THE WORLD BANK

سلطة المياه الفلسطينية
PALESTINIAN WATER AUTHORITY

Environmental and Social Assessment (ESIA) for Associated Works of the Gaza Sustainable Water Supply Program

ESIA Report

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Glossary of Terms

Environmental and Social Terms

Affected Community: Local communities that are subject to risks or impacts from the project

Baseline Data: Data gathered during the Social and Environmental Assessment used to describe the relevant existing conditions of the project, such as physical, biological, socio-economic, and labor conditions, including any changes before the project commences

Chance Find Procedure: A project-specific procedure that outlines what will happen if previously unknown heritage resources, particularly, archaeological resources, are encountered during project construction or operation.

Cumulative Impacts: The combination of multiple impacts from existing projects, the proposed project, and/or anticipated future projects that may result in significant adverse and/or beneficial impacts that would not be expected in case of a stand-alone project.

Environmental and Social Impact Assessment (ESIA): The Environmental and Social Impact Assessment report focuses on the significant issues of a project and predict and assesses the project's likely positive and negative impacts, in quantitative terms to the extent possible. It examines global, trans-boundary, and cumulative impacts as appropriate.

Environmental and Social Management Plan (ESMP): A combination of operational policies, procedures and practices that provide a plan of mitigation and monitoring measures and actions that address the social and environmental risks and impacts identified in the Assessment and resulting from consultation with affected communities.

Full Replacement Cost: Market value of assets plus transaction costs. Depreciation of structures and assets are not taken into account.

IUCN Red List: List of species that are designated by the World Conservation Union (IUCN) to be critically endangered or endangered.

Resettlement Action Plan (RAP): The document in which a project sponsor or the responsible entity specifies the procedures that it will follow and the actions that it will take to mitigate adverse effects, compensate losses, and provide development benefits to persons and communities affected by an investment project.

Technical Terms

Booster Pumping Station: A building in which two or more pumps operate to increase pressure in a water pipe.

Distribution Network: the system that starts from the reservoirs and that is intended to convey water to all consumers.

Gaza Central Desalinization Plant (GCDP): a new 55 MCM/y desalination plant (to be upgraded to 110 MCM/y) to be constructed in the Middle area of the Gaza strip for a regional supply of drinkable water.

Gaza Sustainable Water Supply Program (GSWSP): a comprehensive program that includes the build of desalination facilities and the associated works (construction of north-south water carrier and NRW reduction project)

North-South Carrier (Main Carrier): a system designed to collect fresh water from the GCDP and to convey it to the distribution networks existing in the municipalities of the project area

Pumping Station: A building in which two or more pumps operate to supply water flowing at adequate pressure to a distribution system

Transmission Mains: mains outside the distribution systems for the purpose of conveying water in bulk from the source (wells, main carrier, Mekorot etc.)

Acronyms and Abbreviations

AC: Asbestos Cement

AMSL: Above Mean Sea Level

ACM: Asbestos Containing Materials

CBOs: Community Based Organaizations

Cl: Chloride

CMWU: Coastal Municipalities Water Utility

CO_2: Carbon Dioxide

D.I.: Ductile Iron

dB: Decibel

DMA: District Measuring Areas

EA: Environmental Assessment

EHS: Environmental Health and Safety

EPA: Environment Protection Agency

EQA: Environment Quality Authority

ESIA: Environmental and Social Impact Assessment

ESMP: Environmental and Social Management Plan

EU: European Union

FGDs: Focus Group Discussions

g: gravitation

GCDP: Gaza Central Desalination Plant

GEDCo: Gaza electricity Distribution Corporation

GPP: Gaza Power Plant

GSWSP: Gaza Sustainable Water Supply Program

HDPE: High-density polyethylene

HR: Human Resources

IEE: Initial Environmental Evaluation

IUCN: International Union for Conservation of Nature

JV: Joint Venture

kg: Kilogram

Km: kilometers

l/c/d: Liter per day

m/s^2: meter per second squared

m: meter

m^2: Square meter

m^3: Cubic meter

MCM/y: million cubic meters per year

mg/l: Milligram per liter

MoH: Ministry of Health

MoHE: Ministry of Higher Education

MoLG: Ministry of local Governance

MoM: Minutes of Meeting

MoTA: Ministry of Tourism and Antiquities

NESHAP: National Emission Standards for Hazardous Air Pollutants

NGEST: North Gaza Emergency Sewage Treatment

NGOs: Non-Governmental Organizations

NIS: New Israeli Shekel

NO_3: Nitrate

NOx: Nitrogen Oxides

NRW: Non-Revenue Water

NSR: Noise Sensitive Receivers

OSHA: Occupational Safety and Health Administration

OP: Operational Policy

PA: Palestinian Authority

PCR: Physical Cultural Resources

PEAP: Palestinian Environmental Assessment Policy

PEL: Palestinian Environmental Law

PGA: Peak Ground Acceleration

PM: Particulate Matter

PPE: Personal Protective Equipment

PPHL: Palestinian Public Health Law

PS: Pumping Station

PV: Photovoltaic

PWA: Palestinian Water Authority

RAP: Resettlement Action Plan

RMP: Risk Management Plan

SCADA: Supervisory Control and Data Acquisition

STLV: Short Term Low Volume

TDS: Total Dissolved Solids

ToR: Terms of Reference

UNRWA: United Nations Relief and Works Agency

UPVC: Unplasticized poly vinyl chloride

VFD: Variable Frequency Drives

WB: World Bank

WBG: World Bank Group

WHO: World Health Organization

WWTP: Wastewater Treatment Plant

$\mu g/m^3$: Microgram per cubic mete

Executive Summary

Associated Works of the Gaza Sustainable Water Supply Program

The Gaza Sustainable Water Supply Program consists of a seawater desalination plant of around 55 MCM/y first phase capacity to an eventual 110 MCM/y capacity; and its associated works under title "Associated Works of the Gaza Sustainable Water Supply Program". The World Bank funded the preparation of the detailed design of the Associated Works project as well as its Environmental and Social Impact Study. The project aims at providing infrastructural as well as institutional improvements that support the delivery of reliable, safe and affordable water supply and meet the needs of various communities in the Gaza Strip.

A detailed design of the project components was carried out by the international consultant Lotti & Al and TECC as a local partner parallel to conducting this EA study. Preliminary designs and draft final designs for most of the project components were reviewed by the ESIA team in order to conduct the impact assessment study. However, the detailed design of some components, such as the downstream distribution networks, was not available during the preparation of this ESIA. These component will not be covered in this study.

ESIA Objectives and Purpose

The purpose of this ESIA study is to identify the potential direct and indirect impacts, resulted during the construction and operation of the project components, on the environment and socio-economy in the project areas. According to the predicted impacts, mitigation measures are proposed and an Environmental and Social Management Plan (ESMP) was prepared addressing the identified impacts and the corresponding recommended mitigation measures and monitoring actions. The ESIA report is intended to provide stakeholders and decision makers with an understanding of the potential impacts of the project components, in order to facilitate a well-informed decision. The ESIA suggests methods and practices to avoid and/or minimize the negative effects, alongside methods to enhance the positive effects of the project.

Policy, Legal, And Administrative Framework

This EA study has been conducted under the governance of the World Bank Environmental and Social Safeguard Policies as funding agency. The study has also taken account of local laws and regulations set by the Palestinian Authority (PA), as well as international guidelines as necessary and relevant to the proposed project activities. This ensures that environmental and social factors and values are integrated into the decision making process.

Under the World Bank’s operational policies, there are ten environmental and social policies referred to as the Bank’s “safeguard policies”. The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. The initial screening of applicable World Bank social and environmental safeguards policies indicated that, among these policies, only the OP 4.01 Environmental Assessment and the OP 4.12 Involuntary Resettlement are triggered.

The current Project triggers OP 4.01 (Environmental Assessment) where Category A is proposed for the Associated Works to the Gaza Sustainable Water Supply program as the Gaza Central Desalination Plant (GCDP), which is a main part of the program. Category A project is due to its significant, unprecedented and possibly irreversible impacts on the environment in Gaza. Although the North-South transmission line, pumping stations, water blending and storage reservoirs, and distribution reinforcement and extension are

considered category B investments, all of these subcomponents are associated with the desalination plant. Thus, these associated works are also treated in the manner of a Category A project. In this regard, a comprehensive Environmental and Social Impact Assessment has been undertaken.

This project also triggers OP 4.12 (Involuntary Resettlement) due to the presence of two lands, allocated for the construction of a reservoir and a booster pumping station, which were privately owned, the assessed negative impact on the private small desalination units industry, and the presence of two main public markets within the main carrier right of way that will be affected during construction. However, neither the generation of a RAP or a RPF nor the development of a ToR for them comes within the scope of this assignment.

This ESIA shall take into consideration the timeframe of The Palestinian Environmental Assessment Policy (PEAP) and magnitude of impacts through the different stages of the proposed project, and consider alternative locations, operations, and technologies possible. Upon submission of the EA report for review, EQA requests amendments as needed and a final EA is distributed to the inter-ministerial EA committee for review and approval. Collectively, major water supply infrastructure projects such as the proposed components of the project are classified as actions that generally have a significant impact on the environment and will require the preparation of an Environmental Assessment (EA) as promulgated in Annex 2 of the PEAP.

The PEAP is broadly consistent with the WB's OP 4.01 for projects requiring a full ESIA; there are requirements for environmental management plans (including mitigation measures), environmental audits, public participation and disclosure.

Project Components

In order to accomplish the long-term goals of the project, two main components are set. The first component is the civil works associated to the desalination plant and the second is utility capacity building and operational support. The project components are is located in Gaza Strip that is located in the south-west area of the Palestinian Territories. It is a narrow area of land bordering the eastern coast of the Mediterranean Sea. Gaza Strip is about 43 km long and between 6 to 13 km wide, and its total area is 365 square kilometers (km^2). The project components are distributed across the northern, middle and the southern areas of the Gaza Strip. This study focuses only on the civil works component, which includes:

- Construction of 20 water blending and storage reservoirs. The reservoirs are located in Beit Hanoun, Beit Lahia, Jabalia, Gaza, Al Bureij, Al Musadar, Al Zawaida, Khanyounis and Rafah.
- Construction of a 42.5 km long North - South carrier,
- Construction of transmission loops to feed the reservoirs,
- Construction of the main pumping station in Al Qarara and 5 booster pumping stations along the North-South carrier in Rafah, Deir Al Balah, Al Bureij, Wadi Gaza and Gaza city.
- Closure of wells with insufficient quality to operate the blending into the reservoirs,
- Construction of a new downstream distribution network
- Replacement of old or undersized distribution pipelines, and

Improvement of Mekorot connections to increase the amount of water received from Mekorot to a total of 20 MCM/year.

Project Alternatives

Within the Gaza Sustainable Water Supply Program produced by PWA, it has been stated that there are no viable alternative options for developing alternative water sources in the Gaza Strip. The potential alternative options to develop additional water resources, and reasons they are unviable are:

- Surface water sources – eliminated due to lack of rainfall and surface water bodies, plus pollution risks to obtaining consistent and good quality water.
- Additional extraction from groundwater and brackish desalination – eliminated due to the already depleted aquifer status and imminent collapse of groundwater supply, inability to obtain water of sufficient quality and sustainability.
- Increased supply from Mekorot (over and above the 5 MCM additional supply included as part of this project) – eliminated due to political and cost reasons, and also that the original water sources from Mekorot would also be from non-conventional sources (e.g. water obtained from large scale desalination, or recovered wastewater), so large scale purchase would have similar or more significant environmental impacts in a different location.

Therefore, the water supply from desalination plants, blending reservoirs, transmission trunk lines, improved network connectivity and slight increase in the Mekorot supply, are considered in combination to be the most appropriate solutions for improving the existing water supply conditions. The key alternatives that have been considered for the proposed projects are related to the main carrier alignment and the sites of tanks and pumps.

Alternative Carrier Alignment

The main carrier pipeline route has been divided in 4 different sections to avoid the obstacles. One section from Al Qarara (Al Matahen) to the south area of Gaza City; along which the pipeline runs through several urbanized areas, not particularly crowded but presenting a considerable number of obstacles preventing the linear alignment of the pipeline. These obstacles will be widely described in the following paragraphs. The southern part from Al Qarara (Al Matahen) to Rafah City section is passing from agricultural and peri-urban areas to highly crowded areas such as Khanyounis and Rafah cities. The rest of sections are free of obstacles and seems to offer good conditions for the execution of the work.

Alternative Reservoirs and Pumps Locations

The locations of proposed blending tanks and pumps were chosen based on the most vulnerable areas with regard to water supply conditions, as depicted by the Gaza Sustainable Water Supply Program. The land of the reservoirs and pumping stations, are either governmental, Waqf, or municipality owned lands. The only private sites are Al Buraij booster pumping station and Al Buraij reservoir sites. However, the land acquisition of these two sites has been carried out by Al Buraij municipality. The agreements with the owners are almost done. PWA have arranged for securing sites early on for constructing the tanks and pumps to avoid long land acquisition procedures. The land parcels have either been purchased or rented for long term. The advanced land acquisition facilitated securing sites within locations that are near groundwater supply resources and which satisfying hydraulic criteria requirements.

No Actions

The 'no project' option would prevent opportunities to improve water supply in the Gaza Strip. Without the intervention from the Associated Works to the Gaza Central Desalination Plant project the water supply situation will not be improved through efficient use of desalinated water and precious groundwater while ensuring technical as well as financial sustainability of its operation. The situation will be more harmful and the people's health will be put at risk. Infants and children are particularly susceptible to the immediate effect of microbiological contaminants and 'blue baby' syndrome associated with high levels of nitrates. Moreover, adults will become increasingly susceptible to gastrointestinal problems and cancers, and thyroid gland disorders.

An imminent collapse of the water supply could occur because of not providing additional supplies through construction of short term low volume desalination plants and Gaza central desalination plant, the transmission lines and booster pumps that distribute the potable water supply for the Gaza Strip five governorates and communities. Gaza Sustainable Water Supply Program (GSWSP) will include such components of the rolling program of interventions, identified in the Comparative Study for Water Supply Options for Gaza, which provide a comprehensive approach to the provision of domestic water supply. The proposed project components and the desalination facilities are expected to improve water quality dramatically to all Gaza Strip population by mixing and uniformly distributing the best available water resources. The 'no project' option would have significant negative long term impacts on groundwater resources and water supply, on public health and on related industries and economy such as agriculture.

Environmental Impacts

The potential impacts consider impacts during the project phases Pre-construction, Construction and Operational. The pre-construction phase activities are similar in nature to the construction phase activities; hence, the impacts of pre-construction and construction phases are analyzed and dealt with together. Regardless of the anticipated overall improvements for communities and the environment from the proposed projects on water supply conditions, some negative impacts are anticipated and have been identified based on scoping of environmental and social impacts and during the course of this environmental and social study.

During the construction phase, several negative impacts are anticipated; however, they are expected to be temporary and within the normal magnitude that is typical to similar construction activities. Expected impacts during construction include those typical to the construction of similar infrastructure projects, including:

- noise/vibration, dust and traffic hazard due to earthworks (excavation, backfilling, soil borrowing), traffic movement on unpaved roads to and from construction sites, exhaust emissions from construction vehicles and machines (generators, loaders, excavators, etc.)
- disruption of traffic including vehicles and pedestrians movements and risking public safety during the excavation and construction activities.
- potential impacts on public and occupational health and safety that may arise due to Construction accidents which can cause injuries and causalities not only to workers but also for the surrounding communities.
- Soil erosion and generation of solid waste are also anticipated during excavation and construction activities.
- potential impacts of hazardous material and waste due to two possible sources of hazardous waste: presence of old Asbestos Cement (AC) pipes and use of epoxy paint for the insulation of the internal surfaces of the reservoirs.

- Accidental damage during excavation to existing utilities and infrastructure facilities such as wastewater sewers, water pipes, communications and electrical cables. This damage may be interrupted temporarily during this period.
- Accidental damage during excavations to existing utilities and structures, including cesspits and sewer pipes. The existing connection rate to the sewage collection system varies from 40% to 90%. Hence, a large number of buildings (houses, institutes and commercial stores,…etc.) use cesspits for wastewater disposal.
- Interruption of water supply services to local communities. This project involves the construction of 42.5 km carrier pipeline in addition to 110 km of transmission loops and 110 km of distribution network. During the construction activities, it is most likely that the existing water supply will be temporary interrupted
- Potential impacts on socio-economics during construction also include disturbance to businesses and risks to public and occupational health and safety.

In general, impacts from construction activities have been assessed to be short term and can be minimized, if appropriate mitigation measures and best construction practice are applied, as required and based on the recommendations in this ESIA report. The negative impacts during the construction phase are less significant than the positive ones expected in the operational phase.

During the operational phase, a number of potential negative impacts have been identified, but these have been considered through the design of the project to avoid, reduce or mitigate any significant impacts. On the other hand, long-term beneficial impacts are anticipated because of the provision of additional water infrastructure facilities.

In the longer term, and upon the full accomplishment of the Gaza Strategic Water Plan and as envisioned in Gaza Sustainable Water Program of PWA, future quantities from desalinated water and additional quantities from Mekorot are anticipated to support the bulk water supply in Gaza Strip. Many of the underground wells will then start to be gradually decommissioned as planned by PWA, to reduce pressure on groundwater and allow for the recovery of the Coastal Aquifer. This project therefore makes an important initial contribution to the wider program which will have a significant positive benefit on the sustainability of water supply in Gaza Strip.

Prediction and Evaluation of Social Impacts

Major social groups are will be affected from the project such as the target community in the whole Gaza Strip; private sector who distributes desalinated water; communities and social groups that will be affected during the construction phase. Results revealed the expected positive impact of the intended project on the life quality of the target population. Provision of fresh healthy water with adequate quantity for households is essential element of proper livelihood. The community expressed their interest to have higher quality water but they were more concerned about the frequency and quantity of supply. Current water consumption practices do not rely much on tap water for drinking. The community uses tap water for other uses but drinking water is usually purchased from private sector. People expressed their wish to improve the frequency of water supply as this affects their life quality as they have to adopt their daily schedule based on the time when both water and electricity are available.

The intended project most likely will not change the community consumption behavior, as they are not expected to give up purchasing desalinated water for drinking. Additionally, community does not trust service provider as they expressed their fear from the quality of tap water not only because its salinity.

Results indicated that people are not willing to pay for water bills at the current time or in future. Actually, this reflects general attitude in Gaza strip where people suffered from serious economic crisis and difficult political situation that weaken the authorities over the last 15 years. The community is interested to keep the drinking water safe and clean as they were aware of the necessity to keep its tank clean while water for other uses is not important.

ESIA study results indicated relevance of community awareness and culture as major challenges that can minimize the positive impact and sustainability of the intended project. Community awareness on the seriousness of water problem at macro scale, level of confidence between the community and services providers and optimal understanding of water quality standards are major culture and awareness aspects that can affect the objectives and sustainability of the intended project.

The study has revealed the presence of 157 water desalination with almost 1,000 families make their life from this sector. The percentage of income reduction or lay off cannot be predicted at this stage. However, in case of successful national plan in providing blended water and changing water consumption culture, it is most likely these people will be affected. Results indicated that private sector provides water of 50-60 TDS water quality. Such quality is seen by the community as higher quality when compared with the targeted quality of the blended water that will be distributed by the intended project. The study therefore expects very low or no impact on the private sector in case community is convinced on the possibility of suitability of the project-distributed water for drinking. The impact is only expected if proper awareness campaigns are designed to improve level of trust between the community and the public service providers.

Environmental Social Management Plan (ESMP)

The Environmental and Social Management Plan (ESMP) identifies feasible and cost-effective Measures required for the environmental and social monitoring of key environmental and social aspects of the project during project implementation. The ESMP will include an overview of Impacts and Mitigations plan that will include for each impact/issue, (i) suggested mitigation measures to avoid, reduce or minimize, or compensate or offset significant adverse risks and impacts identified and assessed in the ESIA; (ii) the responsible party for implementation and for supervision; (iii) the time frame and periodicity for assessing each mitigating measure; (iv) monitoring indicators; (v) anticipated cost; as well as (vi) party responsible for financing each monitoring measure. The ESMP will summarize mitigation measures to address impacts as identified by the ESIA report. ESMP will split into two matrix (tables) for ease of use, with one each for use during construction and a second for the length of project operation.

Mitigation Measures

The potential negative impacts as discussed above are associated generally with the construction phase, and although expected to be minor, may affect some environmental and natural resources as well as causing some disruption to local communities. Appropriate mitigation measures will be required to be implemented by the construction contractor as identified in this report.

Mitigation measures during construction will address the typical impacts caused by noise, dust, and machinery emissions, and traffic disruptions. Activities involving heavy machinery will be restricted to normal working hours of 06:00 to 18:00, and citizens and businesses will be informed of construction schedules in advance of any activities.

Clean and tidy construction sites must be maintained, with disposal of waste material at approved sites, to protect the existing groundwater resources from contamination by debris, soil and construction material. Surface water and ditches must be protected from spillages, construction waste and spoil. In addition, all construction activities must be managed according to a strictly controlled and monitored environmental management plan.

Due to expected excavation activities, best construction management measures and practices will applied to manage risks from unpredicted utility structures, where they are encountered during construction, and have not been identified within the design drawings. New locations might need to be suggested if necessary to avoid damage.

Other mitigation measures proposed for the operational phase have been developed based on meetings and previous compiled discussions with the PWA, regarding water resource management procedures and service provision practices in place. These measures are not within the scope of the construction contractor's work; they will be the responsibility of the PWA, CMWU, local authorities and Municipalities, or other public institutions which undertake Operation and Maintenance (O&M) activities that begin when the project is handed to the project owner, (the PWA). Some operational impacts have also been already addressed within the design of the proposed project facilities, including the appropriate selection of technologies and best engineering practices, to minimize impacts from the proposed projects when put into operation.

For example, the impact of emissions from diesel generators in the proposed reservoir tank facilities have been minimized by using an energy recovery system (ERD)and by the provision of supporting renewable energy technologies, namely solar energy in some parts of the pumping stations sites.

Other operational impacts are related to occupational safety and pollution risks from using treatment chemicals. Therefore, the operational staff should have the skills required to safely operate different facilities and effectively deal with any incidents. All water that is produced during disinfection of tanks and pipelines for maintenance should be neutralized prior to being discharged and delivered into an approved washout alignment and disposal location.

During the Scoping Session, the impact of potential hazards from unmaintained water supply faculties was raised, but can be minimized through regular cleaning and disinfection of the tanks along with the regular maintenance of all project facilities, appropriate design and correct implementation of the pipeline locations and routes, taking into account the location of existing cesspits and sewer lines.

The social part of the ESIA study indicated the need to conduct several mitigation measures to ensure the achievements of the project objectives and its sustainability. The recommended mitigation measures should be applied at the community level, institutional level and private sector level.

The mainly short-term negative environmental impacts, which inevitably occur during the project construction, will be minimized by proper planning and application of preventive measures, and will be mitigated by restorative actions after the civil works are completed as listed in this ESIA report. In practice, proper planning means that mitigation measures become integrative part of the final design to be submitted by the construction contractor and have to be approved by the supervising engineer and where required coordinated by the Employer (PWA) with the competent authoritiy/ies prior to any construction works.

During operation of the project, measures in order to avoid or minimize negative impacts on air quality and noise levels are to be implemented. Complying with these tasks is primarily subject to proper planning processes, thus clearly reflected in this ESIA report.

Monitoring Plan

The environmental and social monitoring plan specific objectives are 1) insure that the prediction for the impacts is accurate and 2) assure that the mitigation measures are implemented and they are effective in performing its objectives. The monitoring plan will include the monitoring activities (How?), the monitoring indicator (What?), responsible party for monitoring (Who?), the frequency of monitoring (How many?), and the anticipated cost and the party responsible for financing the monitoring activities. The main monitoring actions for the proposed project for construction phase and for operation phase are summarized and presented in this ESIA report (Table 4 and 5). The responsible parties for environmental and social management and monitoring during construction will be the construction contractor, CMWU, PWA, along with MoLG, EQA and MoTA, while the responsible parties during system operations will CMWU, PWA and EQA.

Public Consultation

First Public Consultation (Scoping Session)

As part of the scoping process, the first public consultation session was conducted was conducted on October 13, 2017 at Roots Hotel in Gaza to identify the issues to be covered by the EA study and to gain an understanding of the concerns of the stakeholders. The session was attended by 50 representatives of different relevant Palestinian authorities, international Non-governmental Organizations and local civil society organizations who represent local community categories that are directly involved in or affected by the proposed project components. The main concerns and issues that have been added by the scoping session participants can be summarized as follows:

- Risk of flood/overflow of the tanks,
- Socio-economic impacts on the investors and operators of the small-scale desalination units,
- Social impacts associated with the presence of residential encroachments along the route of the transmission line in the area from Meraj road to Al Najma intersection.
- Safe handling of asbestos pipelines during construction

Second Public Consultation:

As part of the public consultation process for a category A project, the second public consultation session, was conducted on December 11, 2017 at Roots Hotel in Gaza, after the preparation of the first draft of the ESIA report. Representatives of all identified PAPs, public institutions, and non-governmental organizations were invited through official letters sent by the PWA. The first draft of the ESIA report was sent along with the invitation. The session was attended by about 65 participants from different groups who are directly or indirectly affected by the project. The session opened dialogue and interaction between different stakeholders and the environmental and social experts conducting the ESIA (GVC & CEC Consultants) along with the client (PWA). The main concerns and recommendations that have been raised by the second public consultation session participants can be summarized as follows:

- The owner of Tel Al Zatar kindergarten has an objection on the construction of the water facility behind the kindergarten.

- There is a great need of having different public awareness campaigns to ensure the effective implementation and operation of the project.
- Close coordination between the project implementation agencies and the nearby public facilities is very important.
- Service providers have a vital role in enhancing the fees collection rates.
- There is a need of having comprehensive socio-economic studies regarding each socio-economic issue
- The potential of the contamination of water in pipes as a result of the negative pressure.
- A comprehensive energy plan is very important.

Grievance Redress Mechanism for CMWU

An initial assessment of the existing complaint mechanism at CMWU was carried out. The assessment indicated that the existing system for receiving complaints and dealing with them follows a very simple procedure, where the customer is only asked to fill his contact details, with no clear system for following up. According to this assessment, a suitable GRM system for CMWU is proposed as part of ESIA report. This GRM will only respond to social and environmental grievances resulting from this project's interventions. Other grievances are not covered under this GRM. The expected social and environmental grievances due to this project are identified in the ESMP. However, if additional unexpected complaints that fall under social or environmental categories and were not identified in the ESMP, can be discussed for eligibility to be covered under the GRM.

Recommendations

The proposed "*Associated Gaza Strip Works of the Gaza Sustainable Water Supply Program*" project components are suitable from technical and environmental perspectives. The project does not represent a significant environment and social threats provided that the proposed mitigation measures presented in this ESIA report are implemented in accordance with applicable regulations and guidelines, a competent and sustainable operational entity is charged with plant operations, and that the ESMP is followed with care. The project is anticipated to bring long-term benefits by provision of infrastructural improvements that will support the delivery of reliable, safe and affordable water supply to meet the needs of various communities in Gaza Strip.

The ESIA concludes the environmental, social, and health impacts of the project can be maintained within acceptable levels, provided that the recommended mitigation measures are incorporated and the environmental, social, health and safety management of the project facilities are addressed as described within this ESIA.

1. Introduction

1.1. Background

The Palestinian Water Authority (PWA) have developed a rolling program of sophisticated combined interventions to deal with the ongoing water crisis in the Gaza Strip. Specifically, by 2020, PWA plans to implement the following measures:

- improving the water distribution system,
- improving agricultural water management,
- developing wastewater treatment and reuse and
- Increase supply of bulk water resources (constructing of a central desalination plant).

In this context, the Gaza Sustainable Water Supply Program (GSWSP) has been considered as the preferred option for Gaza to stabilize the aquifer and secure its water supply. The program consists of a seawater desalination plant of around 55 MCM/y first phase capacity to an eventual 110 MCM/y capacity; and its associated works under title "Associated Works of the Gaza Sustainable Water Supply Program". The World Bank indicated funded the preparation of the detailed design of the Associated Works project as well as its Environmental and Social Impact Study.

The proposed project "Associated Works of the Gaza Sustainable Water Supply Program" provides infrastructural as well as institutional improvements that support the delivery of reliable, safe and affordable water supply and meet the needs of various communities in the Gaza Strip.

The infrastructural components of the project include: 1) Construction of 20 water blending and storage reservoirs, 2) Construction of a 42.5 km long North - South carrier, 3) Construction of transmission loops to feed the reservoirs, 4) Construction of the main pumping station and 5 booster pumping stations along the North-South carrier, 5) Closure of wells with insufficient quality to operate the blending into the reservoirs, 6) Construction of a downstream distribution network 7) Replacement of old or undersized distribution pipelines, and 8) Improvement of Mekorot Connections with the associated water supply pipeline.

Although the project components are considered to be category B investments, category A is proposed for the project, according to the WB Environmental Assessment Policy (OP 4.01), as all of these subcomponents are associated with the Gaza Central Desalination Plant (GCDP), which is classified as a Category A project due to its significant, unprecedented and possibly irreversible impacts the environment in Gaza. Thus, the preparation of an Environmental Assessment (EA) is required as promulgated by the WB Environmental Assessment Policy (OP 4.01), the Palestinian Environmental Law No.7, and the Palestinian Environmental Assessment Policy (PEAP). Accordingly, the Joint Venture of The Global Vision Consultants (GVC) & Consulting Engineering Center (CEC) prepared this Environmental and Social Assessment report.

The ESIA summarizes the results of the environmental and social impacts associated with the construction, and operation of the proposed components of the project except those of which the detailed design was not available during the preparation of this ESIA, i.e. the downstream distribution networks . The ESIA also provides mitigation measures included in an Environmental and Social Management Plan (ESMP).

Parallel to conducting this EA study, a detailed design of the project components was carried out by the international consultant Lotti & Al and TECC as a local partner. Preliminary designs and draft final designs for most of the project components were reviewed by the ESIA team in order to conduct the impact assessment study. However, the detailed design of some components, such as the downstream distribution networks, was not available during the preparation of this ESIA; these components will not be covered in details within this study.

1.2. ESIA Objectives and Purpose

The purpose of this ESIA study is to identify the potential direct and indirect impacts, resulted during the construction and operation of the project components, on the environment and socio-economy in the project areas. According to the predicted impacts, mitigation measures are proposed and an Environmental and Social Management Plan (ESMP) was prepared addressing the identified impacts and the corresponding recommended mitigation measures and monitoring actions. The ESIA report is intended to provide stakeholders and decision makers with an understanding of the potential impacts of the project components, in order to facilitate a well-informed decision. The ESIA suggests methods and practices to avoid and/or minimize the negative effects, alongside methods to enhance the positive effects of the project.

The objectives of the ESIA study are to:

- Investigate and record the existing environmental, economic, and social conditions of the project areas in relation to the proposed project components locations.
- Ascertain the possible environmental and social impacts of the infrastructural subcomponents,
- Identify the benefits of the proposed project
- Develop an environmental and social management plan (ESMP) to manage, mitigate, and monitor any possible negative impacts during the construction and operational phases of the project and to
- Assess the capacity of the implementing party to implement the ESMP; and to
- Suggest any capacity building needs necessary to fill the gaps.

1.3. ESIA Scoping

An environmental and social scoping session was conducted on October 13, 2017 to identify the issues to be covered by the EA study and to gain an understanding of the concerns of the stakeholders. The session was attended by 50 representatives of the relevant Palestinian authorities, International Non-governmental Organizations and local civil society organizations who represent local community categories that are directly involved in or affected by the proposed project components.

During the session, the PWA presented the project background, approach and objectives, components, and energy management plan and energy supply system. In addition, the ESIA team (JV of GVC & CEC), presented the area description of project components including the proposed routes and locations, sites description, nearby facilities, agricultural activities, and surrounding environment.

The participants were also introduced to the purpose of the environmental assessment for the proposed project and the content of the EA study. The team also explained some environmental concerns as identified during initial consultations with PWA and based on the sites visits conducted by the team and the experience of conducting similar ESIA reports for desalination plants and associated water supply works. The session was then open for the participants to actively discuss and reflect their opinions and concerns for potential

negative environmental impacts. The main concerns and issues that have been discussed by the consultants or raised by the scoping session participants are summarized in Table 1-1 below.

Table 1-1: Main Issues Discussed and Raised During the Scoping Session

During Construction	During Operation
• Damage of infrastructure (About 9 km of the service road and roads intersections, Existing infrastructural services, above and under the ground (water, wastewater, electricity,…) • Traffic disturbance (Blocking of excavated roads) • Disturbance of markets; Disturbance to businesses and economic activities (The Two local markets in Gaza and Khanyounis) • Risks to Public and Occupational health and safety • Loss of existing small-scale agricultural areas • Nuisance to the local community in the vicinity of construction activities • The overall quality of the blended water	• Risk of flood/overflow of the tanks, • Socio-economic impacts on the vendors and operators of the small-scale desalination units as well as the working staff in these units, • Social impacts associated with the presence of residential encroachments along the route of the transmission line in the area from Meraj road to Al Najma intersection. • Impacts associated with the replacement of asbestos pipelines during construction • Increased levels of noise from operation of pumps and generators • Visual impacts of the pumping stations and reservoirs • Instability and lack of energy needed for the operation of different project components

The results from the discussion during the Scoping Session were evaluated and compiled into a scoping document (See Annex 1 for a copy of the scoping document).

Further to the evaluation of the Scoping Session results, the final impact assessment conclusions in this ESIA report consider additional data and evidence collected during different consultation activities, including the second public consultation session, and during the assessment process to evaluate the potential impacts, as presented in the Methodology Section 1.4. This follows the process of:

- Identify potential social and environmental impacts
- Predict likely magnitude of impacts.
- Further evaluate significance of impacts.
- Identify and investigate options for mitigation (avoid, reduce/minimize or offset impacts).
- Evaluate and document expected Residual Impacts (after mitigation).
- Produce the management plan (ESMP).

1.4. Methodology

The ESIA study followed the methodology described in this section, as well as the guidelines provided by the World Bank and the Palestinian Environmental Assessment Policy, as described further in Chapter 2.

1.4.1. Review and Data Collection

An iterative process of information gathering, and impact forecasting was conducted. The available reports were reviewed, a scoping session was conducted, and the relevant agencies were contacted. The agencies' cooperation and any other information including the potential issues deemed important by the ESIA team and other concerns or desires related to the project were obtained. The collected information was used to create informational exhibits and baseline knowledge of known social, economic, and ecological issues in the project area.

All available relevant documents and materials were reviewed including technical proposals, available reports, and maps. A full list of technical and non-technical references can be found in Annex 2 and a list of the ESIA study preparers is attached in Annex 3. Desk study data on the area were verified and supplemented through environmental and socio-economic baseline field investigations. Field surveys included drive-throughs and walk-throughs along the proposed Carrier line sections, pumping stations, and reservoirs with an emphasis on the identification of sensitive receptors.

The collected literature information and field data are represented on GIS-based maps, where relevant, covering the ESIA Study area. Photographs are also provided documenting the field survey findings.

Based on the obtained data and field observations, comprehensive analysis and general conclusions, recommendations and guidelines are provided at the end of this report.

1.4.2. Impact Assessment

The ESIA study was conducted based on the Terms of Reference (ToR) of the *Environmental and Social Assessment (ESIA) to include an Environmental and Social Management Plan (ESMP) for the Associated Works of the Gaza Sustainable Water Supply Program. Grant No.: P117443*, for the benefit of PWA and in accordance to the EA guidelines of the funding agency of the study, WB.

Environmental and social Impact Assessment

The environmental impact assessment process includes a baseline assessment, prediction of the potential environmental impacts, proposed mitigation measures, final impact assessment, and the design of the EMP. The process was guided by continuous correspondence and consultation with the concerned parties. The proposed methodology assigns environmental impacts as having a positive, neutral/negligible, or negative impact. The stages include:

- Identify potential environmental impacts.
- Predict magnitude of impacts and evaluate significance.
- Identify mitigation (avoid, reduce/minimize or offset impacts).
- Evaluate and document expected final residual impacts (after mitigation).
- Produce Environmental Management Plan.

The significance of potential environmental impacts is determined by assessing the changes that would be expected to occur to affected receptors and depending on their sensitivity, such as the local community and

/ or the physical environment. Expected changes that would normally occur are due to direct or indirect causes and the impacts of these changes are expected to occur over a particular timeline (short period mainly referring to construction phase; and long term mainly referring to a prolonged timeline over the operational phase). Therefore, the potential impacts have been divided over the different project phases during the project life.

As a result of the final assessment, the potential impacts are evaluated as low, medium and high significance, as presented highlighted in Chapter 6 along with the proposed mitigation measures to avoid/reduce these impacts.

Social Impact Assessment

Methodology of the social impact assessment was improved during the inception period when secondary information was reviewed, several key informants were interviewed and first public consultation was held. Moreover, the affected communities have been determined and field visits to these communities were conducted along with discussions with stakeholders.

Based on the implemented activities, the team was able to draw the social system, identify the stakeholders, and define the potential impact and investigation areas. Then, list of the hypothetical potential impacts on each social group was prepared, the hypothesized impacts and other potential impacts were investigated and proper mitigation plan to deal with negative impacts was designed.

2. Policy, Legal, And Administrative Framework

Water and environmental legislation and regulations are vital tools to protect public health and the environment and give consideration to sustainable development. These legislative instruments define

responsibilities for monitoring and managing the environment quality and natural resources. They set the responsibilities of different authorities and institutions that are involved in any developmental intervention, including programs, projects and schemes that may affect the environment or public health.

This EA study has been conducted under the governance of the World Bank Environmental and Social Safeguard Policies as funding agency of the study (See section 2.1.1). The study has also taken account of local laws and regulations set by the Palestinian Authority (PA), as well as international guidelines as necessary and relevant to the proposed project activities. This ensures that environmental and social factors and values are integrated into the decision making process.

2.1. Policy framework

2.1.1. World Bank Environmental and Social Safeguard Policies

Under the World Bank's operational policies, there are ten environmental and social policies referred to as the Bank's "safeguard policies". The objective of these policies is to prevent and mitigate undue harm to people and their environment in the development process. The initial screening of applicable World Bank social and environmental safeguards policies indicated that, among these policies, the OP 4.01 Environmental Assessment, and the OP 4.12 Involuntary Resettlement are triggered for the justifications provided in Table 2-1 below.

Table 2-1: World Bank Environmental and Social Safeguard Policies

OP/BP	Safeguard Policy	Objectives	Summary	Relevance
4.01	Environmental Assessment	Help ensure the environmental and social soundness and sustainability of investment projects. Support integration of environmental and social aspects of projects in the decision-making process.	Environmental assessment (EA) is a requirement for projects proposed for Bank financing to help ensure that they are environmentally sound and sustainable, and thus to improve decision making. According to this policy, an environmental and social category is assigned to an investment project after appraisal and before public disclosure. Projects are assigned a category of A, B, or C, in descending order of environmental and social sensitivity. The policy consists of seven basic elements: 1. Screening (The project is classified as Category A project if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented) 2. Environmental assessment (EA) documentation requirements (Detailed Environmental Impact Assessment is required for category A projects) 3. Public consultation (for category A projects, at least two consultations must be conducted) 4. Disclosure (The ESIA findings must be discloused at the World Bank Infoshop (English) and In-country, accessible to local affected groups (local language)) 5. Review and approval of EA documentation (By the Regional	***The Project triggers this policy*** and Category A is proposed for the Associated Works to the Gaza Sustainable Water Supply program as the Gaza Central Desalination Plant (GCDP), which is a main part of the program, is a Category A project due to its significant, unprecedented and possibly irreversible impacts on the environment in Gaza. Although the North-South transmission line, pumping stations, water blending and storage reservoirs, and distribution reinforcement and extension are considered to be category B investments, all of these subcomponents are associated with the desalination plant. Thus these associated works are also treated in the manner of a Category A project. In this regard, a comprehensive Environmental and Social Impact Assessment has been undertaken.

OP/BP	Safeguard Policy	Objectives	Summary	Relevance
			safeguard coordinator for category A projects) 6. Conditionality in loan agreements (for category A projects, the borrower is obligated to implement EMP) 7. Arrangements for supervision, monitoring, and reporting	
4.04	Natural Habitat	Promote environmentally sustainable development by supporting the protection, conservation, maintenance, and rehabilitation of natural habitats and their functions.	This policy prohibits Bank support for projects that would lead to the significant loss or degradation of any Critical Natural Habitats, whose definition includes those natural habitats that are: • legally protected; • officially proposed for protection; or • unprotected but of known high conservation value. The policy is "triggered" if a subproject could result in any one or more of the following four events: • A loss of natural habitats • Construction of "linear features" (e.g., roads, transmission lines, pipelines) that might cut through natural habitats • An effect on the water supply to or drainage from natural habitats • A direct or indirect result in resettlement or migration of people in a way that would adversely affect natural habitats	***Although*** one of the main components of the project is a main carrier line of 42.5 km long that extends along the Gaza Strip from South to North, sites visits conducted by the team indicated that no natural habitats are found to be located along the carrier route even at the location, where the carrier line cuts the Wadi Gaza valley. Moreover, the construction of some reservoirs and booster pumping stations may involve the vegetation clearing at some of the proposed sites, although to a very minimum extent. Hence, the project does not trigger this policy (See Annex 4 (a-1) for screening information of this policy)
4.11	Physical Cultural Resources	Assist in preserving PCR and in avoiding their destruction or damage. PCR includes	This policy addresses PCR, which are defined as movable or immovable objects, sites, structures, groups of structures, and	***The project does not trigger this policy***. According to the Consultant review of the

OP/BP	Safeguard Policy	Objectives	Summary	Relevance
		resources of archeological, paleontological, historical, architectural, religious (including graveyards and burial sites), aesthetic, or other cultural significance.	natural features and landscapes that have archeological, paleontological, historical, architectural, religious, aesthetic, or other cultural significance. They may be located in urban or rural settings, and may be above or below ground or under water. Their cultural interest may be at the local, provincial, or national level, or within the international community.	available information about the cultural resources within the project area; none of the sites allocated for the project components contains a cultural resource. However, as the project extends along a wide area in the Gaza Strip, and as it comprises a lot of excavation works; the potential of discovering new resources during construction is high. Thus, the use of "***chance find***" procedures will be provided in the context of the PCR component of the environmental management plan. (See Annex 4 (a-2) for screening information of this policy)
4.12	Involuntary Resettlement	Avoid or minimize involuntary resettlement and, where this is not feasible, assist displaced persons in improving or at least restoring their livelihoods and standards of living in real terms relative to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.	This policy covers direct economic and social impacts that both result from Bank-assisted investment projects and are caused by: • the involuntary taking of land resulting in: o relocation or loss of shelter; o loss of assets or access to assets; or o loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or • the involuntary restriction of access to legally designated parks and	This ***project triggers this policy*** due to the presence of two lands, allocated for the construction of a reservoir and a booster pumping station, which were privately owned, the assessed negative impact on the private small desalination units industry, and the presence of two main public markets within the main carrier right of way that will be affected during construction. However, neither the generation of a RAP or a RPF nor the development of a ToR for them

OP/BP	Safeguard Policy	Objectives	Summary	Relevance
			protected areas resulting in adverse impacts on the livelihoods of the displaced persons.	comes within the scope of this assignment. (See Annex 4 (a-3) for screening information of this policy)
4.09	Pest Management	The objective of this policy is to minimize and manage the environmental and health risks associated with pesticide use and promote and support safe, effective, and environmentally sound pest management.		The policy is ***not triggered*** for this project
4.20	Indigenous Peoples	The objective of this policy is to design and implement projects in a way that fosters full respect for indigenous peoples' dignity, human rights, and cultural uniqueness and so that they (1) receive culturally compatible social and economic benefits, and (2) do not suffer adverse effects during the development process.		The policy is ***not triggered*** for this project
4.36	Forests	The objective of this policy is to realize the potential of forests to reduce poverty in a sustainable manner, integrate forests effectively into sustainable economic development, and protect the vital local and global environmental services and values of forests.		The policy is ***not triggered*** for this project
4.37	Safety of Dams	The objective of this policy is to ensure quality and safety in the design and construction of new dams and the rehabilitation of existing dams, and in carrying out activities that may be affected by an existing dam.		The policy is ***not triggered*** for this project
7.50	Projects on International Waterways	The objective of this policy is to ensure that the international aspects of a project on an international waterway are dealt with at the earliest possible opportunity and that riparians are notified of the proposed project and its details.		The policy is ***not triggered*** for this project
7.60	Projects in Disputed Areas	The objective of this policy is to ensure that other claimants to the disputed area have no objection to the project, or that the special circumstances of the case warrant the Bank's support of the project notwithstanding any objection or lack of approval by the other claimants.		The policy is ***not triggered*** for this project

2.1.2. Palestinian Environmental Assessment Policy

The Palestinian Environmental Assessment Policy (PEAP) was approved by decree No: 27- 23/4/2000. The PEAP supports the sustainable economic and social development of the Palestinian people. Specifically, the PEAP promulgates the following:

- Ensure an adequate quality of life in all aspects, and ensure that the basic needs and social, cultural, and historical values of the people are not negatively impacted as a result of development activities.
- Preserve the capacity of the natural environment.
- Conserve biodiversity and landscape, and promote the sustainable use of natural resources.
- Avoid irreversible environmental damage, and minimize reversible environmental damage from development activities.

Under the PEAP, proponents of public and private projects are required to submit an Application for Environmental Approval that informs the EQA and relevant approving authorities of the intended project activities. Subsequently, a determination is made whether an Initial Environmental Evaluation (IEE) or a detailed EA is required. If neither an IEE nor EA report is required, the EQA, in coordination with the EA Committee, will determine if an Environmental Approval will be granted and, if so, under what conditions.

In accordance with the EQA, an EA study should include the results of conducted fieldwork, the predicted impacts and benefits of the project, and the proposed mitigation and environmental management measures.

The EA shall take into consideration the timeframe and magnitude of impacts through the different stages of the proposed project, and consider alternative locations, operations, and technologies possible. Upon submission of the EA report for review, EQA requests amendments as needed and a final EA is distributed to the inter-ministerial EA committee for review and approval. Collectively, major water supply infrastructure projects such as the proposed components of the project are classified as actions that generally have a significant impact on the environment and will require the preparation of an Environmental Assessment (EA) as promulgated in Annex 2 of the PEAP.

The PEAP is broadly consistent with the WB's OP 4.01 for projects requiring a full ESIA; there are requirements for environmental management plans (including mitigation measures), environmental audits, public participation and disclosure.

However, the content of the screening and analysis for EIAs under the Palestinian EA Policy is less specific; e.g. no clear criteria is provided to define specific social impacts such as potential resettlement and livelihood impacts.

Moreover, there is a notable mismatch between what the Bank and the Palestinian EIA Policy consider projects with "significant" impacts. For the Bank, "significant" refers to projects with adverse impacts that are sensitive, diverse, or unprecedented, and where impacts may affect an area broader than the site of physical works. In Palestine, the threshold for "significant" is not precisely defined, projects fall in the requirement for a full ESIA and considered on the "Type A" in a form of a category list that is mostly would be considered as having significant impacts by World Bank standards.

2.1.3. Palestinian Cultural Heritage Legislations

The only legislation in place at present in Gaza is concerning cultural and natural heritage is the British Mandate Law of Antiquities of 1929, which was adopted by the Egyptians and revised by the Jordanians in The West Bank (in 1966). The law excludes any archaeological sites (including historic buildings) and artifacts (movable objects), which postdate 1700 AD. The definition also excludes religious buildings, as well as natural heritage sites.

"*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*"

In 2012, two draft laws for the protection of tangible and intangible cultural heritage were prepared. The main provisions of the draft law on tangible cultural heritage include the principle of public ownership of cultural heritage, a ban on the sale or transfer of such properties, and a mechanism enabling the local authorities to reclaim cultural properties illegally removed from occupied territory. No formal enactment of the draft law has yet taken place.

2.1.4. Existing Palestinian policy and legal framework for land acquisition

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 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.

Land Expropriation Law2/1953

Law No.24 of year 1943 was modified by Law No. 2 of year 1953. According to this law on "Land Expropriation for Public Projects" and its articles (3) and (21), the Government can expropriate up to 25% of any privately-owned land for public interest reasons – without compensating the owners. Exceptions are made to owners who prove to be largely damaged by this land expropriation. However, owners are entitled to compensation for all crops and trees, buildings and fixed structures on the expropriated 25% area of the land.

In case the Government needs the whole plot of land, negotiations are made to reach an agreement with owners. However in case of pressing time demands to expropriate land to a specific project serving public interest, the Government is entitled to seize the land immediately and then to initiate compensation negotiations with owners/users (Law 2/1953, Article (12)).

Legal procedures adopted for land acquisition purposes

Different authorities and entities are involved in land acquisition process, these include:

- Palestinian Water Authority (the owner of the project) (PWA)

- Palestinian Land Authority (PLA)
- Ministry of Local Governance (MoLG)
- Municipalities (Beit Hanoun, Gaza, Jabalia, Wadi Gaza, Al Buraij, Al Zawaida, Al Nusairat, Deir Al Balah, Al Qarara, Abasan Aljadeeda, Al Musadar, Khanyounis and Rafah)
- The Central Committee
- The Cabinet
- Ministry of Endowment (Awqaf Ministry)
- Project affected persons (PAP)

a) Private Lands

Out of the 25 sites allocated for the construction of reservoirs and pumping stations, only two sites were privately owned as shown in section 5.1 of this report. The procedure to obtain private lands is as follows:

- PWA identifies the lands required by the project. Thereafter, they communicate with the municipalities in order to identify the technical specifications of the required land
- The municipalities develop the technical documents to the PWA. Thereafter, they forward the documents to the Palestinian Land Authority and the Ministry of Local Governance who raise the land acquisition to the Central Committee responsible of land acquisition for public benefit
- The municipalities prepare an inventory survey to verify the ownership of lands after receiving the maps and coordinates from the PWA,
- The municipalities apply the procedures required to change the type of land use.
- PWA and the concerned Municipalities provide PLA with detailed information on the land and properties to be expropriated
- The PWA announces in daily newspapers the government's intent to expropriate the specified lands and provides full details about the project and grievance duration (60 days after publishing the advertisement)
- The municipalities inform the PAPs with the exact period to submit their complaints related to land acquisition (60 days)
- PLA investigate diversified complaints and propose solutions
- Any objection on principle to the acquisition must be lodged within 60 days of publication of the Land Expropriation for Public Benefit.
- 30 to 90 days later, the case is presented to the Prime Ministry for endorsement, which must take place within 6 months (starting 30 days after the announcement of Expropriation for Public Benefit).
- The endorsed decision is published in the official newspaper
- PLA and the Municipality form a committee of five officials to provide a compensation estimate. Evaluations are based on current land values and prices to land of similar quality.
- A valuation committee from the PWA and PLA evaluate the appropriate compensation of lands
- In case of having any crops and trees, the Ministry of agriculture provides detailed valuation list of the affected crops/ trees
- Details of all land units included in the Prime Ministerial decree are announced, including names of owners and the number and description of the units.
- Affected persons have 30 days to discuss compensation with concerned authorities. Owners have the right to object to the offered compensation and may request mediation.

- Municipality/PLA may form a second committee to conduct a second evaluation
- They propose the alternative lands to be given to the PAPs
- The level of compensation is finalized upon ratification by the Ministry of Finance.

b) Waqf Lands

Waqf lands are the lands owned by the Ministry of Endowment and Religious Affairs. According to the agreement signed with the Ministry of Endowment and the Presidential decree, it is crucial to shed light on the restrictions to rent the lands. According to the presidential decree 4/284/11 of year 2013 related to transfer of ownership to the PWA, it is restricted for the Ministry of Endowment to rent the transferred lands. Consequently, any tenants (who rented the land after the decree) will not be entitled for compensation.

Only one Waqf land is found in the allocated lands for the proposed project components, which is located in Wadi Gaza Municipality as shown in Section 5.1 of this report. The procedure to obtain Waqf lands is as follows:

- PWA identifies the lands required by the project. Thereafter, they communicate with the municipalities in order to identify the technical specifications of the required land.
- The municipalities send the technical documents to the PWA. Thereafter, they forward the documents to the Palestinian Land Authority and the Ministry of Local Governance who raise the land acquisition to the Central Committee responsible of land acquisition for public benefit
- Transfer of ownership decree is issued by the cabinet and an alternative land is assigned to the Ministry of Endowment
- A contract will be signed with the Ministry of Endowment that contains the total area of lands needed and the alternative land
- The tenancy relation between the Ministry of Endowment and the tenants who rent Waqf lands on annual bases is suspended. Thereafter, the Ministry of Endowment receives the alternative lands. They will be able to continue renting the alternative land.
- If no agreement is reached, owners have recourse to Courts.
- Judicial involvement when no agreement is reached

Gaps between the Palestinian legislations and the WB safeguard OP 4.12 along with the stratigies adopted or proposed to bridge these gaps are illustrated in Table 2-2 below.

