	17.60%
Awareness campaigns		5.90%	7.10%	3.90%
Marketing plans		5.90%		2.00%
No suggestions		17.60%		5.90%

16 http://www.wikipedia123.com/Wikipedia-736144-Consumer-attitudes.html

Strategies to encourage traders to purchase crops irrigated by recovered water	Market Type			Total
	Daily market	Super market	Permanent	
Meeting with professionals and experts	15.00%			5.90%
	100.00%	100.00%	100.00%	100.00%

The traders sample reported that the main strategy to be applied on consumers was mainly through Media followed by awareness campaigns and brochures

Table 11. % distribution of traders sample by Strategies to encourage people to purchase crops irrigated by treated water by market type

Strategies to encourage consumers		Market Type			Total
		Daily market	Super market	Permanent	
Scientific programs	N	0	2	0	2
	%	0.00%	11.80%	0.00%	
Media	N	15	9	9	33
	%	75.00%	52.90%	64.30%	
Brochures	N	7	1	1	9
	%	35.00%	5.90%	7.10%	
Awareness campaigns	N	5	5	5	15
	%	25.00%	29.40%	35.70%	
No suggestions	N	1	3	1	5
	%	5.00%	17.60%	7.10%	
Meeting with professionals and experts	N	2	0	0	2
	%	10.00%	0.00%	0.00%	
Total	N	20	17	14	51

Multiple responses

The consumer sample reported that Media is the main channel followed by the internet and one to one meetings. A scientific program was reported as source of information. This will be the appropriate program to provide the awareness rising through.

Table 12 % distribution of consumer sample by Strategies to encourage people to purchase crops irrigated by treated water by market type

Awareness strategy for people		Market Type			Total
		Daily market	Super market	Permanent	
Media	N	375	66	149	590
	%	93.80%	66.00%	76.40%	
Internet	N	111	3	41	155
	%	27.80%	3.00%	21.00%	
One to one meetings	N	129	0	6	135
	%	32.20%	0.00%	3.10%	
Scientific programs	N	40	20	29	89
	%	10.00%	20.00%	14.90%	
Workshops	N	33	0	7	40
	%	8.20%	0.00%	3.60%	
Mosques	N	16	2	7	25
	%	4.00%	2.00%	3.60%	
No suggestions	N	24	5	20	49
	%	6.00%	5.00%	10.30%	
Brochures	N	8	2	9	19
	%	2.00%	2.00%	4.60%	
Raising awareness campaigns	N	2	17	17	36
	%	0.50%	17.00%	8.70%	
Total	N	400	100	195	695

Multiple responses

Annex 10

Copy of Letters

from Antiquity Authority and High Institute for Religion Study; Islamic University of Gaza

Letter from Antiquity Authority Regarding the Cultural Heritage Sites within the Project Component Sites

Palestinian National Authority Ministry of Tourism & Antiquities Gaza Governorates		السلطة الوطنية الفلسطينية وزارة السياحة والآثار محافظات غزة

اليوم : الاثنين

التاريخ: 2012/11/26م

الأخ / م. زهير مدوخ .. حفظه الله،،،

مدير شركة المجموعة العالمية للهندسة والاستشارات

السلام عليكم ورحمة الله وبركاته...

الموضوع : معاينة القطعتان رقم (918 + 921) من أراضي جباليا

تهديكم وزارة السياحة والآثار أطيب التحيات، وبالإشارة للموضوع أعلاه وردا على كتابكم الوارد إلينا بتاريخ 2012/11/25م، بخصوص مشروع استرجاع المياة العادمة في شمال قطاع غزة) ، وبعد الكشف السطحي الذي قام به قسم التفتيش الأثري لقطعة الأرض المذكورة أعلاه ، الواقعة بجوار منطقة المقبرة الشرقية من القطعة رقم (918) ، والقطعة رقم (921)، وهما ضمن عدة قسائم .. تبين انه لا يوجد أي آثار سطحية أو أي علامة تدل عليها، علما بان القطعتين المذكورتين تقعا ضمن امتداد مدينة جباليا من المنطقة الشرقية ، وبناءا على ذلك نوصي بأنه لا مانع لدينا من استخدام الأرض المذكورة أعلاه، **ويجب إبلاغنا مسبقا بموعد أي تجريف أو أعمال بناء حتى يتسنى لنا إيفاد احد مفتشي الآثار تحسبا لوجود آثار في باطن الأرض.**

على أن لا يتعارض ذلك مع شروط وتوصيات أي من الوزارات ذات العلاقة

وتفضلوا بقبول فائق التقدير والاحترام،،،

السلطة الوطنية الفلسطينية
وزارة السياحة والآثار
محافظة غزة
صادر / وارد
رقم: 383
التاريخ: 26.11.2012

د. محمد إسماعيل خلة

وكيل مساعد وزارة السياحة والآثار

السلطة الوطنية الفلسطينية
وزارة السياحة والآثار

❖ صورة لـ:

- الشئون الإدارية والمالية
- دائرة الآثار

Palestinian National Authority
Ministry of Tourism & Antiquities
Gaza Governorates

السلطة الوطنية الفلسطينية
وزارة السياحة والآثار
محافظات غزة

اليوم : الاثنين

التاريخ: 2012/11/26م

الأخ / م. زهير مدوخ .. حفظه الله,,,

مدير شركة المجموعة العالمية للهندسة والاستشارات

السلام عليكم ورحمة الله وبركاته...

الموضوع : معاينة القطعتان رقم (918 + 921) من أراضي جباليا

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على أن لا يتعارض ذلك مع شروط وتوصيات أي من الوزارات ذات العلاقة

وتفضلوا بقبول فائق التقدير والاحترام،،،

د. محمد إسماعيل خلة

وكيل مساعد وزارة السياحة والآثار

السلطة الوطنية الفلسطينية
وزارة السياحة والآثار
محافظة غزة
صادر / وارد
رقم: 383
التاريخ: 26.11.2012

❖ صورة لـ:

- الشئون الإدارية والمالية
- دائرة الآثار

Letter from Higher Institute for Religious Study Regarding Recovered Water Reuse

التاريخ: 2012/08/07

فضيلة الأستاذ الدكتور / ماهر السوسي حفظه الله،،

رئيس لجنة الإفتاء بالجامعة الاسلامية

السلام عليكم ورحمة الله،،

بداية أود أن أتقدم لسيادتكم بخالص التهاني بمناسبة الشهر الفضيل أعاده الله علينا وعلى المسلمين بالخير و البركات كما أود أن أتقدم لسيادتكم بجزيل الشكر على حسن الاستقبال.

الحاقاً للمناقشة التي تمت اليوم في مكتب سيادتكم حول معرفة **الرأي الشرعي** في استخدام الحمأة و المياه المسترجعة في تغذية و ري المحاصيل الزراعية أرجو من سيادتكم اصدار فتوى مكتوبة بهذا الخصوص.

علماً بأن المياه المسترجعة هي عبارة عن مياه عادمة معالجة جزئياً و يتم حقنها في المياه الجوفية من خلال مرورها بطبقات التربة ثم يُعاد استرجاعها مرة أخرى بغرض استخدامها في ري المزروعات، أما الحمأة فهي المخلفات الصلبة التي تنتج من عملية معالجة المياه العادمة و تحتوي على نسبة عالية من مغذيات النبات و فنياً يمكن استخدامها كمصدر جيد للسماد.

تقبلوا فائق الاحترام و التقدير،،

الدكتور أحمد أبو شعبان
استاذ الاقتصاد الزراعي المساعد
كلية الزراعة – جامعة الأزهر

(فاكس رقم: 2825557)

الجامعة الإسلامية – غزة
The Islamic University - Gaza
لجنة الإفتـــاء
هاتف داخلي: (2220)

الرقم ج.س.غ / / Ref.
التاريخ 2012/8/29م Date

فتوى 18/2012م

الموضوع / فتوى شرعية حول استخدام المياه العادمة في الري بعد معالجتها

نص الفتوى :

توجه الدكتور أحمد أبو شعبان أستاذ الاقتصاد الزراعي المساعد، بكلية الزراعة جامعة الأزهر – بغزة بسؤال للجنة الإفتاء عن مدى جواز استعمال المياه العادمة في ري المزروعات بعد معالجتها، وكذلك مدى جواز استعمال الحمأة، وهي المخلفات الصلبة الناتجة عن المعالجة في تسميد الأرض .

الإجابة: الحمد لله رب العالمين، والصلاة والسلام على سيد المرسلين، سيدنا محمد – صلى الله عليه وسلم– وعلى آله وأصحابه أجمعين، ومن تبعهم بإحسان إلى يوم الدين، وبعد:

من خلال مناقشة القضية المطروحة من الأخ الدكتور أحمد أبو شعبان تبين ما يلي:

1. المياه الواردة في السؤال هي مياه الصرف الصحي، وهي لم تعالج معالجة فنية كاملة، نظراً لنقص الإمكانيات بسبب تصرفات الاحتلال.
2. المياه المعالجة خالية من البكتيريا والديدان المسببة للبهلرسيا والكولرا وغيرها من الأمراض الأخرى، وكذلك هي خالية من الميكروبات المضرة بصحة الإنسان رغم ما ذكر في البند السابق، وهذا ما أفاد به الأخ الدكتور المذكور.
3. تضخ المياه إلى طبقات الأرض بعد معالجتها فنياً، حتى تصل إلى المياه الجوفية.
4. بعد استرجاع هذه المياه وسحبها من المياه الجوفية فإنها تكسب نفس صفات المياه الطبيعية من حيث اللون والرائحة والطعم.

وبعد النظر في هذه الحيثيات فإنه ينبني عليها ما يلي:

أولاً: لا يترتب على استعمال هذه المياه أي ضرر ذلك أن المياه المذكورة خالية من كل ما يتسبب بضرر لصحة الإنسان من مثل البكتيريا والديدان والمكيروبات التي تكون بالعادة من ملوثات مياه الصرف الصحي، وبالطبع فقد خلت بذلك كله بسبب المعالجة، والضخ في أعماق التربة.

ثانياً: إن الماء المذكور يطهر بسبب معالجته فنيا وبسبب ضخه في طبقات الأرض السفلى، وذلك لما يلي:

1. هذا الماء بضخه في طبقات الأرض يختلط بالمياه الجوفية، وهي أكثر منه، وعند الفقهاء أن الماء النجس يطهر بالمكاثرة كما جاء عند الفقهاء.

2. إلقاء النجاسة في الماء الكثير لا تضره، وذلك كما ورد في ماء بئر بضاعة حيث كان يلقى في الحيض والنتن مما مات من الحيوانات، حيث صرح النبي صلى الله عليه وسلم بطهارة مائه، وهو نص حديث أبي سَعِيدٍ الْخُدْرِيِّ أَنَّهُ قِيلَ لِرَسُولِ اللَّهِ – صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ –: أَنَتَوَضَّأُ مِنْ بِئْرِ بُضَاعَةَ وَهِيَ بِئْرٌ يُطْرَحُ فِيهَا الْحِيَضُ – الخرق التي تستعملها النساء عند الحيض – وَلَحْمُ الْكِلَابِ وَالنَّتْنُ؟ فَقَالَ رَسُولُ اللَّهِ – صَلَّى اللهُ عَلَيْهِ وَسَلَّمَ –: **"الْمَاءُ طَهُورٌ لَا يُنَجِّسُهُ شَيْءٌ"**

3. إن الماء إذا بلغ حد الكثرة، فإنه لا ينجسه شيء كما ورد عند الحنفية والشافعية، وإن اختلفوا في حد الكثرة، إلا أن الماء محل السؤال هو كثير في مفهوم الحنفية والشافعية، وعلى ذلك فإن ضخ هذا الماء في طبقات الأرض واختلاطه بالمياه الجوفية التي هي أكثر منه يعني طهارته، وفي ذلك حديث رسول الله – صلى الله عليه وسلم – "إذا بلغ الماء قلتين لم يحمل الخبث" والقلتان تقدران اليوم بحوالي خمس مائة لتر، والمياه الجوفية تبلغ أضعاف هذا المقدار بكثير.

4. إن الماء المذكور بعد ضخه في طبقات الأرض السفلى تعود إليه أوصافه الطبيعية (اللون والطعم والرائحة)، وهو عند المالكية ماء طاهر؛ لأن صفاته لم تتغير بالنجاسة التي لاقته.

وخلاصة الأمر أنه يجوز ري المزروعات بهذه المياه ولا شيء في ذلك.

أما عن الحمأة، وهي المواد الصلبة التي تنفصل عن المياه العادمة نتيجة معالجتها، فإنه يجوز تسميد الأرض الزراعية بها، بناء على جواز تسميد الأرض بالسرجين، وهو مخلفات الحيوان، عند كثير من الفقهاء.

والله تعالى أعلم.

رئيس لجنة الإفتاء بالجامعة الإسلامية

د. ماهر أحمد السوسي

Annex 11

Institutional Capacity Assessment and Regulatory Needs

Institutional Capacity Assessment and Regulatory Needs

This chapter is not conventionally part of ESIA studies. However, it was deemed important to include the institutional and organizational setups for the proposed project. This will be in compliance with reform program adopted by the water and wastewater sector in Palestine. This chapter will cover three main topics, i) assessment of the current organizational situation for water sector, ii) proposal of appropriate organization to operate this sector, in order to sustain the operational process as well as achieve financial independence of the sector, iii) proposal of needed capacity building activities for different stakeholders.

In accordance with the assessment of the current situation, the following questions covered:

1- What are the current institutions that tackle the responsibilities of the water and wastewater sector?
2- What are the drawbacks/barriers that hinder those institutions from performing their tasks?
3- What are the proposed capacity building activities?
4- What is the current legal framework governing the water and wastewater sector and
5- What are the needed regulations?

1. Introduction

The analysis of the institutional framework for this project and its sub-components was based on the main activities to be implemented. The discussion of the institutional framework took place on the PWA premises during the workshop conducted on the 15th of July, as part of the SESIA activities. The main objective of this workshop was to discuss the proposed institutional framework needed for water and recovered water collection and reuse and sludge management. Representatives from the PWA, NGOs, universities, and project consultants, PARC, Ministry of Health and *Awqaf* participated in the workshop. In addition, several in-depth interviews were conducted with the PWA, municipalities, CMWU, MoA, etc. The primary data collected was analyzed and supported by the secondary data collected from a wide range of reports, most importantly:

- Vision and Measures of Palestinian Water Authority towards Sustainability of Wastewater Reuse Distribution and Reuse Utility (WWDRU). Draft
- Institutional And Legal Framework For Wastewater Reuse Of Palestine , Technical Assistance on Wastewater Reuse and Storm water Harvesting, Palestinian Water Authority, Austrian Development Agency, July 2011, Draft
- Coastal Municipalities Of Water Utility Vision And Objectives, Booklet
- Institutional water sector review in Palestine, final report, HYDROSULT INC, Palestinian water authority, phase iii, August 2011
- North Gaza Wastewater Treatment Plant report no 3:1, Final Detailed Evaluation, April 2002
- Integrated Water Resource Management, Feasibility of Wastewater reuse, Report no. 14 June 2010 , Russell Mishel, IRG Principal, Iwrm ii Project Manager, Senior Economist
- Technical and Institutional Options for Wastewater Reuse in Palestine, Al MADINA-Consultants, April 2011

This section will present the results of the assessment of Institutional Reform for recovered wastewater distribution and sludge management, including marketing related issues.

This assessment aimed at identifying the needed institutional framework that will be responsible for:

1- Collection of wastewater:
2- Water recovery and distribution
3- Sludge collection and distribution
4- Monitoring will be a crosscutting task

The analysis of institutional frame will be based on the following objectives:

1- Identifying the responsible bodies that are recommended to tackle the responsibilities of the above mentioned tasks
2- Primary performance gap analysis will be applied in order to identify the capacity building and technical assistance needs
3- Estimate the budget needed to bring this body into action
4- Alternatives will be identified for the proposed bodies
5- The needed legal framework to be adopted in order to strengthen the proposed entities

Due to the fact that NGESTP is mainly implemented to enhance the disposal of wastewater and to utilize the produced water for agricultural purposes, more attention was given to presenting the current status of the water sector in the Gaza Strip, including the principals for water policy, entities, responsibilities, reform program and proposed institutional reform.

The discussion of the proposed institutional framework would be incomplete if basic information about the Water Sector in Gaza is not discussed. The reform of the sector is needed in order to have a self-financed sector that is appropriately maintained and operated. The following sections covered under this chapter will illustrate the following topics:

1- Principal of Water Policy in Gaza Strip
2- Water Sector Reform Program
3- Proposed institutional reform
4- Proposed legal framework

2. Principles for Water Policy:[1]

The Palestinian Authority adopted three important principles that formed a base for water sector reform:

- The water sector should be regulated by ***one responsible body***, with the separation of the institutional responsibility for policy and regulatory functions from those of service delivery;
- It is intended to establish ***three regional utilities*** in the West Bank and one in Gaza; and

[1] http://www.pwa.ps/DesktopDefault.aspx?tabID=4127&lang=en

- Encourage involvement of the private sector in the funding and implementation of projects.

Based on the aforementioned principles, the overall institutional framework of the water sector currently has three levels, as follows:

Policy level	• The Cabinet • National Water Council
Regulatory level	• Palestinian Water Authority (PWA)
Operational level	• Coastal Municipality of Water Utility (CMWU)

Figure 1.: Framework of Water Sector

According to the PWA, the water sector is structured based on the following principles:

a) Separating the Operational from Regulation aspect.
b) Dividing the institutional framework into three levels; policy level, regulatory level and operational level.
c) Integrating the service-delivery institutions into regional water utilities at governorates level. These utilities shall be independent financially and administratively.
d) Treated waste water is considered a water resource.

