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Environmental and Social Impact Assessment (ESIA) for Gaza Solid Waste Management Project

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Consolidated ESIA
(Southern and Northern Parts)

Final Report

September 2012

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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT FOR SOLID WASTE MANAGEMENT IN GAZA

Consolidated ESIA (Southern and Northern Parts)

September 2012

EcoConServ ENVIRONMENTAL SOLUTIONS
Universal Group-Gaza

List of Acronyms

ADT	Average daily traffic
AFD	Agence Francaise Developpement
AMSL	Above Mean Sea Level
ARAP	Abbreviated Resettlement Action Plan
CBO	Community Based Organization
CBMC	Community- based monitoring committees
DEEP	Deprived families Economic Empowerment Program
EC	Engineering Consultant
EQA	Environmental Quality Authority
EPR	Extended Producer Responsibility
ESMP	Environmental and Social Management Plan
EU	European Union
FGD	Focus Group Discussion
FS	Feasibility Study
GoJ	Government of Japan
GS	Gaza Strip
GSWMP	Gaza Solid Waste Management Project
HDPE	High Density Poly-Ethylene
IsDB	Islamic Development Bank
JV	Joint Venture
LGUs	Local Governorate Units
JCP	Job Creation Programme
JSC	Joint Service Council
M&E	Monitoring and Evaluation
MEnA	Ministry of Environment Affairs
MDLF	Municipal Development and Lending Fund
MoL	Ministry of Labour
MoLG	Ministry of Local Development
MoH	Ministry of Health
MoP	Ministry of Planning
MSL	Mean Sea Level
PAPs	Project Affected Persons
PCBS	Palestinian Central Bureau for Statistics
PMU	Project Management Unit
PNA	Palestine National Authority
PPP	Polluter Pays Principle
oPt	Occupied Palestinian Territory
RAP	Resettlement Action Plan
RCV	Refuse Collection Vehicles
RPF	Resettlement Policy Framework
SDO	Social Development Officer
SLA	Sustainable Livelihoods Approach
SMP	Environmental and Social Management Plan
SWM	Solid Waste Management

TSs	Transfer Stations
ToRs	Terms of Reference
UG	Universal Group (Maalem)
UNDP	United Nation Development Program
UNRWA	the United Nations Relief and Works Agency for Palestine Refugees in the Near East
WFP	World Food Programme
WHO	World Health Organization
WTP	Willingness to Pay

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Executive Summary

Introduction

The status of Solid Waste Management (SWM) in the Gaza Strip (GS) is associated with many environmental, health and social shortcomings. This is attributed to several technical, institutional and financial factors as defined in the National Strategy for Solid Waste Management (NSSWM) in the Palestinian Territory for 2010-2014.

Most of the collected solid waste in the GS (1450 tons/day in 2007) is disposed of in three main disposal sites; Johr al Deek Landfill east of Gaza City, El-Fukhary Landfill east of Rafah City, and Deir El Balah Landfill in the Middle Area of GS. The three sites are reaching their maximum capacity, in addition to the fact that the expected amount of solid waste is expected to reach around 3700 tons/day in 2040. Accordingly there is a growing need for establishing an integrated SWM that to adequately handle the growing waste generation rates in GS with minimum impacts on public health and the environment.

Within this context the Gaza Solid Waste Management Project (GSWMP) has been initiated. The goal of the project is to improve SWM in Gaza through taking emergency short-term measures to upgrade existing facilities, and long-term measures to establish new facilities that will enable adequate SWM for a time horizon of 30-40 years implemented in certain stages.

The GSWMP will be carried out by the PNA in cooperation with different international organizations which have expressed interest in supporting the project. The United Nations Development Program (UNDP) is supervising the preparation of the Feasibility Study (FS) and Detailed Design for the short-term and the long-term measures of SWM in GS; the Government of Japan (GoJ) has agreed to finance the short-term measures, while different organizations have expressed their interest to finance long-term measures including the World Bank (WB), the European Union (EU), the AFD, the Islamic Development Bank (IsDB), and GoJ.

The preparation of an independent ESIA including a RAP for the long term measures of GSWMP was announced as a competitive bid in May 2011. The consultancy assignment is funded by AFD and has been awarded to the Joint Venture of EcoConServ Environmental Solutions, Egypt, and Universal Group, Palestine.

The ESIA has used the solid waste management scenario designed within the FS and the final designs of the two landfills and related transfer stations. This ESIA report includes a baseline study, an impact analysis and environmental and social management plan for the two landfill sites and related transfer stations. .

ESIA Objectives

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

This ESIA report has been prepared in accordance with the National Environmental Impact Assessment (EIA) guidelines including the EIA Brochure of the PNA. It also recognizes the international policy and guidelines including the WB Operational Policy/Bank Procedures/Good Practice (OP/BP/GP 4.01), EC directive 85/337 and EC directive 97/11/EC

Secondary data collection involved the review of information in previous reports and studies. Moreover, structured site visits were undertaken to collect primary data directly from stakeholders in order to garner their perceptions about the project's predicted impacts. The most important tools included Structured, Questionnaire, Focus Group Discussions (FGD), Semi Structured Interviews (SSI) and Informal/ Unstructured Interviews as well as public consultations through plenary events.

Current Waste Management Situation

Waste is currently collected and hauled to the three main landfills currently operating in the GS; 1) Johr al Deek (Gaza)Landfill, located in Gaza municipality; 2) Deir El Balah Landfill: located in the east side of Deir Al Balah municipality; and 3) El-Fukhary landfill: located in Khan Younis municipality, east of Rafah municipality which it serves. Both Johr al Deek and El-Fukhary landfill sites are not equipped with soil protection measures which present a potential contamination risk to groundwater resources due to waste leachate percolating through the soil layers in the event of rainwater. In addition to potential groundwater contamination, the existing solid waste management system is characterized by the following deficiencies:

- Air pollution and direct harm to health due to emissions and nuisance from the solid waste at the landfill site. This includes odor generated from the chemical decomposition of the waste, particulate matter (PM) and toxic substances which may result from waste burning and/or spontaneous combustion of the waste.
- Direct harm to health may also result from direct contact with the waste in the absence of personnel protection equipment. This already exists as many scanvengers are regularly visiting the landfill sites.
- Nuisance to people and risk on public health due to rats and flyers of random dump sites and accumulation of waste in streets
- Global warming potential due to methane generation from anaerobic degradation of the organic portion of the solid waste in the landfill.
- Contamination of the upper soil layer or wadis due to uncontrolled discharge of rainwater runoff.

What may exaggerate the hazard nature of the above impacts is the co-mixing of hazardous and health care waste with MSW. This is a result of limited control over the site which leads to uncontrolled dumping as well as the absence of waste acceptance criteria and alternatives for hazardous waste treatment.

The current situation is therefore not the most environmentally sound solution to solid waste management in the GS. A sustainable solution with respect to social, environmental and economical impacts is therefore needed for the solid waste management in the GS.

Project Description

The proposed long term measures for the GSWMP includes the construction of two new landfills at El-Fukhary and Johr al Deek, these will use six transfer stations distributed all over the GS. In the period until 2032, it is proposed to use Johr al Deek landfill for the disposal of solid wastes generated from Gaza and North Gaza Governorates and the El-Fukhary landfill for the disposal of solid wastes generated from El-Fukhary, Deir El Balah and Khan Younis Governorates – through three transfer stations; Tel al Sultan, Al Namsawi and Deir El Balah.

From 2032 until 2040, waste generated from Gaza and North Gaza Governorates will be transferred to Johr al Deek from which it will be bulk transported to El-Fukhary, so Johr al Deek will be turned to a transfer station with a storage capacity of 30,000 tons and the landfill will be closed. Waste generated from Rafah, Deir El Balah and Khan Younis Governorates will continue to be disposed of at El-Fukhary landfill which will become the only landfill serving the GS.

The amount of solid waste which will be disposed of at El-Fukhary landfill is estimated at around 550 t/day in Year 2011 increasing to 1,200 t/day in Year 2032.. The amount of solid waste which will be disposed of at Johr al Deek landfill is estimated at around 1100 t/day in Year 2011 increasing to 1,900 t/day in Year 2032. In 2040, the amount of solid wastes which will be disposed of at El-Fukhary landfill is estimated at around 3,700 tons/day.

The two landfills will be constructed in separate cells, each lasting for 5 years. A base lining system which consists (from bottom to top) of ; 1) A double layer Bentonite mat ; 2) a 1.5 mm HDPE layer and 3)a geotextile layer . The base lining system in conjunction with the low permeability clayey soil layers detected at the proposed site will provide an effective containment system for waste leachate. A soil cover with a thickness of 10 cm will also be placed and compacted daily on the surface of the waste layer.

The engineering measures recommended to collect the leachate include a drainage layer which will include HDPE2/3 perforated pipes embedded in lowest elevation areas of the cells bottom which will have enough inclination to collect the liquid in the pipes then by gravity to a collection pit at the lowest point of each cell, then the leachate will be pumped up to a leachate pond and recycled to active cells. The sanitary landfill includes furthermore a degassing system, each vent will be formed in a hole that will contain broken stone around the HDPE filter pile, and will be gradually raised during the progression of landfill cells. Each vent will cover an area with a radius of about 30 meters, and all the vents will be collected in HDPEcollection pipes that will be located inside the re-cultivation layer and the ring road around the landfill and will end in a gas compression station.

Environmental Baseline Investigation

A surface geological and geophysical investigation of the two landfill sites has shown that no major fault type formations have been observed. The geo-morphological study showed that Wadi Gaza is the major wadi in GS, to which 6 sub-basins drain and discharge their water load directly into the Mediterranean Sea. It was observed that the drainage patterns of the 6 sub-basins are at a considerable distance from El-Fukhary landfill.

At El-Fukhary landfill area, the water table appeared at depth of 46m and exceeds 46m at Johr al Deek site. The ggroundwater flow direction is in the N-NW direction. Groundwater vulnerability studies performed for GS indicate that the proposed site of El-Fukhary landfill for the landfill construction is among the most favorable locations for such purpose within the strip.

No rare, sensitive or endangered fauna or flora species were observed during the visits to El-Fukhary and Johr al Deek landfill sites, that would be negatively impacted by the construction and operation activities of the landfills. Birds were observed at both sites, with an increasing number at Johr al Deek. With regards to El-Fukhary landfill, This is an important factor which has been considered when assessing the impact on the nearby Rafah airport – which is not functioning at the moment. The baseline investigation has also shown that the proposed sites for the different project components are at a considerable distance from any cultural heritage sites.

Social Baseline Data Investigation

The surface area in Gaza is very limited, with an average land availability of 0.26 dunum per person in 2007. Gaza Strip is a small closed coastal area of a total surface area of 365 Km^2. By 2007, approximately 1.4 million Palestinians lived in Gaza Strip, of whom almost one million were UN-registered refugees. The current population is estimated to be in excess of 1.5 million. The general unemployment rate in the occupational Palestinian territories (oPt) is considered high with a rate of 23.4% of the labor force. Unemployment rate in Gaza is considered double the rate in the West Bank (37.4% in Gaza against 16.9% in the West Bank in 2010). Literacy level is generally high in Gaza strip reaching around 95% of the population above 15 years of age. Gender discrepancy is not significant except in the groups above 45 years of age.

Social Aspects Related to the Existing SWM systems

In Gaza strip, waste systems are affected by the general political context. In particular, the frequent roadblocks and curfews imposed resulting in the creation of several alternative routes and temporary and emergency disposal sites within urban areas. The location of these transfer stations near residential areas also result in multiple social implications on the local communities including direct negative impacts on health, hygiene and negative visual impacts.

Survey results show the following key results:

- There is a need for higher level of attention to remote and densely populated areas as they lack house to house regular services.
- Local community was relatively satisfied with UNRWA services.
- 80% of the surveyed areas receive their services from the municipalities. Around 17% receive UNRWA services while the rest of the respondents receive the services from other institutions.
- The majority of the interviewed local community members expressed concern and dissatisfaction with the heavy charges for services including SWM
- Service bills are, however, not paid by the majority of the people as they can not afford it
- Key reason for refusing to pay the cost for solid waste services was linked to affordability rather than to poor level of service.
- Half of the survey sample was satisfied by the service and half of it was dissatisfied
- Almost all communities believe that the current system needs to be improved, including those who are satisfied.
- 40% of the survey sample perceived municipalities as suitable institution for system improvements. 31% see that UNRWA can lead the system improvement better while 23% recommended a role for the private sector.
- Results indicated that more than half of the surveyed cases are willing to pay higher cost for improved services. The percentage was the highest in well-off areas.

The Location, Land and Livelihoods Issues of El-Fukhary Landfill

The field observation suggests that more than 80 % of the land around the landfill is uncultivated while round 20% is cultivated with perennial crops which is growing naturally and does not need any care or attention from the owners. The land of the landfill is privately owned by small number of families and is currently not used for any activities. Land owners interviewed during the preparation of the ESIA mentioned that the value of their lands drastically decreased as a result of the waste disposal activities at the dumpsite. Security issue was also perceived to be one of the factors for decreasing land value.

The Location, Land and Livelihoods Issues of Johr al Deek Landfill

Johr al Deek, located at the eastern border line adjacent to Israel borders. The location is already used as a landfill and the high risk of the landfill was a key issue for various workers and users of the landfill. Since access to the landfill will likely be restricted as part of the short term activities of GSWMP, the impact on the groups of waste pickers, particularly those who are working as full timers and whose livelihoods is fully reliant on this business should be carefully considered.

Workers in SWM in Gaza Strip

Under the current situation in Gaza with the high levels of poverty and unemployment, such jobs currently attract high qualified young university graduates as a source of income, even on short term basis. It also attracts large number of urban poor who try to find a day-to-day living from informal segregation of valuable recyclables.

Formal workers:

They work under different formal organizations including the municipalities, UNRWA. The work mode of these organizations varies between temporary and permanent work. Permanent municipalities' workers are contracted on fixed term. Additionally, the municipalities hire temporary workers for shorter term. Some of the formal workers are working in temporary projects. In some cases they are contracted by international institution such as COOPI who runs cash for work programme.

Informal Sector Involvement in the SWM Sector:

The informal sector is becoming increasingly involved in the sector. The informal sector can be mainly divided into three groups:

- Waste pickers who work in the main landfill or in the temporary waste storage sites for recovering recyclables.
- Street pickers who collect the recyclables from the waste bags in front houses and from the containers before they are emptied.
- Informal traders who purchase the sorted recyclables from the previous groups and sell them to the industry for recycling.

Potential Environmental and Social Impacts of the Project

The assessment of potential impacts has been done through analyzing different project activities and envisaging possible changes to the environment. Each potential impact was qualitatively analyzed to classify its significance to three degrees: *major impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards, *medium impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards only in combination with the impact of other sources, and *minor impacts* which are impacts which are not likely to cause violation of applicable standards whether on its own or in combination with other sources.

El-Fukhary Landfill

Impacts during construction phase

Impacts of Spoil Storage (medium to high significance)

The spoil that will be generated from excavation of the landfill to the design depth (20 meters) is considered large and will occupy large area for storage. It was estimated that the soil requirements for landfill operations (daily cover and side embankments) will only consume less than half of the excavated soil, and the remaining soil will either be exported for other uses or stored in an area next to the landfill. Also a temporary land will need to be used for storing the spoil that will be used for landfill operations in Cells 4 and 5 after filling of the other cells. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Specific areas would be used for storing the excavated spoil
- The area allocated for spoil storage should be selected so that no un-favored pattern of surface water collection should be developed that would cause nuisance to adjacent areas (e.g. development of stagnant water ponds for long times).
- Ensure that the height of the spoil will not cause unaccepted visual impacts to adjacent areas additional to the impacts of the landfill

Monitoring Activities:

- Excavated soil should be recorded in the monthly report by summing excavated volumes from the invoices of excavation contractor.
- Samples taken from undisturbed excavated soil should be analyzed in order to ensure that the soil is not contaminated.
- In case the soil will be exported from the site, the project management should keep track of the end uses of the soil and the methods of transportation.

Affecting air quality by dust emissions of construction works (medium significance):

Dust emissions will negatively impact ambient air quality, particularly during the initial phases of construction of the landfill, and to a much less extent during the construction of transfer stations and composting plants. Residential areas or other occupied buildings are not in the immediate vicinity of the site, the impact will not therefore be strongly felt by nearby inhabitants. However, users of nearby roads and scattered farm houses visitors may experience some disturbances due to dust generation. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Spoils of waste that will be reused in the landfill operations should be stored as close as possible from the active cells to minimize distances moved by excavators, trucks and loaders
- Pavement of the access road and ring road stretch that will be used for the following Cell excavation prior to excavation works. This construction schedule should be included in the tender document of constructions works
- In case of receiving complaints from neighbors, watering of soil before excavation, in landfill and transfer stations sites, should be carried out to minimize dust emissions.

Monitoring Activities:

- Ambient Particulate Matter should be measured at the western border of active waste cell and in the nearest farm houses areas located at the west and north of the landfill site. The measurements are to be carried out once during the excavation of each cell.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Noise Impacts (medium significance):

Construction works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. Because the nearest receptors are relatively far, the noise impacts are not expected to be major, as most of the machinery noise will be effectively attenuated by this distance, especially when excavation and filling works are deep below ground level. Construction noise at the transfer stations/composting plants is not expected to exceed that of a conventional concrete building. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Optimize the use of machines and noisy equipment (i.e. switching off when idle)
- In of receiving complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Construction work should be stopped at night-time.

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill should be measured prior to construction works to measure background noise and during a representative day during the excavation of each Cell.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Affecting Air Quality by Equipment and Vehicles Exhaust (Low significance):

Local air quality can be negatively affected by exhaust emissions from vehicles and machines (generators, loaders, excavators... etc.) operating at the landfill. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Impacts of Construction Waste Other than Excavation Soil (Low significance):

These wastes includes non-hazardous waste such as construction debris, packaging waste, scrap wood, metals, garbage and sewage in addition to some limited amounts of hazardous waste such as used oils, empty paints containers and contaminated cloth. As mentioned later, if there will be no hazardous waste handing site in Gaza by the start of the project it is recommended to establish a hazardous waste cell or alternatively place a hazardous waste container, in which the generated hazardous waste by the project activities will be a minor contributor the waste received in this cell. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Spent lubrication oils and paint/chemical containers and other hazardous waste should be separated from other wastes and disposed of/ in approved hazardous waste facility if existing, or in the special cell/container recommended for the project.
- Other solid wastes are to be collected from different areas of the site and disposed in active cells
- Sewage should be collected from cesspits periodically by tankers and sent to the adjacent wastewater treatment plant.

Monitoring Activities:

- Hazardous waste generated at the site should be classified and documented in monthly reports
- Amounts of collected sewage by tankers should be recorded and documented in monthly reports

Risks of Damaging Chance-Find Antiquity Objects (Low significance):

Although the landfill site does not have any nearby antiquities or cultural heritage sites, the extensive excavation that will be carried out, up to 20 meters, could lead to finding any antiquity or culturally valuable object. The possibilities for such chance-finds are not high but the long history of the region does not nullify such possibility especially that such excavation depth is not common in the surrounding areas. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- In the case of finding any culturally valuable object during excavation works, the works should be stopped by the contractor and the Ministry of Tourism and Antiquities should be contacted to handle the site. If the Ministry of Tourism and Antiquities asked for prolonged holding of excavation works, the following Cell could be excavated instead so as not to cause disturbance to the waste filling plan.

Monitoring Activities:

- In case of chance-finds the type of object, location of finding, photographs of the object and the followed procedures to handle the object should be reported to the PDSU

Impacts during Operation phase:

Odors Impacts (medium significance):

The impact of odors is normally considered a mere annoyance, as foul smells can rarely harm health directly. However, due to the nature of landfills, the odors produced can potentially be quite powerful and mainly contains a complex mixture of ammonia and hydrogen sulphide. The nearest residential cluster to the proposed El-Fukhary landfill was found at around 1600 m from the nearest active cell and the nearest scattered house (a farm house which is only used during the morning) is located at a distance of 700-800 m from the nearest active Cell. Because the existing site is being used for waste disposal without covering, the potential odor impacts of the project are not likely to significantly increase the cumulative odors in the area especially with the application of the daily cover in the new landfill operations. This also applies for the related transfer stations which are currently being used as open waste area, and will be more controlled through the project. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- An operation manual that should include waste progression plan in the cells, requirements for waste compaction in order to reduce the area exposed to air which also reduce aerobic decomposition and adequately apply soil cover with a thickness of around 15 cm in order to prevent prolonged exposure of vulnerable wastes to the atmosphere. Also an operation manual that will include the process of unloading waste through hoppers.
- In case of receiving complaints from neighboring areas the application of final cover should be modified so as to implement faster compaction and coverage of waste to effectively reduce the odor emissions
- Additional containers should be present at the transfer station site in case of over capacity especially during peak hours or due to a technical problem with the compactors in order to reduce the waiting period for the vehicles at the site and prevent an accidental overflow of the waste outside the container. The additional capacity containers should safeguard emergency periods where the landfill site may not be accessible

Monitoring Activities:

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Landfill Gas Impacts (medium significance):

The disposal of solid waste in an anaerobic environment causes decomposition of the organic components of the waste to produce landfill gas; this reaction starts gradually after the placement of the waste and is proportional to the moisture content of the waste body. The components of the landfill gas changes over time according to the maturation of the stabilization process of the organic matter, but it is mainly composed of methane, carbon dioxide and other minor constituents including Non-Methane Organic Carbons (NMOC) or Volatile Organic Carbons (VOC), ammonia and hydrogen sulfide. The expected ultimate amount of landfill gas that will be produced at El-Fukhary landfill is 9.68 million tons (which is estimated by 6,917 million m3) in which methane will be 1.612 million tons (2,456 million m3) carbon dioxide will be 8.061 million tons (4,451 million m3) and ammonia will be 6,980 tons (9.885 million m3) in addition to minor components of trance elements. The generation of the landfill gas will be in small quantities at the beginning of the operation, and it will reach the peak between about year 2030 to 2070 then it will be gradually reduced until the year 2158. According to the preliminary design of the landfill there will be a degassing system in the landfill that will end in a gas compression station, in which the gas will be either flared or used in power generation. This degassing system is believed to minimize the migration of landfill gas to the atmosphere or through the soil to the groundwater. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures comprise of the gradual placing of gas vents and construction of the gas compression station with adequate capacity to receive the maximum flow of gas.
- The lining system and final cover of the landfill should be properly maintained to keep their integrity, through ensuring adequate placing, adhering to waste filling plan, avoid overloading landfill cells and regular evacuation of leachate and gas. Also, a maintenance schedule should be included for the degassing system that should be followed by the project operator.

Monitoring Activities:

- Keep records of collected gas through the degassing system
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on quarterly basis

Leachate and Surface Water Impacts (medium significance):

The leachate is generally characterized by its strong organic load, containing heavy metals and toxic hydrocarbons, its acidic nature and offensive smell. The expected yearly amounts of leachate will gradually increase from about 27,000 m^3/year to a maximum of about 280,000 m^3/year. The preliminary design includes a leachate collection and recycling system through a leachate pond next to a wastewater treatment plant. These engineering measures are believed to be sufficient for controlling the generated leachate according to the best available technologies, given that the system will be designed to handle the relatively large expected quantities of leachate. Because of the nature of the collected leachate in the collection pond, the odor around the pond is expected to be offensive. However, the severity of this odor will be gradually attenuated in proportion with the distance from the pond, especially when the leachate recirculation and the regular clean up of settled sludge in the pond is maintained at an adequate rate. Because the soil layers in the area are mainly from clayey nature and the groundwater table is at 46-meter depth which is 26 meters below the bottom of the landfill, which is a relatively large distance to be passed by liquids the risk of contaminating groundwater is low. Further to the generation of leachate, the rain water that will fall over the non-active Cells should be drained and collected in an adequate manner so as to avoid causing unexpected water collection in low elevations areas of the site, but because during the first years of operation the amount of surface water that will be collected from roads, reception areas and composting plant are expected to be minimum the correspondent impacts are expected to be minimum. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures comprise of engineering measures for controlling of leachate as recommended in the Feasibility Study of the project, these measures should include an adequate liner system, adequate slopes of the Cells bottom, a drainage network comprise pipes from adequate capacity, a collection pit at the lowest point of each cell and an adequate pumping station to lift the leachate from the bottom to the collection pond to the top of the landfill taking into consideration head losses..
- The capacity of the leachate collection pond and the correspondent pumping should be designed so as to receive the maximum amount of leachate with low retention time so as to minimize odor impacts by keeping minimum amount of leachate in the pond. The pond should be surrounded with wind break trees so that to minimize dispersion of odor in the surrounding areas. The leachate pond should be regularly de-sludged and the removed sludge should be transferred back to the active landfill cell .
- The leachate collection pumping station and correspondent piping network should be adequately maintained to ensure smooth operation. The design should include a preventive maintenance schedule which should be followed by the landfill operator.
- .
- The three transfer stations serving El-Fukhary Landfill (Tel al Sultan, Al Namsawi and Deir Al Balah) should be designed so that the waste loading/unloading areas are to be covered with an adequate roof to prevent rain from getting into the waste during storage in the transfer stations. The transfer station operator should make sure that no loading/unloading or waste storage operations are taking place in open areas, especially during winter.
- The composting windrows and waste reception areas should be covered to prevent contamination of the run-off from these areas. The same applies to recycling areas.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis.
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream) which should be drilled at least 3 meters below groundwater table. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest .

Impacts on Birds and on Gaza Airport (medium significance):

Generally, the habitats of the migrant birds (such as Aquila heliacal and Falco tinnunculus) include wetlands, lakes, riverbanks, vegetative cover along coastline, forests, etc. Since none of these features exist around the proposed landfill site, there will be a very limited population of migrant birds in this area. However, landfills can become preferable food sources for birds and will attract both migrant and local birds. Larus ridibundus is a particular species that is commonly attracted to landfills. Other migrant species are less commonly attracted to landfills, but may still be encountered. The environmental impacts that could be associated with attracting birds on the landfill site are minimum because there are no collision risks with objects, such as high tension lines, and there are no rare and endangered species in the area. However, the risk factor that may arise is the nearby (about 4.5 km away) Gaza International Airport, which is currently not operating, but in case the airport will become operating there may be some risks on the aviation safety as the airport is located between 3 and 8 kms which requires, according to the World Bank Guidelines, a written permission from the aviation authority, stating that it considers the landfill location as not threatening air safety, should be obtained. It is considered in this ESIA that obtaining the approval of the Palestinian Civil Aviation Authority will make this impact acceptable; therefore obtaining this approval should be done during the design phase of the project. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Obtaining the Approval of the Palestinian Civil Aviation Authority during the design phase of the project.
- Implementing any conditions that may be included in the approval of the Palestinian Civil Aviation Authority during construction and operation of the project

Monitoring Activities:

- Complaints and correspondence with the Palestinian Civil Aviation Authority should be documented and reported in the monthly report

Risks of Receiving Hazardous Waste (medium significance):

There are different types of hazardous wastes that are currently mixed with domestic waste; the most common are healthcare waste, which is commonly found in garbage bins and dumpsites, and hazardous construction waste, such as asbestos and contaminated rubble with different chemicals, such as PAHs. It is well defined in the project objectives that it deals with domestic non-hazardous wastes, but the fact that there are no sufficient places currently available which receives hazardous waste, except for a hazardous waste cell in Johr El Deek and a healthcare waste incinerator in Gaza Hospital, raises the risk of receiving such waste at El-Fukhary landfill. It would be ideal that an effective hazardous waste facility could exist in Gaza before the start of the Long-Term El-Fukhary Landfill, however, if this did not happen, it might be a strategic benefit to accept some hazardous waste in the landfill, given that preparatory measures for receiving these wastes are taken. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- The project proponents in the MLDF should negotiate with other Palestinian authorities and the donor community to initiate a project for hazardous waste management that would be operational before 2018.
- All workers of the landfill, transfer station, recycling and composting plants should receive adequate training on the types of hazardous waste that could be handled, the type of hazards and the appropriate methods of handling
- In case the Long Term landfill will start operation before having a hazardous waste facility in Gaza, a special cell for hazardous waste disposal will be needed to allow for safe hazardous waste storage/disposal and reduce the risk of co disposing of hazardous waste with non-hazardous wastes, this cell could be developed on the north east corner of the site (next to the Short Term Landfill) and would need to be lined as other cells and used for disposal of dry waste with immediate coverage
- Asbestos waste should be wetted once admitted in the landfill and immediately covered
- Flammable and explosive waste should be strictly forbidden from admission in the landfill. The landfill operation manual should include a list of acceptable and non-acceptable waste in the landfill
- All workers in the landfill, recycling plant and composting plant should be provided with anti-puncture gloves, steel-toe shoes, overalls and masks. Strict supervision on the compliance of hand sorters to this should be practiced
- Prepare a documented emergency response plan to any spills or fires, there should be enough tools for fire extinguishing

Monitoring Activities:

- Amounts of identified hazardous waste received in the landfill should be documented and reported in the monthly progress report
- Amounts of flammable and explosive wastes that have been refused from admission
- Topographic survey of the special cell and estimation of the amount of received waste
- Health records for the project staff including any occupational injury and any infection case that could be related to waste handling.

Risks on Occupational Health and Hygiene (medium significance):

Potential impacts on the health and hygiene of both the general public and on-site workers exists as a result of the nature of the waste, these are equally applicable to both the landfill site and transfer stations. Waste sorters at the recycling plant, in addition to regular staff in the landfill and transfer stations, are in direct contact with the waste and accordingly are exposed to unhygienic conditions from the prolonged exposure to waste, dust and vermin. The situation at the existing uncontrolled disposal site is associated with resident populations of vermin which are factors for increasing nuisances to humans and the spread of disease, and disrupting the natural ecosystem. The adoption of high standards for the new landfill, through compaction and daily coverage, will limit the potential for the development of resident populations of vermin and pests, however, it will not be totally eliminated as the waste will be exposed in the landfill for some time before being covered, and some insects and rodents will still be able to tunnel through the cover and reach the waste. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Particular attention will be paid to the health and safety of workers at the sites by worker training of safe working methods and good hygiene practices; the use of personal protective equipment, as required, when working on-site and provision of first aid facilities. Showers, washing basins, clean toilets, changing rooms, and different cleansing equipment should be available at the landfill offices as well as the recycling/composting plants
- Unauthorized entrance to the landfill site should be prevented
- Control of vermin, insects and birds by compaction of deposited waste and application of cover materials according to the waste filling plan.
- If needed and responding to complaints from neighbors, the pests could be combated by sanitary measures such as application of insecticides and pesticide and for rodent control. The leachate collection pond and the surface water pond, when it is not dry, should be applied to effective pesticide to minimize mosquitoes breeding. The preference will be for biological pesticides, but in the current situation of borders closure it is doubtful that such pesticides could be applicable; therefore the application of pesticides should be by an expert that should select the pesticide that has negligible effects on human and minimum effect on non-targeted species and the natural environment.

Monitoring Activities:

- Type, quantity, date, location and method of application for all pesticides should be well documented and reported to the PDSU in the periodic monthly reports
- The complaints about insects and rodents from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Noise Impacts (Medium significance)

Operation works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. As mentioned earlier during discussing construction noise, the nearest receptor is a farm houses about 700 m away from the site and accordingly noise impacts are not expected to be major. It is recommended to plant wind break trees around the landfill borders, especially in the northern and western borders around the recycling/composting plant, to maximize noise attenuation and, in turn, minimize noise impacts to neighboring areas. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Key noisy equipment (such as generators, trommels, conveyor belts … etc.) should be selected with minimum noise;
- Optimize the use of machines and noisy equipment (i.e. switching off when idle);

- In case the landfill manager received complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Landfilling and operations of the recycling/composting plant should be stopped at night-time.
- Planting of a wind break trees where appropriate to act as a noise buffer.

Monitoring Activities:
- Ambient noise at the nearest residential areas from landfill should be measured frequently in an annual basis.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Affecting Air Quality by Vehicles Exhaust

Local air quality can be negatively affected by vehicle exhaust emissions from vehicles and machines (generators, loaders, compactors ... etc.) operating at the landfill and RCVs used to transport waste. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission. Overall, the potential impact of vehicle emissions resulting from the landfill and transfer stations -related traffic is not expected to increase as compared with the current situation since the chosen locations for transfer stations and the landfill have been previously occupied for the same purpose. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:
- All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Monitoring Activities:
- CO_2 emission rate of all vehicles used in the project should be documented from the manufacturer, the distance and fuel consumption should be documented and reported on monthly basis.

Visual Impacts (Low significance):

The solid waste accumulation is an unfavorable seen, especially when it is with large quantities as the case in landfills, and also transfer stations and composting / recycling plants. The operation of landfills, transfer stations and composting/recycling plants is also associated with litter dispersion by wind which adds to the negative visual impacts. The operation of landfill equipment and generated dust from the earthworks also adds to the bad scene at the site. In El-Fukhary landfill during the filling of underground portions of waste cells, the operations will be totally hidden from neighboring areas and nearby roads. Also during the operation on layers above the ground it will be expected that active layers will be surrounded by embankments so that waste on the Cells edges would be compacted against them and the height of the landfill will be maintained with a safe slope, so these embankments will also hide waste filling operations from surroundings. Currently considerable visual impacts are caused by the existing landfill at El-Fukhary which is about 15-meter high and uncovered, so waste is exposed at a high altitude which is a relatively high visual impact. The overall impact of the Short Term measures, including coverage of the waste, is expected to be positive, even though the landfill height will increase. If the new landfill operations are added to the existing Short Term hill the additional impact on the area, during the operational phase, is expected to be minor. In recycling/composting plants and transfer stations, because the waste will be generally contained inside the containers, buildings and fenced areas there will be low visual impacts, especially that at least two of the transfer stations, Tal Al Sultan and Namsawi, are currently used as open waste collection areas and the view from surrounding areas is already unflavored. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- The composting/recycling plant should be fenced with windbreak trees to minimize hide negative waste scene from the view of the neighboring areas.

Monitoring Activities:

- Complaints of neighbors from littering dispersion or about the general aesthetic value of the area should be reported to the PDSU in the monthly progress report of the site.
- Provide adequate fence, wind break trees and roof for the composting/recycling plants

Risks of Unforeseen Exceeding of Landfill Capacity (Low significance):

Some of the assumptions that were basis of the calculations for estimating the landfill capacity may not be materialized during the actual implementation of the project. These assumptions include the regressive population growth starting from 2011, the average waste density will reach 1.2 tons/m3, an average of 5-18% of the waste will be composted and the daily cover to waste ratio will be 1:9. A scenario for changing these assumptions to more pessimistic assumptions, regarding landfill capacity calculations, led to earlier filling date than the design date (end of year 2040). These calculations led that the closing date of the landfill could be few months to 4 years earlier than expected. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- According the results of landfill capacity measurements the planning authorities should start studying expanding the El-Fukhary site through obtaining adjacent lands, or search for new sites.

Monitoring Activities:

- A topographic survey should be carried out for the landfill site on yearly basis to identify the used area and waste height.

Impacts on Flora and Non-Avian Fauna (Low significance):

The baseline study of the project concluded that the El-Fukhary landfill site lacks any presence of significant wetlands of important biodiversity or reproductive value. Furthermore, there is no presence of environmentally rare or endangered species breeding areas, habitats or protected living areas. However, it was found that diverse and abundant fauna species currently use the site for nesting, breeding or feeding. These may be affected by the controlled operation of the landfill as compared with the existing uncontrolled situation where there is a direct contact between birds and animals with the waste. The noise and daily work of landfill construction and operation could disturb the area's birds and wild mammals. End of life closing plans for the landfill will include a restoration of the site for agricultural purposes. The top soil will constitutes a good ecological host for soil organisms as compared with the current situation. The site restoration in general including any baffles and vegetative screens will create a variety of new habitats. No further mitigation measures are required.

Impacts after the Landfill Closure Phase:

Impacts Landfill Gas (Medium significance):

The generation of landfill gas will continue after the landfill closure. The closure year, and the few years afterwards, will be associated with peak generation of landfill gas, and accordingly the impacts that were discussed earlier will be at its maximum effect. Although the proposed degassing system is believed to be sufficient in controlling the impacts and minimizing risks of gas migration to the environment, a new risk will be associated after the landfill closure as there are possibilities that the site will become un-manned especially if there will be no adjacent extension after 2040. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- If the landfill location will be abandoned after closure, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for gas monitoring activities during the operation phase should continue their work the landfill closure and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting any gas leaks, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

- Keep records of collected gas through the degassing system
- Analyze composition of the landfill gas against main components on annual basis.
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on annual basis

Impacts of Leachate and Surface Water (Medium significance):

There will remain two main leachate issues after the landfill closure: the amount of leachate that will remain in the leachate pond after closure of Cell 5 and the amount of leachate that will remain inside the landfill body after closure. Because water in the landfill body is expected to take time to percolate through the whole depth of the landfill until it reaches the collection pit at the bottom of the landfill according to the permeability of the waste, the water that entered the active Cell short time before its closure will be collected some time after its closure. Accordingly the first one or two years after the landfill closure will still receive large quantities of leachate. The recirculation of collected leachate will not be possible after the closure of the landfill, therefore, all collected amounts should be left to naturally evaporate.