Table 2-2: Gaps between the Palestinian Legislations and the WB safeguard OP 4.12 regarding land acquisition

Item	Palestinian Law	WB safeguard OP 4.12	Gap Filling Measures
People and entities entitled for compensation for land loss	• those with registered property rights, • those with registered third party rights • those who have legally obtained the right to register their title but who, for	• those who have formal legal rights to land (including customary and traditional rights recognized under the laws of the country)	All of the identified PAPs and their assets have legal title to their assets. The private lands and local farmers who are currently using some of the proposed sites

	some reason, have not completed registration	• those who do not have formal legal rights to land at the time the census begins but have a claim to such land or assets--provided that such claims are recognized under the laws of the country or become recognized through a process identified in the resettlement plan	for agriculture, both Waqf and governmental lands, are entitled for compensation and should be covered in the recommended RAP.
Extent of Compensation and Property measurement	compensation is payable for loss of land, buildings, crops, profit and other damages arising from the acquisition of land for a project compensation is equal to the market value of lost properties, but there is no explicit reference to depreciation	compensation for lost properties will be calculated based on full replacement cost, in other words, compensation should be equal to what enables the Project Affected People (PAP) to restore their livelihood at the level prior to the resettlement Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. These strategies may include resettlement on public land, or on private land acquired or purchased for resettlement.	Land owners of the privately owned lands will be compensated on the basis of land exchange that considers the land values Local farmers are allowed to use the land until the preparation works of the site are initiated RAP is needed to provide appropriate and sufficient mitigations for these issues.

2.1.4. World Bank Environmental, Health, and Safety Guidelines

Environmental, Health, and Safety General Guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents which are applied when one or more members of the World Bank Group are involved in a project. These Guidelines contain the performance levels and measures that are generally considered to be achievable in new facilities by existing technology at reasonable costs.

The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on environmental, community health and safety and occupational health and safety issues in specific industry sectors.

Among the different environmental issues covered by these guidelines, the project encountered the following environmental issues:

- Air Emissions and Ambient Air Quality
- Energy Conservation
- Water Conservation
- Hazardous Materials Management
- Noise

On the occupational health and safety issues, the following issues are encountered:

- General Facility Design and Operation
- Communication and Training
- Physical Hazards
- Chemical Hazards
- Personal Protective Equipment (PPE)

While on the community health and safety issues, the following issues are encountered:

- Water Quality and Availability
- Structural Safety of Project Infrastructure
- Life and Fire Safety (L&FS)
- Traffic Safety
- Transport of Hazardous Materials
- Disease Prevention
- Emergency Preparedness and Response

Environmental, Health, and Safety Guidelines for Water and Sanitation Industry

The EHS Guidelines for Water and Sanitation include information relevant to the operation and maintenance of potable water treatment and distribution systems. These guidelines provide a list of expected environmental, health and safety impacts that may occur during the construction and operational phases of projects related to drinking water projects. The impacts are related to water withdrawal, treatment, storage and distribution along with proposed management activities.

The environmental performance indicator of these guidelines regarding drinking water states that "*Water quality of potable water supply systems should meet nationally legislated drinking water standards or, in their absence, the most recent World Health Organization (WHO) Guidelines for Drinking Water Quality throughout the distribution network.*"

The EHS guidelines for water and sanitation industry along with the general EHS guidelines will be followed during the impact assessment process and during the preparation of the proposed mitigation measures.

2.1.5. WHO Guidelines for Safe Drinking Water

For the purpose of the design of this project and ESIA study, the main water quality parameters were investigated, particularly for the purpose of determining and selecting from the available and planned water sources for water supply, particularly from the proposed blending. The main relevant parameters are Chloride and Nitrate.

The 4th Edition of the WHO Guidelines for Drinking Water Quality was published in 2011. The edition includes a comprehensive preventive risk management approach for ensuring a safe drinking water quality by including water quality and water scarcity, recognizing the importance of managing these impacts as part of water management strategies, and by including chemical contaminants in drinking water, including information on chemicals and health effects associated with drinking water exposure and revisions of existing chemical fact sheets, taking account of new scientific information.

Chloride

The WHO drinking water guidelines have not established a particular health-based value for chloride in drinking water. However, chloride concentrations in excess of about 250 mg/l can give rise to detectable taste in water.

Excessive chloride concentrations increase rates of corrosion of the distribution system which can lead to increased concentrations of metals in the water supply. This is only the case if steel pipes are used in the distribution system, which is not the case in the proposed project, considering that the pipeline types that considered for the design are D.I., HDPE and UPVC.

Nitrate

The WHO guidelines have set the value of 50 mg/L as NO_3^- (11 mg/L as NO_3-N) to protect against the blue baby syndrome (methaemoglobinaemia) in bottle-fed infants. Although there is no clear evidence throughout conducted research so far, adults are anticipated to become increasingly susceptible to gastrointestinal infection and thyroid gland disorders due to excess nitrate concentrations in drinking water.

2.1.6. Palestinian Guidelines for Drinking Water

Since it is a challenge in the Gaza Strip to supply water with acceptable quality given the reality of the deteriorated quality from the groundwater sources, the PWA considered water standards for a midterms plan for Gaza Strip regarding chloride (Cl) with a limit of (600 mg/l) and nitrate (NO_3) with a limit of 70 mg/l, and maximum Total Dissolved Solids (TDS) of 1,500 mg/l, only to meet the minimum acceptable water quality (see Table 2-3 for the comparison of different WHO and PWA Guideline Parameters for Drinking Water).

Table 2-3: WHO and PWA Guideline Parameters for Drinking Water

Parameter	WHO	PWA
Chloride (mg/l)	250	600
Nitrates (mg/l)	50	70
Total Coliform (colony /100 ml)	0	5 per 5% of samples
Fecal Coliform (colony /100 ml)	0	0
Total Dissolved Solids (mg/l)	1,000	1,500

2.1.7. WHO Ambient Air Guidelines

The WHO Air Quality Guidelines (2005) are recommended by the WB Environmental, Health and Safety Guidelines to be applied in the absence of national legislated standards, in order to prevent or minimize significant to ambient air, by ensuring that emissions do not result in pollutant concentrations that reach or exceed these guidelines and standards. Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines. Table 2-4 sets a comparison between the WHO and Palestinian ambient air quality standards.

2.1.8. Palestinian Ambient Air Quality Standards

The Palestinian Ambient Air Quality Standards (PS 801- 2010) were developed by the Palestinian Standards Institution (PSI) through the Environment Committee. The result is health based standards and objectives for a number of pollutants in air, including particulate matter, nitrogen oxides, ozone and sulfur oxides as shown in Table 2-4 for the comparison between the Palestinian and the WHO ambient air standards.

Table 2-4: WHO and Palestinian Ambient Air Quality Guidelines

	Averaging Period	WHO Guideline value* ($\mu g/m^3$)	Palestinian Guideline value ($\mu g/m^3$)
PM_{10}	24-hour	150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)	150
	1-year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)	70
NO_2	1-hour	200 (guideline)	400
	24-hour	--	200
	1-year	40 (guideline)	100
O3	1-hour	--	200
	8-hour	160 (Interim target-1) 100 (guideline)	120
SO_2	1-hour	--	350
	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)	250
	1-year	--	60
	10-minute	500 (guideline)	--

* PM 24-hour value is the 99th percentile.

2.1.9 WHO Noise Level Guidelines

Guidelines for Community Noise, World Health Organization (WHO), 1999, provided guidelines values for noise levels measured out of doors. These levels, presented in Table 2-5, should not be exceeded by any noise source.

Table 2-5: WHO Outdoor Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)

	Daytime (07 am – 10 pm)	Nighttime (07 am – 10 pm)
Residential, institutional, educational	55	45
Industrial, Commercial	70	70

2.1.10 Palestinian Noise Level Guidelines

The Palestinian Standards Institution have established the Outdoor Noise Standards (PS 840- 2005), through the Environment Committee, to Provide information for the protection of public health against the outdoor noise level. These guidelines are shown in Table 2-6. The Palestinian and the WHO guidelines have almost the same levels, with the Palestinian guidelines having more detailed types of receptors

Table 2-6: Palestinian Outdoor Noise Level Guidelines

Receptor	One Hour L_{Aeq} (dBA)	
	Daytime (07 am – 08 pm)	Nighttime (07 am – 08 pm)
Rural residential areas, hospitals, schools	40	30
Residential	50	40
Residential with some commercial activities, or along main roads	55	45
Commercial	65	60
Industrial	75	65

2.2. Legal Framework

2.2.1. Palestinian Environmental Law

The Palestinian Environmental Law (PEL) No. 7 of 1999 was developed by the Environment Quality Authority (EQA), to protect environmental resources, including land environment; air environment; water resources and aquatic environment; and natural, archaeological and historical heritage. According to the PEL, the protection of these resources shall be addressed in all social and economic development plans in view of sustainable development and protection of the rights of future generations.

The core issues of concern in the PEL are the protection of public health and social welfare, as well as the conservation of ecologically sensitive areas, biodiversity and rehabilitation of environmentally damaged areas. The PEL also sets penalties for violating any article presented under this law. The main objectives of the PEL include the following:

- Protecting the environment from pollution.
- Protecting public health and social welfare.
- Incorporating environmental resources protection in all social and economic development plans and promoting sustainable development to protect the rights of future generations.
- Conserving ecologically sensitive areas, protecting biodiversity, and rehabilitating environmentally damaged areas.
- Establishing inter-ministerial cooperation.
- Promoting environmental information collection and publication.
- Promoting public awareness, education and training.

Article 28 is specifically related to water environment: “EQA in cooperation with the specialized agencies shall specify the standards for the quality and characteristics of fresh water “

In accordance with Article 47, the EQA, in coordination with appropriate authorities, is responsible for determining projects that require environmental approvals prior to licensing. The current project is bounded with Article 47.

2.2.2. Palestinian Water Law

Legislation for the regulation and management of the water sector was encompassed in the approved Water Law No. 3, which was signed on July 2002. The objective of this law as stated in Article 2 is to develop and manage the water resources, increasing their capacity, improving their quality and preserving and protecting them from pollution and depletion.

A new Water Law No. 14 was issued in 2014 to establish for a new phase for the water and wastewater sector and its governance and management. This law aims to develop and manage water resources, increase their capacity, improve their quality, preserve and protect them from pollution and depletion, and to improve the level of water services through the implementation of integrated and sustainable water resources management principles.

The law includes articles that ensure the protection of water resources in terms of quantity and quality, through the statement of the purposes for which the water resources can be used; the determination of the

amounts and means of water utilization for the various sectors and regions; and the definition of the authority's responsibility in the monitoring of water resources.

2.2.3. Palestinian Public Health Law

In accordance with the Palestinian Public Health Law (PPHL) No. 20, developed by the Ministry of Health (MoH) and issued upon resolution by the Legislative Council in 2004, the role of the PA as represented by the MoH and other authorities is to ensure the control of communicable, non-communicable, and genetic diseases by practicable means, including the removal of health nuisances.

As stated in Article 2 of this law, the MoH, and with the coordination with the concerned institutions, must perform regular inspection for drinking water, with respect to its adequacy for human consumption, for the purpose of implementing the provisions of this law.

2.3. Institutional framework

Water Law No. 14/2014 entailed the overall institutional structure of the water and sanitation sector in the Gaza Strip. The institutions demonstrated below are limited to those under which the proposed project will be planned and executed.

2.3.1. The Palestinian Water Authority (PWA)

The PWA is responsible for regulating the water sector and governing the water resources in Palestine through applying principles of integrated and sustainable management of water resources, and setting a general policies and plans for the water and sanitation sector in light of the economic and social needs. PWA is also responsible for setting the design, quality control standards and technical specifications for water projects and monitoring their implementation.

Accordingly, the planning, ownership and execution of the proposed project components is fully under the responsibility of the PWA. In addition to the PWA, there are other supporting institutions in regulating the water sector.

2.3.2. The Water Sector Regulatory Council (WSRC)

The Water Sector Regulatory Council is responsible for the approval of water prices, costs of supply networks and other services required for the delivery of water and wastewater services; issuance of licenses to Regional Water Utilities and any operator that establishes or manages the operation of a facility for the supply, desalination, or treatment of water or the collection and treatment of waste water. WSRC is also responsible for the monitoring and inspection of compliance with the terms, requirements and indicators stipulated in licenses and provided permits.

2.3.3. The National Water Company (NWC)

The National Water Company is responsible to supply water to the water service providers and ensure and guarantee smooth commercial relations with the customers and suppliers. It is also responsible for the provision of all the means necessary for the development of all activities and infrastructure works related to the supply of bulk water. It also undertakes any related tasks assigned by PWA.

2.3.4. The Coastal Municipal Water Utility (CMWU)

The CMWU is the autonomous regional water and wastewater utility in the Gaza Strip that is responsible for the provision of water services in line with sustainable economic, social and environment principles and

meeting the community needs for water of suitable quality, through the development of the necessary plans and programs to develop these services.

Accordingly, CMWU in addition to local municipalities are the responsible service providers for the proposed project components.

Table 2-7 below shows the responsibilities of the main institutions involved in the project implementation and operation.

Table 2-7: Institutional Framework of the Proposed Project

Institution	**Responsibility**
PWA	Planning, ownership and execution of the proposed project components
NWC	Operation and maintenance of the bulk water system in the proposed project: • Water sources, • Bulk Water Supplies (the main carrier, the transmission mains, Mekorot connections and connection lines between the wells to be included in the system and the reservoirs) • Facilities (Main Pumping Station, booster stations along the Main Carrier System, and wells pumps and associated facilities) • Bulk Flow meters • Control Valves
CMWU	CMWU in addition to local municipalities are the responsible service providers for the proposed project components and will be responsible for the operation and maintenance of the downstream components of the proposed project, including: • Storage and blending Reservoirs • Downstream pumping stations • Main Feeders to the water distribution network • District measuring areas • Water distribution networks • Flow meters (including boundaries meters and district meters) • Control valves • Household connections • Customer meters (including connections for commercial and industrial consumptions)

3. Description of the Project

3.1. Project Objectives and Overview

A key objective of the project is to improve the water supply situation in the Gaza Strip through efficient use of desalinated water and precious groundwater while ensuring technical as well as financial sustainability of its operation. To achieve this objective, the project will provide blending of the desalinated water with groundwater and water from Mekorot to achieve a water quality in compliance with WHO and Palestinian standards and transmission of this water to all regions of the Gaza Strip. Initial Chloride content of 400 mg/l is proposed for 2020 and 2025 while a concentration of 250 mg/l is proposed for 2030 and 2035. Thus, the specific objectives of this project are:

- To blend the desalinated water with groundwater by construction of storage and blending reservoirs in such way that the resulting overall water quality in all of Gaza complies with WHO and Palestinian drinking water standards;
- To design and construct a transmission system i.e. the north – south carrier and the necessary distribution system with sufficient hydraulic capacity to transport this water to the end consumers, ensuring a quality service level;
- To put operation and maintenance of the new system on a sustainable track, by determining the costs of operation and maintenance in order to estimate a transparent
- Provide technical assistance to the CMWU and Municipal Water Departments (Gaza and Northern Gaza Municipalities) in technical and commercial operation of their existing and the newly constructed facilities;
- To develop a NRW reduction plan and an Energy management plan.
- To coordinate with CMWU's separate efforts to reduce non-revenue water;
- To coordinate with CMWU's separate efforts to quantify the socio-economic impacts of utility bills on Gaza households; and
- To plan, design and build the power supply system needed to operate the Associated Works based on the feasible alternative to be investigated.

The new water supply and distribution system take in consideration the planned needs of water supply until 2035, including consequences of the expansion of the central desalination plant, the increase of water amount from Mekorot, the reduction of groundwater production and the operation of the three Short Term Low Volume desalination plants as follows:

- Water produced by GCDP (55 MCM/y in 2019 to be upgraded to 110 MCM/y in 2027);
- Water produced by Short Term Low Volume Desalination Plants (three plants to be operational by 2019 to produce a total amount of about 13 MCM/y)
- Water provided by Mekorot (total of 20 MCM/y by 2020);
- Groundwater resources (28.5 MCM/y in 2020, 45.5 MCM/y in 2025, 6.8 MCM/y in 2030 and 23.5 MCM/y in 2035).

Table 3-1 shows the proposed amounts to be involved in the blending process from each source.
The water distribution system will keep working at intermittently basis up to year 2030 while continuous service will take place in 2035.

Table 3-1: Water Contribution from each Resource in the Proposed System

Year	CGDP (MCM/y)	STLV (MCM/y)	Mekorot (MCM/y)	Groundwater (MCM/y)	Total Water Production (MCM/y)
2020	55	13.14	20	28.5	116.6
2025	55	13.14	20	45.5	133.6
2030	110	13.14	20	6.8	149.9
2035	110	13.14	20	23.5	166.7

3.2. Project Components

In order to accomplish the long-term goals of the project, two main components are set. The first component is the civil works associated to the desalination plant and the second is utility capacity building and operational support. This study focuses only on the civil works component which includes the construction of a 42.5 km long North - South main carrier line to carry water from the GCDP through a main pumping station and five booster stations to the proposed transmission loops that will feed 20 water storage and mixing reservoirs proposed in all governorates of the Gaza Strip, in addition to the replacement of old or undersized distribution pipelines, the construction of new pipelines and the improvement of Mekorot connections to increase the amount of water received from Mekorot to a total of 20 MCM/year, Figure 3-1 shows the general layout of the project components.

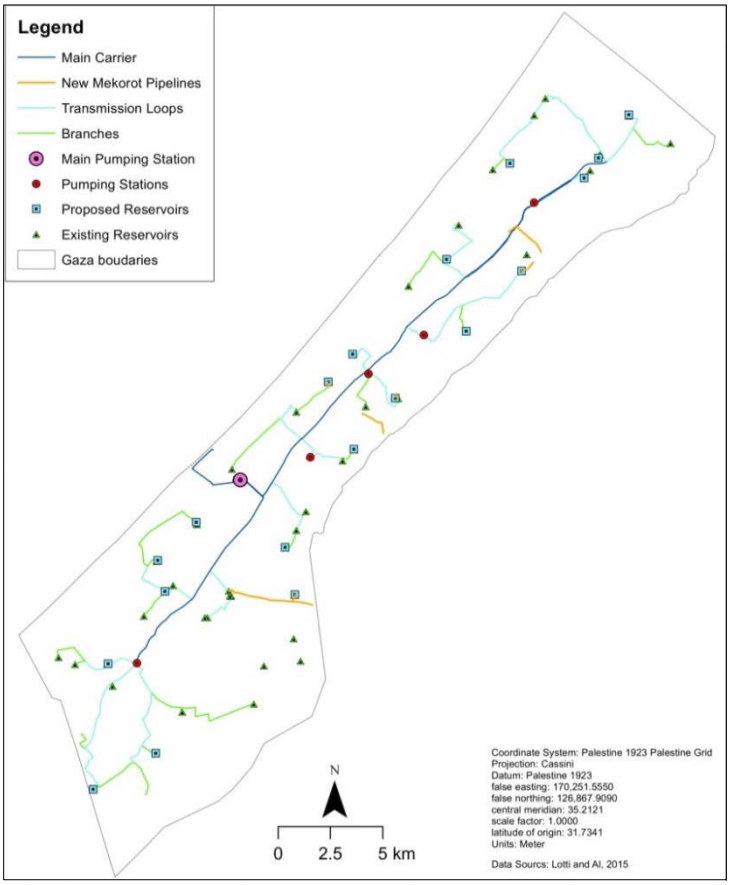


Figure 3-1: General Layout of the Project Components

Detailed information about each site of the project components will be provided in section 5.1 for the location and land use. This will include adjacent facilities, natural, or cultural facilities close to the sites along with physical and social characteristics.

3.2.1. North – South Carrier

A 42.5 km long ductile iron pipeline with diameters from 200 to 1,600 mm is proposed to carry water from the GCDP to the blending reservoirs.

The North-South carrier is divided into eleven sections, as shown in Figure 3-2 below, according to its location land use and according to the main characteristics of the surrounding environment;

- Section 1: the length of this section is about 6 km; it starts from the CGDP and ends up into a disconnecting chamber at Al Matahen area,
- Section 2: runs along about 1 km into Al Qarara Municipality from the disconnecting chamber,
- Section 3: about 1.5 km from the end of the second section to the intersection of Al Qarara Municipality with Salaheldein road,
- Section 4: starts from this point and ends after running along about 3 km of the Sikka road in the southern direction,
- Section 5: this section is a critical one, where the carrier runs along about 3 km of a paved segment of the Sikka road in Khanyounis and passes through the local market in Khnyounis, and
- Section 6: the last section in the southern part, of about 3 km, from the end of the fifth section to Rafah loop.

The remaining five sections are located in the northern part of the main carrier;

- Section 7: from the disconnecting chamber to the south area of Gaza city (9 km along Salaheldein service road),
- Section 8: about 6 km, from south of Gaza city to the area known as the Cars Market in Gaza city,
- Section 9: about 3 km, from the cars market area to the south of the Shejaeya local market,
- Section 10: from the south of the Shejaeya market to the Al Sanafour intersection (about 1.8 km), Section 11: the last section in the northern part, of about 5.5 km, from the Al Sanafour intersection to Beit Hanoun in the northern governorate.

All these sections of the carrier are proposed to run along the route of the railroad (Sikka road), which is a governmental land, except of the seventh section from Al Matahen area to the south area of Gaza city, where the carrier is proposed to run along the route of Salahaldein road. This exception will be discussed in more details in chapter 4 of project alternatives.

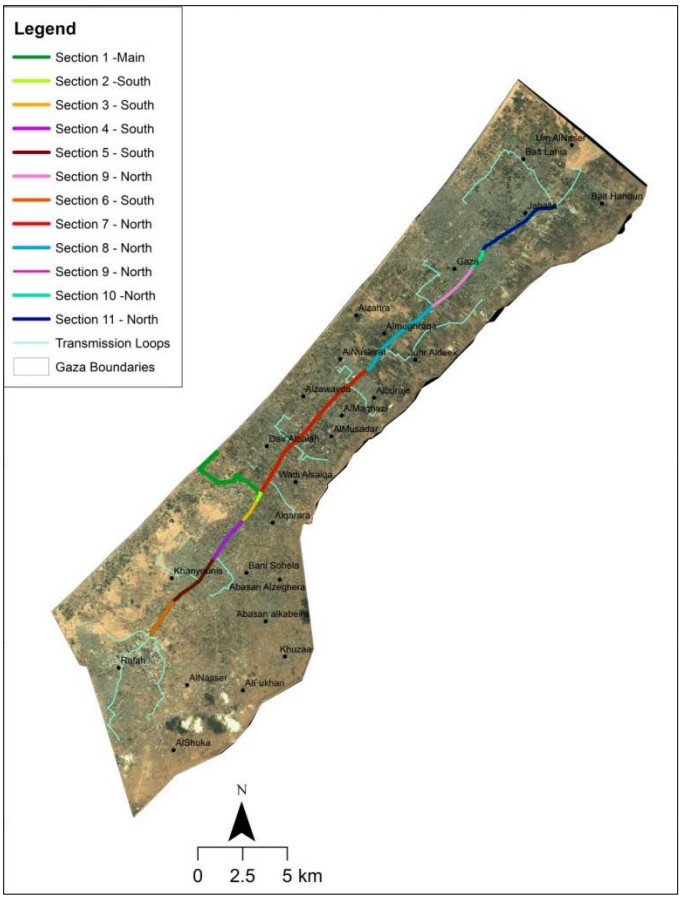


Figure 3-2: Sections of the Main Carrier Line

Along the pipeline profile, air venting valves will be provided at maximum level points, while drains will be provided at minimum level points. Such devices will be installed inside specific manholes. Moreover inspection manholes will be located with a base line of 500m and along singular points (curves, intakes, control valves, etc.). A typical section of the main carrier is provided in Figure 3-3 below.

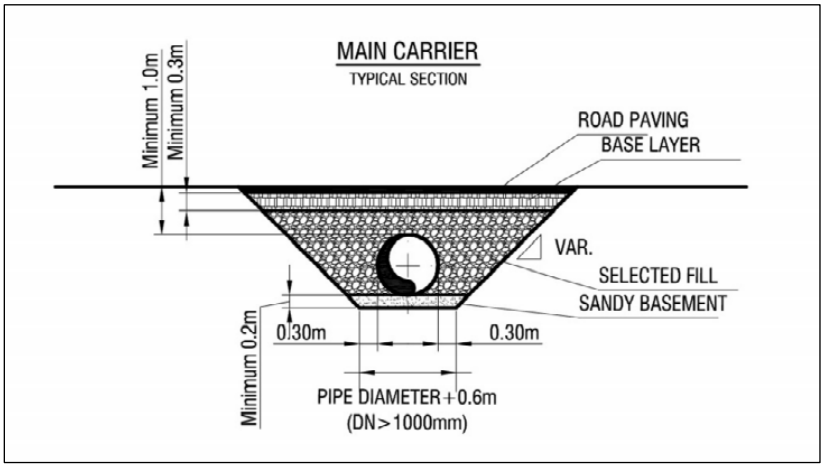


Figure 3-3: Main Carrier - Typical Section (Lotti & Al, 2016a)

3.2.2. Transmission Loops

Transmission loops with a total length of 110 km long and diameters from 150 mm to 700 mm will be constructed to feed reservoirs in the north, middle and south of the Gaza Strip. Pipes material is ductile iron.

3.2.3. The Main Pumping Station and the Booster Pumping Stations

A main pumping station and five booster stations will be constructed along the main carrier and the transmission mains to lift and carry water along the main carrier having a constant flow rate and pressure and also to directly feed some of the reservoirs along the transmission mains.

Main Pumping Station

The main pumping station is located in Al Qarara; at the end of the first section of the main carrier at the junction node MC1. This station will be divided into two pumping pressurization groups and; one to supply the northern branch of the main carrier (N-MC1) and the other to supply the southern branch (S-MC1).

The north main pumping station (N-MC1), with a proposed power of 375 kw, is composed of four pumps on duty and two in stand-by while the south main pumping station (S-MC1), with a proposed power of 474 kw, is composed of three pumps on duty and two in stand-by. These pumps are connected to the same tank fed by the desalination plant.

The site area of the main pumping station is 6,000 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(a) for the site layout.

Gaza Booster Station (N-MC 2)

The N-MC 2 pumping station is located in Gaza city, close to Al Sadaqa Park. The station consists of two pumps; one on-duty and one in stand-by. The site area of the station is 800 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(b) for the site layout.

Deir Al Balah Booster Station (N-01)

The N-01 pumping station is located in Deir Al Balah. The southern border of the site is adjacent to Wadi Al Salqa. The station consists of two pumps; one on-duty and one in stand-by. The site area of the station is 500 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(c) for the site layout.

Al Buraij Booster Station (N-02)

The N-02 pumping station is located in Al Buraij adjacent to a recreational resort. The station consists of two pumps; one on-duty and one in stand-by. The site area of the station is 900 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(d) for the site layout.

Wadi Gaza Booster Station (N-03)

The N-03 pumping station is located in Wadi Gaza Municipal about 600 m to the east of Wadi Gaza. The station consists of two pumps; one on-duty and one in stand-by. The site area of the station is 375 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(e) for the site layout.

Rafah Booster Station (S-01)

The S-01 pumping station is located in Rafah at the end of the second section of the main carrier, with a proposed power of 49 kw. The station consists of two pumps; one on-duty and one in stand-by. The site area of the station is 1,800 m^2 with all ancillary structures fitting within the available area as shown in Annex 5 – M1(f) for the site layout.

3.2.4. Reservoirs with Associated Supply & Distribution Pipelines

A total capacity of 180,000 m^3 is required. 20 new cylindrical and rectangular reservoirs will be constructed and 29 reservoirs will be upgraded to complement the existing ones and the ones already planned or under construction. The minimum storage capacity will be in a range between 11 and 16 hours.

The proposed reservoirs are located as shown in Figure 3-1, which provides a general layout of the project components. The proposed location, area, capacity, dimensions, water source and inlet pipes specifications for each reservoir are illustrated in Table 3-2.
The reservoirs will be supported by the following facilities:

- Disinfection building with associated chemical feed control system.
- Supply booster pumps station.
- Distribution booster pumps station.
- Diesel generator (backup power) and primary power supply and transformer.
- Site utilities.
- Some reservoirs will be provided with micro hydropower generators
- A local SCADA-ready control and monitoring system connected to the centralized Supervisory Control And Data Acquisition (SCADA) of the whole system.

As mentioned in section 3.1., reservoirs will receive water from different resources. Construction of 106 km long networks to connect the selected wells to the blending reservoirs is one of the components of the project. Diameters of the network pipelines range from 110-630 mm.

Table 3-2: Proposed Reservoirs Specifications

Municipality	Reservoir Name/ID	Area (m^2)	Capacity (m^3)	Water Resources	Dimensions	Inlet Pipes			Annex for site layout
						Number	Material	Diameter (mm)	
Beit Hanoun	ST – 26B (C-155)	2,500	4,200	Main carrier	Circular 27*7.2	2	D.I.	200	Annex 5 – M1 (g)
				Wells			HDPE	280	
	ST – 26C (C-155)		4,200	Main carrier	Circular 27*7.2	2	D.I.	200	Annex 5 – M1 (h)
				Wells			HDPE	315	
Jabalia	ST-023	2,400	4,200	Main carrier	Rectangular 20*20*10.5	2	D.I.	300	Annex 5 – M1 (i)
				Wells			HDPE	630	
	BL-T 01B	1,600	6,300	Main carrier	Rectangular 20*15*10.5	2	D.I.	250	Annex 5 – M1 (j)
				Wells			HDPE	450	
Gaza	ST – 045	1,790	6,300	Main carrier	Rectangular 20*15*10.5	3	D.I.	250	Annex 5 – M1 (k)
				Wells			HDPE	360	
				STLV					
	ST – 020	1,800	6,300	Main carrier	Rectangular 20*15*10.5	2	D.I.	300	Annex 5 – M1 (l)
				Wells			HDPE	200	
	F-205 B	300	2,100	Main carrier	Rectangular 20*10*10.5	2	D.I.	150	Annex 5 – M1 (m)
				Wells			HDPE	110	
	ST – 041	4,000	26,400	Main carrier	Rectangular 25*15.3*11.5	3	D.I.	800	Annex 5 – M1 (n)
				Wells			HDPE	280	
				Mekorot			D.I.	630	
Al Buraij	ST-001C	2,600	3,150	Main carrier	Rectangular 20*15*10.5	3	D.I.	150	Annex 5 – M1 (o)
				Wells			HDPE	180	
				Mekorot			HDPE	315	
Al Nusairat	ST-006B	1,000	3,150	Main carrier	Rectangular 20*15*10.5	3	D.I.	300	Annex 5 – M1 (p)
				Wells			HDPE	120	
				Mekorot			HDPE	315	
Al Musadar	ST-031	1,000	2,100	Main carrier	Rectangular 20*10*10.5	3	D.I.	150	Annex 5 – M1 (q)
				Wells			UPVC	110	
							HDPE	110	
Al Zawaida	ST-007	840	2,100	Main carrier	Rectangular 20*10*10.5	3	D.I.	300	Annex 5 – M1 (r)
				Wells			HDPE	200	
				Mekorot			HDPE	315	

Municipality	Reservoir Name/ID	Area (m^2)	Capacity (m^3)	Water Resources	Dimensions	Inlet Pipes			Annex for site layout
						Number	Material	Diameter (mm)	
Khanyounis	ST-009	1,600	8,400	Main carrier	Rectangular 20*20*10.5	2	D.I.	300	Annex 5 – M1 (s)
				Wells			HDPE	200	
	ST-011	2,880	8,400	Main carrier	Rectangular 20*20*10.5	2	D.I.	300	Annex 5 – M1 (t)
				Wells			HDPE	225	
	ST-017	1,200	2,100	Mekorot	Rectangular 20*10*10.5	1	HDPE	355	Annex 5 – M1 (u)
	ST-032B (Al Buraq)	2,910	5,000	Main carrier	Circular 30*7.1	3	D.I.	150	Annex 5 – M1 (v)
				Wells			HDPE	355	
				STLV			HDPE		
	ST-033B (Al Israa)	3,000	5,000	Main carrier	Circular 30*7.1	3	D.I.	300	Annex 5 – M1 (w)
				Wells			HDPE	355	
				STLV			UPVC		
Rafah	ST – 015B	1,800	6,300	Main carrier	Rectangular 20*15*10.5	1	D.I.	400	Annex 5 – M1 (x)
	TRC (ST-039B)	1,800	3,000	Main carrier	Circular 25*7	3	D.I.	150	Annex 5 – M1 (y)
				Wells			HDPE	110	
				STLV			UPVC		
	ST-015A (Al Salam)	1,500	6,300	Main carrier	Rectangular 20*15*10.5	2	D.I.	300	Annex 5 – M1 (z)
				Wells			HDPE	110	

3.2.5. Closure of wells with insufficient quality to operate the blending into the reservoirs

The suitability of each well to proceeding on the blending was evaluated considering the WHO limits for Chloride (≤250 mg/I) and Nitrate (≤50 mg/l). Closure of 136 wells was proposed based on the analysis of reasonable specific criteria dictated by an accurate wells data elaboration, taking into consideration several important factors, such as wells locations; discharge rate; daily pumping time; aquifer hydraulic characteristics; water levels and water quality variations with time.

Different dilution/blending percentages are proposed to be applied to get the required quality. Following are suggestions concerning the wells operation:

- 136 wells to be closed
- 29 wells with Cl content ≤ 500 mg/l and NO_3 content ≤ 100 mg/l, suitable for blending groundwater with desalinated water in 1:1 percentage
- 29 wells with Chloride content ≤ 750 mg/l and NO_3 ≤ 150 mg/l, suitable for blending groundwater with desalinated water in 1:2 dilution percentage
- 12 wells suitable for all use (raw blending)
- 79 wells, for temporary use, with Cl < 1000 mg/l (closure suggested)

3.2.6. Improvement of Mekorot Connections

Mekorot connections will be improved in the Middle, Khanyounis and Gaza governorates to increase the amount of water received from Mekorot to a total of 20 MCM/year. The improvement works include the following main components:

- Supply line from Bani Saed connection up to existing Al Maghazi junction (1.6 km)
- Supply line from Bani Suhila connection point to existing Bani Suhila new Reservoir (4.3 km).
- Supply line from Al Montar connection point in Gaza city to the proposed Reservoir (ST – 041) (3.2 km).
- Reconfiguration of downstream system for those municipalities in the Middle Governorate which receive water from Mekorot (Al Bureij, Al Maghazi, Al Zawaida and Al Nusairat).
- Reconfiguration of downstream system for those municipalities in Khanyounis Governorate which receive water from Mekorot (Bani Suhila, Abasan Al Jadeda, Abasan Al Kabera and Khuza'a).

Mekorot supply lines serving the Middle Governorate, Khanyounis, and Gaza are shown in Figure 3-4, Figure 3-5 and Figure 3-6, respectively.

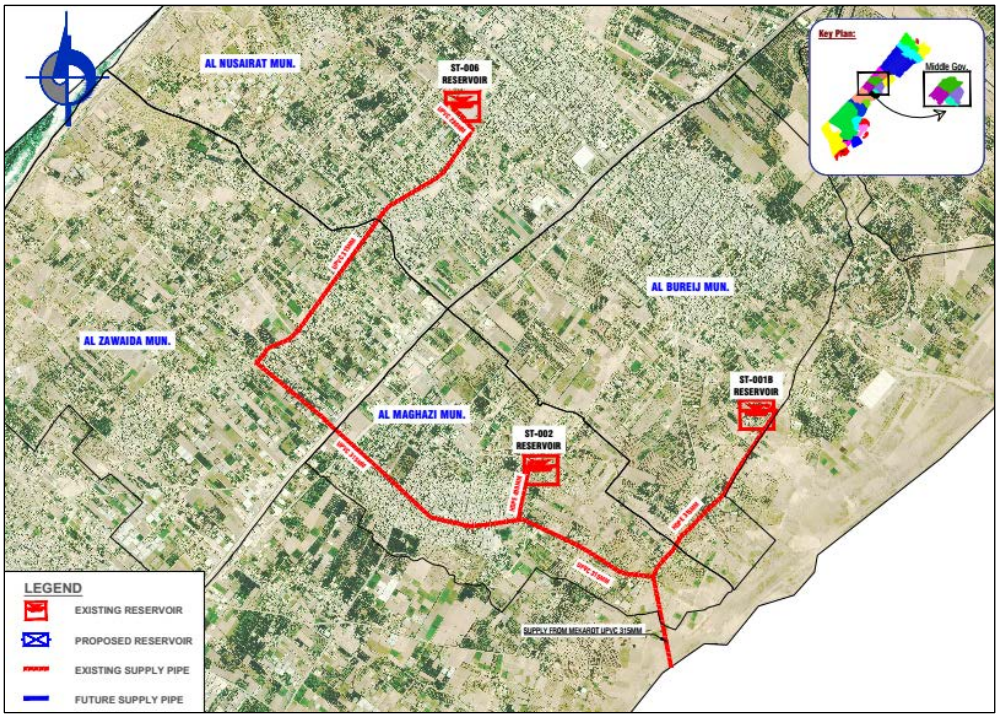


Figure 3-4: Mekorot Supply lines serving Middle Governorate (Lotti & Al, 2017)

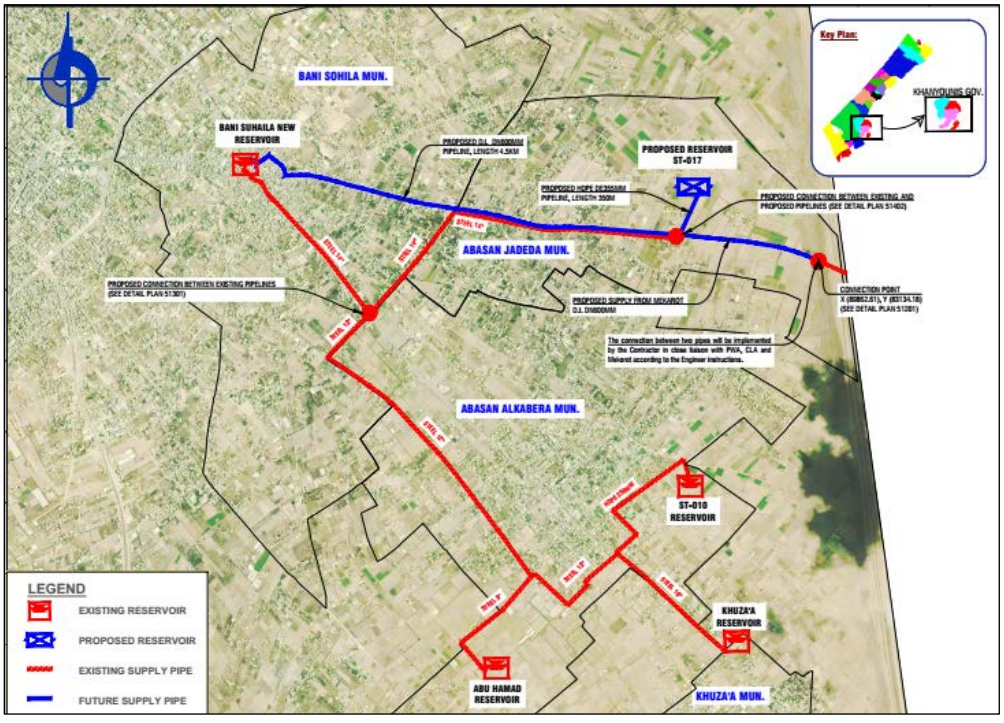


Figure 3-5: Mekorot Supply Lines Serving Khanyounis Governorate (Lotti & Al, 2017)

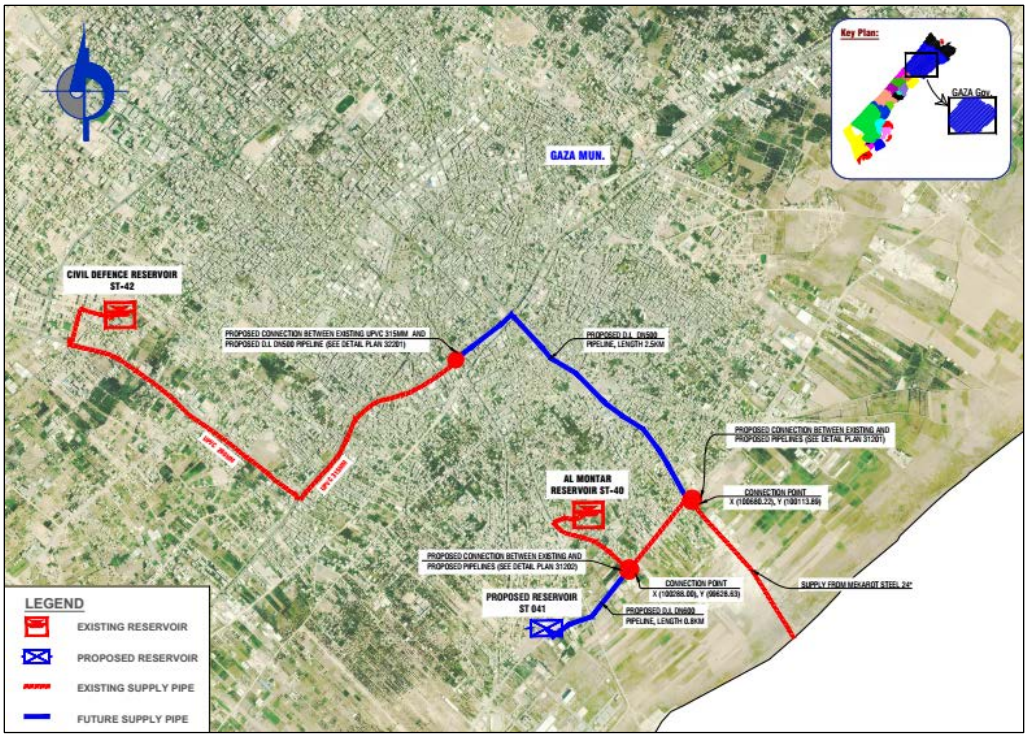


Figure 3-6: Mekorot Supply Lines Serving Gaza Governorate (Lotti & Al, 2017)

3.2.7. Downstream Distribution Networks

This component includes the construction of a new downstream distribution network with an overall length of 110 km and the replacement of old or undersized distribution pipelines with a total length of 10 km. Pipelines materials are HDPE and UPVC. As mentioned above, the detailed design of this component was still under progress during the preparation of this ESIA study.

3.2.8. SCADA System

A SCADA system is designed to provide PWA/CMWU a modern Information System of Supervision and remote control which allows obtaining the following objectives:

- Operational management of the network (via the remote control of valves and pumping stations);
- Safe installation (through the management of alarms and intrusion detection systems);
- Quality control of the distributed water (through sensors distributed at the source and at strategic points of the network);
- Management of emergency situations (through combined use of SCADA and network models for the preparation of emergency plans and their implementation).

The designed SCADA system will achieve these objectives through managing:

- The bulk water to be pumped from the main pumping station at the desalination plant up to the junction to the main carrier;
- The bulk water transmission at the service reservoirs through the main carrier and its components (transmission lines and booster/pumping stations);
- The water blending for each blending reservoirs;

- The secondary main of the water distribution network up to 4 inches within each area ensuring the control on districts and sub-districts as defined and designed by the project; and
- The service main of the water distribution network up to the end consumers

The whole system will be accessible by PWA/CMWU through a remote web based connection and will allow the consultation and acquisition of all historical and real time data related to the system functioning.

3.2.9. NRW Reduction

The main NRW components are technical losses/leaks 15%, illegal connections 10%, inaccurate customer meters reading 10% and authorized NRW (civil defence, public parks, emergencies, etc.) 5%.

The NRW strategic objectives will be achieved through number of physical investment and utilities reforms actions, including (but not limited to):

- The division of the water networks into pressure districts (District Measuring Areas)
- Leakage detection and repair programs (such programs can be implemented by the service providers or outsourced to specialized service providers)
- An improved metering system (bulk water metering, as well as customer metering)
- Illegal connection detection and removal
- Improving the services providers' efficiency and performance in technical, administrative and financial levels to enable to achieve the above mentioned activities

3.3. Project Location

The Gaza Strip is located in the south-west area of the Palestinian Territories. It is a narrow area of land bordering the eastern coast of the Mediterranean Sea. Gaza Strip is about 43 km long and between 6 to 13 km wide, and its total area is 365 square kilometers (km^2). The project components are distributed across the northern, middle and the southern areas of the Gaza Strip as follows:

- 19 reservoirs' locations in Beit Hanoun, Beit Lahia, Jabalia, Gaza, Al Bureij, Al Musadar, Al Zawaida, Khanyounis and Rafah.
- The main carrier line along the Gaza Strip
- Pipelines and connections in Khanyounis and the Middle Governorates
- Main pumping station in Al Qarara
- Five booster stations in Rafah, Deir Al Balah, Al Bureij, Wadi Gaza and Gaza city.

3.4. Served Population

The project is designed to serve the whole population of the Gaza Strip; 2.1 million inhabitants in 2020 and about 3 million inhabitants in 2035. Population projections by governorate are shown in Table 3-3 below.

Table 3-3: Population Projections by Governorate (Lotti & Al, 2016a)

Governorate	2015	2020	2025	2030	2035
North Gaza	362,772	436,229	511,736	585,467	662,675
Gaza	625,824	724,128	821,620	913,870	1,007,826

Middle Governorate	264,455	309,621	354,907	398,180	442,617
Khanyounis	341,393	394,039	446,130	495,318	545,329
Rafah	225,538	265,779	306,372	345,369	385,598
Total	1,819,982	2,129,796	2,440,765	2,738,234	3,044,045

3.5. Construction Phasing, Timeline and Estimated Cost

The project will be constructed upon six contract packages as follows:

1. Implementation of District Measuring Areas (DMAs)
2. Mekorot Improvement Works (Middle and Khanyounis Governorates): 5.9 km supply lines, four proposed reservoirs and 3 km of reconfiguration of the downstream water system.
3. Mekorot improvement works (Gaza governorate): 3.2 km of supply lines, one proposed reservoir, 2 km of main feeders from the proposed reservoir to the water distribution network
4. Southern main carrier system (Rafah and Khanyounis governorates): one main pumping station, one booster station, 66 km of supply lines and four proposed reservoirs and related feeders.
5. Northern main carrier system (Middle, Gaza and North governorates): connection between the GDCP and the main pumping station, four booster stations, 90 km of supply lines and two proposed reservoirs and related feeders.
6. Water distribution network reconfiguration-South: three proposed reservoirs, upgrading of 16 reservoirs, 40 km of pipes in downstream and 35 km of connection lines from wells to reservoirs.
7. Water distribution network reconfiguration-North: five proposed reservoirs, upgrading of 13 reservoirs, 65 km of pipes in downstream system and 70 km of connection lines from wells to reservoirs.

Estimated cost and timeline for each package are illustrated in Table 3-4 below. The construction of all packages, if funds are available, is expected to be ended by 2021.

Table 3-4: Estimated cost and Timeline for Construction Packages

Package	Budgetary Cost USD M$	Start of construction date	End of construction date
1	0.7	January 2018	May 2018
2	8.2	May 2018	April 2019
3	7.8	May 2018	April 2019
4	42.0	July 2018	December 2020
5	88.0	July 2018	June 2021
6	25.3	July 2018	June 2021
7	40.0	July 2018	June 2021
Total Cost	212		

4. Project Alternatives

This section presents the project alternatives including the 'no project' option, other general potential options to achieve the project objectives, and the particular alternative options that were considered in the design. In addition, the criteria used for selecting the best alternative will be briefly described including the potential environmental effects or impacts.

4.1. "No Project" Option

The 'no project' option would prevent opportunities to improve water supply in the Gaza Strip. The already deteriorated conditions of the available water supply system in the Gaza Strip will continue to decline. The 'no project' option would be to continue to provide water directly through groundwater wells without the step of blending suitable water from wells in storage tanks with additional supply from seawater desalination and increased Mekorot connections. This situation would leave communities with supplied water that is saline, high in nitrate and chloride concentrations, which do not meet the WHO drinking water guidelines nor the less stringent PWA interim water quality guidelines is some locations. This situation is predicted to worsen in the future. Moreover, a recent observations by PWA have indicated that the rate of sea water intrusion to the aquifer due to over abstraction of groundwater is increasing and the intrusion front has reached in some locations to 1,000m inland (PWA, 2016).

Without the intervention from the Associated Works to the Gaza Central Desalination Plant project the water supply situation will not be improved through efficient use of desalinated water and precious groundwater while ensuring technical as well as financial sustainability of its operation. The situation will be more harmful and the people's health will be put at risk. Infants and children are particularly susceptible to the immediate effect of microbiological contaminants and 'blue baby' syndrome associated with high levels of nitrates. Moreover, adults will become increasingly susceptible to gastrointestinal problems and cancers, and thyroid gland disorders.

An imminent collapse of the water supply system could occur if additional supplies are not provided through construction of short term low volume desalination plants and Gaza central desalination plant, the transmission lines and booster pumps that distribute the potable water supply for the Gaza Strip five governorates and communities. Gaza Sustainable Water Supply Program (GSWSP) will include such components of the rolling program of interventions, identified in the Comparative Study for Water Supply Options for Gaza, which provide a comprehensive approach to the provision of domestic water supply. The rolling program became a PWA strategy for additional supply of water to Gaza. The GSWSP project has greater emphasis on the Associated Works to the desalination plan. The proposed project components and the desalination facilities are expected to improve water quality dramatically to all Gaza Strip population by mixing and uniformly distributing the best available water resources. The 'no project' option would have significant negative long term impacts on groundwater resources and water supply, on public health and on related industries and economy such as agriculture.

4.2. Project Alternatives

Within the Gaza Sustainable Water Supply Program produced by PWA, it has been stated that there are no viable alternative options for developing alternative water sources in the Gaza Strip. The studied potential alternative options to develop additional water resources and the reasons for their elimination are mentioned hereafter:

- Surface water sources – eliminated due to lack of rainfall and surface water bodies, plus pollution risks to obtaining consistent and good quality water.
- Additional extraction from groundwater and brackish desalination – eliminated due to the already depleted aquifer status and imminent collapse of groundwater supply, inability to obtain water of sufficient quality and sustainability.
- Increased supply from Mekorot (over and above the 20 MCM additional supply included as part of this project) – eliminated due to political and cost reasons, and also that the original water sources from Mekorot would also be from non-conventional sources (e.g. water obtained from large scale desalination, or recovered wastewater), so large scale purchase would have similar or more significant environmental impacts in a different location.

Therefore, the water supply from desalination plants, blending tanks, transmission trunk lines, improved network connectivity and slight increase in the Mekorot supply, are considered in combination to be the most appropriate solutions for improving the existing water supply conditions. The key alternatives that have been considered for the proposed projects are related to the pipes routs and the sites of reservoirs as follows:

- Main carrier alignment
- Alternative Tanks and Pumps Site Locations

The following is a discussion of these alternatives.

4.2.1. Main Carrier alignment

The main carrier pipeline route has been divided in 4 different sections regarding the obstacles found along it:

(1) From Central Gaza Desalination Plant to the intersection of the main carrier (Al Matahen). This section seems reasonably free of obstacles and seems to offer good conditions for the execution of the work and that are no major difficulties in carrying out the work in proper way.
(2) From Al Qarara (Al Matahen) to Rafah City, in this section the alignment of the Main Carrier appears to be mostly clear and free from any physical obstacles. The pipeline crosses areas with different characteristics, passing from agricultural and peri-urban areas to highly crowded areas such as Khanyounis and Rafah cities;
(3) From Al Qarara (Al Matahen) to the south area of Gaza City; along this section the pipeline runs through several urbanized areas, not particularly crowded but presenting a considerable number of obstacles preventing the linear alignment of the pipeline. These obstacles will be widely described in the following paragraphs.
(4) From the south area of Gaza City to Beit Hanoun, in this section the main carrier route runs in what is essentially an urban area of fairly high density. Even though the original path of the railways is still recognizable, the route does not appear to be entirely clear of obstacles.

According to the design ToR, the main carrier has been envisaged to run along the route of the railroad existed in the past (Sikka route). The railroad infrastructure had been destroyed and out of use since 1967. The route areas are still governmental land and remains at today's date relatively free from other uses.

As mentioned in the previous section, during the site visits performed by the ESIA team and PWA, several obstacles were identified along the route alignment in the middle area. It was realized that a significant section of Sikka Road (9 km) has many obstacles that either totally or partially close the Sikka Road respectively preventing the carrier pipe installation. The obstacles are classified into five different groups as follows:

(1) hardly removed or demolished as the military areas,
(2) Could be removed or demolished creating significant social impacts as the residential buildings,
(3) Could be removed or demolished creating middle social impacts as the agricultural areas,
(4) Could be demolished and rebuilt creating minor social impact as the recreational areas,
(5) Could be easily by passed not creating technical and social impacts as the market areas.

The most critical obstacles, mainly included in the first two groups, are those in the middle area from the intersection of the Sikka road with Salaheldein road north of Al Bureij to Al Matahen intersection in Al Qarara. This segment stretches for a length of 9 km. Due to the difficulty in sticking to the rout of Sikka road in this segment another alternative was proposed to install the main carrier along Salaheldein service road for a total length 9 km. The rest of carrier segments will be installed as planned through Sikka route without any change. This alternative has been selected and the PIC consultant is preparing its detailed design documents.

The ***Social implications*** that are related to this rout (i.e. the 9 Km along Sika road) that it has been excluded and replaced by an alternative rout include the following:

- Demolishing a number of houses and evacuating many families that will lose shelter.
- Demolishing workshops and small factories leading to loss of livelihood for many families.
- Demolishing of two recreational parks used by families in the neighborhood.

These implications require a resettlement action plan (RAP) that will result in a huge budget and complicated legal procedures. It is also expected to be strongly rejected by the community and community leaders.

4.2.2. Alternative Reservoirs and Pumps Locations

The locations of proposed blending tanks and pumps were chosen based on the most vulnerable areas with regard to water supply conditions, as depicted by the Gaza Sustainable Water Supply Program. The reservoirs, which will be included in the proposed water supply system, have been categorized as follows:

According to the site visits carried out by The ESIA team, the land of the reservoirs and pumping stations, as illustrated later in chapter 5, are either governmental, Waqf, or municipality owned lands. The only private sites are Al Buraij reservoir (ST-001C) and Al Buraij booster pumping station sites (N-01). However, the land acquisition of these sites has been carried out by Al Buraij municipality where the agreements with the owners are almost done. PWA have arranged for securing sites early on for constructing the tanks and pumps to avoid long land acquisition procedures. The land parcels have either been purchased or rented for long term. The advanced land acquisition facilitated securing sites within locations that are near groundwater supply resources and which satisfying hydraulic criteria requirements.