3. Description of Current Responsible Entities for Water and Wastewater Management

This section provides a snapshot of the main water sector stakeholders. They can be divided into two main groups: i) core/ key responsible entities i.e. NWC, PWA, CMWU, and ii) the inter-related institutions i.e. Ministry of Agriculture, Ministry of Health, etc.

3.1. Core/Key Responsible Entities

3.1.1. The National Water Council (Policy Making Level)

The National Water Council (NWC) is composed of 13 members and headed by President of PA. It includes five ministers (Agriculture, Finance, Local Authority, Health, and Planning), two governmental institutions (PWA, EQA), and other members representing non-government organizations. The head of the PWA serves as the secretary of the Council.

The NWC is responsible for:

- Reviewing and approving the National Water Policy
- Review and approve programs/plans to manage water resources
- Reviewing and approving water tariff, quotas;
- Reconsider the issue of private ownership of water, examine the central water projects and approve their implementation

- Enhancing regional and international co-operation on water issues.

3.1.2. Palestinian Water Authority (PWA) (Regulatory Level)

The Palestinian Water Authority (PWA) was established by Presidential Decree 90/1995 as a central public authority to serve as a regulator body for water resources management and development in Palestine. PWA is governed by the Water Law and its By-law # 2/1996 that defined its mandate as follows:

- Execute the National Water Policy as approved by the National Water Council;
- Ensure most efficient management of available water resources in Palestine;
- Seek to achieve and develop water security through optimal planning and management of water resources and explore further resources to ensure balanced management between supply and demand;
- Set standards and establish technical specifications to assure quality control of water works.
- Licensing the exploitation of water resources including the construction of water projects.
- Seek to achieve strong co-operation between PWA and other relevant parties.

Based on the article 9 of the Bylaws, the PWA shall have the following departments:

- **Administration Department** that includes three sections; Finance, Personnel, and office services.
- **Technical Department** that includes three sections; Standards, Training, and Research.
- **Organization Department** that includes three sections;
  - ***Licenses & Tariffs Section***: in charge of licensing wells, disposal of wastewater, and reuse of treated water
  - ***Monitoring & Inspection Section***: in charge of monitoring and inspecting of water wells, water and wastewater facilities according to standards.
  - ***Customer services:*** in charge of handling customers' complaints
- **Water Resources Planning Department** that includes three sections; Water Strategies & Policies, Water Information, and Hydrology. However, currently the PWA has seven directorates

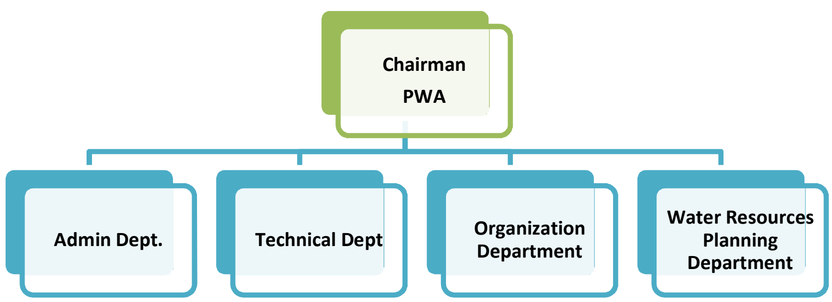

Figure 2.: PWA Organizational Chart

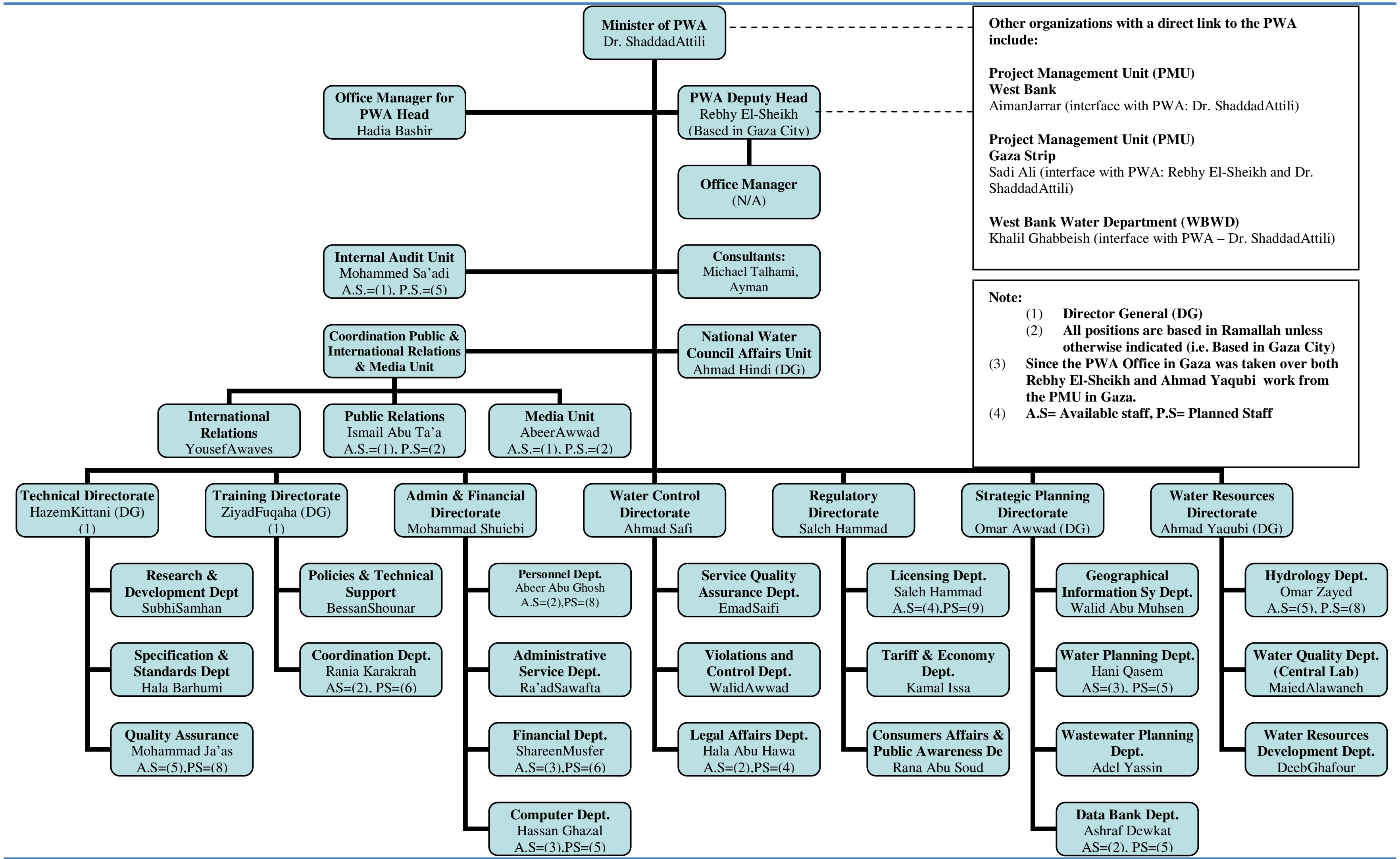

Figure 3: PWA Institutional Structure

Source: PWA

Table 1: Different Departments within the PWA

Directorate	Departments
Financial And Administrative Directorate	• Financial • Personnel Affairs • Administrative Services • IT
Technical Directorate	• Standards & Specifications • Quality Assurance • Research & Development
Regulatory Department	• Licensing • Tariff & Economy • Consumer Affairs
Strategic Planning Directorate	• GIS • Databank • Water Planning • Wastewater Planning
Water Resources Directorate	• Hydrology • Water resources development • Water quality (Central Lab)
Training and Development Directorate	• Policies & Technical Support • Coordination Dept.

3.1.3. Coastal Municipalities of Water Utility (CMWU) (Operational level)

The CMWU was established in Gaza Strip as autonomous public utility based on (Law # 1, 1997 Local Government) and considered as the Operator of water and wastewater. Also, article 25 of the Water Law called to establish regional water utilities in West Bank and Gaza. The CMWU covers all Gaza Strip except Gaza and Jabalia where the municipalities still operating the water and wastewater in their area. Figure 4 below represents the 2012 organizational structures within the CMWU.

The CMWU is mandated to provide the following services:

- Water extraction, operating the services of water, wastewater, and storm drainage. Managing water resources, distribution and selling to consumers.
- Management and improvement of the wastewater and storm drainage that include treatment as per the technical standards as possible.
- Collect and invest rains
- Construction/Operation of facilities related to water and wastewater.
- Develop and implement plans to control water and environment pollution.

The CMWU is managed by a Director General and assisted by three Deputies; Technical, Planning, and Administrative. It has 210 employees spread over Gaza Strip. The Technical directorate has a "Quality Control Department" that dedicated for water quality control and Water Distillation inspection

With regard to the recovery project, CMWU is a strong candidate to operate the new project. Their potential tasks will be as follow:

1- Collect the grey water from dwellings and residential units
2- Distribute the collected water after being recovered
3- Verify the tariff of water collection and water distribution
4- Being responsible for collecting water tariff in cooperation with the Ministry of Finance

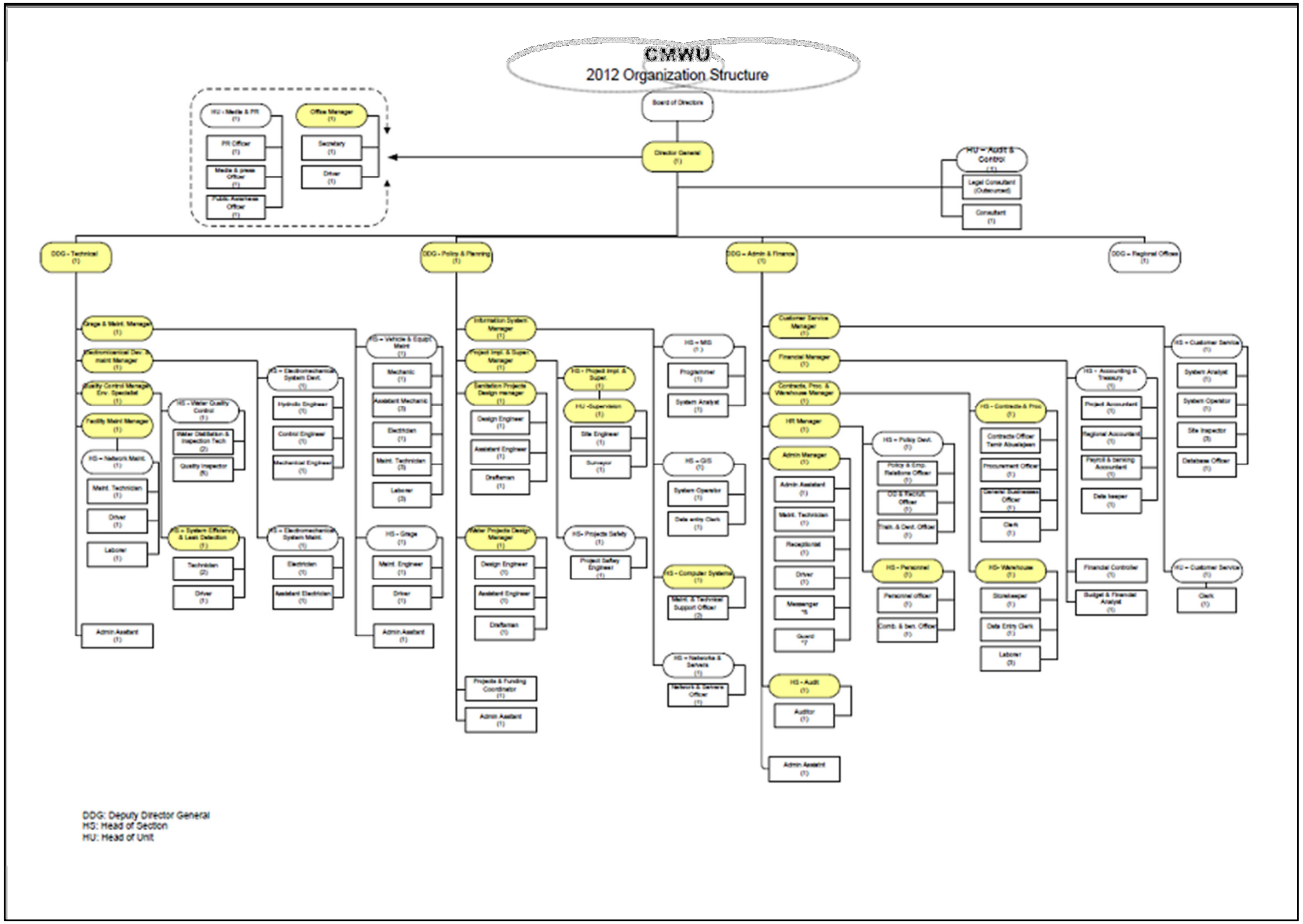

Figure 4: CMWU Institutional Structure (2012)

Source: CMWU

3.2. Key Inter-related Governmental Institutes

3.2.1. Environment Quality Authority (EQA)/ Ministry of Environmental Affairs (MENA)

Since the establishment of PA, the Ministry of Environmental Affairs was mandated to take care of environmental issues in the West Bank& Gaza Strip. However, in June 2002, the Environment Quality Authority was established by Presidential Decree No. 6/2002, superseding the Ministry of Environmental Affairs. The Palestinian Environmental Law No. 7/1999 stipulating the mandate of EQA.

In the water sector, EQA is responsible for the following:

- Setting the quality standards for potable water.
- Setting the standards and practices of collection, treatment , reuse , or disposal of wastewater and storm water;
- Regulating of industrial wastewaters which are not treated by the utility;
- Setting the standards for the disposal of saline water from desalination plants;
- Monitoring the effluent discharges in valleys, streams, and coastal waters;
- Enforcing the standards, norms and guidelines; and
- Enhancing public awareness and training in environmental management.

3.2.2. Ministry of Agriculture (MoA)

The Agriculture Law #2 of2003 stipulated the roles and responsibilities of the MoA. Article 55of the law prohibited using the wastewater in irrigation unless was treated according to national standards.

The MOA has 11 departments, including the "**Soil& Irrigation Department"** which consists of the following sections: Soil, Irrigation, Water, Central Laboratory, and Mechanical Workshop.

The Water Section is responsible for licensing the water wells for agricultural uses, supervision of digging wells, conduct periodic testing of water, cooperate in setting water standards with PWA, MOH, and EQA.

The Central Laboratory conducts periodic testing for water, wastewater, and soil.

3.2.3. Ministry of Health (MoH)

The "Public Health Law ", number 20/2004, stipulates the responsibilities of the MoH in Article #2.

Among 16 tasks, MOH is responsible for periodic testing of potable water and also on monitoring wastewater network and treatment facilities. The MoH cooperates in setting water standards with PWA, MOA, and EQA. The MOH conduct periodic testing for water wells to ensure its suitability for human consumption.

The MOH includes 12 directorates and 12 units. The Primary Healthcare Directorate includes 18 departments, among them, the Environment & Health Department and the Laboratories engage in the wastewater/water reuse. Also, the Public Health Awareness department conducts awareness campaigns

3.2.4. Palestinian Standards Institute (PSI)

PSI was founded in 1994 as Palestine's standards organization. PSI is governed by Palestinian Standards Law #6/2000 and provides access to national and global standards, accredited testing facilities, calibration services, and certification. PSI facilitates trade and investment in Palestine by meeting the needs of business and industry for metrology, standards, conformity assessment and quality. PSI advances citizen health and safety and the protection of the environment. PSI contributed to the development of effluent reuse standards.

3.2.5. Ministry of Local Government (MoLG)

The MoLG is a leading Ministry that supports Local Government Units (LGU) capacity and resources development towards achieving citizen's welfare within a good local governance framework and practices.

The MoLG is the key link between the national government and the municipalities. The MoLG represents the municipalities and also joint service councils (JSC) in national decision making and is aware of their specific development requirements. In the water sector, the MoLG is involved in the coordination of municipal water and in some cases wastewater operations. It is also involved in processing operator license applications. The role of MoLG as local government coordinator and its experience with municipal planning makes it a strategic stakeholder in the development of a water management programme. In particular, the very high percentages of unaccounted for water and the low cost recovery situation are two areas that need to be highlighted and improved.

It is noted that the MoLG has, as part of the thirteenth Government's Programme, as one of its four tasks to: Promote Public Private Partnerships (PPPs) at the LGU level in order to support local development and enable the LGUs to achieve fiscal autonomy. This appears to open the door somewhat for water and wastewater operations to be considered in a PPP light and as a possible avenue to improving the cost recovery issue.

Historically, the MoLG and the PWA have had a strained relationship primarily around the grey area that falls between the date and content of the Water Law and the Local Government Law as it pertains to municipalities and joint service council's domestic/industrial water distribution operations.

The communication situation between the PWA and the MoLG has improved greatly of late; to the point where it was suggested by an MOLG representative that they would be willing to nominate a decision making representative to a day to day working management group that would oversee the management of the water and wastewater sector. That working management group would include equal level status between MoLG, MoA and

PWA personnel and as a group they would make strategic decision involving the overall management of water and wastewater sector service providers including WUAs.