The surface water collection will have special importance after the closure of landfill cells, both during operation and after closure phases. This is because the natural drainage features of the landfill location will be changed due to the existence of a new non-permeable hill in the area so that the collection areas of rain water will be changed. The Feasibility Study includes engineering measures for the smooth drainage of surface water from the landfill ring road and closed cells, designing the final cover so that an adequate slope will be maintained to drain surface water to the surrounding ring road and then to a channel that will collect all surface water in a pond at the lowest elevation area of the site. The following mitigation measures and monitoring activities are recommended for controlling this impact:

<u>Mitigation Measures:</u>

- Mitigation measures include the identification of a sufficiently low elevation area for the collection of storm water after closing the landfill cells. The minimum area identified by the assumptions made in this ESIA is 2,250 m2 and would preferably be more than 5,000 m2 to maintain a dry period for this pond.
- The staff of the leachate pumping station should not leave the site after landfill closure except after abstracted leachate quantities could be neglected. This would be decided by the PDSU-EM through his review of the leachate monitoring activities reports.
- If the landfill location will be abandoned after closure phase, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for leachate monitoring activities during the operation phase should continue their work after landfill closure and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

<u>Monitoring Activities:</u>

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream), as shown in Figure 6-6. Samples from the monitoring wells should be

collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.

- Amounts of sludge removed from leachate pond should be recorded with a manifest

Visual Impacts (Low Significance):

The visual impacts after the closure of the landfill will be the obstruction of the landscape with two new hills: the covered landfill and the un-used spoil if not exported for other uses. The design height of the landfill is 30 meters in which will be the same height for the existing Short Term landfill but for a larger area. The height and area of the remaining un-used spoil is not finally defined as it depends on the depth of excavation, but in all cases it is recommended that the spoil height should not exceed the final height of the landfill to minimize the visual impacts. The visual impacts of the new two hills that will be developed by the project are expected to affect only few houses in the clusters that are located west of the project site (about 800 meters) and the nearest cluster located to the north (also about 800 meters). The only affected houses will be those houses that are located in eastern and southern end respectively of the two clusters, as the houses in the first row will hide the scene from other houses in the correspondent direction. Also few houses that are located in the first south row of Al Fukhari and Khuzaa villages (about 2.5 km to the northeast) may also see the hills after reaching their maximum height. However, in all cases the view of the hills will only be a minor addition to the existing Short Term hill which will slightly affect all these areas before the construction of the Long Term landfill. Furthermore, the more distance from the landfill site the less will be the visual impact. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Carry out and maintain plantation of the final covered landfill cells

Monitoring Activities:

- Keep records of the green areas planted over the final cover of the landfill

Stability Impacts (Low Significance):

The excavation and gradual progression of the landfill cells will work in changing the original structural stresses on the soil underneath the landfill. After the closure phase, the biochemical reactions that will take place will cause changes to the overall density of the landfill and will cause other changes to the stresses over the soil underneath. The landfill site is generally stable as there is no major fault type formation, as mentioned earlier, with medium seismic activity, accordingly the stability risks are classified as low. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures should include a consideration of the stresses both on the soil and on the waste body during different stages of the operation and after landfill closure. The heights, slopes and protection measures should take these factors into consideration

Johr al Deek Landfill

Environmental Impacts during construction phase

Impacts of Spoil Storage (medium to high significance)

The spoil that will be generated from excavation of the landfill to the design depth (20 meters) is considered large and will occupy large area for storage. It was estimated that the soil requirements for landfill operations (daily cover and side embankments) will only consume around half of the excavated soil, and the remaining soil should be exported for other uses since on site storage would require a land area of approximately 130,000 m2. A temporary land will however need to be used for storing the spoil that will be used for landfill operations in Cell 3. The following mitigation measures and monitoring activities similar to those mentioned for El-Fukhary Landfill are recommended for controlling this impact:

Mitigation Measures:

- Specific areas would be used for storing the excavated spoil.
- The area allocated for spoil storage should be selected so that no un-favored pattern of surface water collection should be developed that would cause nuisance to adjacent areas (e.g. development of stagnant water ponds for long times).
- Ensure that the height of the spoil will not cause unaccepted visual impacts to adjacent areas additional to the impacts of the landfill

Monitoring Activities:

- Excavated soil should be recorded in the monthly report by summing excavated volumes from the invoices of excavation contractor.
- Samples taken from undisturbed excavated soil should be analyzed in order to ensure that the soil is not contaminated.
- In case the soil will be exported from the site, the project management should keep track of the end uses of the soil and the methods of transportation.

Affecting air quality by dust emissions of construction works (medium significance):

Dust emissions will negatively impact ambient air quality, particularly during the initial phases of construction of the landfill, and to a much less extent during the construction of transfer stations and composting plants. The nearest residential areas are around 400-600m away from the landfill. The distance varies with cell progression. The impact will not therefore be strongly felt by nearby inhabitants. However, users of nearby roads may experience some disturbances due to dust generation. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Spoils of waste that will be reused in the landfill operations should be stored as close as possible from the active cells to minimize distances moved by excavators, trucks and loaders

- Pavement of the access road and ring road stretch that will be used for the following Cell excavation prior to excavation works. This construction schedule should be included in the tender document of constructions works
- In case of receiving complaints from neighbors, watering of soil before excavation, in landfill and transfer stations sites, should be carried out to minimize dust emissions.

Monitoring Activities:

- Ambient Particulate Matter should be measured at the western border of active waste cell and at the nearest residential house located at the west and south of the landfill site. The measurements are to be carried out once during the excavation of each cell.
- The complaints from neighboring residents from both the landfill, the transfer stations and composting plants should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Noise Impacts (medium significance):

Construction works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. Because the nearest receptors are relatively far, the noise impacts are not expected to be major, as most of the machinery noise will be effectively attenuated by this distance, especially when excavation and filling works are deep below ground level. Construction noise at the transfer stations/composting plants is not expected to exceed that of a conventional concrete building. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In of receiving complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Construction work should be stopped at night-time.

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill should be measured prior to construction works to measure background noise and during a representative day during the excavation of each Cell.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Risks of Damaging Chance-Find Antiquity Objects (Low significance):

Johr al Deek is close to some cultural heritage sites, the extensive excavation that will be carried out, up to 20 meters, could lead to finding any antiquity or culturally valuable object. The possibilities for such chance-finds are not high but the long history of the region does not nullify such possibility especially that such excavation depth is not common in the surrounding areas. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- In the case of finding any culturally valuable object during excavation works, the works should be stopped by the contractor and the Ministry of Tourism and Antiquities should be contacted to handle the site. If the Ministry of Tourism and Antiquities asked for prolonged holding of excavation works, the following Cell could be excavated instead so as not to cause disturbance to the waste filling plan.

Monitoring Activities:

- In case of chance-finds the type of object, location of finding, photographs of the object and the followed procedures to handle the object should be reported to the PDSU

Impacts of Construction Waste Other than Excavation Soil (Low significance):

These wastes includes non-hazardous waste such as construction debris, packaging waste, scrap wood, metals, garbage and sewage in addition to some limited amounts of hazardous waste such as used oils, empty paints containers and contaminated cloth. As mentioned later, if there will be no hazardous waste handing site in Gaza by the start of the project it is recommended to re-operate the hazardous waste cell already present at Johr al Deek. The following mitigation measures and monitoring activities, similar to those presented for El-Fukhary are recommended for controlling this impact:

Mitigation Measures:

- Spent lubrication oils and paint/chemical containers and other hazardous waste should be separated from other wastes and disposed of/ in approved hazardous waste facility if existing, or in the special cell for hazardous wastes present at Johr al Deek.
- Other solid wastes are to be collected from different areas of the site and disposed in active cells.
- Sewage should be collected from cesspits periodically by tankers and sent to the adjacent wastewater treatment plant.

Monitoring Activities:

- Hazardous waste generated at the site should be classified and documented in monthly reports
- Amounts of collected sewage by tankers should be recorded and documented in monthly reports

Affecting Air Quality by Equipment and Vehicles Exhaust (Low significance):

Local air quality can be negatively affected by exhaust emissions from vehicles and machines (generators, loaders, excavators... etc.) operating at the landfill. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Impacts during Operation phase:

Odors Impacts (medium significance):

Due to the nature of landfills, the odors produced can potentially be quite powerful and mainly contains a complex mixture of ammonia and hydrogen sulphide. The nearest residential cluster to the proposed Johr al Deek landfill was found at around 400-600 m from the nearest active cell. The site hosts at the moment uncontrolled dumping activities and waste is not covered and is subjected to air, fauna and waste pickers. The potential odor impacts of the project are therefore not likely to significantly increase the cumulative odors in the area especially with the application of the daily cover in the new landfill operations. This also applies for the related transfer stations Beit Lahya and Al Maslakh which are currently being used as open waste storage sites, and will be more controlled through the project. The composting plants will be constructed at Bait Lahya and Deir El Balah, which are also sites already hosting waste storage/transfer activities. The odour impact is not therefore expected to increase after the implementation of the project. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures comprise of an operation manual which includes waste progression plan in the cells, requirements for waste compaction in order to reduce the area exposed to air which also reduce aerobic decomposition and adequately apply soil cover with a thickness of around 15 cm in order to prevent prolonged exposure of vulnerable wastes to the atmosphere. Also the mitigation measures should comprise of an operation manual that will include the process of unloading waste through hoppers.
- In case of receiving complaints from neighboring areas the application of final cover should be modified so as to implement faster compaction and coverage of waste to effectively reduce the odor emissions
- Additional containers should be present at the transfer station site in case of over capacity especially during peak hours or due to a technical problem with the compactors, in order to reduce the waiting period for the vehicles at the site and prevent an accidental overflow of the waste outside the container. The additional capacity containers should safeguard emergency periods where the landfill site may not be accessible.

Monitoring Activities:

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Landfill Gas Impacts (medium significance):

As previously mentioned, the disposal of solid waste in an anaerobic environment causes decomposition of the organic components of the waste to produce landfill gas; this reaction starts gradually after the placement of the waste and is proportional to the moisture content of the waste body. The components of the landfill gas changes over time according to the maturation of the stabilization process of the organic matter, but it is mainly composed of methane, carbon dioxide and other minor constituents including NMOC or VOC, ammonia and hydrogen sulfide. The expected ultimate amount of landfill gas that will be produced at Johr al Deek landfill is around 2 million tons (which is estimated by 1,400 million m3) in which methane will be 0.330 million tons (500 million m3) carbon dioxide will be 1.64 million tons (907 million m3) and ammonia will be 1,430 tons (2 million m3) in addition to minor components of trance elements. According to the preliminary design of the landfill there will be a degassing system in the landfill that will end in a gas compression station, in which the gas will be either flared or used in power generation. This degassing system is believed to minimize the migration of landfill gas to the atmosphere or through the soil to the groundwater. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures comprise of gradual placing of gas vents and construction of the gas compression station with adequate capacity to receive the maximum flow of gas
- The lining system and final cover of the landfill should be properly maintained to keep their integrity, through ensuring adequate placing, adhering to waste filling plan, avoid overloading landfill cells and regular evacuation of leachate and gas. Mitigation measures comprise of a maintenance schedule for the degassing system that should be followed by the project operator.

Monitoring Activities:

- Keep records of collected gas through the degassing system
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on quarterly basis

Leachate and Surface Water Impacts (medium significance):

The expected yearly amounts of leachate will gradually increase until reaching a maximum of around 85,000 m^3/year . The preliminary design includes a leachate collection and recycling system through a leachate pond. . These engineering measures are sufficient for controlling the generated leachate according to the best available technologies, given that the system will be designed to handle the relatively large expected quantities of leachate. Because of the nature of the collected leachate in the collection pond, the odor around the pond is expected to be offensive. However, the severity of this odor will be gradually attenuated in proportion with the distance from the pond, especially when the leachate recirculation and the regular clean up of settled sludge in the pond is maintained at an adequate rate. The soil layers in the area are mainly from clayey nature and the groundwater table is at more than 50 meter depth below the bottom of the landfill, which is a relatively large distance to be passed by liquids. Further to the generation of leachate, the rain water that will fall over the non-active Cells should be drained and collected in an adequate manner so as to avoid causing unexpected water collection in low elevations areas of the site, but because during the first years of operation the amount of surface water that will be collected from roads, reception areas and composting plant are expected to be minimum the correspondent impacts are expected to be minimum. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures include engineering measures for controlling of leachate as recommended in the Feasibility Study of the project, these measures should include an adequate liner system, adequate slopes of the Cells bottom, a drainage network comprise pipes from adequate capacity, a collection pit at the lowest point of each cell and an adequate pumping station to lift the leachate from the bottom to the collection pond to the top of the landfill taking into consideration head losses.
- Similar to what was recommended at El-Fukhary, the capacity of the leachate collection pond and the correspondent pumping should be designed so as to receive the maximum amount of leachate with low retention time so as to minimize odor impacts by keeping minimum amount of leachate in the pond. The pond should be surrounded with wind break trees so that to minimize dispersion of odor in the surrounding areas. The leachate pond should be regularly de-sludged and the removed sludge should be transferred back to the active landfill cell . The leachate collection pumping station and correspondent piping network should be adequately maintained to ensure smooth operation. The design should include a preventive maintenance schedule which should be followed by the landfill operator.
- The two transfer stations serving Johr al Deek Landfill (Beit Lahya and Al Maslakh) should be designed so that the waste loading/unloading areas are to be covered with an adequate roof to prevent rain from getting into the waste during storage in the transfer stations. The transfer station operator should make sure that no loading/unloading or waste storage operations are taking place in open areas, especially during winter.
- The composting windrows and waste reception areas should be covered (already considered in the conceptual design)to prevent contamination of the run-off from these areas. The same applies to recycling areas.
- The leachate resulting from the own moisture content of the waste received at the composting plants would be prevented form percolating through the soil by constructing an impervious bottom layer for the different composting stages. A leachate collection system shall be installed which allows for leachate storage and recycling for humidification purposes.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream) which should be drilled at least 3 meters below groundwater table. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest .

Risks of Receiving Hazardous Waste (medium significance):

As previously mentioned, it would be ideal that an effective hazardous waste facility could exist in Gaza before the start of the Long-Term Johr al Deek Landfill, however, if this did not happen, the hazardous waste cell which exists at the moment in the landfill, should become operational as an interim solution. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- The project proponents in the MLDF should negotiate with other Palestinian authorities and the donor community to initiate a project for hazardous waste management that would be operational before 2018.
- All workers of the landfill, transfer station, recycling and composting plants should receive adequate training on the types of hazardous waste that could be handled, the type of hazards and the appropriate methods of handling
- In case the Long Term landfill will start operation before having a hazardous waste facility in Gaza, The special cell for hazardous waste disposal which already exists at Johr al Deek shall resume operation and be used for interim safe hazardous waste storage/disposal which will reduce the risk of co disposing of hazardous waste with non-hazardous wastes in the landfill cells.
- Asbestos waste should be wetted once admitted in the landfill and immediately covered
- Flammable and explosive waste should be strictly forbidden from admission in the landfill. The landfill operation manual should include a list of acceptable and non-acceptable waste in the landfill.
- All workers in the landfill, recycling plant and composting plant should be provided with anti-puncture gloves, steel-toe shoes, overalls and masks. Strict supervision on the compliance of hand sorters to this should be practiced
- Prepare a documented emergency response plan to any spills or fires, there should be enough tools for fire extinguishing

Monitoring Activities:

- Amounts of identified hazardous waste received in the landfill should be documented and reported in the monthly progress report
- Amounts of flammable and explosive wastes that have been refused from admission
- Topographic survey of the special cell and estimation of the amount of received waste
- Health records for the project staff including any occupational injury and any infection case that could be related to waste handling.

Risks on Occupational Health and Hygiene (medium significance):

Waste sorters at the recycling plant, in addition to regular staff in the landfill and transfer stations, are in direct contact with the waste and accordingly are exposed to unhygienic conditions from the prolonged exposure to waste, dust and vermin. Similar to El-Fukhary, the situation at the existing uncontrolled disposal site is associated with resident populations of vermin which are factors for increasing nuisances to humans and the spread of disease, and disrupting the natural ecosystem. The adoption of high standards for the new landfill, through compaction and daily coverage, will limit the potential for the development of resident populations of vermin and pests, however, it will not be totally eliminated as the waste will be exposed in the landfill for some time before being covered, and some insects and rodents will still be able to tunnel through the cover and reach the waste. The same mitigation measures and monitoring activities as those proposed for El-Fukhary landfill and related transfer stations and composting plants are recommended.

Noise Impacts (Medium significance)

Operation works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. As mentioned earlier during discussing construction noise, the nearest receptor is a residential cluster located about 400-600m away from the site and accordingly noise impacts are not expected to be major. It is recommended to plant wind break trees around the landfill borders, especially in the southern and western borders and around the recycling/composting plant, to maximize noise attenuation and, in turn, minimize noise impacts to neighboring areas. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Key noisy equipment (such as generators, trommels, conveyor belts … etc.) should be selected with minimum noise;
- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In case the landfill manager received complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Landfilling and operations of the recycling/composting plant should be stopped at night-time.
- Planting of a wind break trees where appropriate to act as a noise buffer.

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill should be measured frequently in an annual basis.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PDSU in the periodic monthly reports.

Affecting Air Quality by Vehicles Exhaust

The same mitigation measures and monitoring activities as previously proposed for El-Fukhary landfill and related transfer stations and composting plants are recommended to control this impact, these are listed below.

Mitigation Measures:

- All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Monitoring Activities:

- CO_2 emission rate of all vehicles used in the project should be documented from the manufacturer, the distance and fuel consumption should be documented and reported on monthly basis.

Visual Impacts (Low significance):

The operation of landfills, transfer stations and composting/recycling plants is associated with litter dispersion by wind which adds to the negative visual impacts of solid waste accumulation. The operation of landfill equipment and generated dust from the earthworks also adds to the bad scene at the site. The most effected groups by the visual impacts are the inhabitants of the close neighborhood who can see the waste from their places. Also the users of roads that could view the landfill could be also impacted by the low aesthetic value of the area. In Johr al Deek landfill during the filling of underground portions of waste cells, the operations will be totally hidden from neighboring areas and nearby roads. Also during the operation on layers above the ground it will be expected that active layers will be surrounded by embankments so that waste on the Cells edges would be compacted against them and the height of the landfill will be maintained with a safe slope, so these embankments will also hide waste filling operations from surroundings.The remaining impacts would be the interrupting of the horizon seen by the spoil hill which will not be reused in the landfill operation, and the final landfill hill after applying final cover. Currently considerable visual impacts are caused by the existing Short Term landfill at Johr al Deek which is about 15-meter high and uncovered, so waste is exposed at a high altitude which is a relatively high visual impact. The overall impact of the Short Term measures at Johr al Deek Landfill is expected to be positive, even though the landfill height will increase, due to covering and profiling the existing waste body. If the new landfill operations are added to the existing Short Term hill the additional impact on the area, during the operational phase, is expected to be minor.For the composting/recycling plants the windbreak trees that will be around the plant site and the roof over the compost piles will hide the waste and the trommel separators to most of the surrounding areas, especially that the nearest residential clusters are relatively far and their average height is relatively low (one or two stories), accordingly the visual impacts are expected to be low. In transfer stations, there will be low visual impacts on the surrounding ground level areas, because the waste will be contained inside the containers while the impact will be higher on elevated neighboring buildings. However, because the transfer stations, Beit Lahya and Al Maslakh, are currently used as open waste collection areas, no new additional visual impacts would be added due to the transfer operations. Accordingly the impact has been classified of low significance.

Mitigation Measures:

- The composting/recycling plant should be fenced with windbreak trees to minimize hide negative waste scene from the view of the neighboring areas.

Monitoring Activities:

- Complaints of neighbors from littering dispersion or about the general aesthetic value of the area should be reported to the PDSU in the monthly progress report of the site.
- Provide adequate fence, windbreak trees and roof for the composting/recycling plants

Impacts on Flora and Non-Avian Fauna (Low significance):

The baseline study of the project concluded that the Johr al Deek landfill site lacks any presence of significant wetlands of important biodiversity or reproductive value. Furthermore, there is no presence of environmentally rare or endangered species breeding areas, habitats or protected living areas. However, it was found that diverse and abundant fauna species currently use the site for nesting, breeding or feeding. These may be affected by the controlled operation of the landfill as compared with the existing uncontrolled situation where there is a direct contact between birds and animals with the waste.

The noise and daily work of landfill construction and operation could disturb the area's birds and wild mammals. End of life closing plans for the landfill will include a restoration of the site for agricultural purposes. The top soil will constitutes a good ecological host for soil organisms as compared with the current situation. The site restoration in general including any baffles and vegetative screens will create a variety of new habitats. The site restoration in general including any baffles and vegetative screens will create a variety of new habitats. No further mitigation measures are required.

Impacts after the Landfill Closure Phase:

Impacts Landfill Gas (Medium significance):

Although the proposed degassing system is believed to be sufficient in controlling the impacts and minimizing risks of gas migration to the environment, a new risk will be associated with the after closure phase as there are possibilities that the site management will be reduced especially after changing the main activity of the site to only transferring waste to El-Fukhary Landfill. Accordingly the monitoring activities for ensuring that the gas is under control may not continue during the after closure phase, therefore the recommended mitigation measures below are to provide mechanisms for continuing the monitoring activities and to adequately handle any detected gas leakage during the after closure phase.

Mitigation Measures:
- Beyond year 2032 and particularly following the closure of El-Fukhary site in 2040, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for gas monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting any gas leaks, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:
The monitoring activities that were recommended in Section 7A.2.2 should be continued after closure of the landfill, until generated gas quantities from the landfill could be considered negligible. These activities are:

- Keep records of collected gas through the degassing system
- Analyze composition of the landfill gas against main components on annual basis.
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on annual basis

Impacts of Leachate and Surface Water (Medium significance):

There will remain two main leachate issues after the landfill closure: the amount of leachate that will remain in the leachate pond after closure of Cell 3 and the amount of leachate that will remain inside the landfill body after closure. The water that entered the active Cell short time before its closure will be collected some time after its closure. Accordingly the first one or two years after the landfill closure will still receive large quantities of leachate. The recirculation of collected leachate will not be possible after the closure of the landfill, therefore, all collected amounts should be left to naturally evaporate.

The surface water collection will have special importance after the closure of landfill cells, during the closure phase. This is because the natural drainage features of the landfill location will be changed due to the existence of a new non-permeable hill in the area so that the collection areas of rain water will be changed. As previously mentioned for El-Fukhary, the Feasibility Study includes engineering measures for the smooth drainage of surface water from the landfill ring road and closed cells, designing the final cover so that an adequate slope will be maintained to drain surface water to the surrounding ring road and then to a channel that will collect all surface water in a pond at the lowest elevation area of the site. The following mitigation measures and monitoring activities are recommended for controlling this impact:

Mitigation Measures:

- Mitigation measures comprise of a sufficiently low elevation area for the collection of storm water after closing the three landfill cells. The minimum area identified by the assumptions made in this ESIA is 5,000 m^2
- The staff of the leachate pumping station should not leave the site after closure of the landfill except after abstracted leachate quantities could be neglected. This would be decided by the PDSU-EM through his review of the leachate monitoring activities reports.
- If the landfill location will be abandoned after closure of the landfill, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for leachate monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

The monitoring activities that were recommended in Section 7A.2.3 should be continued after closure of the landfill, until generated leachate quantities from the landfill could be considered negligible. These activities are:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream). Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest.

Visual Impacts (Low Significance):

The visual impacts after closure of the landfill will be the obstruction of the landscape with two new hills: the covered landfill and the un-used spoil if not exported for other uses. The design height of the landfill is 30 meters in which will be the same height for the existing Short Term landfill but for a larger area. The height and area of the remaining un-used spoil is not finally defined as it depends on the depth of excavation, but should be minimized by directly or gradually exporting form the site during the operating life cycle of the landfill or just completely eliminated by reducing the depth of the landfill as previously discussed.

The visual impacts of the landfill hill that will be developed by the project is expected to affect only few houses in the clusters that are located south west of the project site (about 400-600 meters). In all cases the view of the hills will only be a minor addition to the existing Short Term hill which will slightly affect all these areas before the construction of the Long Term landfill. Furthermore, the more distance from the landfill site the less will be the visual impact.

The impact is considered of minor significance and the planned plantation of the final covered landfill may actually improve the aesthetic value of the area.

Mitigation Measures:

Carry out and maintain plantation of the final covered landfill cells

Monitoring Activities:

Keep records of the green areas planted over the final cover of the landfill

Stability Impacts

The excavation and gradual progression of the landfill cells will work in changing the original structural stresses on the soil underneath the landfill. After closure of the landfill, the biochemical reactions that will take place will cause changes to the overall density of the landfill and will cause other changes to the stresses over the soil underneath. The landfill site is generally stable as there is no major fault type formation, as mentioned earlier in Chapter 5, with medium seismic activity, accordingly the stability risks are classified as low,

Mitigation Measures:

The stresses both on the soil and on the waste body during different stages would be considered during the operation and after closure of the landfill. The heights, slopes and protection measures should take these factors into consideration

Social Impacts and Proposed Mitigation Measures

Impacts during Construction

Creation of temporary job opportunities

The construction phase of the various components of the project will involve creation of a variety of short-term jobs that will result in improvement for the economic conditions of people including the poor with low and medium skills, in addition to highly qualified professionals in engineering and other professions. This have positive temporary impact of high significance on the livelihoods of local people.

Inconvenience to local communities

The construction process will involve site works including movement of heavy vehicles, transferring construction material and influx of high number of construction workers to the construction site. This significance of this impact is expected to have low significance in the site of the landfill due to the low population density of the site. The significance of this impact from the construction of the transfer stations will be of higher significance due to relative proximity to residential areas.

Mitigation measures

- Establishing community-based monitoring committees to follow up and report feedback of the communities.
- Communicate information about the hours of construction with the local population
- Establishing and enforcing a clear complaints system and ensure complaints are well and promptly addressed.
- Full restriction from access to the site by any other group outside the construction team.

Resettlement Impacts

Involuntary resettlement (IR) resulting from development projects will, if unmitigated, give rise to difficult economic, social, and environmental risks that may lead to a variety of unacceptable impacts.

A) Impact on the livelihoods of the informal waste pickers

Complete loss of sources of income

Complete loss of sources of income for the informal workers in El-Fukhary Landfill and complete loss of sources of income for the informal workers in the temporary waste storage sites and transfer stations.

Impact Significance:

Negative impact of high significance

Partial loss of sources of income

Partial loss of income will be encountered by the informal sector groups who give visits to the landfills and TSs on part time basis to make an additional income.

Impact Significance:

Negative impact of moderate significance.

Mitigation measures

ARAP was prepared for the waste pickers in El-Fukhary landfill site
Scenario (A) The integration scenario

The integration scenario of the informal sector involves structured interventions to ensure minimizing of the negative impacts of cutting the income of these groups through working to integrate the individuals who are capable to maintain work in waste sorting and recycling within the formal Municipality and non-municipality systems.

Scenario (A) 1- Transition Assistance

Provide technical assistance and capacity building in recycling related fields
Providing cash and in-kind temporary assistance to assist the targeted families during the construction period of the facilities.

Scenario (A) 2- Provision of Job opportunities

Hire the appropriate individuals of waste pickers by the municipality and other programmes to work in SWM related fields. This should include formalizing the waste pickers employment conditions and measures should be considered to give them priority in benefiting from the job opportunities.

Scenario (B) The non-integration scenario

For the cases where the integration scenarios will not be applicable, it is still recommended to consider other kinds of measures in order to empower the affected groups and their families. This could be attained by allowing the affected groups to benefit from running donors and national programmes. Some programmes may help **eligible families especially those with working children in establishing businesses by making small soft loans available. This may include the "Deprived families Economic Empowerment Program" (DEEP),** UNICEF and other organizations. Benefit from these running programmes include the provision of capacity development programmes in various areas like vocational training programmes or other fields and facilitate access of the informal sector groups and their families particularly women to micro-grants and sources of finance for improving livelihoods.

B) Impacts of loss of privately owned land

The land that will be acquired as part of the project is of marginal nature. Its value is generally low. This impact could be classified as an impact of moderate significance. The compensation plan as part of the ARAP will minimize the impact the impact to minor.

Mitigation measures

- An abbreviated Resettlement Plan has been prepared and will be implemented in order to ensure a fair economic compensation for the affected landowners through a consultative and mutually agreeable process.

Impacts on cultural heritage

- The closest cultural site of significance is located around 2 kilometers away from the site of El-Fukhary landfill. This is also applicable to the sites of the two existing TSs that will be rehabilitated as part of the project.

Impact Significance:

- This impact is classified as an impact of low significance but enhancement measure will be suggested within the social management plan in order to minimize any potential impacts on the cultural heritage.

Mitigation measures

- Monitoring of site excavations
- In case of finding information or signs about archeological sites or in cases of incidental finds the concerned agency, namely, the Ministry of Tourism and Antiquities should be informed and reporting should be made immediately to these agencies.
- Inclusion of clear terms and conditions within the contracts to regulate the issue of accidental finds.

Impacts during Operation

Reduction of the negative health and safety impact

The project is expected to result in more efficient and hygiene waste management that will be positively reflected on the health of the informal sector groups; workers; local communities (as general); neighboring communities to the landfill; and neighboring communities to the existing waste storage sites;

Impact Significance:

- The reduction of the negative health and safety impact resulting from the current poor collection and disposal practices of solid waste is one important positive impact of high value to the local communities who will be the main receptors of these benefits. The impact could be classified as a positive impact of high significance.

Creation of Job Opportunities

The operation of the different investment components including the newly introduced sites (including landfills and transfer stations) of the project will require additional human resources of various backgrounds and qualifications

Impact Significance:

This is considered as positive impact of high significance to the local communities. Moreover, integrating the informal waste pickers within the formal system would also be a positive socioeconomic impact of high significance.

Stimulation for economic growth in the area

The infrastructure improvement is expected to encourage introduction of economic activities including industrial and commercial activities. The development of the area, despite security limitations, will help in creating several job opportunities to the local population and the population from other places.

Impact Significance:

This impact is considered to be a positive socioeconomic impact of moderate significance to the local communities and the local economy.

Traffic Impact

From the Landfill
The current bad conditions and high traffic load of Salah El Dein road accompanied by the bad conditions of the trucks make regular transportation of waste to the final disposal sites a big challenge. The risk on the safety of the road users' is one of the key impacts that should be considered.

From the Transfer Stations
It is generally expected that the access of the vehicles to the transfer stations will result in increased pressure on both side and main roads with the cities/villages where the transfer stations will be located.

Impact Significance:
It is expected that a rehabilitation plan will be implemented for Salah El Dein Road before 2021. The impact of the landfill on traffic load and safety could be classified as moderate negative impact.

Mitigation Measures

For the landfill
- Implementation for the project of Rehabilitating Salah El Dein Road
- After operation, restrict transport trucks travel to the hours outside the rush hours.
- Strict monitoring to the road accidents as part of the monitoring plan
- Regular information sharing about the times of travel of the transport vehicles with the communities and establishments located by the road.

For the Transfer Stations
- Selecting appropriate model of means of waste transport including small trucks that can easily maneuver in narrow streets.
- Arrange the times of transporting waste to and from the TS to avoid traffic rush hours.
- Assist local communities in establishing community-based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PDSU

Higher cost to beneficiary communities particularly the poor

The operation of the long term activities will require significantly higher revenues for SWM in order to maintain and sustain the system. The economic interests of the local population, particularly the poor, should be taken into consideration before proposing any fees system that may overload them economically.

Impact Significance:
From a socially sensitive perspective, and particularly within the poverty conditions in Gaza, the project impact that hits the poor economically should be classified as negative impact of high significance.

Mitigation measures
There is a need to tailor socially sensitive programmes for the fees charging system related to SWM to ensure that poor communities are benefiting, not overloaded financially. Mitigation measures include:

- Municipalities and JSC to maintain the system of exempting/subsidizing poor families
- Design plans to stimulate further economic instruments for SWM revenues
- Awareness raising and building local communities' knowledge about issues related SWM
- More efficient management systems for waste including raising the profile and strengthening the recyclables market and encouraging community based initiative in segregation at source.

Depressing property values

From the Landfill
The establishment of the landfill in the proposed site of El-Fukhary where the current final unmanaged disposal site locates is expected to result in certain economic implications for the land and assets value within the site.

From the Transfer Stations
The impacts on land and assets in the neighborhood of the current waste storage sites that will be rehabilitated in Al Namsawi and Tal El Sultan is not expected to be of high negative significance.

Impact Significance:
For the landfill, the negative effect on the prices of land and property as a result of the establishment of the landfill is considered as an impact of low significance. For the transfer stations, the impact could be classified as an impact of moderate significance assuming that strict management measures will be applied in the site.

Mitigation Measures

- Apply strict measures and best practices in managing the sites. This involves full adherence to the mitigation measures mentioned as part of the environmental management and monitoring plan
- Establishing community- based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PDSU and conduct regular community survey and consultation activities to measure local communities' feedbacks about the sites management.

Potential impact on the social and economic activities of the neighboring communities

From the landfill
The only social and economic activities that could be affected are the limited grazing activities within the area as well as the limited farming activities. However, this is expected to be an impact of minor significance since the area around the landfill is still an open area for grazing and no restrictions will be imposed on them.

From the Transfer Stations
The neighborhood of the TSs is expected to encounter some limitations for the social and economic activities as a result of the location of the TSs with all the associated waste-related activities and the potential odour and visual impact.

Impact Significance:

The impact from the landfill is expected to be an impact of low significance. The impact related to social and economic activities resulting from the establishment of the TSs could be classified as an impact of moderate significance.

Mitigation Measures
- Full adherence to the management practices will help in reducing the negative impacts on the surrounding social and economic activities.
- Establishing community- based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PDSU and conduct regular community surveys and consultation to monitor the project impact on social and economic activities.

Socioeconomic Impact of the Northern Section of the Project

The social impacts of the northern section of the project were examined as part of the ESIA. Most of the socioeconomic impacts of the project under this section of the ESIA have big similarities with the ones described under the analysis of the socioeconomic impacts of the southern part to the project.

Various components are expected to result in several positive socioeconomic impacts, including, improvement of the public health, environmental condition in the residential areas and creation of economic opportunities of the poor segment of the population through creating number of job opportunities that can accommodate low and medium skilled labor. However, the project is also expected to result in a number of negative socioeconomic impacts during both construction and operation.

Impacts During Construction

Creation of temporary job opportunities

One of the key global positive socioeconomic impacts of the project is the creation of job opportunities during the construction phase of the project. As explained under the analysis of the ESIA of the southern part of the project, the construction phase of the various components of the project will involve creation of a variety of short-term jobs that will result in improvement for the economic conditions of certain segment of the population including poor people with low and medium skills.

Inconvenience to local communities

The construction process of the landfill expansion and the associated TSs will involve site works including movement of heavy vehicles, transferring construction material and influx of high number of construction workers to the construction site. The nearest residential area to the landfill is Johr al Deek town which is located more than 1 km. 4000 inhabitants (approximately 500 households) live in the town which also include some industrial activities. Transferring the construction materials will involve high pressure on the main road with several heavy trucks movements. The increased traffic pressure may result in delays for the users of the road and increase in the risk of road accidents. During the construction phase of the TSs, namely Al Maslakhi and Beit Lahia, neighboring communities will be temporarily encountering impacts from construction phase, including noise, dust and traffic impacts in the neighborhoods.

Impact Significance:

This impact is characterized by being a temporary moderate significance impact for the neighboring communities to the TSs that will be rehabilitated and temporary impact of low significance for the landfill.

Mitigation measures

Commitment to the various environmental measures stated on the ESMP will help in mitigating the potential negative impact on public health. Moreover, additional participatory measure that aim to engage local communities and share information transparently with them .

Resettlement Impacts

Potential involuntary resettlement by both acquiring privately owned land for the project components as well as affecting the livelihoods of poor individuals of waste pickers is perceived to be one of the key negative socioeconomic impacts predicted from GSWMP.

A) Complete loss of sources of income

This includes impacts on the livelihoods of the informal waste pickers in both Johr al Deek final disposal site and the associated TSs, namely, namely Al Maskhi, Beit Lahia, El Karama, Um El Nassr and Beit Hanoun who are fully reliant on waste picking as the sole livelihoods source. It is expected that security system will be established to control the landfills and transfer stations for safety purposes. Restricting these groups who are currently entering freely from reaching the landfills and the TSs will result in significant negative impact on these groups' source of livelihoods. The negative implications of discussed under the impacts analysis for the southern part of the project including family impoverishment and social unrest are also potential risks for the northern part of the project.

The social survey conducted as part of preparing the ESIA and the ARAP showed that 33 waste pickers are working in Johr al Deek proposed location for the landfill. Two existing temporary waste storage sites serving Johr al Deek landfill, namely Al Maskhi and Beit Lahia will be upgraded, improved, and converted into TSs. Moreover, three further smaller collection sites, namely, El Karama, Um El Nassr and Beit Hanoun will be cleaned and closed as part of the project. Currently around 16 waste pickers are working in Al Maskhi and 16 waste pickers are working in Beit Lahia.