Field visits were undertaken at an early stage of the project, which confirmed that the selected locations of reservoirs are suitable in terms of meeting both the hydraulic and ownership perspectives. They also fit well within the existing water network and the master plans of the water distribution system in the beneficiary areas. However, during the scooping session, the community representative of Sheikh Radwan

neighborhood asked for selecting another location for ST-045 Reservoir that is planned to be constructed in a traffic island in a crowded location. Thus, this issue was raised by the ESIA team to the designer and PWA to study the possibility of finding another location in the neighborhood that satisfies the hydraulic criteria requirements and land acquisition possibilities. Unfortunately no alternative was identified, and mitigation measures will be taken for the recent location instead. The mitigation measures are given in the ESMP.

Thus, the ***Social implications*** that are related to the locations of the reservoirs can be summarized in the following two points:

- Land acquisition of two privately owned sites that are used for agriculture activity by the owner.
- Objection of the community representative of Sheikh Radwan neighborhood to the construction of reservoir ST-045 in a Traffic island for aesthetic and safety reasons.

The land acquisition issue will be considered in the resettlement action plan (RAP) that is proposed later in this report.

5. Baseline Environmental and Social Data

This chapter presents and identifies relevant baseline data on the environmental and social characteristics of the Gaza Strip for all project components, and more site specific information where available. For the components of which the detailed design is not available, general baseline information is provided.

It provides baseline information on the locations and land use for each component, physical environment, biological resources, historical and cultural resources, and water supply in the project area. It also provides information on the socio-economic conditions for the targeted communities; these include information on population and demography, education, public health, workforce, economic activities, water pricing and infrastructure.

5.1. Location and Land use

As mentioned in Chapter 3, the project components are distributed across the northern, middle and the southern areas of the Gaza Strip.

Land use in the Gaza Strip is dominated by three main categories: built-up areas, agricultural land and bare sandy areas/dunes. Agricultural land has been classified into six categories based on the agricultural crops and type of cultivation: horticulture, mixed agriculture, citrus orchards, rain-fed agriculture, olive orchards and greenhouses. See Annex 5 – M2 for general land use map of all project components locations.

The matrix provided in Annex 4 (b-1) illustrates the detailed location land use baseline characteristics for each project component, including the site land use, encroachments nearby public facilities, and any other nearby features with focus on sensitive receptors. And the following sections will highlight the main issues based on this screening process.

5.1.1. Main carrier

As mentioned in section 3.2.1, the main carrier pipeline route has been divided in eleven different sections regarding the land use and the main characteristics of the surrounding environment:

- Section 1: from the CGDP and to the disconnecting chamber at Al Matahen area,
- Section 2: runs along about 1 km of the Sikka road in Al Qarara Municipality from the disconnecting chamber,
- Section 3: from the end of the second section to the intersection of Al Qarara Municipality with Salaheldein road,
- Section 4: starts from the intersection of Al Qarara Municipality and ends after running along about 3 km of the Sikka road in the southern direction,
- Section 5: runs along about 3 km of a paved segment of the Sikka road in Khanyounis and passes through the local market in Khnyounis, and
- Section 6: from the end of the fifth section to Rafah loop.
- Section 7: from the disconnecting chamber to the south area of Gaza city (along Salaheldein service road),
- Section 8: from south of Gaza city to the area known as the Cars Market in Gaza city,
- Section 9: from the cars market area to the south of the Shejaeya local market,

- Section 10: from the south of the Shejaeya market to the Al Sanafour intersection,
- Section 11: from the Al Sanafour intersection to Beit Hanoun in the northern governorate.

The carrier is proposed to run along the route of the railroad (Sikka road), which is a governmental land, except of the seventh section from Al Matahen area to the south area of Gaza city, where the carrier is proposed to run along the route of Salahaldein service road.

Some obstacles were found to be located along the route of the main carrier (See Annex 4). Of these obstacles, two public markets, schools, roads intersections and Wadi Gaza are the most critical ones (See Figure 5-1 for the schools in the project area).

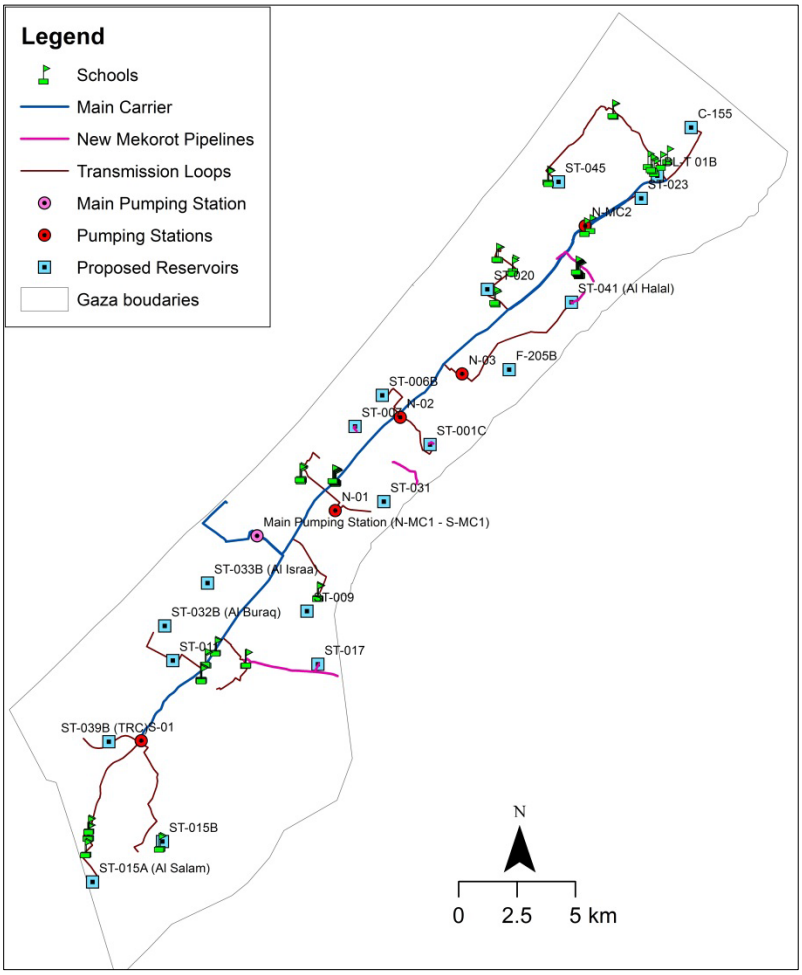


Figure 5-1: Schools in the Project Area

The first market is Khanyounis Market (See Figure 5-2), which is located in the fifth section of the carrier line. Along with the market, many schools are found to be located within this section, and Al Taleem Park is also along the proposed route of this section (See Figure 5-3). Other sections in the southern part are almost free of critical obstacles but they cross areas with different characteristics, passing from agricultural and periurban areas to highly crowded areas such as Khanyounis and Rafah cities.

Figure 5-2: Photos for Khanyounis Market (GVC/CEC, September, 2017)

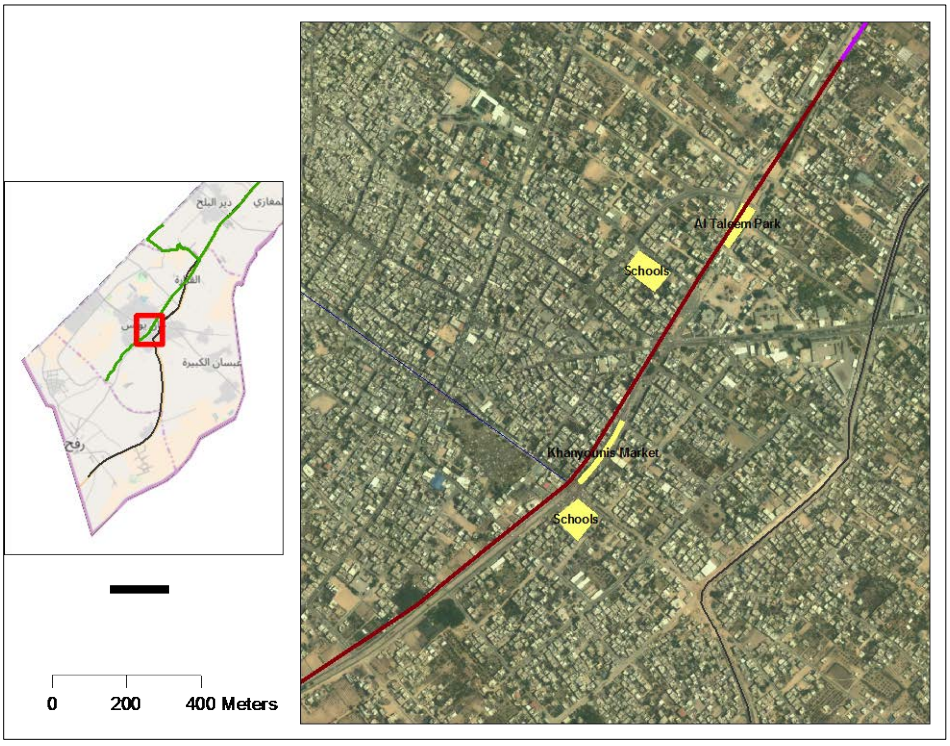


Figure 5-3: Main obstacles found along Section 5 of the Main Carrier in Khanyounis

The second market is Al Shejaeya Market (See Figure 5-4 and Figure 5-5) which is located in the tenth section of the carrier line. In general, the area through which this section passes is considered a highly dense urban area.

One more critical obstacle is found in the eighth section of the carrier line which is Wadi Gaza; as the section is proposed to pass through the Wadi (See Table 5-1).

Figure 5-4: Photos for Al Shejaeya Market (GVC/CEC, October, 2017)

Figure 5-5: Main obstacle along Section 10 of the Main Carrier in Gaza city (Shejaeya Market)

The first section of the carrier, from the desalination plant to the main pumping station, is free of obstacles and seems to offer good conditions for the execution of the work without any major difficulties. On the other hand, the seventh section is proposed to run along about 9 km of the newly constructed Salaheldein service road starting from Al Matahen area to the south area of Gaza city. Another critical issue regarding this section is the presence of a schools complex (7 schools) along its proposed route. Moreover, along Sikka road alignment the main carrier route intersects Salaheldeien road in many locations; intersection near Al Shejaeya Market, Al Sanafour intersection and Road #10 intersection in Gaza city, Al Qarara Municipality intersection, Al Matahen intersection, and Al Buraij Municipality intersection. It also intersects another main road in Rafah city (See Table 5-1). The pipe diameters along these intersections range between 700 mm and 1,600 mm.

5.1.2. Transmission Mains

Based on the location and land use characteristics, the transmission mains in each governorate were divided into different sections, as shown in Figure 5-6. In general, the land use of the proposed transmission mains is characterized as mixed residential/commercial/agricultural use. The proposed transmission pipelines will be constructed within the right-of-way of public roads.

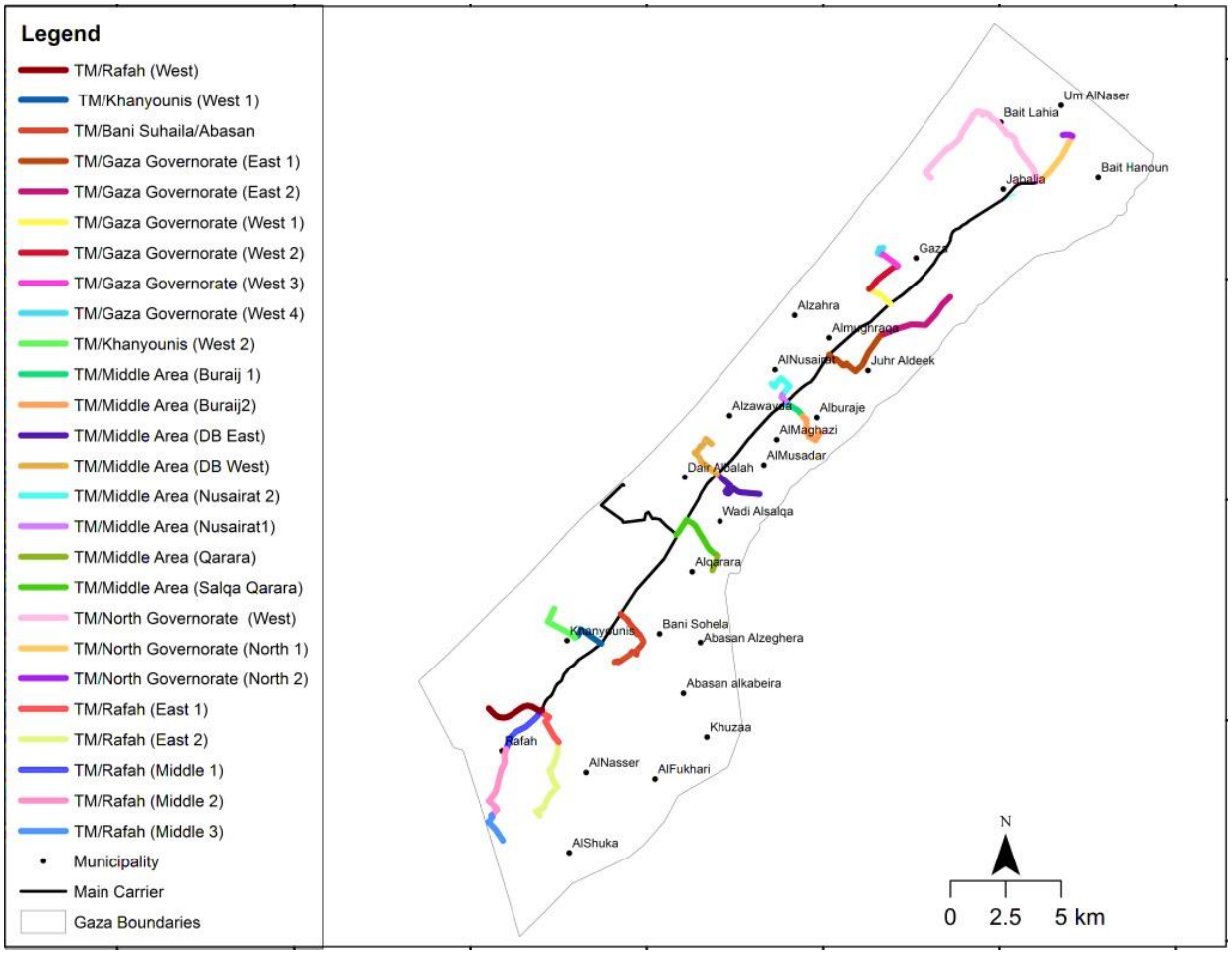


Figure 5-6: Sections of the Transmission Mains in different governorates

Schools and roads intersections are found to be the critical obstacles along the proposed routes of these sections. Along the alignment of the transmission main in Rafah governorate, the route passes through a densely populated residential area (8 m wide sandy roads) as shown in Figure 5-7, and a main road intersection (Al Najma intersection) (See Table 5-1). Six schools are located at different locations along the alignment of this section, in Othman bin Afan Street. The pipe diameter along this section is 600 mm.

Figure 5-7: Densely populated area along the alignment of a section of the transmission main in Rafah

The transmission main in the western part of the Northern Governorate is considered to be a critical section as it passes along the main road in Beit Lahia Municipality, the section passes by a school located along the alignment of this section in Tel Al Zaatar area in Jabalia and a school complex (4 schools) located along the alignment of this section in Beit Lahia (See Figure 5-8).

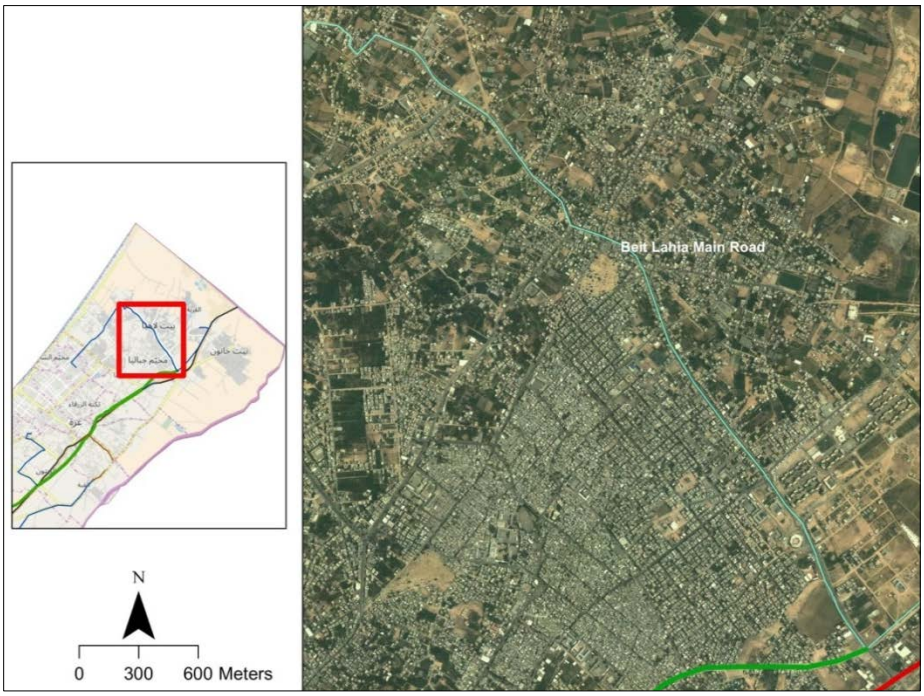


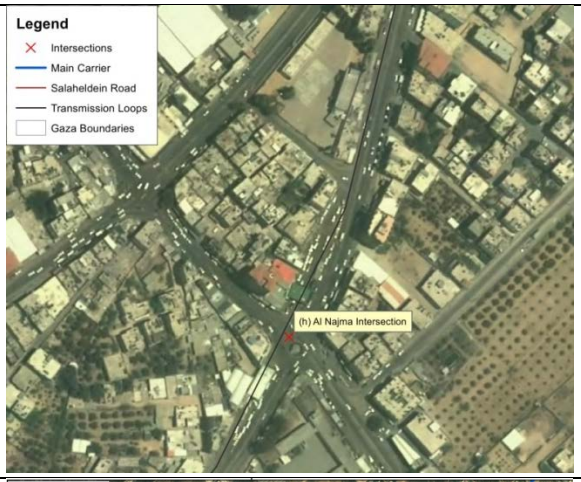
Figure 5-8: The Proposed Alignment of the Transmission Main in Beit Lahia Main Road

Two schools are located along the alignment of the first part of the western section of the Gaza Governorate transmission main, in Road #10. A slaughter house is located along the second part of the same section, and four more schools are located along the third and the fourth parts of it.

Table 5-1: Critical intersections of the main carrier and the transmission mains with roads and Wadis

Intersection	Image
The main carrier intersection with a main road near Al Shejaeya Market in Gaza city	
The main carrier with Al Sanafour intersection in Gaza city	
The main carrier with intersection Road #10 in Gaza city,	

The main carrier with Al Qarara Municipality intersection,	
The main carrier with the Al Matahen intersection,	
The main carrier with Al Buraij Municipality intersection.	

Intersection of the transmission main with main road in Rafah city	
The transmission main with Al Najma intersection in Rafah	
Intersection of the main carrier with Wadi Gaza	

In the Middle Area, a school is found to be located about 50 m to the north of the alignment of first section in Al Buraij Municipality, while a schools complex (6 Schools) is located 80-120 m to the south of the alignment of the western part of Deir Al Balah sections, this section also passes by two graveyards and through two roads intersections in Deir Al Balah. Many schools are also found to be located along the alignment of the transmission mains in Al Qarara, Bani Suhaila and Abasan Al Saghera Municipalities.

Transmission mains alignment in Khanyounis passes by two graveyards, main roads intersection to the south of Khanyounis market and three schools. More details about all sections can be found in Annex 4.

5.1.3. Main Pumping Station

The main pumping station is located in Al Qarara, about 1.3 km to the west of Salaheldein Road. The land of the site is a governmental land and has been allocated for the pumping station construction (see Annex 6 (a) for Official Land Acquisition Documentation). The access road to the site is paved and 12 m wide. Photos for the proposed location of the pumping station are shown in Figure 5-9. See Annex 5 – M3(a) for key map of the Main Pumping Station location.

The site area is 6,000 m^2, located on flat, agricultural land. The land is currently cultivated by a local farmer with seasonal crop. The site is surrounded by open agricultural lands and the nearest residential building is about 70 m to the east of the site.


Figure 5-9: Photos for the proposed location of the Main Pumping Station (GVC/CEC, October, 2017)

5.1.4. Booster Pumping Stations

Gaza Booster Station (N-MC 2)

The N-MC 2 pumping station is located in Gaza city, close to Al Sadaqa Park. The land of the site is originally owned by government who rents it to the Gaza Municipality and has been allocated for the booster station construction (see Annex 6 (b) for Official Land Acquisition Documentation).


Figure 5-10: Photos for the proposed location of the Gaza Booster Station (N-MC 2) (GVC, September, 2017)

The access road to the site is paved and 10 m wide. Photos for the proposed location of the pumping station are shown in Figure 5-10. See Annex 5 – M3(b) for key map of Gaza Booster Station location.

The site area is 800 m^2, located on flat, built-up land. The site is bordered by residential buildings, stormwater infiltration basins as part of the Al Sadaqa Park and a school.

Deir Al Balah Booster Station (N-01)

The N-01 pumping station is located to the east of Deir Al Balah, about 2 km from the eastern border of Gaza Strip. It is located 940 m from Salaheldein Road. The southern border of the site is adjacent to Wadi Al Salqa. See Annex 5 – M3(c) for key map of Deir Al Balah Booster Station location.

The land of the site is originally owned by the Deir Al Balah Municipality and has been allocated for the reservoir construction (see Annex 6 (c) for Official Land Acquisition Documentation). The access road to the site is sandy and 12 m wide. Wadi Al Salqa borders the site to the south, while a solid waste landfill is located 1.7 km to the east.

The site area is 500 m^2, located on flat, agricultural land. The land use around this site is dominated by agricultural land cultivated by seasonal crops. The site is surrounded by open lands of olive trees. The north border of the site is adjacent to a water reservoir currently under construction by B&V. A built-up area including a residential housing project and a school also border the proposed site on the north. The site is approximately 3-4 m to the north of the edge of Wadi Al Salqa.

Al Buraij Booster Station (N-02)

The N-02 pumping station is located in Al Buraij, about 160 m to the east of Salaheldein Road, with its north border adjacent to Al Nakheel recreational resort. See Annex 5 – M3(d) for key map of Al Buraij Booster Station location.

The site land is owned by the Al Buraij Municipality based on a land-swapping agreement with a local citizen (see Annex 6 (d) for Official Land Acquisition Documentation). The access road to the site is sandy and 16 m wide.

The site area is 900 m^2, located on flat, agricultural land. The land use around this site is dominated by mixed agricultural land. The north border of the site is adjacent to a recreational resort, while few residential buildings are located to the west of the site.

Wadi Gaza Booster Station (N-03)

The N-03 pumping station is located in Wadi Gaza Municipal, about 600 m to the east of Wadi Gaza and about 500 m to the south east of Salaheldein Road. See Annex 5 – M3(e) for key map of Wadi Gaza Booster Station location.

The site land is originally a Waqf land that has been rented by the Wadi Gaza Municipality and allocated for the construction of the booster station (see Annex 6 (e) for Official Land Acquisition Documentation).

The site area is 375 m^2, located on flat, mixed agricultural land. The land use around this site is dominated by mixed agricultural land. The nearest residential building is about 100 m away from the proposed site.

Rafah Booster Station (S-01)

The S-01 pumping station is located in Rafah at the end of the second section of the main carrier along the Sikka Road, 3.5 km to the west of Salaheldein Road. See Annex 5 – M3(f) for key map of Rafah Booster Station location.

The land of the site is governmental and has been allocated for the construction of the booster station (see Annex 6 (f) for Official Land Acquisition Documentation). The access road to the site is sandy and 8 m wide. Photos for the proposed location of the booster station are shown in Figure 5-11.

Figure 5-11: Photos for the proposed location of Rafah Booster Station (GVC/CEC, October, 2017)

The site area is 1,800 m^2, located on flat, agricultural land. During the site visit, the land was cultivated with tomato as a local farmer is allowed to cultivate the land with seasonal crops until the activities of the station construction are started. The area where the site is located is mainly an agricultural area (open areas and greenhouses) with some residential buildings found to the south of the site.

5.1.5. Reservoirs

For each of the 19 sites allocated for the 20 proposed reservoirs, location, land ownership and land use are illustrated in Table 5-2. Sites with special concerns will be discussed in more details. Features and facilities in each site are also described in the land use column. In general, lands allocated for these reservoirs are either governmental or owned by municipalities. All official land acquisition documents are provided in separate annex as indicated for each site. The land allocated for F-205B reservoir is the only Waqf land and it has been rented by the Wadi Gaza Municipal. The lands allocated for ST-001C reservoir and ST-031 reservoir are originally private lands that are currently owned by the Al Buraij Municipal, based on land-swapping agreements with their owners.

Table 5-2: Location, Land Ownership and Land Use for the Proposed Reservoirs Sites

Reservoir	Location	Land ownership	Land Use
C-155	• The site is located in Beit Hanoun, adjacent to an existing reservoir • About 600 m to the east of Beit Lahia WWTP • About 550 m west of Salaheldein Road • About 850 m to the NW of Wadi Beit Hanoun • Access road is paved and 6 m wide. See Annex 5 – M3(g) for key map of C-155 Reservoir Location.	Governmental land allocated for the construction of C-155 Reservoir. See Annex 6 (g) for Official Land Acquisition Documentation.	• The site area is 2,500 m^2. The dominant land use of the site is sand dunes • Al Nada residential complex is about 120 m to the south of the reservoir site.
ST-023	• The site is located in Jabalia, about 170 m to the south of Salaheldein Road. • Access road is sandy and 6 m wide. See Annex 5 – M3(h) for key map of ST-023 Reservoir Location.	Municipal land allocated for the construction of ST-023 Reservoir. See Annex 6 (h) for Official Land Acquisition Documentation.	• The site area is 2,400 m^2. The dominant land use of the site is sand dunes • The site is surrounded by residential buildings and mixed agricultural lands. See Figure 5-12.
BL-T 01B	• The site is located in Jabalia, close to an old elevated tank • About 230 m south of the transmission main • About 340 m to the west of the main carrier along the Sikka Road • Access road is paved and 6 m wide. See Annex 5 – M3(i) for key map of BL-T01 B Reservoir Location.	Municipal land allocated for the construction of BL-T 01 B Reservoir. See Annex 6 (i) for Official Land Acquisition Documentation.	• The site area is 1,600 m^2, characterized as a built up area • A kindergarten and a mosque are adjacent to the south western border of the site • Many residential buildings surround the site. See Figure 5-13.

ST – 045	• The site is located in a triangular traffic island north of Gaza city. See Annex 5 – M3(j) for key map of ST-045 Reservoir Location.	Governmental land allocated for the construction of ST-045 Reservoir. See Annex 6 (j) for Official Land Acquisition Documentation.	• The site area is 1,790 m^2.The site land use is a built up with high traffic density • The site is surrounded by residential buildings from all sides • An existing water well building is located in the north western part of the site. • Some ornamental trees are found in the site which is used as a recreational area for local residents. See Figure 5-14.
ST – 020	• The site is located in the west of Gaza city close to the slaughter house, about 200 m away in the north east direction from Road #10 • About 570 m to the east of the Sheikh Ejleen WWTP. • Access road is sandy and is 6 m wide. See Annex 5 – M3(k) for key map of ST-020 Reservoir Location.	Governmental land allocated for the construction of ST-020 Reservoir. See Annex 6 (k) for Official Land Acquisition Documentation	• The site area is 1,800 m^2, located on flat, agricultural land. During the site visit, the site was cultivated with grapes. • The land use around this site is dominated by agricultural lands. • A new residential building is currently under construction close to the NW border of the site • A slaughter house is adjacent to the eastern border of the site. See Figure 5-15.
F-205 B	• The site is located in Johr El Deik area in Gaza city, about 1 km from the eastern border and about 1.7 km to the east of Salaheldien Road • Access road is paved and is 6 m wide. See Annex 5 – M3(l) for key map of F-205 B Reservoir Location.	Waqf land. Rented by the municipality and allocated for the construction of F-205 B Reservoir. See Annex 6 (l) for Official Land Acquisition Documentation	• The site area is 300 m^2, located in a built up area. • An existing reservoir is adjacent to the north east border of the site • A residential building is close to the north west border of the site • Mixed agricultural lands are found to the south east of the site
ST – 041	• The site is located in Al Shejaeya area in Gaza city, about 1 km from the eastern border • Access road is paved and is 10 m wide. See Annex 5 –	Governmental land allocated for the construction of ST-041 Reservoir. See Annex 6 (m) for Official Land Acquisition Documentation.	• The site area is 4,000 m^2, located in an empty sandy land. The area has previously been used as a public market for livestock trading. • The site is surrounded by agricultural lands and residential buildings

	M3(m) for key map of ST - 041 Reservoir Location.		
ST-001C	• The site is located in Al Buraij camp, about 2.3 km from the eastern border • Access road is sandy and is 6 m wide. See Annex 5 – M3(n) for key map of ST-001 C Reservoir Location.	The site land is owned by the Al Buraij Municipality based on a land-swapping agreement with a local citizen (see Annex 6 (n) for Official Land Acquisition Documentation).	• The site area is 2,600 m^2, located in flat agricultural land. • The site is surrounded by open agricultural lands cultivated with olive and citrus trees • Residential buildings borders the site from the north east
ST-006B	• The site is located in Al Nusairat Municipality, about 75 m to the south west of the Vegetables Market. • Access road is sandy and is 10 m. See Annex 5 – M3(o) for key map of ST-006B Reservoir Location.	Municipal land allocated for the construction of ST-006B Reservoir. See Annex 6 (o) for Official Land Acquisition Documentation.	• The site area is 1,000 m^2, located in agricultural land, • The site is surrounded by citrus and olive orchards, • Al Nusairat Vegetables Market and a reservoir under construction are located about 100 m to the north east of the site. • A private small desalination unit is adjacent to the north eastern border of the site
ST-031	• The site is located in Al Musadar Municipality, about 700 m from the eastern border of the Gaza Strip. • Access road is sandy and is 8 m wide. See Annex 5 – M3(p) for key map of ST-031 Reservoir Location.	The site land is owned by the Al Musadar Municipality (see Annex 6 (p) for Official Land Acquisition Documentation).	• The site area is 1,000 m^2, located in flat agricultural land, • Residential buildings are located at 50 m and 70 m distances from the site.
ST-007	• The site is located in Al Zawaida Municipality, about 840 m to the west of Salaheldein Road. • Access road is sandy and is 6 m wide. See Annex 5 – M3(q) for key map of ST-007 Reservoir Location	Municipal land allocated for the construction of ST-007 Reservoir. See Annex 6 (q) for Official Land Acquisition Documentation	• The site area is 840 m^2, located in agricultural land and surrounded by mixed agricultural lands • A residential building is located about 20 m to the north eastern border of the site.

ST-009	• The site is located in Al Qarara Municipality, about 1.1 km from the eastern border of the Gaza Strip. • Access road is paved and is 6m wide. See Annex 5 – M3(r) for key map of ST-009 Reservoir Location.	Governmental land allocated for the construction of ST-009 Reservoir. See Annex 6 (r) for Official Land Acquisition Documentation.	• The site area is 1,600 m^2, located in a flat agricultural land. • The site is surrounded by open agricultural lands • Two residential buildings are located about 20 m and 40 m to the North West and to the north east of the site, respectively.
ST-011	• The site is located in Khanyounis, about 1 km to the west of the Sikka Road (the main carrier route). • Access road is paved and is 10 m wide. See Annex 5 – M3(s) for key map of ST-011 Reservoir Location.	Governmental land allocated for the construction of ST-011 Reservoir. See Annex 6 (s) for Official Land Acquisition Documentation	• The site area is 2,880 m^2, located in a flat empty sandy land. • Khanyounis cemetery is only 10 m to the south of the site. • A mosque is located about 60 m to the east of the site • Residential buildings are found to the north and the north west of the site.
ST-017	• The site is located in Abasan Aljadeeda Municipality, about 900 m from the eastern border of the Gaza Strip • Access road is sandy and is 6 m wide. See Annex 5 – M3(t) for key map of ST-017 Reservoir Location.	Municipal land allocated for the construction of ST-017 Reservoir. See Annex 6 (t) for Official Land Acquisition Documentation	• The site area is 1,200 m^2, located in a flat agricultural land. • The site is surrounded by agricultural lands from all sides. • The nearest residential building is about 110 m away.
ST-032B (Al Buraq)	• The site is located in Khanyounis, to the west of Al Amal neighborhood. • About 1.5 km to the south of Khanyounis WWTP. • Access road is sandy. See Annex 5 – M3(u) for key map of ST-032B Reservoir Location	Governmental land allocated for the construction of ST-032 B (Al Buraq) Reservoir. See Annex 6 (u) for Official Land Acquisition Documentation	• The site area is 2,910 m^2, located in a sand dunes flat land • The surrounding lands are sand dunes, followed be residential buildings at distances between 80 m and 200 m away from the site
ST-033B (Al Israa)	• The site is located in Khanyounis, about 1 km to	Governmental land allocated for the construction of ST-033 B Reservoir.	• The site area is 3,000 m^2 located in a sand dunes flat land

	the north west of Hamad City residential compound • Access road is paved and is 8 m wide. See Annex 5 – M3(v) for key map of ST-033B Reservoir Location	See Annex 6 (v) for Official Land Acquisition Documentation	• Greenhouses are found about 260 m to the south of the site • A residential complex is about 300 m to the south east of the site • Recreational resort is located about 400 m to the west of the site
ST – 015B	• The site is located in Rafah, about 750 m to the north of Salaheldein Road • Access road is sandy, 8 m wide and passes by two primary schools. See Annex 5 – M3(w) for key map of ST-015B Reservoir Location	Governmental land allocated for the construction of ST-015 B Reservoir. See Annex 6 (w) for Official Land Acquisition Documentation	• The site area is 1,800 m^2, located in flat sandy land. • The site's western border is adjacent to a primary school. See Figure 5-16. • Surrounding areas to the south, east and north are mainly agricultural lands (open and greenhouses) with some scattered residential buildings; the nearest building is more than m away from the site.
TRC (ST-039B)	• The site is located in Rafah, 100 m to the north west of Muraj road • Access road is paved and is 8 m wide. See Annex 5 – M3(x) for key map of ST-039 B Reservoir Location	Governmental land allocated for the construction of ST-039 B (TRC) Reservoir. See Annex 6 (x) for Official Land Acquisition Documentation	• The site area is 1,800 m^2 and is mainly sand dunes • Adjacent to an existing water reservoir • Areas to the north and west of the site are either sand dunes or agricultural lands, while areas to the north and east of the reservoir are agricultural and residential areas. No residential buildings exist at distance less than 150 m.
ST-015A (Al Salam)	• The site is located in Rafah, about 200 m away from the southern border of the Gaza Strip • About 780 m to the west of Salaheldein Road • Access road is sandy and 8 m wide. See Annex 5 – M3(y) for key map of ST-015A Reservoir Location	Municipal land allocated for the construction of ST-015A Reservoir. See Annex 6 (y) for Official Land Acquisition Documentation	• The site area is 1,500 m^2, located in flat agricultural land • The surrounding areas are mixed agricultural residential lands. Residential buildings are found 40 m from the south eastern border of the site

Figure 5-12: Photos for the proposed location of the BL-T01 B Reservoir in Jabalia (GVC/CEC, September, 2017)

Figure 5-13: Photos for the proposed location of the ST-023 Reservoir in Jabalia (GVC/CEC, September, 2017)

Figure 5-14: Photos for the proposed location of the ST-045 Reservoir in Gaza (GVC/CEC, Oct, 2017)

Figure 5-15: Photos for the proposed location of the ST-020 Reservoir in Gaza (GVC/CEC, Sep, 2017)

Figure 5-16: Photos for the proposed location of the ST-015 B Reservoir in Rafah (GVC/CEC, October, 2017)

5.1.6. Mekorot Improvements

The land use of the proposed improved water networks areas in Gaza, Khanyounis and the Middle Governorate is characterized as mixed residential/commercial use with some agricultural areas (See Annex 4). The proposed water pipelines will be constructed within the right-of-way of public main roads.

The most critical Mekorot supply line is the one located in the Gaza Governorate, shown in Figure 5-17 below, as it is proposed to be aligned along a densely populated area; a schools complex (8 schools) is located along the alignment of the pipeline in Baghdad Street, two graveyards are located along both sides of the proposed alignment of the pipeline in Baghdad Street, and the line passes along Salaheldein main road adjacent to the western part of the Shejaeya Market and a public taxi station.

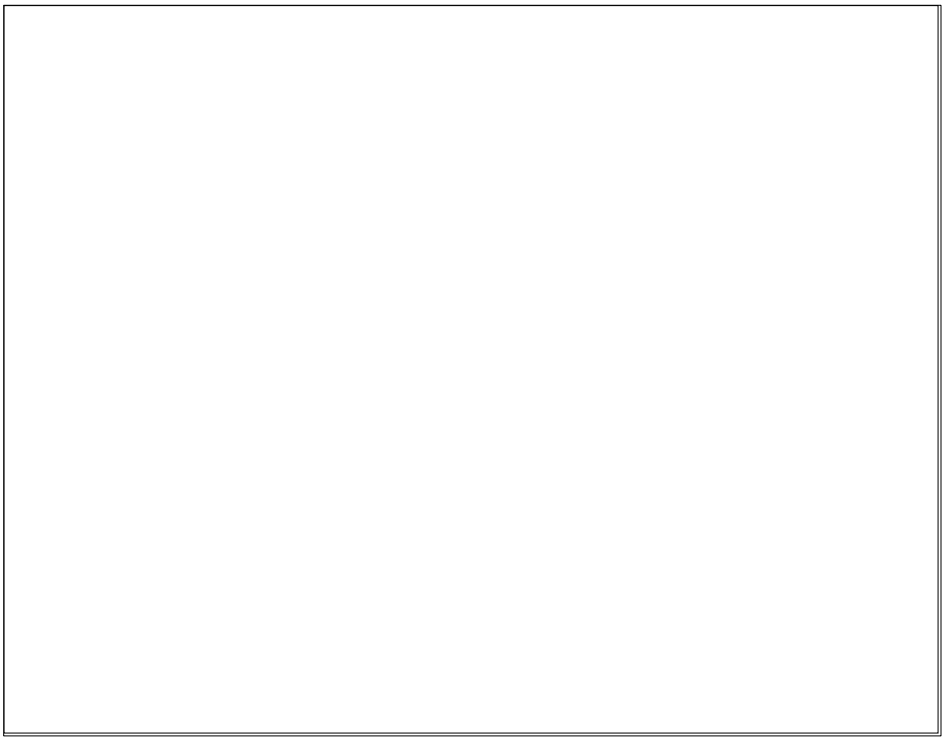


Figure 5-17: Critical obstacles along the proposed Mekorot supply line in Gaza Governorate

5.1.7. Downstream Distribution Networks

The exact locations of the distribution networks to be replaced or constructed have not been finalized yet for all governorates; however, all pipelines are proposed to be constructed within the right-of-way of public main roads. The land use of the proposed distribution networks areas in different governorates is mainly of residential type.

5.2. Physical Environment

5.2.1. Climate

The climate of the Gaza Strip, as a coastal zone region that lies along the Easter Mediterranean Sea; is influenced by the typical climate of the Mediterranean region, with short, mild winters with rainy periods and a hot, dry summer. The Gaza Strip forms a transitional zone between the semi-humid coastal area in the north, and the semi-arid Sinai desert to the south. The project component areas are located within the two climatic categories as they are distributed along the Gaza Strip.

In general, there are two well defined seasons; the wet season starting in October extending into April, and the dry season from May to September.

Temperature

The average ten-year daily mean temperature in the Gaza Strip ranges from 26.5 ˚C in summer to 13.8 ˚C in winter. Average daily maximum temperature ranges from 31.9 ˚C to 19.7 ˚C in the summer and winter, respectively, while minimum temperature ranges from 21.2 ˚C to 7.6 ˚C (EMCC, 2014).

Climate change predictions suggest potential air temperature increase of ~3.5-5 ˚C by 2100, compared with 1961-1990 base periods; with stronger warming in summer than winter. The likelihood of heat waves will also increase and sea temperatures could increase (USAID, 2013 and UNDP, 2010).

Wind

Winds are predominantly onshore from the Mediterranean; from the west and northwest over the eastern part of the Mediterranean, as result of atmospheric pressure conditions in summer, where there is typically a low pressure region north-east of Cyprus and increasing pressure to the west. Land and sea breezes occur, and in late spring the Sirocco hot dry (khamsin) wind blows from the desert in the south. As a result of more local temperature differentials between land and sea, winds often change from land to sea (easterly) during early morning and late night hours.

The average maximum ten-year wind speed in summer is 3.9 m/s from the prevailing northwesterly direction. In winter, the average wind speed is 4.2 m/s and the prevailing direction is southwesterly. Storms have occasionally occurred in winter with maximum hourly wind speeds of up to 18 m/s (UNDP, 2010).

Humidity

The proximity of the Gaza Strip to the sea increases humidity. The daily relative humidity fluctuates between 65% in the daytime and 85% at night in summer, and between 60% and 80% respectively in winter (UNDP/PAPP, 2009). The annual average relative humidity is about 72% (MoA, 2017).

Precipitation

Over the Gaza Strip, rainfall mainly occurs in the winter months, with peak months for rainfall being December and January. Snow is uncommon. The historical average annual precipitation is 360 mm/y, decreasing notably from north to south. Rain tends to fall in intense storms. Figure 5-18 shows average rainfall for the hydrological years 2012-2013, 2013-2014, 2015-2016 and 2016-2017 as measured at the 12 meteorological stations distributed over the Gaza Strip (MoA, 2017). See Annex 5 – M4 for Rainfall Intensity Distribution along the Gaza Strip.

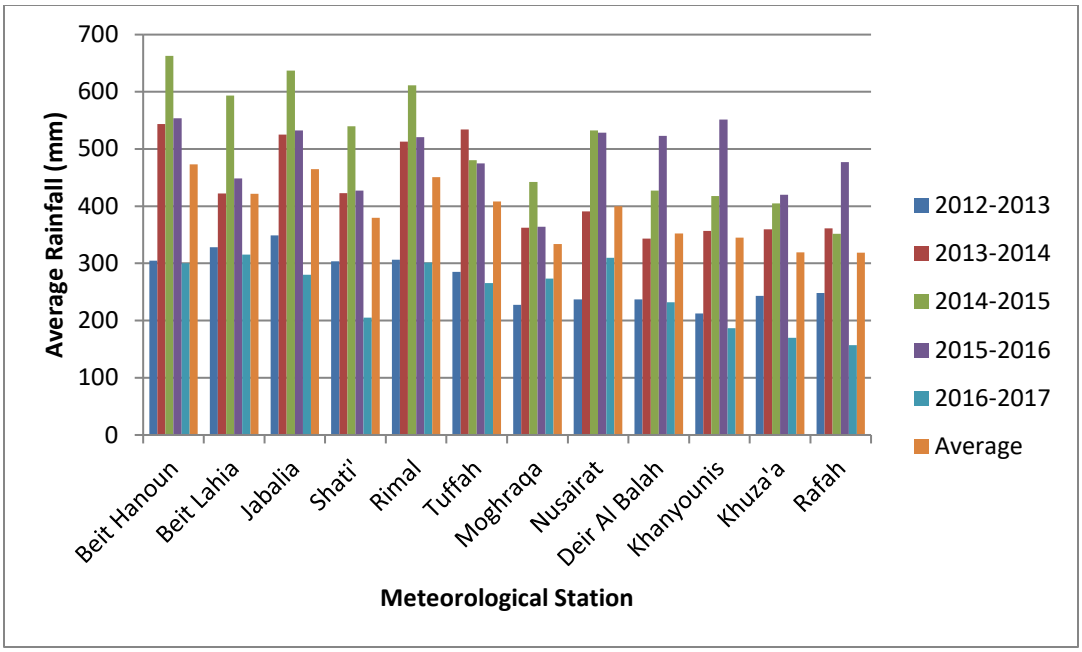


Figure 5-18: Spatial Distribution of Annual Rainfall for Five Seasons, (MoA, 2017)

More frequent and/or intense rainfall events are expected to occur with climate change. However the general pattern is expected to be reduced average annual precipitation, greater seasonal variation and a likely increase in dry periods (USAID, 2013).

Evaporation

In winter, evaporation rates in the Gaza Strip varied from 2 to 3 m/day over a seven year record period. While during summer, a maximum rate of over 6.7 mm/day was reached between June and August. The average annual evaporation rate in the Gaza Strip is around 1900 mm/y (5.2 mm/day) (ARIJ, 2006).
Table 5-3 shows monthly evaporation data for the year 2010. The maximum evaporation rate was reached during the summer months (193 mm in July) while minimum evaporation occurred during the winter months (68 mm in January); the average monthly evaporation rate was 131.8 mm.

Table 5-3: Monthly Evaporation rates in the Gaza Strip (EMCC, 2014)

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Average
Evaporation (mm)	68	76	115	142	162	190	193	183	165	132	87	69	131.8

5.2.2. Geology and Soils

Geology

The geology of the Gaza Strip is composed primarily of calcareous sandstone from the Pliocene Pleistocene age, unconsolidated sands, and layers of clay. Areas of chalk from the Eocene period, and Kurkar limestone and the Saqiye Group from the Miocene-Pliocene period are found about 15-20 km inland. This formation consists of shallow marine clays, shales and marls, reaching a depth of about 120 m, from the ground surface, at the shoreline and fanning out at the eastern boundary of the strip.

Twenty East-West geological cross sections for the Gaza Strip were updated by Al Dasht et al., (2012) and Al-Tayeb (2015), See Annex 5 – M5 for the key map of the Geological Sections along the Gaza Strip.

The general geological formations for the proposed reservoirs and pumping stations sites are almost the same. A superficial layer of sand, clay or clayey sand is found underlain by a Kurkar layer (calcareous sandstone), which overlies a sandstone layer. Discrete clay lenses, with different depths and thicknesses, intersect these layers especially in the western part of the aquifer. See Annex 6 for the representing geological cross sections for each site.

The design of the proposed project structures has been based on a thorough and detailed geotechnical investigation, including the analysis of samples from several boreholes within each of the proposed sites. Further site specific geological information can be found in the detailed Geotechnical Investigation Report.

Soils

Soil in the Gaza Strip is composed mainly of three types; sands, clay and loess. Sandy soil is found along the coastline, extending along the entire length of the Strip, and frequently forms sand dunes. The thickness of sand fluctuates from 2 m to about 50 m due to the hilly shape of the dunes.

Different soil types are found in the proposed locations of the project components; sandy regosols is the dominant soil type in the locations in the western part of the Strip. Loess soil, sandy loess soil, loessal sandy soil and dark brown soil are found in other locations; see Annex 5 – M6 for the key map of Soil Types in the Project Area.

5.2.3. Topography

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 NNE-SSW direction, parallel to the coastline.

Proposed sites for all pumping stations and reservoirs are characterized by flat areas with different elevations above mean sea level as illustrated in the following paragraphs and Table 5-4.

Main Pumping Station

The topography of the proposed main pumping station site is characterized by a flat area with an elevation of 24 m amsl, with a gradual slope from east to west direction. See Annex 5 – M11(a) for topography map of main pumping station site.

Gaza Booster Station (N-MC 2)

The topography of the proposed booster station in Gaza city site is characterized by a flat area with an elevation of 27 m amsl, with a smooth slope from east to west direction. See Annex 5 – M11(b) for topography map of main pumping station site.

Deir Al Balah Booster Station (N-01)

The topography of the proposed booster station site in Deir Al Balah is characterized by a flat area with an elevation of 30 m amsl, with a gradual slope from east to west direction. See Annex 5 – M11(c) for topography map of Deir Al Balah booster station site.

Al Buraij Booster Station (N-02)

The topography of the proposed booster station site in Al Buraij is characterized by a flat area with an elevation of 20 m amsl. See Annex 5 – M11(d) for topography map of Al Buraij booster station site.

Wadi Gaza Booster Station (N-03)

The topography of the proposed booster station site in Wadi Gaza Municipal is characterized by a flat area with an elevation of 18 m amsl. See Annex 5 – M11(e) for topography map of Wadi Gaza booster station site.

Rafah Booster Station (S-01)

The topography of the proposed booster station site in Rafah is characterized by a flat area with an elevation of about 61.5 m amsl. See Annex 5 – M11(f) for topography map of Rafah booster station site.

Reservoirs

Topography for each of the 19 sites allocated for the 21 proposed reservoirs is illustrated in Table 5-4. As mentioned above, all sites share the same general topographical characteristics with different elevations above mean sea level.

Table 5-4: Topography for the Proposed Reservoirs Sites

Reservoir	Topography
C-155	flat area with an elevation of 61 m amsl, with a gradual slope from east to west direction (See Annex 5 – M11(g))
ST-023	The area has a smooth slope from 63 m amsl to 60 m amsl from north east to south west (See Annex 5 – M11(h))
BL-T 01B	flat area with an elevation of 68 m amsl, with a gradual slope from east to west direction (See Annex 5 – M11(i))
ST – 045	The area has a gradual slope from 50.5 m amsl to 48 m amsl. See Annex 5 – M11(j) for topography map of ST – 045 Reservoir site.
ST – 020	Flat area with an elevation of 45 m amsl. See Annex 5 – M11(k) for topography map of ST – 020 Reservoir site.
F-205 B	Flat area with an elevation of 61 m amsl. See Annex 5 – M11(l) for topography map of F-205 B Reservoir site.
ST – 041	Flat area with an elevation of 64 m amsl. See Annex 5 – M11(m) for topography map of ST - 041 Reservoir site.
ST-001C	The area has a gradual slope from 53 m amsl to 50 m amsl, from south to north. See Annex 5 – M11(n) for topography map of ST – 001C Reservoir site.
ST-006B	Flat area with an elevation of 22 m amsl. See Annex 5 – M11(o) for topography map of ST – 006B Reservoir site.
ST-031	Flat area with an elevation of 55 m amsl. See Annex 5 – M11(p) for topography map of ST - 031 Reservoir site.
ST-007	Flat area with an elevation of 22 m amsl. See Annex 5 – M11(q) for topography map of ST - 007 Reservoir site.
ST-009	Flat area with an elevation of 83 m amsl. See Annex 5 – M11(r) for topography map of ST - 009 Reservoir site.

Reservoir	Topography
ST-011	Flat area with an elevation of 50 m amsl. See Annex 5 – M11(s) for topography map of ST - 011 Reservoir site.
ST-017	Flat area with an elevation of 95 m amsl. See Annex 5 – M11(t) for topography map of ST - 017 Reservoir site.
ST-032B (Al Buraq)	The area has a gradual slope from 49 m amsl to 47 m amsl, from south to north. See Annex 5 – M11(u) for topography map of ST – 032B Reservoir site.
ST-033B (Al Israa)	Flat area with an elevation of 26 m amsl. See Annex 5 – M11(v) for topography map of ST – 033B Reservoir site.
ST – 015B	Flat area with an elevation of 65 m amsl. See Annex 5 – M11(w) for topography map of ST – 015B Reservoir site.
TRC (ST-039B)	Flat area with an elevation of 55.5 m amsl. See Annex 5 – M11(x) for topography map of ST – 039B Reservoir site.
ST-015A (Al Salam)	Flat area with an elevation of 67 m amsl. See Annex 5 – M11(y) for topography map of ST – 015A Reservoir site.

5.2.4. Ambient Air Quality

Ambient air quality monitoring data for the whole Gaza Strip are very scarce. Recent short term monitoring campaigns were carried out to assess the air quality in specific locations; one of these campaigns was carried out in 2016 in the GCDP area to assess the background air quality before the operation of the plant. Other five monitoring campaigns were carried out in 2012 to assess the air quality in the area of the existing Gaza Power Plant. While the only integrated study that covers the different governorates in the Gaza Strip was carried out in 2005. Owing to the fact that the Gaza strip is characterized by its small area, such campaigns and studies could be used as indictor of air quality.

The GCDP campaign was performed on 24-25 April and 21-22 May 2016 at five locations, at or near to the boundaries of the proposed GCDP site. Hourly readings of the pollutants PM_{10}, $PM_{2.5}$, CO, NO_2 and SO_2 were taken over a 24-hour period. In general, values for NO_2, SO_2 and CO were significantly below the limits set by the applicable national and international (European Union) standards. In the contrary, considerably high levels of PM_{10} and $PM_{2.5}$ were recorded at all locations; the average PM_{10} concentration ranged from 46.7 $\mu g/m^3$ to 847.5 $\mu g/m^3$, and the average $PM_{2.5}$ concentration ranged from 8.1 to 147.8 $\mu g/m^3$ (Meslmani, 2016).

The same trend of low CO concentrations and high PM concentrations was recorded in the area of the existing Gaza Power Plant during the five monitoring campaigns carried out in 2012. The levels of carbon CO measured were below the limits set by the international standards, while concentrations of $PM_{2.5}$ from 49 $\mu g/m^3$ to 79 $\mu g/m^3$ (Matar, 2014).