3.2.6. Ministry of Finance (MoF)

The **Finance Minister of the Palestinian Authority** is the head of the Palestinian National Authority (PNA) that is in charge of finance. The Finance Ministry is responsible for

- Controlling financial activities of the PNA and its expenditure.
- Supervising, studying and organizing monetary funds and the economic and political analysis of financial aid directed towards the PNA.
- Supervising and controlling the private capital funds of the PNA.
- Providing the money needed for facing the government's expenditures.
- Paying the salaries of government employees.
- Managing and settling employee salaries and retirement of civil administration and compensation in accordance with the laws and regulations in force.
- Scrutinizing and overseeing all financial transactions, including accounting principles adopted legally and that follow the principles of the Ministry for accountability and transparency during all stages of its work.
- Monitoring the implementation of the provisions of financial legislation in force.

The consultant was advised that the Ministry of Finance (MoF) is now in the position of being able to focus greater effort towards the water and wastewater sector. For the past three years it has concentrated on the power sector, which was consuming a vast amount of the treasury funds in comparison to the water and wastewater sector.

3.2.7. Non-Governmental Institutes and Private Partners

3.2.7.1. Non- Governmental Organizations (NGOs)

Numerous environmental and agricultural related Palestinian NGOs have contributed to the wastewater reuse sector through implementation of pilot projects, or provision of support to farmers. It remains essential to keep them involved in further plans for this sector.

3.2.7.2. Water User Associations (WUAs)

WUAs representing the end users of treated wastewater consist of groups of farmers who have shared interests. WUAs in Gaza are generally small and loosely organized. Nevertheless, they can act as focal point for the operator of the effluent distribution systems, or O&M and billing issues.

4. Water Sector Reform Programme

Over the past three years, the PWA is leading a major sector-wide effort to reform the water sector in Palestine. The reform program started on December14th 2009 when the Cabinet of Ministers endorsed the ***"Action Plan for Reform"*** aiming to define and implement a comprehensive programme of institutional and legislative reform in the Palestinian water sector.

The overall reform is expected to include the reorganization of the water sector and the institutions within, capacity building, and the revision of strategies and policies, when necessary, as a result of any change that takes place in the architectural arrangement of the sector.

The Sector Reform includes four components as follows:

1. **Institutional Water Sector Review** (IWSR) aimed to formulate a clear sector structure with clear roles and responsibilities of key sector stakeholders and also to establish a mechanism to ensure proper coordination and cooperation amongst key stakeholders.
2. A **Legislative Review** (LR), including a **redrafting of the Water Law** to reflect the preferred arrangement retained by the Palestinian National Authority (PNA) following the attainment of a consensus on the required institutional architecture, as recommended by the IWSR. This will include a review of pertinent water laws, bylaws and regulations.
3. A **PWA Organizational Reform** that include a capacity evaluation of the existing institution, a gap analysis between the existing and desired institution, the development of roles and responsibilities for each department and position within the institution, and the revision of the National Water Plan;
4. A comprehensive program of capacity building (CB), starting with the **Technical, Planning and Advisory Team** (TPAT) for the PWA, and after the Cabinet of Ministers approval for the preferred institutional arrangement, other CB programs for each of the individual institutions in the Water Sector shall be developed.

Almost all studies related to water reform are ongoing; however they still need final endorsement from the Cabinet or from the PWA: i) The Institutional Water Sector Review, ii) Water Law was also re-drafted. The PWA had improved organizational structure.
The following diagram illustrates the strategic Institutional set up for water sector in Palestine. Please note, at this stage, the set up still under the preliminary process with some achievement has been made regarding the pilot project for wastewater reuse. However, the PWA is undertaken the initiative for the wastewater reuse.

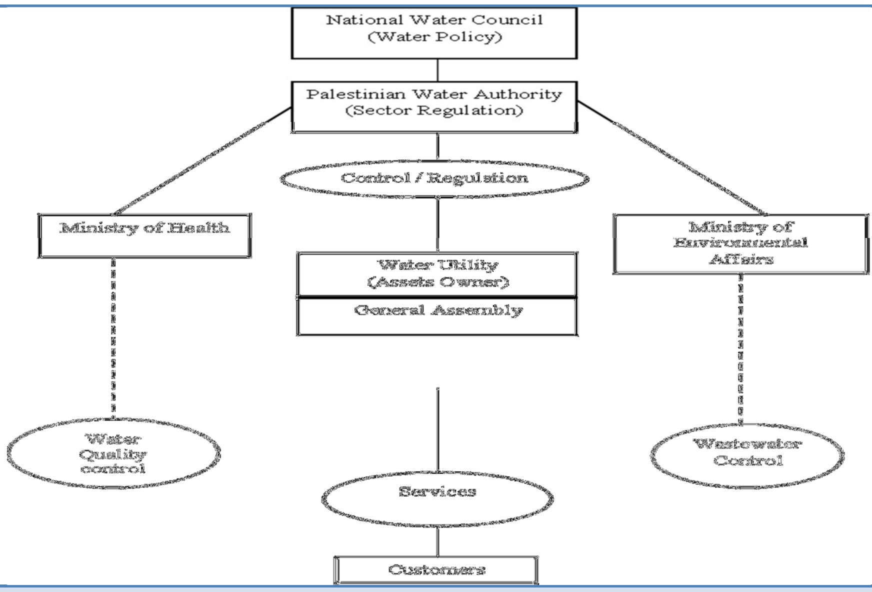

Figure 5: Strategic Institutional Setup for the Water Sector in Palestine

Source: Vision and Measures of Palestinian Water Authority towards Sustainability of Wastewater Reuse Distribution and Reuse Utility (WWDRU) – Draft

The refinement of the consensus building process evolved into modifying various institutional titles and selecting the appropriate elements of the institutional arrangements The result being: i)at the Water Governance Level, ii) A Ministry for Water Affairs; iii)An Independent Regulator reporting to the Prime Minister; iv) At the Water Management Level

The proposed reform shown in the following figure illustrates the needed organizational scheme. The figure could be briefly illustrated in the following points:

- On the level of water sector governance the Prime Minister (Cabinet) will directly work with a new ministry allocated for water and wastewater regulations, cooperating with Ministry of Agriculture and other Ministries, in addition to the donors
- Regarding water management level, the main entities responsible will be Bulk Water Utility CMWU, Municipalities, JSC, WUA for farmers with the NGOs and private sector. In addition to Water and Wastewater Sector Program Agency (PMU). They will get technical assistance by donors.
- Both Bulk Water Utility and Water and Wastewater Sector Program Agency will report to the New Ministry allocated for Water. Another reporting relation should be based on WUA’s for farmers, CMWU and municipalities. They should report to the MoA and MolG
- The essential functions of a new Ministry are seen as follows:
    - Support the water & wastewater sector reform programme;
    - Prepare and implement effective policy;
    - Develop and enforce pragmatic legislation;
    - Produce and continually update strategic, technical (master) and investment plans;

- Prepare and implement a series of focused communication strategies and programmes;
- Facilitate an Integrated Water Resource Management programme;
- Be an effective Palestinian counterpart at the Joint Water Committee meetings;
- Provide technical inputs to the PLO negotiation team;
- Maintain effective and successful relations with the international donor community;
- Support community involvement and provide public awareness campaigns to the organizations in the Water Management mechanism.

The figure below summarized the proposed reformed institutional arrangement for water sector (Hydrosult Inc. 2011)

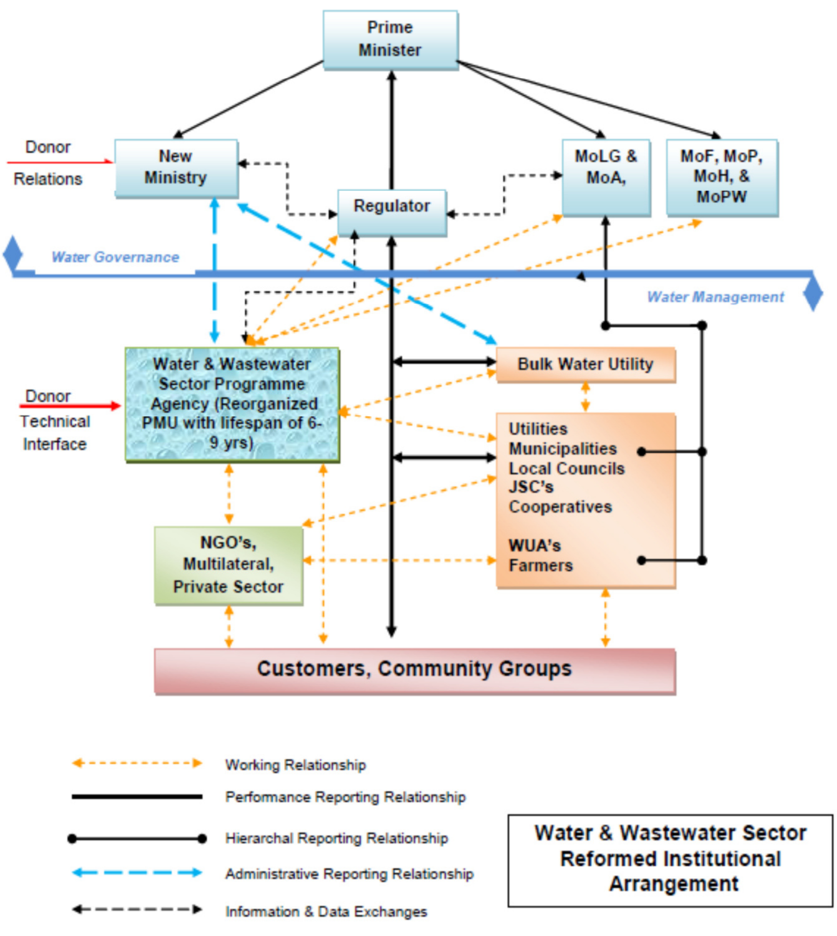

Figure 6.: Water & Wastewater Sector Reformed Institutional Arrangement

Source: Institutional Water Sector Review In Palestine, Hydosult, Inc., 2011

5. Proposed institutional framework for wastewater collection

Waste water collection is one of the fundamental components of this project. The operation of infiltration basins will be mainly based on the efficiency of waste water collection. The project tried to analyze the appropriate scenarios for efficient processing of water and wastewater.

The following points should be covered during the analysis of the entities:

1- The role of proposed entities in the current water collection scheme in Gaza Strip
2- The potential tasks to be applied by the proposed bodies
3- Evaluation of capacity building activities received and the needed trainings.

Based on different studies applied in Palestine, apparently the waste water collection tariff is not unified in the Gaza Strip. In addition, the fees collected do not cover the operation costs. Therefore, the proposed roles of the different entities that might be entitled to work on wastewater collection should be as follow:

1- Develop a legislative framework that governs the operation of wastewater collection
2- Develop a detailed strategy for wastewater collection tariffs that covers the operational costs, to have a self-financed sector
3- Identify the best strategies to collect wastewater efficiently
4- Monitor the process of wastewater collection

The consultant examined various options to propose the institutional needs to tackle the responsibilities of the wastewater collection process. Options were considered at various levels, described as follows:

- **The policy making level:** The Cabinet will be responsible for developing all polices related to wastewater collection in order to enhance the efficiency of this process.
- **The legal level:** As the National Water Council is the main regulatory department for water related issues, it is recommended to develop the regulation framework guided by the needs raised by the Palestinian Water Authority. In the name of improving the Water Governance position in the sector, most of the current PWA functions can be separated into two key areas, namely: functions that are seen as Ministerial in nature such as Policy, Planning, Legislation, Donor Relations, Water Resource Management, Finance and Administration, IT services, Public Awareness and Relations, Library and the Joint Technical Committee; and functions that are seen as Regulatory in nature such as, Licensing, Tariffs Setting, Water Control, and Water Laboratory. Separating the ministerial functions from the regulatory functions could involve a combination of physical and/or resource re-allocations. Within the Ministerial function the priority should be to strengthen and enhance the planning directorate and the water resource directorate. This could be closely followed by preparing Master Plans for Water Sources/Supply, and for Wastewater Collection, Treatment and Reuse; as well as developing communication plans and strategies with relevant stakeholders that are complimentary to the water & wastewater sector. The development of adaptable regulatory roles, responsibilities and operational guidelines/plans should be the initial priority

- **Operational level:** It was proposed that the Coastal Municipalities of Water Utilities (CMWU) should be the sole institute responsible for the collection of wastewater as they are now the responsible entity for sewage related activities. The functions could be elaborated on to include all aspects from the water source to the delivery of water service. This could include: an economic regulation model; developing compliance with public service obligations; monitoring quality of service measures; establishing pragmatic price and tariff mechanisms; improved licensing and abstraction control; looking at methods of financial accountability; benchmarking the service providers; establishing an agreed upon set of service provider performance indicators for water supply and wastewater service; and, develop a means to achieve customer satisfaction reporting[2].
- **Monitoring level:** Two levels of monitoring were proposed .Internal monitoring should be implemented by the CMWU monitoring department, which has the full capacity for self-monitoring (laboratories, capacity building activities, etc.). External monitoring should be done by the Ministry of Environmental Affairs for environmental related standards and parameters, and by the PWA for operational monitoring.

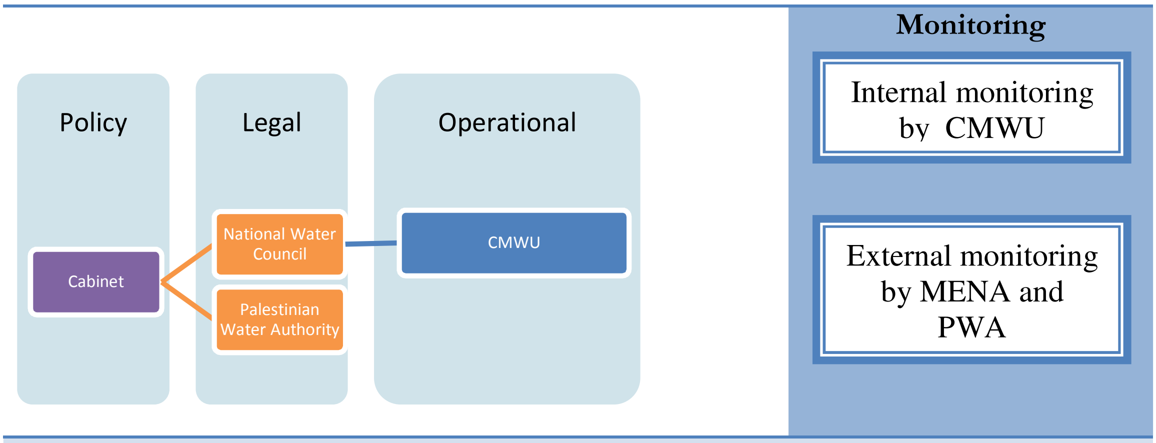

Figure 7.: Proposed Wastewater Collection Institutional Scheme

[2] Institutional water sector review in Palestine, final report, HYDROSULT INC, (member of Snc-Lavalin Group), Palestinian water authority, phase iii, August 2011

Table 1: Proposed Capacity Building needed for Wastewater Institutions

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
Policy level	Cabinet	Develop the polices that arrange wastewater sector			
Legal level	National Water Council in Cooperation with Palestinian Water Authority	Finalize and prepare Laws needed to arrange wastewater collection Prepare strategy for wastewater tariff Bring Laws forward to the juridical department for endorsement			
Operational level	Coastal Municipalities of Water Utilities	5-Arrange for the collection strategy 6-Coordinate with the municipalities to adopt the new tariff 7-Support in cost collection	1- Orientation sessions for wastewater collection 2- Waste water tariff 3- Barriers facing wastewater collection and how to overcome	8 Man/ days 4 Days 8 Days	8000 $
Monitoring for operational activities	<u>Internal monitoring</u> by the CMWU <u>External Monitoring</u> MENA should monitor the environmental related activities PWA monitor the operational activities	1- Clear monitoring strategy to be developed and applied, Monthly, quarterly and annually	1- Orientation sessions for wastewater collection 2- Monitoring and evaluation 3- Report writing 4- Documentation 5- Environmental auditing	10 Days 10 Days 4 Days 4 Days	12000 $

6. Proposed Institutional Framework for Recovered Water Distribution

Wastewater reuse is characterized by the involvement of several departments and agencies, either governmental or private or both. Sanitation and agricultural departments are usually involved to a great extent in wastewater reclamation and reuse. The agricultural and irrigation departments have the authorization of developing the suitable practices and promoting their adoption by farmers and end-users. Other departments play an important role in order to improve the efficiency of wastewater reuse and to ensure minimum health and environmental harms.

Many studies were conducted in order to develop the appropriate institutional framework for proposed water distribution. The SESIA tried to shed light on these studies in order to develop the appropriate scenario. The following figure shows the logical framework that has been proposed by the Institutional and Legal Framework for Wastewater reuse of Palestine.

The needed roles in the proposed organizational structure might be summarized as follows[3]:

- Receiving (treated) wastewater from Coastal Municipalities of Water Utilities or others, performing adequate post treatment, and supply and distribution of treated wastewater to farmers and to any other party.
- Taking all actions needed to treat, store and distribute treated wastewater according to the standards set by the competent parties and pursuant to effective laws.
- Ensuring that the distribution of treated wastewater will at all times abide the quality standards set by the competent authorities in the wastewater and sewage sectors
- Management and promotion of post treatment, storage and distribution in accordance with technical standards and with available resources.
- Owning and operation of wastewater post treatment, storage and distribution utilities and establishment of any other facilities necessary to accomplish the Council's goals.
- Making appropriate plans and putting into use any means to protect public health, and to reduce water and environmental pollution hazards.
- Importing all equipment and machinery needed for post treatment, storage and distribution of treated wastewater
- Entering into agreements with national, international and regional parties as a means of accomplishing set objectives as well as attaining any rights, concessions and licenses it deems necessary; as well as executing such agreements and making use of rights, concessions and licenses in conformity with the law.
- Investing surplus proceeds from the water and sewage sector in the manner it sees fit and in consistence with the goals of the Council subject to applicable laws.
- Engaging in any other acts decided by the Council towards accomplishing its objectives and best interests.