Impact Significance:

The severity of the project direct impacts on the part timer waste pickers is not expected to be of major significance. For waste pickers who are working on full time basis, the significance of the potential impact is considered to be more serious on their and their families' livelihoods.

Mitigation measures

- Under section 6B.2.1.3 of this ESIA comprehensive mitigation plan for tackling the potential negative impact on the livelihoods of waste pickers was elaborated in details. Further analysis and details for implementing this plan has been included in the ARAP of Fukhari landfill and associated TSs.

- The developed mitigation plan and the proposed short and long team measures under the southern section of the project could be adapted and applied on the waste pickers working in the northern part of the project. Moreover, more specific information about the affected waste pickers from the northern part of the project, namely Johr al Deek landfill, is presented in the ARAP for waste pickers that has been developed for the northern section of the project.

B) Impacts of loss of privately owned land

For Johr al Deek Landfill:

The establishment of the landfill including the various component until 2040 will involve permanent land acquisition of around 250 additional dunums. This includes extending the existing Johr al Deek disposal site from 195[1] dunums to 445 dunums. Before the project construction phase, land for the expansion in the landfill site needs to be secured. Since the needed land is privately owned, arrangements for securing the land and providing satisfactory compensation to land owners should be considered during the project planning phase. The land that will be needed is owned by much higher number of owners compared to the case in the southern landfill. The number of owners is expected to reach to around 600 individual.

[1] The actual current used space in the landfill is only 120 dunums and not 195 since large portion of the land is located inside Israeli borders or not used to keep the security buffer zone.

For the transfer stations

The two temporary waste storage sites El Maslakh and Beit Lahia are not expected to result in land acquisition for any privately owned land. In the case of Al Maskhi where upgrading will likely involve relocating the site, the newly selected location will be very close to the old one and is state- owned land.

Impact Significance:

The land that will be acquired as part of the project is of relative low value due to proximity to the current final disposal site and the buffer zone with Israel. However, the land is relatively more fertile and productive and farming activities are taking place around Johr al Deek location. This impact could be classified as an impact of moderate significance. The compensation plan as part of the RAP will minimize the impact to minor.

Mitigation measures

For Johr al Deek Landfill

A RAP will be prepared and will be implemented in order to ensure a fair economic compensation for the affected landowners through a consultative and mutually agreeable process.

Impacts on cultural heritage

Johr al Deek location is considered more sensitive from heritage sites perspective. There are 3 sites located to the north of the site, namely, Roman site, Laqia site and Jabalia Mosaic site as well as important historical triangle located to the west of the site. There is also still the likelihoods of potential accidental finds within the various project sites during the construction of the project.

Impact Significance:

This impact is classified as an impact of medium significance but enhancement measure will be suggested within the social management plan in order to minimize any potential impacts on the cultural heritage

Mitigation Measures:

- Monitoring of site excavations is an essential mitigation measure and the involvement of the Ministry of Tourism and Antiquities as a key stakeholder should be ensured and maintained. In case of finding information or signs about archeological sites or in cases of incidental finds the concerned agency should take immediate action. The provisions and terms of the Contract with the Contractor should also include a provision for dealing with this case.

Impacts During Operation

Reduction of the negative health and safety impact

GSWMP, in general, is expected to result in significant improvement for the SWM system and accordingly for the environmental conditions and human health. Moreover, a potential positive impact on the health conditions of the informal sector groups, the workers in SWM and the local communities in general are expected to be attained from the project implementation. Neighboring communities to the dumpsite and the transfer stations will also likely sense positive impacts on their neighborhoods. Currently Johr al Deek disposal site is poorly managed with no machinery used in the site for regular covering of waste. It is expected that the sanitary condition of the new landfill and the various environmental measures that will be considered will result in improving the conditions within the landfill and will be reflected on the neighboring area. Moreover, most of the existing temporary waste storage sites are located within residential areas. These sites are used as waste disposal sites where waste is accumulated for very long time and in most of the cases the sites are rarely cleaned. It is predicted that positive health, hygiene and visual impacts from the planned upgrading, rehabilitation activities or closure of the existing waste storage site will be positively sensed by the neighboring communities. It is predicted that the general operation conditions will be more hygienic and more attention will be paid to the regular cleaning of the site. Waste will also be removed more regularly and frequently to Johr al Deek landfill.

Impact Significance:

The reduction of the negative health and safety impact resulting from the current poor collection and disposal practices of solid waste is one important positive impact of high value to the local communities.

Creation of Job Opportunities

The improvement of the SWM system as a whole in Gaza Strip will involve several capital cost investment in upgrading the existing infrastructure and fleet or establishing and preparing new locations and introducing new equipment. This is applicable on Johr al Deek landfill where the site will need technical and administrative staff. Junior staff member with low and medium qualifications could be recruited from communities close to the location since this option will ensure a socially sensitive approach and will be more efficient economically. The transfer station that will be upgraded namely Beit Lahia and Al Maslakhi will employ a few staff members to manage and operate the station and to manage and operate the hauling trucks.

Impact Significance:

This is considered as positive impact of high significance to the local communities.

Changes in land use

Some of the changes in the land use will involve positive impacts on land use. This is applicable on the case of improving the conditions of exiting waste storage sites of Beit Lahia and the existing part of the final disposal in Johr al Deek which will be rehabilitated, engineered and better managed. The closure of El Karama, Um El Nassr, Beit Hanoun and the current location of El Maslakhi will involve availing scarce land plots. Some of the changes in land use involve negative impacts like the case in Johr al Deek landfill where additional land plot will be added to the current space of the disposal sites in order to allow additional spaces for cells and other landfill facilities. This land is currently used in various economic activities including farming. Accordingly, there is a potential loss of productive land. The establishment of the landfill will result in a loss of the options for alternative land use and thus represents a permanent commitment of land resources.

Impact Significance:

The change in the land use as a result of the project is a combination between positive and negative impacts depending on the nature of change occurring to the land use. Due to the relatively higher value of land in the northern area of GS, the impact of land loss and the changes in land use is regarded as a negative impact of medium significance.

Mitigation Measures:
To mitigate this impact related and in addition to the preparation of RAP to handle land ownership and compensations issue, adherence to the other mitigation measures listed under various parts of the ESMP will help in ensuring that the sites are properly managed.

Traffic Impact

From the Landfill

For Johr al Deek landfill, which is located in the east of Gaza Governorate, the main access road leading to the landfill is Salah El Dein Road and Al Karama Road (Eastern Road) .The 2 Governorates (Gaza and North Governorates) are expected to be served by two transfer stations that will accommodate waste temporarily until waste is transferred to Johr al Deek landfill. The distance between Beit Lahia TS and JED landfill is around 17-18 km. Most of this distance is located in Al Karama road. On the other hand the distance between Al Maslakh TS and Johr al Deek landfill is around 5 km, of which around 4 km is located on Al Karama Road. It is, thus, anticipated that the majority of the traveling distance from the 2 transfer stations to Johr al Deek landfill will be across Al Karam Road.

Impact Significance:

The traffic impact as a result of waste haulage from Beit Lahia TS to Johr al Deek and from El Maslakh TS to Johr al Deek is not expected to result in significant negative implications on the roads users and the neighboring communities due to the relative low density on the road that will be used. The impact could be, thus classified, as an impact of low significance.

Mitigation Measures

- After operation, restrict transport trucks travel to the hours outside the rush hours.
- Strict monitoring to the road accidents as part of the monitoring plan
- Regular information sharing about the times of travel of the transport vehicles Selecting appropriate model of means of waste transport including small trucks
- Arrange the times of transporting waste to and from the TS to avoid traffic rush hours.
- Assist local communities in establishing community- based monitoring committees

Higher Cost to Beneficiary Communities Particularly the Poor

The operation of the long term activities will require significantly higher revenues for SWM in order maintain and sustain the system. The impacts analysis of the northern part of the project emphasized the importance of considering an appropriate level of payment that local residents can afford. The economic interests of the local population, particularly the poor, should be taken into consideration before proposing any fees system that may overload them economically.

Impact Significance:
This impact could be classified as an impact of high significance.

Mitigation measures

The ESIA has developed two sets of mitigation measures that have been divided into short term immediate measure and strategic or longer term measure. Additionally a number of crosscutting measure that would help in attaining financial sustainability by emphasizing the role of local communities and the importance of participation were also elaborated.

Depressing Property Value

From the Landfill

The establishment of the landfill in the proposed site of Johr al Deek where the current final limitedly managed disposal site locates is expected to result in certain economic implications for the land and assets value within the site. This is also the case in the neighborhoods where such waste disposal facilities are located. However, it has been widely recognized recently that today's state-of-the-art landfills provide a variety of economic, employment and community-enhancement benefits that typically may contribute to property values. Although the proximity to the green line with Israel is lowering the price of land in this specific area, yet land value is relatively high compared to the case in southern Gaza.

From the Transfer Stations

The impacts on land and assets in the neighborhood of the current waste storage sites that will be rehabilitated like the case in Beit Lahia and Al Masalkhi disposal site. This is not expected to be of high negative significance. On the contrary, the rehabilitation of these sites, improving the operation, more frequent cleanliness, improving working conditions and the efficiency of work in the station will likely result in reducing the negative impacts of the waste storage site, including odor, increase in the numbers of flies and mosquitoes and the negative visual impact.

The same applies to disposal site which will be closed and relocated in a close by location. The impact of this will likely be on the same neighboring residential communities. However, constructing the TS on engineered and controlled basis will likely eliminate any potential negative impacts.

Impact Significance:

For the landfill, the negative effect on the prices of land and property as a result of the establishment of the landfill is considered as an impact of medium significance. This also applies to the impacts on assets in the surrounding areas around the TSs. However, rehabilitating the TSs site and introducing improved design and more environmentally friendly management system to the TS will likely improve the situation in the neighborhood.

Mitigation Measures

- The project is not expected to provide direct compensation for the predicted reduction in the price of property value as a result of the project. However, strict compliance with the proposed mitigation measures including hygienic practices within the locations as well as establishing community-based mechanisms to ensure that local communities are channeling their concerns, complains and feedbacks about the site management.

Potential impact on the social and economic activities of the neighboring communities

From the landfill

There is a potential socioeconomic impact as a result of land acquisition to secure space for the landfill. This is examined in more details under the RAP and the impacts under construction above.

From the Transfer Stations

The neighborhood of the TSs might encounter some limitations for the social and economic activities as a result of the location of the TSs with all the associated waste-related activities and the potential odour and visual impact. However, it is expected that better management and control for the site after the rehabilitation will potentially reduce the sensed negative impact and accordingly will have limited impact on the social and economic activities

Impact Significance:

This impact from the landfill is expected to be an impact of low significance. The same impact related to social and economic activities resulting from the establishment of the TSs is still uncertain impact and could be classified as an impact of low to moderate significance.

Mitigation Measures

To mitigate this potential impact, the same mitigation measure illustrated under the southern section of the project are recommended to be used. This includes full adherence to the proper management practices in various sites as well as introducing community-based mechanisms for channeling local communities' feedbacks, concerns and complaints.

Additional recommendations to maximize the social benefits of the project

- Raising the Profile of SWM
- Awareness raising
- Ensuring the benefits are granted to the Local population
- Reducing potential occurrence of work accidents
- Improving the Primary and Secondary Collection systems
- Enhancing Working Conditions of the workers in the SWM sector
- Training and Capacity Development

Analysis of Alternatives

No Project Alternative

The objectives of the GSWMP is basically to improve the environmental and public health conditions in Gaza strip, accordingly it is expected, by definition, that the environmental and social benefits will overweigh the impacts.

The main benefits that are expected by the projects include:

- Closure of open dumpsites around Gaza Strip and upgrade the environmental and public health conditions in their surrounding areas
- Prevent open burning of solid waste in dumpsites and in waste containers to allow for more room for additional waste, this practices are expected to be stopped, or minimized, with more reliable collection of waste.
- Prevent uncontrolled contaminated water leaching from waste in dumpsites to the fragile groundwater aquifer in Gaza Strip
- Provision of important facilities for safe and sanitary management of solid waste generated in Gaza Strip for a long-term time horizon, which shall play an important role in the sound development of the Strip
- Improve the possibilities of recovering organic waste and recyclables in the solid waste, which would reduce waste disposal quantities and achieve socioeconomic benefits.
- Provide work opportunities for the people of Gaza in the project and indirect services for contractors and entrepreneurs, which would help in alleviating unemployment problems

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

Alternatives of Integrated Waste Management Scenarios

The Feasibility Study of the project has studied five alternative locations for the landfill, the FS introduced exclusion criteria for the location, which included exclusion of any site within less than 200 meters from residential areas, and exclusion of any site within 500 meters from any water well. This exclusion criteria has excluded the three locations other than Johr al Deek and El-Fukhary. This exclusion is totally agreed by the ESIA team.

Following the exclusion process the FS has presented three scenarios for the integrated waste management in Gaza Strip as follows:

- Scenario one: Gaza Strip will be served by two landfills, Johr al Deek and El-Fukhary, until year 2040. Johr El Deek will serve North Gaza and Gaza City and El-Fukhary will serve Deir El Balah, Khan Yunis and Rafah.
- Scenario two: North Gaza and Gaza City will be served by Johr al Deek landfill until 2020, then Johr El Deek will be closed and the whole Gaza Strip will be served by El-Fukhary landfill. Scenario three: North Gaza and Gaza City will be served by Johr al Deek landfill until 2015, then Johr El Deek will be closed and the whole Gaza Strip will be served by landfill.

The Feasibility Study made different technical, logistical, environmental and social comparisons between the scenarios and concluded that the preferred scenario is, as described earlier in this ESIA, to operate Johr El Deek serving North Gaza and Gaza City until 2032, where additional waste may breach the minimum distance of 200 meters from adjacent houses, then the whole Gaza Strip will be served by Rafah.

From an environmental and social perspective El-Fukhary site seems to be generally less sensitive than Johr El Deek in terms of proximity of residential areas, sensitivity of groundwater, less land prices and surrounding land use which may allow for future expansion. Some exceptions to this may be effective such as the proximity to Gaza International Airport, which may be an important factor for the final decision on the preferred scenario.

On the other hand, the political situation in Gaza which leads to repeated invasions by the Israeli army and separating between the north and south of Gaza gives environmental importance for having two engineered landfills with sufficient volumes to effectively serve all Governorates of Gaza during emergencies, otherwise waste will unacceptably be accumulated in uncontrolled locations leading to many environmental shortcomings. Also from the social perspective it will be a social balance if each area will include the disposal site for its waste, and if, on contrary, all the waste of Gaza Strip is disposed in one location the inhabitants of the surrounding area of this location may have some negative feelings about the project if they are not convinced about the its benefits.

A final clear preference from the environmental and social perspective between scenarios could not be ascertained, but the more usage of El-Fukhary site with available area in Johr Al

Deek to receive waste in emergencies may be slightly preferable from the environmental and social perspective.

Alternatives of Landfill Height and Depth

The proposed design of El-Fukhary landfill indicates that the landfill depth below ground level will be 20 meters and the height above ground will be 30 meters. This will involve a calculated excavation volume of about 6.7 million m3 of soil, if the excavation slope is 1:2, in which about 40% of this amount will be needed for the landfill operations according to the assumptions presented in the previous Chapter. The spoiling of such large amount of soil, if will not be utilized by other users, will need large area of land which will be difficult to develop and will also increase the dust emissions in the area as result of wind erosion.

On the other hand if less depth and more height have been selected for the landfill, to compensate for the volume, there might be security issues from the Israeli side as the landfill is very close to the borders in addition to less landfill capacity as the excavation slope is expected to be steeper than the above-ground slope, this will add to the landfill capacity issues as presented in the previous Chapter.

An ideal situation will be to have an optimum depth and height for the landfill that will make no, or few, excess soil that will not be reused which is calculated by about 8-9 meter depth excavation and 42-43 meters height as presented in the previous Chapter" the area that could be needed to store the spoil could be used as another landfill cell that will compensate a 20% less landfill capacity resulted from the shallower depth. But, again, this ideal situation may be theoretical if did not have a security approval.

In case a 40-meter height of the landfill is not logistically possible, a detailed investigations of possible uses of excavated soil should be explored or a sufficient land should be allocated for storing this spoil as mentioned in the previous Chapter.

Alternatives of Gas Management

There are two alternatives for the handling of collected landfill gas: to flare it, or to use it for power generation. The environmentally preferred alternative will normally be to use the gas for power generation as this will be utilization of a non-fossil fuel source in power generation which will cause some savings of the precious fuel resources in Gaza Strip, especially during the period where the borders are not freely open. However, the installation of power turbines at the landfill location will need to be economically feasible so that the project will be sustainable so that it is assured that the gas will be utilized and will not be left unused.

In conclusion, the decision about utilization of the landfill gas in power generation should be based on an economic feasibility study considering the amounts of gas that will be collected and the power transmission requirements, but during the first years of operation when the gas recovery will not be feasible it should be thermally destructed through flaring.

Institutional Set-up for managing the ESMP

Environmental and Social Management Plan

The PDSU shall include an Environmental Manager (PDSU-EM) who will have the overall responsibility for implementing the ESMP and shall report directly to the PDSU Director. During the construction phase the Engineering Consultant (EC) of the project, who will supervise construction work, will make sure that the mitigation measures during the construction phase are implemented by the contractor.

Efficient implementation for the social management plan should involve tailored efforts for maximizing the positive social impacts and ensuring that they are reaching the local communities and minimizing the negative impacts that may hit the poor and vulnerable groups. The potentially-affected groups (particularly waste pickers, land owners and communities near the proposed facilities) should be consulted along the process in order to ensure that their views are considered and that suitable measures are in place to eliminate the severity of negative impacts. Efficient consultations with stakeholders and high level of participation are seen as a prerequisite for a successful ESMP. it is strongly recommended to appoint a Social Development Officer (SDO) within the PDSU. The SDO should be leading the various participatory activities.

Each of the two JSC managers (JSCM) of the landfill sites will generally be responsible for implementing mitigation measures and monitoring activities during operation and decommissioning phase. The two JSCMs will supervise the ESMP measures at the two sites in addition to the correspondent transfer stations and the composting/recycling plant at El-Fukhary site, they will report to the PDSU-EM. During the decommissioning phase the two JSCM should provide the resources sufficient of timely implementing monitoring activities.

The specific roles and responsibilities of the SDO planned to be appointed under the PDSU include:

- Establish dialogue with project affected groups, including local communities in the TS and landfills sites, landowners and waste pickers
- ensure the project is implemented in a socially sensitive manner that consider the interests of these groups.
- Monitor the project performance and report challenges and propose measures to improve project performance.
- Design and implement awareness raising campaigns
- Facilitate the formation of various community based mechanisms including community-based monitoring committee and social committee as part of implantation of the ARAP.
- Close facilitation for the execution of the ARAP and ensuring that compensations are reaching the PAPs.
- Maintain databases and efficient records for the PAPs as part of the ARAP
- Prepare quarterly progress reports and raise it to the PDSU and report to the World Bank where applicable.

Moreover, the implementation of the ESMP involves other voluntarily community-based mechanisms to assist the SDO in reaching local communities and to facilitate access to information and feedbacks; it is suggested to benefit from existing mechanisms like the "Districts Committees" by involving them and activating their roles wherever applicable. It is suggested to form 4 voluntary Community- Based Monitoring committees with the main responsibilities of:

Facilitate the PDSU and the SDO access to the local communities
Conduct various surveys and consultation activities as part of engaging local communities in monitoring the project various phases and assessing various impacts.
Assist in the delivery of awareness raising campaigns

ESMP Budget

Because the project is basically an environmental project the distinction between the budget for engineering works and environmental safeguard measures is difficult because ultimately the whole project will have clear environmental and social benefits. It has been assumed that the recommended mitigation measures and monitoring activities are included in the project budget except for the following items, presented in the Table below, that may be considered distinct from the pure engineering components of the project.

It is worth noting that it has been assumed that El-Fukhary Landfill will have an equipped laboratory to carry out leachate, groundwater, gas and noise monitoring activities recommended in the ESMP as part of the project budget.

Table 0 -1: Proposed Budget for the ESMP

Category	Item	Budget (US $)
Project management[2]	Salary of the PDSU Manager in 6 years X 2 offices	**216,000**
	Salary of the PDSU-EM in 6 years X 2 offices	**144,000**
	Salary for the SDO in 6 years X 2 offices	**144,000**
Capacity building	Capacity Development for the SDO	**20,000**
	Training courses on Hygiene and Hazardous Waste Management for project staff	**40,000**
	Capacity building and training activities for staff of the regulatory Ministries including MEnA, MoH, MoL, MDLF	**100,000**
Consultancy	Contracting consulting firm for carrying out environmental/social audit for the project performance and recommending improvement measures (3 audits in 6 years)	**200,000**

[2] The implementation of Gaza SWMP will be divided into two separate projects; El Fukhary implemented by the MDLF and JaD implemented by the UNDP which requires two separate PDSUs that needs to be mentioned and considered in the required personnel of the PDSUs and in turn the cost.

	Allowance for contracting experts in some needed ESMP measures, such as pesticides consultant, groundwater expert, energy expert, safety expert … etc.	**120,000**
	Consultancy services (strategy for raising SWM profile in GS and strategies for developing financial instruments)	**200,000**
Awareness	Designing and implementing awareness raisin campaigns	**80,000**
Compensations	Transition assistance for the waste pickers of Al Namsawi and Tal El Sultan (southern section)	**126,420** [3]
	Transition assistance for the waste pickers of Al Maslakh and Beit Lahia (northern section)	**192,640**[4]
	ARAP for landowners at El-Fukhary landfill	**8,876,500** [5]
	ARAP for landowners at Johr al Deek landfill	8,660,000[6]
	ARAP for waste pickers in El-Fukhary landfill	**228,600**[7]
	ARAP for waste pickers in Johr al Deek landfill	**419,100**[8]
	Total	**19,767,260**

Public Consultation:

The project is characterized by the importance and considerable weight given to socio-economic dimensions. The ESIA, thus, was produced in a highly participatory manner that managed to fully engage stakeholders groups. The ESIA is particularly sensitive to the

[3] This was calculated on the basis of :

A) **Cash Assistance:** 21 waste picker x USD 230/ month (as transition allowance) x 24 month (transition period) = USD 115,920

B) **Capacity development (hands on training):** 21 waste picker x USD 500/training = USD 10,500

[4] This was calculated on the basis of :

A) **Cash Assistance:** 32 waste picker x USD 230/ month (as transition allowance) x 24 month (transition period) = USD 176,640

B) Capacity development (hands on training): 32 waste picker x USD 500/training = USD 16,000

[5] This figure was suggested by the ARAP against calculating not only the areas needed for the project but the actual areas owned by landowners who showed interest in selling to the project. Securing additional land is recommended from environmental and social point of view. The figure also counted for an amount of USD 50,000 for external monitoring to be provided for the resettlement process

[6] This include the estimated cost of average market price for purchasing the land space needed for the landfill, estimated figure for compensation for the rest of land located adjacent to the buffer zone and will not be used by the project and an amount of USD 50,000 for external monitoring to be provided for the resettlement process

[7] This allocation could be provided by several projects and it will be the responsibility of the PDSU with the assistance of community based mechanisms to ensure that they are assisting the affected waste pickers in finding an institution that can secure funds for assisting the waste pickers

This was calculated on the basis of: Initial cost for micro grants for the PAPs to start small business: USD 10,000 x 18 waste pickers = 180,000 + Monthly salary of 450 US$ for 6 moths transition period x 18 families = 48,600 (Total = **228,600)**

[8] **This was calculated on the basis of:** Initial cost for micro grants for the PAPs to start small business: USD 10,000 x 33 waste pickers = 330,000 + Monthly salary of 450 US$ for 6 moths transition period x 33 families = 89,100 (Total = **419,100)**

interests of the primarily affected vulnerable groups like land owners, waste pickers who will be restricted from access to their source of livelihoods and the local population near the waste disposal sites including TSs, landfills and the beneficiaries of the SWM service.

The key consultation activities during the course of the project could be divided into the following:

1) During the Scoping and preparation of the ESIA and ARAPs

a) Plenary session

The Scoping session was attended by a wide range of stakeholders. The scoping session aimed to present the project, scope of work and methodology of the ESIA for the long term activities and obtain participants feedbacks on the issues that the Consultant should pay attention to during the course of the ESIA including design related issues.

The scoping session findings emphasized the importance of developing integrated solutions for SWM, concerning the public as well as the private interest of stakeholders, the importance of planning and conducting awareness raising campaigns and studying the possibility of engaging the private and informal sector in the service provision. It also drew the attention to key technical aspects including the relation between the waste water treatment plant and Al-Fukhary landfill, the need for determining temporary waste storage spots and considering alternative roads. The raised issues during the scoping session were considered by the ESIA team in the preparation of the study.

B) Other Consultation through surveying and participatory tools

Consultation with various groups of stakeholders has been carried out during the scoping period through a comprehensive structured survey, in-depth interviews and FGDs with various types of stakeholders. The information and findings of the various consultation activities were incorporated across the various chapters of the ESIA. Moreover, and to address the sensitive issue of involuntarily resettlement, two landowners inventory survey and multiple waste pickers inventory survey were completed to prepare the ARAPs.

2) After Drafting the ESIA and during the review of findings

After submitting the Draft ESIA, two public consultation workshops were held for reviewing the findings of the ESIA, as follows:

a) For the Southern Part of the Project
b) For the Northern Part of the Project

The consultation successfully helped the Consultant in ensuring that the concerns and recommendations of the consulted stakeholders are recognized and considered in the development of the study and more specifically in the preparation of the mitigation measure and ESMP.

CHAPTER 1 INTRODUCTION AND ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT OBJECTIVES

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Introduction

The Palestinian National Authority (PNA), through the Ministry of Local Government (MoLG) and the Municipal Development and Lending Fund (MDLF), have prepared the Terms of Reference (ToRs) for preparing an independent Environmental and Social Impact Assessment (ESIA), subject of this report, for the Gaza Solid Waste Management Program (GSWMP). The ESIA assignment, funded by the Agence Francaise Developpement (AFD) was announced as a competitive bid in May 2011 and was awarded to the Joint Venture of EcoConServ Environmental Solutions, Egypt, and Universal Group, Palestine.

This report is a core deliverable for the ESIA consultancy service which involves the preparation of an independent ESIA and a Resettlement Action Plan (RAP) for the proposed GSWMP.

Project Background

The status of Solid Waste Management (SWM) in the Gaza Strip (GS) is associated with many environmental, health and social shortcomings. This is attributed to several technical, institutional and financial factors as defined in the National Strategy for Solid Waste Management (NSSWM) in the Palestinian Territory for 2010-2014.

Most of the collected solid waste in the GS is disposed of in three main disposal sites; Johr al Deek Landfill east of Gaza City, El-Fukhary Landfill east of Rafah City, and Deir El Balah Landfill in the Middle Area of GS. The three sites are reaching their maximum capacity, and accordingly there is a growing need for establishing an integrated SWM that to adequately handle the growing waste generation rates in GS with minimum impacts on public health and the environment.

Within this context the GSWMP has been initiated. The goal of the project is to improve SWM in Gaza through taking emergency short-term measures to upgrade existing facilities, and long-term measures to establish new facilities that will enable adequate SWM for a time horizon of 30-40 years implemented in certain stages. The short-term measures include rehabilitation of the existing three disposal sites to enable their usage until new facilities are in operation, and include establishing pilot facilities for resource recovery and composting. The long-term measures include at its first stage (which could extend for 10-15 years) the following:

- Establishment of at least one engineered landfill and two transfer stations
- Sanitary closure of the existing three landfills and other dumpsites
- Provision of adequate collection facilities from waste generators
- Provision of financial support for operating the new facilities for one year[9]

[9] The financial support is expected to be provided by the project sponsors; after the first year of operation sustainable sources of finance are expected to be available

- Expand the pilot-scale resource recovery facility recommended under the short-term measures, if proven to be feasible, to a full-scale facility
- Provision of technical assistance, capacity building for implementing bodies and public awareness to support the sustainability of the project.

The GSWMP will be carried out by the PNA in cooperation with different international organizations which have expressed interest in supporting the project. The United Nations Development Program (UNDP) is supervising the preparation of the Feasibility Study (FS) and Detailed Design for the short-term and the long-term measures of SWM in GS; The MEnA(EQA) has been involved in the process of preparation and approval of the ESIA ToRs; the Government of Japan (GoJ) has agreed to finance the short-term measures, while different organizations have expressed their interest to finance long-term measures including the World Bank (WB), the European Union (EU), the AFD, the Islamic Development Bank (IsDB), and GoJ.
The FS for the project started on 16 May 2011 by a consortium led by DHV B.V. (Netherlands). The FS comprises two main parts:

- Part A which is about the short-term measures. The scope of Part A includes: A1) preparation of a feasibility study, A2) preliminary and detailed design and A3) environmental assessment for the short-term measures comprising improving the three existing landfills and establishment of a pilot source recovery and composting.
- Part B which is about the long-term measures. The scope of Part B includes: B1) preparation of feasibility study and conceptual designs for the long-term interventions (including collection scheme, transfer, recovery and landfilling) and ii) preparation of preliminary and detailed design of the feasible interventions.

The preparation of an independent ESIA including ARAPs for the long term measures of GSWMP was announced as a competitive bid in May 2011. The consultancy assignment is funded by AFD and has been awarded to the Joint Venture of EcoConServ Environmental Solutions, Egypt, and Universal Group, Palestine.

1.3 ESIA Objectives

The ESIA is an instrument that involves examining the project's technical, environmental, socio-cultural, institutional, historical and political context, and stakeholders' views and priorities. It aims to set a mitigation and monitoring plan to tackle the negative environmental and social impacts and defines the institutional responsibilities for implementing these measures.

According to the Consultant's ToRs, the preparation of a Resettlement Policy Framework (RPF) was one of the mitigations documents that the Consultant would have considered in order to tackle the involuntary resettlement issues. The ToRs of the Consultant stated "The consultant will prepare, in accordance with the Bank guidelines, a Resettlement Policy Framework (RPF) and/or a Resettlement Action Plan (RAP)". However, the RPF, as a tool, was not perceived to be an appropriate tool given the considerably high level of details available on the project and the potentially affected persons and the clarity about the type and scale of impact. According to the World Bank OP 4.12 on Involuntary Resettlement, RPF is prepared when the extent and location of resettlement and/or land acquisition cannot be known at appraisal (e.g. in projects with multiple components and unclear/undefined scope of activities). RPF should include information on how subsequent RAPs are developed both with regard to substance and process. The RPF also should estimate, to the extent feasible, the total population to be displaced and the overall resettlement costs. However, in case of GSWMP, the involuntary resettlement impacts on livelihoods of waste pickers and on land property of land owners was possible to be tracked since the project location and activities and their impacts on the potentially affected persons was clear during the preparation of the ESIA. Thus the RAPs/ARAPs as part of the ESIA were perceived to be the more appropriate tool that will be ready for practical application during the project execution. The Consultant has prepared 4 ARAPs/RAPs for waste pickers and landowners for both the northern and southern sections of the project.

According to the Social Assessment and Public Participation in Municipal Solid Waste Management produced by the WB in 2004, , the Social Assessment in SWM projects establishes patterns of existing behavior and creates social engineering tools to provide incentives for desired changes. It can also be used to:

- Identify household solid waste practices and problems,
- Assess user needs and service preferences,
- Determine current payments for solid waste services, and
- Assess willingness and ability to pay for an improved MSWM system.

This ESIA report has been prepared in accordance with the National Environmental Impact Assessment (EIA) guidelines including the EIA Brochure of the PNA. It also recognizes the international policy and guidelines including the WB Operational Policy/Bank Procedures/Good Practice (OP/BP/GP 4.01).

1.4 The Consultancy Terms of Reference (ToRs)

The Consultancy ToRs identify the objective of the study as to "*undertake an independent Environmental and Social Impact Assessment of the proposed Solid Waste Management Project (SWMP) for Gaza Strip*". Seven tasks have been identified in the ToRs as follows:

- Task 1: Identification of the environmental and social regulations, standards, policies and administrative framework.
- Task 2: Specification of project designs, plans and activities that would be associated with environmental and social aspects.
- Task 3: Description of baseline conditions of environmental and social parameters and conditions prior to the implementation of the project interventions.
- Task 4 : Assessment of environmental and social impacts that are expected from the project activities during different stages.
- Task 5: Analysis of different project alternatives according to their environmental and social pros.

- Task 6: Preparation of an environmental and social management and monitoring plan.
- Task 7: Assist the client in consultation with different project stakeholders and licensing authorities.

1.5 Composition of the ESIA Report

The Consultant have addressed the ToRs tasks and developed a report structure that reflects these tasks. The ESIA report composition could be summarized in the following:

Chapter 1: Introduction and Environmental and Social Impacts Assessment Objectives

It presents an overview on the project, the consultancy service objectives and scope of work and the report structure

Chapter 2: Environmental and Social Impacts Assessment Methodology:

This Chapter of the report sheds the light on the adapted methodology to accomplish the consultancy assignment. It presents the applied tools including surveying tools and the various methods used to engage local communities in the preparation of the ESIA. It also gives an overview on the key strengths and weaknesses of the Consultant's methodology to the assignment.

Chapter 3: Laws, Legislations and Institutional Setup:

Chapter 3 of the ESIA introduced an overview on the laws, legislations and institutional aspects of relevance to the project under investigation. It presented the local Palestinian laws related to SWM as well as other environmental regulations and standards. It also presents other international standards and safeguard policies including those of the World Bank and other international funding agencies.

Chapter 4: Project Description

Chapter 4 of the ESIA presents the current situation of SWM in GS and identifies deficiencies which are the basis for the GSWMP. It includes an identification of the project's components and description of their technical design details proposed distribution of responsibilities among different project stakeholders. This chapter also includes a review of the project rationale with a discussion of alternative technologies for solid and hazardous waste management.

Chapter 5A: Environmental Baseline

This Chapter of the ESIA presents the current environmental conditions at the proposed project site. It is considered the base for measuring the potential impact that the project may have on the various environmental parameters.

Chapter 5B: Social Baseline

This Chapter of the ESIA presents the current social details of the project including key characteristics and sensitivities that the project might potentially affect. This chapter is considered the base for measuring the potential impact that the project may have on the various social parameters.

CHAPTER 6: Environmental and Social Impacts And Proposed Mitigation Measures for the Southern Section of the Project

This Chapter includes an assessment of the potential environmental and social impacts that are expected from the project activities in the southern part during different stages. It measures the potential impacts on the various explored environmental and social parameters and will assess the nature and severity of the impacts.

<u>This Chapter is divided into:</u>

6A: Environmental Impacts and Proposed Mitigation Measures for the Southern Section of the Project
and

6B Social Impacts and Proposed Mitigation Measures for the Southern Section of the Project

CHAPTER 7: Environmental and Social Impacts And Proposed Mitigation Measures for the Northern Section of the Project

This Chapter includes an assessment of the potential environmental and social impacts that are expected from the project activities in the northern part during different stages. It measures the potential impacts on the various explored environmental and social parameters and will assess the nature and severity of the impacts.

<u>This Chapter is divided into:</u>

7A: Environmental Impacts and Proposed Mitigation Measures for the Southern Section of the Project

and

7B: Social Impacts and Proposed Mitigation Measures for the Southern Section of the Project

Chapter 8: Analysis of Alternatives

The Chapter on the alternatives analysis studies the various long term project alternatives and assess their environmental and social implications in order to decide the most feasible alternatives from environmental and social prospective. It also examines the "no alternative" scenario

Chapter 9: Environmental and Social Management and Monitoring Plan

Based on the assessed impacts on Chapters 6 and 7, this Chapter of the report presents the various mitigation measures to deal with the negative environmental and social impacts of high and medium significance. It sets comprehensive management plan for the mitigation measure implementation including monitoring and institutional management plan.

Chapter 10: Stakeholders Consultations

Chapter 10 includes documentation for the process of stakeholders consultation along the ESIA cycle and in particular during the scoping and upon drafting the ESIA results.

CHAPTER 2 THE ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT METHODOLOGY

CHAPTER 2 THE ENVIRONMENTAL AND SOCIAL IMPACTS ASSESSMENT METHODOLOGY

2.1 Secondary Data Collection

To prepare the ESIA and the RAP, the Consultant has employed a participatory bottom up approach that depended on a diverse range of tools to serve the objectives of the various parts of the ESIA.

The Consultant accessed large amounts of quantitative and qualitative information from various primary and secondary sources. Secondary data collection involved the review of information in previous reports and studies to obtain background data about environmental and socio-economic characteristics of GS.

Literature review also included consulting web-based resources. The secondary information helped in assessing:

- The environmental and socio-economic baselines of GS in general and the targeted sites for the long term developments related to GSWMP in particular.
- The project background, description, elements and various proposed scenarios.
- Baseline assessment for the existing SWM systems in place (equipment, resources, institutional roles, operation systems)
- The Palestinian legislation and the WB safeguard policies related to the project.
- The institutional and organizational framework relevant to the project.
- Environmental and social standards and guidelines for related environmental and social issues.
- Previous experiences of relevance to the project.

The FS report was one of the main sources of information to help the ESIA Consultant in obtaining baseline information as well as project specific information. Additional site/field investigation tools were also employed in order to collect information primarily.