According to the study conducted by the Environmental Protection and Research Institute (EPRI, 2006), the annual SO_2 concentration over the Gaza Strip ranges between 60 $\mu g/m^3$, which was recorded in Khanyounis, and 180 $\mu g/m^3$, which was recorded in Gaza Governorate. This can be justified by the fact that Gaza Governorate is very densely populated and also because most of the industrial activities are located in it (See Figure 5-19).

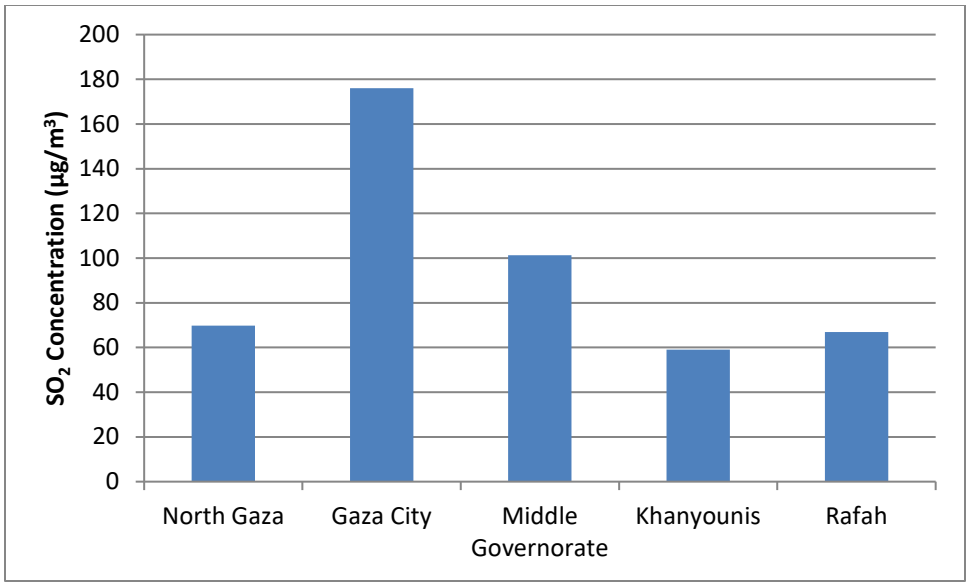


Figure 5-19: SO_2 Concentration over Different Governorates in the Gaza Strip (EPRI, 2006)

Similar to SO_2, NOx concentrations in Gaza Governorate were the highest. The heavy traffic in Gaza Governorate as compared to southern areas may explain the high concentrations of NOx measured (See Figure 5-20).

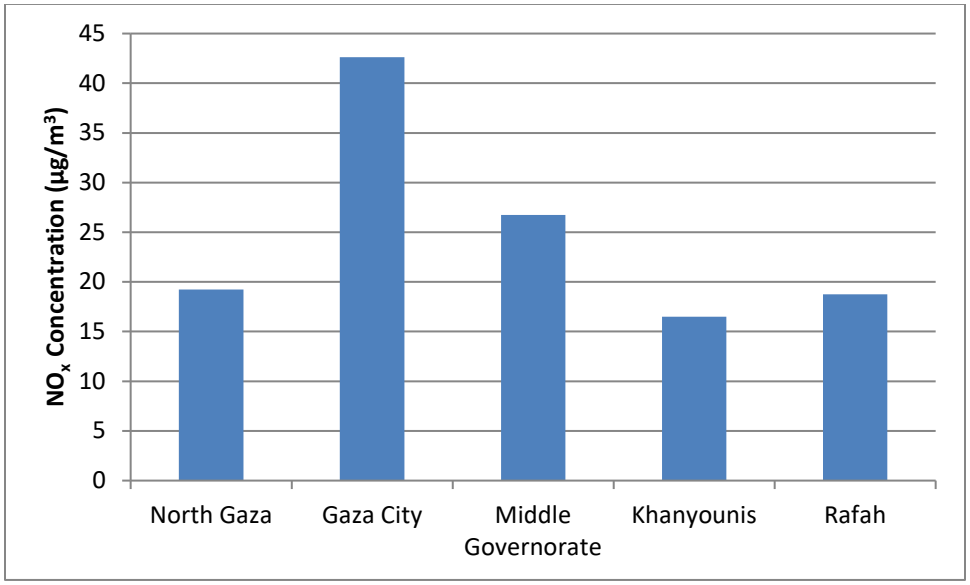


Figure 5-20: NOx Concentration over Different Governorates in the Gaza Strip (EPRI, 2006)

5.2.5. Noise

Most of the proposed reservoirs and pumping stations sites are located in open rural suburban areas, with no major industrial or traffic activities identified in the vicinity of the sites, except of the ST-045 Reservoir

and the BL-T01B Reservoir sites which are located in densely populated urban areas with high traffic density in Gaza City and in Jabalia, respectively.

In comparison, the main carrier line will pass through about 9 km of Salaheldein Road, which is considered a major road with high traffic volume. The other sections of the carrier line will pass through areas with different characteristics; rural suburban areas and urban commercial and residential areas.

Similar to the main carrier line, the locations of network pipes to be constructed or replaced will have a range of different noise levels, and as these are located within existing roads, it is likely that there is an existing high level of traffic noise at some locations on the larger roads.

A recent study (Al Madhoun et. Al, 2013), measured the traffic noise level at various development sites of different traffic volumes in Gaza City (urban, rural and camps) . The results obtained show that the average noise level during weekdays, in the urban areas ranged from 69.57 dB to 87.88 dB, and in the rural area ranged from 53.15 dB to 55.83 dB.

In general, the lowest noise level reached in locations with similar conditions of the proposed sites are above the Palestinian Standard for Outdoor Noise and the guidelines set by WHO for different receptors; 55 dB day time and 45 dB night time when the receptor is residential, institutional or educational and 70 dB at all times when the receptor is commercial or industrial.

5.2.6. Surface Water (Wadis)

There are three wadis in the Gaza Strip, moving through different locations; between Gaza city and the Middle Governorate (Wadi Gaza), the southern part of the Gaza Strip (Wadi Al Salqa), and the northern part of the Gaza Strip (Wadi Beit Hanoun). See Annex 5 – M8 for the map of the Wadis Locations in the Gaza Strip.

Wadi Gaza

Wadi Gaza, which crosses the central area of the Gaza Strip from east to west, is considered to be the most significant watercourse in the Gaza Strip. Its watershed is estimated to cover more than 3,500 km^2 of the northern Negev Desert and Hebron Mountains, as well as the smaller catchment within Gaza (MedWetCoast, 2001). The estimated annual flow in the Wadi is 16 MCM/y. However, currently, only minimal amounts of the higher winter flows reach Gaza due to the diversion of water from Wadi Gaza towards artificial recharge and irrigation within Israel.

The depth of the channel of Wadi Gaza varies from 6-12 m in the east, becoming less deep in the west (3-4 m) until it reaches zero level at the mouth (Zaineldeen & Aish, 2012). The bed of Wadi Gaza is generally characterized by a poorly sorted gravel layer which is around 1-5 m deep. The upper layer of the bed consists of pebbles, cobbles, gravel and some boulders, with sand and clay. Parts of the Wadi, especially at its mouth, are partly covered with aeolian sand dunes.

In the past, the site used to have a significant environmental and socio-economic value and was considered as a National Natural Reserve area. Prior to the construction of the temporary wastewater treatment plant in the southern part of the wadi, the wadi has been suffering from serious environmental issues; significant amounts of raw sewage were discharged directly into the wadi from the Middle Governorate and Gaza City (ICRC, 2011). Furthermore, the wadi has been converted in some places into an illegal solid waste dump

site that receives hundreds of tons of all types of solid waste, that are randomly dumped into the wadi bed and along its banks (Sweep-net, 2014).

The construction of this temporary treatment plant in 2015 was an emergency response to the deteriorating situation, until the operation of the permanent wastewater treatment plant east of Al Bureij which is proposed to be constructed soon.

Wadi Al Salqa

Wadi Al Salqa is located in the southern region of the Gaza Strip, between Deir El Balah and Khanyounis. Its watershed is estimated to cover 40 km^2. The mouth of the wadi is located near the coastal zone of the Mediterranean Sea and is called Al-Berka, where the seasonal water is collected after flowing from east to west. This wadi was observed to remain almost dry during recent rainy periods; however, it is known that when it receives excess water from extremely storm events, the area is flooded.

The proposed Deir Al Balah booster station (N-01) site is located approximately 4 m away from the edge of Wadi Al Salqa. For discussion on potential flooding impacts and mitigations see Chapter 6

Wadi Beit Hanoun

Wadi Beit Hanoun is located in the northern part of the Gaza Strip. It is considered a main tributary of Wadi El-Hassa which is located behind the armistice line (originating at Dora in Hebron Governorate and ending at the Mediterranean Sea between Beit Lahia and Asqalan). Its watershed is estimated to cover 729 km^2 of Hebron Mountains; around 5.5% of the total catchment area is located in the Gaza Strip (Ubeid, 2014).

The wadi is characterized by short duration floods that occur after heavy rainfall while most of the times it is completely dry. Freshwater flows into it in the winter season. Israel has retained and changed the course of the Wadi and it became dry since the early seventies (Jaradat, 2010).

5.2.7. Groundwater

The Gaza Strip lies over about 2% of the area of the 18,370 km^2 Coastal Aquifer Basin. The general direction of flow in Gaza aquifer follows the dip of the aquifer towards the coast. The western boundary of the aquifer follows the coastline, where both outflows of freshwater to the sea and inflows (intrusion) of seawater are observed to occur (UN-ESCWA and BGR, 2013).

Local aquifer recharge in the Gaza Strip is very limited; natural groundwater recharge from different sources is estimated to be around an average of 55-60 MCM/y (PWA, 2012). This includes recharge from rainfall, agricultural return flow, water and wastewater network losses, and recharge basins, in various locations. It is likely that the limited recharge rates are at least partially due to the dense building fabric and the spread of impervious surfaces in the highly urbanized Gaza Strip, as well as supply-demand imbalance.

Groundwater is the main water supply source for all human usage in the Gaza Strip (domestic, agricultural and industrial). Over 4,000 water wells, of which around 2,600 are legally registered, penetrate the shallow aquifer of the Gaza Strip. The combined impact of the wells is that abstraction by pumping has been exceeding the sustainable yield of the aquifer, which is causing a negative impact on the aquifer and consequently on the quantity and quality of public water supply (Hamdan, 2011).

Groundwater Levels

The groundwater level over the aquifer lies at depths varying between a few meters from the surface up to 90 m. These variations are linked to topographical and geological conditions. As illustrated in the groundwater level contour map in Annex 5 – M9, a cone of depression is present in the aquifer in Rafah, with water level depth of about -19 below msl. Another cone of depression with water level depth of about -6 below msl is found in the northern part of the Strip. Groundwater level is in the range of -2.5 below msl to 4 above msl in the areas of the other project components.

Heavy abstraction is observed to have caused the groundwater level to decline during the last few years to about -10 to -20 below msl, which in turn has led to a local diversion of groundwater flow and disturbed the flow balance along the coast (PWA, 2016).

Groundwater Quality

The quality of water in existing wells is critical to the design and success of the proposed project. Many wells do not have sufficient water quality to contribute to the water to be supplied by this project and are not suitable for blending with other sources. During the design stage, the water quality data for the wells has been reviewed in detail to ensure that only wells with sufficient quality of water will be used as a supply to the proposed tanks while 136 wells with insufficient quality will be closed.

There are significant existing groundwater quality problems in the Gaza Strip, caused by high salinity (Chloride) and high Nitrate (NO_3) concentrations. In Annex 5 – M10 and M11, Chloride and Nitrate contour maps are presented. It is noted that most of the aquifer water exceeds the WHO drinking standards for chloride (250 mg/l) and Nitrate (50 mg/l).

The majority of the aquifer has a Chloride concentration of 500-1500 mg/l, while along the coastal line it exceeds 2,000 mg/l due to the influence of seawater intrusion. Such high concentrations can be found in the south-eastern part of the Gaza Strip, reflecting the upward leakage of highly saline water from the lower water horizons. In the project area, Chloride concentrations range from 500 mg/l to 2,000 mg/l.

The aquifer also suffers from high levels of Nitrate (NO_3). The NO_3 concentration in pumped domestic water generally ranges between 50 mg/l and 300 mg/l. High NO_3 concentrations indicate the percolation of wastewater to the aquifer through damaged networks, cesspits and septic tanks (e.g. Khanyounis aquifer), or the leakage of organic fertilizer through the unsaturated zone (e.g. Beit Lahia aquifer).

5.2.8. Seismology

The Gaza area lies in a considerable distance from the Jordan rift area. According to the seismic hazard distribution map, prepared by the WHO (WHO, 2010), the seismic hazard in the Gaza Strip is medium with a peak ground acceleration (PGA) factor of (0.8 - 2.4) meter per second squared (m/s^2). Based on the seismic peak ground acceleration map for the region, that provides accurate data about seismic activity in Palestine (see Figure 5-21), the northern part of the Gaza Strip is located within zone 2A, with a PGA factor (z) of 0.15 gravitation (g) (1.4715 m/s^2). While the southern and the Middle Governorates are located within zone 1, with a PGA factor (Z) of 0.075 gravitation (g), (0.735 m/s^2). Generally, the Gaza Strip is considered to be located in a relatively weak seismic area.

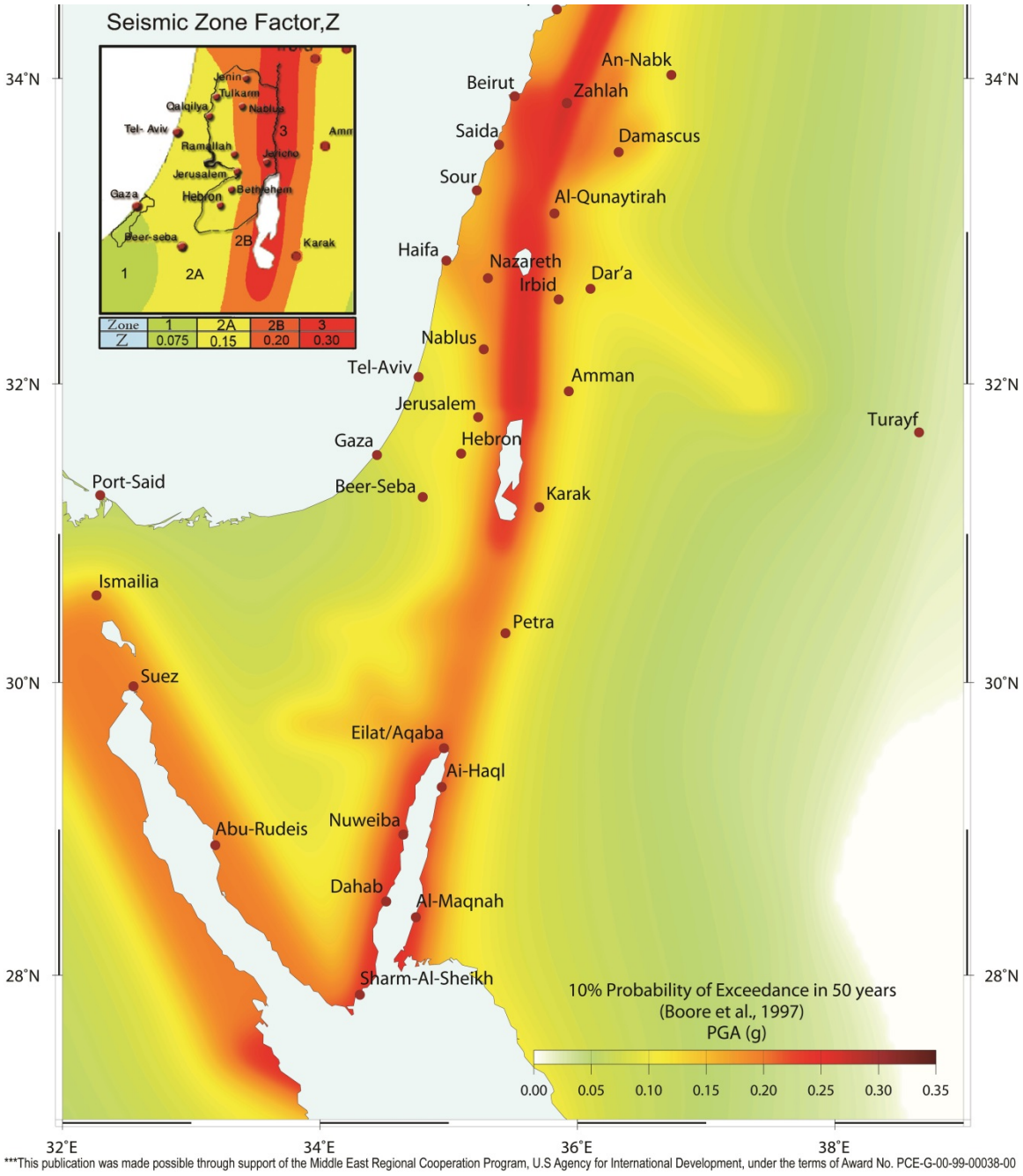


Figure 5-21: Seismic Hazard Map and Seismic Zone Factor for Building Codes in Palestine, (Earth Sciences and Seismic Engineering Centre – An-Najah University)

5.3. Terrestrial Biological Resources

Interesting biodiversity elements in terms of species, habitats and ecosystems can be found in the Gaza Strip. It is rich in terrestrial resources, including fauna and flora (Abd Rabou, 2005). However, various anthropogenic pressures exerted on these ecological features including pollution, habitat alterations and modification, and overpopulation have impacted most of them (Euroconsult and IWACO, 1994).

According to the conducted site visits, the reviewed literature, which includes scientific publications and evaluation of the documented species the documented species by IUCN Red list of threatened species (2017), it was confirmed that no specific significant floristic species are witnessed in the area, other than the regular common species (trees, shrubs and herbaceous plants) in addition to many agricultural fields that provide refuge to wildlife species, especially birds. The only critical location is the Wadi Gaza that is intersected by the main carrier line. The lower part of the Wadi Gaza and its surroundings is designated as environmentally protected area. Wetlands in the Wadi are considered as a significant habitat for many Fauna and Flora species. Unfortunately, these wetlands are threatened by many factors. The large amounts of raw sewage discharged into it and the continuous grazing, tree cutting, and solid waste dumping by the inhabitants has considerably degraded its environmental quality. As a result, many species of fauna and flora that used to exist in the wetlands area are losing their significant habitat that they used to breed and flourish in. Specific information about flora and fauna in the Wadi area will be illustrated in the following sections along with the general species found in the Gaza Strip.

Wadi Al Salqa, which borders the southern side of the proposed booster station in Deir Al Balah, is another location which may potentially have considerable terrestrial biodiversity resources, however, it was confirmed that no specific significant species are witnessed in the area, other than potentially the regular common species mentioned above.

The matrix provided in Annex 4 (b-2) illustrates the baseline data on the biological environment of the study area for each project component including the presence of terrestrial communities in areas affected by construction, facility siting, land application or disposal, the presence of rare or endangered species, sensitive habitats, and species of commercial importance in land application sites.

5.3.1. Terrestrial Flora

The Gaza Strip, as an arid to semi-arid zone, harbours a diversity of wild vascular plant species including trees, shrubs and herbs. The sites however are either inhabited by short-lived herbs which have no conservation value, or agricultural trees including grapes tomato and guava.

Wadi Gaza harbours a diversity of wild vascular plant species (*Subkingdom Tracheobionta*) belonging to the divisions: *Coniferophyta* (conifers) and *Magnoliophyta* (flowering plants), and including trees, shrubs and herbs. Flora along with agricultural plants provides food, shelter, protection, breeding, nesting and resting sites for most Palestine faunistic species. (Abd Rabou et al., 2008 and Abd Rabou et al., 2007a).

Reeds and Tamarisks are major plants harvested in Wadi Gaza for multi-uses. Tree and herbs cutting for timber production and medicinal and nutritional uses were found to be continual customs and habits among the families inhabiting Wadi Gaza leading to the deterioration of the fragile ecosystem of Wadi Gaza. Reeds (e.g. *Phragmites Australis* and *Arundo Donax*) and other plants like *Typha spp.* and *Phoenix Dactylifera* are commonly used in roof thatching, production of baskets, carpets, kites, food dishes, chairs, huts inside farms etc.

5.3.2. Terrestrial Fauna

The flora along with the agricultural orchards that are prevailing in the Gaza Strip provides food, shelter, protection, breeding, nesting and resting sites for faunistic species (Abd Rabou et al., 2008). The project covers most parts of the Gaza Strip, thus, special focus was made on the vertebrate wildlife species that are

common in the Gaza Strip. A variety of wild mammals, birds, reptiles and amphibians have been discussed in the following sections.

Wild Mammals

Poaching, killing, hunting and habitat fragmentation and modifications are affecting the populations of some mammalian species (Abd Rabou et al., 2007a and Abd Rabou, 2009). Most of the nowadays-recorded mammals are rodents. The Palestine Mole-rat *Spalax leucodon ehrenbergi* is an endemic species to Palestine. It occurs in most environments of the Gaza Strip and its heaps are found everywhere. The species is considered as a pest in the sense that it attacks the bulbs and tubers of agricultural plants or crops. Also rats and mice are pest species, and they are commonly combated by the Palestinians due to the damage they cause to crops, domestic poultry and other property.

The Red Fox *Vulpes vulpes* has been found to breed in many localities in the Gaza Strip. Many residents claimed that the two hedgehog species; Long-eared Hedgehog *Hemiechinus auritus* and Ethiopian Hedgehog *Paraechinus aethiopicus* are sometimes trapped or hunted for food purposes (Abd Rabou et al., 2007a).

While the Palestine Mole-rat has not yet been evaluated by IUCN Red List of Threatened Species, the Red Fox *V. vulpes*, the Ethiopian Hedgehog *P. aethiopicus* and the long-eared Hedgehog *H. auritus* were all of least concern with stable population trend (IUCN 2017).

Wild Birds

The Gaza Strip is located on major migration routes in the Palearctic region. The various ecosystems of the Gaza Strip are a refuge to both resident and migratory bird species (Abd Rabou et al., 2007b).

Surveys of bird fauna revealed the occurrence of about 50 passerine and non-passerine bird species (Table 5-5), Many of these bird species are commonly and illegally hunted in the Gaza Strip for different reasons including game, trade and food. These include: the Common Quail *Coturnix coturnix, Chukar Alectoris chukar*, Doves *Streptopelia* spp., Finches *Carduelis* spp., and many others. The Lesser Kestrel *Falco naummani* and the Common Kestrel *Falco tinnunculus* are globally threatened species and they are commonly hunted by local bird hunters. These falcons in addition to other raptor species are sometimes found to be sold in local animal and pet shops.

In Wadi Gaza, along with its interaction area with the Mediterranean Sea, surveys in the last few years pointed out the occurrence of a considerable number of bird species. It is worth mentioning that tens of species, especially aquatic birds have never been seen in the last few years as a result of the massive destruction of about 70 % of the wetland ecosystem of Wadi Gaza and water pollution. Many aquatic bird species which were considered as rare in the past (Abd Rabou et al., 2007b) have disappeared from the area nowadays.

Table 5-5: Wild bird species recorded in the Gaza Strip

Family	Latin Name	Common Name	Arabic Name
Passerines			
Alaudidae	*Galerida cristata*	Crested Lark	القبرة المتوجة
Hirundinidae	*Hirundu rustica*	Barn Swallow	السنونو
Motacillidae	*Motacilla flava*	Yellow Wagtail	الذعرة الصفراء

	Motacilla alba	White Wagtail	الذعرة البيضاء
Pycnonotidae	*Pycnonotus xanthopygos*	Yellow-vented Bulbul	البلبل أصفر العجز
Sturnidae	*Acridotheres tristis*	Common Myna	المينا الشائعة (الياسمينا)
Turdidae	*Erithacus rubecula*	European Robin	أبو الحناء
	Luscinia svecica	Bluethroat	المسهر أو الدحل
	Phoenicurus phoenicurus	Common Redstart	الحميراء
	Saxico latorquata	Stonechat	أبلق الرعيان
	Turdus merula	Blackbird	الدج أو الشحرور
Non-passerines			
Ardeidae	*Bubulcus ibis*	Cattle Egret	أبو قردان
Accipitridae	*Milvus migrans*	Black Kite	الحدأة السوداء
	Buteo buteo	Common Buzzard	الصقر الحوام
Falconidae	*Falco naummani*	Lesser Kestrel	العويسق
	Falco tinnunculus	Common Kestrel	العوسق
Phasianidae	*Alectoris chukar*	Chukar	الشنار
	Coturnix coturnix	Common Quail	الفر أو السمان (السلوى)
Rallidae	*Gallinula chloropus*	Moorhen	دجاجة الماء
Burhinidae	*Burhinus oedicnemus*	Stone Curlew	الكروان الصحراوي
Charadriidae	*Vanellus spinosus*	Spur-winged Plover	الزقزاق الشامي

From a total of 21 bird species listed in Table 5-5, three Passerines (Yellow Wagtail, Bluethroat and Blackbird) and five Non-passerines bird species (Black Kite, Lesser Kestrel, Common Quail, Moorhen and Stone Curlew) were of least concern while the remaining were not recorded in the IUCN list (IUCN, 2017)

Reptiles

The arid to semi-arid nature of the Gaza Strip attracts many reptilian species, consisting of principal categories such as snakes, lizards and turtles (Abd Rabou et al., 2007c). Number of resident reptilian species found in the Gaza Strip is illustrated in Table 5-6. The Greece or Spur-thighed Tortoise *Testudo graeca* is a commonly occurring species. It is commonly caught and reared as a pet animal in many Palestinian homes. Lizards are very common in both wild and agricultural places in the Gaza Strip. The Desert Monitor *Varanus griseus* is the largest lizard species in the Gaza Strip. It feeds upon a wide range of vertebrates and invertebrates that prevail in agricultural and sand dune ecosystems. Poaching, killing and alterations of ecosystems put pressure on the species and as a result it is locally threatened.

According to IUCN Red list criteria the Spur-thighed Tortoise, *T. graeca* was identified as globally vulnerable, an animal species that is likely to become endangered. Agama and Palestine Viper were both categorized as of least concern with a stable and an unknown population trend respectively (IUCN 2017). Other reptiles have not been evaluated by IUCN Red List yet.

Table 5-6: Reptiles recorded in the Gaza Strip

Family	Latin Name	Common Name	Arabic Name
Testudinidae	*Testudo graeca*	Greece or Spur-thighed Tortoise	السلحفاة اليونانية
Agamidae	*Agama stellio*	Agama	الحردون

Scincidae	*Chalcides ocellatus*	Ocellated Skink	الدفان
Chamaeleonidae	*Chameleo chameleon*	Mediterranean Chameleon	الحرباء
Varanidae	*Varanus griseus*	Desert Monitor	الورل الصحراوي
Geckonidae	*Hemidactylus spp.*	Gecko	أم بريص
Lacertidae	*Acanthodactylus boskianus*	Bosc's Lizard	السحلية الشائعة
Colubridae	*Coluber jugularis asianus*	Syrian Black Snake	العربيد
	Malpolon monspessulanus	Rear-fanged or Montpellier Snake	الثعبان خلفي الأنياب
	Coluber nummifer	Coined Snake	الثعبان النقدي
	Coluber rubriceps	Red Whip Snake	الثعبان أحمر الرأس
Viperidae	*Vipera palaestinae*	Palestine Viper	الحية الفلسطينية

Amphibians

Only two frog species belonging to the order Anura are recorded in the moist and agricultural places of the Gaza Strip (Table 5-7). The Common Toad *Bufo viridis* is the largest, with females being larger than the males. The Tree Frog *Hyla arborea* is a small tree frog found in the Wadi Gaza and in storm-water harvesting ponds and other moist localities in the Gaza Strip (Abd Rabou et al., 2007c). These two species are very sensitive to the accelerating ecosystem alterations and modifications. Habitat protection has been shown to be the most important approach to conserving the local frog populations. According to the IUCN Red List of Endangered Species, the two frog species are listed as 'Least Concern' in view of their wide distribution, presumed large population, and because it is unlikely to be declining fast enough to qualify for listing in a more threatened category.

Table 5-7: Amphibians Recorded in the Gaza Strip

Family	Latin Name	Common Name	Arabic Name
Bufonidae	*Bufo viridis*	Common Toad	العجلوم الشائع
Hylidae	*Hyla arborea*	Tree Frog	الضفدع الشجري

5.4. Historical and Cultural Heritage

The archaeological sites and historical buildings in the Gaza Strip vary between monuments, mosaic sites, mosques, churches and others. Most of these sites are located in the coastal zone of the Gaza Strip. And Gaza City is found to comprise most of these sites; the most notable one is Tel Al-Ajjul site which is located some 6 km south-west of Gaza City, near the outlet of Wadi Gaza to the sea. Construction relics were discovered there, which date back to periods between 2,200 BC (Old Pharaonic) to 800 BC (New Pharaonic) (Al-Goula et al, 2013).

Some other important sites in the Gaza Strip include mosqes like the Al-Omary Large Mosque, Al-Sayyed Hashim Mosque, Kateb Welaya Mosque in Gaza city, Al-Naser Mosque in Beit Hanoun city and others, and monasteries and churches like Saint Hilarion Monastery (Tel Um Amer), Located on coastal dunes 10 kilometers south of Gaza City, Byzantine Church in Jabalia, located to the west of Salaheldien regional road, Saint Perfirius Church in, located in Alzaytoun neighborhood in Gaza city (MoTA, 2013)

In the coastal zone of Deir Al Balah, there are also many archaeological sites. Some of these are: Deir Al Balah cemetery, Deir Al Balah Castle, Tel Alrqesh, Al Khader monastery and mosque and other sites (Al-Goula et al, 2013). Deir Al Balah cemetery dates back to the late Bronze Age (1550-1200 BC) and is located on the beach of Deir Al Balah; no monuments are left in this site since 1971 after an illegal exploration campaign.

Deir Al Balah castle was established by Amuri Salibi, the King of Jerusalem, (1163-1173 AD). Tel Alrqesh is located directly on the coast of Deir Al Balah. This site dates back to the late Iron Age, and the Persian period (538-332 BC). Tel Om Amer is located to the south of Al Nuseirat Camp, and dates back to the Byzantine era. Al Khader monastery and mosque are located at a distance of about 200 meters south of the city centre of Deir Al Balah.

The most important archaeological sites in the Southern part of the Strip are Tel Rafah, located in the coastal zone of Rafah close to the Southern border of the Gaza Strip with Egypt (Apart from the proposed components in Rafah), and archaeological structures and old Khans like Khan of the Emir Younis al-Nuruzi and Castle of Sultan Barquq in Khanyounis Governorate.

No archaeological sites are found in the proposed locations for different project components. Based on desk study review, observations from the conducted site visits, and consultation with the stakeholders, it is confirmed that no traces of archaeological and cultural heritage have been found at the proposed project sites. It is therefore considered that no historical or cultural resources will be affected in the site locations. See Annex 5 – M12 for the Archaeological Sites in the Gaza Strip along with the locations of the project components.

However, if any archaeology is discovered during construction, the chance find procedures will be used; work activities will to be stopped immediately and the responsible competent authority (MoTA) needs to be contacted. Work will not be allowed to proceed without a written approval from the relevant agencies.

5.5. Existing Infrastructure

5.5.1. Transportation and Traffic

The system of public transportation in the Gaza Strip is divided into two main types; buses and taxis. Buses are considered to be a basic constituent in the public transportation system in the Gaza Strip. The roads network consists of 76 km of main roads, 122 km of regional roads and 99 km of local roads (PCBS, 2013). There was a single railroad, known as Sikka route, running from north to south along its center. The railroad infrastructure had been destroyed and out of use since 1967. The route areas are still governmental land and remains at today's date relatively free from other uses. As mentioned in Section 3.2 and section 5.1, this route will form the route of most of the main carrier alignment, while only in one section of the main carrier the alignment will take place in Salaheldein service road. A map in Annex 5 – M13 shows the main regional roads of the Gaza Strip as follows:

- Salaheldein Road: 58 km long, and is considered the core of Gaza's transportation. It extends along the center of the Gaza strip from Rafah Crossing to Beit Hanoun Crossing. As mentioned above, the alignment of about 9 km of the main carrier will take place in the service line of Salaheldein Road. Details are provided in section 3.2 and section 5.1. A Cross section of this road is provided in Figure 5-22.

- Al-Karama Road: 20 km long, and extends from Rafah (South) to Beit Hanoun (North), to the east of Salaheldein road.
- Al-Rasheed Road: 45 km long, and extends from Rafah (South) to Beit Lahia (North) along the coastal line of Gaza.

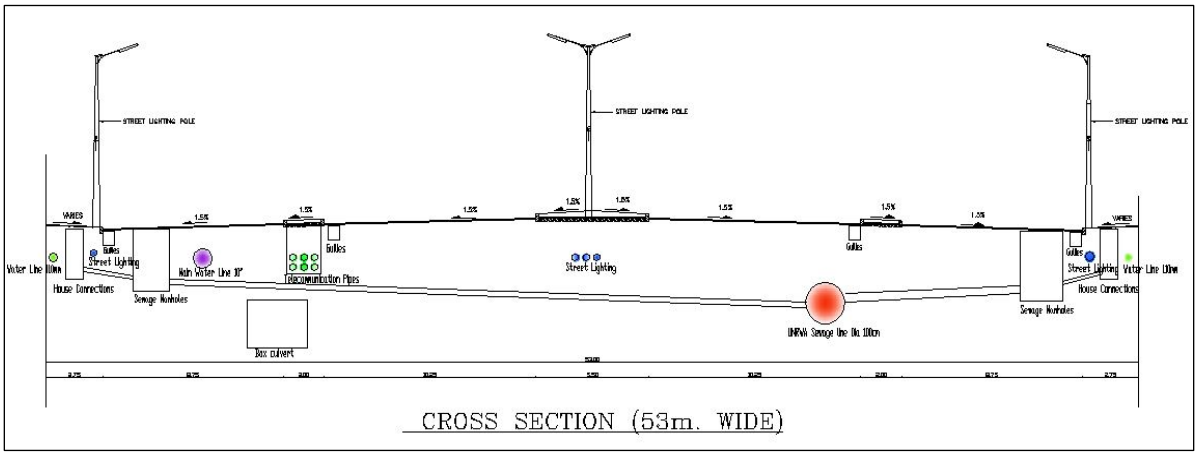


Figure 5-22: Cross section of Salaheldein Road including the existing Infrastructure

There are also numerous local roads that are typically of three types of construction – tarmac, dirt/sandy roads that are unpaved, and 'interlock' roads. The local site descriptions in Section 5.1 include more details on the types of roads at the project specific locations.

5.5.2. Energy and Electricity

Currently Gaza Strip is undergoing a chronic electricity crisis, as rolling power cuts occur from 12 to 18 hours daily leading to a very unpredictable and discontinuous supply. The three sources of electricity supply in Gaza Strip (connections from Egypt, Israel and the Gaza Power Plant (GPP)) only meet around 45% of the estimated 470 MW per day electricity demand. Electricity distribution is done as equitably as possible through Gaza electricity distribution corporation (GEDCo). This is a critical constraint to the proposed projects because the existing power supply is inadequate and unreliable to provide the required electricity to ensure the full and reliable operation of the proposed pumping stations, reservoirs, internal networks and supporting facilities.

5.5.3. Solid Waste Management

Dumping waste in open landfills is the current practice of waste disposal in Gaza Strip. Three central dump sites are located in the eastern part of the Gaza Strip; Johr El Deek landfill, located southeast of Gaza municipality, the Deir El Balah landfill, which is located east of Deir Al Balah municipality, and the Al Fukhari landfill located east of Rafah municipality, See Figure 5-23. A total amount of approximately 3,224 tons per day is disposed of at these three formal landfill sites. And the estimated per capita waste generation is 1.05 kg/day for Gaza and North Gaza Governorates, 0.72 kg/day for Khanyounis and the Middle Governorates and 0.75 kg/day for Rafah Governorate (UNDP-PAPP, 2012).

Figure 5-23: Existing and Proposed Solid Waste Landfill Sites, (UNDP-PAPP 2012)

The Johr El Deek landfill is operated basically as an unprotected dump site; it has not been equipped with soil protection measures. This landfill serves the Northern and Gaza Governorates. The site comprises 90 dunums for landfill and 30 dunums for hazardous waste disposal and other facilities. The site exceeds its maximum capacity (UNDP-PAPP, 2012).

The Deir Al Balah landfill site is lined and has leachate collection, but currently this leachate does not receive treatment. The landfill was proposed to be closed in 2013, but it is still receiving waste from the Middle Governorate. The site is currently exceeding its maximum capacity, and an alternative landfill site has not yet been found. Similar to Johr El Deek landfill, The Al Fukhari landfill has not been equipped with soil protection measures, and is currently exceeding its maximum capacity (UNDP-PAPP, 2012).

Waste collection is often performed with the use of donkey carts, but also tractors, tipper cranes and waste trucks are used. North Gaza Joint Service Council is responsible for waste management in the municipalities of Jabalia, Beit Lahia, Beit Hanun and Umm al Nasser. While Gaza Municipality organizes its own waste collection and transportation, and operates the Johr al Deek landfill. Deir al Balah Joint Service Council

covers 13 municipalities in the middle region of Gaza, including Khanyounis. And Rafah Municipality manages waste collection, transport and disposal by itself.

UNWRA manages waste collection and transportation from the eight refugee camps in the Gaza Strip. Refuse collection is currently implementing in camps using labor force and push carts. Tractors are used to deploy refuse containers into temporary locations and finally off-loaded by solid waste crane trucks.

Generally the collected waste is stored for transfer in temporary storage sites. To be transported to the three dump sites either by the service providers themselves, or outsourced by private contractors.

Waste composition indicates a high proportion of organic material (60-70%), with relatively small quantities of other waste categories (paper/cardboard 6-8%, plastic 10-19%, glass 2%, metals 2-3%, and other materials (3-7%) (UNDP-PAPP, 2012). Some sorting of wastes takes place for recyclable materials and composting of waste is being conducted at the pilot scale. However, the disposal of solid waste will remain a critical issue in Gaza Strip due to constraints on the availability of suitable sites. The situation in respect of waste disposal in Gaza Strip constitutes a threat to the health of the workers in the waste sector, and represents a source of soil and groundwater pollution.

5.5.4 Sanitation

The total volume of wastewater generated in the Gaza Strip is 48.54 MCM/y (ARIJ, 2015). There are five existing wastewater treatment plants in the Gaza Strip, three of them are considered as intermediate plants located in Beit Lahia, Gaza and Rafah areas as well as two temporary treatment plants in Khanyounis (Mawasi area) WWTP and the newly constructed Wadi Gaza WWTP. Moreover, three central WWTPs are proposed to serve the Northern, the Middle and Gaza and the Southern governorates. For the northern governorates, the permanent northern treatment plant (NGEST) (East of Jabalia), with a total capacity of 36,000 m^3/day, is almost fully implemented with 5% remaining works; these works are currently under implementation. While for Gaza and the Middle governorates, the Gaza Central WWTP (East of Al Buraij) is expected to be fully implemented by 2047, with a total capacity of 180,000 m^3/day, (Dorsch Consultants, 2015). And for Khanyounis governorate, the tender documents for the construction of phase 1 of the Khanyounis central WWTP (East of Khanyounis), which is proposed to have a full flow capacity of 44,948 m^3/day, are available (CMWU, 2017). Rafah WWTP will also be upgraded, to reach a capacity of 20,000 m3/day, to serve Rafah Governorate (ICRC, 2014).

According to the National Water and Wastewater Strategy for Palestine (PWA, 2013), the coverage of the wastewater network in the Northern area is around 80%, Gaza City around 90%, the Middle area 75%, Khanyounis 40% and Rafah 75%. New connections are continuing to be implemented, that about 83.5% of households in the whole Gaza Strip were using wastewater networks for the disposal of the generated wastewater in 2015, while about 9.8% were using porous cesspits and about 6.7% were using tight cesspits (PCBS, 2016). Currently, Khanyounis has the lowest connection rat; however, in 2025, 83% of the population of Khanyounis city and 63% of the population in the surrounding area is expected to be served by piped sewage system (CMWU, 2017).

In general, the Gaza Strip wastewater network is developed as conventional, gravity systems. They are designed to be separate from storm drainage. However, the separation is not fully effective and storm flows do enter the sewers in the frequent winter storms.

5.6. Water Supply in the Project Area

5.6.1. Resources and Quality

Groundwater from the coastal aquifer forms the main source of water in the Gaza Strip. This resource provides about 89% of all water supplies. There are 25 municipalities responsible for providing domestic water through municipal wells distributed over the Gaza Strip municipal areas; these wells provide water for both municipal and industrial uses (PWA, 2016), see Annex 5 – M14.The remaining amount is provided through purchasing from the Mekorot (about 7%) and brackish and seawater desalination (about 4%), (PWA, 2016).

Water quality is far below the internationally recommended standards for certain parameters, and is considered to have severe negative impacts on the public health (see Section 5.7.3. on public health below). Depending on the results of the groundwater chemical analyses carried out by the public health laboratory of the Ministry of Health (MoH) for about 211 domestic water wells in the Gaza Strip in 2013/2014, it can be concluded that the Gaza Strip suffers from very poor water quality in general (PWA, 2014).

Of the municipal wells in Gaza, only 19.3% have recorded chloride concentration less than 250 mg/l (the allowable WHO limit). The rest exceeds that limit (PWA, 2016). As for Nitrate, its concentration in the municipal wells ranges from 50 to more than 200 mg/l. Only 12.4% of municipal wells had Nitrate concentration less than 50 mg/l (the allowable WHO limit). Taking the effect of both Chloride and Nitrate concentrations, it can be concluded that only 3.6% of the domestic water supply is acceptable for human use (PWA, 2016).

5.6.2. Networks and Consumption Quantity

Although About 98% of the Gaza Strip population is served by a water network, the rapid population growth and associated increasing demand create a great challenge for the development of the network further to consider them. In addition, significant parts of the existing network were constructed more than 20 years ago. Therefore comprehensive upgrading of older parts of the network will be required to ensure it remains in a good condition to operate in the future.

Table 5-8: Quantity of Water Supply for Domestic Sector in the Gaza Strip by Governorate, 2015

	Water supply for domestic sector (MCM)[1]	Water consumed by domestic sector (MCM)	Total losses (MCM)	Daily consumption (l/c/d)
The Gaza Strip	95.3	53.5	41.8	79.2
North Gaza	24.5	12.5	12.0	92.5
Gaza	32.4	19.0	113.4	81.9
Middle Area	14.9	7.5	7.4	76.4
Khanyounis	13.8	8.7	5.1	68.7
Rafah	9.7	5.8	3.9	69.2

(1) Data includes water purchased from Mekorot of 6.4 million m^3.

According to CMWU, the total length of the water distribution networks in the Gaza Strip is about 800 km, with pipe diameters varying from 2 to 20 inches according to purpose and capacity. The distribution network efficiency is about 64.7% due to physical and commercial loss, leading to reduced available

quantities for consumption; the average water consumption is 84 liters per capita per day (l/c/d) (CMWU, 2017).

Table 5-8 above summarizes total water production and consumption in the proposed project area, as published on PCBS information system (PCBS, 2016) based on data collected from the Water information system in PWA, 2016.

5.6.3. Current Water Supply in the Project Area

The water supply in the Gaza Strip is an intermittent distribution system. This is due to insufficient water infrastructure and the lack of water sources. The methods for distribution water networks depend on two schemes; direct supply from wells and supply by water tanks to networks. Table 5-9 below summarizes the current water supply conditions in the Gaza Strip.

Table 5-9: Current Water Supply Situation in the Gaza Strip (PWA, 2016, CMWU, 2017 and Lotti & Al, 2016b)

Governorate	Municipality	Water Supply Status	Quality
North	Beit Hanoun	• Water supply through 9 water wells with a total production of 3,583,640 m^3/y. • The water network efficiency 47.6%.	• Three Water wells out of 9 comply with WHO standards for the chloride concentration (C/137, C/127A and C/128). • The nitrate concentration of 8 wells is higher than WHO standard, only C/167 well has a low nitrate concentration of less than 50mg/l. • 88.9% of Beit Hanoun municipality groundwater does not comply with WHO standard.
	Beit Lahia	• Water Supply through 11 water wells with a total production of 5,831,951 m^3/y • The water network efficiency is 40%.	• Ten water wells out of 11 comply with WHO standards for the chloride concentration (A/205, A/180, A/185, D/67, E/6, A/211, A/231, D/84 and E/176). • All wells have high nitrate concentration above the WHO standard
	Jabalia	• Water Supply through 25 water wells with a • Tika ground circular reservoir with capacity of 3000 m^3 located geographically in Beit lahia. • The total production is 13,770,616 m^3/y. • The water network efficiency is 55%.	• Only 17 Water wells out of 25 comply with WHO standards for the chloride concentration. • The nitrate concentration of 19 wells out of 25 wells is higher than WHO standard. • 20% of Jabalia municipality groundwater complies with the WHO standard.
	Um Al Nasser	• Water supply through one well with a production of 203,756 m^3/y. • The water network efficiency is 82%.	• The Water well does not comply with the WHO standards for the chloride & nitrate concentrations.
Gaza	Gaza City	• Water Supply through 77 wells • Al-Montar ground circular reservoir with capacity 5,000 m^3 • Al-Kawther reservoir (out of service).	**72 out of the total 77 water wells were included in the quality study, since the other five wells were still newly constructed. • Three out of 72 wells comply with WHO standards for the chloride concentration

Governorate	Municipality	Water Supply Status	Quality
		• The total production is 27,024,755 m^3/y. In addition to 3,419,000 m^3/y from Mekorot. • The network efficiency does not exceed 63%.	(D/70, D/71, D/72). More than 48% of the water wells in Gaza governorate are located in the western area of the governorate which where high chloride concentrations dominate. • The nitrate concentration of 71 wells is higher than WHO standard.
Middle Area	Al Zahra	• Water supply through two wells and one reservoir • The total production is 417,163 m^3/y. • The water network efficiency is about 63.2%.	• The chloride concentration of these two wells is higher than WHO standard. While the nitrate concentration comply with WHO standard.
	Al Moghraqa	• Water supply through two water wells with a total production of 645,960 m^3/y. • The water network efficiency in the governorate is 40.5%.	• The chloride concentration of the well F/203 is higher than WHO standard. While its nitrate concentration is below the WHO standard. • The chloride and nitrate concentrations of the well F/264 comply with the WHO standards.
	Al Nusairat	• Water supply through 15 water wells located in Al Nusairat and two wells located in Al Mograqa. With a total production of 2,467,867 m^3/y. • Mekorot pipeline which provides 697,190 m^3/y. • Al-Nusairate reservoir (out of service) • The water network efficiency is 68.3%.	** 11 out of the total 15 water wells were included in the quality study. • Only one out of the 11 wells complies with the WHO standards for chloride concentration. • Four wells out of 11 comply with WHO standards for the nitrate concentration.
	Al Buraij	• Water supply through 8 water wells. In addition to Mekorot pipeline which provides 71,960 m^3/y. • The water network efficiency is 69.7%.	** Five out of the 8 water wells were included in the quality study. • None of the five water wells complies with the WHO standards for the chloride concentration. • Three wells out of 5 comply with the WHO standards for the nitrate concentration.

Governorate	Municipality	Water Supply Status	Quality
	Al Maghazi	• Water supply through 5 wells with, with a production of 1,035,452m^3/year. • Mekorot pipeline which provides 426,189 m^3/y. • A new water tank is currently under construction. • The water network efficiency is 56%.	** Four out of the 5 water wells were included in the quality study. • None of the four wells complies with the WHO standards for the chloride concentration. • Two wells out of the four wells comply with the WHO standards for the nitrate concentration.
	Al Zawaida	• Water supply through 4 wells, with a production of 1,008,751 m^3/y. • The water network efficiency is 74.5%.	• None of the four wells complies with the WHO standards for the chloride concentration. • Only one well out of the four wells complies with the WHO standards for the nitrate concentration.
	Deir Al Balah	• Water supply through 13 water wells • Four water reservoirs: o Desalination plant elevated circular reservoir 100 m^3 o Abu Hamam ground rectangular reservoir 2,000 m^3 o Abu Gharaba ground circular reservoir 1,000 m^3 o Deir Al Balah reservoir (out of service). • The total production is 4,446,800 m^3/y. • The water network efficiency is 53.5%.	** Twelve out of the 13 water wells were included in the quality study. • None of the 12 wells complies with the WHO standards for the chloride concentration. • Two wells out of the 12 wells comply with the WHO standards for the nitrate concentration.
	Al Musadar	• Water supply through 1 well, with a production of 146,840 m^3/y. • The water network efficiency is 58.6%.	• The chloride concentration of the well is higher than WHO standard. While its nitrate concentration is below the WHO standard.
	Wadi Al Salqa	• Water supply through 2 water wells and one ground circular reservoir of 350 m^3 capacity, with a total production of 118,345m^3/y.	** One of these two water wells was included in the quality study.

Governorate	Municipality	Water Supply Status	Quality
		• The water network efficiency is 66.5%.	• The well does not comply with WHO standards for the chloride concentration. But comply with the WHO standards for the nitrate concentration.
Khanyounis	Khanyounis city	• Water supply through 32 wells. • 5 reservoir: o Rahma ground circular 5000 m^3, o Maan ground circular 2000 m^3, o Ayah elevated circular 500 m^3, o Saada elevated circular 300 m^3, o Saada ground circular 1000 m^3 • The total production is 8,904,447 m^3/y. • The water network efficiency is 60.4%.	** 28 out of the 32 water wells were included in the quality study. • Six Water wells out of 28 comply with the WHO standards for the chloride concentration. • The nitrate concentration of 27 wells is higher than the WHO standard. • 100% of Khanyounis Governorate ground water does not comply with the WHO standards.
	Al Qarara	• Water supply through two wells, with a production of 1,323,820 m^3/y. • The water network efficiency is 62.0%.	• The chloride concentration in the two wells is higher than WHO standard, on the other hand, the nitrate concentration is less than the WHO standard.
	Bani Suhailla & Eastern Villages Municipalities	• Water supply through 7 wells. • 9 reservoirs: o Ground circular reservoir 1000 m^3, o Elevated circular 250 m^3, o Ground rectangular 4000 m^3, o Ground circular 1000 m^3, o Khuzaa elevated circular 150 m^3, o Khuzaa elevated circular 400 m^3, Abassan K ground circular 1800 m^3, o Abassan K elevated circular 320 m^3 and o new Abassan elevated circular 250 m^3 • The total production is 2,043,980 m^3/y. • In addition to Mekorot pipeline which provides 1,786,292 m^3/y.	• None of the seven wells complies with the WHO standards for the chloride and nitrate

Governorate	Municipality	Water Supply Status	Quality
		• The water network efficiency is 62.3%.	
	Al Fukhary	• Water supply through 1 well, with a production of 272,143 m^3/y. • The water network efficiency is 66.7%.	• The water well does not comply with WHO standards for the chloride and nitrate concentrations.
Rafah	Rafah city	• Water supply through 21 wells. • 5 reservoirs: o Saudi ground circular 2,500 m^3, o UNDP ground circular 3,000 m^3, o TIKA ground circular 3,000 m^3, o ground circular 4,000 m^3 and o Ground circular 2,000 m^3. • The total production is 8,767,237 m^3/y. • The water network efficiency is 61%.	• Two Water wells out of 21 comply with WHO standards for chloride concentration • The nitrate concentration of 7 wells comply with WHO standards • 95.2% of Rafah Governorate groundwater does not comply with WHO standards.
	Al Nasser	• Water supply through three wells. • One ground circular reservoir of 1800 m^3 capacity • The total production is 427,233 m^3/y. • The water network efficiency is 94.0%.	• Two water wells comply with WHO standards (Al Nasser2, P/163) for the chloride concentration • The three wells do not comply with WHO standards for nitrate concentration.
	Al Shoka	• Water supply through 4 wells, with a production of 518,259 m^3/y. • The water network efficiency is 61%.	None of the four wells complies with the WHO standards for the chloride and nitrate

5.7. Socio-economic Conditions

5.7.1. Population and demography

The Gaza Strip is one of the most densely populated areas in the world, with a population density reaching 5,324 capita/km^2 (PCBS, 2017).

According to the Civil Affairs General Directorate in the Ministry of Interior in Gaza, the total population in the Gaza Strip reached 2,015,644 inhabitants at the end of 2016, with 50.66% of males and 49.34% of females. The highest population is found in Gaza governorate exceeding 778 thousand inhabitants, followed by approximately 391 thousand inhabitants in Khanyounis governorate while the lowest was reported in Rafah with more than 250 thousand inhabitants. The population of the northern governorates reached nearly 328 thousand inhabitants and 283 thousand inhabitants in the Middle Governorates (MoI, 2016).

According to (PCBS, 2014), the average annual population growth is 3.41%. The growth rate is expected to slow down slightly as a result of changes in education and family structure, as has been observed in other Mediterranean countries.

The project is designed to serve the whole population of the Gaza Strip; 2,440,765 inhabitants 2,738,234 inhabitants and 3,044,045 inhabitants in 2025, 2030 and 2035, respectively (Lotti & AI, 2016a).

Age and gender structure

As illustrated in Table 5-10, individuals aged (0-14) have the highest percentage among other age groups in the Gaza Strip as they counts for 44.78% of the total population in the Gaza Strip. Females count for about half of this percentage (48.67 %). While the elderly population aged (65 years and over) constituted 2.54% of the total population.