[3] Palestinian **Water Authority/Institutional and Legal Framework** - 13 - DHV B.V. ALMEDANA ENFRA

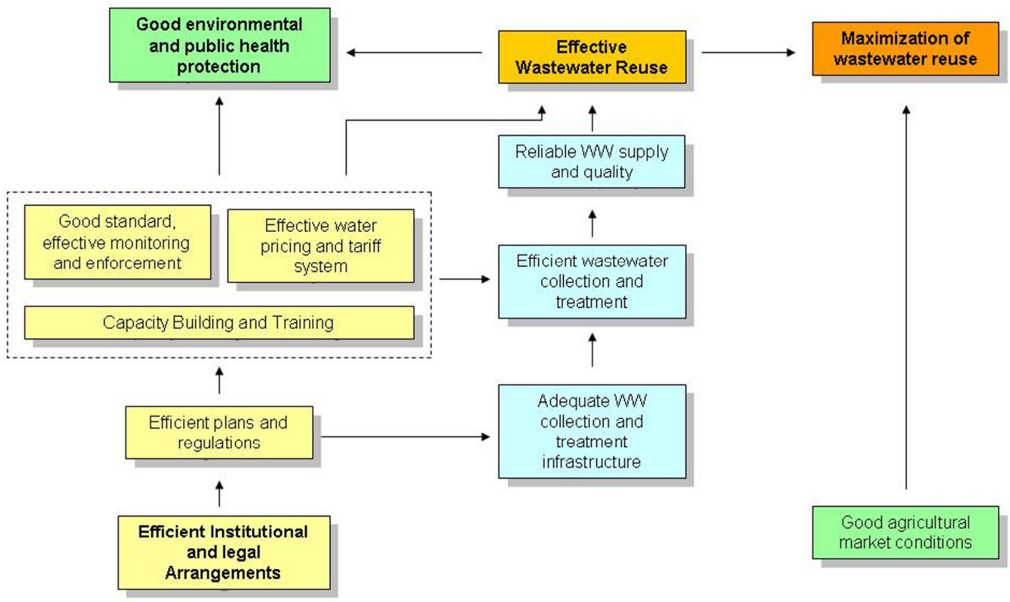

Figure 8 – Logical Framework for Maximized Reuse of Wastewater

Source: Technical and Institutional Options for Waste Water Reuse in Palestine, April 2011

The consultant assessed various options for institutional framework of recovered water distribution institutions. The main guidance for this process was the ambitious tasks that should be applied by the proposed entities. The options are proposed on the policy, legal, operational and monitoring level.

- **The policy making level**: This will be the responsibility of the Cabinet in cooperation with the juridical department
- **The legal level**: The National Water Council will be the key player to determine the needed legislations and regulatory framework for recovered water distribution. Potential support from the Juridical Department to provide legal guidance to enhance the proposed Laws.
- **Operational level**: this is a fundamental issue which has raised continuous negotiations among different institutes. Thus the consultant will mention the different proposed entities with justifications for accepting or rejecting each proposed entity. This discussion will be based on reports, meetings and the consultant's perceptions.

1. The first unsupported option is the involvement of the Palestinian Water Authority in the operational process. The PWA has evolved into what it is today, a four-in-one organization, which places it in a precarious position. It has the ability to set a tariff, directly collect the water charges established for bulk water and regulate that tariff; all of which is a definite conflict of interest. In which case who is safeguarding the citizens of Gaza in terms of receiving sufficient water at an affordability price and of suitable (potable) quality. In addition the PWA/PMU also designs wells and water

distribution systems and the PWA regulatory function approves and issues licenses. Again, a process that is a conflict of interest.[4] These conflict situations would be eliminated if the regulatory function is separated from the political influence, and the engineering functions (PMU) are at arm's length from the ministerial function in PWA.

2. Public Private Partnership (PPP). The private sector is not ready to play significant role to manage this scheme. However, private sector firms could work in cooperation with the CMWU.

3. Coastal Municipalities of Water Utility (CMWU): The CMWU is mandated as "Operator" of the water and wastewater systems in Gaza Strip. The consultant highly recommends this option that involves two essential steps:
   - Modify the current mandate of the CMWU
   - Build the capacity of CMWU to provide this service.

- Finally, there is an option to create a new utility named "Wastewater Distribution Utility" to take care of the recovery water. This entity is highly recommended by the consultant and by the PWA. Having a separate unit will put limitation to any crosscutting activities that might be handled by different entities. However, this option is not yet finalized and the capacity of this entity, including financial capacity is also not yet finalized. However, accordingly, PWA will be the responsible authority to take care the recovery water distribution.

- Monitoring level: Different levels of Monitoring should be applied according to the tasks performed. i.e Ministry of Finance will do the financial auditing, The MENA will do environmental inspections…etc

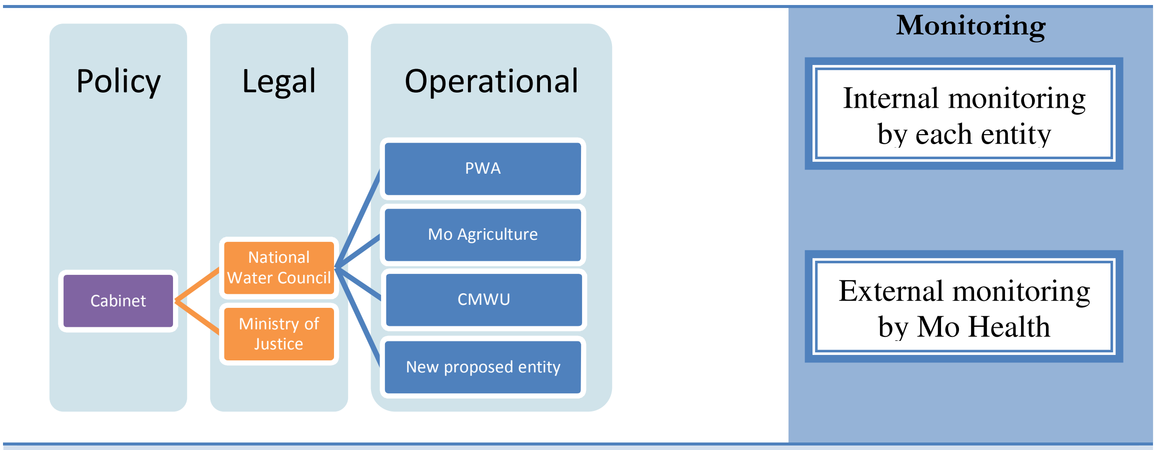

Figure 9.: Proposed Recovered Water Distribution Institutional Scheme

[4] Institutional Water Sector Review In Palestine, page 17

Table 2: Proposed Capacity Building needed for Recovered Water Institutions

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
Policy level	**Cabinet**	**Develop the polices that arrange water sector**			
Legal level	**National Water Council**	Legislation and national policies: generally this is performed by the National Water Council, and Cabinet of Ministries who will be held responsible by an independent and democratically elected parliament. At this level cross cuttings with other national interests are to be made, including integrated water resources management policies, public health and environmental policies, etc. Plans and Regulations: this includes elaboration the national legislation and policies on the operational levels (below levels 3, 4 and 5). This plans and regulations shall be practical, implementable and should enable effective monitoring and evaluation.			
Operational level	**Palestinian Water Authority** **Ministry of Agriculture**	○ **A steering committee formed from PWA, MoA, CMWU, PS will be established for the operation of the process.** ○ **The new entity allocated for water distribution will be responsible for :** - **Proposing recovered water tariff**	○ **Orientation session regarding recovered water distribution** ○ **Community**	**10 Days** **10 Days** **20 Days**	**32000$**

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
	Coastal Municipalities of Water Utilities and the Proposed new entity	- Distribute recovered water - Highlight groups entitled for subsidy - Provision of orientation sessions to the farmers - Collect treated water coast	mobilization ○ Marketing and management skills ○ Barriers facing recovered water, case studies ○ Tariff strategies for recovered water ○ Documentation ○ Book keeping and auditing ○ Periodically performance gap analysis to propose the needed training	15 Days 10 Days 10 Days 10 Days 10 Days	
Monitoring for	Internal monitoring	1- Clear monitoring strategy to be developed and applied, Monthly,	1- Orientation sessions for	10 Days	16400 $

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
operational activities	by the each entity External Monitoring MENA should monitor the environmental related activities PWA monitor the operational activities MoF monitor the budget and collection fees	quarterly and annually 2- Budget should be monitored by MoF	water distribution 2- Monitoring and evaluation 3- Report writing 4- Documentation 5- Environmental auditing 6- Accounting and financial auditing	10 Days 4 Days 4 Days 8 Days 10 Days	

7. Proposed institutional framework for sludge management

Sludge production and disposal are entering a period of dramatic change, which has been driven mainly by International Funding Agencies around the world. The implementation of the NGESTP is predicted to result in a high volume of sludge. Disposal to landfill has become virtually impossible. Further increases in sludge production can be expected due to the implementation of the project and the natural increase of population. Seemingly the Palestinian Authority has not developed an institutional framework to deal with the sludge. In addition, the "*know how*" needed to deal with the sludge is not well identified in the Gaza Strip. Thus the proposed institution will be based on the needed responsibilities. The main objectives of the proposed entity for sludge management are to:

• Maintain cost-effective and secure methods of sludge disposal whilst
• Engender public confidence in sludge as a natural fertilizer.

This entity will address challenges that might be faced in sludge distribution with a holistic approach. Rather than tackling each issue individually, this new sludge management concept takes sludge production, treatment, downstream processing including effluent treatment, sludge derivative application, and the environment as an integrated system. It focuses on the areas of greatest challenge and issues of real concern, which require innovative approaches.

- **The policy making level:** the Cabinet will be the responsible entity to identify the policies of sludge management in Gaza
- **The legal level**: The Ministry of Agriculture is the potential entity to develop the sludge related legal framework, as they are fully aware of sludge, hazards of using sludge, and potential treatment for the sludge. The development of a new complete law for sludge treatment will be put under the water law, as both sludge and wastewater systems will be operated according to the water law. Therefore, coordination between the Ministry of Agriculture and National Water Authority will be useful to the project
- **Operational level**: Running the project under the Ministry of Agriculture will raise a conflict of interest between regulation and operational responsibilities. Therefore a steering committee for sludge management will be a feasible option. In addition, the new entity allocated for water distribution will be responsible for sludge management. This entity is highly recommended by the consultant and by the PWA. Having a separate unit will put limitation to any crosscutting activities that might be handled by different entities. However, as it is mentioned above, the new entity is under the finalization. The capacity and the financial capability will be depending on the conclusions and recommendations of the study.

- **Monitoring level:** Internal self-monitoring monitoring will be the responsibility of a representative from each institution. It is essential that external monitoring be done by inspection from MENA and MoH, in addition to Palestinian Society for Consumer Protection.

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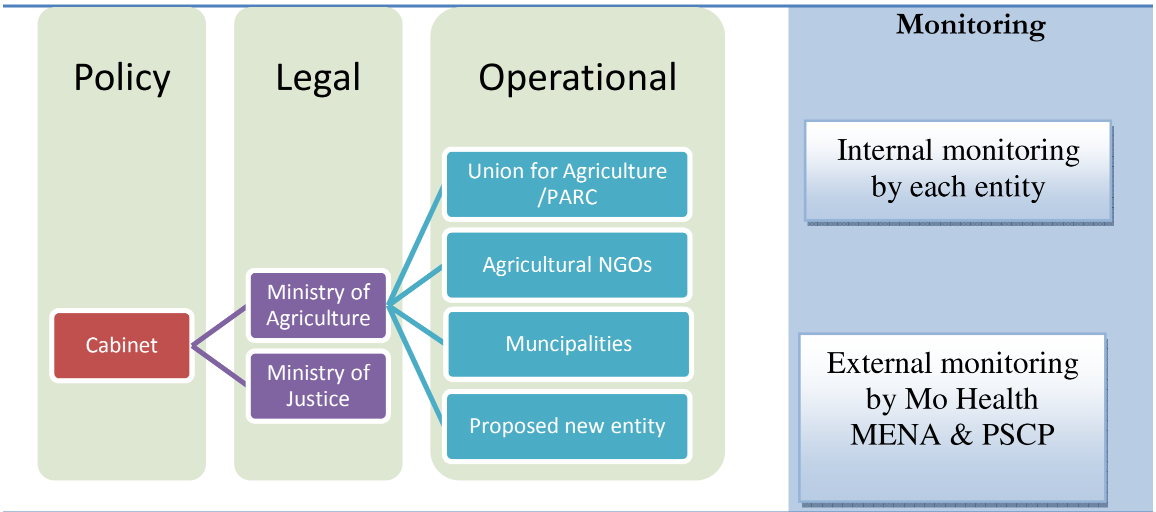

Figure 10: Proposed Sludge Management Institutional Scheme

Table 3: Proposed Capacity building needed for Sludge Management Institutions

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
Policy level	**Cabinet**	**Develop the polices that arrange water sector**			
Legal level	**Ministry of Agricultural in cooperation with Ministry of Justice and National Water Authority**	They will work together to finalize the legal framework for sludge distribution			
Operational level	**Union for Agriculture** **Palestinian Agricultural Relief Committee** **Ministry of Agriculture** **Municipalities and new entity**	○ **A steering committee formed from the different organization will be established for the operation of the process.** ○ **The new entity allocated for sludge management will be responsible for :** - **Proposing pricing mechanisms for sludge** - **Trading and distribution of sludge** - **Highlight groups entitled for subsidy** - **Provision of orientation sessions to the farmers**	○ **Orientation session regarding sludge and benefits of sludge as fertilizers** ○ **Community mobilization** ○ **Marketing and management skills** ○ **Barriers facing sludge merchandizing case studies** ○ **Pricing strategies for sludge**	**20 Days** **15 Days** **20 Days** **20 Days** **10 Days** **10 Days** **10 Days**	**40.000$**

Level	Responsible entity	Proposed tasks	Proposed Capacity building	Total proposed training days	Total cost in $
		- Mobilize the farmers to use the sludge - Sell sludge in the allocated places for sludge distribution	○ Documentation ○ Book keeping and auditing ○ Periodically performance gap analysis to propose the needed training	10 Days	
Monitoring for operational activities	<u>Internal monitoring</u> by the each entity <u>External Monitoring</u> MENA should monitor the environmental related activities Palestinian Society for Consumer Protection MoF monitor the budget and collection fees MoH monitors health related issues	1- Clear monitoring strategy to be developed and applied, Monthly, quarterly and annually 2- Budget should be monitored by MoF	1- Orientation sessions for sludge benefits and hazards 2- Monitoring and evaluation 3- Report writing 4- Documentation 5- Environmental auditing 6- Accounting and financial auditing	10 Days 10 Days 5 Days 5 Days 10 Days 10 Days	20000 $

8. Proposed Legal Framework for Recovered Water and Sludge Management

Analyzing the legal framework governing wastewater treatment and distribution in addition to sludge management is crucial for identifying the institutional framework. The current legal framework was discussed and covered in detail in Chapter 3. Therefore this section will focus on the main legal framework, trying to fill the gaps in the current law by proposing some essential laws needed for this sector.

The vision, goals, policy and strategic principles for the management of the water sector were developed following the establishment of the Palestinian Water Authority (PWA) in 1996. The National Water Policy is based on the principles of sustainable development, and was developed to guide the structure and tasks of water sector institutions and the water sector legislation. In particular, the Policy:

- declares that all sources of water are public property;
- recognizes that water has a social, an environmental and an economic value;
- direct that water sector management shall be carried out by one responsible body, with clear separation of policy and regulatory functions from service delivery functions.

A Strategy for Water Management in Palestine was later issued by PWA in 1999. Strengthening national policies and regulations, and enforcing water pollution control and protection of water resources, feature among the eight key elements of the Strategy. In particular, the strategic need is seen to "improve the legal framework by introducing new rules and regulations that provide incentives and enforcement mechanisms" (Key Element No.2). In addition, "legal regulatory and institutional instruments will be developed to enforce pollution control and protection of water resources through coordinated efforts with relevant institutions" (Key Element No.6).

The Palestinian Authorities issued many laws and decrees that formulate the legal and institutional framework for water sector at large. The main laws are:

Table 4: Legal Framework for Water Sector

Law	Summary of the main articles
Palestinian Water Authority, Law No 2/ 1996	The Water Law formulates and issued on July 17th 2002. It formulates the mandate of all relevant water sector organizations to develop and manage the water resources and increase its capacity, improve its quality and protect the water resources from pollution and depletion. Furthermore, Water Law established the institutional framework that governs the water sector. According to this law, the ***Water National Council*** and the ***Palestinian Water Authority*** are the prime institutions in the water sector.
The Agriculture Law, No.2/2003	The Agriculture Law was issued on August 5th, 2003.The article 55 of the law stated that "it is strictly prohibited to irrigate agricultural crops using wastewater unless treated in accordance with the national standards adopted by the competent technical authorities".