2.2 Primary Data Collection

In addition to the literature review, structured site visits were undertaken to collect primary data directly from stakeholders in order to garner their perceptions about the project's predicted impacts. The main tasks and issues covered through the site visits and stakeholder consultations are:

- Environmental and social baseline and current situation.
- Stakeholders' perceptions of the project and the anticipated impacts.
- Stakeholders views and recommendations on the mitigation of predicted negative impacts.
- Roles and responsibilities associated with the Environmental and Social Mitigation Plan (ESMP).

The Consultant has identified and targeted key six groups of stakeholders, these groups include:

- Local communities including services' beneficiaries.
- Local Communities near transfer or landfill stations.
- Workers who work officially in the services provision.
- Institutions in charge of the provision of the services (including governmental, semi-governmental and non-governmental).
- Informal sector (scavengers and sorted material traders and manufacturers)
- Landowners of the intended landfill stations who are also farmers and potential users of compost.

The primary data collection method involved employing a number of qualitative and quantitative tools. The most important tools could be summarized as follows:

2.2.1 Structured Questionnaire

A structured questionnaire was designed, tested and applied in the field to collect quantitative data on the status of the current situation of SWM and communities views on the services quality, service providers, practices, service fees, suggested developments and willingness and affordability to pay for an improved level of service. The questionnaire also investigated community view on the suggested institutions to manage the improved system and community awareness needs and local communities' recommendations for the appropriate awareness raising tools. The Arabic survey questionnaire is attached in Annex 2-a.

Six communities were purposively selected to represent different socio economic settings in GS. The Consultant has identified a set of criteria relevant to the study objectives and can reflect the overall view on SWM issues in GS. The following criteria were used as basis for selecting the surveyed communities:

- Economic status
- Refugee status
- Population density
- Urbanization
- Remoteness of the targeted areas

In total 300 respondents were surveyed in the six localities. 50 respondents were randomly selected in each locality and this is the minimum number that can reflect the statistical variation within the selected community and suit the available time and resources.

Figure 2.1: Interviewing one of the local workshops in Abasan Al Kabeera

Figure 2.2: Interviewing one of the ladies in Tal El Sultan

Box 2.1 The key characteristics of the survey targeted areas

Southern Rimal neighborhood is located in Gaza city and characterized by high living standard, low population density. According to MoLG, Southern Rimal is classified as "A" residence area. Solid waste is managed by the Municipality of Gaza.

AL Zaitoun neighborhood is highly populated area in Gaza strip and classified as c residence area. Al Zaitoun is also characterized by poor infrastructure, very low level of public service, and low living standard. Solid waste is managed by Municipality of Gaza.

Um Alnasser Village : is a remote area in the northern Governorate with high poverty level and low population density. Um Alnasser village is located close to Beit Lahia existing waste storage site. The solid waste services are provided by Solid Waste Management Council, North Area.

AL Buraij Refugee Camp: is highly populated refugee camp which is served by UNRWA.

Tal Al Sultan neighborhood: is relatively newly established neighborhood in Rafah with very good urban planning. The services provision is shared between Rafah Municipality and UNRWA. The residential gathering is located near Tal El Sultan waste storage site. .

Abbasan Al Kabeera: is a remote area in Khan Younes Governorate with relatively low population density. The area is very well organized and living standard is moderate. The services are provided by Abbassan Municipality.

The data collection team consists of three qualified social surveyors who were trained on applying the designed questionnaire. The team was supervised by the team leader on a daily basis. Data was entered using Excel and analyzed using SPSS. Box 2.2 below presents the key characteristics of the survey sample.

Box 2.2: Key Characteristics of the Survey Sample

Survey Sample Characteristics:

	Number of respondents	% of the survey sample
Gender		
Male	281	93.7
Female	19	6.37
Age group		
Below 40 years	185	61.6
Between 40 and 60	96	32
Above 60 years	19	6.4
Educational Level		
Illiterate	11	3.7
Primary education	32	10.7
Preparatory education	50	16.7
Secondary education	98	32.6
University degree	105	35
Post graduate studies	4	1.3
Economic Activity		
Small business	35	11.7
Unemployed	84	28
Vocational activities	33	11
Housewife	12	4
Student	17	5.7
Worker	31	10.37
Retired	8	2.7
Governmental Officer	80	26.6
Average family monthly income		
Less than NIS 1000	148	49.3
From NIS 1000 to NIS 2000	86	28.7
From NIS 2000 to NIS 3000	43	14.3
From NIS 3000 to NIS 4000	15	5
More than NIS 4000	8	2.7
Family size		
Less than 4 members/family	54	18
5 to 9 members/family	169	56
10 members and more by family	77	26

2.2.2 Focus Group Discussions (FGD)

The team has conducted six focus group discussions in the same localities to verify and to further investigate the survey quantitative results in a qualitative in-depth manner. Additionally, a seventh FGD was conducted in El Yarmouk Gaza City. The Consultant has designed guidelines/checklists to be used during facilitating the discussions. The FGD covered the same issues of the survey, more specifically:

- Community views on SW services quality,
- Payment issues (amount and regularity), Suggested improvements,
- Willingness to pay (WTP),
- Suggested managing institutions,
- Awareness needs and appropriate approaches,
- Views on the nearby transfer station/disposal sites10

Figure 2.3: Men FGD in Um Alnasser **Village**

Figure 2.4: Mixed FGD for young men and women, El Yarmouk

Box 2.3 below presents details about the conducted FGDs including the targeted locality, gender structure and hosting Community Based Organizations (CBOs).

Box 2.3 Information about FGDs Hosting CBOs and Sample Characteristics

Focus Group Characteristics

Locality	**Hosting CBO**
Tal Al sultan	Handicapped Association
Abbassan Al Kabeera	Palestinian Center for Social Improvement
Al Buraij refugee camp	Al Buraij Center for Social Rehabilitation
Al Zaytoon	Eastern Gaza Society for Families Improvement
Southern Rimal	Universal Gaza
Um Alnasser village	Um Alnasser Village Rehabilitation and Development Society

10 This aspect was only covered where applicable. The issue was raised in 3 out of the seven FGDs, namely (Tal Al sultan, Um Alnasser village and Al Yarmook)

Al Yarmook	Falesten Al Ghad Association

Target areas	Numbers		Total
	Males	Females	
El Yarmouk	16	2	18
Abasan Al Kabeera	3	7	10
Al Buraij Camp	--	15	15
Tal El Sultan	17	--	17
Al Zytoon	9	14	23
Bedwin Village	18	--	18
Al Remal	9	--	9
Total	**72**	**38**	**110**
%	**65.5**	**34.5**	**100**

Target areas	Average age	
	Males	Females
El Yarmouk	30	25
Abasan Al Kabeera	55	40
Al Buraij Camp	--	42
Tal El Sultan	38	--
Al Zytoon	35	38
Bedwin Village	40	--
Al Remal	40	--

2.2.3 Semi Structured Interviews (SSI) and Informal/ Unstructured Interviews

The SSIs allowed for interviewing 2: 3 individuals from similar social groups/affiliation. The tool was flexible to accommodate diverse type of questions including closed an open ended questions. SSIs were adapted with various institutions representatives including but not limited to representatives of the municipalities, Joint Service Councils (JSC), the Environmental Quality Authority (EQA), UNRWA, COOPI, The Job Creation Program (JCP). Lists of the interviewed stakeholders is include in Annex 2-b.

With specific type of stakeholders with special characteristics, informal interviews proved to be the most efficient tool. To learn about the complexity and livelihoods dynamics and the level of dependency of the informal sector groups on landfills and transfer station, an informal approach was needed to ease the process and make these groups less skeptical about the surveyors/Consultant. The study objectives were simplified and transparently presented to these groups and reference was made to the social analysis as a tool to protect the interest of potentially affected groups from the project. The informal waste pickers whose livelihoods are primarily dependant on sorting and selling recyclable materials were met near the landfills and transfer stations.. The interviews covered issues related to the working environment, income, safety issues and the potential impact of closing the transfer stations on the livelihoods of the waste pickers.

Around 10 unstructured interviews have been conducted with the informal waste pickers in different spots across GS, most importantly Johr al Deek landfill, Al Yarmook transfer station and the northern transfer station. Additionally, waste pickers from street containers and the owners of small shops specialized in purchasing the collected recyclables were also interviewed

Figure 2.5: Interviewing waste pickers in Northern Gaza

Figure 2.6: Interviewing waste pickers in Al Yarmouk transfer station, Gaza

Scanned copy of the registration forms used during some of the FGD and SSI are attached in Annex 2-c and guidelines/checklists used for the SSIs are attached in Annex 2-d and FGDs transcripts are included in Annex 2-e.

The findings of the social surveys conducted as part of the ESIA report and the DAWPS of the Feasibility Study were compared to the extent possible along the presentation of relevant sections. However, the difference between the methodology adapted by the ESIA surveys and those of the DAWPS suggests that the comparison should be made cautiously. The main reasons for this are as follows:

- The ESIA surveys used multiple tools, as explained above, and triangulation exercises (cross-examinations) were employed in order to confirm the results of the various tools. This resulted in a possibility of presenting quantitative results supported with in-depth and qualitative analysis as part of the ESIA. However, the DAWPS used the FGD method and worked to deploy structured questionnaire within the same groups. In the case of the DAWPS, there is a fear that the revealed opinions of the interviewees could have been affected by the fact that they were operating within a group that involve power relations of various kinds. This confirms the challenges in comparing the results of the two sets of surveys.
- The sample size of the ESIA surveys is considerably larger (a minimum of 500 interviewees were reached and consulted using various tools against 117 respondents in the DAWPS.
- Phrasing the questions and structuring the questions of the structured survey as part of the ESIA and the questions of the DAWPS also were largely variant. The questions of the ESIA surveys were all asked as open questions and the questionnaires were administered by field surveyors. The case with the DAWPS was different where respondents filled the

questionnaires which were mostly of closed questions with specific answers that respondents had to answer from.

- Although the surveys as part of both the studies included WTP surveys, the way questions phrased and the issues investigated under each of the survey also suggested challenges in comparing the results. The WTP survey as part of the ESIA asked respondent about their willingness to pay more fees in order to receive improved SWM services. It also asked about the specific amount that each respondent is willing to pay. The DAWPS seemed more to be focusing on assessing respondents' acceptance for the cost recovery and service fees principles by asking: "What is your opinion about the principle that the customers have to pay for the costs that the local authority makes for the collection, transport and disposal of solid waste in Gaza?".

2.3 Additional Consultation Activities

It is worth noting that the stakeholders' consultation activities were not limited to the activities mentioned above. Further public consultations through plenary events have been conducted. This includes a scoping consultation session with the main objective of reviewing the ESIA scope of work and ToRs with stakeholders and obtaining stakeholders views on the issues that need special attention during the field investigations and the analysis. Additionally , two plenary public consultation sessions were organized after drafting the ESIA in order to validate and review the study findings with the relevant stakeholders and potentially affected groups by the project. The results of the public consultations have been included in the final ESIA. The various consultation and participatory activities largely contributed to enriching and validating the findings of this ESIA.

2.4 Field Measurements

Field measurements for ambient air quality and noise are important in order to assess the current environmental conditions at the project's site.

The Consultant has performed the field measurements based on the final layout of El-Fukhary and Johr al Deek landfill sites and the locations of the transfer stations included in the FS. Measurements were performed at a point adjacent to the landfill and at additional point located at the nearest sensitive receptor.

2.5 Groundwater Modeling

The Groundwater Modeling System Software (GMS), and the available data were used to design and implement GMS 3D saturated GW model for the two landfill areas at El-Fukhary and Johr al Deek. Based upon the collected information, a calibration and verification of the groundwater hydraulic model was conducted and the developed model was implemented via scenarios dealing with rainfall intensity and volume of leachate. The developed model was used to evaluate El-Fukhary and Johr al Deek landfill areas including the following:

- Studying the impact of the landfill leachate on the quality of groundwater;
- Studying the rate of migration of leachate and contaminants, their timing and duration, in the landfill vicinity at El-Fukhary and Johr al Deek for both chloride and nitrate.

2.6 Strengths and Weaknesses of the adopted Methodology

The applied methodology involved a number of strengths that positively affected the quality of the gathered information and was highly informative for the ESIA process. The most important strength is that the applied methodology enables the Consultant to formulate the ESIA and the ESMP in the most practical manner driven from the adopted participatory approach during the ESIA preparation. The practical application of the ESMP in the future is expected to be efficient because the ESIA process has already enhanced the stakeholders' sense of ownership over the project and the project is a demand-driven intervention that local communities are ready to accept and contribute to.

The process involved active participation from CBOs. The FGDs have been facilitated and hosted by local CBOs. This secured convenient venues for the FGDs' participants and allowed the Consultants and survey team to engage the CBOs members and introduce the project to them.

The tools were carefully selected to suit the type of interviewed stakeholders and the issues that need to be investigated. For instance, informal interviews were conducted with the waste pickers during their work time, while tools like the structured questionnaire which included willingness to pay questions were selected to target the mostly men groups who tend more to be the decision makers on financial and expenditure related issues on the household level.

Based on the Consultant and research team previous experience and knowledge of the local settings, the survey and the FGDs samples were carefully selected to capture the various specificities of communities in GS. It also gave special attention to the inclusion of special groups like those located near transfer stations and poor population in refugees' camps. The selection of the six representative communities has been made against pre-determined set of criteria as explained above. Despite the relative limited size of the survey sample, the sample characteristics are generally consistent with the general socioeconomic characteristics of GS communities as will be explained in more details on the Baseline Chapter. This includes characteristics related to education, economic conditions and poverty status, economic activities …etc. Moreover, the results of the survey pretest and the stated answers did not reflect any significant variation within the selected interviewees inside each of the neighborhoods. In that sense, the Consultant view was to maintain a relatively small size for the quantitative survey since it was anticipated that an increased number of questionnaires will not change the survey results. Complementary qualitative tools were employed to capture in-depth understanding of perception and views of various stakeholders groups.

Due to the nature of issues covered by the structured survey sample including the WTP questions, the Consultant intentionally widened the participation of men in the survey sample. Accordingly, men were dominating the structured survey sample. However, gender balance was attained by more engagement for women in the FGDs and other tools.

Multiple data analysis techniques were used in order to present the findings informatively. A combination of computer software for the analysis of quantitative data as well as manual compilation of transcripts and analysis of qualitative data were used. The presentation of the survey findings combined the various tools results.

Mitigating the impact of dumpsites immediate closure does not primarily fall within the scope of the ESIA for the long term. Accordingly the potential negative impacts on these groups should be examined as part of the ESIA for the short term activities. However and despite this fact, the Consultant was keen on studying the informal sector as a key vulnerable social group that operates within the current poverty and unsecured context of GS and has strong relation to the project.

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CHAPTER 3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

CHAPTER 3 POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This chapter includes a summary of the laws, regulations and institutional setup relevant to environmental management in GS, with particular focus on SWM. National and international guidelines for environmental assessment, landfill site selection criteria and technical design requirements were reviewed and key points are presented. A review of the most pertinent regulations and standards governing health and safety has been included. The section also includes a review of environmental quality standards for ambient air, drinking water, and limit values for liquid and gaseous emissions.

3.1 Legal Framework

The following is a summary of the laws and regulations reviewed by the Consultant in the course of conducting the current ESIA:

- Local Council Law (1), 1997
- Palestinian Environmental Law 7, 1999
- Solid Waste Management Regulations , 2004
- Joint Service Council (JSC) Regulations, 2006
- Palestinian Reform and Development Plan (2008 -2010)
- National Strategy for Solid Waste Management in the Palestinian Territory, 2010
- Laws relevant to private sector participation in the solid waste sector
- Land Ownership Law 3, 2011
- Palestinian Water Law
- Regulations for Groundwater Pollution Control
- Guidelines for Wastewater Reuse in the Gaza Strip, Palestine 2002
- Water Pollution Control System

3.1.1 Local Council Law, 1997

The old municipalities law – British mandate law (1) 1934 was implicitly cancelled. The local council law issued in 1997 has replaced the old law and is currently the prevailing council law. According to the new law, **waste collection and disposal are** the responsibility of local councils, which was clearly stated as follows:

- Waste collection from streets, houses and public areas, transportation and regulated disposal is the responsibility of the local council.
- Protection measures for safe public health shall also be taken by the council, this includes the implementation of an efficient waste collection system.

The law provides for municipalities the possibility to form JSCs through which they can join forces and collaborate onto the delivery of municipal services including collection and disposal. Regulations to give effect to this law were adopted the following year. Municipalities have since created JSCs for the purpose of facilitating solid waste management; a profile of this initiative is provided as a case study in Volume 6 of the Regional Guidelines prepared under the METAP Regional Solid Waste Management Project.

3.1.2 Palestinian Environmental law 7, 1999

The Environmental Law of Palestine (PEL) includes a framework for environmental protection including SWM and sets roles and responsibilities for the EQA as follows:

- To promote environmental awareness in schools, universities and clubs and encourages volunteer work aiming to protect t he environment (article 4)
- To ensure the right of every individual to live in a sound and clean environment and stress on resource conservation and sustainable development including the protection of water resources, soil quality, flora and fauna (Article 5)
- To implement a land use policy which ensures the protection of natural resources and areas with special habitats (Article 6)
- To build up a national solid waste management strategy and takes responsibility of monitoring its implementation (Article 7)
- To minimize waste generation and promote recycling and reuse. At the bottom of the waste hierarchy, waste shall be disposed of in regulated and properly selected sites (Articles 8 to 10). However, no regulations or instructions on how to implement these measures are issued to date.
- To ensure a safe disposal of hazardous wastes and to prohibit the import of such waste to Palestine (Articles 11 to 13). However, no waste acceptance criteria has been developed for hazardous wastes, no identification list for hazardous wastes has been also identified.
- To prohibit the incineration of garbage and solid waste unless performed according to Ministry's instructions and standards (Articles 23).
- Noise shall be controlled as stated in article 26.
- To prohibit the discharge of any solid or liquid or other substance unless conforming with the regulations (Article 30).

Part IV of the law gives the authority to EQA to periodically inspect and to acquire all needed information and collect all necessary samples. EQA has the authority to apply penalties on projects not complying with the laws/regulations.

3.1.3 Regulations which complement the Environmental Law

Solid Waste Management Regulations (2004)

The Solid Waste Management Regulations, issued by the EQA in 2004, are the first trial to develop regulations that aims to complement the Environmental Law. These include the following key guidelines related to waste collection:

- MSW collection is the responsibility of municipalities and village councils, as well as ensuring that this the process does not have health and/or environmental implications.
- It is prohibited to dispose of waste outside the street containers designated for this purpose. These containers should be closed and manufactured out of a metallic or similar material. The number of these containers should be sufficient and waste has to be collected at least three times per week in urban areas.
- It is the responsibility of industrial, commercial and agricultural waste generators to arrange for the collection and transport of their wastes to the designated treatment/disposal areas. This has to be pre-arranged with the authorities.

The regulations also include an article about classification of the different waste streams into MSW, construction and demolition waste, and other waste streams depending on the generating industry

Key guidelines for landfills included in the regulations

In general , the construction of a waste landfill is subjected to an environmental approval according to the conditions and instructions of Environmental Impact Assessment Policy. The co-mixing of hazardous and non hazardous wastes is prohibited. And the different cells of the landfill should be classified according to one of the following types:

- Inert landfills;
- Non hazardous landfills;
- Hazardous landfills.

The landfill operator shall be responsible for the landfill for a period of 20 years following its closure. Additional technical considerations related to the site selection and landfill design include the following:

- The site should be fenced, and located at a considerable distance from residential or commercial areas – no distance has been indicated.
- The landfill site should be lined with a protective insulation layer in order to protect groundwater.
- A leachate collection system should be constructed.
- The site should have sufficient quantity of soil which will be needed for daily covering the waste.
- Regular inspection of the monitoring wells.
- The landfill operator should prepare a waste register.

Joint Service Council (JSC) Regulations, 2006

The JSC regulations were issued by the MoLG in 2006, they set the managerial system and authorities for the JSCs. The work of the JSC shall be organized by the Minister of Local Government in coordination with the councils of concern.

3.1.4 Palestinian Reform and Development Plan (2008-2010)

The Palestinian Reform and Development Plan 2008 - 2010 (PRDP) is a national plan which sets out Palestinian Authority medium term agenda for Palestinian reform and development. Among the primary objectives set out in the PRDP is "strengthen public institutions" which is of support to "good governance" as one of PA national goals. This is to increase the capacity of public sector organizations in delivering basic health services which will have a direct positive effect on the daily life of the citizens as has been stated by PRDP. This is also in line with "strengthen local government" policy and objective set out in PRDP. That is work with local government unit to empower and increase the accountability and effectiveness through intensive capacity building.

The Palestinian National Policy Agenda (PNPA) has conservation and recycling of natural resources including SW as one of its objectives. This is under "develop physical capital" objective and is stated as "Equitable, efficient and environmentally friendly management of solid waste". The other PNPA objective of developing affordable and regional SWM is listed in the development budget resources. The main two objectives and targets in this regard stated in PRDP are complete construction of a new sanitary landfill in the West Bank and increase number of SW tons disposed of in regional sanitary landfills.

3.1.5 National Strategy for Solid Waste Management in the Palestinian Territory, 2010

The National Strategy for Solid Management in the Palestinian Territory. was endorsed by the Cabinet in May 2010 and represents the first cross-sectoral strategy for solid waste in Palestine. The strategy aims at establishing the framework to all decisions, programs, activities, and mid-term investment plans to develop the solid waste sector in Palestine.

At institutional level, the strategy confirmed the urgent need to address major issues like:

- Ineffective legislative framework
- Lack of standards for various stages of SWM
- No division of tasks and responsibilities among various stakeholders
- Lack of resources (human, financial, organizational capacity) in the instates involving in SWM
- No unified system to manage data related to SWM
- Limited participation of the private sector
- Insufficient public awareness in SWM issues and weakness of participation.

Among the strategy's policies are the following:

Policy (1) – Strategic Objective 1: Development and update of the legislative framework supporting integrated SWM

Policy (2) – Strategic Objective 1: Strengthen the organizational framework of national institutions and supporting their complementary roles in SWM.

Policy (3) – Strategic Objective 2: Establishing an integrated, coordinated, and sustainable institutional approach to support institutional capacity building in the SWM sector.

Policy (4) – Strategic Objective 3 : Developing the current management systems for SW collection and transport , in order to improve the quality and effectiveness of services and its availability to all citizens
Policy (5) – Strategic Objective 3 : Safe and efficient disposal of SW in regional sanitary landfills servicing all communities

Policy (6) is concerned with diverting waste from landfills through waste minimisation, reuse and recycling. The MoLG shall play a vital role as the key executing party for achieving most of the strategic objectives. This shall be considered in any new institutional set-up for SWM in GS. The municipalities in GS are the main parties responsible for the SWM at all stages including primary collection, secondary collection, and landfill management.

Policy (7) – Strategic Objective 3 : Prohibiting the use of random dump sites and closing or rehabilitating the existing sites to limit their environmental and health risks.

Monitoring the implementation of the solid waste management strategy has been assigned to the national team for solid waste management by a Ministerial Council Cabinet Decision in 16 May 2010. This is the steering committee which develops the solid waste management strategy and is chaired by the Minister of Local Government.
Policy (14) of the strategy promotes private sector participation in SWM projects

3.1.6 Laws Relevant to Private Sector Participation in the Solid Waste Sector

The Investment Law: As stipulated in this law, financial incentives are given in the form of tax reductions to companies which have a capital exceeding 100,000 USD. Solid waste management projects may also benefit from these tax reductions but upon approval from the Ministerial Cabinet. This approval process is not required from other projects.

The Local Authority Law: The law gives the right for the Local Government Units (LGUs) to sign contracts with private sectors to participate in SWM projects but only for a period of less than three years. Projects of more than three years require an approval from the Minister of Local Government.

3.1.7 Laws and Regulations Relevant to Water Pollution Control

The potential impact of landfills on water resources is recognized. This could be the result of uncontrolled leaching of contaminants from the body of the landfill or the discharge of treated landfill leachates. Within this context, the following national laws and regulations were reviewed:

- Palestinian Water Law
- Regulations for Groundwater Pollution Control
- Guidelines for Wastewater Reuse in the Gaza Strip, Palestine 2002
- Water Pollution Control System

An important aspect of the Regulations for Groundwater Pollution Control was that EQA should determine head protection areas surrounding wells and divide them into three areas classified according to duration of impact. Activities like solid waste disposal , storage of hazardous wastes and waste handling are among the activities being restricted by the regulations within the different zones of a well head protection area.

In the Guidelines for Wastewater Reuse in the GS, it is stated that the Palestinian Water Authority (PWA) is responsible for the monitoring of the quality and quantity of treated wastewater. *Whether this includes treated landfill leachates or not was not clear*. Producing standards for the conservation and protection of the environment are the responsibility of EQA including the standards for reuse and discharge of treated wastewater.

3.1.8 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 considers all the regulations and procedures related to the acquisition of private land for the purpose of public interest projects. It defines the meaning of public interest projects and presents the entitlements 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.

3.1.9 Palestinian Labour Law number 7, 2000 and supplementary bylaws

3.2 Project Approval Requirements

Article 45 of the PEL; "The Ministry (EQA), in coordination with the competent agencies, shall set standards to determine which projects and fields shall be subject to the environmental impact assessment studies. It shall also prepare lists of these projects and set the rules and procedures of the environmental impact assessment".

Article 47 of the PEL states that; "The Ministry (EQA), in coordination with the competent agencies, shall determine the activities and projects that have to obtain an environmental approval before being licensed. This includes the projects that are allowed to be established in the restricted areas".

According to the PEL and the Palestinian Environmental Assessment Policy (PEAP) which was approved through resolution No: 27-23/4/2000, the project proponent must first obtain an initial approval from the appropriate ministry or local planning committee. The proponent then submits an application for environmental approval to the EQA. The EQA notifies the appropriate permitting authorities that an application for environmental approval has been received. The application should also list what environmental and other permits must be obtained and complied with, indicate how the expected conditions of these permits will be fulfilled, and include a signed statement by the proponent that these conditions will be fulfilled.

Based on the application submitted to the EQA, screening criteria are used to determine whether an initial environmental evaluation (IEE) would be sufficient for the project of concern or whether a comprehensive EIA is required. *Under these screening criteria, the GSWMP falls under the category of major projects and therefore it is required to submit an EIA.*

An Inter-Ministerial Committie is formed to approve the EIA, following which an environmental clearance is given to the project. The EQA is expected to liaise with the institutions of concern with respect to the project.

Role of the EA Inter-Ministerial committee in EIA approval

The project owner must first seek an initial approval from the competent authority on the proposed project.

- After obtaining initial approval from the competent authority, the project owner must apply for an environmental approval from the MEnA branch offices.
- An initial environmental assessment shall be conducted in order to approve/reject the proposed location for the project.
- The project shall be compared against the newly proposed classification systems. Then it is determined whether or not the project will need an initial environmental assessment or a full EIA study
- For an initial environmental assessment, the feedback shall be given in a period of 14 days. For a full EIA study , the EIA report shall be revised by the branch office, environmental protection department, environmental assessment department, enviroenmtnal approval department. The feedback shall be given within 21 days.
- Upon approval of the EIA study, copies of the report will be distributed on the environmental assessment committee in the different ministries and relevant authorities. The EA committee shall discuss the EIA report and give recommendations
- The recommendations of the inter-ministerial EA committee shall be addressed in a period of maximum 28 days. The EA cvomiitee will be review again the final version and send feedback in period not exceeding 21 days.

An Environmental Approval may specify:

- Required measures to mitigate adverse environmental impacts or capture potential environmental benefits, including a compliance schedule. This may include land compensation measures issued by the Higher Planning Council after reviewing the project. The procedures involve the Ministry of Finance , the MoLG and municipalities of concern.
- Measures that the proponent must implement in order to comply with relevant standards and requirements.

- Monitoring and reporting duties of the proponent.

The project proponent shall express the commitment to the standards and requirements for the protection of the environment and to apply all the required mitigation measures addressed in the EIA. He shall express the legal commitment towards the EIA.

Regarding landfill closure, the Solid Waste Management Regulations issued by the EQA in 2004 state that the landfill operator is responsible for monitoring the landfill for a minimum period of twenty years after landfill closure. Monitoring includes gas and leachate analysis. It is also the operator's responsibility to report any negative impacts identified during monitoring and he shall implement proposed mitigation measures as stated by the EQA.

3.3 International Environmental Assessment Guidelines

The following international assessment guidelines were considered in carrying out the present ESIA:

- EC directive 85/337
- EC directive 97/11/EC
- World Bank Operational Policy/Bank Procedures/Good practices (OP/BP/GP 4.01) and associated documents.

According to the WB Operational Policy on Environmental assessment (OP 4.01), an environmental and social category is assigned to an investment project after appraisal and before public disclosure during the International Finance Corporation (IFC) project/investment cycle. Projects are assigned a category of A, B, or C, in descending order of environmental and social sensitivity. The GS SWMP falls under the environmental Category A which includes landfill subprojects. These types of projects require a detailed ESIA to be conducted.

According to the OP 4.01, project-specific ESIA should include the following:

- Environmental and social baseline describing the existing environmental and social conditions prior to the project being constructed and operating.
- Identification of potential environmental and social impacts resulting from the project of concern.
- Comparison of alternatives sites, scenarios, technologies and designs.
- Mitigation Plan for potential impacts including monitoring.

3.4 World Bank Safeguard Policies and Guidelines

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

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

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

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

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

3.4.1 OP 4.12 - Involuntary Resettlement

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

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

- Involuntary resettlement should be **avoided where feasible, or minimized, exploring all viable alternative project designs**;
- Where it cannot be feasibly avoided, **resettlement activities should be conceived and executed as sustainable development programs**, providing sufficient investment resources to enable the displaced persons to share the project benefits. **Displaced persons should be meaningfully consulted and should have opportunities to participate** in planning and implementing resettlement programs and compensation measures; and,
- Displaced persons should be **assisted in improving their livelihoods and standards of living or at least in restoring them, in real terms, to pre-**

displacement levels or to levels prevailing prior to project implementation, whichever is higher.

The policy cover the involuntary taking of land resulting in relocation or loss of shelter, loss of or access to productive assets, or loss of sources of income or means of livelihood, whether or not the affected persons must move to another location. It also covers the involuntary restriction of access to legally designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

OP 4.12 will likely be triggered as part of the long term activities planned under the GSWMP. The planned expansion of the Rafah and Johr al Deek landfills will require acquisition of privately owned land. Fair compensations for the land owners should be provided. Under this consultancy assignment, a RAP or an Abbreviated Resettlement Plan (ARP) will be developed to set a clear compensation plan for the potential affected persons (PAPs) from the planned development. According to OP 4.12, the RAP/ARP is the most important resettlement instrument that will be applied should IR be undertaken. RAP/ARP should assess the number of PAPs, propose alternative locations for the sub-projects if possible, identify the eligibility criteria, include provisions for compensation and assistance, and address the means by which the project monitoring and evaluation will take place to ensure that the PAPs receive their compensation and that their grievances are heard and addressed. The mitigation measures and compensation policies proposed in the RAP shall be disclosed to the PAPs for feedback and comments.

3.4.2 OP 17.50 - Disclosure

WB policy OP 17.50 on Disclosure is also relevant to the project. This policy details the Bank's requirements for making operational information available to the public. The Bank reaffirms its recognition and endorsement of the fundamental importance of transparency and accountability to the development process. In addition, timely dissemination of information to local groups affected by the projects and programs supported by the Bank, including non-governmental organizations, is essential for the effective implementation and sustainability of projects.

3.4.3 OP 4.04 - Natural Habitats

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

3.4.4 OPN 11.03 – Cultural Property

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

3.5 IFC standards

In addition to the world bank safeguard policies, the different IFC standards are a key reference which should be considered and used as guidance wherever relevant. Below is a summary of the relevant IFC standards:

3.5.1 IFC performance standards:

Listed below are the eight Performance Standards which establish standards that the client is required to meet during the the period of an IFC investment (IFC , 2012):

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

3.5.2 IFC General EHS guidelines

The Environmental, Health, and Safety (EHS) Guidelines are technical reference documents with general industry-specific examples of Good International Industry Practice (GIIP). These EHS guidelines are required to be applied whenever a World Bank Group member is involved in a project. The EHS Guidelines focuses on the below four sectors:

1. Environmental – The first chapter of the EHS is dedicated to ensure a project's environmental impact is minimized. The environmental section focuses on Air emissions and Air Quality, Energy Conversation, Wastewater and Ambient Water Quality, Water Conservation, Hazardous Materials Management, Waste Management, Noise, and Contaminated Land.
2. Occupational Health and Safety - These guidelines are in place to ensure all reasonable precautions are implemented to protect the health and safety of workers. The chapter examines: General Facility Design and Operation, Communication and Training, Physical hazards, Chemical Hazards, Biological Hazards, Radiological Hazards, personal Protective Equipment, Special hazard Environments, and Monitoring.
3. Community Health and Safety – This section complements the previous two chapters and addresses key aspects pertaining to project tasks outside of a traditional project's scope. The chapter focuses on: Water Quality and Availability, Structural Safety of Project Infrastructure, Life and Fire Safety, Traffic Safety, Transportation of Hazardous Materials, Disease Prevention, and Emergency Preparedness and Response.

4. Construction and Decommissioning – The final chapter details preventative and control measures to ensure community health and safety impacts that may occur at any point during the project's life (Pre, during, and post) are minimized. The chapter goes in further detail in the guidelines presented in the prior three chapters.

3.5.3 IFC EHS guidelines for waste management facilities:

These IFC guidelines (IFC, 2007) concerns the design, construction and operation of non hazardous/hazardous waste facilities. The guidelines cover the following aspects:

- Project siting
- Erosion and sediment
- Waste collection, handling and transposrt
- General environmental requirements such as impacts to air and water resources, gas collection systems, leachate collection systems, landfill depth, buffer zonto water resources
- Guidance on project operations
- Employee health and safety
- Training requirements
- Record keeping and monitoring

3.6 European Union (EU) Environmental Policy

The EU's environmental priorities for the period up to 2010 were set in the Sixth Environment Action Programme, July 2002. Priority action has included climate change, nature and biodiversity, the environment and health, and the management of natural resources and waste. The precautionary and the "polluter pays" principles guide the EU environment policy. General public participation in environmental projects is also a key part of the EU policy.

3.7 International Agreements involving PNA

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

3.8 Standards/Guidelines

The following national and international standards and guidelines were reviewed during the course of conducting the current ESIA:

- Palestinian standards for landfill site selection.
- WB guidelines for landfill site selection.
- EU Landfill Directive (1999/31/EC).
- IFC Occupational Health and Safety Guidelines.
- World Health Organization (WHO) Guidelines for Air and Water Quality.
- WB Guidelines Effluent Discharge Requirements.
- European Commission Environmental Standards.
- Israeli Environmental Standards.
- Egyptian Environmental Law Limit Values for Ambient Air Quality.

3.8.1 Landfill Site Selection Criteria

The review has included the Palestinian Guidelines on landfill site selection which are part of the Solid Waste Management Regulations issued by the EQA in 2004, as well as the WB Landfill Site Selection Criteria. Additional information were acquired from the EU Landfill Directive (1999/31/EC). The reviewed documents share a good deal of information and have tackled the following key points:

- A phased site selection criteria should be implemented, which includes an exclusion criteria followed by site short listing from which the preferred site should is selected.
- Other important considerations include :
  - Land use and land area requirements such as the availability of materials for daily cover of wastes.
  - Geology, hydrology and geology faults; Landfill not to be placed on regionally important aquifer of high vulnerability to contamination and not to be placed on geological faults.
  - Surface water.
  - Ecology.
  - Topography.
  - Site visibility.
  - Archeological heritage sites.
  - Airports; According to the recommendations of the International Civil Aviation Authority (ICAO). The potential hazard to aircraft due to bird strike should be assessed. In high risk areas and in order to prevent birds from feeding at landfills, the tipping area may be enclosed by a net or enclosure to limit bird incursions. The proper siting of landfills as not to be in air flight paths can reduce the risk of hazard near airports.
  - Meteorology; The direction and strength of wind should be identified
  - Traffic /access to the landfill site

3.8.2 Landfill Design Guidelines

The Solid Waste Management Regulations, issued by the EQA in 2004, include the following guidelines for landfills:

- Co-mixing of hazardous and non hazardous wastes is prohibited.
- The landfills should be classified according to one of the following types:

  - Inert landfills;
  - Non hazardous landfills;
  - Hazardous landfills.

According to the above, the landfills proposed to be constructed in the GSWMP should be classified as non hazardous waste landfills . National Waste Acceptance Criteria should be developed or international waste acceptance criteria shall be adopted such as the EU Landfill Waste Acceptance Criteria (Annex 3-b)

- The landfill should be sealed from the surrounding environment and a leachate collection system installed.
- The quality of groundwater due to potential leaching of contaminants of concern from the landfill waste should be monitored using existing or new wells in the vicinity of the landfill.
- Waste should be covered with soil on a daily basis.
- The landfill site should be selected at a considerable distance from households.
- Closure plans at the end of life should be put in place.