Table 5-10: Age Structure of Population in the Gaza Strip

Age	Percentage*	Gender Ratio*
0-14 years	44.78%	1.05 male(s)/female
15-24 years	21.25%	1.01 male(s)/female
25-54 years	28.02%	0.96 male(s)/female
55-64 years	3.4%	1.1 male(s)/female
65 years and over	2.54%	0.71 male(s)/female

* Source: CIA World Factbook (2018), Gaza Strip Demographics Profile

5.7.2. Education

Education in the Gaza strip is currently considered one of the basic needs; however access to quality education in a safe, child-friendly environment for children and youth is compromised by a protracted conflict and occupation. According to the PCBS, The 2017 overall illiteracy rate in the Gaza strip has reached around 2.8%. The rate among Palestinians aged 15 and above amounted to 4.7% of the population, 2.9% for males and 9.1% for females. The prevailing social, economic, and political circumstances force many to discontinue formal education. In Rafah governorate, illiteracy rate of 3.8% has been reported which is considered high compared to Gaza 2.4% and the Northern governorate 2.8% (MoHE, 2017).

Table 5-11 below shows the number and type of schools, from perspective of supervision institution, in each governorate. A total of 714 schools were registered in the Gaza strip for the year 2016/2017 distributed as follows:

- 392 school under the supervision of MoHE; 54.90 % of total number
- 267 school under the supervision of UNRWA; 37.39% total number
- 55 schools under the supervision of private sector; 7.7% total number

On the other hand, there are 15 higher education institutions Gaza strip distributed as follows:

- Five universities (One governmental, two public and two private);
- Four university colleges (Two governmental and two private);
- Six Community colleges (One public, one governmental, two private, and two under the supervision of UNRWA).

Table 5-11: Number and Type of Schools in each Governorate, (MoHE, 2017)

Governorates	Governmental	UNRWA	Private sector	Total
North Gaza	65	46	8	119
Gaza	163	70	27	260
Middle Governorate	43	58	6	107
Khanyounis	83	51	11	145
Rafah	38	42	3	83
Total Number	392	267	55	714

The successive aggressions on the Gaza Strip have targeted all aspects of life and aggravated the already existing crisis faced by the education sector. During the 2014 aggression, nearly 615 educational facilities, including kindergartens, schools, and tertiary education institutions, were damaged or destroyed, affecting 350,000 students. The whole student population was affected, including 226,913 students enrolled in 176 governmental schools partially damaged, in addition to four completely damaged schools that used to provide education to around 6,000 students who could not relocate to other schools due to overcrowdings and distance (Abu Mezyed et. al, 2017).

5.7.3. Public Health

A Baseline Study on Water Quality and Public Health in the Gaza Strip was conducted in 2015 by the Gaza-Program Coordination Unit (G-PCU) at the PWA, to explore the health impacts attributed to the existing poor quality of water in the Gaza Strip.

Hepatitis A

Hepatitis A remains a major cause of morbidity among reportable infectious diseases among the refugee population of the Gaza Strip (UNRWA, 2011). A person usually contracts hepatitis A from contaminated water (drinking or washing vegetables/fruits) or food or from close contact with someone who's infected. The mode of transmission is usually oral-fecal route; therefore inappropriate sewage disposal and biological water pollution play an important role in the transmission of the disease.

In 2009, the incidence of hepatitis A across the Gaza Strip governorates was high 45.6 per 100,000 inhabitants, and then dropped to 20.7 per 100,000 inhabitants in 2010. However, since 2010 there is a steady increase from 20.7 per 100,000 inhabitants to 61.4 per 100,000 in 2012 and 73.3 per 100,000 in 2013. The increasing trend of hepatitis was applicable for all governorates with Dier Al Balah, the north, and Khanyounis governorates being particularly affected. Possibly, the conflict, siege and the massive destruction of infrastructure including water resources and inappropriate sewage disposal

together with the decline in socioeconomic indicators had contributed to the spread of the diseases during that period (G-PCU, 2015).

Diarrhea

Diarrheal diseases were the highest self-reported diseases among residents in the Gaza City. Such diseases were more prevalent among people using municipal water than people using desalinated water and water filtered at home for drinking (Yassin, et. al, 2006).

According to (G-PCU, 2015), A constantly increasing trend in the incidence of diarrhea was recorded in both UNRWA and MOH reports, it was clear that there is an increasing trend in the incidence of diarrhea during the period between 2009 and 2013. The rate was 4017.1 per 100,000 inhabitants in 2009 and increased to 6909.1 per 100,000 inhabitants in 2012. After 2012, a steady decrease was observed in the years 2013 (6448.2 per 100,000 inhabitants). Data per governorate shows Deir Al Balah (in 2009, 2010 and 2011) and the North (in 2012 and 2013) elicited the highest incidence rates of Diarrhea while Gaza reported the least incidence. The high incidence of diarrheal disease in some governorates is often linked to contaminated food, poor water quantity and quality and due to bad sanitation and hygiene.

Parasitic infection

Parasitic infection is an intestinal infection caused by a microscopic parasite that's found in areas with poor sanitation and unsafe water. These parasitic infections can cause long-term effects such as anemia, retarded growth and mental disorders (G-PCU, 2015).

This infection is still a public Health problem in the Gaza Strip, due to gaps in sanitation, water, bad hygienic habits, and inadequate community awareness. In the last five years (2009–2013), a total of 57,191 cases were reported as parasitic infestations with a fluctuation trend. The incidence rates shows some declining trends in the last years (in 2009, 776 per 100,000, in 2013 580). In more details, since 2009, the incidence has decreased, from 776.2 per 100,000 inhabitants in 2009 to 710.2 per 100,000 inhabitants in 2010. After 2010 a marked increase was observed in the years 2011 (821.2 per 100,000). The incidence has decreased significantly to reach 719.2 per 100,000 inhabitants in 2012 and 580.5 per 100,000 inhabitants in 2013.

Blue baby syndrome

The study highlighted a recorded increase in nitrate concentration which may cause methaemoglobinaemia in infants. The high methemoglobin level was strongly associated with nitrates concentrations in drinking water wells and the highest mean methemoglobin level was in Khanyounis, where the highest mean nitrate concentration was recorded in drinking water (Abu Naser et. al., 2007).

Typhoid

Typhoid fever is a septicemic illness that is endemic in Palestine. Typhoid usually spreads by drinking or eating food or water contaminated with the feces of an infected person. Risk factors include poor sanitation, poor hygiene and hardship conditions (Wain, et al. 2015).

Steadily decline in the incidence of the disease was recorded in the Gaza Strip in the last several years. At the governorate level, the incidence rate of typhoid has significantly decreased from 25.4 per 100,000 inhabitants in 2009 to 16.22 in 2010, 10.6 in 2011, and 10.1 in 2012. The majority of cases in the years 2009 to 2013 were reported in Khanyounis (G-PCU, 2015).

Meningitis

The available data from all sources show that the incidence rate of meningitis in the Gaza Strip is constantly increasing. Through 2009 to 2013, 7,967 cases of meningitis were reported in the Gaza

Strip. Meningitis related diseases are endemic in Gaza with seasonal and governorate variations. The yearly incidence of meningitis in the years 2009-2013 has increased from 40.7 to 184.4 per 100.000 inhabitants; especially in the last two years. In all years, Dier Al Balah has reported the highest incidence among all other governorates followed by Gaza governorate (G-PCU, 2015).

Kidney Failure

MOH reports indicate that the number of cases with kidney failure is increasing (MOH, 2014); it was 369 in 2009 and increased significantly afterwards. The highest number of kidney failure was reported in Gaza (234) followed by the north (119). Gaza obtained around 40% of cases and the north obtained 20.5% of cases slightly higher than the population concentration in these areas. The lowest reported cases were found in Khanyounis (G-PCU, 2015).

5.7.4. Employment and Workforce

Unemployment in the Gaza strip has been persistently high. According to percentage distribution of labour force participants, April- June, 2017, the general unemployment rate was 44% among labour force participants. 71.5% of unemployment rate for females and 36.2% for males. The working youth in the Gaza Strip engages is somewhat different economic activities. Most employed young persons in the Gaza Strip work in the service sector, followed by commerce and agriculture.

In 2015 Over the Governorate scale within the Gaza Strip, the unemployment rate was reported the highest in Deir Al-Balah with 48%, followed by Khanyounis with 42.5%, while Gaza Governorate had the lowest rate of 29.8%.

Temporary employment is dominant in the Gaza Strip. Many jobs are characterized by daily wages and short-term contracts. In 2017, the average daily wage recorded in the Gaza Strip was NIS 59.5 per day. Although this might be a relatively higher rate compared to other developing countries, it is still too low to allow families to meet daily basic needs, given relatively high prices for basic commodities as a result of blockade and several economic restrictions.

In addition, according to patterns of consumption, the poverty rate is considered to be growing amongst Palestinians. The Gaza Strip experiences extreme poverty amounting to over 65%. The number of people receiving relief aid from UNRWA and international relief agencies is more than a million, which is up to 50% of the population of the Gaza Strip. The Palestinian economy is tightly linked to political changes in the area and consequently this is reflected in the Gaza Strip with regard to particular issues involving poverty, unemployment rates and income levels. Therefore, it is expected that people will tend to look for the most affordable services and commodities to support daily life needs, including purchasing clean water.

5.7.5. Types of Communities

Three main types of communities are found over the Gaza Strip; urban communities or cities, rural communities or semi urbanized areas and refugee camps. Table 5-12 shows the population estimates for different types of localities in different governorates for the year of 2016. In general, Gaza Governorate has the highest population among other governorates and Gaza city has the highest population among other urban communities. While Deir Al Balah Governorate is characterized by having the highest population in refugee camps, and Khanyounis Governorate is found to have the highest population in rural communities.

Table 5-12: Type of Locality and Population Estimates in Different Governorates (PCBS, 2017)

	Locality Name	Locality Type	2016
Gaza Governorate	Ash Shati' Camp	Camp	45,033
	Gaza	Urban	583,870
	Madinat Ezahra	Rural	4,010
	Al Mughraqa (Abu	Rural	8,496
	Juhor ad Dik	Rural	3,795
	Urban Total		**583,870**
	Rural Total		**16,301**
	Camps Total		**45,033**
North Governorate	Umm AlNaser (Bedouin village)	Rural	3,923
	Beit Lahia	Urban	89,949
	Beit Hanoun	Urban	53,094
	Jabalia Camp	Camp	58,517
	Jabalia city	Urban	171,642
	Urban Total		**314,686**
	Rural Total		**3,923**
	Camps Total		**58,517**
Deir Al Balah Governorate	An Nuseirat Camp	Camp	37,366
	An Nuseirat	Urban	48,769
	Al Bureij Camp	Camp	31,932
	Al Bureij	Urban	13,099
	Az Zawayda	Urban	22,530
	Deir al Balah Camp	Camp	8,563
	Al Maghazi Camp	Camp	21,380
	Al Maghazi	Urban	8,696
	Deir al Balah	Urban	72,409
	Al Musaddar	Rural	2,491
	Wadi as Salqa	Urban	6,145
	Urban Total		**171,649**
	Rural Total		**2,491**
	Camps Total		**99,241**
Khanyounis Governorate	Al Qarara	Urban	25,675
	Khan Yunis Camp	Camp	48,969
	Khan Yunis	Urban	185,250
	Bani Suheila	Urban	41,174
	'Abasan al Jadida(as Saghira)	Rural	7,878
	'Abasan al Kabira	Urban	23,914
	Khuza'a	Rural	11,880
	Al Fukhkhari	Urban	7,194
	Urban Total		**283,207**
	Rural Total		**19,758**
	Camps Total		**48,969**
Rafah Governorate	Rafah	Urban	164,000
	Rafah Camp	Camp	46,541
	Al-Nnaser (Al Bayuk)	Rural	8,495
	Shokat as Sufi	Urban	14,453
	Urban Total		**178,453**
	Rural Total		**8,495**
	Camps Total		**46,541**

All communities, regardless of their type, are highly populated and are using water supplied by the public networks (if available) for domestic uses and not for drinking, as will be discussed in the following sections.

5.7.6. Economic Activities and Sectors

Agriculture

The agriculture sector has been the largest economic sector in the Gaza Strip and still plays an important role in the economy. However, a wide array of serious problems including fluctuations of the political environment and the imposition of disruptive and restrictive rules and regulations has adversely impacted the sector (ARIJ, 2015). During the period between 2005 and 2015 the contribution of the agriculture sector to Gaza' GDP fluctuated between 5.6% and 8.5%, reaching 5.7% in 2015 (Paltrade, 2017). The recent Palestinian Central Bureau of Statistics reports (PCBS, 2016) indicate that in the third quarter of 2016, only 4.5% of total workers in the Gaza Strip work in agriculture, and the agriculture sector recorded the lowest average daily wage at 22 NIS.

According to records over the past 20 years, the cultivated land area in the Gaza Strip covers 8.4% of the entire cultivated land in the Palestinian Territories. Irrigated agriculture comprises about 45% of the cultivated land in Gaza and consumes about 60% of the water abstracted. Therefore it is a significant user of existing and future water resources from the over utilized polluted aquifer.

As revealed from field visits, many of the proposed project sites are located in agricultural lands. As mentioned in the land use Section 5.1, number of the sites is cultivated with seasonal crops, grapes and guava and surrounded with olive and citrus orchards along with greenhouses. Detailed description for each site can be found in Section 5.1.

Private Desalination Units

Currently, most of the households in the Gaza Strip do not depend on public supplied water as a drinking water source. The public supplied water is for general domestic use. The only source of drinking water is the fresh filtered water provided by the private sector. The price of this water varies from plant to another and from distributer to another. The current cost per 1 m^3 of purchased desalinated drinking water from private vendors is approximately 30 NIS (CEP, 2015)

There are 154 working private desalination units, with different capacities, distributed along the five governorates of the Gaza Strip. The majority of these units are located in Gaza Governorate (33.1%). Only around 31% of the working active plants are licensed by PWA, of which only 10% have valid license up to 31-December 2015. The main reason is the costly complicated procedure and requirements for licensing these plants (CEP, 2015).

The estimated daily average production of all the plants in summer is 13,128 m^3/d and in winter is 8,656 m^3/d. The produced water is distributed to consumers by plant distributors (owner tanks) or by water vendors (private trucks owners) or both. 51.3% of the plants have their own trucks for distribution purposes; a range between 1 and 7 trucks per plant.

The number of operating staff ranges between 1 to 15 workers for each plant. The workers have different education and qualifications backgrounds; an average of 2.67 operators hold high school or less, an average of 1.1 operators hold a diploma and some operators hold a bachelor or high degree. Thus, the majority of workers and operators in this sector suffer from lack of basic technical qualifications aspects and skills (CEP, 2015).

5.7.7. Current water consumption culture

Currently households in the Gaza Strip do not depend on public supplied water as a drinking water source. The public supplied water is for general domestic use. The only source of drinking water is the fresh filtered water provided by the private sector for a price significantly higher than the public

supplied water. Only 9% of people in the Gaza Strip used municipal water for drinking purposes while 90% used desalinated water from different sources. In addition, approximately, 21% of population has individual in-house reverse osmosis units for drinking purposes mainly (Ismail, M., 2003). Such results indicate the reliance on desalinated water consumption culture among communities in Gaza.

The current cost per 1 m^3 of purchased desalinated drinking water from private vendors is approximately 30 NIS including the delivering cost (CEP, 2015). The public supplier (CMWU network) provides the same volume of water for 0.5 NIS and up to 2 NIS, however with lower quality, and often not for drinking. Therefore, households deal differently with the two sources of water. They usually have different systems to deal with drinkable water such as special tanks and pipes that are cleaned frequently, while the tanks and pipes for the public supplied water are not cleaned.

Based on previous reports and social survey, it appears that communities feel comfortable with individual drinking water consumption as they buy it from the private sector. For public general use water supply the priority appears to be a higher quantity but with less concern about the quality (UNICEF, 2013). The negative impact of the current consumption behavior on the aquifer and potential deterioration do not appear to be of high concern for the general public. People show a higher level of trust in water provided by the private sector because they provide lower salt content.

5.7.8. Water pricing and household budget

Water pricing is a sensitive issue that may affect the sustainability of water supply. Analyses of family expenditure in the Gaza Strip indicate that water expenses do not constitute a major share of their income. This is true even for low income families; water expenditure per month count for less than 2% of the total family expenditure). Comparing this amount with other expenditure components such as food, electricity or even communication, suggests this percent a month is not significant. A very important point is the fact that elasticity of demand for drinking water is very low - an increase in water cost will most likely not affect the level of demand, especially for drinking water.

Current water tariffs vary according to the consumption rate and vary slightly between municipalities. The average water tariff in the whole Gaza Strip, in 2015, was about 2 NIS/m^3 (Fichtner, 2015).

The domination of short-term employment modes; a high rate of unemployment among youth including university graduates; in addition to the various social implications on individual households are factors that increase the level of poverty among the Gaza Strip

5.7.9. Affordability and willingness to pay

Currently, public service providers collect around 35% only of water supply fees as an average of most Gaza Strip areas (UNICEF, 2013). This has affected the ability of the water service provider to sustain the quality of services and affected the affordability to maintain water networks at national level. All the implemented maintenance and some of the operations are therefore covered by projects that are financed by donor companies.

People in the Gaza Strip have suffered from serious economic crisis and a difficult political situation that has weakened the authorities over the last 15 years. This has encouraged people not to pay for public services including water and electricity. Such behaviors have become part of the culture in Gaza Strip. This has caused serious damage to the public sector and consequently to the level of service quality. The current low coverage of water fee collection indicates that communities may not be willing to pay for the improved services due to the project implementation.

6. Environmental Impacts

This Chapter identifies the potential impacts of the project components on the features identified in the EA. It considers impacts during the following project phases:

- Pre-construction

- Construction
- Operational

The pre-construction phase activities are similar in nature to the construction phase activities; hence, the impacts of pre-construction and construction phases are analyzed and dealt with together. Before construction starts, the following pre-construction activities are expected to take place:

- Site fencing and installation of access control gates.
- Site clearing, topsoil removal and site leveling,
- Access roads enhancement works.
- Allocation of a plot of land for temporary areas,
- Provision of temporary connection to service utilities (water, electricity, sanitation)

During the construction phase, several negative impacts are anticipated; however, they are expected to be temporary and within the normal magnitude that is typical to similar construction activities.

During the operational phase, a number of potential negative impacts have been identified, but these have been considered through the design of the project to avoid, reduce or mitigate any significant impacts.

On the other hand, long-term beneficial impacts are anticipated as a result of the provision of additional water infrastructure facilities.

As discussed previously in Chapter 1 of this report, potential impacts have been classified into negative or positive impacts, and evaluated and as high, medium, low, or negligible significance. The classification and evaluation of impacts was initially based on the frequency of issues raised during the scoping session, alongside the professional judgment and experience of the EA team. A summary of the identified key potential impacts during the scoping session is provided in Table 1-1, Chapter 1.

The impacts and limitations presented hereinafter are those common to all proposed project components that are typical to other similar water infrastructure projects in Gaza Strip. Where required, component and site specific issues are highlighted within the discussion.

Impacts during construction and operational phases

Sections 6.1 to 6.6 identify the construction phase and operational phase impacts. Implementing established design and construction standards, and adhering to the mitigation procedures in this EA report will minimize and/or eliminate the anticipated adverse impacts.

The identified environmental issues that are expected to be impacted from this project are:

- Land use and landownership
- Physical environment (air, noise, soil, groundwater)
- Biodiversity
- Cultural heritage
- Existing infrastructure:
- Visual Landscape

Each environmental issue from those listed above was discussed in sections 6.1 to 6.6 in the following sequence:

- Indicating the relevant baseline information for each environmental issue as given in chapter 5.

- Identifying the impact receptors (environment, community, workers)
- Stating construction phase potential impacts, and residual impacts assessment.
- Stating operational phase potential impact, and residual impacts assessment.

A table summarizing the environmental impacts, their receptors, duration and significance is provided at the end of this chapter (Table 6-2). Tables summarizing mitigation measures and proposed monitoring actions for both the construction and operational phase, including the responsible party are provided in Chapter 9 of this report.

6.1. Impacts on land use and land ownership

Based on the assessment of the baseline conditions of land use as provided in section 5.1 in relation to the proposed project activities, the following receptors have been recognized:

- The local environment,
- The local community
- The construction staff and workers.

The potential impacts on land use for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on land use and private property during construction include:

- Loss of existing small-scale agricultural areas.
- Effects on local communities that use existing land.
- Indirect impacts on other receptors including local communities, agriculture and biodiversity.
- Blocking of excavated roads.

The main components of this project as described in chapter 3 and in the land use baseline (section 5.1) are: 20 reservoirs, 6 pumping stations (one main pumping station and 5 booster pumping stations), and the main carrier line and associated transmission loops. The construction of these components will involve the use of different types of lands and will impact the recent land use pattern. The impact of each project component on land use is illustrated hereafter.

During the construction of the 20 proposed reservoirs and the 6 pumping stations, localized impacts are anticipated on land use within the proposed sites and surroundings. Small scale agricultural areas will be lost at 8 reservoirs and 5 pumping stations as these sites are recently used for agricultural activities as illustrated in Table 6-1. These 13 sites are scattered all over the Gaza strip and have small areas per site ranging from 840 to 2,600 m^2 for the reservoirs and from 375 to 6,000 m^2 for the pumping stations sites (More details can be found in Section 5.1).The location maps of all these sites are given in Annex 5. The proposed sites are mostly cultivated with seasonal crops and in some locations there are grapes, olive, and citrus trees. The total agricultural area that will be permanently lost for the construction of the 8 reservoirs is 11,500 m^2 (11.5 Dunums) and 9,600 m^2 (9.6 Dunums) for the construction of the 5 pumping stations. This area is relatively small and scattered along the Gaza strip.

Table 6-1: Recent land use of the reservoirs and pumping stations sites

Project Component code	Number of sites	Recent land use	Area range per site (m^2)
Reservoirs			
ST–020, ST-001C, ST-006B, ST-031, ST-007, ST-009, ST-017, ST-015A	8	Agricultural land	840 to 2,600
C155,ST-023,BL-T01B,ST– 045, F-205B, ST–041, ST-011, ST-032B, ST-033B, ST–015B, TRC (ST-039B),	12	Sand dunes/bare land	300 to 4,000
Pumping stations			
N-01, N-02, N-03, S-01 Main pumping station	5	Agricultural land	375 to 6,000
N-MC2	1	Paved yard	800

There will be no impact on land use at the 12 reservoirs sites given in Table 6-1 as these site are bare land that are recently not used for any purpose. The site used for the booster station N-MC2 is part of a yard that is recently used as a parking area that serves Al Sadaqa Recreation Park that is owned by Gaza Municipality. The remaining area of the parking yard will be enough to serve the cars even after allocating 800 m^2 for the booster pumping station.

Some reservoirs and pumping stations are close to sensitive facilities. Reservior ST-011 in Khanyounis is just opposite to an Islamic cemetery. The booster pumping station N0-2 has its north border adjacent to Al Nakheel recreational resort. Reservior BL-T 01B in Jabalia is adjacent to a kindergarten and a temporary shed used as a mosque. Reservior ST – 015B in Rafah is adjacent to a primary school. The function of the above mentioned facilities may be negatively affected during construction activities. However, appropriate mitigation measures and monitoring will minimize these impacts.

All proposed reservoirs and pumping station sites are now owned by the government or corresponding municipalities and are allocated for the purpose of the project. Official land-swap agreements between the municipalities and the land owners of the privately owned lands have been made to guarantee appropriate compensation from loss of cultivated land and a potential source of income. It is worth mentioning that most of the sites are either governmental, Waqf, or municipality owned lands. The official agreements and land ownership documentation for all sites are given in Annex 6. Table 5-2 illustrates the ownership of each site (Governmental, Waqf, and Municipal) and Table 7-2 discusses the associated social impacts.

According to the PWA, the farmers will be allowed to continue using the land for cultivation and will give them chance to collect their produce or relocate trees in advance before the commencement of the construction activities.

The main carrier line will be installed in the right of way of the rail road (Sikka road) that extends from the north to the south of Gaza strip. Most of the rail road route is unpaved and with an average width of 25m. A 9 km segment of the main carrier (from al Buraij to Al Matahen intersection) will be installed in right of way of Salah Al den road instead of the rail road due to the existence of obstacles in the later road. The main carrier will pass through Wadi Gaza and will be installed in the Wadi bed for a distance of around 100m with a narrow width of trench (around 3 m). The excavation works will temporarily and insignificantly disturb the biodiversity (fauna and flora) in a localized and limited area. The pipe will be laid at a suitable depth to protect it from erosion during the Wadi floods and it will be anchored

to the Wadi bed with buried concrete blocks. After burying the pipes the fauna and flora in the trench area will be restored and will naturally re-flourish. The main carrier will pass through two markets. The first is Al Shejaeya Market where the pipeline will extend for a distance of 300 m in through the market road. The second is Khanyounis Wednesday Market where the pipeline will extend for a distance of 450m. The construction activities in these two sections will disturb the business activities in the area. However, this disturbance is of localized nature and will last for a limited time.

The proposed transmission loops and the internal network replacements will be within the public right-of-way of existing roads as identified within the corresponding municipal master plans. The existing roads are either paved, unpaved or interlock; with or without sidewalks. Excavated roads will be temporarily blocked; however they will be reinstated to their original status within the trenched area, after the installation of the water pipes.

Residual Impact Assessment

The residual impacts on land use and private property from construction activities in the proposed reservoirs and pumping stations sites are considered of *negative short term and insignificant*, due to attaining agreements between landowners, PWA and municipalities.

The impacts on the recreational land use close to Al Buraij booster pumping station N-02 are expected to be of *negative short-term and with low significance*, following the implementation of the mitigation and monitoring measures. Most of the recreation resort activities start after 3PM thus the impact will be limited to 2 or 3 evening hours where the work activities overlap with recreation activities. The impact can be mitigated by controlling the work schedule and coordination with the management and owners of the recreational resort to minimize the disruption and nuisance.

The residual impacts due to the construction of reservoir ST–015B in Rafah and N-MC 2 booster pumping station in Gaza city that are adjacent to schools and Jabalia reservoir BL-T01B adjacent to the kindergarten *negative short-term and with low significance due* to scheduling the construction of these two tanks to be implemented in the summer holiday and /or to limit the daily work activities after the school hours.

During the installation of main carrier pipeline, including the transmission loops and the internal network, the residual impacts on land use, private property and disruption of traffic is considered of *negative short-term and with low significance*, due to potential localized interruption of traffic, which is mitigated by the implementation of an appropriate traffic management plan.

Operational Phase

Potential Operational Impacts

Potential impacts on land use and property during the operational phase include:

- Permanent loss of existing small-scale agricultural areas at locations of the reservoirs and pumping stations.

The change in land use for the reservoirs and pumping stations means that a total area of about 21 dunums will no longer be used for agriculture. The reservoirs will also change the landscape of the area. The sites will permanently change land use from agricultural to built-up areas.

The proposed water pipelines including the main carrier, transmission loops, and downstream will be located within the right-of-way of public main roads. Therefore, there will be no changes to the existing land use at these sites during the operational phase.

Residual Impact Assessment

The impact on land use after mitigation is assessed as a *negative long term impact and Insignificant* based on the limited area to be affected.

6.2. Impacts on physical environment

6.2.1. Air Quality

Based on the assessment of the baseline conditions of air quality as provided in section 5.2.4 in relation to the proposed project activities, the following *receptors* have been recognized:

- The local environment
- The local community
- The construction staff and workers

The potential impacts on air quality for all the project components during the *construction* and the *operation* phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on air quality that may arise during construction are:

- Dust generation and gas emissions leading to the reduction of air quality.
- Nuisance to the local community in the neighborhood of the construction sites.
- Indirect impacts on human health.
- Dust accumulation on adjacent vegetation.
- Limited odors release out of construction vehicles.

Earthworks (excavation, backfilling, soil borrowing)for the main carrier line and pipe networks in addition to the new structures for the pumping stations and reservoirs will result in temporary airborne particles and dust generation. Moreover, traffic movement on unpaved roads to and from construction sites will also generate dust especially in sand dunes areas and silty soils. The dust issue will worsen in dry windy weathers which can occur in Gaza summer season. Most of the reservoir and pumping station sites in this project have unpaved access roads (e.g. ST-023, ST-020, ST-007) and some of the sites are located in a sand dune area (e.g. ST-011,ST-032B,C-155) (see Table 5-2). In addition, more than 90% of the main carrier that stretches for 42.5 km passes through the unpaved rail road track and a considerable length of the transmission loop pipes will be constructed in unpaved roads.

In addition to dust, exhaust emissions from construction vehicles and machines (generators, loaders, excavators, etc.) operating at the project sites may negatively affect local air quality by emission of gases such as carbon monoxide (CO) and nitrogen oxides (NO_x). The impacts will be lasting for the duration of the construction period; the *most susceptible receptors* from the *indirect impact* on health (dust or emission inhalation) are the *construction staff and workers and nearby residents*. The workers and construction staff will be at ***high risk*** due to proximity and long period of exposure to the ***health hazards*** of ***dust*** and gas ***emissions***. The neighborhood public, the pedestrians, and the temporary workers will be at ***low risk*** due to the short time and lower frequency of exposure to the dust and gas emission ***health hazards***.

Residual Impact Assessment

The impacts on air quality from dust and construction vehicles emissions cannot be avoided but are restricted spatially to the areas directly close to generation and decreasing significance with distance. The residual impacts from construction activities in all proposed sites and of all project components are considered *negative short-term and with medium significance*, given that the impacts are reduced with the application of the mitigation and monitoring measures.

Operational Phase

Potential Operational Impacts

The impact on air quality during operation is limited to the standby power generators installed in the pumping stations and reservoirs sites. A typical rate of emissions from diesel generators is 0.7 kg CO_2–equivalent/kWh. The estimated daily emissions (by the ESIA team) from the main pumping station is the highest (6000 kg CO_2–equivalent/day) compared to the 5 booster pumping stations (1500 Kg CO_2–equivalent/day, max booster PS) and the distribution pumping stations at the reservoirs sites (1800 Kg CO_2–equivalent/day, max reservoir PS).

Residual Impact Assessment

The impact on air quality during the operational phase after mitigation is assed as *negative long term impact and insignificant*.

6.2.2. Noise quality

Based on the assessment of the baseline conditions of noise as provided in section 5.2.5 in relation to the proposed project activities, the following *receptors* have been recognized:

- The local environment,
- The local community
- The construction staff and workers.

Construction Phase

Potential Construction Impacts

Potential impacts of noise during construction include:

- Nuisance and health impacts on workers and local residents
- Disturbance to terrestrial fauna.

Construction works for all the project components will require the employment of heavy machinery and transport trucks that will create noise. The impact of construction noise depends on the proximity of the construction activities to noise sensitive receivers (NSRs); the specific heavy equipment deployed; and the length of time over which the construction works are implemented.

The baseline noise levels vary from one component of the project to another. The recent noise along the main carrier is high due (70 – 88 dB) to the heavy traffic along Salaheldein Road that runs parallel to the rail road track in which the main carrier will be installed. The background noise at some of the reservoirs and pumping stations are low (53-56 dB) since they are far from the heavy traffic roads and located in rural areas (e.g. ST-031,ST-009) , while others have a high background noise (70 – 80 dB) due to proximity to heavy traffic roads (e.g. ST-020,ST-045).

It is expected that the construction activities to add up more noise to the existing baseline that will reach to 100 dB along the main carrier and to 80 dB in rural reservoirs located in rural areas .Theses levels of noise exceed the Palestinian Outdoor Noise (PS 480-2005) and WBG/IFC guidelines (55 dB day

time- 45 dB night time for residential areas).The higher noise levels produced during construction of the project components will affect workers and the residents health and amenity and it will affect the terrestrial fauna as well. The project components involving pipelines installations, especially the main carrier, will have a longer impact on a wide range within the community than those of fixed site locations such as the reservoirs and the booster pumping stations. The noise may also disturb the terrestrial fauna along the main carrier and some sites of the reservoirs where these components are surrounded by agricultural areas that form a habitat for the birds' nests. This is anticipated to cause temporary and local nuisance but not be long term or of high impact on residents health or on biodiversity. The workers and construction staff will be at ***high risk*** due to proximity and long period of exposure to the health hazards of ***noise***. The neighborhood public, the pedestrians, and the temporary workers will be at ***low risk*** due to the short time and lower frequency of exposure to the ***noise health hazards***.

Residual Impact Assessment

The impacts from noise cannot be completely avoided during construction, but are restricted spatially to the areas directly close to where it is generated and decreasing significance with distance. The residual impacts from noise during construction in all proposed sites and of all project components are considered *negative short-term and with medium significance*, given that the impacts are reduced with the application of the mitigation and monitoring measures stated above.

Operational Phase

Potential Operational Impacts

Potential impacts of noise in the operational phase include:

- Nuisance and health impacts on workers and local residents
- Disturbance to terrestrial fauna.

Noise emissions during the operation phase are limited to pumps and diesel generators that will be installed in the reservoirs and pumping stations sites. The piping network including the main carrier and the connecting pipes network will not create noise. Pumping stations within each reservoir site and in the booster pumping stations are expected to be the main operational source of noise in these locations. Pumps are expected to create a significant level of noise (in the range of 70 to 90 dB) that may exceed the limits of Palestinian standard for outdoor noise PS 840-2005 mentioned in item 2.1.10 of this study. Moreover, each reservoir and pumping station site will be provided with a backup diesel generator that may produce a noise in the range of 72 to 82 dB . Thus, the workers will the main receptor of the noise impact. In addition, houses located close to the borders of some sites will also be affected. The workers and operators of the reservoirs and pumping stations will be at ***medium risk*** due to proximity and short period of exposure to the ***health hazards of noise*** (short time of the generators deployment). The neighborhood public, the pedestrians, will be at ***low and insignificant risk*** due to the short time and lower frequency of exposure to the ***noise health hazards***.

Residual Impact Assessment

The impact on noise after mitigation is assessed as a *negative long term impact and insignificant*, considering baseline noise levels in the sites, localization and confinement of noise generating sources (such as pumps and motors) and the incorporation of noise reduction measures as listed above.

6.2.3. Soil quantity and quality

Based on the assessment of the baseline conditions of soil as provided in section 5.2.2 in relation to the proposed project activities, the following receptors have been recognized:

- The local environment,
- The local community
- The construction staff and workers

The following is a description of the expected impacts for the construction and operation phases.

Construction Phase

Potential Construction Impacts

Potential impacts on soil during construction include:

- Loss of vegetation cover and venerability to soil erosion by wind and water due to soil structure disturbance by excavation.
- Landslides and other types of soil movements in the works areas.
- Possible soil pollution due to spillage from machinery and construction materials

The main activities under this project that will affect soil are the excavation and backfilling works for the main carrier and the connecting pipe network (Loops), the main pumping station and the 5 booster pumping stations, and the 20 reservoirs sites.

Most of the main carrier and the connecting pipes will be installed in unpaved routes with a total length of around 270 km with an excavated trench of a width in the range of 2 to 4 m and a depth in the range of 2 to 3 m, with an estimated volume of soil to be excavated is 2,000,000 m^3. The excavated area is estimated as 800,000 m^2 along the 270 km of the pipes trenches. This area will be vulnerable for erosion by storm water surface runoff and wind due to the disturbance of its natural properties by excavation. The average area of each reservoir site is 4000 m^2 and the estimated volume of soil to be excavated from each site is 6,000 m^3. Most of the excavated soil from all the project sites is clay and cannot be used technically for backfilling. This soil will be exported out of the construction sites and used for other purposes under the supervision of the ministry of national economy and natural resources (MNE). The construction contractor should be responsible for the coordination with the Department of Quarries in the MNE to decide the locations for clay transfer for storage or for direct use. Suitable backfilling material will be borrowed by the construction contractor from other locations from Gaza for backfilling. Seven of the reservoirs and the pumping stations sites will be constructed on agricultural lands (Table 5-2). Seven reservoirs will be installed on sand dunes land (Table 5-2). Five booster pumping station will be installed on agricultural land while one site will be a paved site that is recently used as a parking area. Hence, the loss of vegetative soil will be experienced only at the sites of the reservoirs and the pumping stations. However, the areas of these lands are relatively small and scattered all over the Gaza strip.

Residual Impact Assessment

The residual impacts on soil from construction activities in all proposed sites and of all project components cannot be completely avoided but are considered *negative short-term and with low significance*, given that the impact is localized and reduced with the implementation of the mitigation and monitoring measures.

Operational Phase

There is no impact on soil quality or quantity during the operation phase due to the project components since all the sites of the reservoirs and pumping stations will be developed with suitable landscaping and the pipes trenches will eventually restore its original characteristic especially after applying the recommended mitigation measures.

6.2.4. Groundwater

Based on the assessment of the baseline conditions of groundwater as provided in section 5.2.7 in relation to the proposed project activities, the following receptors have been recognized:

- The local environment,
- The local community

The following is a description of the expected impacts on groundwater and the proposed mitigation measures for the construction and operation phases.

Construction Phase

Potential Construction Impacts

Potential impacts on groundwater during construction include:

- Pollution of groundwater from excavations or from pollutant spillages during construction.

Potential impacts on groundwater quality could occur through creating pathways for pollution during various excavation and backfilling works for the reservoirs facilities and for the installation of pipes (around 270 km). In general, it is expected that works will not have impacts on the groundwater since the excavations will be at the surface and typically above the level of groundwater that exists at a depth of 30 to 70 m below ground surface. But in rare cases, quality of the groundwater may be contaminated during construction works by spillages accidents including: spillage of raw sewage from damaged cesspits, oil from construction equipment and any other possible contaminants to the groundwater systems. Thus, groundwater will be at ***low risk*** of pollution from the exposure to ***spillage hazard***s due to the shallow excavation and deep aquifer in all the project areas. Moreover the expected quantities of spillage (sewage, oil, etc..) are relatively low.

Residual Impact Assessment

The potential for spillage accidents to occur is short term and of low probability during construction period if mitigation measures are implemented. However, if they occur the residual impact on contaminating groundwater sources is considered of *short term negative with low significance*.

Operational Phase

Potential Operational Impacts

Potential impacts on groundwater in the operational phase include:

- Improved water supply infrastructure and additional water resources (desalination and Mekorot connections) will help to reduce over-abstraction from the groundwater.
- Improved treated wastewater quality will help to reduce over-abstraction from the groundwater for agricultural use.

The overall effect of the proposed project is integrated within the larger package of water infrastructure improvements undertaken by PWA, which will contribute to reducing pressure on the aquifer from over pumping, slowing the rate of sea water intrusion and reducing the deterioration of groundwater quality by providing additional alternative sources from desalination. According to PWA, many wells in the project area will be decommissioned from the system for poor quality. PWA anticipates that ceased pumping for approximately 30 years may allow recovery of the costal aquifer.

The improvement of water storage facilities and water supply networks will improve the availability of water supply by blending and storing water, and reduce the amount of water losses through leakage. This will in turn reduce abstraction rates from groundwater, increase the groundwater table, reduce seawater intrusion and improve groundwater quality as a consequence.

Another beneficial indirect impact that will result from the implementation of the project is the increase in the potential of wastewater reuse since the new water supply will reduce the salinity of the generated wastewater. Thus the treated wastewater will become suitable for reuse in irrigation. For example, the current salinity of the treated wastewater in Gaza and the Middle Governorates is in the range of (2,000 – 3,000) mg/l as TDS. And it is expected that the implementation of the project will reduce this value to less than 1,000 mg/l. taking into consideration the significant increase in the amount of generated wastewater (see section 6.55) this impact will result in a *positive significant* impact on the groundwater aquifer.

Residual Impact Assessment

The impact on groundwater is assessed as a *long term positive impact with high significance*, considering the improved water supply and quality and reduced water abstraction from groundwater wells.

6.2.5. Surface water

Based on the assessment of the baseline conditions of surface water as provided in section 5.2.6 in relation to the proposed project activities, the following receptors have been recognized:

- The local environment

The following is a description of the expected impacts on surface water for the construction and operation phases.

Construction Phase

Potential Construction Impacts

Potential impacts on surface water include:

- Hydrological changes linked to flooding and runoff during construction.
- Formation of stagnant water ponds due to improper management of construction material storage and waste.
- Water quality impacts from excavations or from pollutant spillages during construction.

There are two locations only where surface water body is identified in the vicinity or intersects with project components. The first location is where the main carrier trench crosses Wadi Gaza (section 8

north). The second location is the site of Deir Al Balah booster pumping station site (N-01) which is located at a close distance to the Wadi northern bank.

Regarding the first location, the water carrier will be constructed across Wadi Gaza bed for a distance of 100 m with an estimated trench width of 6m. The estimated construction time of this section of the main carrier is 10 days which is a very short time. Thus, the expected impact on the surface water in this location is insignificant given the localized nature and the short duration of construction and the possibility to construct this section in the dry season when the Wadi is not running. Moreover, the main carrier will be buried under the bed of the Wadi and will not be affected by flooding during operation phase and will not create any obstruction to the flow in the Wadi.

The second location is Deir Al Balah booster pumping station site (N-01) that will be constructed adjacent to Wadi Salqa. The construction of the booster pumping station will encounter many activities (excavation, spillage …) that may affect the surface water during the winter since Wadi Salqa is a seasonal Wadi. On the other hand, the pumping station may be exposed to the risk of flooding due to its proximity to the Wadi.

During construction, blockage of storm water runoffs is a potential impact due to inappropriate management of debris and excavated soil and stockpiling of construction material, which would potentially result in water pooling and flood risks. Stagnant water pools may produce algal blooms, anoxic sediments, and odors which could become a nuisance for the surrounding area. In addition to flood risks, the main potential risk to surface water quality, particularly near the Wadi, is from potential spills and leaks from construction machinery. The ***risk*** of pollution of surface water from the exposure to ***spillage hazard***s during construction is assessed as ***low risk*** due to the buffer distance between Wadi Salqa surface water and the pumping station site. Moreover the expected quantities of spillage of oils, from machinery are relatively low.

Residual Impact Assessment

The residual impacts on surface water during construction in all proposed sites and of all project components are considered ***local negative short-term and insignificant***, given the implementation of the appropriate mitigation and monitoring measures.

Operational Phase

Potential Operational Impacts

Potential impacts on surface water in the operational phase include:

- Discharges of washout water from tanks or pipelines.
- Pollution from fuel spillages.
- Flood risks to new infrastructure.

During operation maintenance, cleansing and disinfection of facilities in the booster pumping station site will be required. Chemical spillages and/or leakage and the use of diesel generators will require fuel storage, so ongoing risk of diesel spills could also affect surface water.

The new structures in the booster pumping are exposed to the risk of flooding. Thus, the finished floor level of the booster pumping station should be raised above the expected flood levels and a concrete

fence should be built to surround the site. These measures should be communicated with the designer to be included in the tender documents. The ***risk*** of pollution of surface water from the exposure to spillage hazards during operation is assessed as ***low risk*** due to the buffer distance between Wadi Salqa surface water and the pumping station site (N-01). Moreover the expected quantities of spillage (disinfection chemicals, oil, etc..) are relatively low.

Residual Impact Assessment

The impact on surface water after mitigation is assessed as a ***negative short term impact and insignificant***, considering the baseline surface water environment and the low probability and short term nature of any impacts from accidental pollution.

6.3. Impacts on biological resources

Based on the assessment of the baseline conditions of terrestrial biological resources and biodiversity as provided in section 5.3 in relation to the proposed project activities, the main receptor is the local environment.

The potential impacts on biological resources and biodiversity for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts:

Potential impacts from the project components on terrestrial biodiversity during construction include:

- Direct habitat loss or disturbance during construction site preparation.
- Disturbance to or displacement of faunistic species during site clearance and construction.

According to the baseline terrestrial ecology review and site visit observations (Section 5.3), it was discovered that no traces of significant or sensitive biological resources or habitat or species of high conservation value (flora or fauna) have been found within the proposed project sites along the route of the pipes. The reservoirs and the pumping stations sites are in areas with limited faunistic habitat potential, with the exception to the existing cultivated crops (such as the booster pumping station of Rafah, cultivated with tomatoes) or herbs and trees (such as the main pumping station, cultivated with small Guava trees).

Most of the excavation works for network pipeline installations will be in urban areas that lack significant flora or fauna diversity. Most floristic species identified are herbal types that are characterized by short-lived style and rapid ecological colonization.

With regard to faunistic species, there is potential that some common species of no conservation value will lose access to habitat during construction on the proposed project sites. There are slight chances of encountering smaller resident mammals such as birds, hedgehogs, and reptiles such as desert monitors in the proposed sites of reservoirs and pumping stations. Thus, the risk of fuanistic species to get harmed due to the exposure of excavation hazards is assessed as ***insignificant risk***.

Residual Impact Assessment

Based on the habitat types of the sites with no particularly sensitive ecology and lack of identified fauna during site visits, the residual impacts on terrestrial biodiversity during construction on all project sites

are considered *local negative short-term with low significance*, given that some localized impacts on existing biodiversity cannot be completely avoided, but are reduced by the application of the proposed mitigations and monitoring measures.

Operational Phase

Potential Operational Impacts

Once the project sites are operational, there are not considered to be any potentially significant impacts, positive or negative, on terrestrial biodiversity.

Residual Impact Assessment

The impact on terrestrial biodiversity during operation is assessed as *insignificant*.

6.4. Impacts on cultural heritage

Based on the assessment of the baseline conditions of cultural heritage in section 5.4 in relation to the proposed project activities, the main receptor are:

- The local environment.
- The local community

The potential impacts on cultural heritage for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on cultural heritage during construction include:

- Disturbance to culturally valuable areas to the local community.
- Disturbance to unknown / buried archaeology during excavations.

Based on observations from the site visits and consultation about proposed locations during the scoping session, no traces of archaeological and cultural heritage have been identified in the sites where project activities will be implemented. Most of the archaeological sites are located towards the West of Gaza Strip and usually in proximity to the coast, but these are away from the proposed project locations. Moreover, the officially identified archeological sites in Gaza strip are presented on a map produced by the MoTA and these sites where checked by the ESIA team and none of them coincides with any of the project sites.

If unexpected or buried archaeology is discovered during construction, the chance find procedures will be used; work activities will to be stopped immediately and the responsible competent authority (MoTA) needs to be contacted. Work will not be allowed to proceed without a written approval from the relevant agencies.

Residual Impact Assessment

The residual impacts on cultural heritage during construction on all project sites from all proposed components are considered *negative short-term and insignificant.*

Operational Phase

Potential Operational Impacts

As mentioned above, no archaeological heritage sites are known to exist in the proposed project sites. The risk of discovering buried heritage is limited to the construction phase only. Once the project sites are operational, there will not be any potentially significant impacts, positive or negative, on historical or archaeological heritage.

Residual Impact Assessment

The impact on historical or archaeological heritage during operation is assessed as *insignificant.*

6.5. Impacts on existing infrastructure

Based on the assessment of the baseline conditions of infrastructure given in section 5.5 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community

The potential impacts on the existing infrastructure for all the project components during the construction and the operation phases are given hereafter.

6.5.1. Utilities and Public Services

Construction Phase

Potential Construction Impacts

Potential impacts on existing public service utilities during construction include:

- Interruption of public service supplies due to:
  a. Accidental damage during excavation to existing utilities such as wastewater sewers, water pipes, communications and electrical cables
  b. Reallocation of some utilities to accommodate the new pipes.
- Risk on public health and surrounding environment due to the spill of raw sewage from damaged sewers.

The excavations for the 20 reservoirs and the 6 pumping stations is unlikely to cause damage to since these sites as mentioned previously are either agricultural or bare lands that don't accommodate any infrastructure utility. Excavation works for the installation of the water pipelines are the major cause of potential damage to existing utilities since keeping in mind that the total length of the pipes that will be installed in this project is around 270 km. The lack of as-built drawing for the existing infrastructure utilities increases the possibility of their accidental damage. The excavation in the paved roads is the most critical task for the contractor. According to the design documents, a length of around 9 km in Salaheldein paved road (from Al Buraij to Al Matahen intersection) will be cut and excavated to install the main carrier. This section of the road accommodates lots of infrastructure utilities. If the excavation works are not performed with care, the probability of damaging the utilities and harming the public health and the local environment is high. The route of the main carrier in the unpaved rail road (Sikka road) is mostly empty from underground utilities. On the other hand, the transmission loops and the distribution pipes will be installed in a more vulnerable route since they run through build-up areas with intensive presence of infrastructure utilities.

Residual Impact Assessment

The impacts on existing infrastructure utilities and public services during construction from all project sites may not be completely avoided given that accidental damages may potentially occur, or particular interruptions to public services may still be required to be executed, especially when connecting to the existing water supply system. Therefore, the residual impact following the implementation of the proposed mitigation measures is considered of *short term, negative with low significance*.

Operational Phase

Potential Operational Impacts

The construction of the project components including the reservoirs, pumping stations and pipelines will considerably contribute to the overall improvement of the water infrastructure in Gaza Strip as planned by the PWA as discussed later in the Cumulative Impact section later in this chapter.

However, the impacts on the existing infrastructure during operation due to the proposed facilities under this project include:

- Occasional need to disturb roads for future maintenance of network pipes.
- Additional load on existing sanitation and sewer collection systems and existing wastewater treatment plants.
- Additional demand on energy and power supply in the local area where the facilities are proposed especially the boosters and the reservoirs pumping stations.

6.5.2. Roads and Traffic movement

Based on the assessment of the baseline conditions of roads and traffic movement given in section 5.5.1 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community.

The potential impacts on the existing roads and traffic movement for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on existing roads and traffic movement during construction include:

- Damage to road infrastructure from excavations and construction traffic especially the movement of heavy machinery.
- Disruption of traffic including vehicles and pedestrians movements and risking public safety.

As mentioned previously, all the pipe lines will be constructed in the public right-of-way of existing roads which are either paved, interlock or unpaved roads. This is to limit disruption to private property as much as possible. The installation of the main carrier pipe line, the transmission loops, and the distribution pipelines involves cutting and removal of existing pavements and interlock tiles. It also involves the excavation and destruction of the existing road layers. The main carrier will run for 9 km inside in the newly constructed Salah Al Deen road. It will also run through a considerable length of paved roads in Rafah city. However, most of the carrier line will run through the Sikka unpaved road. Traffic flow, including vehicles and pedestrians, during excavations and pipeline installation works will be interrupted especially in densely populated and heavy traffic areas. Heavy construction machinery may have an indirect impact on the public safety and may damage existing infrastructure utilities. The

risk of traffic movement to be interrupted due to the construction works of the main carrier and the main transmission pipes is assessed to be as ***high risk*** since the works will be along and in close proximity to heavy duty roads such as Salaheldein road. Accordingly, the ***risk*** of accidents between vehicles and accidents with pedestrians is assessed as ***high risk***.

Residual Impact Assessment

The impacts on roads infrastructure and traffic movement during construction on cannot be entirely prevented. However, impacts can be reduced to *short term, negative with low significance*, given that the impact is localized, during an accelerated construction process and implementation of all appropriate mitigation measures as illustrated below.

Operational Phase

Potential Operational Impacts

Potential impacts on roads and traffic during operation include:

- Occasional need to disturb roads for maintenance of network pipes in case of damage.

There would be no effects on roads and traffic during operation of the projects due to the installed pipes. However, in case of maintenance or repair of damaged pipes, there will be infrequent localized disturbance of roads and traffic flow.

Residual Impact Assessment

The impact on roads and traffic during operation is assessed as *insignificant*.

6.5.3. Energy and Electricity

Based on the assessment of the baseline conditions of energy and electricity given in section 5.5.2 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community.

The potential impacts on the existing energy and electricity for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on electricity supply during construction include:

- Accidental damage during excavations to existing electric utilities infrastructures such as electrical cables and poles.
- Relocation of electrical cables and poles during the pipelines installation that will cause temporary interruption to public services.

During the construction of the pipe lines under this project that extend for a distance of a round 270 km accidental damage to existing electric utilities is most likely to happen. Moreover, the relocation of electric cables and electric poles is usually needed. This results in finical losses to repair the damaged facilities and will interrupt the public services and may indirectly risk the public health and safety.

Residual Impact Assessment

The residual impacts on electricity due to the construction of the project components especially the pipelines are considered *short term, negative and insignificant*, given that there is a potential for interruption due to accidental damage or requirement to relocate electricity services utilities.

Operational Phase

Potential Operational Impact

Potential impacts on energy use during operation include:

- Increased demand on energy to operate the pumping stations.
- Shortage of electricity supplies if the additional demand of the new pumping stations is solved at the expense the local community.
- Failure to provide sufficient power supply to ensure the operation of the proposed facility
- Interruptions in power supply could cause damage to the project infrastructure due to surges or loadings.

According to the Energy Management Plan Report (2017) prepared for this project and the desalination plants, a considerable amount of energy is required to meet the demand of the water supply system.The management plan considered the typical alternative energy sources normally used in Gaza Strip to contribute in saving additional power supplies. These sources include diesel generators and photovoltaic solar system which will be installed on the roofs of the proposed buildings as a supporting power supply for all the pumping stations in this project (1 main, 5 booster, and 20 reservoir pumping stations). Moreover, micro power generators will be installed on the inlet pipes to recover energy from the pressurized water interring the reservoirs. These micro power generators were found to be feasible for 5 reservoirs only out of the 20 reservoirs to be constructed under this project.

The 20 reservoirs pumping facilities and the 6 pumping stations will be equipped with Variable Frequency Drives (VFDs) that work on stabilizing pumping rates and motor cycles in manner that stabilizes energy consumption. All proposed facilities will be provided with adequate transformers that are compatible with the existing local grid system, energy efficient and in accordance to the power utility company requirements.

Because of the political instability in Gaza strip, a consistent power supply from the grid is not guaranteed and the fuel for the backup Diesel generators is not always available.