Law	Summary of the main articles
The Public Health Law , No 20/2004	The Public Health Law was issued on December 27th , 2004.The law stipulates clearly the role and responsibilities of the Ministry of Health (MoH). According to **article #2**, the MoH is responsible for 16 items that include but not limited to: • Periodic testing of potable water to ensure its suitability for human consumption. • Licensing of facilities that collects, process and dispose the waste. • Health supervision of all sewage and wastewater treatment plants. The article 43 of the said law prohibits the use of wastewater for fertilization of agricultural land, irrigation of field crops, except in accordance with the conditions and regulations set by the ministry in coordination with the concerned authorities
Environment Law, No.7/1999	The Environment Law was issued on December 28, 1999. **According to article 29,** the Ministry of Environment (later named *Environment Quality Authority)*, in coordination with the competent authorities sets the necessary standards and criteria for how to collect and process or re-use or disposal of wastewater and rainwater properly compatible with the preservation of the environment and public health. The article 30 prohibits for any person to discharge any solid, liquid or other except in accordance with the conditions and standards prescribed by the competent authority.
The Water Law, No.3/2002 (and proposed amendments)	The Water Law No. 3 of 2002 has to be considered as the basic legislation for any activities related to water sector. This law comprises of all regulations that govern water in the Palestinian territory and Gaza Strip. The following are some of the important articles that will regulate the project: • **Chapter 2 (Article 6)** According to this law an organization should be established under the auspices of the Palestinian Authority in order to be responsible for water sector and should be named as Water Authority. • **Chapter 2 (Article 7)** discusses the responsibility of water authority • **Chapter 5 (Article 18-20)** discussed the licenses and tariff mechanisms • **Chapter 7 (Articles 25-27)** that discusses the water utilities roles and responsibilities. • **Chapter 8 (Articles 29-32)** environmental protection for the water sources. • **Chapter 9 (Article 33-35)** related to inspection and monitoring for water quality

The discussion of the legal framework drew the attention to the importance of having the following legislation:

1- The most important law should cover the financial implications (water collection and recovered water tariff). The importance of this law derives from the importance of having a sustainable utility for water management. With no financial support, the proposed utility and sector reform will not be sustained. In addition, independent (self-financed) projects reduce the burden on the state budget
2- The second main regulation needed is one that tackles sludge collection, treatment, or dumping and sludge management. Sludge represents a completely new sector, which should be organized and well regulated in order to benefit from it.
3- Identifying the responsibilities of different entity for each legislation is crucial in order to warrant the commitment of different institutions and their dedication to the project according to the articles of Laws.
4- A detailed Law that criminalizes the usage of untreated water should be set in force in order to put limitations on unorganized usage of water

Annex 12

The Resettlement Policy Framework (RPF) and the Resettlement Action Plan (RAP)

Term of References (ToRs)

   
   
   
   
   

Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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Terms of Reference
RPF of NGESTP

September 2012

Table of Contents

ACRONYMS

AHLC	Ad Hoc Liaison Committee
BLWWTP	Beit Lahia Wastewater Treatment Plant
BP	Bank Policy
CA	Civil Administration
CAP	Consolidated Appeal for Palestine
CMWU	Coastal Municipalities Water Utility
COGAT	Coordinator of Government Activities in the Territories
DCA	Department of Civil Administration
DCL	District coordination liaison
ECHO	European Community Humanitarian Aid Department
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQA	Environmental Quality Authority
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWASH	Emergency Water and Sanitation Group
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI	Gross National Income
ISDS	Integrated Safeguards Data Sheet
IWA	Israeli Water Authority
JSC	Joint Service Council
JSET	Joint Supervision and Enforcement Team
JWC	Joint Water Committee
JWU	Jerusalem Water Undertaking
Lpcd	Liters per capita per day
MAS	Palestinian Economic Policy Research Institute
MCM	Millions of cubic meters
MoA	Ministry of Agriculture
MoP	Ministry of Planning
NGEST	North Gaza Emergency Sewage Treatment
NGO	Non Governmental Organization
NIS	New Israeli shekel
NSU	Negotiations Support Unit
NWC	National Water Council
OCHA	Office for the Coordination of Humanitarian Affairs
OP	Operation Policy
PA	Palestinian Authority

PAP	Project Affected Person
PCBS	Palestinian Central Bureau of Statistics
PHG	Palestine Hydrology Group
PMU	Project Management Unit
PNA	Palestinian National Authority
PRDP	Palestinian Reform and Development Plan
PSIA	Poverty and Social Impact Analysis
PWA	Palestinian Water Authority
RAP	Resettlement Action Plan
RFP	Request For Proposal
SLA	Sustainable Livelihoods Approach
SWAp	Sector Wide Approach
SWM	Solid Waste Management
ToR	Term of Reference
UNDP	United Nations Development Program
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International Development
WaSH MP	Water, Sanitation and Hygiene Monitoring Program
WB	World Bank
WBG	West Bank and Gaza
WBWD	West Bank Water Department
WHO	World Health Organization
WSWG	Water Sector Working Group

1. INTRODUCTION

The Beit Lahia Wastewater Treatment Plant (BLWWTP) was established in 1976 with a design capacity of 5,000 m3/d. BLWWTP comprise 7 stabilization ponds (2 anaerobic ponds, 2 aeration ponds, 2 facultative ponds and one polishing pond) to provide biological treatment. The original plan was to use the treated effluents for irrigation of the agricultural lands located near the northern borders of Gaza. The rapid growth of population in Northern Gaza has led to raising the generated wastewater discharge much higher than the design capacity of BLWWTP, the influent of BLWWTP has been estimated by 12,000 m3/d in 2004 and reached about 24,000 m3/d later in 2009.

The large discharge of sewage to BLWWTP had two major consequences, the first was that the sewage was only partially treated because the load was much higher than the design capacity of the plant, and the second was that the effluent of the polishing pond (Pond 7) was directed to an adjacent area of sand dunes to be infiltrated, but the high effluent volumes and its low quality (especially high suspended solids which caused clogging of the soil in the sand dunes area) have led to accumulation of large amounts of partially treated wastewater forming a lake that has developed gradually to cover an area of about 35 ha north and west of BLWWTP. Because this effluent pond was higher in elevation than the surrounding areas, flooding hazard to the near settlements was high, and sand embankments that were placed at the borders of the lake did not prevent flooding hazard, as the southwest side of the lake has collapsed in an occasion causing casualties and damage to neighboring agricultural lands.

The flooding hazards, risks of drowning, especially to children, the nuisance caused to neighboring communities and the environmental risks to soil and groundwater were direct factors that led to the initiation of the Northern Gaza Emergency Sewage Treatment (NGEST) Project.

2. BACKGROUND INFORMATION ABOUT THE PROJECT

2.1. Project Description

The project has 2 main components and corresponding stages: Part A: which was an emergency intervention to drain off the effluent lake and direct the BLWWTP effluent to engineered infiltration ponds so that they could be safely drained to the groundwater, and Part B which included establishment of North Gaza Wastewater Treatment Plant (NGEST) with a treatment capacity starting with 35,600 m3/day, and reaching 70,000 m3/d in future extensions, to cover the sewage treatment requirements of North Gaza during the design period of the project.

Part A of the project comprised construction of a Terminal Pump Station next to BLWWTP, a Force main to discharge the water for a distance of about 8 km and 9 infiltration ponds with an area of about 81 donums near the eastern borders of Gaza.

Part A has started operation in April 2009 and was completed in 2010, the effluent lake north of BLWWTP has been completely drained off by the completion of the project in 2010. While Part B is currently under construction and is expected to be commissioned in 2013.

A detailed Environmental Assessment study has been prepared for the two parts of the project, and the project impacts were identified based on the initially proposed schedule of the project in which the time between the operation of Parts A and B was expected to be about 2 years. However, the political situation of Gaza strip and the closure of the borders have caused delays of construction works of Part B and accordingly the time lag between the two project phases is expected to be about 4 years. A direct impact of this delay is that the amount of partially treated effluent infiltrating to the groundwater will be, in reality, more than the previously assessed through groundwater modeling in the original EA of the project. Within this context, the Effluent Recovery, Irrigation Scheme and Remediation Works project, subject of this Supplementary Environmental and Social Assessment, was initiated.

Effluent Recovery, Irrigation Scheme and Remediation Works project is expected to have four main components with the following rationale:

1. Pumping out quantities of the infiltrated partially treated effluent from the groundwater to avoid potential long term irreversible impacts to the groundwater and surrounding areas

2. Reuse the abstracted water from the groundwater in irrigation according to sound environmental and public health practices

3. Remediate the land of the evacuated effluent lake at BLWWTP and use the land as a location for a suitable development project

4. Decommission BLWWTP and adequately develop the site for a subsequent use, after the operation of NGEST expected in 2013

2.2. The Potential Impacts of the Project

Between significant positive and negative impacts, direct and indirect impacts, and immediate and long-term impacts. Identify impacts that are unavoidable or irreversible. Wherever possible, describe impacts quantitatively, in terms of environmental and/or social costs and benefits. The environmental and social impacts should be classified for both the construction and operational phases of the project. Although not exhaustive, the main impacts to be investigated are:

1. Impacts on the livelihood of the affected people and their socio-economic conditions. Potential loss of income, wells, assets and lands
2. Impacts on water supply and water quality;
3. Impacts on the local agriculture industry;
4. Impacts on vehicle, donkey, foot traffic, and commerce in the project areas during the construction period;
5. Construction-related impacts (noise, dust, debris, increased accidents) during the

construction phase;

6. Impacts related to construction of the effluent reuse pipeline, well field, and pumping of the effluent from beneath the infiltration ponds. Specific attention should be given to the possible impact on existing wells of groundwater level drawdown that may be caused by the effluent recovery wells;
7. For the decommissioned site, explore consequences of keeping the site open including examination of safety issues for children;
8. Public health negative and positive impacts anticipated.

3. SCOPE AND OBJECTIVE OF THE ASSIGNMENT

3.1. Objective and Rationale for the Assignment

This ToR is aimed at developing a Resettlement Policy Framework (RPF) for the Northern Gaza Emergency Sewage Treatment. The objective for the RPF is to set out the policies, principles, institutional arrangements, schedules and indicative budgets that will take care of anticipated resettlements. These arrangements are also to ensure that there is a systematic process (as against an adhoc one) for the different stages of the implementation of a framework that assures participation of affected persons, involvement of relevant institutions and stakeholders, adherence to both World Bank and Palestine procedures and requirements, and outline compensation for affected persons.

The consultant is to develop the RPF taking into consideration the outlined objective and principles. This RPF will serve as the framework within which a resettlement action plan will be developed when the project is certain of the locations and specific impacts of the project.

3.2. Specific Requirements of the RPF

The preparation of this RPF shall follow the requirements of the World Bank's Operational Policy on Involuntary Resettlement, OP 4.12. The RPF shall also make reference to Palestinian legal and institutional requirements related to land acquisition. Any identified gaps between these two requirements are to be clearly captured, explaining how these gaps will be filled, and which should take precedence with reasons.

3.3. Scope of Assignment

The assignment by the consultant shall cover the following key areas as described in this ToR. Other areas considered relevant may be considered by the consultant so far as they add value to the outlined areas below.

a) ***Project Description***

Provide a brief description of the project to place the RPF in the relevant context. This would include a summary of the background to the project and the different components. Most importantly, the consultant shall identify the possible resettlement issues that each component and subcomponents are likely to generate and for which reason this RPF is being developed.

b) ***Palestinian Legal and Institutional Guidelines and Requirements***

This will present a review of the national laws governing land acquisition and other assets. It shall also look at the various land tenure and ownership systems in Palestine, the different legal instruments regarding government and individual acquisitions and resettlement and compensation policies. The consultant shall describe any discrepancies identified in the different legal instruments.

The RPF shall also identify the legally mandated institutions associated with these legal instruments and their respective roles. This should be at all levels where implementation of project activities is likely to take place. Particular attention should be given to local-based institutions and structures at the project site(s). The institutional arrangements will include implementation and monitoring mechanisms that ensure inclusiveness and participation of all affected people, groups and communities.

c) World Bank Safeguards Policies

The Consultant shall spell out the World Bank's policy on Involuntary Resettlement OP 4.12 and assess how this applies in the specific case of the NGEST. Attention should be paid to and documented on the gaps between the Bank's policy and policy on involuntary resettlement if applicable, noting that where the differences are significant whichever policy is considered to be of a comparatively higher standard shall apply.

d) *Gaps* Gaps Between the Palestinian Regulation and the World Bank Policies

The Consultant shall present the gaps between the WB safeguard policy on involuntary resettlement and the Palestinian Legislations. Practical measures and recommendations to bridge the gap between the two sources of legislations should be explored.

e) Estimated Population, Displacement and Categories of Affected People

This requires a record of the number of estimated people likely to be affected or displaced by the project activities (Project Affected Persons – PAP) as noted in the project component description above. The different categories of affected persons may include those who may be losing legal title to land and those without legal title but who use the land for economic activities or for residential purposes. There may be those who may be losing temporary access to property or business sites. These are only examples of those who are likely to be affected through displacement. The RPF shall identify the right categories based on the impacts noted or expected.

The Consultant will be encouraged to conduct an initial social and economic survey at the various proposed sites for the project activities required under the different components and subcomponents that trigger the involuntary resettlement policy. The survey shall cover issues on the social structure, economic activities, social characterization of potential affected persons, and the numbers likely to be involved, the different social institutions, social capital and mechanism for social cohesion. The RPF shall also explore and describe existing conflict resolution mechanisms and potential for conflict situations arising as a result of the potential conflicts inherent in dealing with natural resources in general, and oil and gas in particular. This information will serve as critical baseline data for a future Resettlement Action Plan (RAP).

f) Eligibility Criteria for various Categories of Affected People

The consultant shall determine the method for setting a cut-off date for eligibility for compensation and also as a means for making this information (on cut-off date) reach the wider public. In addition, the consultant shall determine the compensation type for the different categories, losses and affected persons. These may include persons affected by land take, rights of access to resources or properties like housing, and water sources, loss of livelihood, and loss of cultural properties. The RPF shall take particular note of the multidimensional impact of the project and factor that into the analysis especially with regard to different sites and different forms of social impacts. The RPF shall pay particular attention to the different forms of impacts as a result of the nature of the project and explore the relevant issues appropriately.

The criteria for compensation should be in line with national legal requirements and provisions, World Bank OP 4.12, social sustainability and poverty reduction factors and fairness to avoid conflict and dissatisfaction. The section should also identify and document the unit of compensation that is whether individuals, families or groups and indicate the scenarios or cases for the application of each unit of analysis or a combination of units where appropriate.

g) Entitlement Matrix for proposed Resettlement and Compensation Policy

Following from the above, the RPF shall develop a matrix that detail the type of compensation that each identified PAP will be entitled to and a rationale as part of the matrix explaining the reasoning behind the entitlement as will be proposed in the Matrix.

h) Methods for Valuing Affected Assets

This section shall describe in detail the methods used in valuing those assets that will be eligible for compensation either as per national or World Bank policy on involuntary resettlement (OP4.12). This method shall be consistent with both national policy requirements and regulations and OP4.12. This process should capture the methodology for taking of inventory of assets, values assigned and agreement reached with each identified PAP and consider inflationary realities in the final determination of values. The RPF shall include a clear statement alluding to the possibility of revised values should there be major discrepancies between dates for value determination and actual date for payments. The PAPs should have an opportunity to do their own valuation if they have doubts or misgivings through the facilitation of the project for further negotiations between the PAP(s) and the client. Valuing of assets should be a process of engagement with PAPs and not an imposition. The RPF shall demonstrate that the methods used for the exercise in its entirety were fully participatory and acceptable to all stakeholders.

i) Organizational Arrangements and Procedures for Delivery of Entitlements

The RPF shall describe the process for organizational arrangements, responsibilities and roles. The RPF shall describe the approval processes for the various stages of the compensation work including the various actors and their roles and responsibilities. This section will also spell out the actual process for delivering the entitlement including the roles for the different agencies and reporting formats.

j) Methods for Consultation with and participation of Affected People

The consultant should as a matter of importance, describe in clear terms the methodology for consultation and participation by the PAPs in the process until they have received their entitlements. This process should be elaborate and clear to avoid and minimize confusion and suspicion. This could be done according to the different levels of consultations, the expected outcome form the different stages of the consultation and participation approach that would be adopted.

The consultation process includes that for the development of the RPF and subsequent RAPs. The RPF should categorically emphasize the importance of documentation and other evidential indication for the consultation and participation process for this RPF and for subsequent RAPs. The record of consultation and participation for this RPF should be attached as an annex to the final RPF report for the client. As part of this, the consultant will develop a program for the disclosure of the RPF to facilitate the work of the client on this matter. The responsibility for both the disclosure and dissemination however lies with the client.

k) Grievance Redress Mechanisms

Under the grievance redress mechanism, the consultant shall describe the options available to PAPs for grievance redress they may have about the process, the identification of eligible people for compensation, the valuing and compensation and any other complaints they may have with the entire process. The RPF shall indicate how these would be disseminated and accessible to them in a way that is clear and comprehensible to the PAPs. The grievance redress mechanism should also have an in-built monitoring mechanism to check on responsiveness to complaints or grievances lodged. The different forms of receiving the complaints should be clearly described together with the different stages of going through the process. In addition, the redress mechanism shall indicate alternatives, in case the proposed mechanism, for any reason, does not respond to all grievances and complaints

.

l) Budget and Funding Arrangements

The RPF should clearly state the sources of funding for subsequent RAPs, an overall cost estimates for resettlement including for monitoring of the resettlement activities. If there are multiple sites, the RPF should give an indicative budget for resettlement for each of the sites or communities. The financial responsibility of the relevant stakeholders, where applicable, should be categorically stated to avoid ambiguity of source of funds for resettlement activities. These budgets should take into consideration inflationary tendencies

m) Monitoring Arrangements

The RPF shall provide appropriate mechanism for monitoring the implementation of the resettlement activities. The consultant shall propose current and participatory monitoring methodologies that would involve the PAPs themselves. The roles of different players like the PAPs, civil society, traditional authorities, and local government authorities among others, in the implementation and monitoring process will need to be clarified. The RPF shall develop, as part of this, a template for monitoring with indicators based on the main issues identified and spelt out in the RPF.

n) Implementation Schedule

To avoid confusion with cut-off dates and other time lines especially because compensation will have to be paid prior to commencement of any civil works, it is important for the RPF to set out implementation schedule for the resettlement. Due to the fast track nature of this project, the RPF shall in addition to the implementation schedule identify potential risks that could militate against the smooth implementation of the resettlement actions and suggest plausible mitigation measures to serve as a guide to the client and the team who will be working on the implementation.