The national guidelines presented above were reviewed against the EU Landfill Directive (1999/31/EC) and found to fall under the umbrella of the directive. In summary , key points that should be considered when designing and constructing the landfill include 1) Landfill lining system; 2)side slopes; 3)leachate minimization and treatment; 4)gas management; 5)construction planning; and 6)operation procedures.

3.8.3 Ambient Air Quality Standards

Palestinian Standards for ambient air quality - adapted from the ESIA report for Khan Younis Wastewater Treatment Plant (WWTP) (UNDP/PAPP 2009) – was compared against the European Commission (EC) Standards, WHO Standards and the Egyptian Standards. The results are shown in Table 3.1. Regarding the Palestinian ambient air quality standard, the limits for the constitutients of potential concern are very close to the reference standards. The Consultant could not identify limits for stack emissions , which shall need to be developed. Also, the same applies to vehicle emissions.

Regarding the Palestinian standards for treated wastewater, the limits for the constitutients of potential concern are also very close to the reference standards. The only exception is the limit for Chlorides.

Table 3.1: National and international ambient air quality standards

Pollutant	Palestinian		European Commission		WHO		Egyptian	
	Concentration (µg/m3)	Averaging period	Concentration (µg/m3)	Averaging period	Concentration (µg/m3)	Averaging period	Concentration (µg/m3)	Averaging period
$PM_{2.5}$	-	-	25	1 year	25	24h	-	-
	-	-	-	-	10	1 year	-	-
PM_{10}	150	24h	50	24h	50	24h	150	24h
	70	1 year	40	1 year	20	1 year	70	1 year
SO_2	250	24h	350	1h	500	10 min	150	24h
	60	1 year	125	24h	125	24h	60	1 year
NO_2	400	1h	200	1h	200	1 h	400	1h
	100	1 year	40	1 year	40	1 year	150	24h
Pb	0.5	1 year	0.5	1 year	-	-	0.5	1 year
CO	30,000	1h	-	-	30,000	1h	30,000	1h
	10,000	8h	10,000	8h	10,000	8h	-	-
Benzene	-	-	5	1 year	-	-	-	-
Ozone	120	8h	120	8h	120	8h	120	8h
PAHs	-	-	1 ng/m^3	1 year	-	-	-	-
Formaldehyde	-	-	-	-	100	30 min	-	-

3.8.4 Noise Standards

Table 3.2 shows the Palestinian noise standards corresponding to areas of different activities, in the day and during the night (UNDP/PAPP 2009).

Table 3.2: Palestinian Outdoor Noise Standards

Type of place and activity	Maximum permissible noise (dBA) 7am – 8pm	Maximum permissible noise (dBA) 8pm – 7am
Rural, Schools, hospitals	40	30
Residential	50	40
Residential/commercial	55	45
Commercial	65	50
Industrial	75	65

3.8.5 Water Quality Standards

Table 3.3 shows the WHO standards for the maximum concentrations of heavy metals in drinking water.

Table 3.3: WHO Standards for heavy metal content in drinking water

Pollutant	WHO Standards
	Concentration (mg/l)
As	0.010
Cd	0.003
Cr	0.05
Ni	0.070
Hg	0.006
Cu	2
Pb	0.01
An	0.020
Se	0.040

3.8.6 Wastewater Discharge Limit Values

Palestinian Standards for Treated Wastewater Discharge (UNDP/PAPP 2009) were compared against the WB Guidelines for Effluent Discharge Requirements. The limit values were also compared with the required effluent quality set for for Khan Younis WWTP(UNDP/PAPP 2009). The results are shown in Table 3.3

Table 3.4: National and international standards for treated wastewater discharge

Pollutant	Palestinian Standards for Treated Wastewater		World Bank Guidelines for Effluent Discharge Requirements	Required Effluent Quality for Khan Younis WWTP
	Discharge to sea water at 500 m from shore (mg/l)	Discharge to aquifer through percolation (mg/l)	Concentration (mg/l)	Concentration (mg/l)
BOD5	60	40	30-50	<20
TSS	60	50	50	<15
N	-	-	10	<25
NH4-N	5	10	-	<10
NH3-N	25	15	10	<15
O&G	10	0	10	-
Phenol	1	0.002	0.5	-
P	5	15	5	-
F	-	-	20	-
Cl	-	600	0.2	-
CN	0.1	0.1	1 (free =1)	-
Coliform	Faecal Coliform <50,000 CFU/100ml	Faecal Coliform <1,000 CFU/100ml	400 MPN/100ml	Faecal Coliform <200 CFU/100ml
Ag	-	-	0.5	-
Al	5	1	0.2	-
As	-	-	0.1	-
Cd	0.01	0.01	0.1	-
Cr+6	-	-	0.1	-
Cr	0.5	0.05	0.5	-
Co	1	0.05	-	-
Cu	0.2	0.2	0.5	-
Fe	2	2	3.5	-
Hg	0.001	0.001	0.01	-
Ni	0.2	0.2	0.5	-
Pb	0.1	0.1	0.2	-
Zn	5	5	2	-
Se	0.02	0.02	-	-

3.9 Institutional Framework

Solid waste management service in the GS including primary and secondary waste collection, landfill management and monitoring are being performed under the authority or supervision of the MoLG which regulates and oversees local government performance represented by municipalities, village councils and JSCs; the MOPAD which is responsible for overall planning and development on a national and regional scale as well as coordinating with funding agencies; and the EQA responsible for environmental protection and monitoring major polluting activities. The United Nations Relief and Works Agency (UNRWA) as well as several NGOs are also key participants in the SWM services in GS.

In general the JSC - as in the case of North Gaza and the Middle Area - or the municipality if no JSC exist are responsible for the primary, secondary collection and landfill management. Individual municipalities also participate in primary collection with their own staff and resources since the services of the JSC may not be sufficient. A review of the different organizations involved in waste management in GS is presented in the following sections.

3.9.1 North Gaza Joint Service Council

The North Gaza JSC is responsible for the waste collection in Gaza North Governorate which includes the municipalities of Beit Hanoun, Jabalia , Beit Lahia. and Um Al Nasser Village. The population of Gaza North Governorate is around 300,000. The JSC was established in August, 2002 by a statue endorsed by the MoLG as a non-profitable public enterprise and started functioning since April 2004. The North Gaza JSC operates the following facilities:

a) The council headquarters and office at the service yard in Beit Lahia; and
b) Garage and workshop at the service yard in Beit Lahia.

Primary collection is performed using street containers, donkey-carts and small tractors with trailers the council contracts private firms to transfer solid wastes to Johr al Deek Landfill.

The North Gaza JSC Board includes the mayors of the municipalities and a supervisor from the MoLG, The organizational chart of the JSC is shown in Figure 3.1. In total, there are 222 workers in North Gaza JSC.

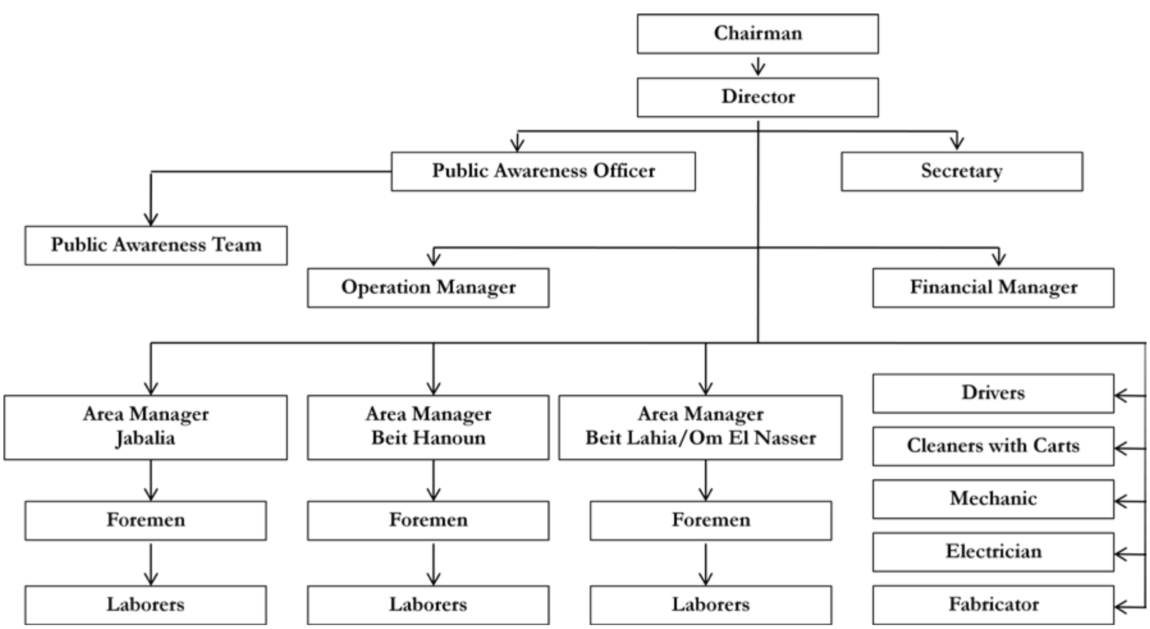


Figure 3.1: Organization Chart – North Gaza Joint Service Council (UNDP/PAPP 2011)

3.9.2 Gaza Municipality

Gaza Municipality manages waste in the Gaza Governorate , it is the largest municipality in GS and serves approximately 600,000 of citizens. Gaza Municipality manages primary and secondary collection of wastes, in addition to managing Johr al Deek landfill and related transfer stations.

The solid waste is managed through "Public Health & Environment Department". The department consists of a director, 3 coordinators, 11 area coordinators, 20 inspectors, 29 observers in addition to waste collectors and street sweepers. The number of waste collectors and sweepers fluctuates as they are mainly supplied through Cash for Work/Job Creation schemes, it is estimated at 633 in total. The Johr al Deek Landfill has a manager, 2 drivers, 2 weigh scale operators, 2 inspectors, and 2 guards. Collection of waste is carried out in two shifts. Environmental monitoring is carried out by "Preventive Health Section" that conducts periodic inspections.

3.9.3 Middle Area JSC

Deir El Balah and Khan Younis Governorates are served by the Middle Area JSC. The Council was established in 1995 as a non-profitable public enterprise and now it serves 13 municipalities (Khan Yunis, Deir El-Balah, Nuseirat, Buraij, Maghazi, Zawaydah, Bani Suhaila, Qarara, Abassan Kabira, Abassan Saghira ,Khuza'a, Al Musader, and Wadi Salqa). In total, the Council serves more than 500,000 of people.

The municipalities are responsible for primary collection while the JSC is responsible for secondary collection and managing Deir El Balah sanitary landfill that was constructed in 1997 through GIZ fund.

The JSC is managed by a Director, two Senior Engineers, one is in charge of Khan Younis Garage while the other manages Deir El Balah Garage and Landfill. In addition to that, the Council has one Accountant and one Secretary. Also, the Council has a Unit of Awareness which consists of 7 women-guides; 4 in Khan Younis and 3 in the Middle areas. Human resources for the landfill include two workers for the weighing bridge, three guards, one driver for the bulldozer and one pump operator.

The analysis of water samples from the three monitoring wells at Deir El Balah landfill, is outsourced to universities or ministries' laboratories.

3.9.4 Rafah Municipality

Rafah Municipality manages the solid waste in Rafah Governorate including primary and secondary collection, it also manages the Rafah landfill. Rafah Municipality supports the concept of an integrated body to manage solid waste across all GS. Recently, Rafah Municipality signed Memorandum of Understating (MoU) with Khan Younis Municipality

and the Middle area Council to join-forces towards establishing one body to manage the solid waste in Southern Governorates (Middle Area, Khan Younis, Rafah).
Within the Solid Waste Management Department, RM has a "Public Health Guidance" unit which provides guidance and awareness to the community on public health.

Rafah landfill is owned and operated by Rafah Municipality. RM serves more than 200,000 of population, and employs 140 workers.

3.9.5 Environmental Quality Authority (EQA)

The EQA was established as one of the Palestinian institutions of the Palestinian National Authority (PA) after the Oslo Agreements of 1993-1995. The Palestinian Environmental Authority (PEnA) was established on the 10th of December 1996. At the end of 1997, a merger was worked out between PEnA and the Environmental Planning Department (EPD), which was part of the Ministry of Planning and International Cooperation. In August 1998, the President of the PA appointed a state Minister for Environment and issued a decree that gave the Minister authorization over PEnA. A few months later, PEnA was merged with the Ministry of Environmental Affairs (MEnA), which was established in August 1998. In 2002, a Presidential Decree was issued converting MEnA into EQA with the same responsibilities and staff.

. The Environment Quality Authority (EQA) seeks to promote sustainable environmental development of the Palestinian society. The main goal of EQA is to protect the environment and the natural resources in the oPt.

EQA has developed the Palestinian Environmental Strategy (PES) 2000-2010, with the objective to identify and analyze the main environmental problems and their causes in Palestine, to define environmental targets and to present series of prioritized measures that will lead to reaching these targets. The implementation of the strategy requires the monitoring of the environmental conditions in the Palestinian territories and the enhancement of public awareness of the people regarding environmental protection and conservation.

EQA is primarily concerned with the development of regulations, strategies, management plans and monitoring programs, with an aim of sound use and conservation of the environmental resources in Palestine. EQA is also concerned with directing and executing environmental projects and research activities as well as the promotion of technical assistance needed to ensure the success and sustainability of a high quality environment. One other major role and responsibility that EQA emphasizes upon is public awareness promoted through educating and training environmentalists and the public.

Recently the UNDP received a grant from the Swedish International Development Agency (SIDA) to strengthen the regulatory and institutional framework of the environmental sector and build capacities for environment mainstreaming, monitoring and regulatory and enforcement mechanisms. One Component of the Program is aiming at supporting the

EQA in improving environment monitoring compliance, and enforcement of the environmental law in the oPt.

The project which is close to completion has responded to the Environment Quality Authority's request and needs to strengthen the regulatory and institutional framework of the environment sector. It is building capacities for environment mainstreaming, monitoring, and regulatory and enforcement mechanisms which will in due course provide an enabling environment for implementation of national development plans and strategies in a sustainable approach.

The project has involved multiple elements, namely:

- Formulating a management plan that supports better performance of EQA monitoring and enforcement functions
- Preparing appropriate manuals and procedures for the implementation of the monitoring and management plan
- To equip the environmental protection directorate of EQA with necessary tools for better environmental monitoring, inspection and enforcement.

EQA has four technical departments;

1. Natural Resources Department
2. Environmental Policies Department
3. Environment Protection Department (which includes Solid Waste management)
4. Environmental Awareness Department

In normal operating mode, EQA in Gaza Strip has 120 employees. At the moment only 35 employees are present, most of them are newly appointed staff. With this sharp shortage in human resources, the EQA is not functioning efficiently.

During the last war on Gaza, the EQA office in Gaza was bombarded. Most of tools and equipment were destroyed. Currently, EQA has very limited laboratory equipment. The solid waste is monitored by the Environmental Protection Department. The department mainly monitors transfer station and landfills. The EQA is currently drafting Environmental Inspection Instructions.

3.9.6 UNRWA

UNRWA is serving the whole refugee population which comprises around one third of GS population. UNRWA is responsible for the primary and secondary collection and disposal of waste. They are offering the service free of charge to the local population. UNRWA is paying for the municipalities for the cost of waste disposal at the dumpsites. The interview conducted with UNRWA, Gaza11 City revealed that UNRWA pays USD 4.5/ton for waste disposal at Johr al Deek and Deir El Balah dumpsites and USD 3.5/ton for waste disposal at Rafah dumpsite. UNRWA deposes an average of 180: 200 ton/ day.

UNRWA hires a total of 418 employees (cleansing workers, drivers and supervisors) for all the components including SWM. This number is changeable. In cases of availability of funds from external sources (e.g. from the JCP), additional workers are sometimes hired. The collection workers of UNRWA use 3 wheeled hand carts with two buckets for waste collection from houses. The salaries of the cleansing workers vary between USD 500: 800/month. The supervisor salary ranges from USD 1000 to 1200. The organogram for the UNRWA Environmental Health Programme is shown in Figure 3.2.

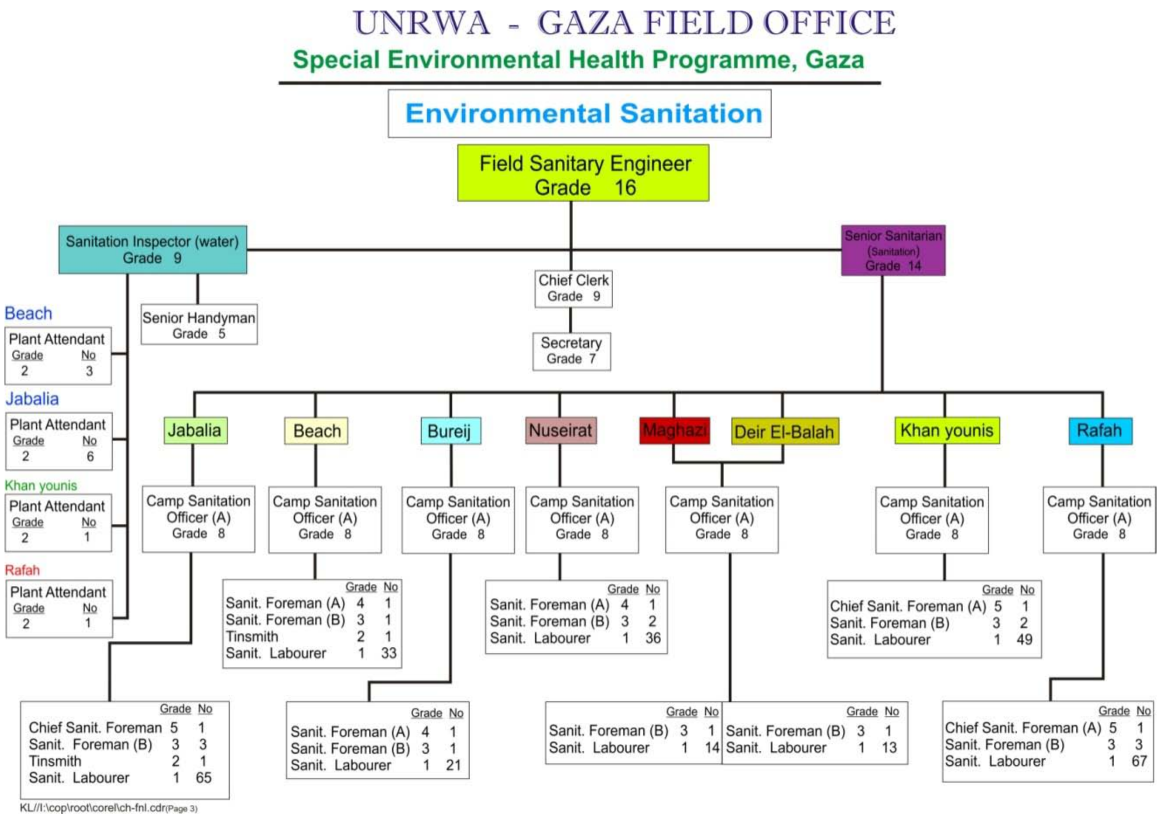


Figure 3.2: UNRWA Environmental Health Programme Organogram

3.9.7 The Job Creation Program (JCP)12

JCP was established in July 1994 under the umbrella of the Palestinian Economic Council for Development and Reconstruction (PECDAR). At the beginning of 2001, JCP became an autonomous entity working directly under the Palestinian National Authority-President Office. The Program has executed many important employment creation projects in close coordination with governmental authorities. These projects have included recently SWM

11 Meeting Eng. Zohdy Salah, Head of the Health and Environment Department
12 The information presented about JCP is mostly the outcome of two interviews conducted between the ESIA team and JCP team including Eng. Nael Ahmed El Gomla, Project Coordinator and Mr. Ahmed Shehebar and Mr. Ahmed Gabr Site Supervisors.

services with funds from various sources since 2006. This started with funds for Japan Government, Canada, UAE. Currently 18 months project is operational since June 2010 with additional fund from Japan Government. The fund goes for purchasing equipment, wages and carrying out clean up campaigns.

JCP is operating service in six main localities across GS. The total number of workers is 540 where third of this number works in collection. They are using donkey carts to perform the house to house collection. Two thirds of it works in sweeping and street cleansing.

Workers are divided into groups each groups consists of 10 workers and a supervisors. Daily plans are developed by the project coordinator in full collaboration with the municipalities and the JSCs.

Figure3.3: One of JCP street sweeper in Gaza City

Figure 3.4: The daily action plan of JCP

Workers performance is closely monitored and assessed. The street sweeper contract is only for one month and is un-renewable. The supervisor contract is for two months and the waste collectors have a six months contract on the basis that the waste collector secures the donkey cart. Salaries range from USD 12/ day for street sweepers and waste collectors to USD 23/day for supervisors.

3.9.8 COOPI

COOPI - Cooperazione Internazionale has been working in the occupied Palestinian territories since 2002. Under its Country Strategic Plan 2009-10, COOPI is working in three main programme areas: (1) Livelihoods enhancement (2) Vocational training (3) Environment.

COOPI has secured funding from the UTL (UnitÃ Tecnica Locale) of the Italian Cooperation to implement a 10 months project on the recycling of plastic in Gaza city. The project has ended in December 2010. The projects included technical collaboration with the Municipality of Gaza City and Al Ramlawi plastic company, a plastic recycling factory. The specific objective was to develop a sustainable pilot system of plastic recycling in Gaza City. It was planned to be based on labour intensive activities, employing at least 100 scavengers in the separation of the plastic, increasing the amount of recycled waste in the area. However, the decrease in the plastic price as a result of the influx of the raw material through importing from Egypt hindered project sustainability.

Moreover, COOPI is implementing a "Cash for Work" project funded by ECHO, based on urban solid waste collection through animal carts in seven of the northern municipalities of Gaza Strip. Under the "Cash for Work Programme", COOPI is working in the provision of job opportunities in waste collection service for selected poor individuals. The programme is running since four years now.

Coopi conducted an assessment for the SWM situation in Gaza City including a social impacts analysis of the current situation. The situation showed several negative social implications resulting from the deficiencies in the system. They aimed to support the system in Gaza City and in the meantime help carefully targeted groups of the poor to temporarily benefit from the job opportunities generated as part of an improved collection system.

Selecting the beneficiaries is done thorough a structured screening system that includes the following:

- Coordination with the Ministry of Social Affairs (MoSA) to get lists of people who benefit from different social welfare programmes.
- Phone interviews to collect basic information on the beneficiaries and their families.

A needs assessment questionnaire is filled by COOPI team to decide on the most needy and vulnerable cases and those who are willing to work. The questionnaire is applied through door to door visits. The questionnaire is designed to serve specific selection criteria include, among others, the family size, food insecurity according to the standards of the World Food Program, educational attainment and ownership of livestock and other assets.

- Scoring and compiling the results to determine the level of vulnerability and decide the potential beneficiaries.

The selected individuals are hired by COOPI for 60 days. The total number of beneficiaries is currently 135. They benefit from a salary of NIS 60/ day and are covered by health insurance. Protective safety tools are also provided to the workers. The results of the programme showed improvement in the living conditions of the families that were targeted

Figure 3.5: The entrance sign of Al Yarmouk Transfer Station indicting the rehabilitation work implemented by COOPI

Moreover, COOPI worked in the same seven targeted municipalities in the provision of awareness raising to families and school students in the primary and secondary schools after the municipalities expressed interest in receiving this type of assistance. They design their programmes based on the results of needs assessment using various tools including the KAP approach (knowledge, attitude and practice).

COOPI also invested in assisting selected municipalities through the provision of collection equipment. It also provided rehabilitation for two transfer stations, namely, Al Yarmouk and El Sheikh Radwan. The rehabilitation included improvements for the site, preparing ramps and planting trees. Although these works helped in enhancing the work efficiency, the surrounding communities in the transfer stations neighborhood do not sense these improvements and are still suffering from the location of these dumpsite and the negative implications it has on their daily life13.

3.10 Conclusions and Key Lessons Learnt

As part of the ESIA and the assessment for the current situation, the work of the exiting institutions engaged in SWM has been evaluated and the following are the key lessons learnt driven from the conducted interviews and the collected information.

- The majority of the programmes are working under very limited and restricted resources and this is affecting the sustainability of their interventions. This is not only the case of SWM projects/interventions, the majority of the external funds directed to GS are managed through an emergency relief approach. For the organizations working in SWM, with the exception UNRWA, the jobs created are provided with the main objective of eliminating poverty and not as part of an integrated and sustainable SWM systems. Generally speaking, a sustainable development approach is still lacking. There is a need to start addressing the financial, institutional, environmental and social sustainability of the projects through adapting flexible set of measures and actions that can fit into the dynamic situation of Gaza. The short term approach to employment in this sector should be gradually shifted to a more sustainable long term approach that allows the beneficiaries and their families to attain sustainable livelihoods enhancements.

- Collaboration with the concerned authorities to coordinate the needed service and reach the most needy cases and target them with assistance (jobs) is a favorable approach that has been adapted by some institutions (e.g. COOPI). GSWMP should benefit from this approach and set strong coordination mechanisms with the existing governmental and non-governmental organizations.

- The ongoing and serious supervision of project workers and applying a clear appraisal system was found to be a main reason for efficient performance. The field observations showed that the performance of JCP workers and supervisors is quite efficient. This was attributed to the strict evaluation system and the immediate penalization in cases of deficiencies in the performance14. Penalization involves cutting down salaries and it could

13 Results of the FGD with men and women in Al Yarmouk neighborhood
14 JCP Project Coordinator.

reach terminating the contracts of workers after frequent warnings and salary cut down. This approach should be encouraged as an incentive to attain the highest efficient system possible.

- The provision of equipment for waste transport is a crucial issue of concern for all the interviewed institutions working in the filed. It was suggested that sub contracts for privately-owned equipment might be a solution to deal with the restriction on importing equipment and spare parts. The donors' programmes should allow for this level of flexibility by allocating funds for equipments and allow for hiring equipment from local population.

- Awareness raising and efforts to raise the profile of SWM among local population and other actors are crucial for the sustainability of the systems and to allow for the introduction of new financial instruments to maintain the systems. The awareness raising models implemented by COOPI and JCP were successful models that engaged women and civil society organizations. This approach should be considered by GSWMP.

- Sorting stations as a preparatory step for strengthening the recycling industry and accommodating large number of the poor segment of population who work informally in this sector was perceived to be one of the key needed intervention.

- The protection of the health and safety of the workers in the sector is an important human aspect that should be considered. Protective measures like heath and safety training and protective tools among should be strictly considered and generalized on all the workers working for institutions including the municipalities and JSC. Financial allocations, training and capacity building for these aspects should be secured as part of GSWMP.

CHAPTER 4 PROJECT REVIEW

CHAPTER 4 PROJECT REVIEW

Chapter 4 includes an analysis of the current situation of SWM in GS and identifies the deficiencies which are the basis for GSWMP. The Chapter includes an identification of the project's components but lacks the description of their technical design details as these have not been provided to date by the FS Consultant. This chapter also includes a review of the project rationale with a discussion of alternative sites/scenarios/technologies for solid and hazardous waste management.

4.1 Situation Analysis for Solid Waste Management

4.1.1 Overview of the Gaza Strip

The GS consists of five governorates, including a total of 25 villages and municipalities. It has a total surface area of 365 km^2, a total length of 40 km and a variable width of 7-10 km. The main source of water in GS is the shallow aquifer that underlies the whole Strip . The population of GS is estimated at 1,416,543 including refugee camps. These are distributed between the five governorates as shown in Figure 4.1. Population is expected to reach 3,196,098 in 2040 (UNDP, 2012). This has been calculated based on a regressive growth rate starting at 3.5% in 2011 and reaching 1.11% in 2040. This regressive growth has been assumed to be constant for all governorates.

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

An increased population density, limited land area and limited water resources make a challenging situation for designing a solid waste management plan with respect to environmental and economic sustainability.

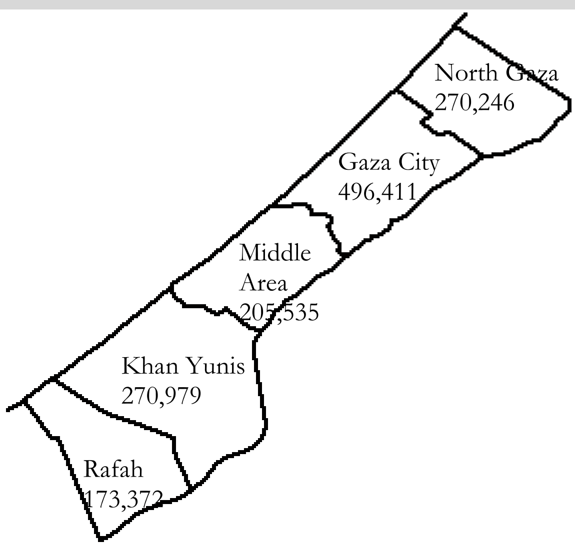


Figure 4.1 Current population in the GS

4.1.2 Solid Waste Generation Amounts

The average per capita generation of 1.07, 1.05, .67, .67, and .70 kg per person per day (pppd) have been assumed for the North Gaza, Gaza city, Middle area , Khan Younis and Rafah Governorates respectively by the FS Consultant. Based on that, the total waste generation has been estimated at 2645.7 tons/day in 2007 which is expected to rise up to 4886.9 tons/day in 2040 (UNDP, 2012). This includes household, commercial, market and agricultural. In calculating the amount of generated waste, it has been assumed that the amount of agriculture waste is 1200 tons/day and shall remain constant throughout the study period. Figure 4.3 shows the expected rise in the amount of solid waste generated for the GS over the time period from 2007 up to 2040.

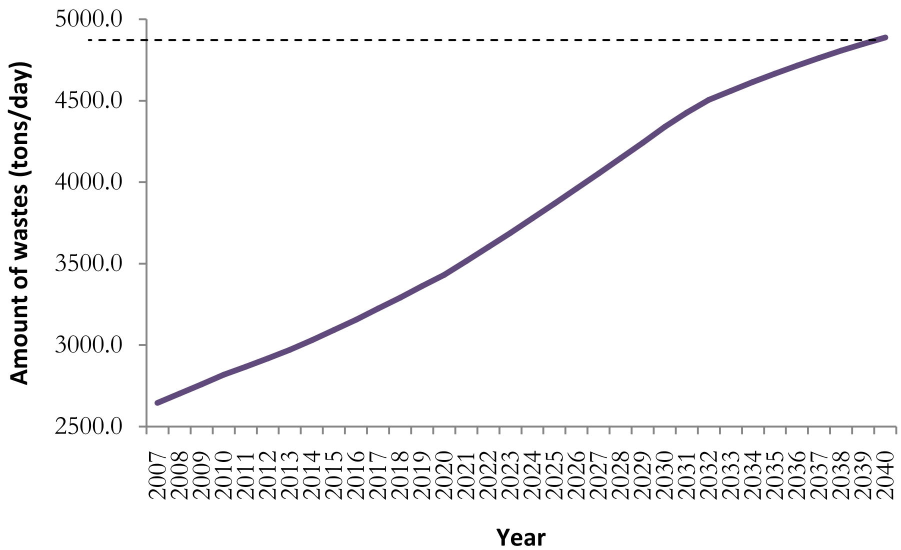


Figure 4.3: Estimated rise in the amount of solid waste generated in the GS (the numbers include 1200 tons/day of agricultural waste)

4.1.3 Solid Waste Composition

Table 4.1 shows the results of three studies on the waste composition for the GS (UNDP, 2012). The results show a high organic content of around 65% for the solid waste. This percentage is key when calculating the density of the waste and the amount of gas which will result from aerobic and anaerobic chemical decomposition.

Table 4.1: Solid Waste Composition in GS

Component	MoP, 2010	EQA, 2007	UNDP/DHV, 2011
Paper	10.0	8.0	8.4
Plastic	12.0	8.0	16.1
Organic waste	65.0	70.0	65.4
Metals	5.0	3.0	2.8
Glass	3.0	6.0	2.3
Other inorganic	5.0	5.0	5.0
Total	100	100	100

4.1.4 Hazardous Wastes

The total amount of hazardous industrial waste generated in the GS is estimated at 800 tons per year This includes scrap, sludge, asbestos, batteries, electrical waste mainly generated from the following industrial activities:

- Furniture making
- Garment and textile
- Food processing
- Garages and workshops
- Metal workshops
- Electroplating
- Construction and demolition
- Agricultural

Hazardous medical waste is also generated in the GS from a total of 40 health care facilities, 24 hospitals and 28 medical laboratories. Co-mixing of hazardous and non-hazardous wastes is currently taking place at both existing landfill sites in El-Fukhary and Johr al Deek as well as in other dump sites scattered in GS.

Co-mixing of hazardous wastes and non hazardous wastes shall be prohibited according to local and international regulations such as the EU Lanfill Directive, since the landfills at El-Fukhary and Johr al Deek are designated to be non-hazardous waste landfills. However, hazardous waste disposal, including asbestos and health care wastes, if not allowed for disposal at these sites shall present a significant impact which needs appropriate mitigation measures until the development of an integrated hazardous waste management plan. Waste Acceptance Criteria for the two landfills have to be produced in order to control the co-mixing of hazardous and non-hazardous wastes

4.1.5 Solid Waste Collection and Transfer Stations

Solid waste management service in the GS include primary and secondary waste collection, transfer stations and landfill management and monitoring. These are performed under the authority of the following organizations as previously discussed in Chapter 3:

1. North Gaza Joint Service Council
2. Gaza Municipality
3. Middle Area Joint Service Council
4. Rafah Municipality
5. UNRWA

An evaluation of the solid waste collection in each of each of the five governorates and the refugee camps are summarized in Table 4.2. Key notes are as follows:

- Tractors and trucks are used but not in a good condition and need maintenance.
- Donkey carts are being used in the current system.
- Transfer areas or interim waste storage areas are being used.

4.1.6 Waste Treatment

a) Recycling

Waste recycling activities take place by the informal sector prior to waste arrival at the landfills. However, no accurate estimation of the amount of waste being recycled is currently available. Four plastic factories are currently operating in GS which use recycled plastic to produce plastic bags and pipes.

b) Composting

Composting rates were estimated at 1% in 2007 and according to the FS this will be expected to rise up to around 18% at 2040. Compositing in GS currently takes place at a pilot plant near Rafah – a project established by the Palestinian Friends Society (NGO) and at Beit Lahia in the north of the GS. The latter is financed by the Italian Government, supported by CRIC (Italian NGO) and managed by the UNDP.

Expanding the Rafah pilot composting plant is currently under investigation – a project financed by the Government of Japan through the UNDP. Expanding the Beit Lahia pilot composting plant is also under investigation – operated by PADICO, a private Palestinian company. Increasing the rate of wastes being composted will help to divert wastes from landfills.

Table 4.2: Summary of current waste collection and disposal system in GS

Area	Served by	Waste generated (t)	Mean of transport						Transfer stations	Waste delivered to transfer station t/day	Area of transfer station (dumum)	Distance to landfill (km)	Landfill
			Donkey carts	Tractors/ trailors	Compactor truck	Tipper cranes	Tipper truck	Skip loaders					
North Gaza	JSC	350	100	32	1	12	-	-	East of Jabalia	140	5	20	Johr al Deek
									North of Umm al Nasser	104	10	26	
									North of Beit Hanun	60	3	28	
									Beit Lahya	200	10	12	
Gaza	Gaza M.	738	280	5	8	5	6	6	Yarmouk	300	10	8	
									Sheikh Radwan	60		10	
									Shejaeea	70		5	
Middle Area	JSC	355	69	8	-	15	2	-					Deir El Balah
Rafah	Rafah M.	130	57	4	2	6	-	2	Tel Al Sultan	65	10	15	Rafah
Refugee camps	UNRWA	160	-	11	-	13	-	2					The three landfills

4.1.7 Waste Disposal

Figure 4.4 shows the amount of waste expected to be disposed in each of the five governorates in the period from 2007 up to 2040. The difference between the amount of waste generated and that which is actually disposed of is the amount of recycled, composted or waste not originally collected in the first place. The graph in Figure 4.4 was produced based on data from the FS.

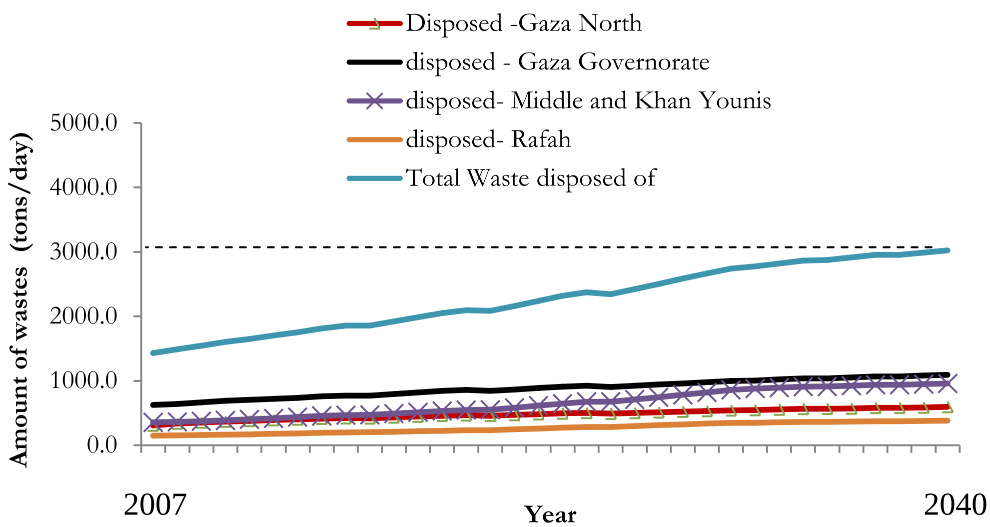


Figure 4.4: Amount of solid waste expected to be disposed of in each of the five governorates

In estimating the amount of waste being disposed of, the following assumptions were made by the FS Consultant:

- Complete composting of agricultural waste may take place at source - or alternatively agricultural waste would be completely burned or partially burned and partially composted at source.
- Composting rates were estimated at 1% in 2007 rising to 18% at 2040.