Moreover, there may also be an indirect effect that increased demand for these resources may affect the power supply to the local community. According to the Energy supply report 2017, it is estimated that the associated works will require 7.15 MW of electricity at 2020 and will increase to 9.11 MW by 2035. The recent need of power in Gaza is 550 MW according to GEDCO, while the available power from the different electricity sources is in the range of 140-200 MW only according to GEDCO. Thus the demand of the power supply at the first run of the project on 2020 will be around 3.5% to 5.0% of the total available power supply in Gaza. The power demand of the central desalination plant (not included in this project) is around 25 MW will have more impact on the local community than the associated works included in this project. The two projects will be running at the same time so they will have a cumulative impact on the power demand and will significantly affect the local community power supplies. However, as illustrated above, there is a plan that includes the construction of a power generation station to feed the desalination plant and to minimize its dependency on the general electricity grid.

Despite of the considered measures during the design phase, the impact during the operational phase cannot be completely avoided, given the uncertainties for any improvements on the current power supply conditions in the near future.

Residual Impact Assessment

The impact on energy and power supply during the operational phase cannot be avoided due to the required considerable consumption of energy of the proposed facilities. The impact is reduced to *negative long term impact with low significance*, considering the selection of energy efficient equipment and the incorporation of a renewable source and energy recovery mechanisms.

6.5.4. Solid Waste Management and Disposal

Based on the assessment of the baseline conditions of solid waste management given in section 5.5.3 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community
- The construction staff and workers

The potential impacts on the existing solid waste management for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts of solid waste during construction include:

- Generating demand for additional land fill capacity.
- Harm to human health or the environment from improper handling, transport and disposal of waste.
- Unfavorable impact on the aesthetics of the area due to solid waste accumulation.
- Additional load on municipal waste management.

The construction works will produce a wide range of liquid and solid wastes. These wastes include: packaging and domestic wastes, spent welding rods, grinding wheels, visors and shot blast from welding operations, spoil and surplus rock from boring activities or backfilling, used lubricating oils from machinery maintenance, rest of materials, pieces of pipes and cables, sludge from waste water and pressure test and disinfection waters. In case of improper management of construction solid waste the local environment will be negatively impacted in terms of pollution and risking wildlife. Moreover, public health and safety of the local community will be negatively impacted. The contractor should set a solid waste management plan in coordination with local authorities including the solid waste transfer routs and the proper dumpsites. The majority of the generated waste is non-biodegradable, and may be persistent to their final disposal location. Therefore, mechanisms to reduce construction waste generation, as well as reuse opportunities shall be considered.

Residual Impact Assessment

The residual impacts on solid waste management during construction on all project sites and of all proposed project components are considered *insignificant*.

Operational Phase

There are not expected to be any particular significant issues for solid waste disposal during operation of the projects.

6.5.4. Hazardous Material and Waste

Based on the assessment of the baseline conditions of hazardous materials and waste given in section 5.5.3 in relation to the proposed project activities, the main impact *receptors* are identified as:

- The local environment.
- The local community
- The construction staff and workers

The potential impacts of the hazardous materials and waste for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts of hazardous material and waste during construction include:

- Harm to human health from contact with substances and waste.
- Indirect impacts on surface or groundwater quality from accidental discharge of hazardous waste.

Two possible sources of hazardous waste are expected during the construction of the project components under this project; presence of old Asbestos Cement (AC) pipes and use of epoxy paint for the insulation of the internal surfaces of the reservoirs.

Practical experience and public health literature indicate that exposure to epoxy may lead to serious health hazards. When epoxy fumes are inhaled, they can affect the nose, throat, and lungs. Most symptoms from the inhalation of epoxy involve inflammation and therefore irritation of the nose, throat, and lungs. Repetitive and high amounts of exposure to these fumes can result in sensitization and asthma. Though epoxy hardners are not considered hazardous in their purchased form, they may become regulated hazardous material if they are mixed with other chemicals, which is not the case when used for reservoirs lining. In addition, inappropriate storage and disposal of epoxy may be associated with contamination concerns.

AC pipes were used in the water supply networks of Gaza strip in the 1970s before they were later banned from use until the recent time due to health concerns. A gradual, but slow, replacement of the AC pipes by other pipe materials (mainly UPVC& HDPE) took place in the last twenty years. However, few kilometers of AC pipes still in use and some will be substituted under this project with other pipe materials.

Exposure of the public and workers to crushed asbestos fibers are known to be hazardous to human health, including three major health effects: lung cancer, mesothelioma, and asbestosis. In addition, crushed asbestos is classified as Regulated Asbestos Containing Material (regulated waste) according to the EPA's National Emission Standards for Hazardous Air Pollutants (NESHAP). Moreover, the environmental health and safety (EHS) guidelines issued by the World Bank Group (WBG) presents hazards posed by Asbestos Containing Materials (ACM) and procedures to deal with situations where these materials are encountered during construction.

As indicated above, the hazards in construction sites will occur if the workers are exposed to crushed asbestos fibers. To avoid this situation, the old AC pipes will not be excavated and will remain intact and buried institute. This process is the most suitable method to prevent the pipes from being crushed during excavations. However, accidental crushing of AC pipes that may occur can be tackled by following the mitigation measures given in Chapter 9.

According to the Palestinian National Strategy for Solid Waste Management-2010, asbestos is also mentioned as a hazardous material; however, ways for AC management and disposal are not mentioned in the above mentioned document. Moreover, there is no specialized sanitary landfills in Gaza strip that can be used for the disposal of AC pipes in case of removing it from ground. In the recent practice, hazardous waste including asbestos is currently being mixed with domestic waste at the existing landfills.

In such condition, and due to the various reasons explained above, it is recommended to abandon the AC pipes in place, and to be substituted by new pipes.

Indirect impacts on surface or groundwater quality from accidental discharge of hazardous waste may occur. However, the groundwater in the project sites is considerably deep (in the range of 30 to 70m below surface) and the expected amounts of chemicals or equipment oil spillage is negligible and no significant effect on groundwater is expected. The only structure that is adjacent to a surface water body is the Dier Al Balah booster pumping station (N-03) that is located just to the north of Wadi Al Salqa (a seasonal Wadi). The pillage of chemicals may affect the surface water quality in the winter season only. This Wadi runs 3 to 4 times per year for 2 to 4 days each run according to the intensity of rain storms and the upstream flow coming through the Gaza strip eastern boarders. Nevertheless, the impact on the surface water is temporary, localized and very limited to this site.

Residual Impact Assessment

The residual impacts from hazardous material and waste during construction of all project sites are considered *short term, negative and low significance*. This assessment is based on the fact that accidental spills, contact with chemicals, and contact with accidentally crushed AC pipes may occur even after implementing the above stated mitigation measures. This may affect occupational health and safety conditions.

Operational Phase

Potential Operational Impacts

Potential impacts of hazardous materials and waste during operation are related to use of chemicals and include:

- Indirect impacts on human health from contact with chemical substances.
- Indirect impacts on surface or groundwater quality from accidental spillage of chemical substances.

The only chemical of concern in the operational stage is sodium hypochlorite that will be used as a disinfectant in the proposed 20 reservoirs to be constructed under this project. Exposure to sodium hypochlorite may cause skin and eye irritation or other allergic responses. Long exposure to this chemical may lead serious allergies especially to the respiratory system. The proposed automated

chlorination feed equipment will control the dosing of the chemical via feed lines, minimizing the direct contact of the operator with the chemical.

The impact on the groundwater and surface water in the operational period is similar to that in the construction period as mentioned above and expected to be insignificant as discussed.

To minimize the negative impacts, particular working requirements should be controlled by personnel training on safe working practices to avoid any accidental effect on the workers' health and local environment.

Residual Impact Assessment

The residual impacts from hazardous material during operation are *short term, negative and low significance*, considering the fact that accidental spill of chemical and the personnel contact with hazardous materials may occur and affect the public health even after implementing the mitigation measures.

6.5.5. Sanitation and Wastewater Generation

Based on the assessment of the baseline conditions of sanitation and wastewater given in section 5.5.4 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community
- The construction staff and workers

The potential impacts on the existing sanitation and wastewater for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on sanitation during construction include:

- Accidental damage during excavations to existing utilities and structures, including cesspits and sewer pipes.
- Need for relocation or temporary interruption public services.
- Spills of raw sewage due to accidental damage of sewer lines or cesspits.
- Indirect impacts on public and workers health from accidental raw sewage spills

The existing connection rate to the sewage collection system varies from 40% to 90%. Hence, a large number of buildings (houses, institutes and commercial stores,…etc.) use cesspits for wastewater disposal. These cesspits will be found along the pipelines routs especially in the densely populated areas. The accidental damage of these cesspits is highly expected based on previous experience with similar projects in Gaza. Moreover, the sanitary sewers may also be damaged during construction or relocated in some sections to accommodate the new water pipelines under this project. The damage of cesspits and/or the sanitary sewers will lead to spill of wastewater and consequently may pose a threat to the workers, public health, and ground water quality. It will also disrupt public services and the traffic flow.

Residual Impact Assessment

The impacts on existing sewage collection infrastructure during construction from all project sites especially the pipelines installation is not completely avoidable given that accidental damages may

potentially occur, or particular interruptions to public services may be required to be executed. Therefore, the residual impact following the implementation of the proposed mitigation measures is considered of *short term, negative with low significance*.

Operational Phase

Potential Operational Impacts

Potential impacts on wastewater infrastructure during operation include:

- Overloading the existing wastewater infrastructure due to additional wastewater generation as a result of the increased water supply after the construction of phase I of the Gaza Central Desalination plant and this project's components.

Wastewater is typically produced at the rate of 80% of the water consumed. Thus, increasing the water supply and the per capita share of water will increase the wastewater generation.

According to the plans of PWA, as illustrated in Table 3-1, the total water supply from all water resources (GCDP, Mekorot, groundwater, STLV) will increase from 116.6 to 166.7 MCM/y between 2020 and 2035, respectively. The per capita water share will increase from 70-90 l/c/d to 120 l/c/d. The water distribution system will keep working at intermittent basis up to year 2030 while continuous service will take place in 2035 (the target year). Thus, a considerable increase of water supply will take place (around 50% increase) and the NRW is expected to be reduced to 20% by 2035 compared to 40% recently. Based on that, the wastewater generation due to the development on the water supply projects including the project under consideration (The associated works) will considerably increase (around 70 % increase). The recent wastewater production is estimated at 140,000 m^3/d and expected to increase due to the additional water supply to 250,000 m^3/d by 2035.

Based on these estimates, it is expected that some parts of the existing wastewater collection system needs to be upgraded to be able to accommodate the additional flow. The full capacity of the three central wastewater treatment plants: NGEST, Gaza Central, and Khanyounis is 36,000 m^3/d, 180,000 m^3/d, and 44,000 m^3/d, respectively. Thus the total capacity of these three WWTPs is 260,000 m^3/d. However, these treatment plants are still under construction of the first phase of each one and will reach their full capacity only after implementing all phases in the range of 2030 to 2040. The existing Rafah wastewater treatment plant has a full capacity of 15,000 m^3/d ant it is already overloaded and doesn't meet the required treatment standards. Comparing the capacity of the three planned and the existing wastewater treatment of Rafah (275,000 compared to 250,000 m^3/d) it is expected that the treatment plants will be able to accommodate the increase of the wastewater generation due to the additional water supply. However, the PWA should keep working on implementing the construction of the remaining phases of the three central WWTPs and increasing the capacity of Rafah WWTP according to the planed time schedule.

Residual Impact Assessment

The impact on wastewater infrastructure is assessed as a *medium term negative impact with low significance*. Mitigation of this impact is outside the scope of this project. The responsible parties including PWA and the local municipalities are advised to expedite planning and establishing adequate wastewater collection and treatment systems in the project area that consider the projected population growth and the expected increase of generated wastewater.

6.6. Water Supply and water Quality

Based on the assessment of the baseline conditions of water supply and water quality given in section 5.6 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment.
- The local community
- The construction staff and workers

The potential impacts on water supply and water quality for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on water supply and water quality during construction include:

- Interruption of water supply services to local communities.
- Risk of water pollution from wastewater leakage or oil spillage from construction equipment.

This project involves the construction of 42.5 km carrier pipeline in addition to 110 km of transmission loops and 110 km of distribution network. During the construction activities, it is most likely that the existing water supply will be temporary interrupted in cases of connecting the new pipes with the existing system and in cases of water quality testing. It may also be interrupted incases of accidental damage of existing water supply pipes. In all these cases the water supply will be turned off and the local communities will be negatively affected.

Negative impact on water quality of the existing water distribution system is likely to happen in cases of leakage of wastewater from damaged cesspits or sewage pipes and from oil spillage from construction equipment. These pollutants may inter the water distribution system during the repair of damaged pipes or from loose pipe connections.

Residual Impact Assessment

The residual impacts on water supply during construction on all project sites are considered of *short term, negative with low significance*, given that interruption of water services on the communities cannot be avoided on the local level, during executing the connections of the new pipes to the existing supply and distribution system.

Operational Impact

Potential Operational Impacts

Potential impacts on water supply quantity and quality during operation include:

- Increasing the water supply quantity
- Improving water supply quality.
- Risks of water contamination during storage, transmission, and/or distribution

The impacts on water supply quantity and water supply quality are illustrated hereafter in two separate subsections.

6.6.1. Impacts on Water Supply Quantity

The project under consideration will contribute with other projects in increasing the quantity of water supply to the Gaza strip residents. The additional water supply as presented in Table 3-1 will come from the GCDP, 3 STLV plants, and Mekerot connection in addition to existing groundwater wells with good quality. According to Table 3-1, the water supply will increase on phases as it will be 116.6, 133.6, 149.9, and 166.7 MCM/y at the years 2020, 2025, 2030, and 2035, respectively. Moreover, the per capita share of water will increase gradually from the recent range of 70-90 l/c/d to reach 120l/c/d by 2035 (the target year). The recent water supply in the Gaza strip is estimated at 95.5 MCM/y. However, due to the high percent of NRW (40-50%), the amount of water that reaches the residents is 53.5 MCM/y as illustrated in Table 5-8. Moreover, and because of the deteriorated quality of more than 50% of the water wells (136 wells will be closed out of a total of 285 wells), a considerable amount of the recent 95.5 MCM/y will be excluded (around 45MCM/y). Thus, the project in fact will increase the water supply from 50 MCM/y to 116.6 MCM/y at the year 2020, reaching to 166.7 MCM/y at 2035. Another important contribution of the project is the reduction of NRW from 40-50% recently to an estimated value of less than 20% by 2035. This will increase the water amount reaching the residents and will contribute in increasing the water share per capita to the WHO guidelines of 120 l/c/d.

The construction of 19 reservoirs under this project will considerably improve the water supply infrastructure. These reservoirs (besides the existing ones) are expected to reduce the gap between supply and demand that will provide more uniform water distribution pattern within their service areas.

6.6.2. Impacts on Water Supply Quality

The project under consideration (The associated works) is a substantial component within a larger package of infrastructure that the PWA is planning to execute to meet the high demand on water supply in the Gaza strip. As illustrated in the project description, the 20 reservoirs that will be constructed together with the existing reservoirs will be used to blend the good quality water from the GCDP, 3 STLV plants, and Mekorot supplies with water from selected existing groundwater wells. Moreover, the main carrier pipe line (42.5 km) together with the transmission loops (110 km) that will be constructed in this project are considered a vital link between the produced water supplies and the blending reservoirs along the Gaza strip.

The blending process that will take place in the reservoirs from the different resources mentioned above will dilute the chlorides, the nitrates and the TDS from the recently found in the groundwater wells and will lead to the improvement of the water quality. As illustrated in section 3.2.5, the blending process was evaluated considering the WHO limits for Chloride (≤250 mg/l) and Nitrate (≤50 mg/l). The wells with high chloride and nitrate will be closed while those with suitable concentrations will be blended with the desalination and Mekerot water. The supplied water after blending will enable the residents of Gaza strip to drink water directly from the tap for the first time in the last 30 years.

A possible risk may be encountered in case of the contamination of water during storage as a result of inadequate maintenance of the storage reservoir, insufficient disinfection and the entrance of some pollutants from the ambient air into the water tank through the access hatches and/or air vents if they are not closed well.

Moreover, water system leaks and loss of pressure may lead to water contamination during transmission and/or distribution. Water system leaks can reduce the pressure of the water system compromising its integrity and ability to protect water quality (by allowing contaminants to leak into the system). Leaks in the distribution system can result from improper installation or maintenance, inadequate corrosion protection, settlement, stress from traffic and vibrations, overloading, and other factors. Another source of risk is the existence of impaired pipes in the downstream water supply network.

However, this project involves the construction of 110 km of distribution pipes and the replacement of 10 km of old existing pipes which will minimize the risk of water quality deterioration due to impaired pipes. And as mentioned in the project description chapter, section 3.2.8 in specific, the project is designed to include a SCADA system to ensure adequate hydraulic and quality parameters through the whole system.

The overall impact of the operation of the proposed reservoirs and associated facilities is expected to be long term and beneficial with regards to providing an improved water quality to end users for domestic use. This project will considerably improve the public health as it will reduce the water borne diseases that are spread currently in the Gaza Strip as illustrated in the health baseline information given in this report (Section 5.7.3).

Residual Impact Assessment

The impact on water supply quantity and water supply quality is assessed as *a long term positive impact with high significance*, considering the improved water supply and quality.

6.7. Disturbance of visual landscape

Based on the assessment of the baseline conditions of land use given in section 5.1 in relation to the proposed project activities, the main impact receptors are identified as:

- The local environment
- The local community

The potential impacts on landscape for all the project components during the construction and the operation phases are given hereafter.

Construction Phase

Potential Construction Impacts

Potential impacts on water supply and water quality during construction include:

- Visual intrusion.
- Disturbance in existing landscape status.

Many activities under this project are identified with the potential of affecting the existing land escape such as earthworks and trenching; stockpiling; civil works; transport of equipment, personnel and materials; and waste management. The impact on landscape by these activities can be summarized as visual intrusion. Also constant movement and transport of personnel, machinery, materials and equipment, as well as the lighting during construction may create a noticeable disturbance in the landscape. Landscape will be affected in the long term by construction activities, however, all impacts will be restored and construction landscape will gradually restore its original status.

Residual Impact Assessment

The impact on landscape during construction is assessed as a *short term negative impact with law significance*, considering mitigation measures to be taken.

Operational Phase

Potential operational Impacts

Potential impacts on landscape during operational phase include:

- Visual intrusion.

The main concern about the landscape during operation is the architectural shape of the new facilities (reservoirs and pumping stations). As illustrated in site descriptions, most of the sites are either located in an agricultural area or a sand dune lands. Thus, the architectural design of these facilities should harmonize with the surrounding landscaping. Moreover, the facilities if not maintained will cause serious visual intrusion and discomfort for the surrounding community. The sites along the pipe trenches will not cause any landscape harm as vegetative cover will be restored and the pavements wherever damaged will be restored to its original status. In case of having

Residual Impact Assessment

The impact on landscape during operation is assessed as *a long term positive impact with law significance*, considering the fact that the new facilities will have a pleasant architectural appearance and nice landscaping inside each site.

6.8. Cumulative impact from proposed projects

The consideration of cumulative impacts includes:

- Cumulative construction impacts from the simultaneous construction of multiple projects.
- Cumulative impacts from integrating new water supply infrastructure facilities.

6.8.1. Cumulative impacts from the simultaneous construction of multiple projects

Individual minor construction impacts from multiple projects in the same area may collectively impose more significant cumulative impacts. The construction of the proposed Gaza Sustainable Water Program projects may coincide with other major infrastructural projects conducted by other funding agencies in Gaza Strip as part of the Gaza Recovery Plan. These other interventions may include the construction of the following known projects:

- The Gaza Central Desalination Plant with an initial capacity of 55 MCM per year in 2018, and total capacity of 110,000 MCM per year after expansion in 2035, currently under design and tender documents preparation.
- The expansion of the existing Deir Al Balah desalination plant 2600 m^3/day capacity to 6000 m^3/day, currently under construction.
- Expansion of the the existing 6000 m^3/d STLV desalination plant in Deir Al Balah to add an additional capacity of 14000m^3/d, financed by EU , currently under design and tender documents preparation.
- The STLV desalination plant of 10,000 m^3/day capacity in Gaza, currently under construction.

As illustrate, some of these projects are ongoing and others are still in the design and tender documents preparation. Due to political instability and financing issues, the exact schedule and period for the construction of these projects is not clearly known at this stage, in relation to the construction schedule of this proposed project. However, if coinciding, cumulative impacts are anticipated in the project area, including disturbances to the local communities; impacts on the health and safety of public and workers; impacts on the local environment; typical construction disturbances; pressure on the availability and supply of construction material; impacts on traffic and transport in the project area. While the impacts

anticipated will be as discussed in the construction impacts above, the local significance of these could be increased.

In general, the proposed project components are located in different and geographically scattered locations. This should minimize the chance for significant cumulative impacts during the construction phase.

6.8.2. Cumulative impacts from integrating new water supply infrastructure facilities

In the longer term, and upon the full accomplishment of the Gaza Strategic Water Plan and as envisioned in Gaza Sustainable Water Program of PWA, future quantities from desalinated water and additional quantities from Mekorot are anticipated to support the bulk water supply in Gaza Strip. Many of the underground wells will then start to be gradually decommissioned as planned by PWA, to reduce pressure on groundwater and allow for the recovery of the Coastal Aquifer. This project therefore makes an important initial contribution to the wider program which will have a significant positive benefit on the sustainability of water supply in Gaza Strip.

Residual Impact Assessment

The cumulative impacts from construction activities of multiple infrastructure projects simultaneously, including projects other than this project are anticipated to be *negative, short term with medium significance.*

This project will have a *high significant beneficial cumulative impact* together with other projects, for improving the overall water supply infrastructure and services in Gaza Strip and in turn the livelihood of the benefiting communities. The impacts of this project on water supply and availability is discussed in section 6.6.

Table 6-2: Potential Impact Significance

Potential Impact	Affected	Time scale		Magnitude	Residual Impact [1]
		Construction Phase	Operation Phase		
Land Use, Land Ownership and Private Property	Local environment, local community and workers	Short term	Long term	Local	Negative with low significance
Physical Environment					
Soil Quantity and Quality	Local environment, local community and workers	Short term	N.A.[2]	Local	Negative with low significance
Air Quality	Local environment, local community and workers	Short term	Long term	Local	Negative with medium significance; construction, low significance; operation
Noise	Local environment, local community and workers	Short term	Long term	Local	Negative with medium significance; construction, low significance; operation
Groundwater	Local environment and local community	Short term	Long term	Local	Negative with low significance; construction; positive with high significance; operation.
Surface water	Local environment	Short term	Short term	Local	Negative with low significance
Terrestrial Biodiversity	Local environment	Short term	N.A.	Local	Negative with low significance
Historical and Archaeological Heritage	Local environment and Local community	Short term	N.A.	Local	Negative with negligible significance
Socio-Economic Conditions					

Potential Impact	Affected	Time scale		Magnitude	Residual Impact [1]
		Construction Phase	Operation Phase		
Employment Opportunities for Local Communities	Local community	Temporary	Long term	Local	Positive with medium significant; low significance; operation phase.
Economic Activities and Local Businesses	Local community	Short term	------	Local	Negative with medium significance
Material for Construction and Operation	Proposed Project	Short term	Short term	Local	Indirect negative with high significant; construction phase, medium significance; operation phase
Public and Occupational Health and Safety	Public; workers	Short term	long term	Regional	Negative with medium significance.
Affordability to Pay for Water Services	Public; local community	N.A.	Long term	Regional	Positive with low significance.
Willingness to Pay for Water Services	Public; local community	N.A.	Medium term	Regional	Negative with moderate significance.
Existing Infrastructure					
Infrastructure Utilities and Public Services	local environment and local community	Short term	Long term	Local	Negative with medium significance
Roads, Traffic and Heavy Machinery	local environment and local community	Short term	N.A.	Local	Negative with low significance
Energy and Electricity	local environment and local community	Short term	Long term	Local	Negative with low significance; construction phase, High significance; operation phase
Solid Waste Management and Disposal	local environment and local community	Short term	N.A.	Local	Negative with low significance

Potential Impact	Affected	Time scale		Magnitude	Residual Impact [1]
		Construction Phase	Operation Phase		
Hazardous Material and Waste	local environment, local community and workers	Short term	Long term	Local; may extend to final disposal destination	Negative with medium significance
Sanitation	local environment, local community	Short term	Medium term	Local	Negative with low significance
Water Availability, Supply, Use and Quality	local environment, local community	Short term	Long term	Local	Negative with medium significance
Water Supply Quantity and Quality	Public	N.A.	Long term	Regional	Positive with medium significance
Sustainability of the Project	Public; local environment	N.A.	Long term	Regional	Positive with Low significance
Cumulative Impacts					
Cumulative impacts from the simultaneous construction of multiple projects	Local community, local environment	Short term	N.A.	Local	Negative with low significance
Cumulative impacts from integrating new water supply infrastructure facilities	Public; local environment	N.A.	Long term	Regional	Positive with high significance

Note:
1. See Chapter 9: Environmental and Social Management Plan (ESMP).
2. N.A. Not Applicable

7. Socio-Economic Impacts and Management Plan

The relevant baseline information for this section is presented in Section 5.7. This chapter could be considered as a social study for the proposed project. The chapter will include the methodology used to study the socio-economic impacts, the analysis of these impacts on different project phases and the proposed management plan to mitigate and monitor the expected impacts.

7.1. Methodology

As stated in previous sections of this report the project is designed to serve all communities in the Gaza strip *evenly*. A hydraulic model was applied to ensure even water distribution to all communities through main pipelines and reservoirs. However, further distribution of water depends on the operators' ability to ensure proper water supply. In some localities the efficiency of public water supply networks may affect water distribution.

The assigned work aims at assessing potential social impact of the planned project considering both positive and negative impact as well as temporary and long-term ones. The specific objectives are:

- Drawing the system to identify all stakeholders with their interest and power.
- List and investigate the potential impacts on each social group.
- Design proper mitigation plan to deal with negative impacts.

Methodology of the social study was improved during the inception period when secondary information was reviewed, several key informants were interviewed and first public consultation was held. The consultancy team has conducted several activities during the inception period. These include desk review of project documents and related studies, field visits to the potential target communities and discussion with stakeholders. The team has conducted field visits to the project sites to explore potential social impacts along the planned carrier line and land needed for constructing the reservoirs and pumping stations. Based on these activities, the team was able to draw the social system, identify the stakeholders and list the potential impacts.

Accordingly, the following *potential impact and investigation areas were defined*,

1. Short term economic impact; the project will produce both negative and positive economic sequences. The following types of economic impacts will be tackled in this chapter:

    a. The main carrier line will pass through two local markets where several shops will be negatively affected during the construction phase. Shejaiya local market in Gaza city and Khanyounis local market (Wednesday market) which are located within the planned route for the main carrier line.

    b. During construction phase, the project is expected to generate considerable positive impact through job creation. The amount of work volume will be used to predict the level of job creation.

2. Long term economic impact at various levels and different stakeholders

a. Generate long term employment to operate and maintain the system. The operator is expected to increase the number of employees to operate the networks including the main carrier line, the pumping stations and the reservoirs.

b. The planned project activities are expected to affect household budget in both directions. A decrease in expenditure will occur as a result of saving the price of purchased drinking water. On the other hand, potential increase will occur based on the increased fees. The study will assess impact on both directions.

c. Other providers of drinking water are expected to be affected negatively. The study therefore will be integrated as one of the stakeholders to investigate potential impact on their income and possible mitigation measures to minimize the reduction of income. These include owners of private desalination plants, labors, owners of distribution vehicles.

3. As planned in the project description, the project aims at improving the supplied water quality for all Gaza communities. Such improvement is expected to affect quality of life positively through reducing the efforts that are put to sustain drinkable water for the households. This will serve all the communities in the Gaza Strip evenly.

4. Affordability and willingness to pay the additional fees are also major concerns that must be handled in the study. Inception investigation showed that services providers complains low fees collection rate. The intended project has high initial investment that will be covered by donors. However, to ensure the sustainability of water supply the running fees must be covered. Fees collection therefore is of great importance.

5. The project aims at providing safe water for the targeted families. This however, is not possible when internal household water network is not maintained. The study therefore will investigate the actual situation of the household water networks and community view and awareness on the sequenced impact.

6. The project will use Governmental land for the alignment of the main carrier line. Similarly, most of the reservoirs will be established on government owned land. Only in two locations, land will be taken from landlords. The study will investigate the process of land acquisition and its fairness in addition to any type of impact on the landlords or land users.

The targeted groups include,

- Representatives of communities who will receive the water. This will include
  - Representatives of community based organizations
  - Women (can be represented directly and by CBOs)
  - School children (can be presented by schools principals)
- Services providers
  - CMWU
  - Municipalities
  - PWA
- Private sector

  - Water distributors
  - Shops/Desalination units owners
- Community Key persons (community leaders)
  - Mukhtar
  - School principals
  - Imams

In addition to desk review of available documents and related studies, information were gathered using FGDs, semi structured interviews and key informant interviews. Tentatively, the following tools were used as detailed in Table 7-1.

Table 7-1: Framework of Socio-economic study

Type of effect	Potential affected people	Methods	Tools	Sample
Positive economic impact; potential employment during the construction (short term) and operation of the system (long term)	Number of workers during the construction	Reporting the numbers, wages, and length of contracting. Multiply by the average family size to assess the temporary economic impact.	Estimation of the work volume and the needed human resources and period of time.	No sample. Expert approach to assess the work load and needed HR and associated costs
	Number of workers to operate the networking, pumping stations and reservoirs systems	Reporting the number and wages, Multiply by the average family size to assess the long term (annual) economic impact.	Interview with future operator to discuss the expected increase in employment volume, wages and contracting conditions.	Representative of future operator of the planned system
Negative economic impact (loss of income) temporary or long term)	Small scale traders in the two local markets located along the planned project areas (short term impact during construction phase)	-Field survey to count the number of shops that will be affected during the construction. -Review the maps to explore potential temporary alternative location. -Interviews with traders to assess their income and possible reduction and their suggested solutions including proposed alternative location. -interview with municipalities to temporality relocate the local market. (See Annex 8(b) for the interviews template and Annex 8(c) for interviews results)	-Maps -Semi structured interview with traders -Semi structured interview with municipalities.	20 traders in each local market and representative of the two municipalities.

Type of effect	Potential affected people	Methods	Tools	Sample
	-Owners of private desalination units. -Owners of distribution vehicles. -labors working along the production and distribution value chains	-PWA list of all private desalination units in the Gaza Strip with names and contact details. -list of distribution vehicles -Semi structured interviews with owners of the units to estimate current income, possible change and potential solution (See Annex 8 (d) for interview template and Annex 8(e) for results from the interview with desalination units' owners). -Semi structured interviews with vehicles owners and labors units to estimate current income, possible change and potential solution (See Annex 8 (f) for interview template and Annex 8(g) for results from the interview with distribution vehicles' owners).	Semi structured interview	30 semi structured interviews (15 owners of desalination plants and 15 owners of vehicles)
Affordability and willingness to pay for improved water quality. Ability to deliver safe healthy water to households.	-Targeted households, with focus on gender.	-Investigate their current payment for water supply (public supply and purchased from private sector). -Affordability and willingness to pay. -Awareness on improved water quality and its value. -Quality of household water networks and storing system. -level of trust on public water supply institutions.	Results of a recent ESIA for the STLV desalination plant in the southern governorate. The study has been conducted by GVC.	2 FGD with two communities in Southern Gaza strip
Land acquisition and resettlement.	Land owners in case of privately owned lands (Two cases have reached a land-swapping agreement) Land users (local farmers who use	Agreement document to be annexed.	--	-

Type of effect	Potential affected people	Methods	Tools	Sample
	governmental or Waqf land for agriculture)			
Access to services	Targeted communities	Review the project documents and maps to explore the coved communities and quantify them.	Vulnerability mapping if available with socioeconomic data.	-
Public and occupational health and safety	-Workers in construction period. -Risks during construction for surrounding communities.	-Review the maps to explore potential affected communities, social services institutions (hospitals, schools, markets). -Technically assess potential risks for workers and nearby communities.	Maps and documents.	-

The relevant baseline information for this section is presented in Section 5.7. Based on the assessment of baseline findings in relation to the proposed project activities, the following receptors have been identified: local community. The presented potential impacts and mitigations are general to all project components, and are specified to particular sites and project components where required.

The social impact assessment focused on five potential affected people. The first group is the people who will be temporarily affected during the construction phase. The other groups will be affected during operation phase such as :(1) the targeted communities, to investigate their current water supply problems and potential impact of the project on their livelihood, especially women and children (2) all people benefiting from the private water desalination sector, (3) those who are expected to benefit from long term job creation and (4) landlords and land users of lands that will be used to establish the reservoirs and pumping stations.

7.2. Socio-Economic Impacts

7.2.1. Construction Phase

Markets along the main carrier line

Reviewing the maps of the intended project has revealed the potential impact on two local markets during the construction phase. Shejaeya market is located in eastern part of Gaza city and is kind of fixed market that does not move while Khnayounis market is located in Khanyounis and only on Wednesdays. Study team visited these two locations and counted the number of shops, stalls and peddler carts See Figure 7-1 below for photos during the survey. (See Annex 8(a) for more photos from the survey).

In the Shejaeya Market, 108 shops and 38 stalls were found on the main carrier line route, while around 60 shops and 60 stalls were found in the surrounding roads. All interviewed traders in this market expect losses during the construction phase as it will reduce the customers and sales. Shops owners were concerned as their shops are permanent while the stalls owners were open to discuss potential move of their enterprises. *According to the interview with director of planning department in the municipality*

of Gaza, the contracts with stall owners does not give them the right to use the Sikka road (where the carrier line work will take place). However, shops will be affected.

Figure 7-1: Photos during the Survey of the Affected Markets (GVC/CEC, November, 2017)

The Municipality of Gaza has recommended the need to prepare work and traffic plan that allows the sustainability of movement in the street to reduce the impact of the construction on trading activities; and to open additional spaces for the stalls during the construction phase. In all cases the construction time in this location should not take long time as it will affect the traffics as well as trading activities.

The situation is different in Khanyounis as the local market is active only on Wednesdays with diversified number of peddler carts. During the field visit to the market, more than 450 peddler carts were counted in addition to 50 stalls, and around 60 shops which open every day. Those who work every day will be affected more compared to those who come only on Wednesdays. *Based on Interview with Eng. Saad Ashour from Municipality of Khanyounis,* the municipality revealed its readiness to offer alternative space for the local market. But also they recommended conducting the construction on several phases to reduce the period of construction and allow for mitigation plans for traders.

Daily income from the trading activities varies according to their enterprises. In average a daily income of 90 NIS per enterprise.

Mitigation Measures

For both locations, the following measures should be carried out to minimize the expected temporary negative effects of the project.

- The construction phase should not last more than ten days.
- Good construction and traffic planning;
- Phasing of construction work; and
- Offering alternative spaces for traders

Public and Occupational health and safety

The project is expected to be associated with several public and occupational health and safety concerns. The construction phase will pass several communities in the Gaza Strip where one or more of the following potential impact can take place:

- Construction accidents can cause injuries and causalities not only to workers but also for the surrounding communities.
- Several types of physical hazards can happen due to movement of heavy machinery and contact with hazardous material.
- Disturbance and impact on the wellbeing of the local community.
- Possible conflict between the communities and the construction companies.

Impact on health and safety of workers and the public is of high priority during construction period. Workers are particularly susceptible to impacts from working within confined space of proposed tanks and water connection chambers; as well as to impacts from working from height.

In general, on public health and safety, it is anticipated that the public will be more susceptible to ***risks*** from the pipelines construction works including the construction of the main carrier and transmission loops, and the internal distribution networks rehabilitation and construction works than from work within the designated sites of reservoirs and the pumping stations, given that works will be within public roads of residential and commercial areas.

The ***risk*** of workers and local community to be harmed by the exposure to ***health hazards*** (noise, dust,..) and ***physical hazards*** (construction machinery, trucks,..) from the construction activities of the project components is assessed as ***high risk*** with great significance. The ***high risk*** is anticipated based on the fact that the work, especially on the construction of the main carrier and the transmission loops, is carried out in highly urbanized areas and along heavy traffic roads that extend for more than 250 km. Moreover, the expected heavy traffic of construction machinery and equipment is expected to interrupt the general traffic activities of the vehicles and the pedestrians' movements. This will increase the probability of accidents, and consequently increase the ***risk*** of injuries and causalities and property damage. The **risk** from ***noise*** and ***dust*** on workers and local community is assessed and illustrated in section 6.2 in this report.

Mitigation Measures

The construction Mitigation Measures for the public and occupational health and safety measures are as follows:

- Prepare, submit and implement Contractor's safety plan for Engineer's approval prior to starting any project activities.
- Comply with the requirements under the Palestinian Labor Law (No. 7, Year 2000), regarding the occupational health and safety measures. The number of working hours for workers involved in particular construction activities that include construction and excavations shall not exceed 6.5 hours.
- Perform preliminary and periodical (depending on length of project) medical tests to all involved workers, as a requirement of the Palestinian Labor Law.
- Comply with the Secondary Legislations associated with the Palestinian Labor Law, particularly the Ministerial Cabinet Order No.49, Year 2004 about protection measures from work risks and illnesses and Guidelines No.1, year 2005 on provision of precautionary measures to protect workers at construction sites.
- All workers shall be insured by the contractor for any potential work accidents and injuries according to the Palestinian Labor Law.
- Provide adequate hearing protection, hard hats, safety goggles, brightly colored vests, and other appropriate safety equipment to protect workers and visitors from injury.

- Provide first aid kits on construction sites and ensure the presence of personnel with the minimum first aid skills at construction site all times.
- Provide ladders, safe scaffolding, harnesses and any necessary PPE.
- Apply special safety requirements for construction of elevated structures such as tanks. Provide appropriate scaffoldings, guardrails and personal protection equipment.
- Apply the OSHA confined space safety measures (29 CFR 1910) and entry permits requirements, during tanks insulation and disinfection process. Ventilation openings, gas detector, ladder and body harness, and reliable communication devices must be provided during working inside tanks and chambers.
- Apply the OSHA working from height measures (OSHA 29 CFR 1910.23 and 24) during the construction.
- Identify and isolate construction zones by using warning signs, pylons, fencing, and ribbon barriers.
- Inform residents, and the public and commercial areas of work schedules as well as with the management plans prepared by the Contractor.
- Take appropriate measures to prevent unauthorized persons from entering the work area.
- Consider maintaining a safely accessible grazing site for herders to reach their regular site or provide an alternative site and route.
- Implement safety measures to protect people from injury and adjacent property from damage.
- Provide temporary bridges, safe pathways, handrails and any other safety measure during pipeline excavations and installation to protect roads' users from injuries as appropriate and needed.
- Include the locations of the hospitals and clinics nearest to the construction site within Contractor's safety plan, in case of illness or a construction accident.
- Provide portable toilet and hand washing area and maintain them properly, with no leaks or spills to the surrounding area. Waste and refuse needs to be properly disposed of.
- Consider suitable engineering and occupational health and safety practices during site preparation in areas where unprotected electrical cables and unstable objects are stored and exist.
- Comply with seismic loads in design of tanks.
- Provide emergency paths and exits where needed.

Confined Space Work (OSHA 29 CFR 1910)

- Use safeguards to confine heat, sparks, and slag, and to protect the immovable fire hazards.
- Maintain suitable fire extinguishing equipment in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed.
- Relocate combustibles, where practicable, at least 10.7 m from the work site. In the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids, or dusts with air) or equipment which have previously contained such materials, or that may develop in areas with an accumulation of combustible dusts. Where relocation is impracticable, combustibles shall be protected with flame-proofed covers or otherwise shielded with metal or asbestos guards or curtains.
- Vent and purge of all hollow spaces, cavities or containers to permit the escape of air or gases before preheating, cutting or welding. Purging with inert gas is recommended.
- Keep clear all welding and electrical cables and venting pipes of potential trips and falls wear all proper safety equipment at all times.

- Remove all electrodes from holders and the holders carefully located so that accidental contact cannot occur and the machine be disconnected from the power source when arc welding is to be suspended for any substantial period of time, such as during lunch.
- Close torch valves, in order to eliminate the possibility of gas escaping through leaks or improperly closed valves, when gas welding or cutting, and the gas supply to the torch shall be positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable, the torch and hose shall also be removed from the confined space.

Working near Schools, Hospitals, Mosques, Churches and Public Areas

When engaged in construction in the vicinity of Schools, Hospitals, Places of Worship and Public Areas, incorporate the following into all activities:

- Maintain and consider safe and careful movement and access of heavy machinery and vehicles in access to and operations within all construction sites in general and near sensitive receptors in particular including: schools, hospitals, health clinics, mosques, churches and crowded public areas, such as open markets.
- Inform PWA to coordinate with relevant local authorities to announce and inform the public of planned schedule for construction works near sensitive receptors, including residential areas.
- Inform PWA to coordinate with local authorities to clear public crowded areas from construction site, including open local markets under the jurisdiction of the corresponding local authority.
- Provide an appropriate buffer zone from all sides of the entire construction project sites that are located near public areas, to protect the public at all times.
- Take appropriate measures to prevent unauthorized persons from entering the work area and construction sites, particularly school students and unattended children. Provide guards when and where it is found necessary to provide adequate security of the work and protection of the public.
- Adopt appropriate noise and dust control measures near sensitive receptors.
- Ensure safe access and passages are provided for the public where construction sites are near sensitive receptors and crowded areas. Provide detours for roads used by students and the public for commuting.
- Provide appropriate protection, signage and buffer zones at excavation sites and unstable structures.
- Surface crossing of trenches should be discouraged; however, if crossings must be provided for easy access, such crossings are permitted only under the conditions required by the OSHA Excavations Standards 29 CFR 1926.651, in provision of the required safety factor, the appropriate width, fitted standard rails and provide the minimum required extends past the surface edge of the trench.

Job opportunities

The project will involve huge construction component that may last up to three years. Usually the construction work is given to local firms. This generates considerable number of Jobs. Roughly estimated around 100 jobs will be created for three years. Considering average family size of 6.5, total number of 650 persons will benefit from the temporary income during the construction phase.

Residual Impact Assessment

The impacts on public and occupational health and safety during construction of all proposed components cannot be completely avoided but their chances and magnitude can be minimized with the

application of mitigation measures, given that accidents may still potentially occur the residual impact is considered of ***short term, negative with low significance***

7.2.2. Operation Phase

Targeted Communities

Major impact of the intended project is to provide the local communities in the whole Gaza Strip with fresh safe healthy water for drinking and public use. The study therefore focused on the potential impact on these communities. The study has used the results from similar recent ESIA study that was conducted by GVC on water desalination plants that covers two communities in southern Gaza. The recent study has investigated the views of the targeted communities on potential impact and their reaction towards the intended water supply of desalinated water. Two FGD were conducted in Rafah and Khanyounis in addition to interviews with municipalities in both governorates.

Mapping of vulnerability and the intended water supply network

As show in the vulnerability map provided in Figure 7-2, sever poverty exists almost in all governorates of the Gaza Strip with more concentration in southern governorate of Rafah. As shown in the map; the distribution of the reservoirs to be used in the system (Existing and Proposed Reservoirs) is designed to serve all localities evenly regardless of its vulnerability level. However, the strength of local public water supply system and efficiency of local networks may affect the distribution equity.

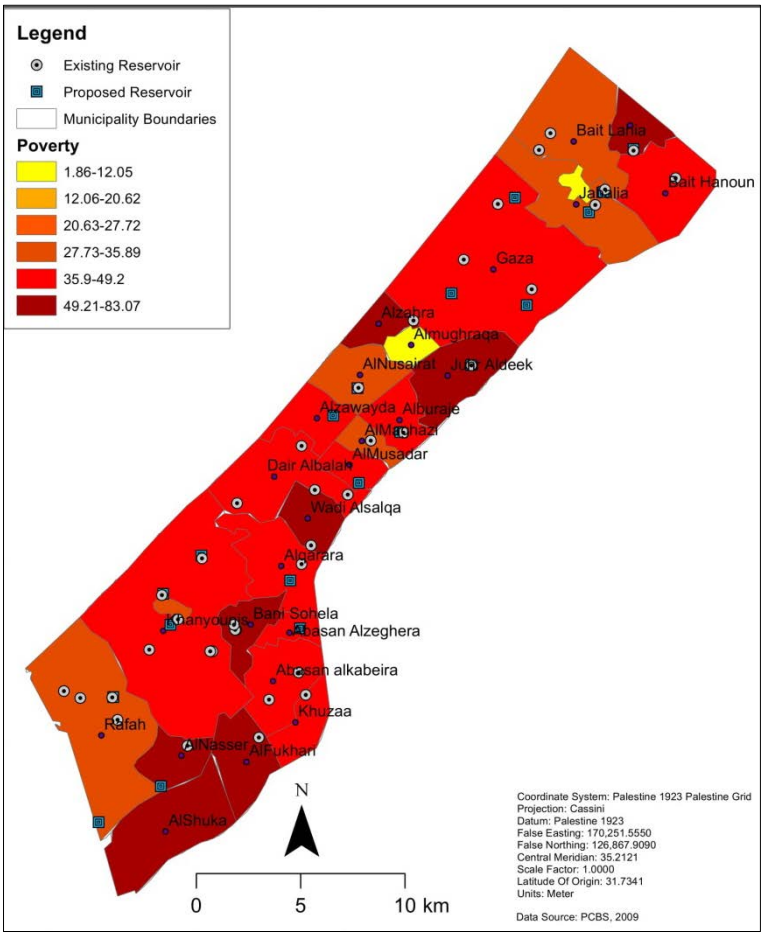


Figure 7-2: Poverty Vulnerability Map

Water quality and quantity problems

Participants in FGD highlighted the significance of water problem in their life. Water problem is not restricted to the quality but also the quantity. Communities in the western part of Rafah and Khanyounes complained the low quality and quantity of water. The situation in both areas is bad. However, water quality seems to be worse in Khanyounis. It was stated by FGD participants in Rafah that tap water chloride ranges from 400-600. This indicates that TDS is higher which causes saltiness taste. The situation is to wide extent worse in Khanyounis as chloride content exceeds 1000.

One of the respondents stated "Water quality in Al Amal neighborhood used to be fine several years ago. However it is too bad to drink now. Most people purchase the desalinated water for drinking as tap water is unhealthy and can cause serious diseases". Quantity of water was also stated as major problem for the households. Other participant in FGD stated "Sometimes we have to purchase desalinated water not only to drink but also for home consumption as we experience very long period of cut in water supply.

Female participants complained from the quality and quantity of water as it affects their ability to achieve the household tasks. One of the respondents in Rafah stated “water is too salty we can't drink it, use it in cocking or even make Wudu'. Even such salty water, sometimes we have to wait for two days to catch it.”

Lack of electricity causes further deterioration of the situation as water is supplied for few hours a day and sometimes every two days. Households may not have electricity power during these few hours to pump the supplied water. In some localities, people have to wake up early in the morning to catch the supplied water. Otherwise they won't see it for another two days. In several cases, households have to purchase desalinated water to overcome the shortage of domestic water supply. The cost of the purchased water creates significant burden on the family budget especially for poor ones.

Gender Related Issues

In general, an overall positive long term significant impact is expected to take place on women. These impacts are summarized in the following two points:

- Most of the vulnerable communities depend on purchased and transported desalinated water for drinking. This task is usually undertaken by women and sometimes by children. The project aims at delivering drinking water through public supply system. Women have expressed their satisfaction as the project will reduce their work load at household level.

- Women are main users of domestic water; usually men do not feel the impact of using law quality domestic water as all household duties are done by women. As mentioned above, women participants in the FGDs complained that the deteriorated water quality is affecting their life in different aspects, including hair bathing (washing) and dish washing. Therefore, the project is expected to help them in providing high water quality not only for drinking but for other domestic uses.

Acceptance and attitudes

Results of field investigations indicated that level of acceptance for the project was quite different between different areas even within the southern governorate of the Gaza strip. The project is perceived as positive intervention towards improving the quality of supplied water. However, some voices in Rafah were skeptical regarding the project. Community in khanyounis showed higher appreciation to the project as it was seen as positive intervention that will help provision of better quality water to their households. The deteriorated water quality and frequent cut in water supply in the western part of

khanyounis were major reasons behind the appreciation. This indicates that communities with lower water quality show higher interest in the planned project. In general, all the communities in the Gaza Strip receive water with very low quality with some variations as illustrated in Section 5.6 for the Water Supply in the Project Area.

As shown in the previous ESIA study, community in southern areas, as in all communities in the Gaza Strip, showed low level of trust on the service provider as they were concerned not only on water salinity but water hygienic status. They were not sure that service provider can provide better water quality that allows for the use of water for drinking. In general, community is custom not to use tap water for drinking not only because its salinity but also because they don't trust service providers. This represents serious challenge for the intended project especially when private sector provides the community with very low TDS that can reach as low as 50 mg/l. In comparison with the intended TDS concentration from the project of 700 mg/l up to year 2025 and 440 mg/l for 2030 and 2035 scenarios, consumers may not be satisfied or convinced to use the tap water for drinking.

Potential Impacts

Project is designed to serve the maintenance of groundwater through saving the naturally recharged aquifer from extensive public use. Impact at macro scale will be studied through hydrological design and environmental impact assessment. Social impact assessment aims at assessing the impact on the targeted population and other social groups that are related to the intended project. Results of FGD and interviews with key persons revealed the expected positive impact of the intended project on the life quality of the target population. Provision of fresh healthy water with adequate quantity for households is essential element of proper livelihood. Participants in FGD express their interest to have higher quality water but they were more concerned about the frequency and quantity of supply. As discussed in Section 5.7., the Gaza Strip community uses tap water for other uses while drinking water is usually purchased from private sector. People expressed their wish to improve the frequency of water supply as this affects their life quality as they have to adopt their daily schedule based on the time when both water and electricity are available. Some cases they have to wake up late in the night to catch the opportunity of pumping the supplied water to their tanks. Several cases have reported their purchase of desalinated water for household use as they missed the chance of filling their tank.

The impact of the intended project most likely will not change the community consumption behavior as they are not expected to give up purchasing desalinated water for drinking. The target quality level is to reach a TDS level of about 450 mg/l which is acceptable from technical and health point of view. However, it is still taste salty when compared to the desalinated water that is provided by the private sector. Additionally, community does not trust service provider as they expressed their fear from the quality of tap water not only because its salinity. Frequency and sustainability of water supply can be of some minor impact on the family budget as family can save the purchase of desalinated water when they don't catch the supplied tap water. Important to design proper conveyance system that sustains proper distribution that minimizes the cut hours in water supply.

Their ability and willingness to pay

Possible water tariff after the implementation of the project is affected by the design, cost of desalination, level of desalination, blending rate and efficiency of conveyance system. According to the utility model that was developed to estimate the cost and Tariff of generating water, water costs varies overtime to reach the peak of 0.21 Euro in year 2021. Additional 20-30% may be added to cover the financing costs. Such cost and according to the utility model must be covered by the customers to keep the system financially independent.

End-user tariffs need to be increased to a cost-covering level. However, an immediate water tariff increase to a cost-covering level would not be socially and politically acceptable. Thus, the cost-recovering water tariffs will have to be introduced gradually (Fichtner, 2015).

As described in the baseline, analyses of family expenditure in the Gaza Strip indicate that water expenses does not constitute major share of their income. This is true even for poor and very poor families where water bill in average is around 20 NIS a month in addition to other 20 NIS for drinking water from private sector. In total, water expenditure per month does not account for more than 2% of the total family expenditure). Comparing this percent with any other expenditure component such as food, electricity or even communication, shows that it can be neglected. Even very poor families with no income can get the desalinated water from Charity desalination plants.

The average water tariff in the whole Gaza Strip, in 2015, was about 2 NIS/m^3. Affordability wise, FGD participants in both areas complained the difficult economic situation and claimed that people are not able to pay the bill now and expected even further burden after the project implementation due to increasing water costs.

Results indicated that ability to pay is not major issue currently or even in future after the project implementation. Water public supply fails to collect the fees from the served communities. With varying percentages, fees payment does not exceed 40 % of total population. Such situation indicates that willingness to pay is relevant as community can pay but does not want to pay water bills. One of FGD participants stated "*All public services including water and electricity supply must be covered by the government as it receives the fund to cover it"*. FGD discussion showed a debate between two groups regarding the necessity to pay the cost of public services. Other participant stated *"people are able to pay for bill as they pay 20 NIS / m^3 for portable water and pay for the mobile phone much more than they are asked for water bill"*.

Actually, this reflects general attitude in Gaza strip where people suffered from serious economic crisis and difficult political situation that weaken the authorities over the last 15 years. This has encouraged people not to pay for public services including water and electricity. Such behaviors became as part of the culture in Gaza strip. This has caused serious damage to the public sector and consequently to the level of service quality. Electricity supply is very good example of this. For water consumption people pay a minimum 20 NIS / m^3 for desalinated potable water and sometimes they pay the same price for other uses when they don't catch the public water supply. At the same time they don't pay the water bill.

The current low coverage of water fees collection indicates that communities will not be willing to pay for the improved services due to the project implementation. The study suggests the relevance of willingness to pay as major challenge for the intended project. Desalination and operation costs must be covered by the community. Otherwise, the sustainability of the intended project is threatened. This problem will be further discussed in the mitigation measures through the social management plan.

Residual Impact

The residual impacts on affordability and impact on household budgets for supplied water during operation of all proposed components, taking into account the measures, are considered of *insignificant,* and given that the current culture of water consumption is not expected to change dramatically due to local practices and habits. For the impact of willingness to pay on project operation, it is likely that this will be *insignificant*, given that the current culture of payment / nonpayment will unlikely change if not enforced by local authorities, which is a measure that is not part of the scope of this project.