4. METHODOLOGY

The Consultant should be employing **a participatory bottom-up approach in the preparation of the Resettlement Policy Framework (RPF).** Various qualitative and quantitative data collection tools will be used to engage various categories of Project Affected People (PAPs). In the meantime, the Consultant will utilize the available information by starting the assignment with thorough review and analysis for the baseline prepared as part of the ESIA prepared in 2006 and the additional SESIA that has been implemented during 2012[1] that is the one during which the RPF ToR was prepared. The main tools that will be deployed include but are not limited to:

4.1. Secondary data collection method:

Literature review: including laws, legislations that govern expropriation and land acquisition (both national and international guidelines and safeguard policies) trying to highlight the gaps and how to fill the gaps, socio-economic baseline data, all reports

[1] Included in the SESIA detailed results that were based on focus group discussions and In-depth interviews conducted with the Project Affected People

developed during the preparation of the project i.e. Palestinian Human Development Report, Environmental ESIA . Proposed reports and Legislations to be reviewed

1- Human Development Report 2009/10 Investing in Human Security for a Future State- occupied Palestinian territory
2- Palestinian Environmental Law . 7, 1999
3- Palestinian Laws
    - Basic laws
    - Basic Laws declaration for Palestinian Human Right
    - Expropriation Law (*Istmlak*)
    - Land Ownership Law 2/1953
    - Antiquities Law 1966
    - Law 21Consumer protection laws
    - Palestinian Labor Laws 7/2000
    - Health and safety Law 3/2011
    - Palestinian Reform and Development Plan PRDP (2008 -2010)
    - Local Council Law 1/1997
4- Palestinian Environmental Assessment Policy
5- World Bank OP.4. 12 concerning Involuntary Resettlement

4.2. Primary data collection methods

Different surveying tools could be employed to collect the needed data, more deep information to be acquired from the entities responsible for compensation i.e. municipalities or other entities responsible for the relocation of farmers to other lands i.e. Awqaf Department. The qualitative methods are generally more interactive and participatory techniques that can pave the way with the local community to the introduction of the structured inventory survey.

The sample of the qualitative research is usually smaller but focused rather than large samples. The exact targeted number of FGDs and SSIs (sample size) will be determined among the team of experts and will be discussed with the Client.

Data analysis:

The data collected through various surveying methods explained above will be carefully recorded on questionnaire, interviews transcripts and other data sheets. Various software for the analysis of both qualitative and quantitative data will be used, most importantly SPSS.

The Consultant will also ensure thorough review for the qualitative raw information in order to extract useful experiences/quotations/lessons learnt and add to the analysis of the RPF wherever applicable.

C. Field Observation

The Consultant should also rely on field observations to enrich the findings on the current situation. Local surveyors (enumerators), local NGOs and natural/community leaders will be mobilized to assist in this task and field observation checklists will be designed in order for the team to fill during the field observations.

- The Consultant should ensure adopting a consultative and participatory approach that allows the stakeholders for feedback and facilitate the process of endorsement of the studies. The following consultative workshops will be arranged

    1) **A kick-off workshop (Scoping)** will be arranged by the beginning of the assignment with the main objective of bringing the various stakeholders together, introduce the assignment ToRs, review the ToRs and allow for feedback and for sharing special issues for the Consultant attention.

       The kick off workshop will be a good opportunity for the Consultant to consider aspects that may not originally be included on the ToRs and that appear to be of concern and importance to the local stakeholders. In such cases, these aspects should be considered in the RPF.

    2) **Consultation for the draft RPF:** This will aim to engage local key stakeholders and involve them in the revision of the draft findings of the RPF. This step is very important and a key disclosure requirement for the World Bank and other IFIs.

       The requirements for arranging a public consultation including but not limited to:
       - Identification and invitation of various groups of stakeholders and ensure balanced representation (according to affiliation, gender, interests, ..etc) for all the groups including those who will be encountering various types of negative impacts.
       - Selecting a venue which is neutral and convenient, provide transportation (if required) in order to encourage marginalized groups to participate.
       - Preparation and dissemination of Arabic non-technical executive summary before the workshop and uploading the executive summary to public domain like the Promoter or the Consultant's website.
       - Preparation and delivering a presentation for the findings of the RPF
       - Recording and addressing the comments and concerns that the participants will raise during the Consultation and ensure proper documentation for the event.

- It is crucial to adopt a gender sensitive approach with special attention to be paid to the affected women in general and the female headed households in particular.

- The Consultant should consider local culture sensitive planning. In this regard, attention will be paid to develop alternative and plans in a culturally sensitive manner that is acceptable to the local population an that proved to be successful in the Palastenian context.

5. Fundamental Structure and Composition of the Consultant Team

The Consultancy firm should be demonstrating capability to mobilize an experienced highly qualified team of experts to fulfill the ToRs requirements. The following table presents the team of the key experts, the required qualifications and the key tasks anticipated for each of the team members. The Consultant is encouraged to propose additional experts as needed and elaborate on the proposed tasks for both the fundamental and the additional experts in the technical proposal.

Table 1: Resettlement Policy Framework Fundamental Team

Consultant	Minimum Required Qualifications	Main responsibilities within the assignment
Team Leader	• Relevant postgraduate degree • At least 15 years experience in similar types of assignments • Tracked expertise and knowledge in safeguard policies of international institutes.	1- Mobilize surveying team 2- Coordinate among the team 3- Revise the final report for quality assurance 4- Reporting for the client
Resettlement Specialist and principle investigator	• Relevant university degree in social development and preferably a postgraduate degree • At least 10 years experience in similar types of assignments • Tracked record of experience on involuntary resettlement like Resettlement Policy Framework (RPF) and Resettlement Action Plan (RAP).	1- Prepare all survey tools in cooperation with the other team members 2- Review the legal framework that govern the resettlement activities 3- Develop the final report 4- Disseminate the results
Social community specialist and household survey expert	• Relevant university degree in social development and preferably a postgraduate degree • Expertise in areas related to community mobilization, participatory tools and consultation with stakeholders	1- Prepare the surveying tools 2- Test the survey tools
Data analyst		1- Software experts who will develop the

		data entry programs
Team of field surveyors and quality control supervisors	1- University graduates 2- Experience not less than 5 years in data collection using quantitative and qualitative tools	3- Participate in testing the tools 4- Collect data (qualitative , quantitative and observation sheets) 5- Supervise data collection process and monitor the quality of data.
Team of data processing personnel	6- University graduates 1- Experience not less than 5 years in data processing (editing – coding – cleaning ..etc)	2- Responsible for editing, coding, data entry and re-entry 3- Transcription of the qualitative data 4- Summarizing the qualitative data

6. The Proposed Activities to Achieve the Assignment

The project ToRs included a comprehensive list of activities that the Consultant needs to accomplish within the frame of working in this assignment. The Consultant will be fully responsible for conducting the various activities include in the ToRs, The presentation below for the proposed activities is concentrating only on the general activities, both the general ones and those of relevance to specific three tasks stated in the ToRs.

General activities

- Review for the Palestinian legislations related to various types of lands and assets acquisition including the various entitlements

- Review the international safeguard policies related to the assignment including the WB OP 4.12 regarding Involuntary Resettlement

- Review previous reports and action taken as part of ESIA 2006 and SESIA 2012 to ensure orientation with the lessons learnt from these phases. Identifying the gaps in these documents regarding the discussion of the PAPs in order to fill the gaps during field work

- Conduct the various data collection activities to ensure that the RPF and the RAP are founded on comprehensive baseline information. This may involve conducting any complementary activities to fill in any information gaps (e.g. interviews, meetings, field observations).

- Ensure that the RPF is providing a comprehensive package that meets the WB social principles and standards and that sufficiently cover the following:

    - Identification for the PAPs
    - Parameters/criteria for the entitlements package (both monetary and non-monetary) for those project affected persons (PAPs),

- Institutional framework adopted,
- Mechanisms for consultation and grievance resolution,
- The time frame (especially in relation to other project activities)
- Cost estimates
- Monitoring and evaluation mechanisms and tools

The Consultant should make sure that PWA is supported technically and is becoming fully aware of the compensations requirements with the WB policies.

7. Duration of the Assignment and time plan

The team of experts will be collaborating together with other stakeholders in order to submit the required input and meet the deliverable schedule. The assignment should involve close collaboration with PWA with their capacity as the project proponent. The assignment shall be completed within eight (8) weeks after signing of contract.

8. Deliverables and Outputs

The team of experts will be collaborating together and with other stakeholders in order to submit the required input and meet the deliverable schedule briefly presented on Table 2 below.
The Consultant is expected to have the following deliverables:

Inception Report with detailed work plan and indicators of performance. This will be discussed by consultant, client and other experts to ensure quality of final outcome. This should be delivered one (1) week after signing of contract;

Draft RPF Report This will be circulated for comments and relevant issues raised incorporated into revised version. This will be delivered three (3) weeks after submission of inception report.

Final RPF Report The final report should include a concise Executive Summary and should have all annexes and bibliography and the dissemination/disclosure plan. This will be delivered two (2) weeks after submission of draft report.

Table 2: List of deliverables and outputs for the assignment of the preparation of the RPF

RPF assignment	Due date
Inception report	1weeks
Draft Resettlement Policy Framework	6 weeks
Final RPF Report	8 weeks

9. Potential Table of Contents for the RPF

Box 1: Tentative Table of Contents for the RPF[2]

Executive Summary

An executive summary will be prepared to be used as a stand-alone document in a manner that can be accessible to non-technical readers both in English and Arabic languages.

Chapter One: Project Description

This Chapter sheds the light on the project, the objectives of the RPF, project background, anticipated sub-phases and location, assessment of associated facilities and RPF implementing arrangements

Chapter Two: RPF Purpose and Objectives

This Chapter presents the main objectives of the framework, direct and indirect social impacts and the Consultant methodology that has been used in the preparation of the RPF. Additionally it should include:

- Principles and Objectives governing resettlement
- Methodology of preparation and implementation
- Review of the National Legislation governing land acquisition and resettlement
- Requirements of the Lenders for resettlement
- Gaps between national and Lenders' legal requirements

Chapter Three: legislative Framework for the Resettlement in Palestine

This Chapter presents summary about the key relevant laws in relation to the land ownership, expropriation, transfer of ownership and compensation issues. It also presents the main administrative and institutional framework for the issue related to land management and resettlement in Palestine.

Chapter Four: The World Bank Safeguard Policies

OP 4.12 on involuntary resettlement is the key safeguard policy for the World Bank. This Chapter of the RPF presents in details the various principles related to this safeguard policy including, but not limited to, the resettlement instruments, scope and coverage of the RPF, RAP preparation and approval, Project affected persons and the vulnerable groups, the eligibility procedures and criteria, valuation of assets, implementation procedures, grievance and redress mechanism, budget and funding, disclosure requirements and the WB resettlement document, consultation and implementation process and monitoring and evaluation.

[2] The Box includes an idea about the main requirements for the RPF driven from the Consultant previous experience in preparing RPF/RAP. It also considers the requirements under this project ToRs The Consultant will be tailoring these requirements to fit with the project needs and context

Chapter Five: Gaps Between the Palestinian Regulation and the World Bank Policies

This chapter aims to present the gaps between the WB safeguard policy on involuntary resettlement and the Palestinian Legislations. It also aims to present some measures and recommendations to bridge the gap between the two sources of legislations.

Chapter Six : Social Assessment and socio-economic surveys

This Chapter should include the baseline, socio-economic data, and census and the steps for the preparation of sub-phase PAPs

Chapter Seven: Estimated Population Displacement, Eligibility categories and Methods of Valuing Affected Assets.

This Chapter should present the estimate of displaced population, land acquisition and likely categories of impact, eligibility criteria for various categories of PAPs, the valuation of Land used by the Public and the calculations for Compensation Payments and related Considerations

Chapter Eight: Organizational Elements and Procedures for Delivery of Entitlements

Under this Chapter the RAPs submittal and approval process should be explained. It also should link between the RAP and the actual project execution including how resettlement will be linked to the civil works.

Chapter Nine: Methods for Consultation with and participation of Affected People

This chapter describes in clear terms the methodology for consultation and participation by the PAPs in the process until they have received their entitlements. This process should be elaborate and clear to avoid and minimize confusion and suspicion. This could be done according to the different levels of consultations, the expected outcome form the different stages of the consultation and participation approach that would be adopted.

Chapter ten: Grievance Redress Mechanisms

Under the grievance redress mechanism chapter, detailed description for the options available to PAPs for grievance redress should be highlighted. The identification of eligible people for compensation, the valuing and compensation and any other complaints they may have with the entire process should be mentioned

Chapter Eleven :Budget and Funding Arrangements and time plan

This chapter states the sources of funding for subsequent RAPs, an overall cost estimates for resettlement including for monitoring of the resettlement activities. If there are multiple sites, the RPF should give an indicative budget for resettlement for each of the sites or communities. The financial responsibility of the relevant stakeholders, where applicable, should be categorically stated to avoid ambiguity of source of funds for resettlement activities. These budgets should take into consideration inflationary tendencies.

The cut-off dates and other time lines especially because compensation will have to be paid prior to commencement of any civil works, it is important for the RPF to set out implementation schedule for the resettlement.

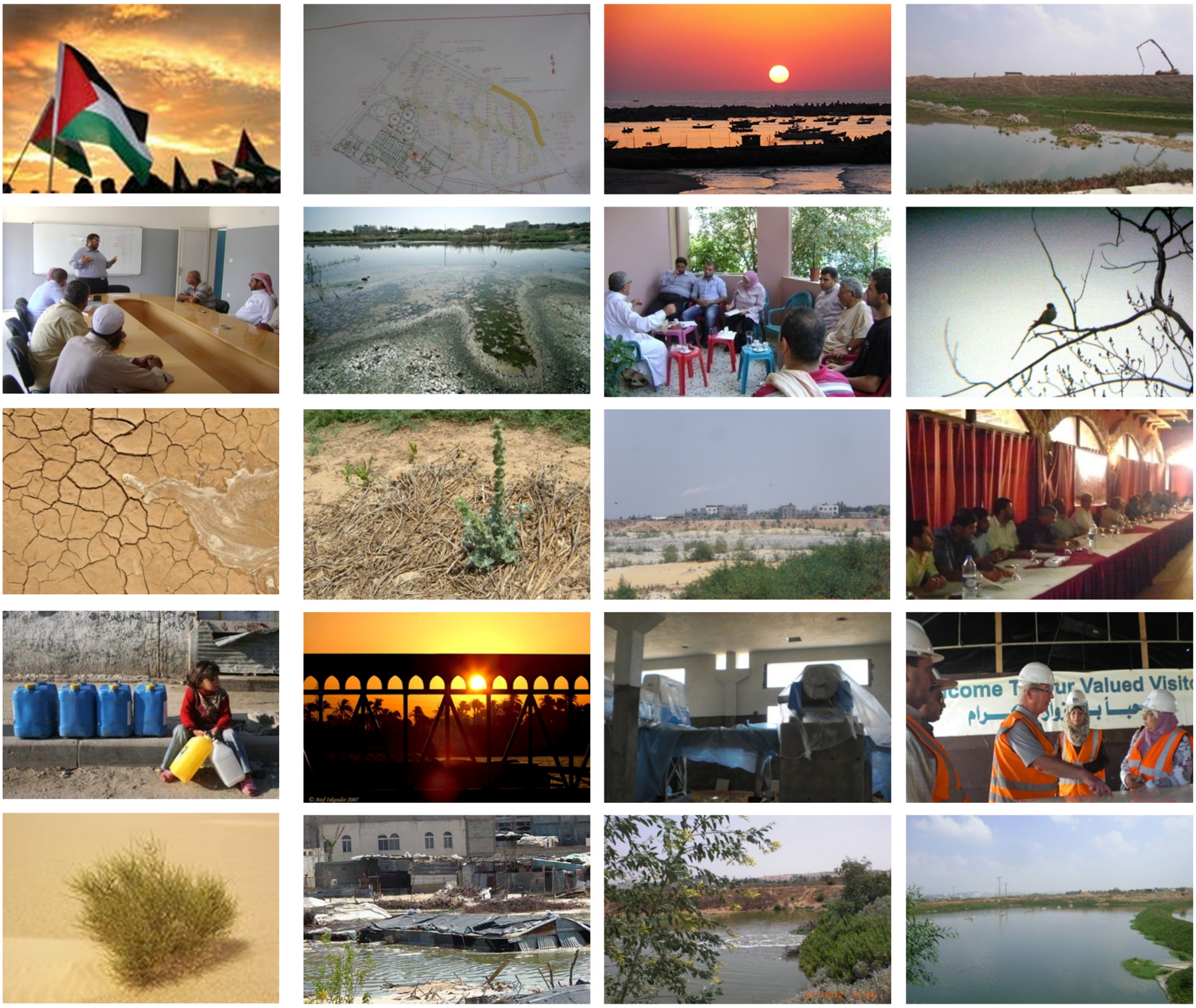
Chapter Twelve : Resettlement Action Plans (RAPs)