Hazardous waste is currently mixed with municipal waste and disposed of. Hazardous health care waste is either incinerated in the central incinerator in Shifa Hospital incinerator which have a capacity of 500kg/day , burnt in open air or co-mixed with solid non-hazardous waste and disposed of in one of the three main landfills- El-Fukhary, Johr al Deek and Deir El Balah. Although a separate cell for the disposal of hazardous wastes has been constructed in Johe al Deek Landfill, funded by the EU , this is no longer being used for no clear reasons. The following section will present a detailed description of Gaza's three main landfill sites.

4.1.8 Landfill Disposal Sites

Waste is collected and hauled to the three main landfills currently operating in the GS. The locations of these are shown in Figure 4.5. Also waste may be disposed of in random dump sites. The description of the three main landfills in Gs is presented below.

Figure 4.5: Location of the three main solid waste landfills in GS

a) Johr al Deek (Gaza)Landfill

Located in Gaza municipality, in the buffer zone with Israel, it has an area of 120 dunums and not equipped with soil protection measures (Figure 4.6). The landfill serves the municipalities of Gaza and Gaza North. The amount of waste which has been disposed of in the landfill is estimated at 3,000,000 tons with a rate of 450,000 tons/year. Waste disposed is composed of around 80 % Municipal Solid Waste (MWS), and the remaining 20% includes Slurry, construction waste, industrial and medical and hazardous waste. Figure 4.7 shows the current situation at Johr al Deek dumpsite. It is clearly observed that the site has no access control, no soil cover. Also smokes resulting from waste combustion can be clearly seen.

b) Deir El Balah Landfill

Located in the east side of Deir Al Balah municipality in the buffer zone with Israel. It has an area of 60 dunums. Unlike Johr al Deek landfill , it is equipped with soil protection measures. It serves 13 municipalities and village councils in Khan Younis and the Middle area Governorates. It is estimated that the amount of waste disposed of in the landfill is 90,000 ton/year. Wastes disposed of constitutes of around 95 % MSW and 5% other.

c) El-Fukhary landfill

Located in Khan Younis municipality, east of Rafah municipality which it serves (Figure 4.8). It is not equipped with soil protection measures. It has an area of 25 dunums. It is estimated that the amount of waste disposed of in the landfill is 63,000 ton/year. This constitutes of 90 % MSW and 10 % other. Figure 4.9 shows the current situation at El-Fukhary dump site and Figure 4.10 shows the entrance to the dump site. Same comments as for Johr al Deek can be made with regards to El-Fukhary dump site. Although the figure does not show smoke and emissions resulting from waste combustion, this was observed during site reconnaissance visit to the dump site, where tens of stray dogs and birds were also observed.

Figure 4.6: Johr al Deek dump site

Figure 4.7: Current situation at Johr al Deek

Figure 4.8: El-Fukhary dump site

Figure 4.9: Current situation at El-Fukhary dump site

Figure 4.10: Entrance to El-Fukhary dump site

4.1.9 Current SWM System Deficiencies and "Zero Option" Alternative

The current system has deficiencies which may intensify if no measures are taken towards improving the current waste disposal system or in other words if a "Zero Option" concept has been adopted. The main deficiencies may be summarized as follows:

- Air pollution and direct harm to health due to emissions and nuisance from the solid waste at the landfill site. This includes odor generated from the chemical decomposition of the waste, particulate matter (PM) and toxic substances which may result from waste burning and/or spontaneous combustion of the waste.
- Direct harm to health may also result from direct contact with the waste in the absence of personnel protection equipment. This already exists as many scanvengers are regularly visiting the landfill sites.
- Nuisance to people and risk on public health due to rats and flyers of random dump sites and accumulation of waste in streets
- Global warming potential due to methane generation from anaerobic degradation of the organic portion of the solid waste in the landfill.
- Contamination of the upper soil layer or wadis due to uncontrolled discharge of rainwater runoff.
- Contamination of groundwater resources due to waste leachate percolating through the soil layers in the event of rainwater. In such case, the migration of the contaminants would be uncontrolled and may reach the groundwater.

What may exaggerate the hazard nature of the above impacts is the co-mixing of hazardous and health care waste with MSW. This is a result of limited control over the site which leads to uncontrolled dumping as well as the absence of waste acceptance criteria and alternatives for hazardous waste treatment.

The current situation is not the most environmentally sound solution to solid waste management in the GS but may seem as the most cost effective one. However, this is true only when considering the direct financial cost while not monetizing mitigation for the potential harm done to water, health and land resources. A sustainable solution with respect to social, environmental and economical impacts is therefore needed for the solid waste management in the GS.

4.1.10 Rehabilitation of existing disposal sites

Short term measures for the current GSWMP includes rehabilitation of the three existing landfills and related transfer stations and establishment of a pilot source recovery and composting plant.

The long term measures include preparation of a feasibility study and detailed design of the SWM in GS including the construction of at least one landfill and related transfer stations. The long term measures proposed by the FS Consultant are described in the following section. The ESIA of these long term measures is the subject of this report.

4.2 Current Project

4.2.1 Overview

The long term measures of the GSWMP consist of the construction of two landfills serving the whole of GS, one at El-Fukhary and one at Johr al Deek. The two sites were selected among five proposed sites and a disposal scenario was proposed which consists of the following:

- Until 2032, waste generated from Gaza and North Gaza Governorates will be disposed of at Johr al Deek.and waste generated from Rafah, Deir El Balah and Khan Younis Governorates will be disposed of at El-Fukhary
- From 2032 until 2040, waste generated from Gaza and North Gaza Governorates will be transferred to Johr al Deek from which it will be bulk transported to El-Fukhary, so Johr al Deek will turn into a transfer station and the landfill will be closed. Waste generated from Rafah, Deir El Balah and Khan Younis Governorates will continue to be disposed of at El-Fukhary which will become the only landfill serving the GS.

The system will use the existing waste storage areas in GS after being transformed to proper transfer stations.

4.2.2 Alternative Waste Disposal Systems

Landfilling solid wastes is placed at the bottom of the waste hierarchy, preceded by waste minimization, reuse, recycle and recovery. Before the decision is made as to go for the landfill option, other alternatives should have been studied and proven not sustainable with respect to long term implementation in the GS. Minimization, recycle, reuse are only successful after the implementation of long term awareness projects which does not yet exist in the GS, actually it is among the recommendations of the GSWMP. It is therefore yet too early to fully depend on these options in order to divert waste from landfill. In this context, the current GSWMP has considered the implementation of composting alternative in order to divert around 18% of solid waste from the landfill at 2040. If successful, this percentage may also increase. Incineration or waste to energy plants may be regarded as more attractive alternative to waste management in the GS especially when considering the limited land available for landfills. However, the following reasons may be pro the construction of landfills and against building waste incinerators:

- The high moisture content of solid waste in GS
- Relatively higher capital and operational cost as compared with landfills
- High technical requirements for the operation and maintenance
- Relatively higher maintenance costs as compared with landfills
- Represent a potential target for any attacks on GS which cannot be excluded at the moment.

The use of the landfill alternative while adopting the highest possible mitigation measures for potential environmental and social impact is considered the best possible technology for solid waste disposal in the GS. Increasing the level of awareness about waste minimization, reuse, recycle and recovery such as composting shall also be implemented as to gradually divert as much waste as possible from the landfill.

4.2.3 Alternative Sites for the landfills

During the FS of the GSWMP, five sites were first proposed, and by using site selection criteria these were reduced to only two sites. The five selected sites were chosen in areas of the GS where soil is not sandy but rather silty/clayey in nature. This was based on a preliminary geological assessment of the Gaza strip. The site selection criteria has included a detailed physical/technical, environmental, planning, nature and landscape , political/legal, financial/economic and social analysis. One of the main excluding factors being considered was the distance from residential buildings – less than 300m was deemed unacceptable.

The current ESIA will only focus on the two sites finally selected by the FS Consultant which are:

- North East of the existing El-Fukhary landfill
- South West of the existing Johr al Deek landfill

These were compared and given final weighed score of 2.8 and 3.2 for Johr al Deek and El-Fukhary sites respectively. The weighing score may be further optimized using sensitivity analysis, however, both sites will be environmentally assessed in the current ESIA. The proposed disposal scenario and landfill layouts for both sites are described below.

4.2.4 Disposal scenario

The proposed disposal scenario in the period until 2032 consists of using Johr al Deek landfill for the disposal of solid wastes generated from Gaza and North Gaza Governorates and El-Fukhary landfill for the disposal of solid wastes generated from Rafah, Deir El Balah and Khan Younis Governorates. From 2032 until 2040, waste generated from Gaza and North Gaza Governorates will be transferred to Johr al Deek from which it will be bulk transported to El-Fukhary, so Johr al Deek will be turned to a transfer station with a storage capacity of 30,000 tons and the landfill will be closed. Waste generated from Rafah, Deir El Balah and Khan Younis Governorates will continue to be disposed of at El-Fukhary which will become the only landfill serving the GS. Figures 4.11 and 4.12 show the amount of wastes that will be disposed of at Johr al Deek and Al-Fukhary in the period until 2040. Key limitations and guidelines used during the optimization of the final disposal scenario can be summarized as follows:

- Minimum distance to Israeli borders shall be 500m, this was key in designing the landfill layout at Johr al Deek and to determine the maximum area that can be used after which waste will have to be transferred to El-Fukhary.
- Transportation of waste from the north to the south of GS is to be avoided as much as possible due to current bad conditions and high traffic load of Salah El Din road and also due to potential impact of hauling the waste due to bad conditions of the trucks.

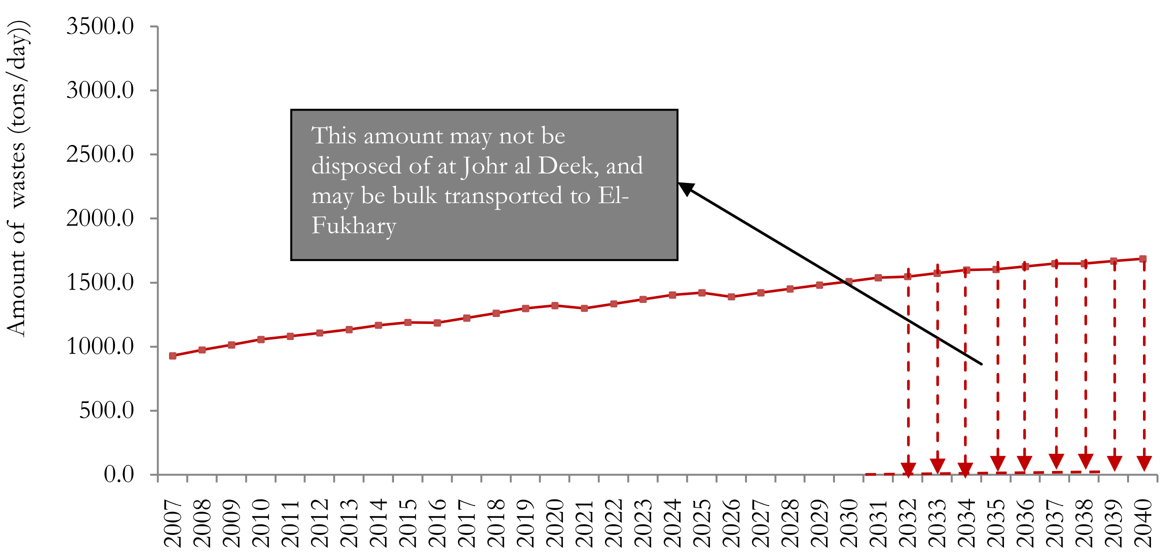


Figure 4.11: Amount of wastes disposed of at Johr al Deek

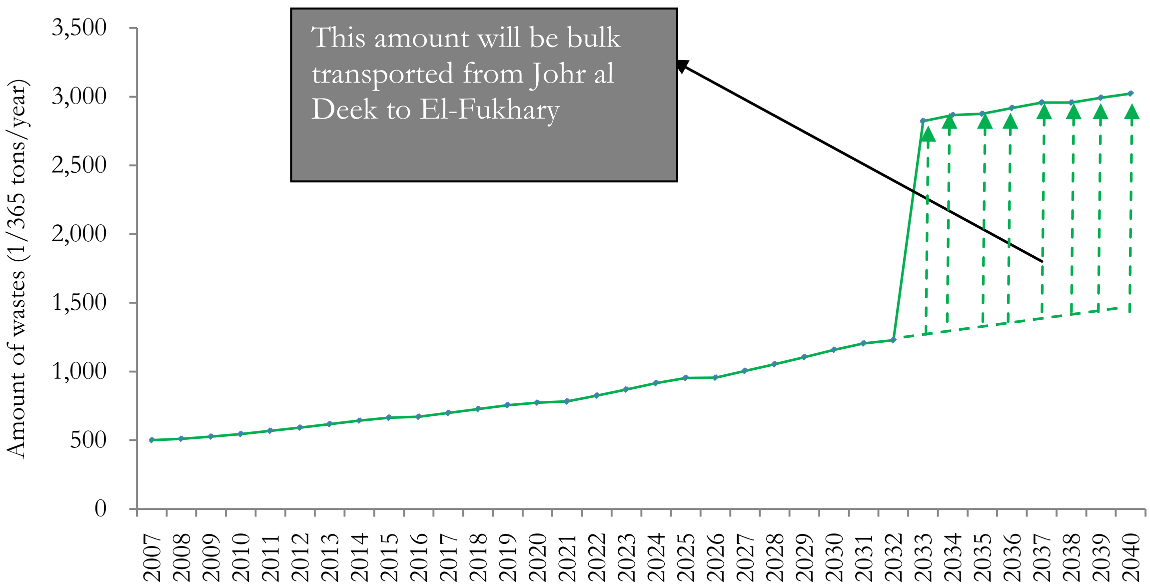


Figure 4.12: Amount of wastes disposed of at El-Fukhary

4.2.5 Proposed landfill layout at El-Fukhary

A zoom in on the proposed site for El-Fukhary landfill is shown in Figure 4.13 and 4.14. The closest residential areas to the site are El Fukhary and Al Buyuki areas which are at a distance of around 1600m and 1700 m respectively as shown in Figure 4.14.

Figure 4.13: Proposed site for the El-Fukhary landfill (indicated by a yellow circle) at an Eye altitude of 24 km.

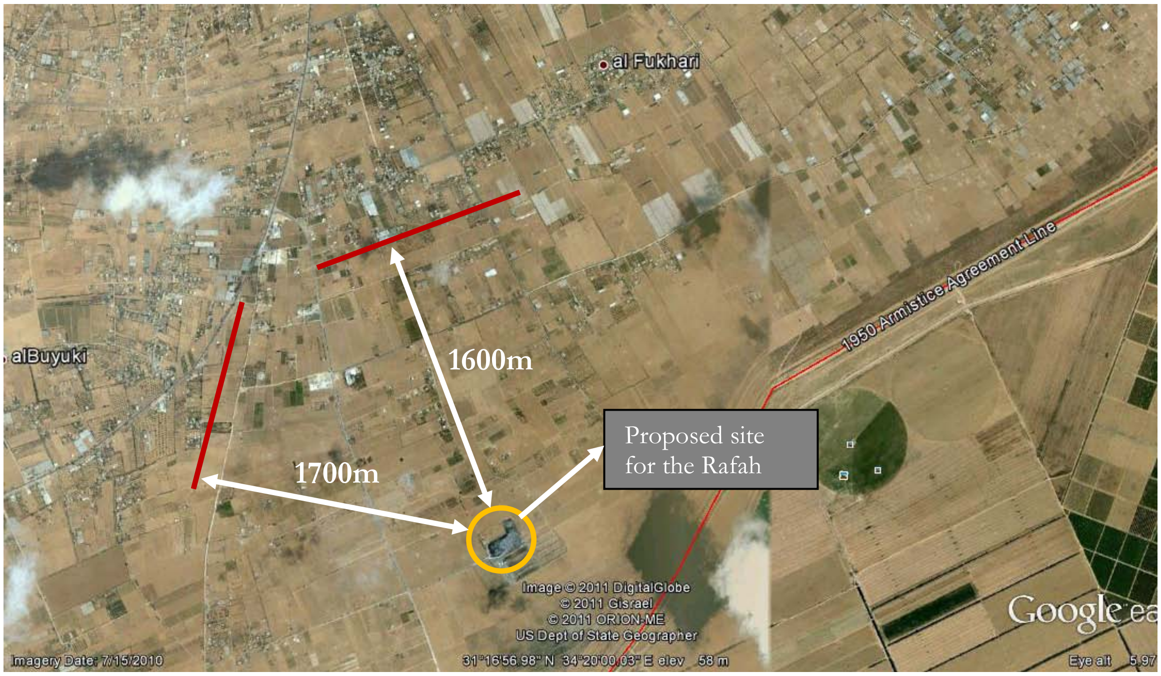


Figure 4.14: Proposed site for El-Fukhary landfill (indicated by a yellow circle) at an Eye altitude of 6 km.

The proposed layout for the landfill site at El-Fukhary is shown in Figure 4.15. The figure shows the area that will be used for short term expansion of the existing dump site (referred to as ST), and cell progression for long term expansion. The latter is shown in more details in Figure 4.16 a and b (UNDP, 2012). Note that the designated site for the construction of the WWTP is adjacent to the proposed landfill site. Site reconnaissance visits were conducted and figure 4.17 shows some of the photo shots taken in different directions around the existing dump site.

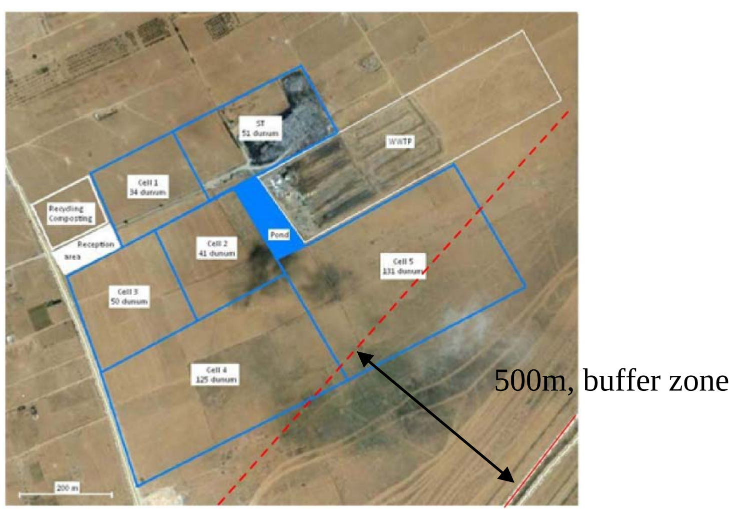


Figure 4.15: Proposed layout for the El-Fukhary landfill for both short term and long term expansions. Source(UNDP, 2012)

Figure 4.16a: Proposed cell progression for the El-Fukhary landfill for the long term expansions (Cells 1 and 2). Source (UNDP, 2012)

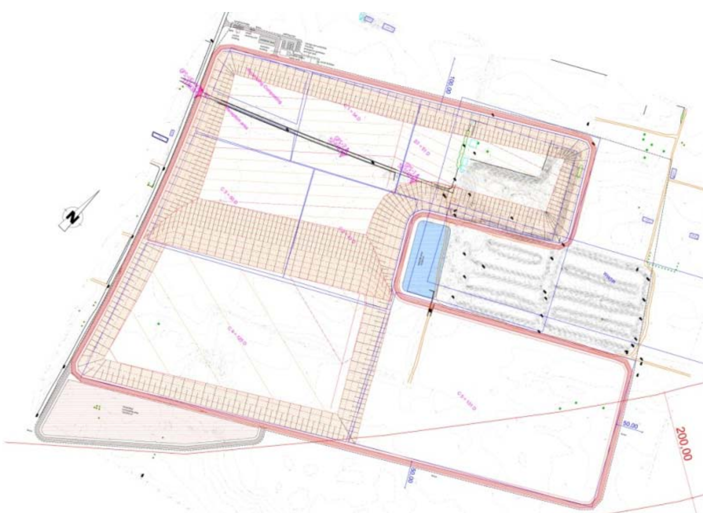


Figure 4.16b: Proposed cell progression for the El-Fukhary landfill for both short term and long term expansions (Cells 3 and 4). Source (UNDP, 2012)

Figure 4.17: Photo shots of the surroundings of the existing dump site at El-Fukhary

4.2.6 Proposed landfill layout at Johr al Deek

A zoom in on the proposed site for Johr al Deek landfill is shown in Figure 4.18 and 4.19. The closest residential area to the site is at a distance of around 600m as measured on the Google Earth map (Figure 4.19). The map is dated back to 2007, however recent field visits showed that no construction permits have been given since 2007 in the area surrounding the existing landfill.

The proposed layout for the landfill site at Johr al Deek is shown in Figure 4.20. The Figure shows the area that will be used for short term expansion of the existing dump site (referred to as ST), and cell progression for long term expansion. Note that the design for the cell progression was designated as to ensure that a distance of 500 m remains free from construction between the borders of the proposed layout and the Israeli borders. Site reconnaissance visits were conducted and figure 4.21 shows some of the photo shots taken in different directions around the existing dump site.

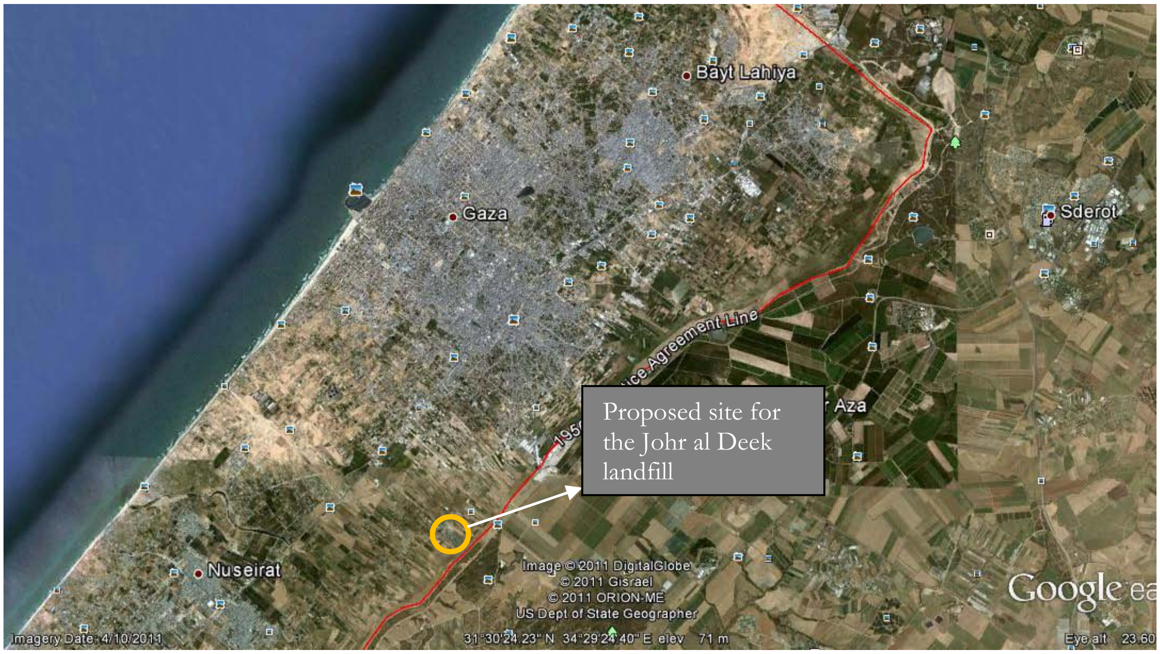


Figure 4.18: Proposed site for Johr al Deek landfill (indicated by a yellow circle) at an Eye altitude of 24 km.

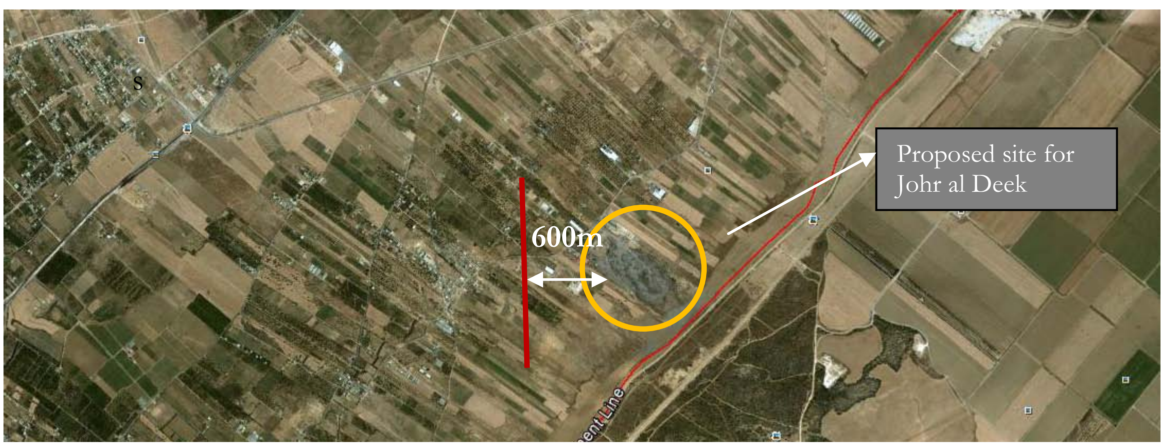


Figure 4.19: Proposed site for Johr al Deek landfill (indicated by a yellow circle) at an Eye altitude of 6 km.

Figure 4.20: Proposed layout for Johr al Deek landfill for both short term and long term expansions. Source (UNDP, 2012)

Figure 4.21: Photo shots of the surroundings of the existing dump site at Johr al Deek

4.2.7 Primary collection system

The existing primary collection system consists of a number of different containers as summarized in Table 4.5 (UNDP, 2012). Most of the containers are old, with no cover. Also, as shown in Table 4.5, waste is usually left into the street. Waste collection frequency is summarized in Table 4.6 (UNDP, 2012). It is to be noted that in case on delays in waste collection, it is a usual practice to burn it which represents a potential source of pollution. This is of particular concern when hazardous or demical wastes are co-mixed with MSW at source. The means of collection include donkey carts, tractors, compactor truck , tipper cranes and wheel loaders as previously describe din Table 4.2. Most of the mechanical means of transports are in bad conditions which increase the indirect negative environmental impact as results of increased emissions and increased consumption of fuel.

As shown in Tables 4.5 and 4.6, the current collection system is charaterised by its inconsistency in types, container specifications, container location, lack of segregation system at source, random waste collection frequency (although relatively efficient) . The expected improvements to the current primary collection system are expected to result in a significant positive impact.

Table 4.5 – Primary collection system in GS (UNDP, 2012)

	Put into the street H2H	Container in building	Container in street	Open waste pile in street	Dump site
1. Gaza North	17	3	4	3	
2. Gaza City	10	1	7	4	
3. Deir Al Balah	12	1	7		1
4. Khan Yunis	6	2	11	3	1
5. Rafah	4		12	1	
Total	**49 (44.5%)**	**7 (6.4%)**	**41 (37.3%)**	**11(10%)**	**2(1.8)**

N=110

Table 4.6 – Waste collection frequency in the neighborhoods per Governorate (UNDP, 2012)

Governorate	Frequency Solid Waste Collection				Total
	Several times per day	Daily	3 X per week	1 or 2 X per week	
1. Northern Gaza	5	20	3	0	28
2. Gaza City	10	13	4	0	27
3. Deir Al Balah	2	14	5	0	21
4. Khan Yunis	0	17	2	5	24
5. Rafah	7	8	0	2	17
Total	**23**	**72**	**14**	**17**	**117**

4.2.8 Transfer Stations

Figure 4.22 shows the locations of the transfer stations which will be used in the current SWM system for both the short and long term measures (UNDP, 2012). The Figure also shows the proposed transport routes for the disposal at Johr al Deek and El-Fukhary. The final designs for the transfer stations as well as information gathered through field visits are presented below more details about the final designs are included in Annex 4-A.

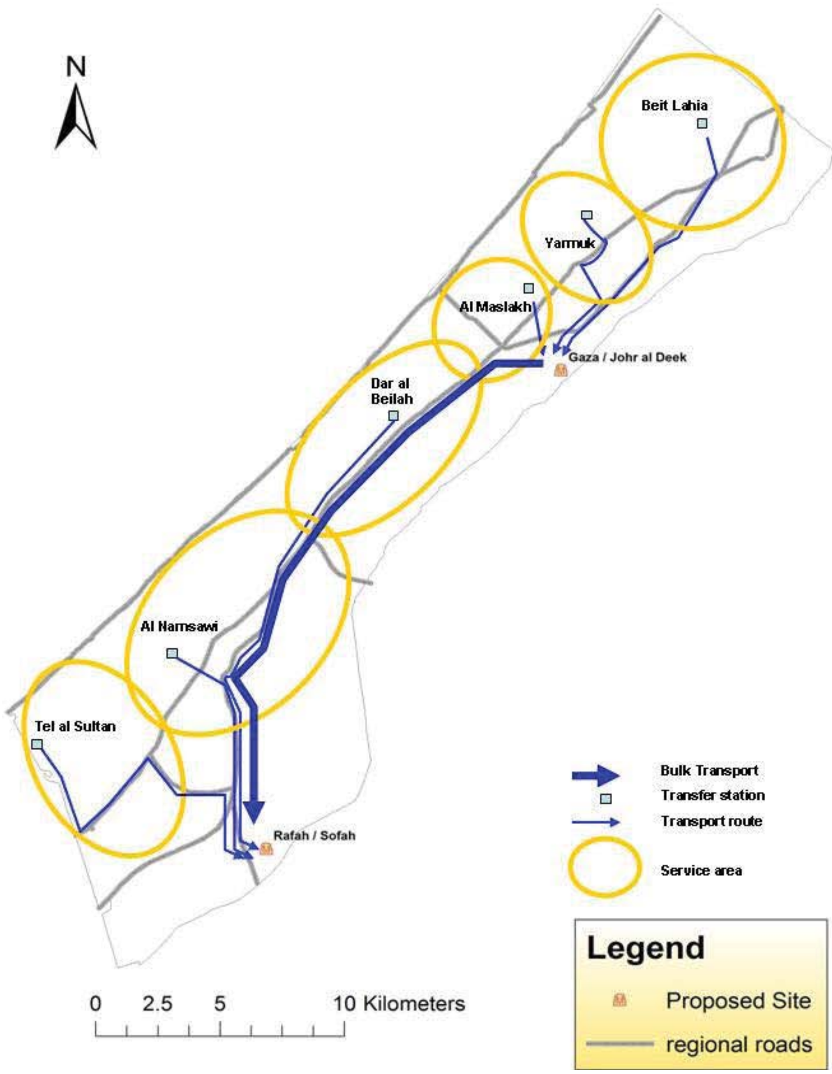


Figure 4.22: Proposed locations for the transfer stations. Source (UNDP, 2012)

Design features

Below in Figures 4.23 and 4.24 , the design components for Al Namsawi transfer station in Khan Younis are presented. Similar concept has been adopted for the other transfer stations , which are included as mentioned above in Annex 4-A. The transfer will be fenced and covered with a steel shed. The unloaded wastes will be compacted into containers, then sent for disposal. The amount of wastes which is expected to be transferred through each of the transfer stations are shown in Table 4.3 below, as reported in the FS.

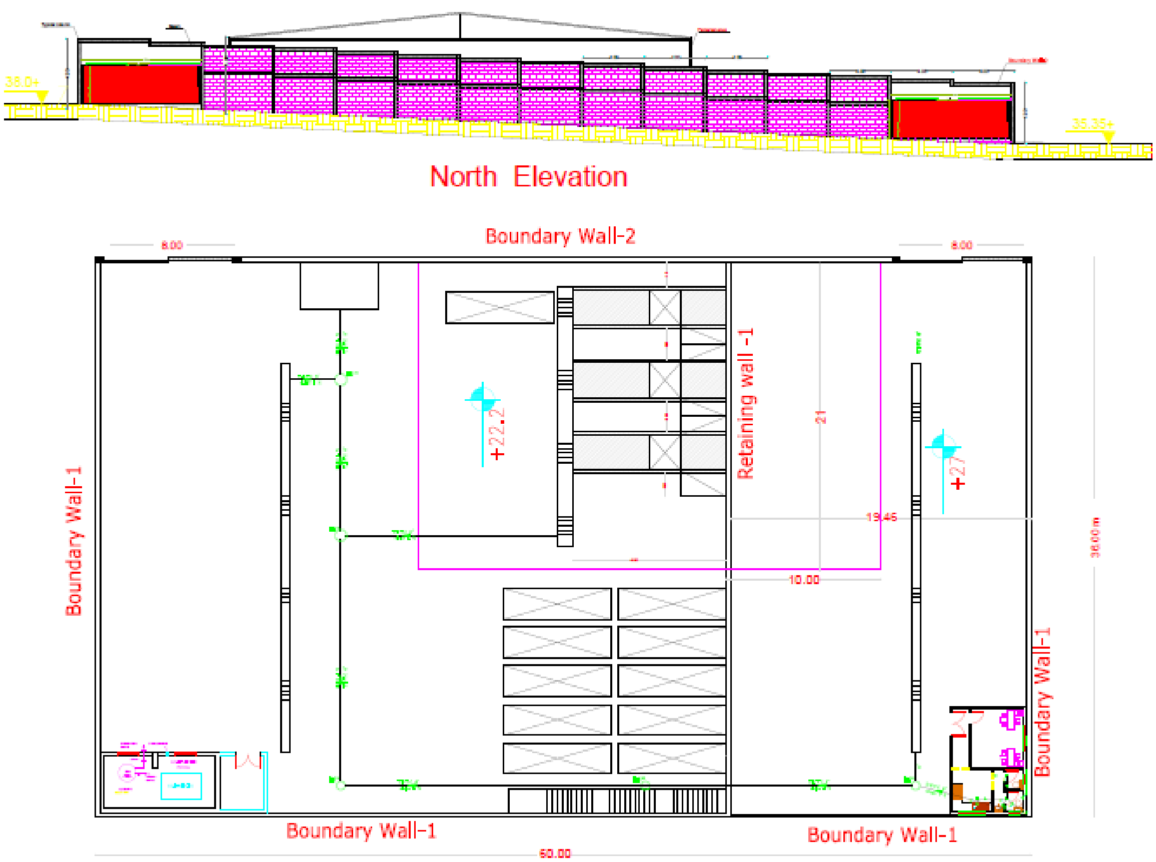


Figure 4.23: Layout and elevation of the transfer station at Al-Namsawi(UNDP, 2012)

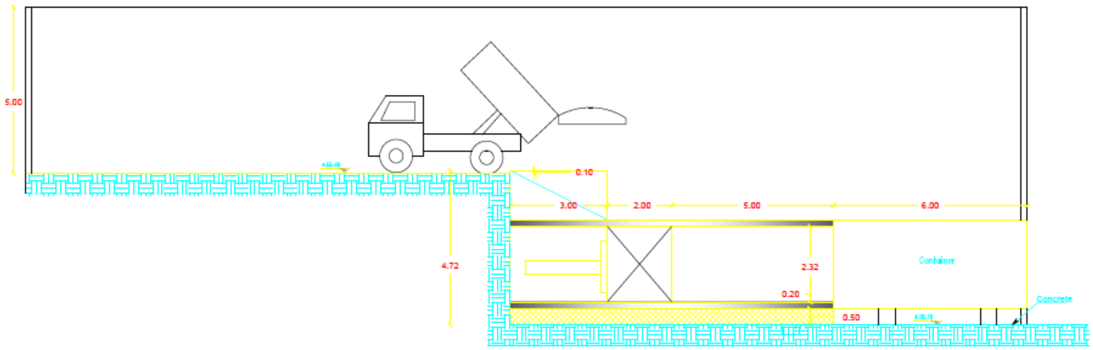


Figure 4.24: Cross section in Al-Namsawu transfer station (UNDP, 2012)

Table 4.3 – Amount of wastes transferred through the different transfer stations (UNDP, 2012)

Region	Transfer / Transport	Waste Flow (tons / day)			Distance to Landfill (or Bulk transfer site)
		2015	2020	2040	
North Gaza	Through Beit Lahia	212	240	346	12 km
	Direct to Johr al Deek	206	233	336	12 km
Gaza City	Through Yarmuk	320	361	522	8 km
	Through Al Al Mashlakh	100	113	163	3 km
	Direct to Johr al Deek	351	397	572	8 km
Middle Area	Through Deir al Balah TS	208	235	339	23 km
	Through Al Namsawi	159	180	259	11 km
	Direct to Rafah	100	113	163	15 km
Rafah	Through Tel al Sultan	98	111	160	15 km
	Direct to Rafah	100	113	163	10 km
TOTAL		**1854**	**2096**	**3023**	

Surrounding Environment

The ESIA team has performed field visits to the different transfer stations, the surrounding environment is shown in Figures 4.25, 4.26, 4.27 and 4.28. The existing sites are currently being used as open temporary waste storage sites. After the execution of theGSWMP, the conditions at the transfer stations will be significantly improved and this would cause a positive impact as compared with existing environmental conditions. Treatment ponds were noticed near both Tel al Sultan and Beit Lahia. Table 4.4 summarises the existing status at each of the transfer stations and intended development plan

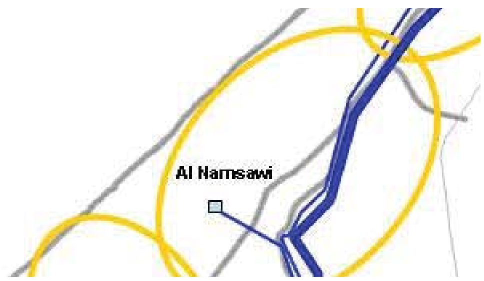


Figure 4.25: Existing environment at Al Namsawi transfer station site



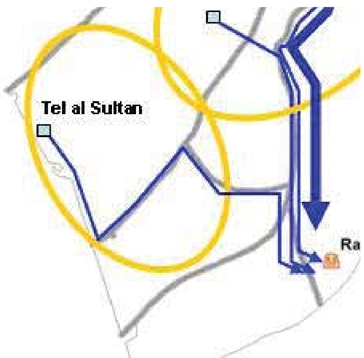




Figure 4.26: Existing environment at Tel al Sultan transfer station site

Figure 4.27: Existing environment at Beit Lahia transfer station site

Table 4.4 – Development pland for the existing transfer stations sites (UNDP, 2012)

Location	Current situation	New situation
North Gaza		
Bei Lahia	Temporary Storage Site	Site will be cleaned, and transformed into Transfer Station to serve North Gaza
Um al Nasser	Temporary Storage Site	Site will be cleaned and abandoned
Beit Hanoon	Temporary Storage Site	Site will be cleaned and abandoned
Gaza City		
Yarmuk Transfer Station	Transfer Station, including temporary storage	Site will be cleaned and will remain in operation as transfer station
Al Maslakhi	Temporary Storage Site	Site will be cleaned, and transformed into Transfer Station to serve Gaza Governorate
Al Karama	Temporary Storage Site	Site will be cleaned and abandoned
Deir al Balah		
Deir al Balah	None yet	New transfer station will be established for Deir al Balah
Khan Yunis		
Al Namsawi	Temporary Waste Storage Site	Site will be cleaned, and transformed into Transfer Station to serve Khan Yunis
Rafah		
Tel al Sultan	Temporary Waste Storage Site	(1) Dump site will be covered and closed. (2) Composting plant will be expanded. (3) Transfer station will be constructed.