Maintenance of household internal water network

Major Objective of the intended project is to provide healthy safe water to the targeted communities. This is one of the major objectives for the intended project. Therefore, significant concern is given to the maintenance of public water network as to improve its efficiency and decrease any contamination possibilities. Such intervention will help delivering fresh health water to the households. However, lack of maintenance of the internal networks and water tanks at household level may endanger the fresh water to be contaminated. Therefore, study investigated the community practices regarding the maintenance of their internal water networks and tanks.

It was obvious that no maintenance is made to the households' internal networks and tanks that receive the public water supply. In contrary, people are very careful in keeping the fresh water tanks where they store the desalinated portable water clean. One of The participants said "*I don't care for the maintenance of the internal network or the tank as the received public water is of a very low quality and full of sand. We don't drink it. I care about the fresh water tank as I clean it every time before I purchase fresh water"*.

It was obvious that people in general are interested to keep the drinking water safe and clean as they were aware of the necessity to keep its tank clean while water for other uses is not important. Results showed that willingness to keep their internal water network clean when they receive clean water that deserves the maintenance of the system. This most likely will happen when they accept quality level as drinkable water. This potential is restricted however by several factors including the competition with private sector which provide “high quality” water (TDS 50-70) and lack of trust in the service provider. These challenges are also relevant and can restrict the positive impact of the intended project. This will be also described in the mitigation measures below.

Level of awareness

All the above findings indicated relevance of community awareness and culture as major challenges that can minimize the positive impact and sustainability of the intended project. Following are major culture and awareness aspects that can affect the objectives and sustainability of the project:

1. Community lack to the knowledge and awareness towards water problem at macro scale. Some local communities feel comfortable with their current drinking water consumption as they buy it from private sector. For public water supply they wish to receive more quantity but don't care much about the quality. The negative impact of the current consumption behavior on aquifer and potential deterioration are not among the interest of the people. People showed higher level of trust on private sector because they provide lower TDS content.
2. Lack of knowledge and trust between the community and services providers is a major challenge that can hinder the achievement of the project objectives. One of the FGD participants in Rafah stated *"CMWU is a private company that collects our money to make huge profits. I estimate their profit to exceeds 22 million US$ a month. Why should poor people like us pay bills for rich company that receives funds from all over the world?"* Such statement reflects a general misunderstanding of the nature and mission of CMWU as semi-governmental institutions who uses the collected fees to sustain and improve water supply in quantitative and qualitative terms. The link between CMWU and maintenance of water resources at macro scale and its effects at micro scale must be promoted.

3. Water consumption culture and community standard on water quality are very important issues that should be considered by the project implementers. There is a clear gap between the

meaning of the international and national standards of healthy fresh water and community view on fresh water.

International standards such as WHO standard sees water with 250 mg/l TDS as healthy fresh water for drinking as it provides humans with the needed salts for their bodies. Even higher level of TDS up to 400 mg/l can be accepted as average quality for wide range of national standards in several counties.

Due to competition among private desalination plants, the TDS is decreased to reach 50-60 TDS which gives the water sweet taste and attracts more customers. Such level of TDS can never be target quality not only in the Gaza strip but in any other place as the TDS must be higher to satisfy the human body needs.

Other aspect of water quality is the microbial contamination, which is not accepted by all national and international standards. Recent study indicated the occurrence of potable water contamination with microbial pathogens in Gaza strip. Such threat on health is not seen in the community as it does not affect the color or taste of the purchased water (See section 5.7.3. on Public Health).

The project aims at reducing the consumption pressures on the aquifer. This would need to change consumption behavior of the community. This can never be changed unless their knowledge and attitudes are changed. Provision of fresh healthy water to the community is good thing but they should be informed about the quality of this water otherwise they will use it as unhealthy not for drinking water and will not maintain their internal networks and tanks which will turn the expensive supplied water to unhealthy water. Therefore, the project implementers must plan for awareness campaigns that bring people to the right understanding and awareness on their responsibilities towards the priceless water resources.

Community participation in assessing the needs and designing interventions will create better awareness and higher level of success in achieving the project objective. This will be further discussed below in the social management plan.

The impacts on the targeted local communities of all proposed components during the operation stage will be totally positive. Thus, the residual impact is considered of *long term*, positive *with medium significance*.

Private sector water distributers

The project will have an impact on the private sector water distributers as the project is expected to deliver improved water quality to all communities in the Gaza Strip where drinking water is entirely supplied by the private sector. However, the study hypothesized that private sector water distributers are major stakeholder in the intended project as fresh water will be delivered to the households at relatively cheap prices. The hypothesis is based on the expected competition and the sequencing negative impact of the income of private sector. The private sector in water desalination and distribution business includes owners of the desalination plants, workers, owners of distribution vehicles and drivers.

The current level of activities and tariff

A list of all private sector desalination units was obtained from PWA. According to the list, 154 desalination units operate in the Gaza Strip (51 in Gaza Governorate, 25 in Northern Governorate, 30 in Middle Governorate, 35 in Khanyounis and 13 in Rafah). The total daily production varies between 1,700 in winter to 2,700 in summer. The number of staff working in the desalination plants is 484 in addition to around 180 distribution vehicles and associated 300 workers. In total around 800 families are making their living from water desalination and distribution. This is in addition to the owners of the desalination and distribution assets, thus, the total number of families affected in this sector is about 1,000 families.

The price of desalinated water varies between 5 and 6 NIS/m^3. This price reflects the price at plant and mainly for distribution vehicles. The price for consumers varies between 20 and 30 NIS depends on the distance.

The amount of income varies between different groups. Rough estimate of the income for owners of a desalination plant can range between 3,000 to 4,500 NIS per month. Average revenue per day is 400 – 500 NIS which is created by selling 80-100 m^3 per day. The cost per day can reach 300 NIS per day to cover the electricity, maintenance and labor costs. Daily profit can vary between 100-200 NIS a day. Labor pay rate in the Gaza Strip is about 40- 50 NIS per long day from morning to the night. A monthly wage can reach 1200 -1500 NIS.

A desalination plant with actual production of 80-100 m^3 a day can cover the needs of 4-5 distribution vehicles. Vehicles capacity varies from 3 m^3 to 8 m^3. In average the capacity per car is 5 m^3. Vehicles can fill the tank 3-5 times a day in summer while the rate is minimized to 2 in winter. An average daily distribution per car is 20 m^3. This generates revenue of 400 NIS a day as one cubic meter is sold for 20 NIS. Daily cost of the car varies based on the car quality and the made kilometers. Wages of drivers and the labor is around 120 NIS a day while fuel and maintenance can cost another 100. Additional cost is the price of purchased water which is 100 NIS for the 20 cubic meters. In total the daily cost is about 300 NIS in average. After deducting this amount from the daily revenue of 400 NIS; the car owner can generate a daily profit of 100 NIS in average.

Potential Impacts

The study investigated potential impact on the private sector based on the assumption of the competition between the private sector and the intended project. Results of interviewing 15 owners of desalination plants and 15 owners of vehicles owners indicated that private sector provides water of 50-60 TDS. Such quality is seen by the community as higher quality when compared with the targeted quality of the blended water that will be distributed by the intended project. The study therefore, expects very low or no impact on the private sector at the early stages after the project implementation. The community is not yet convinced on suitability of the project distributed water for drinking. The impact is only expected if proper awareness campaigns are designed to improve level of trust between the community and the public service providers. The awareness campaign should also work on changing community understanding on water quality standards and the associated risk with consuming fresh water from private sector.

Following are brief description of potential impact on the livelihood of private sector incase behavior consumption of the community is changed towards consuming the project distributed water for drinking.

Owners of desalination plants

The results of interviews with private sector producing and distributing desalinated water revealed that 100% expect significant damage of their enterprises as a result of the intended project. The losses for the owners of the assets (the plants and vehicles) are not only losing their income but also their huge investment on the desalination sector. The investment for the plant varies according to its capacity but with minimum cost of 50,000 US$ and up to 100,000 US$.

The actual impact of the intended project is not yet clear at this stage as it depends on the results of awareness programs to change community attitude towards the public supplied water. However, if the project succeeded to change the water consumption behavior, almost 1,000 families will totally lose their income. In such case, Resettlement Action Plan is needed to deal with this group.

Workers and drivers of distribution vehicles

As discussed above no impact of the project is expected on these groups unless significant change in water consumption behavior. The interviews with owners, drivers and labor who distribute water revealed their fear to lose their income. Income for 300 families will be endangered in case people stop consuming desalinated water from the private sector.

View of Private sector for potential solutions

View of private sector is affected by the general aid dependency culture in the Gaza Strip. The first suggestion when they were asked about their views on potential solution for their potential problem, was the compensation and employment for the laid off workers and drivers. One of FGD participants stated *"our business generates income for 20 families, reduction on demand on our water will push me to lay off workers and drivers as my revenue will not allow me to keep them. In such case, the project implementer has to compensate me and find a job for the laid off workers"*. Such reaction is usual in the Gaza Strip were people gained the aid dependency culture. Consultant believes that such approach can't be applied to solve such problem as it involves sustainable cost that can never be covered by a sustainable system. Alternative approaches such as provision of micro enterprises funds to establish income generating business can help this group to mitigate the negative impact on their income.

The impacts on the private sector water distributers during operation construction of all proposed components cannot be completely avoided but their chances and magnitude can be minimized with the application of mitigation measures. Given that, the residual impact is considered of *short term, negative with low significance*.

Long term job creation

The number of jobs created at long term is significantly less. Operator has not yet planned for the additional needed HR to operate the 19 reservoirs, 6 pumping stations and main carrier line. However, it is expected that at least one employee is needed to operate each reservoir. This indicates that the operator would need at least to hire additional 20 technicians to operate and maintain the reservoirs. Vision is not clear if the current staff can operate and maintain the main carrier line and pumping stations or should be new jobs created.

It is still too early to discuss the volume of work load needed to operate the system and if the HR currently available can cover this load. However, considering rough estimate of 20 additional job multiplied by 6.5 (average family size) the project may offer income for 130 persons on fixed term. The residual impact is considered of *short term, positive with low significance*

Landlords and land users of acquiesced land

Land area, land owner and land user for each of the 25 sites allocated for the construction of the pumping stations and the reservoirs were investigated as shown in Table 7-2. The collected data was used to determine the social impacts resulting from the land allocation for the construction of the proposed components; these impacts are also illustrated in Table 7-2 while the proposed mitigation measures will be discussed in chapter 9.

Table 7-2: Expected Social Impacts related to Land acquisition

Component	Site Area (m^2)	Site land use category	Ownership	User	Social Impact related to Land acquisition
Main PS	6,000	Agricultural	Governmental land	Empty/Not used	No social impact
N-MC 2 PS	800	Paved yard/parking	Governmental land	Municipality of Gaza	No social impact
N-01 PS	500	Agricultural	Municipal land	Empty/Not used	No social impact
N-02 PS	900	Agricultural	Private	landlord	Loss of land and livelihood, Negative long term with high significance
N-03 PS	375	Agricultural	Wadi Gaza Municipality	Empty/Not used	No social impact
S-01 PS	1,800	Agricultural	Governmental land	Local farmer	Loss of livelihood, Negative long term with medium significance
C-155	2,500	Sand dunes	Governmental land	Empty/Not used	No social impact
ST-023	2,400	Sand dunes	Municipal land	Empty/Not used	No social impact
BL-T 01B	1,600	Sand	Municipal land	Empty/Not used	No social impact
ST – 045	1,790	Built up/ traffic island	Governmental land	Municipality of Gaza	Visual discomfort for the community (Shiekh Radwan Reservior area)
ST – 020	1,800	Agricultural	Governmental land	Empty/Not used	No social impact
F-205 B	300	Agricultural	Waqf land	Empty/Not used	No social impact
ST – 041	4,000	Sand	Governmental land	Empty/Not used	No social impact
ST-001C	2,600	Agricultural	Private	Landlord	Loss of land and livelihood, Negative long term with high significance
ST-006B	1,000	Agricultural	Municipal land	Empty/Not used	No social impact
ST-031	1,000	Agricultural	Al Musadar Municipality	Empty/Not used	No social impact
ST-007	840	Agricultural	Municipal land	Empty/Not used	No social impact
ST-009	1,600	Agricultural	Governmental land	Empty/Not used	No social impact
ST-011	2,880	Sand	Governmental land	Empty/Not used	No social impact

Component	Site Area (m^2)	Site land use category	Ownership	User	Social Impact related to Land acquisition
ST-017	1,200	Agricultural	Municipal land	Empty/Not used	No social impact
ST-032B (Al Buraq)	2,910	Sand dunes	Governmental land	Empty/Not used	No social impact
ST-033B (Al Israa)	3,000	Sand dunes	Governmental land	Empty/Not used	No social impact
ST – 015B	1,800	sand	Governmental land	Empty/Not used	No social impact
TRC (ST-039B)	1,800	Sand dunes	Governmental land	Empty/Not used	No social impact
ST-015A (Al Salam)	1,500	Agricultural	Municipal land	Empty/Not used	No social impact

7.3. Summary of socio-economic impacts

The study has started by drawing the social system to highlight the potential impacted social groups. Inception period activities led to determination of potential social groups. Major groups are the target community in the whole Gaza Strip (the study has used the results from similar recent studies in Rafah and Khanyounis); private sector who distributes desalinated water; communities and social groups that will be affected during the construction phase.

Results revealed the expected positive impact of the intended project on the life quality of the target population. Provision of fresh healthy water with adequate quantity for households is essential element of proper livelihood. The community expressed their interest to have higher quality water but they were more concerned about the frequency and quantity of supply. Current water consumption practices do not rely much on tap water for drinking. The community uses tap water for other uses but drinking water is usually purchased from private sector. People expressed their wish to improve the frequency of water supply as this affects their life quality as they have to adopt their daily schedule based on the time when both water and electricity are available.

The intended project most likely will not change the community consumption behavior as they are not expected to give up purchasing desalinated water for drinking. The target quality level is to reach a Chloride level of 250 mg/l (about 440 mg/l TDS) for 2030 and 2035 scenarios (as mentioned by designer), which is acceptable from technical and health point of view. However, it is still taste salty when compared to the desalinated water that is provided by the private sector which can be of 50 TDS quality. Additionally, community does not trust service provider as they expressed their fear from the quality of tap water not only because its salinity.

Analyses of family expenditure indicated that water expenses does not constitute major share of their income; in total water expenditure does not account for more than 2% of the average family expenditure. Such result indicates that ability to pay is not major issue currently or even in future after the project implementation. Results indicated that people are not willing to pay for water bills at the current time or in future. Actually, this reflects general attitude in Gaza strip where people suffered from serious economic crisis and difficult political situation that weaken the authorities over the last 15 years. This has encouraged people not to pay for public services including water and electricity. Such behaviors became as part of the culture in Gaza strip. This has caused serious damage to the public sector and consequently to the level of service quality. For drinking water consumption people pay a minimum 20

NIS/m^3 for desalinated portable water and sometimes they pay the same price for other uses when they don't catch the public water supply. At the same time they don't pay the water bill.
The community is interested to keep the drinking water safe and clean as they were aware of the necessity to keep its tank clean while water for other uses is not important. Participants in FGD showed their willingness to keep their internal water network clean when they receive clean water that deserves the maintenance of the system. This most likely will happen when they accept quality level as drinkable water. This potential is restricted however by several factors including the competition with private sector which provide “high quality” water (TDS 50-70) and lack of trust in the service provider. These challenges are also relevant and can restrict the positive impact of the intended project.

Study results indicated relevance of community awareness and culture as major challenges that can minimize the positive impact and sustainability of the intended project. Community awareness on the seriousness of water problem at macro scale, level of confidence between the community and services providers and optimal understanding of water quality standards are major culture and awareness aspects that can affect the objectives and sustainability of the intended project.

The study has revealed the presence of 157 water desalination unit with almost 1,000 families make their life from this sector. The percentage of income reduction or lay off cannot be predicted at this stage. However, in case of successful national plan in providing blended water and changing water consumption culture, it is most likely these people will be affected. Results indicated that private sector provides water of 50-60 TDS water quality. Such quality is seen by the community as higher quality when compared with the targeted quality of the blended water that will be distributed by the intended project. The study therefore expects very low or no impact on the private sector in case community is convinced on the possibility of suitability of the project-distributed water for drinking. The impact is only expected if proper awareness campaigns are designed to improve level of trust between the community and the public service providers.

The study indicated the need to conduct several mitigation measures to ensure the achievements of the project objectives and its sustainability. The recommended mitigation measures should be applied at the community level, institutional level and private sector level. They are summarized the SMP in section 9.3.

8. Grievance Redressal Mechanism

8.1. Diagnostic of the Grievance Redressal mechanism at CMWU

According to the TOR of this project, the recent Grievance Redressal mechanism (GRM) of the CMWU should be reviewed and assessed. Based on that, the consultant contacted the CMWU management and customer service to identify the features of the applied GRM in their institute. Unfortunately, it was found that the CMWU follows a simple non comprehensive procedure to deal with complaints that cannot be described as a GRM system. The following is a brief description of this procedure:

1. The contact information with the CMWU customer service is through the following methods:
   -Telephone call
   -Fill a complaint through the main web site of the CMWU
   -Send a message through the Facebook page of the CMWU
2. The customer service officer refers the complaint to the engineers in the site related to the complaint to solve the problem on site. They deal only with complaints related to water service cuts and request for maintenance of flooding sewage manhole and house connection.

This procedure lacks many features of the typical GRM systems such as:

1. The contact information is not common for the community and not publicized in local media or at the water facilities manged by the CMWU.
2. There is no grievance officer especially assigned for this purpose.
3. There is no registration of the complaints in a data base or “complaints register”, thus there is no available historical data in CMWU records on complaints.
4. There is no feedback system with complainants.
5. There is no tracking and evaluating system for the decision made regarding complaints.
6. There is no written GRM system that is approved for implementation by the CMWU management.

In conclusion, the recent procedure at CMWU is not technically considered as a GRM system. Consequently, the consultant proposed a GRM system that can be used by the CMWU to deal with expected complaints from the implementation of the GWSP project.

8.2. Proposed grievance redressal mechanism

The scope and components of the proposed GRM system are illustrated in sections 8.2.1and 8.2.2 presented hereafter.

8.2.1 Scope of the proposed GRM

This GRM will only respond to social and environmental grievances resulting from this project’s interventions. Other grievances are not covered under this GRM. The expected social and environmental grievances due to this project are identified in the ESMP. However, if additional unexpected complaints that fall under social or environmental categories and were not identified in the ESMP, can be discussed for eligibility (as illustrated in section 8.2.2 point B) to be covered under the GRM.

8.2.2 Components of the proposed GRM

The main components of the proposed GRM system are:

A. Complaint receiving and processing center
B. Complaints receiving channels
C. Levels of complaint escalation
D. Complaints handling mechanism

The following is a description for each of these components.

A. Complaint receiving and processing center

According to the TOR of this project, CMWU will be responsible for managing the grievance redressal process. Thus it is proposed to utilize the existing customer service office in the main building at Al Zahra city and develop its capacity to function as the grievance redressal center (GRC). This center will receive complaints from potentially affected people (PAPs) by one of the communication channels mentioned later. The GRC will be headed by a grievance redressal officer (GRO) who is responsible for handling the complaints according to a defined complaint handling process. The GRO may be the head of the CMWU customer service himself or a newly assigned person working under his supervision.

B. Complaints receiving channels

The following communication channels with the GRC should be established for PAPs to enable them to voice their grievances:

- Telephone and mobile numbers.
- Fax number.
- E-mail address.
- Website address (a link to the GRC on the CMWU official web site)
- Facebook page for the GRC.
- Communication through the construction manager in each project site during construction phase or the operators during operation phase.
- Face to face meeting with the GRO at the CMWU main office.

These communication channels should be publicized to the community through local media, social media, NGO's, selected shopping centers, community leader's offices, and sign boards on all the project components.

C. Levels of complaint escalation

Aggrieved persons or groups should be allowed to escalate their complaints to higher levels of responsibility if they are not satisfied with the proposed resolutions at lower levels of contact. Thus, the proposed GRM system starts from the project level grievance redressal system as an alternative for other formal systems that include civil courts. Moreover, the project level grievance redressal system is composed of two complaint levels:

- Level 1: grievance redressal officer (GRO) level
- Level 2: grievance redressal committee (GRC) level.

If the aggrieved persons or groups are not satisfied by the project level grievance redressal system (Level 1 & Level 2) they have the right to escalate to the level of other formal bodies reaching to civil courts which is consider as level 3. The GRC is a committee that comprises three persons as the following:

- Head of the project management unit (PMU) at PWA.

- Grievance redressal officer (GRO).
- External neutral expert relevant to the complaint subject.

D. Complaints handling mechanism

The main steps complaints handling procedure are:

1. Receiving and registering a complaint.
2. Screening and assessing the complaint.
3. Formulating a response.
4. Communicating the decision to the complainant
5. Tracking and evaluating results.

The following is an explanation for these steps:

1. **Receiving and registering a complaint:**

The complaint received by the GRO through one of the channels mentioned above should be registered in a **complaint register**. The registration process starts with filling a **"Complaint Form**" that contains the personal information of the complainant, date and channel of complaint, description of the complainant, relevance of the complaint and complainant to the project, and the complainant demands to solve the issue. The next step is to log the information from the "**Complaint Form**" into a software data base system "**compliant register**" (e.g. excel, access, specially developed software).

2. **Screening and assessing the complaint:**

The **GRO** will "**screen"** the complaint for "**eligibility**". The main eligibility criteria may include:

- The complaint is related to the project.
- The complainant has standing to file.
- The issues raised in the complaint fall within the scope of issues the grievance mechanism is authorized to address.

If the complaint is rejected (screened out) for ineligibility, the complainant should be informed of the decision and the reasons for the rejection. It is advisable to communicate with the complainant before informing him with rejection decision to make sure that the data in the "**complaint form**" are complete and precise. If no new data is introduced then the complainant should be notified with the "**rejection decision"**. If the complaint is found eligible, the complainant should be **notified**, and the grievance should be processed and proceed to an **assessment**. During the assessment, the **GRO (or** person the GRO refer to**)** should **gather information** about the case and key issues and concerns to help determine whether and how the complaint might be resolved.
The screening should be done within 3 days and assessment within 10 days from the complaint filling date. The rejection decision due to ineligibility should be informed to complainant within 5 days from the complaint filling date.

3. **Taking decision and Formulating a response**

The **GRO** should refer the complaint to the relevant person on the project sites or in the formal locations that are related to the project. After receiving the feedback from the relevant persons and considering all the collected facts and based on the assessment in the previous step, the GRO will formulate a response to the complainant containing the decision taken regarding the resolution.

The response should be formulated within 15 days from the complaint filling date.

4. Communicating the decision to the complainant

The decision should be communicated to the complainant with the appropriate way using his communication information found in the database of the "**complaint register**". The communication should be done immediately after taking the decision and formulating the response.

5. Tracking and evaluating results.

Whatever the decision, it should be followed up in order that the reaction to the decision may be known and in order to determine whether the issue has been closed or not. If the complainant accepted the decision a settlement should be finalized and the case can be closed otherwise the complainant can go to the Level 2 complaint (i.e. to the GRC).

In order to build the capacity of the CMWU and PWA staff in the implementation of the proposed GRM system, a training module has been proposed and presented in Table 8-1. The module includes the learning objectives, the timetable, and the required budgets.

Table 8-1: Proposed Training Modules for the CMWU GRM System

Training Module	Learning objectives	Duration and Date	Proposed trainees	Proposed cost
Theory of grievance redressal mechanisms As related to Bank-Financed projects	• Having a full understanding of the guidelines and common practice of the WB regarding GRM systems	- 2 days theoretical presentations. - One month Before the commencement of the GWSP project construction	-CMWU main office customer service and public relations - One representative from the customer service from the 5 governorate branches -PWA/PMU staff and public relations	3,000 USD
Skills of registering filling and documenting complaints	• Having a full understanding of filling and documenting processes. • Learn to use a data base software for complaints logging and retrieving • Gain the ability to develop a report about the grievance and redress	- 1 day theoretical presentations - 1 day on the job training - One month Before the commencement of the GWSP project construction	-CMWU main office customer service and public relations - One representative from the customer service from the 5 governorate branches -PWA/PMU staff and public relations	3,000 USD
Skills of the complaint handling	• Learn the procedures of assessing the	- 1 day theoretical presentations	-CMWU main office customer service and public relations	

	eligibility of the complaint • Learn the procedures of formulating a response to the complainant • Learn the skills to communicate decision to complainant	- 1 day on the job training - One month Before the commencement of the GWSP project construction	- One representative from the customer service from the 5 governorate branches -PWA/PMU staff and public relations	3,000 USD
Tracking and evaluation	• Learn procedures of tracking the complaint after the implementation of resettlements • Learn the skills of evaluating the GRM procedures	- 1 day theoretical presentations - 1 day on the job training - One month Before the commencement of the GWSP project construction	-CMWU main office customer service and public relations - One representative from the customer service from the 5 governorate branches -PWA/PMU staff and public relations	3,000 USD

9. Environmental and Social Management Plan

9.1 Objectives of ESMP

The Environmental and Social Management Plan (ESMP) identifies feasible and cost-effective Measures required for the environmental and social monitoring of key environmental and social aspects of the project during project implementation. The ESMP will include an overview of Impacts and Mitigations plan that will include for each impact/issue, (i) suggested mitigation measures to avoid, reduce or minimize, or compensate or offset significant adverse risks and impacts identified and assessed in the ESIA; (ii) the responsible party for implementation and for supervision; (iii) the time frame and periodicity for assessing each mitigating measure; (iv) monitoring indicators; (v) anticipated cost; as well as (vi) party responsible for financing each monitoring measure. The ESMP will summarize mitigation measures to address impacts as identified by the ESIA report. ESMP will split into two tables for ease of use, with one each for use during construction and a second for the length of project operation.

The ESMP is designed to monitor the effectiveness of the management actions. A component of the ESMP is to establish monitoring programs to evaluate the performance of the project against the goals of sustainable development: economic growth, social equity, and ecological integrity. Appropriate, measurable, defined, and valid indicators will be identified, developed, and agreed upon by stakeholders. The ESMP will include regular auditing and reporting, and lead to the refinement of targets and indicators. Monitoring results will be made publicly available.

The main objectives of the ESMP are to:

1. Implement all recommendations and mitigation measures shown in the EA report, and any future needs that might arise.
2. Implement and enhance all laws and regulations related to labor affairs and benefits.
3. Provide local awareness for the need of the desalination plant and the nature of its service. A detailed record of public awareness activities should be properly documented.
4. Inform workers regarding onsite job risks.
5. Enforce equal opportunity employment for equal qualifications.
6. Implement all environmental laws and regulations of the Palestine Authority.
7. Supervise all activities that might affect the environment or the socio-economic aspects of the community.
8. Establish a monitoring policy and an inspection program to cover environmental contaminants or those that might adversely affect the environment of the area.
9. Implement immediate mitigation measures wherever appropriate. Emphasis should be on the protection and conserving valued environmental components. Workshops and training sessions should be held regularly on various fields related to project activities.
10. Inspect and supervise environmental conditions at the desalination plant.
11. Take corrective steps to mitigate environmental impacts.

In addition, the ESMP will:

12. Assess effectiveness of the proposed mitigation measures in the ESIA.

13. Detect environmental contamination as early as possible, to ensure the implementation of an environmental management plan by the project operators.
14. Ensure compliance with this ESIA and regulatory authorities.
15. Prepare periodic reports on the environmental and socio-economic status of the project and the community, including activities or actions taken during the year and analysis and evaluation of results and present recommendations, to improve or develop better approach.

Table 9-1 presents and summarizes the expected impacts of the proposed project components and mitigations measures to be implemented during the construction and operational phases are listed. Environmental mitigation actions are presented in a matrix format as a part of ESMP. The matrix includes an identification of the environmental elements, the related impacts and mitigation measures to be carried out for each environmental element. This first part of ESMP is a tool for environmental auditing and compliance, and if properly applied, will ensure the success and sustainability of the project

9.2 Mitigation Measures

9.2.1 Construction Phase

The mainly short-term negative environmental impacts, which inevitably occur during the project construction, will be minimized by proper planning and application of preventive measures, and will be mitigated by restorative actions after the civil works are completed as listed in Table 9-1.

In practice, proper planning means that mitigation measures become integrative part of the final design to be submitted by the construction contractor and have to be approved by the supervising engineer and where required coordinated by the Employer (PWA) with the competent authoritiy/ies prior to any construction works.

9.2.2 Operation Phase

During operation of the project, measures in order to avoid or minimize negative impacts on air quality and noise levels are to be implemented. Complying with these tasks is primarily subject to proper planning processes, thus clearly reflected in Table 9-2.

9.3 Social Management Plan (SMP)

The social impact assessment investigations indicated that several obstacles can restrict the achievement of the objectives of the intended project. Based on these findings, the study designed set of mitigation measures that are necessary to achieve the designed objectives. These measures are integrated in a social management plan that should be implemented at three levels as it targets the three major stakeholders of the project. These are community, institutions and private sector. Following is description of the suggested measures for each stakeholder.

9.3.1 Community Level

Major restriction of the project objectives achievement is caused by the attitude and consumption culture of the community. As results indicated, community does not trust services providers, is not willing to pay the bills and deals with public supplied water as saline not for drinking water. Additionally, community judges on water quality according to its taste regardless of the international and national standards. Other standards such as possible microbial contamination are irrelevant as long as it does not affect the color or the taste of water. The study therefore suggests several mitigation measures that must target the targeted communities in order to maximize the level of objectives achievements of the project.

Awareness campaigns

Results indicated that the community does not have any “ability to pay” problem. They purchase desalinated water from private sector for high prices and have other expenditure categories where they spend much more on less vital products and services. On the other hand willingness to pay was major issue. Major reason for this is lack of knowledge, awareness and participation which led no or low trust on services providers. The study therefore suggests the following awareness campaigns messages:

Awareness campaigns

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1. Highlight and teach local communities on water crisis in the Gaza Strip and the necessity to react at all levels including micro scale household level to solve the problem. The community must feel responsible towards the deterioration of water resources and the catastrophic sequences of not sustaining the available resources on the coming generations. Awareness message must include measures at macro scale as well and highlight the responsibilities of communities to achieve these measures. Responsibilities towards seawater desalination and minimization of groundwater abstraction are among these measures. National costs for not preserving water resources and sequencing citizen costs should also be major component of the awareness messages.

2. Awareness campaign must provide information on service provider, its legal status, mission, achievements and significance of its role. The results revealed that community does not trust services providers and does not know anything about their legal status and role. It is very important to bring the community to common understanding of water problem and the significant role that services provider does to solve the problem

3. The community cooperation with service providers is essential to achieve any progress towards conserving the national water resources. Such cooperation can never be achieved without promoting the role of services providers and necessity to cooperate with them. Payment of bills is one type of this cooperation. People don't pay the bill because they don't trust the service providers and because they don't see or understand how this money can improve their lives. In other words, they don't see any positive impact on their lives when they pay the money. This should be the basis for designing suitable awareness tools and messages that reflect the necessity of paying water bills and its positive impact on the national water resources and consequently on the lives of individual household. Religion includes similar messages that must be promoted as integral part of the awareness campaign.

4. The results revealed a clear gap between the meaning of the international and national standards of healthy fresh water and community view on fresh water. For communities public water is not for drinking because it is of bad quality. Community understanding of water quality must be changes. Sweetness of water can't be the only quality criteria to judge water quality. Other criteria such as TDS content and microbial contamination are relevant. Community must be aware of the meaning of healthy water and the efforts that are done by service provider to insure the quality of the supplied water. They also should be informed about potential risks that can happen as a result of dealing with private sector water distributers. The technical monitoring

system that are applied to ensure the quality of publically supplied water must be simplified and presented in easy for to the community to improve level of trust in services providers.

The above mentioned awareness messages must be promoted in the targeted communities using several effective tools. Following is a list of possible awareness campaign tools:

1. The role of local NGOs and CBOs as major community outreach tool should be utilized to disseminate the above awareness messages.
2. Religion is integral component of the local community culture. One of the major problems in the Gaza Strip that people do not see their practices in wasting water resources or not paying water bills as religiously forbidden practices. Discussion with Masjids imams and religious scholars indicated that these practices are forbidden. Several evidences from Quran and Suna are clear in rejecting these practices. Coordination with ministry of Awqaf and masjid imams to promote the above mentioned messages are necessary and seen as effective in the local communities where religion is major influencer of people's behaviors.
3. Public lectures, interviews with officials, articles and brochures through television, radios and public media are also very effective tools to promote the above described messages.
4. The role of local community committees should exceed reflecting the community concerns to promote the needed awareness among the targeted population. Their role must be in both directions from population to authorities and decision makers and vice versa.

Social monitoring system

The results indicated that willingness to pay is not major challenge in the local community as the monthly water costs represents minor share of the average households budget. The same results was found in previous study (Ismail, 2003), as he found that individuals with GDP of US$400 can afford 1.53 to 2.1US$ extra of the current municipal water tariffs. In the same sake, poor families with seven family members and average monthly income of US$340 can afford up to US$0.84 /m^3 of desalinated water.

However, some severe poverty cases can face challenge in covering water cost. The problem here is the fact that water services provider does not have any mechanism to differentiate between rich, poor and very poor customers. This create chaotic situation where better off families can claim severe poverty and use it as an excuse for not paying water bills. Service provider must show readiness to exempt severe poverty cases from paying water bills. Establishment of social investigation unit to assess poverty for claiming customers is necessary to improve fees collection rates.

Allow further participation

The study revealed trust and information exchange gap between planners at macro scale and local communities. This was very clear in Rafah where people were suspicious towards the suggested project. The study therefore suggests allowing further participation when designing and implementing interventions. Community involvement in designing the intervention will make them feel responsible for the achievement of the designed objectives.

Southern municipalities of Rafah and Khanyounis established local community committees. The role of these committees is usually investigating the views and problems of the local communities. This is very good approach as it starts designing interventions based on the community's needs. However, participation should not be restricted to assessing the needs. Community must also participate in designing the interventions and implementing them.

Monitoring system for household settings

Major concern of donors and implementers of the intended project is to deliver healthy fresh water to the targeted households. The objective is to improve the quality of tap water. Water usually passes two phases before reaching tap in the household. First phase is water supply from the service provider while the second phase is inside household as service provider pump water in the household internal networks and tanks.

Results indicated that community does not care much about cleaning the internal networks and household tanks as it receives low quality water that are not used for drinking. This will unlikely change after the project implementation as study showed that people consumption behaviors will not change. People will continue purchase drinking water from private sector. Consequently, they will keep cleaning tanks of purchased fresh water and will not clean their internal network and household tanks.

Changing people behaviors would need first changing their beliefs and attitudes towards the public supplied water. This can be achieved through awareness campaign messages and tools. However, monitoring mechanisms are necessary to ensure the cleanness of internal networks and tanks. Regular monitoring visits by service providers can help to ensure cleaning of households' networks and tanks. Such activity must be integrated with awareness activities which describe optimal and cheapest cleaning methods.

9.3.2 Institutional Performance

To achieve the above described mitigation measures, service provider should work on improving their institutional performance. This section describes major actions that must be made by service providers to better achieve the targeted project objectives.

Improve fees collection rate

Donors are generous enough to finance the initial costs to construct the desalination plant and improve the efficiency of distribution network. However, running costs including maintenance and operation costs can never be covered by donors. To ensure sustainability of the system, customers must totally cover all running costs. Otherwise, the project will never be able to continue its services. There is urgent need to improve fees collection rate.

To improve fees collection rate, service providers must put significant efforts to achieve the following tasks:

1. Designing and conducting awareness campaign through special designed communication and advocacy units that aims at delivering the above described messages.
2. Initiating social investigation units and activate them to receive exemption applications, investigate and judge them.
3. Work on achieving proper plans to improve fees collection rates. The plan should integrate all related activities in well described time schedule with clear responsibilities and monitoring tools.
4. Coordination with other governmental bodies to improve the legal frames and the associated implementation mechanisms to ensure proper reaction in case when better off household reject paying water fees.

5. Capacity building of field workers in public communications to improve their ability to better communicate with public.

The implementation of these activities will involve additional costs. This is expected to be covered by increasing fees collection rate.

Coordination and cooperation with public awareness institutions

The above text on the awareness programs tools describes the necessity of coordinating with national and international institutions to disseminate the designed awareness messages. This should be the task of communication and advocacy unit. Coordination with CBOs, ministry of Awqaf, masjids, Ministry of education, media and UNRWA are necessary to implement the designed awareness campaign.

Further participation for community

Service provider has to revise the institutional structure to give more chance for services providers to participate in designing and implementing water resources related interventions. The role of community representing committees must be extended to exceed assessing the needs. Regular meetings with them and conducting training to help them understanding water problem and macro scale can motivate local communities to push the implementation of designed interventions and make them successful.

Private sector distributers

The results illustrated that private sector will unlikely be affected by the intended project as people will not stop purchasing their desalinated water. However, implementing awareness campaign may lead to such change in consumption behavior and then the above described social impact on private sector will be relevant. The study therefore suggests some mitigation measures to minimize the impact on the livelihood of the owners of desalination plants, workers and drivers. Following is brief description of these measures which are roughly calculated. However, further detailed analyses would need conducting Resettlement Action Plan (RAP) study that is beyond the scope of this study.

Desalination plants owners

The study has revealed the presence of 154 water desalination with almost 1,000 families make their life from this sector. The percentage of income reduction or lay off cannot be predicted at this stage. However, in case of successful national plan in providing blended water and changing water consumption culture, it is most likely these people will be affected. The study suggests two mitigation approaches. First is integration approach where private sector is supposed to be integrated to the system while the second approach is compensation. Following is brief description of both approaches:

1) Integration Approach

Under this approach, the study suggests purchasing the desalinated water from service providers at the cost of seawater desalinating. The estimated cost for desalinating one per cubic meter of seawater is about 3 NIS. Private desalination plants sell on average 100 m^3 daily for 5 NIS per cubic meter. This represents the average actual production and sales of the desalination plant. The operating desalination plants produce daily between 800 to 1,000 cubic meters. However, they have much higher capacity. An average capacity per desalination plan can reach 320 cubic meters a day. Service provider can purchase this quantity of water for 3 NIS / m^3 (the cost of desalinating one cubic meter of seawater) and blend it with wells water before pumping it in the public network.

This scenario will help all stakeholders to achieve their objectives. Owners of desalination plants will generate higher revenue from selling 320 m^3 a day for 3 NIS the cubic meter instead of selling 80 -100 for 5 NIS a day. This will increase the revenue. For sure the cost will increase but will leave definitely

higher income for the owners of desalination plants. It will also allow them to keep and may be increase the number of workers to enable the production of the maximum capacity of the plants.

The suggested approach however, needs to be technically investigated to ensure its technical feasibility and ability of the public network to deal with such valued water sources and if the blending facilities are available for the service provider.

This scenario was appreciated when discussed with the owners of desalination plants with some reservation on the price of cubic meter. One of the plants owners refereed to CARE project that purchased their water to deliver to public schools as very good solution to make use of their capacities to serve the population and to be paid by public sectors or donors. Such approach is not sustainable as donors and public sector can bear the cost as long as the fund is there. Once program is over the fund will stop and the services will stop consequently. The suggested approach suggests complete integration as part of the public water distribution system that generates the cost from fees collection.

2) Compensation Approach

Compensation scenario is usually appreciated by the socially affected groups but difficult to implement by public sector. Compensation needs financial resources that in most cases are not available. Donors also are not willing to pay compensation for the socially affected groups and ask governments to cover these costs. This will unlikely happen under the ongoing economic crisis that restrict the government resources.

The only possible scenario in this case is to purchase the desalination plants from the owners and produce desalinated water to be used as described in the integration scenario. This will allow the owners to use received money in establishing another enterprise to sustain the livelihood of their families. Workers can be kept by the public sectors as operators for the purchased desalination plants.

Such approach may not be the most economic optimal one as the efficiency of small desalination plants will be less than the efficiency of one big plant. The cost to produce one cubic meter may then increase. However, such costs must be paid by the system as any public intervention must not harm any social group. Additionally, service providers can keep the purchased units operating till they end their economic lives and then construct one big plant to substitute them.

Anyway, application of such approach may need further technical and economic studies that investigate each case individually. Investigation must include the maximum capacities and technical efficiency and per unit cost for each plant before deciding on purchasing it. Feasibility study to explore the potential involved revenues and cost during the remaining operating age of the plant is also needed. All these investigation can be covered in RAP.

Workers, cars owners and drivers

Both integration scenario and compensations will keep employment opportunities for workers inside the desalination plants. It may also provide more employment as the plants will increase their productivity to reach the maximum capacity. This case will allow workers on cars to obtain jobs in the plants. The problem may remain with cars owners who will lose significant part of their income as a result of demand reduction. Changing the activity from transporting water to any other commodities can help the car owners mitigating the negative economic impact.

Table 9-1 Summary of Mitigation Measures during the Construction Phase

Environmental Element	Potential Impact	Mitigation Measures
Land Use, Land Ownership and Private Property	• Loss of existing small-scale agricultural areas. • Effects on local communities that use existing land. • Indirect impacts on other receptors including local communities, agriculture and biodiversity. • Blocking of excavated roads.	• Keep copies of official land ownership documentation at all times in the construction site offices, including agreements on the demolition and removal of obstructing structures. • Verify right-of-way continuously as a follow up to the design and planning phase measures, prior to installation of water pipelines. • Protect and do not remove trees and plants (including root systems). However, if it is necessary to uproot any plant or tree, then it should be replanted in a location that is agreed upon by the appropriate authorities and landowners. • Prohibit filling, excavating, trenching, or stockpiling of materials or waste on private or agricultural land, except as approved by the landowner. Excavated materials should be reused as fill, re-shaping, or restoration purposes wherever they meet the required standards. Refer to the Planning Phase measures regarding informing of landowners. • Minimize dust but applying dust control measures, and avoid leaks and spills of contaminants, so that current and future land use is not endangered. • Restore original site characteristics after the project activities are completed as much as practical. • Reinstate the damaged infrastructures due to the installation of the pipelines in the main paved roads such as Salaheldein road (e.g. the road section from Al Buraij to Al Matahen intersection along the carrier, 7 km length). • Scheduling the construction of reservoir ST–015B in Rafah that is adjacent to the school and Jabalia reservoir BL-T01B adjacent to the kindergarten to be implemented in the summer holiday and /or to limit the daily work activities after the school hours. • Reinstate any accidental damage to existing structures and private property caused by construction activities. Construction activities shall be performed with care and following good practice to ensure protecting existing structures within the vicinity of construction from damage.

Environmental Element	Potential Impact	Mitigation Measures
		• Provide a buffer zone from construction sites with clear signage to minimize impacts on local business and recreational activities during construction of the reservoirs and pumping stations especially for the booster pumping station (N0-2) that is adjacent to a recreation site.
Physical Environment		
Air Quality	• Dust generation and gas emissions leading to the reduction of air quality. • Nuisance to the local community in the neighborhood of the construction sites. • Indirect impacts on human health. • Dust accumulation on adjacent vegetation. • Limited odors release out of construction vehicles.	• Apply best management practices during construction to minimize the impact on air quality from dust and emissions. • Wet or cover securely stockpiles of materials especially during windy conditions. • Issue site workers with dust masks and appropriate personal protection equipment. • Cover truck loads when transporting fine materials. • Transport spoils piles in covered trucks. • Plan vehicle movements and do not overload vehicles, especially trucks to minimize exhaust emissions. • Water spray construction site and stockpiles to minimize dust generation. • Control the speed of transporting vehicles, select transportation routes to minimize dust impact on sensitive receivers and wash truck tires before leaving the construction site. • Schedule and monitor activities such as excavation and backfilling which have a higher risk of dust release. • Assure the use of well-maintained mechanical construction equipment. • Comply with relevant local emission standards from vehicles and heavy equipment where available and applicable.
		• Identify locally sensitive receptors where noise limits shall be monitored and controlled. • Comply with Palestinian Labor Law regarding provision of protective hearing devices and appropriate safety equipment to workers on construction sites, where construction works are expected to produce noise over an appropriate level.

Environmental Element	Potential Impact	Mitigation Measures
Noise Quality	• Nuisance and health impacts on workers and local residents • Disturbance to terrestrial fauna.	• Limit noise to acceptable magnitude and duration, particularly near sensitive receptors. Comply with local standards and regulations regarding noise levels including the Palestinian Standard Institution Noise standard for the Outdoor Environment PS 840 – 2005. • Apply OSHA 1910.95 (a) and OSHA 1910.95 (b) regarding exposure periods to different noise levels. • Provide well-maintained construction vehicles and machinery, in order to minimize noise. Environmental Assessment Report • Give advance warning to residents and business owners when heavy machinery and loud equipment are expected to be used around residents and businesses. • Install and maintain mufflers on construction equipment. • Restrict the movement of machinery within project boundaries and plan vehicle movements to and from sites. • Prohibit operating heavy or noisy machinery between the hours of 6:00 pm (18.00) and 6:00 am during working days and all day during Fridays or designated local holidays (unless the public will be best served during these hours and approval has been provided by local government and surrounding residents). • Schedule working hours and work days taking into consideration sensitive receptors such as existing places of worship and schools, to avoid using heavy machinery during prayers times and school hours as much as possible. • Coordinate closely with the nearby schools and other public facilities
Soil Quantity and Quality	• Loss of vegetation cover and venerability to soil erosion by wind and water due to soil structure disturbance by excavation. • Landslides and other types of soil movements in the works areas.	• Install and maintain soil erosion and sediment control measures, such as swales, grade stabilization structures, dikes, waterways, filter fabric fences and sediment basins until erosion concerns are eliminated. • Provide well-maintained construction vehicles and machinery, in order to minimize pollutant spillages. • Control the movement of machinery within the project boundaries.

Environmental Element	Potential Impact	Mitigation Measures
	• Possible soil pollution due to spillage from machinery and construction materials	• Protect soil from spills and/or disposal of sanitary, oil, hazardous materials, and any other possible contaminants. • Inform the responsible authorities through PWA immediately if any soil contamination accidents occur. Suitable solutions must be administered to handle the situation in order to avoid risks on human health or the environment. • Abide by local laws concerning weights and speeds of vehicles that transport construction materials to and from construction to avoid top-soil compaction. • Ensure that staging areas used in this project are fenced and marked prior to construction activities. • Lightly compact topsoil during or after replacement over any graded areas to prevent erosion. • Ensure that excavated soils are properly stored for refill and reuse. • Replace topsoil in original locations from all graded or excavated areas that support or could support vegetation or move to an area for potential reuse. • • Restore, as far as practical, to the original site characteristics. support or could support vegetation or move to an area for potential reuse. • Restore, as far as practical, to the original site characteristics.
Groundwater	• Pollution of groundwater from excavations or from pollutant spillages during construction	• As built drawing of existing sewage collection system submitted to the contractor wherever is available. • Physical inspection for existing cesspits and sanitary sewers should be performed before excavation works for pipelines to avoid wastewater spillage. • Ensure all necessary equipment is available and in good working condition and well maintained, along with backup power in order to minimize leaks and spills.

Environmental Element	Potential Impact	Mitigation Measures
		• Maintain a clean construction site, and dispose of waste material at approved disposal site, to protect the existing groundwater resources from contamination by debris, soil and construction material.
Surface Water	• Hydrological changes linked to flooding and runoff during construction. • Formation of stagnant water ponds due to improper management of construction material storage and waste. • Water quality impacts from excavations or from pollutant spillages during construction	• Ensure that surface water and ditches are protected from spillages, construction waste and spoil, particularly if used as source of water for irrigation. • Ensure no sanitary, oil, hazardous materials, and any other possible contaminants will be spilled or buried in the sites areas. • Inform competent authorities of any spillage or contamination accidents to take appropriate action. • Provide approved designated protected areas for storage of spoil and excavated materials away from surface water. • Ensure that natural storm water flows or storm water systems are not blocked by excavations and constructed pipelines. • Minimize project activities that will create stagnant water ponds in areas susceptible to such impacts in rainy seasons. Drain stagnant water ponds if created. • Address the weather conditions and consider flooding potentials during heavy storms to guarantee the safety of workers and the public from flooding incidents. When necessary, retreat from the project construction area, and resume works when conditions are permissible.
Biodiversity	• Direct habitat loss or disturbance during construction site preparation. • Disturbance to or displacement of faunistic species during site clearance and construction.	• Limit working to daytime hours only because most mammalian species are of nocturnal life styles. • Install fencing or other suitable protection during project construction to prevent exposure of wild and domestic animals to construction hazards. • Prohibit hunting by workers and protect all migratory birds in the project sites, particularly in in proximity to Wadi Gaza and Wadi Al Salqa. • Protect trees and plants (including root systems). However, if it is necessary to uproot any plant or tree, then it should be replanted in a location that is agreed upon by the appropriate authorities and landowners.

Environmental Element	Potential Impact	Mitigation Measures
		• Restore original site characteristics as far as possible after the sites are completed.
Historical and Archaeological Heritage	• Disturbance to culturally valuable areas to the local community. • Disturbance to unknown / buried archaeology during excavations.	• Watching brief during excavation work to identify any unknown buried archaeology on commencement of excavations. • If any archaeology is discovered during construction, the chance find procedures will be used; all construction activities will be stopped, and the responsible authority (MoTA) needs to be contacted. • Take all necessary precautions to protect and preserve assumed or identified archaeological and/or cultural sites. (Delineate the discovered site or area, secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities take over). • Work shall not start until proper authorization from relevant authorities is given in writing.
Existing Infrastructure		
Utilities and Public Services	• Interruption of public service supplies due to: a. Accidental damage during excavation to existing utilities such as wastewater sewers, water pipes, communications and electrical cables b. Reallocation of some utilities to accommodate the new pipes. • Risk on public health and surrounding environment due to the spill of raw sewage from damaged sewers.	• Physical inspection for existing utilities should be performed before excavation works for all pipelines. • As built drawing should be collected and submitted to the contractor wherever is available. • Suggest new pipeline routes in coordination with the design team and local authorities if the relocation of existing utilities is not possible. • Repair the damage done to existing facilities during construction or replace the damaged items if repair is not possible. • Provide emergency services in a timely manner for residents in coordination with local councils. In case of accidental damaged to public utilities and services such as damage to water supply and electricity and disruption occurs for more than 12 hrs. • Utilize local authorities' utility emergency plans when disturbances in services occur.

Environmental Element	Potential Impact	Mitigation Measures
		• Apply good practice construction management measures where unpredicted utility structures are encountered during construction. • Coordinating with utility companies (GEDECO, PALTEL, ….etc) , through PWA, on the removal of obstructions where encountered, prior to commencement of work in the project area if relocation activities are required; relocation activities of electric and telephone poles will not be part of the scope of the contractor's work.
Roads and Traffic movement	• Damage to road infrastructure from excavations and construction traffic especially the movement of heavy machinery. • Disruption of traffic including vehicles and pedestrians movements and risking public safety.	• Prepare and submit Contractor's traffic plan for the Engineer's approval prior to starting any project activities for each road that will potentially be blocked during construction works. • Special care and planning shall be taken where transmission pipelines excavations and installation will be performed, for tight roads, busy roads and near public buildings such as schools and worship buildings. • Inform residents and the public of work schedules as well as with the management plans prepared by the contractor. • Organize and manage construction activities, so that traffic disruption and delays within construction zones are minimized. Measure shall be coordinated with the Municipality through PWA, for approval and minimal disturbance of local community. • Provide temporary alternative lanes and routes. Traffic shall be managed through or around construction zones to minimize disruptions. • Use flagmen and other appropriate means to direct traffic safely through and around construction zones, and to minimize conflicts between local traffic and construction vehicles. • Reinstate excavated roads up to approximately 1.3 m wide of trenched area after pipeline installation activities. Conform to design recommendations for the types of reinstatement including dirt roads, paved roads, and interlock roads. • Minimize the use of heavy machinery, as much as possible. • Control the movement of machinery within the project boundaries.

Environmental Element	Potential Impact	Mitigation Measures
		• Prohibit operating heavy machinery between the hours of 6:00 pm (18.00) and 6:00 am during working days and all day during Fridays or designated local holidays (unless the public will be best served during these hours and approval has been provided by local government and surrounding residents). • Ensure all safety measures and appropriate engineering practices while performing works on hillsides and steep slippery surfaces. • Abide by the local laws concerning weights and speeds of vehicles that transport construction materials to and from construction, storage and quarry sites, in order to minimize safety hazards, such as traffic accidents.
Energy and Electricity	• Accidental damage during excavations to existing electric utilities infrastructures such as electrical cables and poles. • Relocation of electrical cables and poles during the pipelines installation that will cause temporary interruption to public services.	• Physical inspection for existing electricity utilities should be performed before excavation works for all pipelines to avoid accidental damage of unknown buried cables. • As built drawing of buried electricity cables should be submitted to the contractor wherever is available. • Repair the damage done to existing electrical facilities during construction or replace the damaged items if repair is not possible. • Provide emergency services in a timely manner for residents in coordination with local councils. In case of accidental damaged to public utilities and services to electricity and disruption occurs for more than 12 hrs. • Coordinating with GEDECO, through PWA, prior to commencement of work in the project area if repair or relocation activities are required. • Inform the residents in advance through media and/or the community representatives of any relocation activities that may interrupt the public services. • Interruptions in power supply could cause damage to the project infrastructure due to surges or loadings.
	• Generating demand for additional land fill capacity. • Harm to human health or the environment from improper handling, transport and disposal of waste.	• Consider reducing generated constructed waste as much as possible. • Prepare a comprehensive site waste management plan prior to the commencement of construction activities, this should identify expected types and volumes of waste, how it will be stored and when and where it will be disposed of.