This Chapter explains the various steps of preparing the RAP and the key elements that should be covered by the RAP including the timeframe, resettlement and the project schedule, grievance redress mechanism, method for consultation and participation, monitoring and evaluation arrangements

Annexes

The RPF annexes could include:

- The Eligibility criteria for the PAPs
- Method of valuating of affected assets and compensation
- Entitlement matrix
- Resettlement and compensation planning
- Budgeting and sources of funding for the RAPs



Submitted to:

Palestinian Water Authority
Project Management Unit Directorate building
Al Wehda Street, in front of Ministry of Health
Shaath building, 4th floor
Al Rimal, Gaza City

Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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Terms of Reference Resettlement Action Plan of NGESTP

December 2012

Table of Contents

ACRONYMS

AHLC	Ad Hoc Liaison Committee
BLWWTP	Beit Lahia Wastewater Treatment Plant
BP	Bank Policy
CA	Civil Administration
CAP	Consolidated Appeal for Palestine
CMWU	Coastal Municipalities Water Utility
COGAT	Coordinator of Government Activities in the Territories
DCA	Department of Civil Administration
DCL	District coordination liaison
ECHO	European Community Humanitarian Aid Department
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EQA	Environmental Quality Authority
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
EWASH	Emergency Water and Sanitation Group
FAO	Food and Agriculture Organization
GDP	Gross Domestic Product
GIS	Geographic Information System
GNI **ISDS**	Gross National Income Integrated Safeguards Data Sheet
IWA	Israeli Water Authority
JSC **JSET**	Joint Service Council Joint Supervision and Enforcement Team
JWC	Joint Water Committee
JWU	Jerusalem Water Undertaking
Lpcd	Liters per capita per day
MAS	Palestinian Economic Policy Research Institute
MCM	Millions of cubic meters
MoA	Ministry of Agriculture
MoP	Ministry of Planning
NGEST	North Gaza Emergency Sewage Treatment
NGO	Non Governmental Organization
NIS	New Israeli shekel
NSU	Negotiations Support Unit
NWC	National Water Council
OCHA	Office for the Coordination of Humanitarian Affairs
OP	Operation Policy
PA	Palestinian Authority

PAP	Project Affected Person
PCBS	Palestinian Central Bureau of Statistics
PHG	Palestine Hydrology Group
PMU	Project Management Unit
PNA	Palestinian National Authority
PRDP	Palestinian Reform and Development Plan
PSIA	Poverty and Social Impact Analysis
PWA **RAP**	Palestinian Water Authority Resettlement Action Plan
RFP	Request For Proposal
RPF **SLA**	Resettlement Policy Framework Sustainable Livelihoods Approach
SWAp	Sector Wide Approach
SWM	Solid Waste Management
ToR	Term of Reference
UNDP	United Nations Development Program
UNRWA	United Nations Relief and Works Agency
USAID	United States Agency for International Development
WaSH MP	Water, Sanitation and Hygiene Monitoring Program
WB	World Bank
WBG	West Bank and Gaza
WBWD	West Bank Water Department
WHO	World Health Organization
WSWG	Water Sector Working Group

1. INTRODUCTION

The Beit Lahia Wastewater Treatment Plant (BLWWTP) was established in 1976 with a design capacity of 5,000 m3/d. BLWWTP comprise 7 stabilization ponds (2 anaerobic ponds, 2 aeration ponds, 2 facultative ponds and one polishing pond) to provide biological treatment. The original plan was to use the treated effluents for irrigation of the agricultural lands located near the northern borders of Gaza. The rapid growth of population in Northern Gaza has led to raising the generated wastewater discharge much higher than the design capacity of BLWWTP, the influent of BLWWTP has been estimated by 12,000 m3/d in 2004 and reached about 24,000 m3/d later in 2009.

The large discharge of sewage to BLWWTP had two major consequences, the first was that the sewage was only partially treated because the load was much higher than the design capacity of the plant, and the second was that the effluent of the polishing pond (Pond 7) was directed to an adjacent area of sand dunes to be infiltrated, but the high effluent volumes and its low quality (especially high suspended solids which caused clogging of the soil in the sand dunes area) have led to accumulation of large amounts of partially treated wastewater forming a lake that has developed gradually to cover an area of about 35 ha north and west of BLWWTP. Because this effluent pond was higher in elevation than the surrounding areas, flooding hazard to the near settlements was high, and sand embankments that were placed at the borders of the lake did not prevent flooding hazard, as the southwest side of the lake has collapsed in an occasion causing casualties and damage to neighboring agricultural lands.

The flooding hazards, risks of drowning, especially to children, the nuisance caused to neighboring communities and the environmental risks to soil and groundwater were direct factors that led to the initiation of the Northern Gaza Emergency Sewage Treatment (NGEST) Project.

2. BACKGROUND INFORMATION ABOUT THE PROJECT

2.1. Project Description

The project has 2 main components and corresponding stages: Part A: which was an emergency intervention to drain off the effluent lake and direct the BLWWTP effluent to engineered infiltration ponds so that they could be safely drained to the groundwater, and Part B which included establishment of North Gaza Wastewater Treatment Plant (NGEST) with a treatment capacity starting with 35,600 m3/day, and reaching 70,000 m3/d in future extensions, to cover the sewage treatment requirements of North Gaza during the design period of the project.

Part A of the project comprised construction of a Terminal Pump Station next to BLWWTP, a Force main to discharge the water for a distance of about 8 km and 9 infiltration ponds with an area of about 81 donums near the eastern borders of Gaza.

Part A has started operation in April 2009 and was completed in 2010, the effluent lake north of BLWWTP has been completely drained off by the completion of the project in 2010. While Part B is currently under construction and is expected to be commissioned in 2013.

A detailed Environmental Assessment study has been prepared for the two parts of the project, and the project impacts were identified based on the initially proposed schedule of the project in which the time between the operation of Parts A and B was expected to be about 2 years. However, the political situation of Gaza strip and the closure of the borders have caused delays of construction works of Part B and accordingly the time lag between the two project phases is expected to be about 4 years. A direct impact of this delay is that the amount of partially treated effluent infiltrating to the groundwater will be, in reality, more than the previously assessed through groundwater modeling in the original EA of the project. Within this context, the Effluent Recovery, Irrigation Scheme and Remediation Works project, subject of this Supplementary Environmental and Social Assessment, was initiated.

Effluent Recovery, Irrigation Scheme and Remediation Works project is expected to have four main components with the following rationale:

1. Pumping out quantities of the infiltrated partially treated effluent from the groundwater to avoid potential long term irreversible impacts to the groundwater and surrounding areas

2. Reuse the abstracted water from the groundwater in irrigation according to sound environmental and public health practices

3. Remediate the land of the evacuated effluent lake at BLWWTP and use the land as a location for a suitable development project

4. Decommission BLWWTP and adequately develop the site for a subsequent use, after the operation of NGEST expected in 2013

2.2. The Potential Impacts of the Project

The environmental and social impacts have been classified during the ESIA and the Supplementary ESIA consequently the following are the potential positive impacts:

1. The recovered effluent from the groundwater will be an important source of irrigation water, as water resources in the Gaza Strip are scarce.
2. The groundwater quality is suitable for Unrestricted Use. The only restriction is the Total-N, > 15 mg/l. (considered as an advantage for agricultural use). However, it is advisable not to be used for uncooked vegetables.
3. The recovery will limit the horizontal dispersion and the vertical building up of the water table, which without recovery will have a negative impact on current land use.
4. Sludge has a high content of organic matter that can help conserving soil organic matter, and sludge stimulates biological activity in the soil.

5. The fertilizer effect of sludge enables a reduction in cost for nitrogen and phosphorus mineral fertilizers and may improve crops yield on sludge treated at low costs. Moreover, the sludge will be reliably available compared to imported fertilizers.
6. Sludge reuse is the best environmental solution than landfill disposal /incineration.

Among a number of negative impacts that are expected to result from the project, certain impacts were perceived to attribute to involuntary resettlement resulting from physical or livelihoods resettlement. This mainly involves:

1. **Sever potential impact on the tenants who rent lands from *Awkaf*** for a few amount of money that includes the cost of water. They will be affected in sense of losing their lands and paying for water.

2. **The owners of small plots of lands** who will be expropriated during the construction of the 27 wells. Some of the land owners have small plot of lands that don't exceed one dunum. When the wells pass in the middle of such plots of lands, it will not be able to make use of their lands

3. **Sever potential impact on 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 the well's owners used to gain his income through selling water will be badly affected

4. **Sever potential impact on the operators of wells** who are untrained might suffer due the termination of wells. They are maximum 10 people, therefore, the magnitude of their vulnerability might be mitigated

5. SCOPE AND OBJECTIVE OF THE ASSIGNMENT

5.1. Objective and Rationale for the Assignment

These ToRs aim for developing a Resettlement Action Plan (RAP) for the Northern Gaza Emergency Sewage Treatment. The objective for the RAP is to set out the policies, principles, institutional arrangements, schedules and indicative budgets that will take care of anticipated resettlements. These arrangements are also meant to ensure that there is a systematic process (as against an ad hoc one) for the different stages of the implementation of a framework that assures participation of affected persons, involvement of relevant institutions and stakeholders, adherence to both World Bank and Palestine procedures and requirements, and outline compensation for affected persons.

The consultant is to develop the RAP taking into consideration the outlined objective and principles. The main goal of the RAP is to identify the Project Affected Persons, strategies for compensation/ restoration of business and to compensate losses adequately according the correspondent legislations and safeguard policies, and to apply the project activities with the least disturbance to the communities hosting the project. In order to achieve this goal the following has to be considered:

1. Describe the existing Palestinian legal and policy framework for land acquisition; As well as, reviewing the laws, regulations that apply to reclaiming informally settled public land and involuntary eviction and resettlement.
2. Reviewing the World Bank policies related to resettlement in order to ensure that the RAP is developed in full compliance with these policies.
3. Identify the gaps between the national legislations and the World Bank policies related to involuntary resettlement and propose practical procedures to bridge these gaps.
4. Identify the key social impacts that will associate with the involuntary resettlement process and the main categories to encounter these impacts.
5. Prepare socioeconomic/inventory/census survey for the PAPs to identify and quantify different categories of different categories of project affected people (PAPs) who would require some form of assistance, compensation, rehabilitation or relocation.
6. Prepare an entitlements matrix listing all likely effects as per relevant typologies to be developed on assets and resources.
7. Prepare standards for compensation and restoration of the social and economic base of the PAPs to replace all types of loss, as appropriate.
8. Develop clear executive time plan for the RAP implementation linking the various steps to the various project components and execution plan, including institutional responsibilities, and monitoring parameters.
9. Document the various consultation activities to be conducted as part of the RAP and ensuring that information has been shared transparently through an active and informative consultation process.
10. Develop communication and consultation plan to be adopted by the project promoter along the various stages of the project cycle.
11. Identify the institutional responsibility for implementation and procedures for the grievance redress, arrangements for monitoring and implementation of the monitoring system.
12. Consult the agencies responsible for land acquisition within the promoter company and the other institutes participating in the arrangement of resettlement activities. Their roles and responsibilities will be assessed.

5.2. Specific Requirements for the RAP

The preparation of this RAP shall follow the requirements of the World Bank's Operational Policy on Involuntary Resettlement, OP 4.12. The RAP shall also make reference to Palestinian legal and institutional requirements related to land acquisition. Any identified gaps between these two requirements are to be clearly captured, explaining how these gaps will be filled, and which should take precedence with reasons.

The main objective of the census survey for the RAP is to help in establishing a comprehensive quantitative descriptive baseline for the PAPs. It also helps in providing in-depth understanding for the current socioeconomic situation related to project PAPs including their livelihoods and living conditions and the appropriate compensation tools. The RAP census questionnaire (socio-economic survey) will be designed to investigate a number of issues in order to assist in establishing a full profile about the PAPs. It will also help in establishing baseline conditions to help in measuring the impacts of resettlement of PAPs during later stage of the project. Box 1 below presents the main aspects that should be covered as part of the RAP inventory survey

Box 1: Key issues to be considered in designing the RAP inventory questionnaire

- Profile of the affected person including names, gender, age, education, place of residence, occupation, family size, profile of family members,
- Nature of displacement (physical or economic) including the location, number and types of persons and assets affected
- Magnitude of expected impacts on them and their families including total or partial loss of assets
- Income and expenditure (livelihoods pattern including both formal and informal sources of income)
- Social organisations including NGOs and other community organisations that are having a role/could play a role with PAPs, particularly during the compensation phase.
- Views on the appropriate and acceptable types of compensation.

The Consultant will tailor the questionnaire of the socio-economic (census/inventory) survey to reflect the various types of assets within the framework of the Sustainable Livelihoods Approach (SLA). The questions will be structured to address the various examples of assets to the extent possible.

Moreover, and in addition to the socio-economic (census/inventory) survey, the Consultant is expected to utilize additional qualitative tools for data collection including, but not limited to, Focus Group Discussion (FGDs) and Semi-Structured Interviews (SSI). Box 2 below presents and tentative table of contents for the RAP.

Box 2: Tentative Table of Contents for the RAP

Executive Summary – Non-Technical Summary

An executive summary will be prepared to be used as a stand-alone document in a manner that can be accessible to non-technical readers both in English and Arabic languages.

Chapter 1 – Introduction
The introduction of the RAP will include presentation for the project objectives, the project components and a general description of the project and identification of the project impact area.

Chapter 2 – Approach and Methodology
This chapter sheds the light on the objectives and scope of the RAP and the methodology and tools that the consultant used in preparing the RAP. Tools include but are not limited to thematic maps, households and land use inventories, surveys and studies.

Chapter 3 – Policies, Regulations and Guidelines
This chapter of the RAP include the various Palestinian land acquisition act and regulations, the World Bank OP 4.12 on involuntary resettlement. It will also include a comparison between the Palestinian and the WB legislations and recommend some local measures to bridge these gaps.

Chapter 4 – Stakeholder Consultation and Identification of Social Impacts
Describe the various stakeholders, the potentially affected groups and the various social impacts and the mitigation arrangements to identify a project's adverse impacts and the populations that will be affected.

This chapter will also describe the process of promoting consultation/participation of affected populations and stakeholders in resettlement preparation and planning and the plan for disseminating RAP information to affected populations and stakeholders.

Chapter 5 – Resettlement Action Plan

- *Description and objectives*: This will include a socio-economic baseline including people who will be affected by the project and all adverse impacts on their livelihoods associated with the project's land acquisition. Negative impacts might include breakup of communities and social support networks; loss of dwellings, farm buildings, and other structures, loss of business; loss of access to public infrastructure or services; and reduced income resulting from these losses. This part also will describe the results of these impacts and the mechanisms used to minimize displacement during implementation.
- *PAPs inventory/census survey:* This part of Chapter 5 involves the results of the conducted registration survey/inventory/census of the PAPs. It involves full profile about the families of the PAPs, size of the families, ages, occupation, their assets, ownerships, the impact that they will encounter…etc.
- *Eligibility criteria and entitlement policy matrix:* The RAP will establish and disclose the criteria by which affected people will be considered eligible for compensation and other resettlement assistance. This procedure should include provisions for consultations with affected persons, households, and community leaders, local authorities, and, as appropriate, NGOs. Eligible PAPs could be divided into 1) those who have formal legal rights to land or other affected assets and 2) those

who do not have formal legal rights to land or other assets at the time of the census, but who have claim to such legal rights by virtue of occupation or use of those assets.

- *Organizational arrangements:* This section of the Chapter describes the institution(s) responsible for delivery of each item/activity in the entitlement policy; implementation of the RAP and the various coordination activities. The section will also identify the agency that will coordinate all implementing agencies and investigate if it has the necessary mandate and resources.
- *Grievance redress mechanism:* Describes the step-by-step process for registering and addressing grievances and provide specific details regarding a cost-free process for registering complaints, response time, and communication modes. It also describes the mechanism for appeal, provisions for approaching civil courts if other options fail.
- *Monitoring and evaluation:* This section describes the internal/performance monitoring process of the RAP. It defines key monitoring indicators derived from baseline survey, frequency of reporting and content for internal monitoring. It also defines methodology, key indicators and arrangements for external monitoring and the final external evaluation
- *Timetable and budget:* This part includes list the chronological steps in implementation of the RAP with a brief explanation of each activity. It describes the linkage between resettlement implementation and initiation of civil works for each of the project components. It provides a clear statement of financial responsibility and authority and lists the sources of funds for resettlement and describes the flow of funds and identifies resettlement costs, if any, to be funded by the government.

Chapter 6 – Consultation with affected groups
This Chapter presents all the consultation and participatory activities that have been carried out as part of the RAP preparation.