Figure 4.28 – Existing environment at El Maslakh transfer station site

4.2.9 Landfill design features (during operation and end of life closure)

The landfill is designed to operate in 5years cells, the underground slopes are 1: 2(2.5) and the overground slopes are 1:2 (3). The proposed depth for the landfill is 20m below ground level and the proposed height above ground level is 30m. For each cell the following will be constructed:

a) Containment System

A base lining system which consists of double layers of 1.5 mm HDPE and Geo-synthetic clay will be installed with geo-textile on top of both layers. A soil cover to waste ratio of 1:6 will be placed daily and compacted on the surface of the waste layer.

b) Leachate Collection System

The engineering measures recommended to handle leachate include a HDPE lining system of the Cells base, a drainage layer which will include HDPE 2/3 perforated pipes embedded in lowest elevation areas of the Cells bottom which will have enough inclination to collect the liquid in the pipes then by gravity to a collection pit at the lowest point of each Cell. The leachate will be then pumped up to a leachate pond where the collected leachate will be recycled to active cells.

c) Gas Collection , treatment and recovery System

According to the preliminary design of the landfill there will be a degassing system in the landfill through 150 vents at El-Fukhary and 40 vents at Johr al Deek, each vent will be formed in a hole of 800 mm diameter that will contain broken stone around HDPEfilter pile, and will be gradually raised during the progression of landfill cells. Each vent will cover an area with a radius of about 30 meters, and all the vents will be collected in HDPE collection pipes that will be located inside the re-cultivation layer and the ring road around the landfill and will end in a gas compression station.

4.2.10 Composting plants

According to the FS, the following composting facilities are proposed to be constructed over the period until 2032:

- Tel al Sultan (30,000 t/year) in 2016, to be expanded by 60,000 t/year in 2021
- Johr al Deek , in the vicinity of the landfill (30,000 t/year) in 2016, to br expanded by 60,000 t/yearin 2021 and possibly by 50,000 t/year in 2032.
- Beit lahia (50,000 t/year) in 2026 to be expanded by 50,000 t/year in 2032
- El-Fukhary landfill (50,000 t/year) in 2026
- Deir al Balah (50,000 t/year) in 2032

The above sums up to a total of 5 locations with a minimum capacity of 30,000 t/year and a maximum capacity of 100,000 t/year and possibly reaching 140,000 t/year.

A typical layout for a 50,000 t/year capacity composting plant is shown in Figure 4.29 as proposed by the FS (UNDP, 2012). The layout consists of a waste reception and storage area, pre-treatment unit, composting area (primary and secondary), final compost storage area, a leachate collection and storage unit. The collected leachate will be recycled for compost humidification purposes using a pump with a capacity of 5m3/hour (UNDP, 2012). The input to the plant will consist of a separated organic fraction of the domestic wastes mixed with green (agricultural waste). The sepeicfictaions and recommended equipment for the composting plant are summarized below as recommended by the FS (UNDP, 2012).

Specifications of the composting plant:

- The composting plant shall be constructed as an open roofed area to minimize the environmental impact of the waste/compost.
- The floor shall be supplied with an impervious layer.
- The composting shall be achieved using an aerated pile system technology.

Equipment are needed for the following key activities:

- Weighing bridge
- Crushing and shredding
- Feeding hopper with a belt conveyor
- Rotating drum
- Internal transport using front-loaders
- Magnetic separation of metals
- Balistic separation
- Air compressors for forced aeration of compost piles
- Grinder

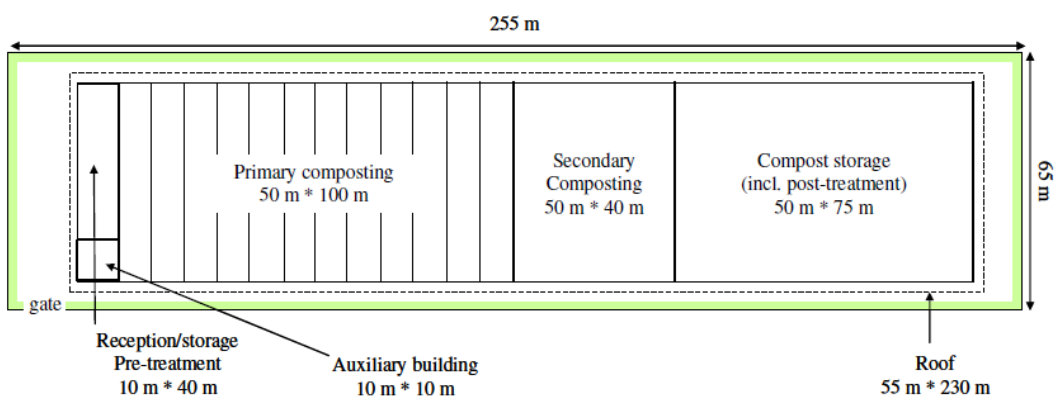


Figure 4.29: Proposed layout for a typical 50,000 tons/year composting facility

The life cycle of the compost starting at the entrance of the composting plant is shown in Figure 4.30 below. The environmental impacts which may result from the different stages will be presented in Chapters 6A and 7A. The proposed mitigation and monitoring plan will be included in Chapter 9.

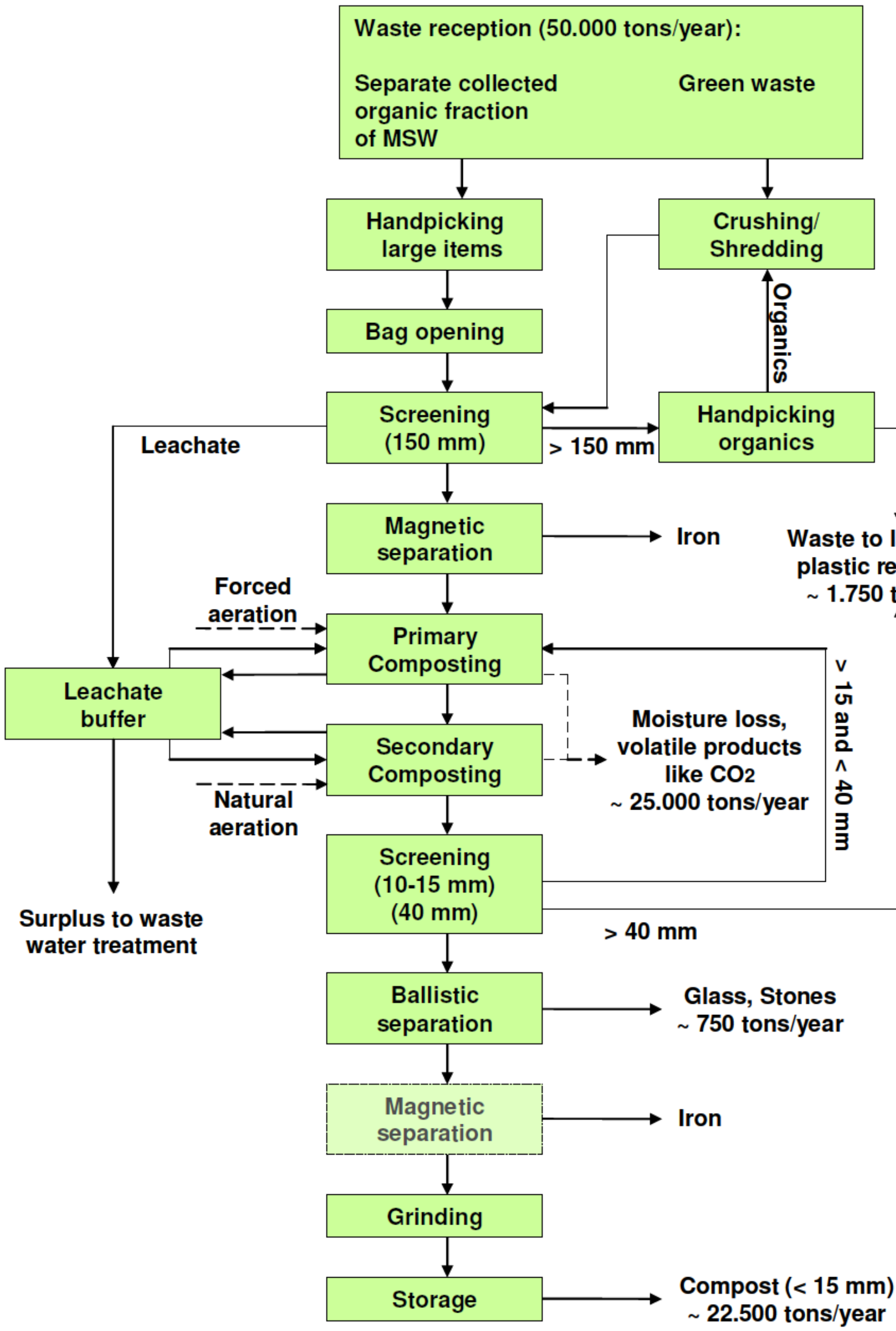


Figure 4.30: Compost life cycle for a typical 50,000 tons/year composting facility

CHAPTER 5 ENVIRONMENTAL AND SOCIAL BASELINE

CHAPTER 5 ENVIRONMENTAL AND SOCIAL BASELINE

5A ENVIRONMENTAL BASELINE DATA

5A.1 Introduction

Environmental baseline data represent the existing situation in the areas which could be influenced by the project. Baseline data for El-Fukhary and Johr al Deek sites are presented in this chapter. The existing environmental conditions in Gaza and Khan Younis Governorates were also studied in order to cover most of the locations of the existing transfer stations that may be used as part of the proposed integrated SWM system. To date, the exact locations of these transfer stations have not been identified as the Final Draft F.S is not yet submitted. When these are identified and if necessary, site specific evaluation of the baseline conditions at these locations will be performed.

Environmental baseline data are presented in the following order:

- Meteo-climatologically Conditions;
- Ambient air quality;
- Soil Characteristics;
- Geological survey;
- Water resources;
- Geophysical survey;
- Fauna and flora.

5A.2 Project Location and Surrounding

Refer to Chapter 4, Section 4.2 for a comprehensive description of the project location and surrounding.

5A.3 Climate

GS is located in a transitional zone between the temperate Mediterranean climate to the West and North and the arid desert climate of the Negev and Sinai deserts to the East and South. There are two well defined seasons: the wet season (October to April), and the dry season (May to September). . A review of the published literature and previous studies performed for GS was conducted and the results are presented below.

The average daily temperature in GS ranges from 25ºC in Summer and 13ºC in Winter, The maximum daily temperature can reach 29-30ºC and the minimum temperature is around 9ºC (UNDP/PAPP 2009; UNEP 2009). Annex 5A-a shows the daily recorded temperatures at Gaza meteorological station for the Year 2006 (refer to Figure 5A.1 for the location of Gaza station).
Data on humidity and wind speed were measured at different locations in Khan Younis (UNDP/PAPP 2009). The daily relative humidity fluctuates between 65% in daytime and 85% at night in Summer and between 60% and 80% respectively in Winter. Wind speed is

largely variable with a maximum velocity of around 3.9 m/s (14 km/hour). The maximum recorded wind speed is 18 m/s (65 km/hour), during winter storms. The prevailing wind direction is SW with an average speed of 4.2 m/s in winter and from NW during summer. The wind speed averages for GS in the period between 1997 and 2007 are included in Annex 5-b.

5A.3 Precipitation and Evaporation

Figures 5A.1a and 5A.1b show the average rainfall for the hydrological years 2006/2007 and 2010/2011 respectively, as measured at the 12 meteorological stations distributed over GS (PWA 2011). It is noticed in both Figures that rainfall intensity in the south of GS (Khan Younis and Rafah governorates) is lower than the intensity measured in Gaza and Gaza North Governorates. The rainfall depth recorded at Gaza South (closest station to Johr al Deek) and Khuza'a (closest station to El-Fukhary) was 272 mm and 140.5 mm respectively for the hydrological year 2010/2011 (Table 5A.1). The average annual rainfall depth between 1999 and 2009 for Khuza'a was 236.69mm (Annex 5A-c).

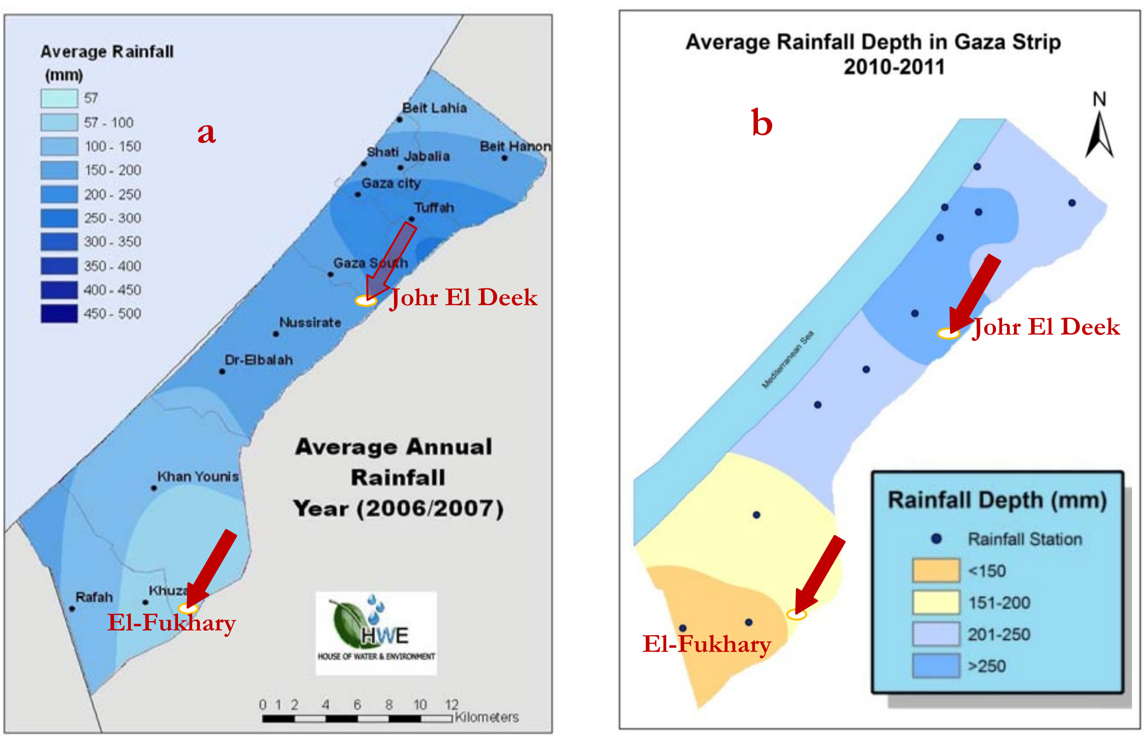


Figure 5A.1: Average rainfall intensity for the hydrological year a)2006/2007 and b)2010/2011 (PWA 2011)

Table 5A.1: Rainfall Depth for the season 2010 -2011 in GS

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

Annex 5A-d includes measurements for the cumulative annual rainfall at the Gaza meteorological stations recorded/interpolated in the period between 1973 and 2007. Using these data the graph of Figure 5A.2 was produced which shows a comparison between the the amount of yearly cumulative rainfall recorded at Gaza South and Khuzaa meteorological stations.

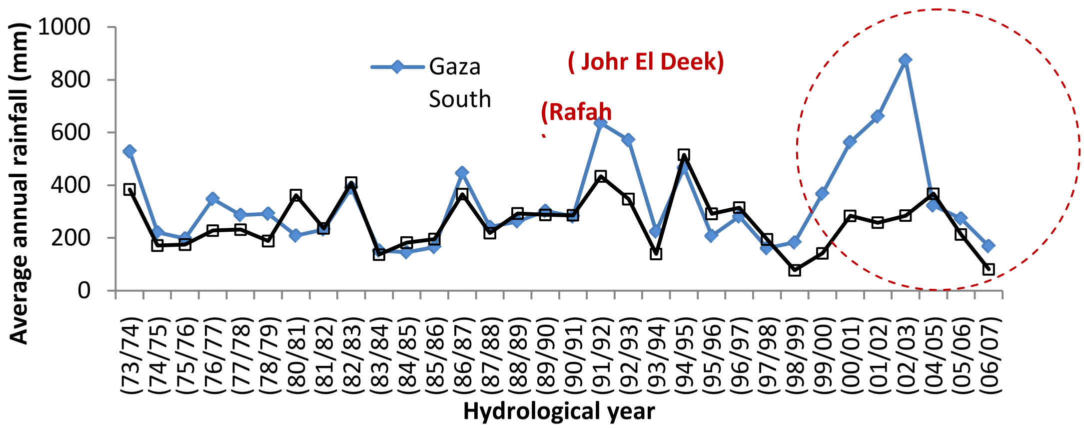


Figure 5A.2: Comparison between the cumulative annual rainfall amounts recorded at Gaza South and Khuzaa meteorological stations.

The results shown in Figure 5A. 2 agree with the data previously presented on precipitation in Figure 5A.1 and Table 5A.1. This shows that the expected rainfall intensity at El-Fukhary would be low as compared to Johr al Deek. This is an important variable in the leaching assessment of wastes disposed of at the two sites.

The average annual evaporation rate in the GS is around 1900 mm/y (5.2 mm/day). For Khan Younis Governorate, this ranges from 2.1 mm/day in Winter to 6.3 mm/day in Summer – this may represent El-Fukhary. For Gaza Governorate, data recorded at the Gaza meteorological station shows that the average annual evaporation is around 4.6 mm/day (Annex 5A-d1) – this may represent Johr al Deek. The maximum evaporation rate increases during the summer and may reach over 6 mm/day between June and August(UNDP/PAPP 2009).

5A.4 Ambient Air Quality and noise

Ambient air quality and noise measurements at El-Fukhary and Johr al Deek sites were conducted. The measurements were conducted adjacent to the existing landfill site as well as at the nearest residential cluster to each of the two landfills. The field measurements for ambient air include CO_2 , CO, PM2.5, PM5 and PM10. The results could be summarized as follows:

El-Fukhary Landfill (Location: N= 31^0 16.233′ E=34^0 19.571′ Elevation= 50.6m Date:09/01/2012)

- The lowest CO_2 concentration was 214.0 ppm recorded at noon and the maximum was 742.0 ppm recorded at around 4PM. The mean daily value was 429.0 ppm, standard deviation of 233.0 ppm.
- The lowest CO concentration was 0.1 ppm recorded at noon and the maximum was 6.8 ppm recorded at around 4PM. The mean daily value was 1.4 ppm standard deviation of 2.5 ppm.
- The lowest noise level being measured was 65.6 dB recorded at around 4PM and the highest was 79.9 dB recorded at around 11AM. The mean daily value was 75.4 dB, standard deviation of 4.9 dB.
- The lowest concentration for PM2.5 being measured was 168 $\mu g/m^3$, recorded at around noon and the highest was 3476 $\mu g/m^3$, recorded at around 10AM. The mean daily value was 821 $\mu g/m^3$, with a standard deviation of 732 $\mu g/m^3$.
- The lowest concentration for PM10 being measured was 420 $\mu g/m^3$, recorded at around noon and the highest was 8691 $\mu g/m^3$, recorded at around 10AM. The mean daily value was 2053 $\mu g/m^3$, with a standard deviation of 1829 $\mu g/m^3$.

Nearest residential cluster to El-Fukhary Landfill (Location: N= 31^0 17.238′ E=34^0 18.929′ Elevation= 44.9 m Date:09/01/2012)

- The lowest CO_2 concentration was 194.0 ppm recorded at noon and the maximum was 787.0 ppm recorded at around 4PM. The mean daily value was 420.0 ppm, standard deviation of 244.0 ppm.
- The lowest CO concentration was 0.1 ppm recorded at noon and the maximum was 6.4 ppm recorded at around 4PM. The mean daily value was 9.5 ppm standard deviation of 21.5 ppm.
- The lowest noise level being measured was 73.5 dB recorded at around 4PM and the highest was 87.5 dB recorded at around 11AM. The mean daily value was 78.6 dB, standard deviation of 5.9 dB.
- The lowest concentration for PM2.5 being measured was 255 $\mu g/m^3$, recorded at around 1 PM and the highest was 1303 $\mu g/m^3$, recorded at around noon. The mean daily value was 468 $\mu g/m^3$, with a standard deviation of 209 $\mu g/m^3$.
- The lowest concentration for PM10 being measured was 637 $\mu g/m^3$, recorded at around 1 PM and the highest was 3257 $\mu g/m^3$, recorded at around noon. The mean daily value was 1171 $\mu g/m^3$, with a standard deviation of 523 $\mu g/m^3$.

Johr al Deek Landfill (Location: N= 31^0 27.566′ E=34^0 27.092′ Elevation= 62.3m Date:10/01/2012)

- The lowest CO_2 concentration was 215.2 ppm recorded at noon and the maximum was 566.5 ppm recorded at around 4PM. The mean daily value was 370.1 ppm, standard deviation of 143.0 ppm.
- The lowest CO concentration was 0.1 ppm recorded at noon and the maximum was 0.3 ppm recorded at around 4PM. The mean daily value was 0.2 ppm standard deviation of 0.1 ppm.
- The lowest noise level being measured was 69.5 dB recorded at around 4PM and the highest was 85.6 dB recorded at around 11AM. The mean daily value was 77.3 dB, standard deviation of 6.4 dB.
- The lowest concentration for PM2.5 being measured was 210μg/m^3 , recorded at around 1 PM and the highest was 5450 μg/m^3, recorded at around 9AM. The mean daily value was 1268 μg/m^3 , with a standard deviation of 1414 μg/m^3.
- The lowest concentration for PM10 being measured was 526 μg/m^3 , recorded at around 1 PM and the highest was 13625 μg/m^3, recorded at around 9AM. The mean daily value was 3169 μg/m^3 , with a standard deviation of 3536 μg/m^3.

Nearest residential cluster to Johr al Deek Landfill (Location: N= 31^0 27.458′ E=34^0 26.675′ Elevation= 69.4 m Date:10/01/2012)

- The lowest CO_2 concentration was 205.0 ppm recorded at noon and the maximum was 595.0 ppm recorded at around 4PM. The mean daily value was 328.0 ppm, standard deviation of 158.0 ppm.
- The lowest CO concentration was 0.1 ppm recorded at noon and the maximum was 0.9 ppm recorded at around 4PM. The mean daily value was 0.4 ppm standard deviation of 0.4 ppm.
- The lowest noise level being measured was 42.7 dB recorded at around 4PM and the highest was 68.0 dB recorded at around 11AM. The mean daily value was 50.8 dB, standard deviation of 10.7 dB.
- The lowest concentration for PM2.5 being measured was 179 μg/m^3 , recorded at around noon and the highest was 3366 μg/m^3, recorded at around 10AM. The mean daily value was 764 μg/m^3 , with a standard deviation of 1059 μg/m^3.
- The lowest concentration for PM10 being measured was 447 μg/m^3 , recorded at around noon and the highest was 8416 μg/m^3, recorded at around 10AM. The mean daily value was 1910 μg/m^3 , with a standard deviation of 2647 μg/m^3.

Air quality data for the five governorates of the GS were also gathered from the literature and presented below (UNDP/PAPP 2009). These are a useful reference that would complement the current field measurements , the pollutants of concern which have been reviewed have included SO_2, NO_x, CO and suspended particulate matter (SPM).

For the transfer stations, the following describes the mean , maximum and minimum noise level being measured at each transfer stations. The measurements were conducted (September 2012) between 8AM and 4PM , taking ten readings per hour.

Al-Namsawi

The lowest noise level being measured was 51 dB recorded at around 3PM and the highest was 67 dB recorded at around 12PM. The mean daily value was 66 dB, standard deviation of 12 dB.

Yarmuk

The lowest noise level being measured was 80 dB recorded at around 2PM and the highest was 92 dB recorded at around 1PM. The mean daily value was 85dB, standard deviation of 3 dB.

Tel al Sultan

The lowest noise level being measured was 47 dB recorded at around 8AM and the highest was 78 dB recorded at around 1PM. The mean daily value was 60dB, standard deviation of 9dB.

Beit Lahia

The lowest noise level being measured was 54dB recorded at around 3PM and the highest was 77 dB recorded at around 2PM. The mean daily value was 70dB, standard deviation of 8dB.

Al-Maslakh

The lowest noise level being measured was 64dB recorded at around 8AM and the highest was 87 dB recorded at around 2PM. The mean daily value was 75dB, standard deviation of 8dB.

5A.4.1 Sulfur Dioxide (SO_2)

Concentrations of SO_2 in air samples taken from different areas in Gaza Strip (North Gaza, Gaza, Middle Zone, Khan Younis and Rafah Governorates) are presented in Figure 5A.3-a The concentration of SO_2 measured in Gaza was the highest among all the governorates.

This may be explained by the fact that most of the industrial activities are located in Gaza and also because Gaza is more densely populated as compared to other governorates.

5A.4.2 Nitrogen oxides (NO_x)

Seasonal concentrations of NO_x in air samples collected from different locations in Gaza Strip are presented in Figure 5A.3-b. Similar to SO_2, NO_x concentrations in Gaza were the highest among all governorates. The heavy traffic in Gaza as compared to southern areas may explain the high concentrations of NOx measured in Gaza.

b

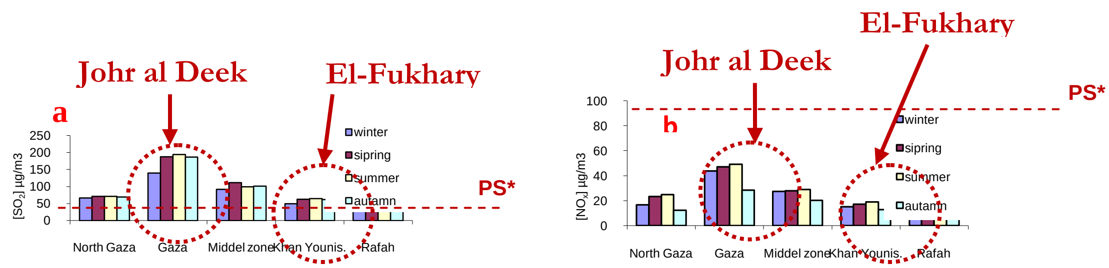


Figure 5A.3: a) Seasonal variations of sulfur dioxide (µg/m^3) in different locations and seasons in GS; b) Seasonal variations of NO_x (µg/m^3) in different locations in GS. *PS refers to Palestinian Standard for ambient air quality.

Note that the SO_2 emissions have exceeded the Palestinian Standards while NO_2 emissions were below the Standards at almost all locations and time periods where the measurements were taken.

5A.4.3 Carbon Monoxide (CO) and Suspended Particulate Matter (SPM)

Concentrations of CO and SPM for air samples taken in 1997 at the market in Khan Younis city center are presented in Table A5.2 (preliminary EA study in 1997). The market is regarded as a high area for air pollution in the governorate.

Table 5A.2: Results of air quality survey (source: UNDP/PAPP, 2009)

		Sunday	Monday	Tuesday	Wed.	Thurs.	Friday	Sat.
Suspended Particle Matter (SPM)	Upper* Lower**	0.2-1.0 0.5	0.1-0.5 0.3	0.1-1.0 0.4	0.1-1.0 0.4	0.2-0.4 0.3	0.05-0.25 0.15	0.05-0.25 0.1
Carbon Monoxide (CO)	Upper Lower	0-10 2	0-10 2	0-20 4	0-10 2	0-10 1	0-10 2	0-5 1

*****Upper value: ppm/1 hr average for SPM and ppm/8 hr average for CO
**Lower value: Daily average of measured values.

5A.5 Soil Characteristics

5A.5.1 General characteristics

The soil in GS is mainly composed of three types; sand, clay and loess as shown in Figure 5A.4. The sandy soil is found along the coastline extending from South to outside the northern border of the Strip, in the form of sand dunes. The thickness of sand fluctuates between two and 50 meters due to the hilly shape of the dunes

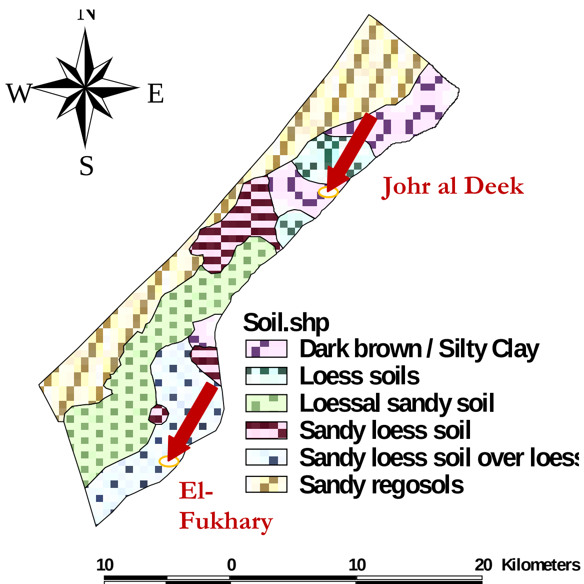


Figure 5A.4: Soil map of GS (PWA, 2003)

Soils at the El-Fukhary site are mostly loessial soils, and the ridges consist of sandstone (Kurkar). Sand dunes are found along the coast to the north, south and west of the area, and have high rainwater infiltration capacities. Johr al Deek is surrounded by loess soils and dark brown/silty clay. Figure A5.5 shows the different land uses for the GS. The north of GS – surroundings of Johr al Deek - is more populated and cultivated as compared with the south of the Strip – surroundings of El-Fukhary. The potential of nuisance (odor and air emissions) and impact on vegetation due to waste disposal at Johr al Deek could be higher than at El-Fukhary.

5A.5.2 Landfill soil cover

The Analysis of the type of soil at both sites will be used to evaluate if additional soil shall be exported from outside the site for waste daily cover. If needed, both sites would have access to soil exported from outside the site for the daily cover of waste; however, it seems that this will be an easier practice at El-Fukhary due to more available land and clearer environment. The soil types at the two sites are different which may affect the set of conditions which will be used in placing the soil layer (compaction, water content, weight, etc.). The soil resulting from the site clearance and construction stage shall be stored for later use.

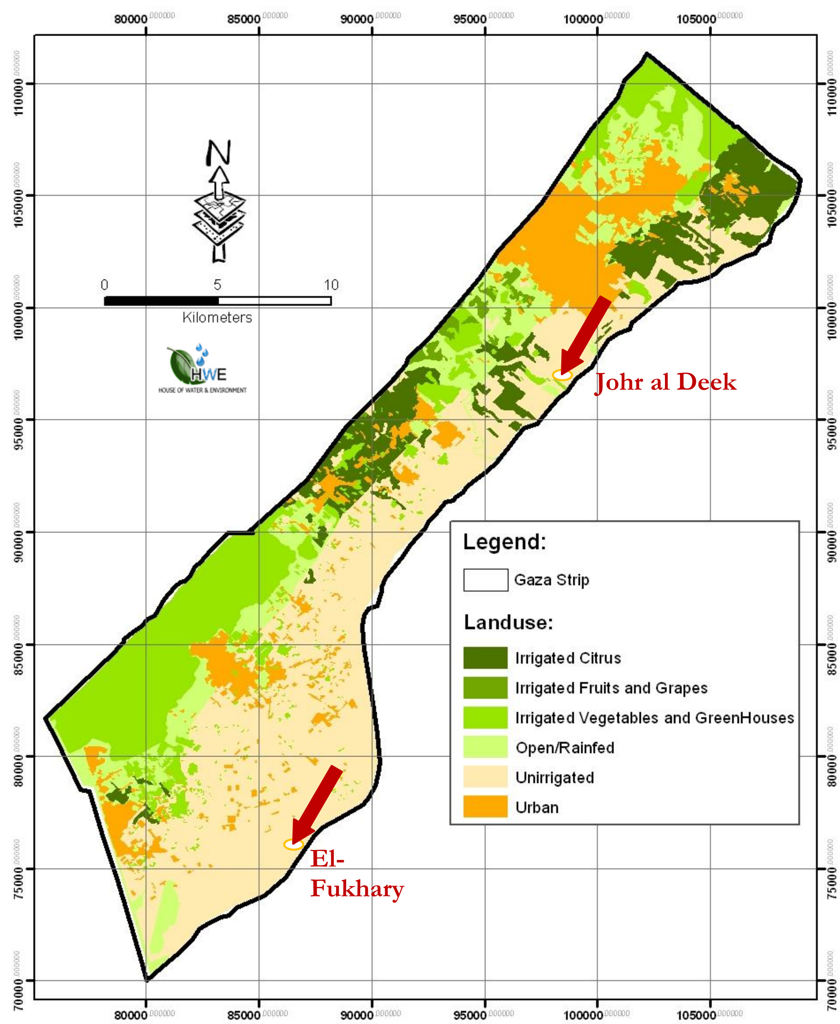


Figure 5A.5: Land use map for GS

5A.5.3 Geotechnical investigation

Four boreholes were drilled during the FS for the GSWMP. Two at El-Fukhary; Borehole 1 south west of the existing landfill and Borehole 2 north west of the existing landfill, and two at Johr al Deek; a western borehole (Borehole 1) and an eastern borehole (Borehole 2). Soil characteristics for the boreholes are presented in details in the Draft FS.

Regarding El-Fukhary boreholes, the top layer consisted of clayey silt the thickness of which varied between 10m to 3m for the two boreholes. The water content ranged from 10 to

11.6%. The top layer was followed by a deeper layer consisting of fine sands which ranged from 1 to 11 m for Borehole 1 and Borehole 2 respectively. The water table in the two boreholes was at 46 m.

For Johr al Deek, the top layer (7m thickness) consisted of clayey silts followed by sand-silt-clay mixture with a water content of over 10% in Borehole 1 and silty sands with a water content of 8.5% for Borehole 2. According to the FS investigation , the water table exists at more than 50m. Schematic geologic cross sections have been constructed based on the boreholes at Al-Fukhary and Johr al Deek, these are shown in Figure 5A.6a and Figure 5A.6b for El-Fukhary and Johr al Deek sites respectively

5A.5.4 Field Permeability Tests

No permeability calculation has been conducted/published at Al-Fukhary or Johr al Deek sites within the FS for this project. However, field permeability tests in El Fukhary area - located at a distance of 3 km from El-Fukhary Landfill site - have been previously conducted at different depths of 29.5m, 35m, 40m, 45m and 50m (UNDP/PAPP 2009). The results are shown in Table 5A.3. These results may be used to represent the soil permeability at the El-Fukhary site.