Environmental Element	Potential Impact	Mitigation Measures
Solid Waste Management and Disposal	• Unfavorable impact on the aesthetics of the area due to solid waste accumulation. • Additional load on municipal waste management.	• Apply good housekeeping practices at all times in all project sites, including approved designated and protected areas for temporary waste storage. • Prohibit filling, excavating, trenching, or stockpiling of materials or debris on private vegetation areas, except as approved by the landowner. Whenever possible, suitable excavated materials should be reused as fill, re-shaping, or for restoration purposes where they meet the required standards. • Ensure that Municipal waste garbage containers are relocated, if necessary, in a safe and accessible location in order to facilitate the work of Municipality for maintaining regular municipal waste collection schedules. • Burning of waste material of any type is prohibited.
Hazardous Material and Waste	• Harm to human health from contact with substances and waste. • Indirect impacts on surface or groundwater quality from accidental discharge of hazardous waste.	• Provide all necessary Personal Protective Equipment (PPEs) for handling hazardous material depending on type and status of material • Perform storage and disposal of residual hazardous material by an experienced professional, in coordination with local and competent authorities to identify appropriate disposal sites. • Identification the AC pipes locations along the construction sites with the help of the local municipalities, CMWU, and PWA to minimize the risk of accidental crushing of AC pipes. • Seek professional help from specialists, if AC pipes are accidentally encountered. • Apply Asbestos Standards of the Occupational Safety and Health Administration (OSHA) in • 29 CFR 1910.1001 and 29 CFR 1926.1101 during construction activities at all times during handling asbestos material. • Asbestos waste of asbestos shall be handled according to NESHAP 40 CFR section 61.141 and labeling requirements in section 61.150 and transferred to the hazardous waste cell upon coordination and approval of competent authorities.
Sanitation and Wastewater Generation	• Accidental damage during excavations to existing utilities and structures, including cesspits and sewer pipes.	• Physical inspection and inventory for existing cesspits should be performed before excavation works for all pipelines.

Environmental Element	Potential Impact	Mitigation Measures
	• Need for relocation or temporary interruption public services. • Spills of raw sewage due to accidental damage of sewer lines or cesspits. • Indirect impacts on public and workers health from accidental raw sewage spills	• As built drawing for the sewage system should be submitted to the contractor wherever is available. • Repair the damage done to existing sewers during construction or replace the damaged items if repair is not possible. • Provide emergency services in a timely manner for residents with damaged cesspits. • Apply good practice construction management measures where unpredicted utility structures are encountered during construction. • Coordinating with local municipality and CMWU on the removal of obstructions where encountered, prior to commencement of work in the project area if relocation of sewers is required. • Inform the local community in advance of the planned construction activities.
Water Supply and water Quality	• Interruption of water supply services to local communities. • Risk of water pollution from wastewater leakage or oil spillage from construction equipment.	• Physical inspection and inventory for existing water supply system and other utilities should be performed before excavation works for all pipelines. • As built drawing for the water supply and other service utilities should be submitted to the contractor wherever is available. • Repair the damage done to existing water supply pipelines during construction or replace the damaged items if repair is not possible. • Provide emergency services in a timely manner for residents with damaged water supply connections. • Apply good practice construction management measures where unpredicted utility structures are encountered during construction. • Coordinating with local municipality and CMWU on the removal of obstructions where encountered, prior to commencement of work in the project area if relocation of sewers is required. • Inform the local community in advance of the planned construction activities.
Disturbance of visual landscape	• Visual intrusion. • Disturbance in existing landscape status.	• Keep construction sites clean and follow good housekeeping procedures. • Following best practices in stockpiling to minimize visual intrusion. • Following best practice procedures in solid waste management at and around the construction sites.

Environmental Element	Potential Impact	Mitigation Measures
		• Control the movement of vehicles and equipment to minimize the impact on the landscape features. • Start the process of replanting trees in the fished sites and allow the vegetative cover to be restored.
Cumulative impact from proposed projects	• Cumulative construction impacts from the simultaneous construction of multiple projects. • Cumulative impacts from integrating new water supply infrastructure facilities.	• Collect information about projects that may coincide with this project. Coordinate development actions and construction efforts in order to minimize the impacts of each project and create synergistic benefits. • Coordinate between the various construction teams if two or more projects involve excavation in the same area (especially pipes installation), to minimize environmental disturbances and maximize use of energy and local resources where and when possible. • Verify the status of implementing local and regional plans with PWA, CMWU and local municipalities against the proposed components of this project. By the time this project is set for tendering, the status of infrastructural settings in the project areas may have changed. Therefore, verify status to integrate different projects smoothly. This would eliminate redundant facilities and provide mechanisms to mitigate or avoid impacts.
Socio-Economic Conditions		
Markets along the main carrier line (Shejaeya and Khnayounis markets)	• During the construction phase, he customers and sales will be reduced to the permanents shops; in addition, the temporary shops might be lost. • Disturbance to local businesses. • Reduced turnout of local community to local businesses and recreational areas near construction zones. • Reduced income generation from businesses.	• The construction phase should not last for more than ten days. • Good construction and traffic planning; • Phasing of construction work; and • Offering alternative spaces for traders • Provide a buffer zone from construction sites at market areas with clear signage to minimize impacts on local business. • Inform local businesses in the area of the intended construction starting date, schedule and duration prior to commencement of construction works, through flyers, mass media or corresponding Municipality, through coordination with the PWA.

Environmental Element	Potential Impact	Mitigation Measures
		• If construction works to be conducted within open market areas coordinate with local municipality, through PWA to provide a temporary location for the merchants to stage stalls. • Avoid staging of construction material and machinery, or stockpiling of construction waste outside the construction site in the market area.
Material for Construction and Operation	• Increased pressure on construction material demand. • Increased prices of construction material	• Follow design recommendations where appropriate, as this issue has already been considered during the design phase for the selection of suitable, feasible and available construction material. • Follow lessons learnt and procedures that have been experienced by the previously conducted USAID construction projects in Gaza Strip, regarding coordination of material entry in advance. • Work closely with PWA, which is generally responsible for the coordination efforts for the delivery of construction material through Karm Abu Salem checkpoint.
Public and Occupational Health and Safety	• Physical hazards from falling and injuries. • Risks from movement of heavy machinery. • Physical hazards from contact with hazardous material. • Disturbances and impacts on the wellbeing of the local community.	• Prepare, submit and implement Contractor's safety plan for Engineer's approval prior to starting any project activities. • Identify and isolate construction zones by using warning signs, pylons, fencing, and ribbon barriers. • Inform residents, and the public and commercial areas of work schedules as well as with the management plans prepared by the Contractor. • Take appropriate measures to prevent unauthorized persons from entering the work area. • Consider maintaining a safely accessible grazing site for herders to reach their regular site or provide an alternative site and route. • Implement safety measures to protect people from injury and adjacent property from damage. • Dispose waste and refuse properly. • Provide temporary bridges, safe pathways, handrails and any other safety measure during pipeline excavations and installation to protect roads' users from injuries as appropriate and needed.

Environmental Element	Potential Impact	Mitigation Measures
		• Provide temporary shoring as appropriate and needed. • Provide adequate hearing protection, hard hats, safety goggles, brightly colored vests, and other appropriate safety equipment to protect workers and visitors from injury. • Provide all required safety personal protection equipment and appropriate communication means for divers undertaking regular quality control checks during the offshore construction activities of the brine outfall. • Apply special safety requirements for construction of elevated structures such as tanks. Provide appropriate scaffoldings, guard rails and personal protection equipment. • Apply the OSHA confined space safety measures (29 CFR 1910) and entry permits requirements, during tanks insulation and disinfection process. Ventilation openings, gas detector, ladder and body harness, and reliable communication devices must be provided during working inside tanks and chambers. • Apply the OSHA working from height measures (OSHA 29 CFR 1910.23 and 24) during the construction of proposed tank. Provide ladders, safe scaffolding, harnesses and any necessary PPE. • Provide first aid kits on construction sites and ensure the presence of personnel with the minimum first aid skills at construction site all times. • Include the locations of the hospitals and clinics nearest to the construction site within Contractor's safety plan, in case of illness or a construction accident. • Maintain portable toilet and hand washing area properly, with no leaks or spills to the surrounding area. Waste and refuse needs to be properly disposed of. • Consider suitable engineering and occupational health and safety practices during site preparation in areas where unprotected electrical cables and unstable objects are stored and exist. • Comply with seismic loads in design of tanks. • Provide emergency paths and exits where needed.

Environmental Element	Potential Impact	Mitigation Measures
		Confined Space Work (OSHA 29 CFR 1910) • Use safeguards to confine heat, sparks, and slag, and to protect the immovable fire hazards. • Maintain suitable fire extinguishing equipment in a state of readiness for instant use. • Relocate combustibles, where practicable, • Vent and purge of all hollow spaces, cavities or containers to permit the escape of air or gases before preheating, cutting or welding. Purging with inert gas is recommended. • Keep clear all welding and electrical cables and venting pipes of potential trips and falls. • Wear all proper safety equipment at all times. • Remove all electrodes from holders and the holders carefully located so that accidental contact cannot occur and the machine be disconnected from the power source when arc welding is to be suspended for any substantial period of time, such as during lunch. • Close torch valves, in order to eliminate the possibility of gas escaping through leaks or improperly closed valves, Working near Schools, Hospitals, Mosques, Churches and Public Areas • When engaged in construction in the vicinity of Schools, Hospitals, Places of Worship and Public Areas, incorporate the following into all activities: • Maintain and consider safe and careful movement and access of heavy machinery and vehicles in access to and operations. • Inform PWA to coordinate with relevant local authorities to announce and inform the public of planned schedule for construction works near sensitive residential areas and open local markets under the jurisdiction of the corresponding local authority.

Environmental Element	Potential Impact	Mitigation Measures
		• Provide an appropriate buffer zone from all sides of the entire construction project sites that are located near public areas, to protect the public at all times. • Take appropriate measures to prevent unauthorized persons from entering the work area and construction sites, particularly school students and unattended children. • Adopt appropriate noise and dust control measures near sensitive receptors. • Ensure safe access and passages are provided for the public where construction sites are near sensitive receptors and crowded areas. • Surface crossing of trenches should be discouraged; however, if crossings must be provided for easy access, such crossings are permitted only under the conditions required by the OSHA Excavations Standards 29 CFR 1926.651, in provision of the required safety factor, the appropriate width, fitted standard rails and provide the minimum required extends past the surface edge of the trench.
Public Service (water supply, wastewater, electricity, communications and traffic)	• Temporary loss during relocation of or excavation to existing utilities such as wastewater drainage, water pipes, communications, electrical cables and accesses roads. • Risk on public health and surrounding environment due to the spill of raw sewage from damaged sewers.	• Provide emergency services in a timely manner for residents in coordination with local councils. In case of accidental damaged to public utilities and services such as damage to water supply and electricity and disruption occurs for more than 12 hrs. • Coordinate with community leaders regarding the work plans that may lead to services interruptions. • Communicate with the community leaders to hear their voice, complains, and respond to their demands during the crises. • Compensate the community for any temporary damage during the service loss event. • Utilize local authorities' utility emergency plans in full coordination with the community when disturbances in services occur.

Table 9-2 Summary of Mitigation Measures during the Operation Phase

Environmental Element	Potential Impact	Mitigation Measures
Land Use, Land Ownership and Private Property	• Permanent loss of existing small-scale agricultural areas at locations of the reservoirs and pumping stations.	• At reservoir and pumping station sites suitable fencing should be provided to allow continued use of adjacent agricultural areas. • Operators of the reservoirs and pumping stations sites should properly maintain all structures, observe good housekeeping measures, and keep facilities and sites cleaned and safe. • Prevent access of unauthorized persons and ensure public safety by ensuring that the provided signage at all sites is clear for the public.
Physical Environment		
Air Quality	• Impact on air quality due to the emissions from the standby diesel generators in the pumping stations and reservoirs sites	• Using emissions filter for all the diesel generators in the project. This type of filters is available in the market and has high efficiency of CO, NOx, and PM 2.5. • Using natural gas generators instead of diesel generators if possible. This will considerably reduce the gas emissions (may reach to more than 80% emissions reduction). • Reducing the operating hours of the standby generators by supplying the pumping stations and the reservoirs distribution pumps with electricity connections that enable more supply hours in the Gaza electricity distribution schedule. • Comply with relevant local emission standards from heavy equipment where available and applicable.
Noise Quality	• Nuisance and health impacts on workers and local residents • Disturbance to terrestrial fauna.	• Replace and maintain noise muffling equipped or other used acoustic reduction technologies as needed. • Confirmation of expected noise levels from installed equipment against safe working levels, and provision of warning signs and protective equipment for workers by the operator. (Mitigation Measures are already considered in the design phase with the selection of pumps with standard specification).
Groundwater	• Improved water supply infrastructure and additional water resources	• Since the impact will be positive, no mitigation measures are required to reduce operational impacts on groundwater.

Environmental Element	Potential Impact	Mitigation Measures
	(desalination and Mekorot connections) will help to reduce over-abstraction from the groundwater. • Improved treated wastewater quality will help to reduce over-abstraction from the groundwater for agricultural use.	
Biodiversity	• Once the project sites are operational, there are not considered any potentially significant impacts, positive or negative, on terrestrial biodiversity.	• No mitigation measures are required to reduce operational impacts on terrestrial biodiversity, however the following there are still opportunities to keep and manage any vegetation/floral habitats that naturally develop over time at the project sites during operation.
Existing infrastructure		
Utilities and Public Services	• Occasional need to disturb roads for future maintenance of network pipes. • Additional load on existing sanitation and sewer collection systems and existing wastewater treatment plants. • Additional demand on energy and power supply in the local area where the facilities are proposed especially the boosters and the reservoirs pumping stations.	• Mitigation measures are considers in next related sections.
Roads and Traffic movement	• Occasional need to disturb roads for maintenance of network pipes in case of damage.	• No mitigation measures are required to reduce operational impacts on roads and traffic, however the following is noted: • Coordination between the PWA and CMWU with local Municipality regarding possible closure of the road under maintenance and inform the local community in advance to avoid any risk on the public health and safety commercial loss.

Environmental Element	Potential Impact	Mitigation Measures
Energy and Electricity	• Increased demand on energy to operate the pumping stations. • Shortage of electricity supplies if the additional demand of the new pumping stations is solved at the expense the local community. • Failure to provide sufficient power supply to ensure the operation of the proposed facility • Interruptions in power supply could cause damage to the project infrastructure due to surges or loadings	• Maximize the use of PV solar system to contribute to power production. • Use of energy efficient equipment. • Follow lessons learnt and procedures that have been experienced previously by PWA and CMWU with other water supply facilities and projects in Gaza Strip, particularly regarding diesel availability.
Hazardous Material and Waste	• Indirect impacts on human health from contact with chemical substances. • Indirect impacts on surface or groundwater quality from accidental spillage of chemical substances.	• See mitigation measures for occupational health and safety in construction phase for safe handling of chemicals, supply of PPE, and use of safety data sheets: these will continue to apply during the operation phase. Comply with the requirements under the Palestinian Labor Law (No. 7, Year 2000), and its Secondary Legislations particularly regarding dealing and hazardous material and allowable concentrations. • Reservoirs design has incorporated automated dosing equipment to minimize requirements for manual handling of chemicals by plant operators/workers.
Sanitation and Wastewater Generation	• Overloading the existing wastewater infrastructure due to additional wastewater generation as a result of the increased water supply after the construction of phase I of the Gaza Central Desalination plant and this project's components.	• Review and adjust the schedule of the wastewater treatment plants construction phases to be ready in parallel with the construction phases of the additional water supply projects. • Review and upgrade the existing sewage collection networks and set an investment plan for the upgrading works with an implementation schedule that works in parallel with the construction phases of the additional water supply projects. • Plan for the construction of new sewage collection networks and sewage pumping stations according to the approved master plans

Environmental Element	Potential Impact	Mitigation Measures
		taking into consideration the additional water supplies in a timely manner.
Water Supply and water Quality	• Increasing the water supply quantity • Improving water supply quality. • Risks of water contamination during storage, transmission, and/or distribution	• Produce and implement Operation and Maintenance plans and manuals for all project components and assign the parties responsible for maintenance activities. • Train operators of the reservoirs and the pumping stations constructed under this project to comply with operation and maintenance procedures. • Include the new project infrastructure within PWA, CMWU and Ministry of Health (MoH) monitoring program to test and confirm the supplied water quality from wells to the reservoirs tanks. • Supply water to consumers fairly and uniformly so that the water service will be available to all projected population; at the same tariff; at all times and seasons beyond the projected service year in 2035. • Keep the chlorination units in all the reservoirs well maintained and calibrated according the manufacturer's recommendation to comply with the safe chlorine dosage and to guarantee the residual chlorine concentration to minimize biological pollution risks in the distribution network. • Ensure the automated water quality monitoring system is operational at various stages, to ensure the quality of the desalinated water is suitable to be taken into the supply for blending. This mitigation measure is not covered under this project. It is rather covered in the GCDP project However, the PWA and CMWU are the parties responsible for both projects and should guarantee this issue. • Inspect storage facilities regularly, and rehabilitate or replace storage facilities when needed. This may include draining and removing sediments, applying rust proofing, and repairing structures

Environmental Element	Potential Impact	Mitigation Measures
		• Test water quality and implement best practices to prevent corrosion, • Prevent cross-connections with sewerage systems. • Separate water lines and sewer pressure mains (e.g., at least 3 m apart or in separate trenches, with the sewer line at least 0.45 m below the water line) • Implement a leak detection and repair program, this includes: - Specialized leak detection equipment in distribution network (≤ 4") (acoustic hydrophones, correlators, infrared thermography analysis); - Specialized leak detection equipment in bulk carrier networks (> 4") (leak detection vehicles, GPR (Ground Penetrating Radar), infrared thermography analysis, ultrasonic investigations with correlators and geophones, camera inspection, etc); - Leaks repair spare parts and tools (repair collars, welding equipment, pressure release valves, UPVC pipe welding equipment, etc); • Reduce residence time in pipes • Maintain positive residual pressure of at least 20 m water column (~2 bar) • Ensure the adequate Implementation of the proposed SCADA system for continuous monitoring of hydraulic parameters, especially the pressure, as well as quality parameters • Ensure adequate residual disinfection levels. Collect samples from several locations throughout the distribution system, including the farthest point, and test for both free and combined chlorine residual to ensure that adequate chlorine residual is maintained
Surface Water	• Discharges of washout water from tanks or pipelines. • Pollution from fuel spillages.	• Fuel storage tanks should be enclosed within a bund and periodic inspections of the tanks should be carried out.

Environmental Element	Potential Impact	Mitigation Measures
	• Flood risks to new infrastructure.	• Operational staff should have the needed skills to properly operate different facilities and effectively deal with any pollution incident. • All water produced during the disinfection of pipelines should be neutralized prior to discharging and delivering into an approved washout alignment. • Maintain clean drainage catch basins and pipes within the proposed facilities to ensure continuous flow of storm water and avoid flooding.
Energy and Electricity	• Increased demand on energy to operate the pumping stations. • Failure to provide sufficient power supply to ensure the operation of the proposed facility • Interruptions in power supply could cause damage to the project infrastructure due to surges or loadings	• Comply with the operational manual and design recommendations for controlled mechanisms to allow safe shut down of facilities in the case of interruptions to the power supply. • Follow lessons learnt and procedures that have been experienced previously by PWA and • CMWU with other water supply facilities and projects in Gaza Strip, particularly regarding diesel availability
Cumulative impacts on the water supply and groundwater aquifer	• A potential cumulative indirect impact on the water supply situation and the groundwater aquifer is anticipated from the construction and operation of several similar infrastructure projects.	• Verify with Municipality the status of implementing local and regional plans against the proposed scope and elements of this project. By the time this project is set for tendering, the status of infrastructural settings in the project areas may have changed. Therefore, verify status to integrate different projects seamlessly. This would eliminate redundant facilities and provide mechanisms to mitigate or avoid impacts . • Collect information about projects that may coincide with the proposed project. Coordinate development actions and construction efforts in order to minimize the impacts of each project and create synergistic benefits.

Environmental Element	Potential Impact	Mitigation Measures
		• Coordinate between the various construction crews if two or more projects involve excavation in the same area, to minimize environmental disturbances and maximize use of energy and local resources where and when possible.
Socio-economic condition		
<u>Landlords and land users of acquired land</u>	• Permanent loss of existing small-scale agricultural areas and livelihoods at locations of the reservoirs and pumping stations.	• Official land- swap agreements between the municipalities and the land owners of the privately owned lands have been made to guarantee appropriate compensation from loss of cultivated land and a potential source of income. • Resettlement Action Plan (RAP) is needed to deal with landlords and land users. The RAP will provide mitigations for land related impacts (compensations, swap agreement, ..etc.) • At reservoir and pumping station sites suitable fencing should be provided to allow continued use of adjacent agricultural areas. • Operators of the reservoirs and pumping stations sites should properly maintain all structures, observe good housekeeping measures, and keep facilities and sites cleaned and safe. • Prevent access of unauthorized persons and ensure public safety by ensuring that the provided signage at all sites is clear for the public.

Environmental Element	Potential Impact	Mitigation Measures
Water quality and quantity problems	• Supplied water quality and quantity impacts on the health and wellbeing of the local community. • Occupational health and safety of workers.	• Implement safety measures to protect people from injury. • Dispose of waste and refuse properly. • Train operators to comply with operation and maintenance procedures, develop manuals and safe working practices for operational sites. • Provide adequate hearing protection, hard hats, safety goggles, brightly colored vests, and other appropriate safety equipment to protect workers and visitors from injury. • Apply the OSHA confined space safety measures (29 CFR 1910) and entry permits requirements, during any maintenance for reservoir tanks and relevant parts of the desalination plant. • Apply the OSHA working from height measures (OSHA 29 CFR 1910.23 and 24) for any required maintenance that requires working at height • Provide first aid kits on operational sites and ensure the presence of personnel with the minimum first aid skills at all times. • Continue conducting effective public awareness campaigns by PWA, CMWU and local civil society organizations to emphasize that water supplied from tanks is domestic non-potable quality.
Gender Related Issues	• An overall positive long term significant impact is expected to take place on women. • The purchasing and transporting of desalinated water for drinking by women and sometimes by children will be stopped. In addition, the project will	• No mitigation measures are required.

Environmental Element	Potential Impact	Mitigation Measures
	reduce women workload at household level. • The project is expected to help women in providing high water quality not only for drinking but for other domestic uses such as hair bathing (washing) and dish washing.	
Ability, Willingness and Affordability to Pay for Water Services	• Impacts of the project on water pricing, impact on the affordability of water for local communities. • Limited willingness to pay for supplied (non-drinking) water by local communities, leading to lack of opportunity for investment in the project facilities and funding for maintenance in the future.	• Plan for awareness campaigns that give people more understanding and awareness of their responsibilities towards sustainability of water resources. • Ensure financial sustainability by commitment of citizens to pay their water bill fees; primarily by awareness campaigns and secondly by rule-of-law.
Maintenance of household internal water network	• Contamination possibilities from public and internal water networks including the water tanks at house level.	• Improve the community knowledge and awareness towards water problem at macro scale. This can be achieved through public awareness campaigns • The link between CMWU and maintenance of water resources at macro scale and its effects at micro scale should be promoted. • Enhance the community participation in assessing the needs and designing interventions will create better awareness and higher level of success in achieving the project objective.
Private sector water distributers	• Expect significant damage of the owners of desalination plants enterprises (the plants and vehicles) as	• Resettlement Action Plan is needed to deal with this group and to provide mitigation measures for this issue.

Environmental Element	Potential Impact	Mitigation Measures
	a results the project. The actual impact of the intended project is not yet clear at this stage. However, if the project succeeded to change the water consumption behavior, almost 1,000 families will totally lose their income. • The workers and drivers of distribution vehicles might loss their income.	
Visual landscape	• Visual intrusion, especially the Sheikh Radwan reservoir ST-045 site.	• Keep the sites of the newly constructed facilities clean and observe good housekeeping and safety procedures. • Keeping the facilities well maintained in terms of the architectural external appearance.

9.4 Monitoring

The environmental and social monitoring plan specific objectives are 1) insure that the prediction for the impacts is accurate and 2) assure that the mitigation measures are implemented and they are effective in performing its objectives. The monitoring plan will include the monitoring activities (How?), the monitoring indicator (What?), responsible party for monitoring (Who?), the frequency of monitoring (How many?), and the anticipated cost and the party responsible for financing the monitoring activities. The main monitoring actions for the proposed project for construction phase and for operation phase are summarized and presented in Table 9-3 and 9-4 respectively.

9.5. ESMP Institutional Setup

9.5.1 Construction Phase

The Palestinian Water Authority contractor (ENGINEER), responsible for managing this program and for periodic monitoring of the environmental aspects and compliance with the mitigation measures of this program.

It is the construction contractor (CONTRACTOR)’s responsibility to take into account all the construction-related mitigation measures listed in this report: during construction phase. And it is the ENGINEER’s responsibility to monitor and document any departure changes in scope of this project from any of the terms and conditions stated in this report. Both CONTRACTOR and ENGINEER are the primary responsible parties for the mitigation and monitoring tasks; however, both shall adhere to informing and coordinating with all applicable stakeholders with relevance to their corresponding mandates.

The CONTRACTOR shall read, consider, and comply with the Mitigation and Monitoring Plan (MMP) for this project. The CONTRACTOR shall act responsibly to provide notification of CONTRACTOR'S schedule to enable the ENGINEER to carry out his responsibilities.

The CONTRACTOR shall designate an environmental coordinator. This individual(s) shall have knowledge of environmental issues that include, but not limited to biology, cultural resources, soil erosion, dust control, topsoil preservation, topsoil restoration, biological and cultural sensitivity training. This individual(s) shall be responsible to:

- Coordinate the CONTRACTOR'S work related to compliance with environmental mitigation measures
- Work closely with the ENGINEER to ensure that the CONTRACTOR thoroughly understands the mitigation and monitoring requirements for implementation
- Work closely with the ENGINEER to ensure that the CONTRACTOR modifies or incorporates necessary mitigation actions and monitoring plans to reflect on-site field conditions

9.5.2 Operation Phase

Inter-relations between all stakeholders involved in monitoring issues, is considered of major importance. PWA, CMWU, municipalities are the directly responsible bodies for the operation and monitoring of project components .While PWA and EQA have full competence to access all the results of monitoring activities in the project area. The stakeholder’s functions and responsibilities in monitoring activities are presented Table 9-4.

The grand total of the cost of implementing the Environmental and Social plan in construction and operation phases is 199,000 USD. As indicated in Tables 9-3 and 9-4, the cost will be either covered

by the contract with contractor in the construction phase or by the operator's expenses in the operation stage.

Table 9-3 Environmental and Social Monitoring Plan in construction phase

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
Land Use, Land Ownership and Private Property	• Loss of existing small-scale agricultural areas. • Effects on local communities that use existing land. • Indirect impacts on other receptors including local communities, agriculture and biodiversity. • Blocking of excavated roads.	• Document consultation with neighbours and/or local council prior to removal of any object and its resolution. • Verify work with land use and planning maps, as well as design alignments. Signature and official stamp of Municipality is required. • Take same-point vantage photographs prior, during, and post-construction to ensure site restoration back to original characteristics as much as practical.	• Ownership documents • Land use map	• Monitoring – CONTRACTOR • Oversight – ENGINEER, in coordination with local authority	Daily – All activities	No cost is required.
Physical Environment						

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
Air Quality	• Limited odors release out of construction vehicles. Dust generation and gas emissions leading to the reduction of air quality. • Nuisance to the local community in the neighborhood of the construction sites. • Indirect impacts on human health. • Dust accumulation on adjacent vegetation. • Limited odors release out of construction vehicles.	• Document air quality concerns in the Environmental Checklist as provided in the Contractor's Manual. • Document complaints and how they were resolved.	• Air Quality Parameters (PM_{10} , NO_2, O_3, SO_2)	• Monitoring – CONTRACTOR • Oversight – ENGINEER, MoH and EQA	• Daily – Maintenance of vehicles, compliance with worker and public health and safety. • Monthly – Environmental Checklist. • As needed – Complaints and resolution.	The allocate budget for the maintenance of his vehicles and pear all the costs as part of the project budget. An inspection and environment officer should be assigned by him to follow up and control these. The salaries and other inspection costs are estimated at **US$ 80,000.**

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
Noise Quality	• Nuisance and health impacts on workers and local residents • Disturbance to terrestrial fauna.	• Document noise concerns in the Environmental Checklist as provided in the Contractor's Manual. • Document complaints and how they were resolved.	• Noise level (dBA)	• Monitoring – CONTRACTOR • Oversight – ENGINEER, Ministry of Labour (MoL) and Ministry of Health (MoH)	• Daily – Maintenance of vehicles and worker and public safety. • Monthly – Environmental Checklist. • As needed – Complaints and resolution	Costs as part of the project budget.
Soil Quantity and Quality	• Loss of vegetation cover and venerability to soil erosion by wind and water due to soil structure disturbance by excavation. • Landslides and other types of soil movements in the works areas. • Possible soil pollution due to spillage from machinery and	• Document all hazardous material removed and location of disposal. • Maintain log of all maintenance of vehicles and machinery. • Inspect and document construction activities to ensure that measures are implemented. • Document description of proposed debris	• Some soil quality parameters such as pH, DS, EC, nitrate, phosphorus, heavy metals	• Monitoring – CONTRACTOR • Oversight – ENGINEER	• Daily – Work activities. • Periodically – Same-point vantage photographs.	Costs are part of the project budget.

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
	construction materials	and location of soil disposal site for review and approval. • Take same-point vantage photographs prior, during, and post-construction to ensure site restoration back to original characteristics as much as practical.				
Groundwater	• Pollution of groundwater from excavations or from pollutant spillages during construction	• Maintain a log of all equipment and its condition. • Maintain licenses of all operators. • Inspect and document that chemicals and residues are safely stored. • Document confirmation made with survey and design layout of potential cesspits identified.	No test is required in groundwater	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with local authority and PWA and EQA.	Daily – Work activities.	Costs are part of the project budget

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
		• Document location of septic tank disposal. Document any significant spillage accidents and resolutions.				
Surface Water	• Hydrological changes linked to flooding and runoff during construction. • Water quality impacts from excavations or from pollutant spillages during construction. • Washout flushing from disinfection of pipelines and tanks prior to commissioning	• Document any potential concerns for spills and stagnant water body creation and its resolution • Take photographs prior, during, and post-construction to ensure site restoration back to original characteristics as much as practical	• Some water quality parameters in runoff	• Monitoring – CONTRACTOR, in coordination with local authority and PWA if needed • Oversight – ENGINEER	• Daily – All work activities, especially during rainy seasons • Periodically – Same-point vantage photographs	**US$ 12,000** is to cover clearance works in the wadi, if available
Biodiversity	• Direct habitat loss or disturbance during	• Log any presence of wild or domestic animals within the project	• Species and habitat	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in	• Daily – Work activities. • Periodically – Same-point	**US$ 20,000** is estimated as the budget for the trees

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
	construction site preparation. • Disturbance to or displacement of faunistic species during site clearance and construction.	site and action taken. • Take photographs prior, during, and post-construction to ensure site restoration back to original characteristics as much as practical. • Document agreed landowner decision if removal of trees or plants are required.		coordination with EQA and MoA, and tree owners.	vantage photograph. • As needed – Wild or domestic animals entry.	resettlement plan and compensation
Historical and Archaeological Heritage	• Disturbance to culturally valuable areas to the local community. • Disturbance to unknown / buried archaeology during excavations.	• Utilise survey results, design drawings, and identified archaeological site locations to document construction activities do not impact the sites. • Keep documentation of official correspondences with MoTA.	• Archeological heritage sites	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with MoTA.	• Daily – Work activities. • As needed – Findings and actions taken.	**US$ 10,000** is estimated as the fees for the archaeological expert to conduct the investigation. The contractor is to take the risk of any damages to cultural properties.

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
		• Document any archaeological findings and actions taken.				
Existing Infrastructure						
Infrastructure Utilities and Public Services	• Interruption of public service supplies due to: a. Accidental damage during excavation to existing utilities such as wastewater sewers, water pipes, communications and electrical cables • Reallocation of some utilities to accommodate the new pipes. • Risk on public health and surrounding environment due to the spill of raw sewage	• Periodically consult site survey results and design layout for existing utilities • Document approved Municipal emergency utility services plan • Document how, and when the residents are informed of any public services interruptions • Document changes to services pipelines alignment and utilities points promptly during	• No. of public services unities	• Monitoring – CONTRACTOR, in coordination with local authority and relevant utility companies • Oversight – ENGINEER, in coordination with local authority	• Daily - Site preparation and all construction work activities • Periodically – Consult survey results and design layout • As-needed – Repair or replacement of damage facilities	No cost is required.

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
	from damaged sewers	construction on shop drawings • Document on-site checks on potential hazards where fragile infrastructure utilities exist • Document potential hazards or accidents, and their resolutions				
Roads, Traffic Movement	• Damage to road infrastructure from excavations and construction traffic especially the movement of heavy machinery. • Disruption of traffic including vehicles and pedestrians movements and risking public safety.	• Document when and how the public was informed of work schedules and management plans • Document compliance with the engineer approved Traffic Plan • Document potential health and safety concerns and resolutions	• No of traffic complaints	• Monitoring – CONTRACTOR, in coordination with local authority and the traffic police • Oversight – ENGINEER, in coordination with local authority	• Daily – Site preparation and all construction works • Daily – Heavy equipment works • As needed – Work complaints and resolution	**US$ 20,000** is the estimated budget for the implementation of the traffic plan

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
		• Document complaints and how they were resolved.				
Solid Waste Management and Disposal	• Generating demand for additional land fill capacity. • Harm to human health or the environment from improper handling, transport and disposal of waste. • Unfavorable impact on the aesthetics of the area due to solid waste accumulation. • Additional load on municipal waste management.	• Maintain checklist of all materials and indicate if it is to be reused or disposed. • Cross-check with materials list prior to disposal. • Maintain log of all disposed items and location of disposal. • Maintain log of all reused or recycled items, amount, and location used.	• Quantity of accumulated solid waste in each site	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with local authority.	• Daily – All work activities.	Cost is part of the project budget.
Hazardous Material and Waste	• Harm to human health from contact with substances and waste.	• Maintain chemicals transport and storage log sheets, including MSDS and	• Type of hazardous material, waste, and quantity of each type.	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with local	• As needed– work activities involving hazardous chemical material.	Cost is part of the project budget.

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
	• Indirect impacts on surface or groundwater quality from accidental discharge of hazardous waste.	chemical mixture data sheets. • Document through verification and checklists that log sheets reflect actual practices.		authority, MoH and EQA.		
Socio-Economic Conditions						
Economic Activities and Local Businesses	• Disturbance to local businesses. • Reduced turnout of local community to local businesses and recreational areas near construction zones. • Reduced income generation from businesses.	• Document periodic inspections by MoL, MoH, and Ministry of Local Government (MoLG).	• No of disturbed market.	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with local authority MoL, MoH, and MoLG.	• Periodic – Ministry inspections. • As needed – Complaints and resolution. As needed – Safety awareness campaigns.	No cost is required
Material for Construction and Operation	• Increased pressure on construction material demand. • Increased prices of construction material	• Bill of quantities of the materials to be used in the project components.	• The price and availability of construction materials	• Monitoring – CONTRACTOR. • Oversight – ENGINEER, in coordination with PWA, CMWU.	Once for each project	No cost is required.

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
Public and Occupational Health and Safety	• Physical hazards from falling and injuries. • Risks from movement of heavy machinery. • Physical hazards from contact with hazardous material. • Disturbances and impacts on the wellbeing of the local community.	• Record when the public was informed of work schedules and management plans • Conduct periodical site inspections • Document and report potential health and safety concerns and their resolution • Record and document any accidents and how they have been resolved • Record vaccinations taken by workers • Conduct site visits and document that workers are	• No of injured workers in the site	• Monitoring – CONTRACTOR • Oversight – ENGINEER, MoL and MoH	• Daily – All activities	The contractor is responsible for the occupational and workers health at site. These costs are covered by the contractor budget. The salaries of an environment and safety officer are estimated at **US$20,000** per year

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who?)	Frequency of Monitoring (How many?)	Implementation and budget (US$)
		properly wearing their PPE • Document the removal of PPE and its disposal				

Table 9-4 Environmental and Social Monitoring Plan in Operation phase

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who)	Frequency of Monitoring (How many)	Implementation and budget (US$)
Land Use, Land Ownership and Private Property	• Permanent loss of existing small-scale agricultural areas at locations of the reservoirs and pumping stations.	• Use and maintain facility checklists and monitoring tools to conduct frequent checks on system conditions by PWA, WBWD and local authorities	No. of influenced site	• Monitoring and Oversight – local authority, PWA, WBWD, EQA, MoLG, MoPWH, MoE, MoH	• Periodically – System conditions check up •	No cost is required.
Physical Environment						

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who)	Frequency of Monitoring (How many)	Implementation and budget (US$)
Air Quality	Impact on air quality due to the emissions from the standby diesel generators in the pumping stations and reservoirs sites	• Carry out Complaint monitoring and ambient air sampling. • Refer to the operation manual to be implemented by Pumping stations operator.	• Air quality parameters.	Monitoring and Oversight by CMWU, PWA, EQA.	Monthly or as needed	**USD 5,000** for air quality analysis
Noise Quality	• Nuisance and health impacts on workers and local residents • Disturbance to terrestrial fauna.	• Carry out complaint monitoring for noise measurements. • Refer to the operation manual to be implemented by the Desalination Plant operator.	• Noise level in the site	• Monitoring and Oversight by CMWU, PWA, EQA.	Monthly or as needed	**USD 2,000** for measuring the noise level
Surface water	• Discharges of washout water from tanks or pipelines. • Pollution from fuel spillages. • Flood risks to new infrastructure.	• Carry out water sampling from the tanks, permeate water from the desalination plant.	• Surface water quality such as :TDS, TSS, CL, NO_3, FC • Volume of discharge water	• Monitoring and Oversight by CMWU, PWA, EQA,	• Daily – During operation. • Periodically – System conditions checkup.	**US$ 20,000** for water quality analysis and testing

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who)	Frequency of Monitoring (How many)	Implementation and budget (US$)
	• Hydrological changes linked to increased runoff from hard surface areas. • .	• Carry out chemical testing of the water samples.				
Socio-economic condition						
Public and Occupational Health and Safety	• Supplied water quality impacts on the health and wellbeing of the local community. • Occupational health and safety of workers.	• Monitor the safety measures expressed in in OSHA 29 CFR 1910.23 and 24 • Perform supplied water quality testing throughout the operations of supply, to include arsenic and total coliform, and reporting on water quality results.	• No of injured Workers and operator	• Monitoring and Oversight by CMWU, PWA	• Monthly – During operation	The cost is prat of operation budget

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who)	Frequency of Monitoring (How many)	Implementation and budget (US$)
Affordability to Pay for Water Services	• Impacts of the project on water pricing, affecting the affordability of water for local communities. • Limited willingness to pay for supplied water by local communities, leading to lack of opportunity for investment in the project facilities and funding for maintenance in the future.	• Check the number of people pays the water bills in regular base. • Check the municipality or CMWU returns. •	• No. of people pays and the returns of each municipality.	• Monitoring and Oversight by CMWU and PWA	• Monthly – During operation	The cost is prat of operation budget
Energy and Electricity	• Increased demand on energy to operate the pumping stations. • Failure to provide sufficient power supply to ensure the operation of the proposed facility • Interruptions in power supply could cause damage to the project infrastructure due to surges or loadings	• Monitor the electricity consumptions in the pumping stations	• Electricity consumption in each pumping stations.	• Monitoring and Oversight by CMWU and PWA,	• Monthly – During operation • Periodically – System conditions check up	The cost is prat of operation budget

Environmental Element	Potential Impact	Monitoring Activity (How?)	Indicator (What?)	Monitoring Responsibility (Who)	Frequency of Monitoring (How many)	Implementation and budget (US$)
Water Supply Quantity and Quality	• Increasing the water supply quantity. • Improving water supply quality for domestic use. • Risks of distributing high quality water through deteriorated downstream water supply infrastructure. • Risks of water contamination during storage, transmission, and/or distribution	• Monitor the water quality parameters in the reservoirs and transmission lines.	• TDS, NO3, FC, Cl, heavy metals • Volume of pumped water to domestic use	• Monitoring and Oversight – local authority, PWA, CMWU, EQA, , MoH	• Monthly – During operation • As needed – Capacity building	**USD 10,000** for water quality testing
Cumulative impacts on the water supply and groundwater aquifer	A potential cumulative indirect impact on the water supply situation and the groundwater aquifer is anticipated from the construction and operation of several similar infrastructure projects.	• Report results of project scope review; including type, location, time and duration of activities. Document information about proposed or current projects in the area as obtained from stakeholders.	• No of mutual objective projects	• Monitoring Oversight – PWA, CMWU.	• As needed - Through life of the project	No cost is required

10. Public Consultation

The public has the right to be properly and timely informed about any type of projects that can cause an impact on the environment. This right is guaranteed by national as well as international laws and policies governing this study.

Both positive and negative environmental and socio-economic impacts are expected to be generated during construction and operation activities of the project; and many stakeholders are directly or indirectly affected. As a result, capturing the opinion of public, community and private stakeholders concerned with the project must take place at an early stage.

As part of the ESIA Study, many activities were carried out to ensure the adequate engagement of stakeholders; sections below provide details of the stakeholders' identification and the key consultation activities conducted during the scoping and the impacts assessment phases.

10.1. Stakeholder Identification

Stakeholders may include locally affected community groups or individuals and their formal and informal representatives, national or local public authorities, civil society and community-based organizations and groups with special interests, or private businesses.

In order to identify the stakeholders concerned of the project, the approach adopted was based on stakeholders' interest and influence, namely:

- National public institutions concerned with the Project, e.g. ministries,
- Local public institutions concerned with the Project, e.g. municipalities,
- Potential affected businesses, e.g. private water desalination units owners and workers, water distribution vehicles owners and workers, and shops and stalls owners in the affected markets
- Existing facilities along the proposed routes of the pipelines and around the proposed locations of the other components, e.g. educational, recreational, cultural, etc.,
- Non-Governmental Organizations (NGOs) working on matters of public or community interest

Different activities were used to communicate with the identified stakeholders, these include consultation sessions, both in the scoping phase and after the preparation of the first draft of the ESIA, semi structured interviews, and key informant meetings as discussed in section 10.2 below.

10.2. Stakeholder Engagement and Consultation

The key consultation activities during the course of the project could be divided into the following:

10.2.1. First Public Consultation

As part of the scoping process, the first public consultation session was conducted on October 13, 2017 at Roots Hotel in Gaza to identify the issues to be covered by the EA study and to gain an understanding of the concerns of the stakeholders. The session was attended by 50 representatives of the relevant Palestinian authorities, international Non-governmental Organizations and local civil society organizations who represent local community categories that are directly involved in or affected by the proposed project components.

During the session, the PWA presented the project background, approach and objectives, components, and energy management plan and energy supply system. In addition, the ESIA team (JV of GVC &

CEC), presented the area description of project components including the proposed routes and locations, sites description, nearby facilities, agricultural activities, and surrounding environment.

The participants were also introduced to the purpose of the environmental assessment for the proposed project and the content of the ESIA study. The team also explained some environmental concerns as identified during initial consultations with PWA and based on the sites visits conducted by the team and the experience of conducting similar ESIA reports for desalination plants and associated water supply works. Photos from the scoping session are shown in Figure 10-1.

Figure 10-1: Photos from the Scoping Session (GVC/CEC, October, 2017)

The session was then open for the participants to actively discuss and reflect their opinions and concerns for potential negative environmental impacts. The main concerns and issues that have been added by the scoping session participants can be summarized as follows:

- Risk of flood/overflow of the tanks,
- Socio-economic impacts on the investors and operators of the small-scale desalination units,
- Social impacts associated with the presence of residential encroachments along the route of the transmission line in the area from Meraj road to Al Najma intersection.
- Safe handling of asbestos pipelines during construction

The results from the discussion during the Scoping Session were evaluated and compiled into a scoping document, and were considered during the preparation of the first draft of the study. See Annex 1 for a copy of the scoping document, where the list participants, the presentations, and more photos can also be found.

10.2.2. Second Public Consultation

As part of the public consultation process for a category A project, the second public consultation session, was conducted on December 11, 2017 at Roots Hotel in Gaza, after the preparation of the first draft of the ESIA report. Representatives of all identified PAPs, public institutions, and non-governmental organizations were invited through official letters sent by the PWA. The first draft of the ESIA report was sent along with the invitation.

The session was attended by about 65 participants from different groups who are directly or indirectly affected by the project. The session opened dialogue and interaction between different stakeholders and the environmental and social experts conducting the ESIA (GVC & CEC Consultants) along with the client (PWA).

The progress in the design contract of the associated works including different contract packages time schedule and cost, along with the key points from the NRW management study were first presented by PWA. Then, the consultant presented the legal framework of the project and the expected positive and negative environmental impacts considering physical and biological environmental elements, with more concern given to the critical issues such as land use and surrounding facilities of the main carrier, the new Mekorot pipelines, the transmission mains and the reservoirs and pumping stations sites. Impacts on traffic were discussed in more details in areas with high population densities and large traffic volumes.

Later, the consultant also presented the baseline socio-economic conditions in the project area and the expected socio-economic impacts along with the proposed mitigation measures.

The session opened dialogue and interaction between different stakeholders and the consultant; to allow them to actively discuss and reflect their opinions and concerns for potential negative environmental impacts and proposed mitigation measures, some photos from the scoping session are shown in Figure 10-2.

The main concerns and recommendations that have been raised by the second public consultation session participants can be summarized as follows:

- The owner of Tel Al Zatar kindergarten has an objection on the construction of the water facility behind the kindergarten.
- There is a great need of having different public awareness campaigns to ensure the effective implementation and operation of the project.
- Close coordination between the project implementation agencies and the nearby public facilities is very important.
- Service providers have a vital role in enhancing the fees collection rates.
- There is a need of having comprehensive socio-economic studies regarding each socio-economic issue
- The potential of the contamination of water in pipes as a result of the negative pressure.
- A comprehensive energy plan is very important.

Figure 10-2: Photos from the Second Public Consultation Session (GVC/CEC, December, 2017)

The results from the discussion during the second public consultation session were evaluated and compiled into one document including the MoM, list of participants, presentations, and more photos from the session (See Annex 9).

Moreover, the second public consultation MoM was sent to all participants to ensure that all their comments were included and to receive any further concerns and recommendations. Following are the main points received:

- The section of the transmission main that connects the main carrier with Al Atatra existing water reservoir in Beit Lahia, is proposed to pass along Beit Lahia main road, which is considered to be the main traffic/transportation line in Beit Lahia.

All concerns, comments and recommendations raised during or after the second public consultation were considered in the preparation of the final ESIA and ESMP.

10.2.3. Surveys, Interviews and Meetings

In addition to the consultation undertaken during the two consultation sessions, further consultation has been undertaken with the identified PAPs and public institutions using semi structured interviews and

individual meetings. A survey to count the number of shops and stalls in each local market within the project area has also been conducted.

The information collected during these consultation activities were used in the assessment process of the impacts on land use and nearby facilities during construction, and the socio-economic impacts during construction and operation of the project, as illustrated in Chapter 6 and Chapter 7 of this report. Some photos will be provided were needed in the text below, but more details about each of the mentioned activities, including more photos and interviews templates and results sheets, can be found in Annex 8.

Survey

A field survey was carried out to count the number of shops and stalls that will be affected during the construction of the main carrier line in Khanyounis Market and Shejaeya Market. Photos from the survey in the Shejaeya market and Khanyounis market are shown in Figure 10-3 and 10-4, respectively.

Figure 10-3: Photos from the Survey in Shejaeya Market (GVC/CEC, November, 2017)

In the Shejaeya Market, 108 shops and 38 stalls were found on the main carrier line route, while around 60 shops and 60 stalls were found in the surrounding roads. The situation is different in Khanyounis as the local market is active only on Wednesdays with diversified number of peddler carts. During the field visit to the market, which took place on Wednesday 1st November, 2017, more than 450 peddler carts were counted in addition to 50 stalls, and around 60 shops which open every day.

Figure 10-4: Photos from the Survey in Khanyounis Market (GVC/CEC, November, 2017)

Semi Structured Interviews

As part of the social study, semi structured interviews were used to get information about the identified PAPs and to know more about their concerns. The interviews have targeted private desalination units' owners, water distribution vehicles' owners, and small scale traders in the two local markets expected to be affected during the construction of the main carrier line. See Annex 8 for the questionnaires templates and the data collected during the interviews.

- **Private Desalination Sector**

Semi structured interviews with owners of 15 small scale desalination units, and the owners and labors of 15 water distribution vehicles were carried out to estimate the current income, possible change and potential solution from their point of view. Geographical distribution was considered during the interviews that took place on 8 and 9 November, 2017. Photos during the interviews are shown in Figure 10-5.

Figure 10-5: Photos during the Interviews Targeted the Private Desalination Sector (GVC/CEC, November, 2017)

The results of interviews with private sector producing and distributing desalinated water indicated that private sector provides water of 50-60 TDS. The results also revealed that 100% of them expect significant damage of their enterprises as a result of the intended project. The losses for the owners of the assets (the plants and vehicles) are not only losing their income but also their huge investment on the desalination sector.

- **Traders in the Affected Markets**

During the preparation of the social study, 20 traders in the Shejaeya Market and 20 traders in Khanyounis Market were interviewed to assess their income and possible reduction and their suggested solutions including proposed alternative location. Photos during the interviews are shown in Figure 10-6.

Figure 10-6: Photos during the Interviews Targeted the Traders in the Shejaeya and Kanyounis Markets (GVC/CEC, November, 2017)

Questionnaires were used to collect information about enterprises in the markets (Type of enterprise, size of the enterprise measured in area and rough estimate of the value, average daily income, number of working days per week, the availability of other sources of income, average monthly income, and percentage of income share from this enterprise). Information about the traders' concerns about the project impact was also included (The possibility of sustaining their activity during the construction phase, percentage of income decrease and for how long the decrease is expected to last).

Moreover, they were asked to suggest mitigation measures and possible alternative location. Potential risk to apply the mitigation measures, and any further comments were also included.

All interviewed traders in the Shejaeya Market expect losses during the construction phase as it will reduce the customers and sales. Shops owners were concerned as their shops are permanent while the stalls owners were open to discuss potential move of their enterprises. The situation is different in Khanyounis Market as the local market is active only on Wednesdays with diversified number of peddler carts.

Key Informant Meetings

National and local public institutions have also been contacted or consulted during the preparation of this ESIA study. The main institutions are the Municipality of Gaza, the Municipality of Khanyounis, the Ministry of Higher Education and Ministry of Tourism and Antiquities. Main outcomes of each meeting, including comments and recommendations raised/discussed during the meeting and data

provided to the consultants, are illustrated in Table 10-1. The general opinions and concerns from the interviewed personnel were incorporated and addressed within this ESIA report.

Table 10-1: Summary of the Key Stakeholder Meetings and Outcomes

Person	Institution	Date	Subject	Main Outcomes
Director of planning department	Municipality of Gaza	7 November, 2017	The section of the main carrier line that is proposed to pass along the Shejaeya Market	• The municipality stated that the contracts with stall owners does not give them the right to use the Sikka road (where the carrier line work will take place) • Permanent Shops will be affected during the construction phase • There is a need to prepare work and traffic plan that allows the sustainability of movement in the street to reduce the impact of the construction on trading activities • It is recommended to open additional spaces for the stalls during the construction phase • In all cases the construction time in this location should not take long time as it will affect the traffics as well as trading activities
Director of the mayor's office	Municipality of Khanyounis	7 November, 2017	The section of the main carrier line that is proposed to pass in the area of Khanyounis Market	• The municipality revealed its readiness to offer alternative space for the local market • It is recommended to conduct the construction on several phases to reduce the period of construction and to allow for mitigation plans for traders.
General directorate of buildings	Ministry of Higher Education (MoHE)	7 December, 2017	Locations of schools within the project areas	• A map including the locations of the schools in the Gaza Strip, up to year 2017, was provided to the consultant

Person	Institution	Date	Subject	Main Outcomes
Director of Antiquities Department	Ministry of Tourism and Antiquities(MoTA)	13 November, 2017	Archaeological sites in the project areas	• A map including all archaeological sites in the Gaza Strip was provided to the consultant
Eng. Mazen Abu Samra / Site Manager-Project Management Unit	PWA	30 October, 2017	Land Acquisition documents	• Land acquisition process is very complicated under the current situation in the Gaza Strip • Official land acquisition documents for each location were reviewed • a list was prepared for the documents that need to be updated

11. Conclusions and Recommendations

This ESIA has investigated and assessed the significance of the predicted positive and negative impacts associated with the proposed Associated Work to Gaza Water Supply Program. During the construction phase, several negative impacts are anticipated; however, they are expected to be temporary and within the normal magnitude that is typical to similar construction activities. During the operational phase, a number of potential negative impacts have been identified, but these have been considered through the design of the project to avoid, reduce or mitigate any significant impacts.

The project is expected together with other projects will have a high significant beneficial cumulative for improving the overall water supply infrastructure and services in Gaza Strip and in turn the livelihood of the benefiting communities. No significant negative cumulative impact is expected from the construction and operation of infrastructure water supply projects (planned and under construction).

In conclusion, by providing the required mitigation measures to address the potential impacts of the project on the environmental, social, and health and safety issues in PWA and CMWU, every potential adverse impact can be limited within acceptable levels.

In order to ensure effective application of the management actions and monitoring proposed in this ESIA, a comprehensive ESMP was prepared. Recommendations are provided for the best practicable environmental and social option, mitigation and management actions, as well as suggested monitoring during construction and operation phases of the project.

This ESIA is recommended for approval so that the construction and implementation of the project can begin in a timely fashion. The proponent of the project is committed to the standards and requirements for the protection of the environment and will apply all the required mitigation measures addressed in this ESIA.