Appendices

- List of Project Affected Persons
- Summary of consultation
- Socio-economic household census survey questionnaire
- Socio-economic and census survey
- Record of interagency/forum/consultation meetings (including place and date of the meeting and number of participants attend the meeting)
- Legal Frame work that Governs the project
- RAP team and **report structure**
- Consultation with stakeholders and PAPs
    a. Consultation during the ESIA
    b. Consultation during the RAP
- Approvals needed for the project

6. METHODOLOGY

The Consultant should be employing **a participatory bottom-up transparent approach in the preparation of the Resettlement Action Plan (RAP).** Various qualitative and quantitative data collection tools will be used to engage various categories of Project Affected People (PAPs). In the meantime, the Consultant will utilize the available information by starting the assignment with thorough review and analysis for the baseline prepared as part of the ESIA prepared in 2006 and the additional SESIA that has been implemented during 2012[1] part of which these RAP ToRs were prepared. The main tools that will be deployed include but are not limited to:

6.1. Secondary data collection method:

Literature review: including laws, legislations that govern expropriation and land acquisition (both national and international guidelines and safeguard policies) trying to highlight the gaps and how to fill the gaps with practical measures. Proposed reports and Legislations to be reviewed

1- Human Development Report 2009/10 Investing in Human Security for a Future State- occupied Palestinian territory
2- Palestinian Environmental Law 7, 1999
3- Palestinian Laws
    - Basic laws
    - Basic Laws declaration for Palestinian Human Right
    - Expropriation Law (*Istmlak*)
    - Land Ownership Law 2/1953
    - Antiquities Law 1966
    - Law 21Consumer protection laws
    - Palestinian Labor Laws 7/2000
    - Health and safety Law 3/2011
    - Palestinian Reform and Development Plan PRDP (2008 -2010)
    - Local Council Law 1/1997
4- Palestinian Environmental Assessment Policy
5- World Bank OP.4. 12 concerning Involuntary Resettlement

6.2. Primary data collection methods

Tools

Different surveying tools could be employed to collect the needed data, more deep information to be acquired from the entities responsible for compensation i.e. municipalities

[1] Included in the SESIA detailed results that were based on focus group discussions and in-depth interviews conducted with PAPs

or other entities responsible for the relocation of farmers to other lands i.e. Awqaf Department. A combination of both qualitative and quantitative data collection methods will be employed, The qualitative methods will aim to collect in-depth understanding and are generally more interactive and participatory techniques that will help in paving the way to the introduction of the structured inventory survey. The exact targeted number of FGDs and SSIs (sample size) will be determined before starting the RAP.

The Consultant should employ a gender sensitive approach with special attention to be paid to the affected women in general and the female headed households in particular.

The inventory survey should be covering a case by case of the PAPs with the aim of setting quantitative baseline conditions that allows for planning the various resettlement aspects including the allocations needed for compensation,

Data analysis:

The data collected through various surveying methods explained above will be carefully recorded on questionnaire, interviews transcripts and other data sheets. Various software for the analysis of both qualitative and quantitative data will be used, most importantly SPSS.

The Consultant will also ensure thorough review for the qualitative raw information in order to extract useful experiences/quotations/lessons learnt and add to the analysis of the RAP wherever applicable.

C. Field Observation

The Consultant will also rely on field observations to enrich the findings on the current situation. Local surveyors (enumerators), local NGOs and natural/community leaders will be mobilized to assist in this task and field observation checklists will be designed in order for the team to fill during the field observations.

D. Consultation for the draft RAP:

The Consultant should employ a consultative and participatory approach that allows the stakeholders for feedback and facilitate the process of endorsement of the studies. A consultation meeting for presenting the RAPs findings will be planned. This will aim to engage local key stakeholders and involve them in the revision of the draft findings of the RAP. This step is very important and a key disclosure requirement for the World Bank. . The requirement for arranging a public consultation include but are not limited to:

- Identification and invitation of various groups of stakeholders and ensure balanced representation (according to affiliation, gender, interests, ..etc) for all the groups including those who will be encountering various types of negative impacts.

- Selecting a venue which is neutral and convenient, provide transportation (if required) in order to encourage marginalized groups to participate.
- Preparation and dissemination of Arabic non-technical executive summary before the workshop and uploading the executive summary to public domain like the Promoter or the Consultant's website.
- Preparation and delivering a presentation for the findings of the RAP
- Recording and addressing the comments and concerns that the participants will raise during the Consultation and ensure proper documentation for the event.

7. Composition of the Consultant team

The Consultancy firm should be demonstrating capability to mobilize an experienced highly qualified team of experts to fulfill the ToRs requirements. The following table presents the team of the key experts, the required qualifications and the key tasks anticipated for each of the team members. The Consultant is encouraged to propose additional experts as needed and elaborate on the proposed tasks for both the core and the additional experts in the technical proposal.

Table 1: Resettlement Action Plan Core Team

Consultant	Minimum Required Qualifications	Main responsibilities within the assignment
Team Leader	• Relevant postgraduate degree • At least 15 years' experience in similar types of assignments • Tracked expertise and knowledge in safeguard policies of international institutes.	1- Set plan for the assignment 2- Coordinate among the team of experts 3- Revise the final report for quality assurance 4- Reporting for the client
Resettlement Specialist and Principal Investigator	• Relevant university degree in social development and preferably a postgraduate degree • At least 10 years' experience in similar types of assignments • Tracked record of experience on involuntary resettlement like Resettlement Action Plan (RAP) and Resettlement Action Plan (RAP).	1- Prepare all survey tools in cooperation with the other team members 2- Review the legal framework that govern the resettlement activities 3- Develop the final report 4- Disseminate the results
Social Development	• Relevant university	1- Prepare the surveying tools

and Household Survey Specialist	degree in social development and preferably a postgraduate degree • Expertise in areas related to community mobilization, participatory tools and consultation with stakeholders	2- Test the survey tools
Data Analyst	• University graduate • Experience not less than 5 years in analysing data using SPSS/STATA • High ability to analyse qualitative data • Experience outside Egypt will be preferable •	1- Software experts who will develop the data entry programs
Team of field surveyors and quality control supervisors	• University graduates • Experience not less than 5 years in data collection using quantitative and qualitative tools	1- Participate in testing the tools 2- Collect data (qualitative , quantitative and observation sheets) 3- Supervise data collection process and monitor the quality of data.
Team of data processing personnel	• University graduates • Experience not less than 5 years in data processing (editing – coding – cleaning ..etc)	1- Responsible for editing, coding, data entry and re-entry 2- Transcription of the qualitative data 3- Summarizing the qualitative data

8. THE PROPOSED ACTIVITIES TO ACHIEVE THE ASSIGNMENT

The project ToRs included a comprehensive list of activities that the Consultant needs to accomplish within the frame of working in this assignment. The Consultant should be fully responsible for conducting the various activities included in the ToRs, The presentation below concerns only on the general activities that the Consultant is needed to fulfil as part of the assignment

General activities

- Review for the Palestinian legislations related to various types of lands and assets acquisition including the various entitlements

- Review the international safeguard policies related to the assignment including the WB OP 4.12 regarding Involuntary Resettlement

- Review previous reports and action taken as part of ESIA 2006 and SESIA 2012 to ensure orientation with the lessons learnt from these phases. Identifying the gaps in these documents regarding the discussion of the PAPs in order to fill the gaps during field work

- Conduct the various data collection activities to ensure that the RAP is founded on comprehensive baseline information. This may involve conducting any complementary activities to fill in any information gaps (e.g. interviews, meetings, field observations).

- Ensure that the RAP is providing a comprehensive package that meets the WB social principles and standards and that sufficiently cover the following:

    - Identification for the PAPs
    - Parameters/criteria for the entitlements package (both monetary and non-monetary) for those project affected persons (PAPs),
    - Institutional framework adopted,
    - Mechanisms for consultation and grievance resolution,
    - The time frame (especially in relation to other project activities)
    - Cost estimates
    - Monitoring and evaluation mechanisms and tools

The Consultant should make sure that PWA is supported technically and is becoming fully aware of the compensations requirements with the WB policies.

9. Duration of the Assignment and time plan

The team of experts will be collaborating together with other stakeholders in order to submit the required input and meet the deliverable schedule. The assignment should involve close collaboration with PWA with their capacity as the project proponent. The assignment shall be completed within Twelve (12) weeks from signing of contract.

10. Deliverables and Outputs

The team of experts will be collaborating together and with other stakeholders in order to submit the required input and meet the deliverable schedule briefly presented on Table 2 below.

The Consultant is expected to submit the following deliverables:

Inception Report: The report should reflect detailed work plan and indicators of performance. This should be delivered two (2) week after signing of contract;

Draft RAP Report: This will be circulated for comments and relevant issues raised incorporated into revised version. This will be delivered five (5) weeks after submission of inception report.

Conducting Consultation and preparing report: This should be planned in two (2) weeks from the submission of the draft RAP

Final RAP Report The final report should include a concise Executive Summary and should have all annexes and bibliography and the dissemination/disclosure plan. This will be delivered two (3) weeks after conducting the consultation.

Table 2: List of deliverables and outputs for the assignment of the preparation of the RAP

RAP assignment	Due date from the start of the assignment
Inception report	2 weeks
Draft Resettlement Action Plan	7 weeks
Conducting Consultation and preparing report	9 weeks
Final RAP Report	12 weeks

Annex 13

Copy of Public Consultations Documentations

Public Consultation 1

(Scoping Phase)

سلطة المياه الفلسطينية
Palestinian Water Authority

Invitation

It is the pleasure of the Palestinian Water Authority (PWA) to invite you to participate in the First Public Consultation (Scoping) Session for the "Supplementary Environmental and Social Assessment (SESA) of North Gaza Emergency Sewage Treatment Project Effluent Recovery & Reuse System and Remediation"

The main purpose of the session is to discuss and comment on the scope of the SESIA, discuss the predicted social and environmental impacts from the project and propose mitigation measures. The input of the participants of the session is meant to be considered in the preparation of the SESIA

The session will take place on Tuesday 10th July 2012 at 09.00 am in
The Museum – Hotel, Gaza Strip, Palestine
The Session Agenda is attached

EcoConServ
ENVIRONMENTAL SOLUTIONS

First Public Consultation Agenda:

Time	Agenda	Presented
09:00 – 09.45	Registration	
09.45 - 10:00	Welcome Statement	PWA (Eng Sadi Ali)
10:00 - 10:30	Project Description and Component - Presentation	PWA (Eng Sadi Ali)
10:30 - 11:30	Presentation for the SESIA 10.30 - 11:00 Environmental impact Assessment 11:00 – 11:30 Social Impact Assessment	 Eng Dewi Rimayani H. Ms. Zaenab H.
11.30 - 12.00	Coffee break	
12:00 - 12:45	Open Discussion	SESIA Team (UG and EcoConServ)
12:45 - 13:00	Wrap up and Closing	Eng. Dewi Rimayani H.

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع استرجاع المياه المعالجة لاستخدامها في الري

كشف الحضور

التاريخ: 2012-07-10

مجموعة المناقشة Group Discussion 5	4	3	2	1	البريد الإلكتروني E-mail	رقم الجوال Mobile	المؤسسة Organization	الإسم Name	ر.م S.N
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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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ر.م S.N	الإسم Name	المؤسسة Organization	رقم الجوال Mobile	البريد الإلكتروني E-mail	مجموعة المناقشة Group Discussion 1	2	3	4	5
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ر.م S.N	الإسم Name	المؤسسة Organization	رقم الجوال Mobile	البريد الإلكتروني E-mail	مجموعة المناقشة Group Discussion 1	2	3	4	5
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6	نزار الوحيدي	م. أ. زراعة							
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جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع استرجاع المياه المعالجة لاستخدامها في الري

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13	م. محمود شيم	=	9-186670	mahmoud_pwa@hotmail					
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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البينية والاجتماعية لمشروع استرجاع المياه المعالجة لاستخدامها في الري

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5

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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			✓			9419256	[illegible]	[illegible]	
			✓	✓	Eng.rana el[illegible]	8 822950	[illegible]	[illegible]	

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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		✓		✓				م. [illegible]	6
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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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				✓				م. محمد الخزيسر	✓
✓	✓	✓	✓	✓		3,960696	جمعية الهلال الزراعية	سعد ابو هزيا	✓
	✓		✓			9189260	CMWU	نزيه سعيد عسولة	✓
		✓	✓	✓	bahaa.alagha@gmail	9254783	سلطة جودة البيئة	بهاء الآغا	✓
			✓	✓				كريم جليل معل	✓
			✓	[illegible]				علي عبد الهادي صعيد	✓
	✓		[illegible]	1				باسم سعيد	✓
			✓					M. Solaib	✓

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع استرجاع المياه المعالجة لاستخدامها في الري

كشف الحضور

التاريخ: 2012-07-10

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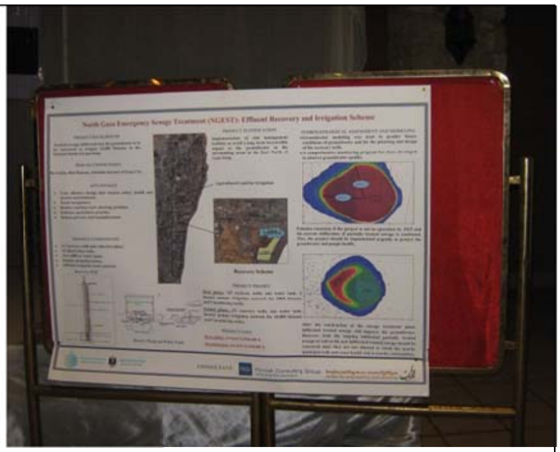
Scooping Session Preparation



Displays at the Scooping Session Hall

Scooping Session Participants

Scooping Session Participants

Scooping Session Participants

Scooping Session Participants

Presentation of Project Introduction and Components during the Scooping Session

Presentation of Social Impact Assessment Methodology and Scope of Work during the Scooping Session

Moderation Activities during the Scooping Session

Presentation of Environmental Impact Assessment Methodology and Scope of Work during the Scooping Session

Public Consultation 2

Palestinian National Authority
PALESTINIAN WATER AUTHORITY

السلطة الوطنية الفلسطينية
سلطة المياه الفلسطينية

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

التاريخ : - - 2012

السيد / السيدة : ......المحترم،،،

دعوة خاصة

تحيه طيبة وبعد،

تحت إشراف سلطة المياه الفلسطينية (PWA) وتمويل البنك الدولي (WB) وضمن الدراسة البيئية والاجتماعية الخاصة بمشروع استرجاع المياه المعالجة لاستخدامها في الري

تدعوكم سلطة المياه الفلسطينية لحضور جلسة تشاورية بعنوان:

استعراض و مناقشة نتائج دراسة التأثيرات البيئية والاجتماعية للمشروع

والتي ستعقد يوم الاثنين الموافق 22- 10- 2012 في قاعة الاجتماعات بمطعم لايت هاوس (شارع الرشيد - غزة)
وذلك في تمام الساعة التاسعة صباحا وفقاً للأجندة المرفقة.

مع وافر الاحترام و التقدير ...

سلطة المياه الفلسطينية

المرفقات:
- CD يتضمن تقارير و ملحقات الدراسة .
- الأجندة الخاصة بالورشة .

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

مشروع دراسة الأثر البيئي و الاجتماعي لاسترجاع المياه المعالجة لاستخدامها في الري

استعراض و مناقشة نتائج دراسة التأثيرات البيئية والاجتماعية للمشروع

اليوم : الاثنين الموافق 22- 10- 2012

المكان: قاعة الاجتماعات (قاعة السفير) بمطعم لايت هاوس (شارع الرشيد - غزة)

الأجـــــندة

09:30 – 09:00	تسجيل الحضور	
09:45 – 09:30	كلمة سلطة المياه الفلسطينية (م. سعدي علي)	
	الجزء الأول : استعراض كافة نتائج الدراسة	
10:15 – 09:45	**عرض نتائج الجانب البيئي من الدراسة**	
	(د.طارق جنينة و م. مايا هانوم)	
10:30 – 10:15	**إغلاق محطة بيت لاهيا و إعادة استخدام الحمأة**	
	(د. فهد رابح)	
10:45 – 10.30	**عرض نتائج دراسة حركة المياه الجوفية**	
	(د.أيمن عوض الله)	
11.15 – 10:45	**عرض نتائج الجانب الاجتماعي من الدراسة**	
	(أ.أمل فلنس ، أ. زينب حافظ)	
12.00 – 11:15	استراحة	
13.00 – 12.00	**الجزء الثاني : نقاش مفتوح وتسجيل آراء واهتمامات المشاركين**	**(فريق الخبراء)**
13.15 – 13.00	**ختام ورشة العمل** (م . /مأمون بسيسو)	

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

استعراض و مناقشة مخرجات الدراسة النهائية حول التأثيرات البيئية والاجتماعية للمشروع

Attendance Sheet كشف الحضور

التاريخ: 2012-10-22

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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	٠٥٩٩/٧٢٠٣٤٤		ميسا كامل رمضان مطر	١٨

Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

استعراض و مناقشة مخرجات الدراسة النهائية حول التأثيرات البيئية والاجتماعية للمشروع

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

استعراض و مناقشة مخرجات الدراسة النهائية حول التأثيرات البيئية والاجتماعية للمشروع

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			عبد القادر أبو خوصة	٤٠
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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

استعراض و مناقشة مخرجات الدراسة النهائية حول التأثيرات البيئية والاجتماعية للمشروع

Attendance Sheet كشف الحضور

التاريخ: 2012-10-22

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Project: Supplementary Environmental and Social Assessment of North Gaza Emergency Sewage Treatment Project, Effluent Recovery & Reuse System and Remediation Works

استعراض و مناقشة مخرجات الدراسة النهائية حول التأثيرات البيئية والاجتماعية للمشروع

Attendance Sheet كشف الحضور

التاريخ: 2012-10-22

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Information poster by the PWA

Banner of the Second PC

Introduction by Eng. Sadi Ali PWA

Introduction About the Study by Eng. Zohair (Consultation Firms)

Participants

Environmental Results by Dr. Tarek Genena

Sludge management by Eng. Fahd Rabah

Socioeconomic impacts by Ms. Amal Fatlas

Project impacts and vulnerability by Ms. Zeinab Hafez

International Agencies

Discussion and comments

one of the participants' comments

Annex 14

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