Table 5A.3: Field permeability test results (El Fukhary area). Source(UNDP/PAPP 2009)

Depth below ground surface level (m)	Location soil description	Coefficient of permeability K (m/day)
29.5	Clayey Sand(SC)	0.06
35	Kurkar(SP)	20
40	Clayey sand(SC)	0.06
45	Kurkar(SP)	20
50	Sand stone(SP)	20

5A.6 Geological survey

5A.6.1 Topography and Physiography

GS 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. These are narrow and consist primarily of sandstone.

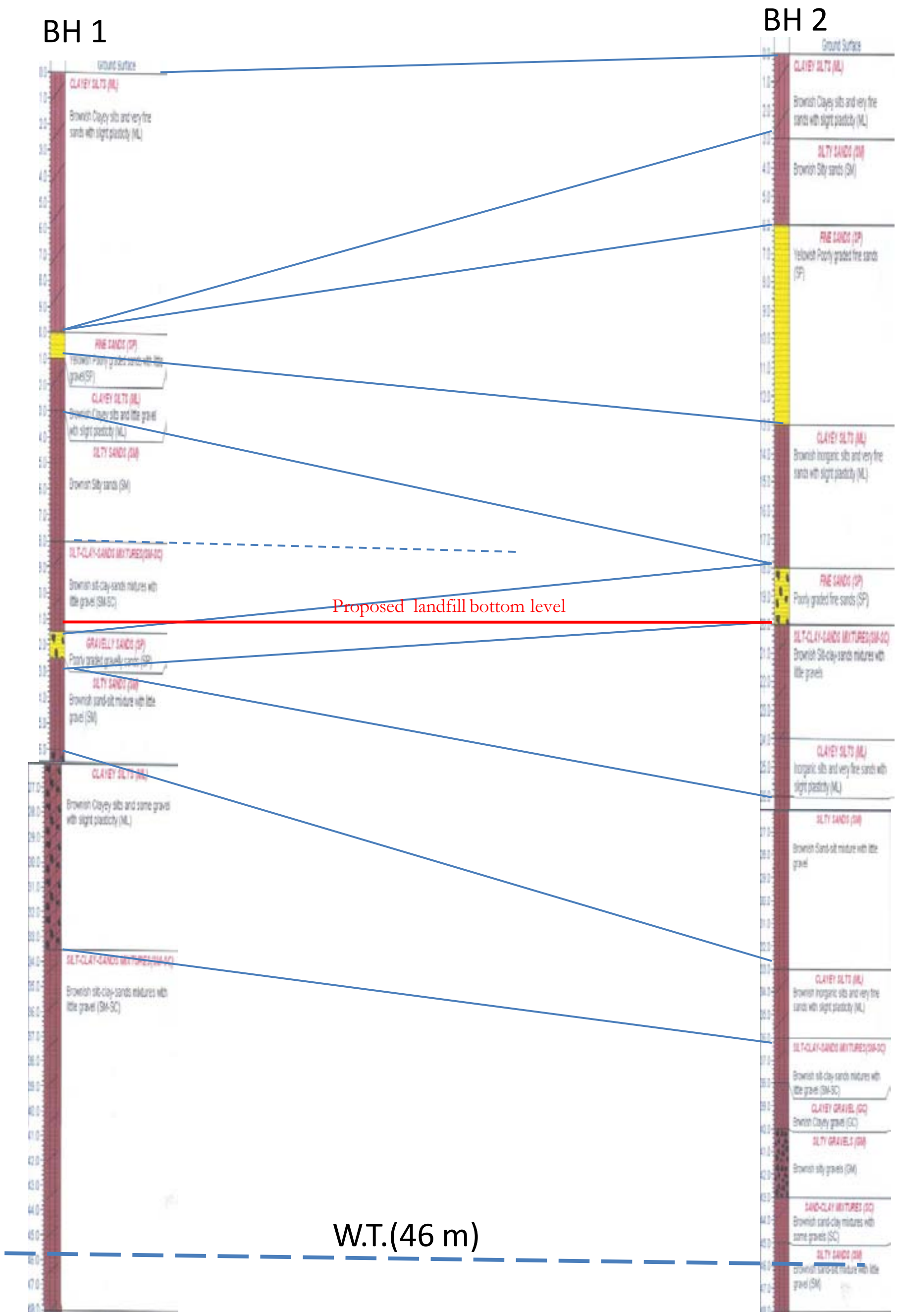


Figure 5A.6a: Schematic Geologic Cross Section for El-Fukhary

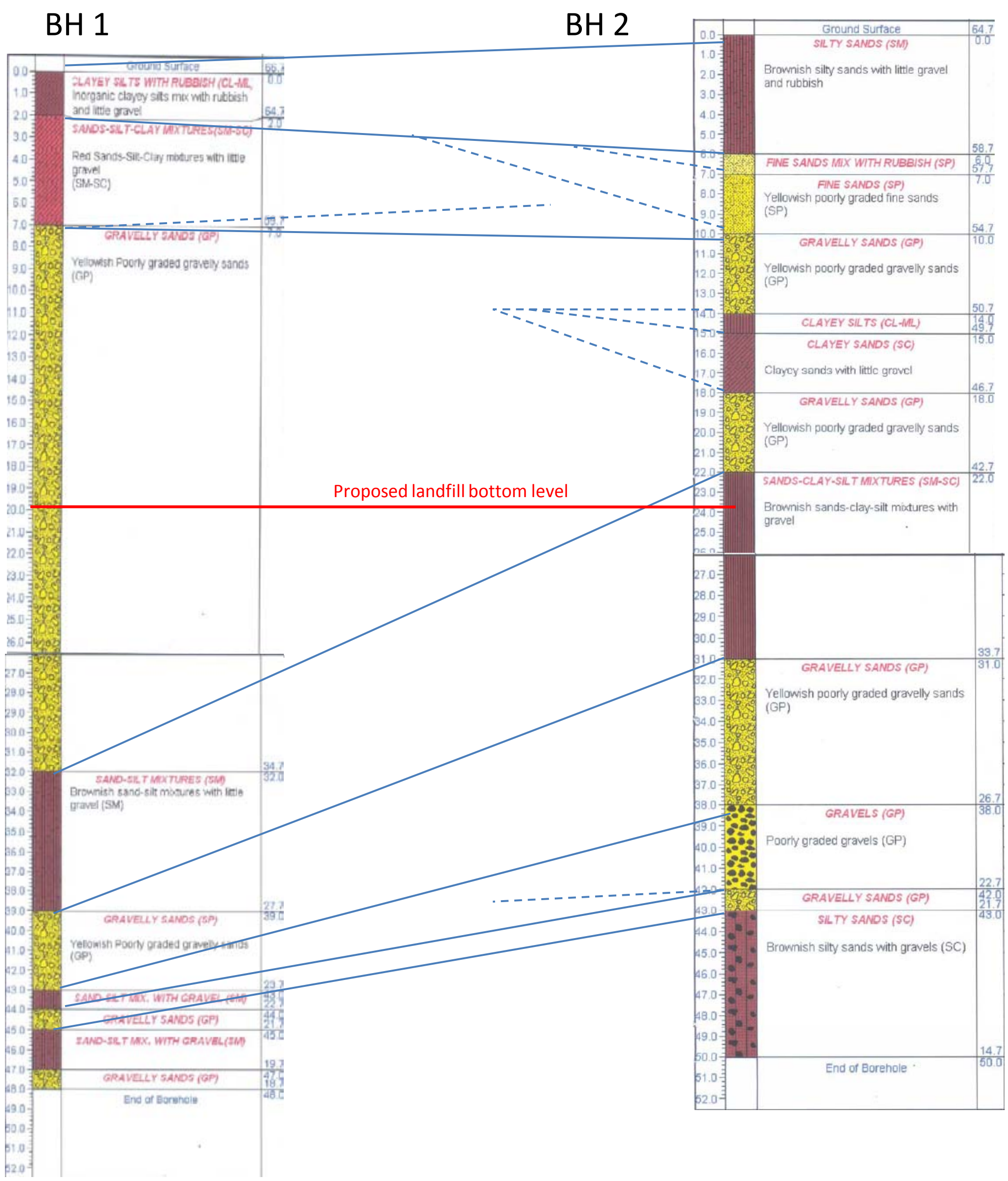


Figure 5A.6b: Scematic Geologic Cross Section for Johr al Deek

(Kurkar). In the South, these features tend to be covered by sand dunes as shown in Figure 5A.6c.

Land surface elevation in Khan Younis and Rafah Govornorates ranges from zero to about 100 m above mean sea level (AMSL). Two high ridges appear on the topography map in the south of GS (Figure 5A.7); the northern ridge covers the area of Bani Suhaila, Abasan, and Khuza'a. The second ridge covers the southern eastern part of Rafah and is occupied by the Gaza International Airport and the industrial zone. The ridges' elevation reaches as high as 90 meters AMSL. Between the two ridges, a depression area exists which is known as Al Fukhari area. The land surface elevation at Rafah ranges between 51.6 to 52.5m AMSL. The topographic survey map indicates that visual impact at El-Fukhary landfill may be more significant as compared with Johr al Deek

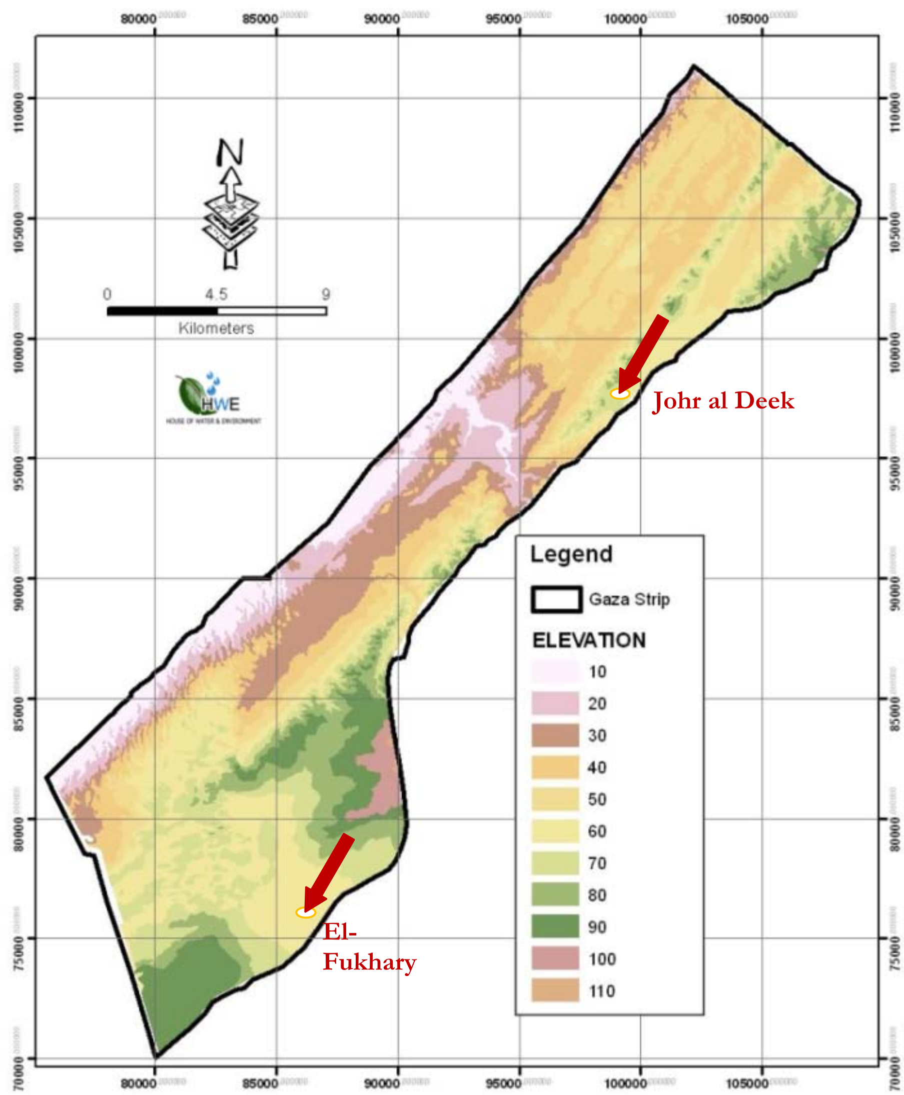


Figure 5A.6c: Detailed topographic survey map of Gaza Strip

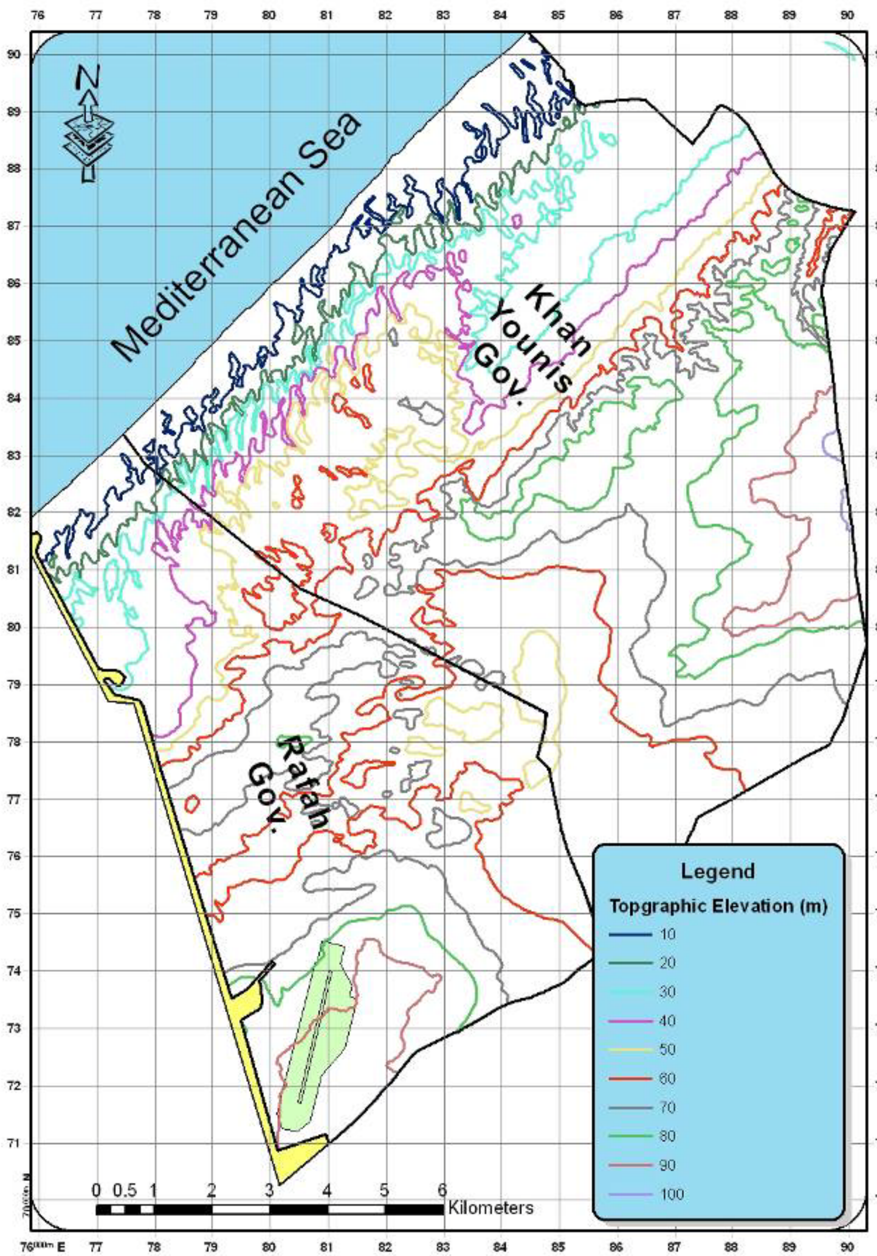


Figure 5A.7: Topographic map for Rafah and Khan Younis Governorates. Source (UNDP/PAPP 2009)

5A.6.2 Geomorphology

Three small valleys (Wadi Bet Hanoon, Wadi Gaza and Wadi Salqah) cross the GS from East to West; they have little water in Winter and are dry in Summer. Wadi Gaza is the only river inside the area and is characterized by a stream regime, where it grows from the limestone hills of Neqab and its stream develops with SE-NW direction, for about 7 km inside GS, then dividing into two sectors. The Wadi cuts through thick loess sediments overlying a gravel horizon on partly hardened calcareous sand (locally known as "Kurkar"). Six sub-basins drain and discharge their water into Wadi Gaza through which it goes directly into the Mediterranean Sea. It was observed that the drainage patterns of the 6 sub-basins are at a considerable distance from Al-Fukhary and Johr al Deek landfill locations. The coastal land with a width of 1.0 to 3.0 km along the sea is covered with sand dunes of 20-40m height AMSL.

5A.6.3 Geology

Investigation of the Geology of GS was based on the following sources:

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

The geology of GS consists of a sequence of geological formations ranging from upper Cretaceous to Holocene. This sequence is gradually sloping westwards as shown in Figure 5A.8. Annex 5A-f includes a tabular presentation of the geological history of GS. The formations of this sequence are:

a) Tertiary Formations

The Tertiary formations consist of Saqiya group (upper Eocene to Pliocene) with a thickness of 400 m to 1000 m underlined by Eocene Chalks and limestone as shown in Figure 5A.8.

b) Quaternary Formations

The Quaternary deposits throughout the Gaza Strip overlie the Saqiya group, while at the East they overlie the Eocene Chalks and limestones. The thickness of the Eocene deposits reaches to about 200 m. The coastal aquifer is composed of loose sand dunes (Holocene age) and Kurkar group (Pleistocene). The Kurkar group is composed of marine and aeolian calcareous sandstone (locally known as "kurkar"), reddish silty sandstone ("hamra"), silts, interlayers of clay deposited during the Last Glacial stage and during the Holocene, unconsolidated sand and conglomerates. Close to the present shoreline, the sequence of the Kurkar Group attains an average thickness of 200 m in the South and around 120 m in the North, wedging gradually out towards the foothills of the Judea and Samaria Mountains in the East. The Holocene deposits are found at the top of the Pleistocene formation with a thickness up to 25m.

c) Sand Dunes

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

d) Sand, Loess and Gravel beds

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

e) Alluvial Deposits

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

f) Beach Formation

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

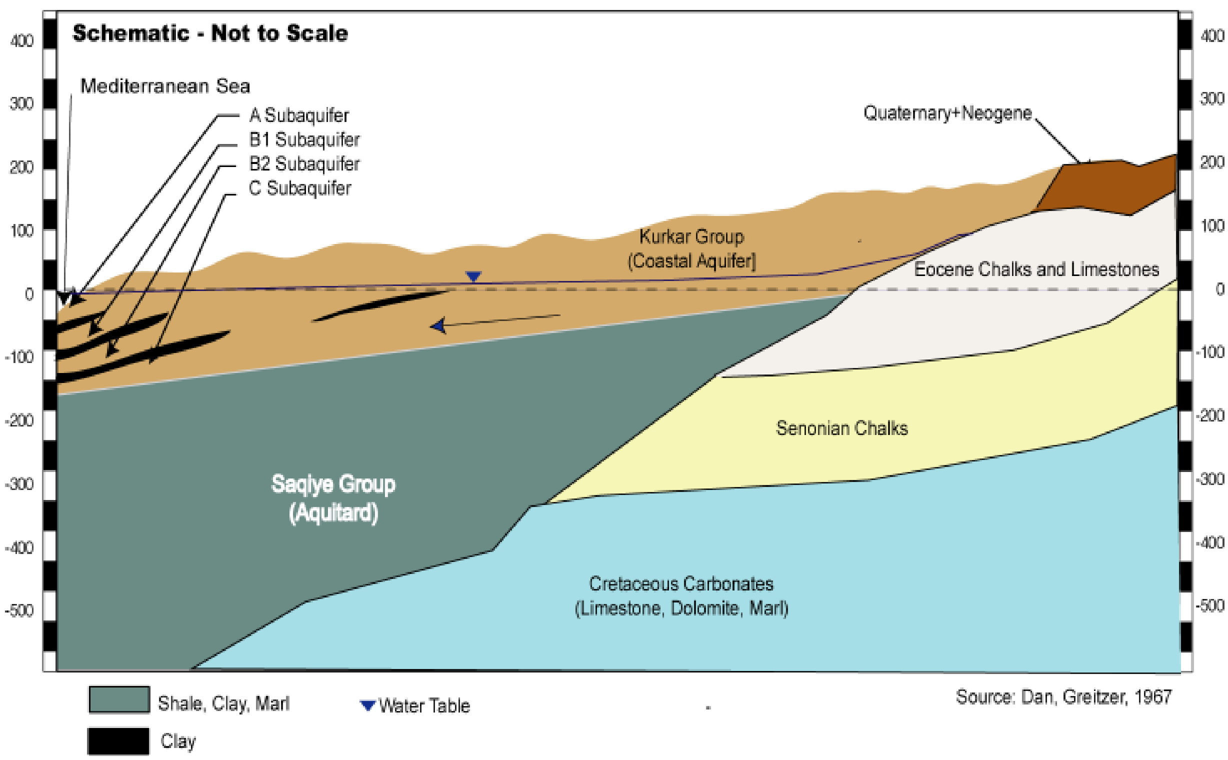


Figure 5A.8: Typical hydrgeological cross section of GS (PWA/USAID 2000a)

5A.6.4 Seismicity

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

Figure 5A.9 shows the variability of the peak ground acceleration (PGA) in Palestine, as developed by the Institute for Petroleum and Geophysical Research. The hazard is based on 10% probability of exceedance in 50 years (10/50), or a return period of circa 475 years. This hazard is mainly contributed by magnitude 6.0 - 6.5 earthquakes. Evidently, larger earthquakes (M>7) may occur in the region, once in 1000 to 6000 years on the average depending on the seismogenic zone, posing much higher hazard.

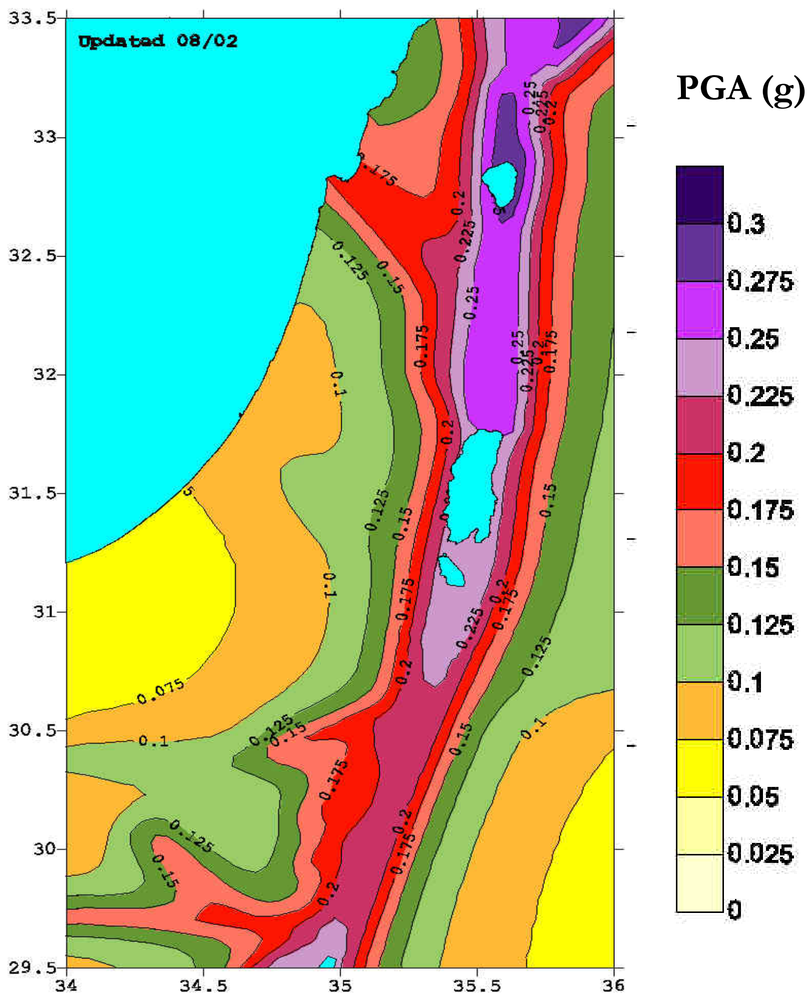


Figure 5A.9: Seismicity map of Palestine

Figure 5A.9 shows that the maximum value of PGA is approximately 0.3 g, in the northern part of the Dead Sea fault. For structural design purposes in the Gaza strip, the PGA is taken as 0.075g which corresponds to an earthquake of magnitude 5 on Richter scale. According to the geological survey, no major fault type formations have been observed in Gaza Strip area.

5A.7 Water Resources

5A.7.1 General characteristics

The coastal aquifer of GS is part of a regional groundwater system that stretches from the coastal areas of Sinai in the South to Haifa in the North. The coastal aquifer is generally 10-15 km wide, and its thickness ranges from zero - 200 m at the East and the coastline respectively.

The coastal aquifer consists primarily of Pleistocene age Kurkar Group deposits including calcareous and silty sandstones, silts, clays, unconsolidated sands, and conglomerates. Near the coast, coastal clays extend to around 2-5 km inland, and divide the aquifer sequence into three or four sub-aquifers, depending upon location (referred to as sub aquifers A, B1, B2, and C) as shown in Figure 5A.10. Towards the East, the clays pinch out and the aquifers are largely unconfined (phreatic).

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

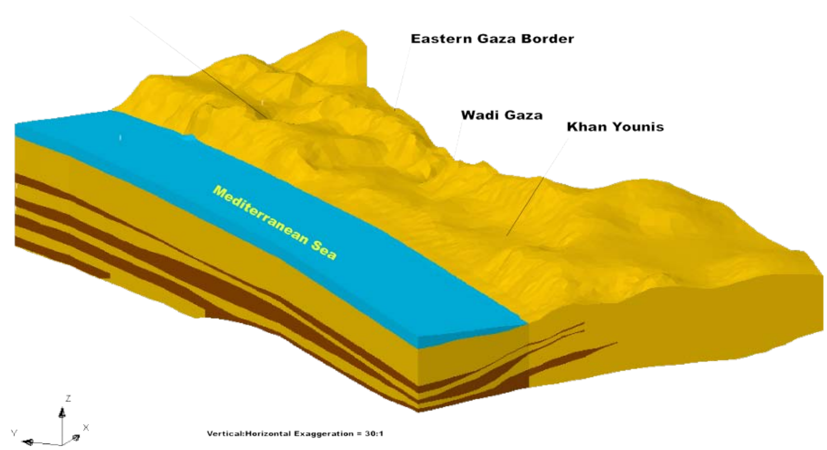
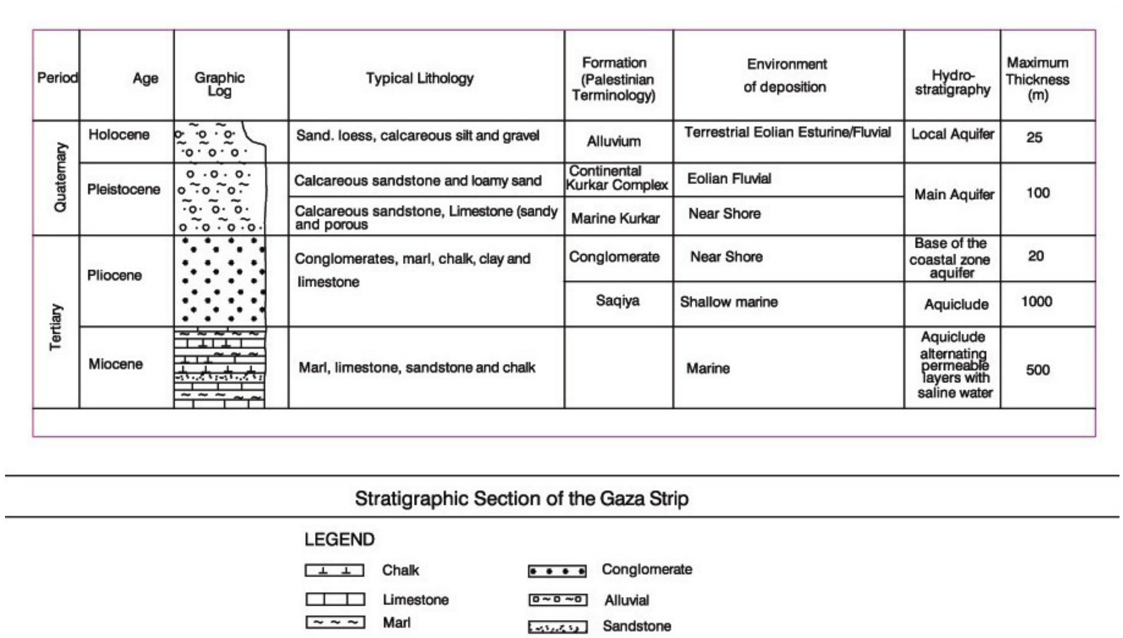


Figure 5A.10: 3D Geological presentation of the Gaza Strip

5A.7.2 Aquifer Lithology

In addition to the 134 well logs that were gathered from PWA database, and the 27 new well logs collected from CMWU, data points representing nodes of the CAMP finite elements model have been also procured from PWA(CMWU 2008). These data points represent the seven layers composing the sub aquifer of the Gaza coastal aquifer and the confining layers between them. These layers are shown in Figure 5A.11, which will be employed for the determination of the thickness and elevation of the different layers for the groundwater model for the project proposed sites.



Period	Age	Graphic Log	Typical Lithology	Formation (Palestinian Terminology)	Environment of deposition	Hydro-stratigraphy	Maximum Thickness (m)
Quaternary	Holocene		Sand. loess, calcareous silt and gravel	Alluvium	Terrestrial Eolian Esturine/Fluvial	Local Aquifer	25
	Pleistocene		Calcareous sandstone and loamy sand	Continental Kurkar Complex	Eolian Fluvial	Main Aquifer	100
			Calcareous sandstone, Limestone (sandy and porous	Marine Kurkar	Near Shore		
Tertiary	Pliocene		Conglomerates, marl, chalk, clay and limestone	Conglomerate	Near Shore	Base of the coastal zone aquifer	20
				Saqiya	Shallow marine	Aquiclude	1000
	Miocene		Marl, limestone, sandstone and chalk		Marine	Aquiclude alternating permeable layers with saline water	500

Figure 5A.11: Stratigraphic column of Gaza Aquifer

5A.7.3 Aquifer Hydraulic Properties

Most aquifer tests have either been conducted on shallow agricultural wells or municipal wells that are screened over relatively long depth intervals. Little is known about the hydraulic properties of the deep aquifer layers. Relative hydraulic conductivity (K) values for individual sub-aquifers are also not well defined and permeabilities of the clay layers separating the sub-aquifers have not been determined.

Annex 5A-g shows some of the carried pumping tests by PWA team and the CAMP project with their corresponding transmissivity and hydraulic conductivity. The transmissivity results values ranged between 700 and 5,000 m^2/d. Corresponding values of K were mostly within the range of 20 to 80 m/d. The specific yield values estimates were 15-30 % while specific storativity was about 10-4 (PWA/USAID 2000b)

5A.7.4 Groundwater Level

The PWA historical groundwater data cover the period from 1971 to 2006. The current groundwater level monitoring system in PWA has around 125 wells which are monitored on a monthly basis. Figures 5A.12 shows the interpreted groundwater elevation for the hydrological years 2006/2007 and 2000/2001. Two large cones of depression can be observed; one in the north and the other in the south of the GS, where water levels is below sea level. These depressions in the groundwater level are mainly due to un-balance of aquifer recharge scheme, where the amount of abstraction due to pumping for the different activities is higher than the amount of recharge - mainly due to rainwater. Figure 5A.12 also shows that the groundwater level at El-Fukhary and Johr al Deek is relatively high as compared to the rest of the strip. This may suggests that the groundwater tends to flow away from the sites.

Two wells were selected to represent the histogram of the groundwater behavior. The wells were located at the groundwater cones of depression in the northern and southern part of the GS. The histograms of the groundwater behavior at the two wells, named A/53 and P/61 are presented in Figure 5A.13. A general pattern of water table declination was observed for the two wells. Figure 5A.14 shows groundwater levels in Khan Younis area. It is observed that groundwater drops to more than 12 m below sea level.

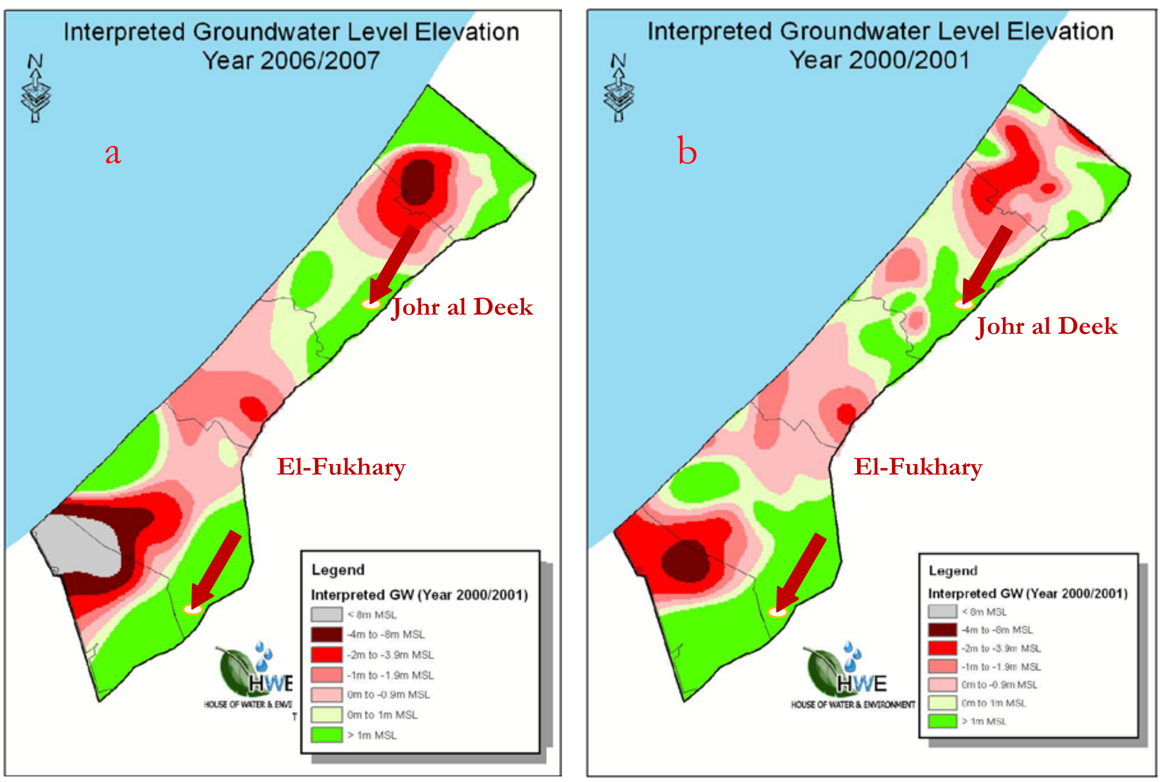


Figure 5A.12: a) Groundwater elevation for the hydrological year 2006/2007 and b) Groundwater elevation for the hydrological year 2000/2001

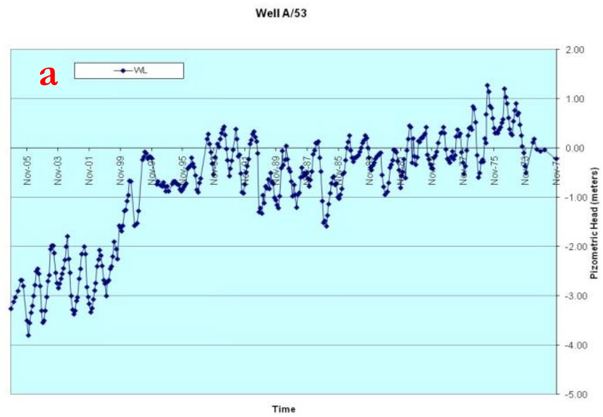


Figure 5A.13: Groundwater level in a) Well A/53 located north of the GS and b) Well P/61 located in the south of the GS

Trends for groundwater levels and direction of groundwater flow in the Northern Gaza Coastal aquifer which encompasses Johr al Deek site are shown in Figure 5A.15 and Figure 5A.16 for the period between 1994 and 2004. The three maps were constructed using data supplied from the agricultural water level monitoring. The maps provide a depiction of the shallow part of the aquifer because all the wells considered were shallow. The levels reflect changes in recharge to and discharge from the aquifer which is influenced by the rate of precipitation, abstraction, lateral flow, intrusion, upcoming of saline water, return flow from irrigation, wastewater or urban storm water. As mentioned for the GS, changes in the groundwater level have affected the direction of water flow, towards the cone of depression which has formed over the years in the northern area.

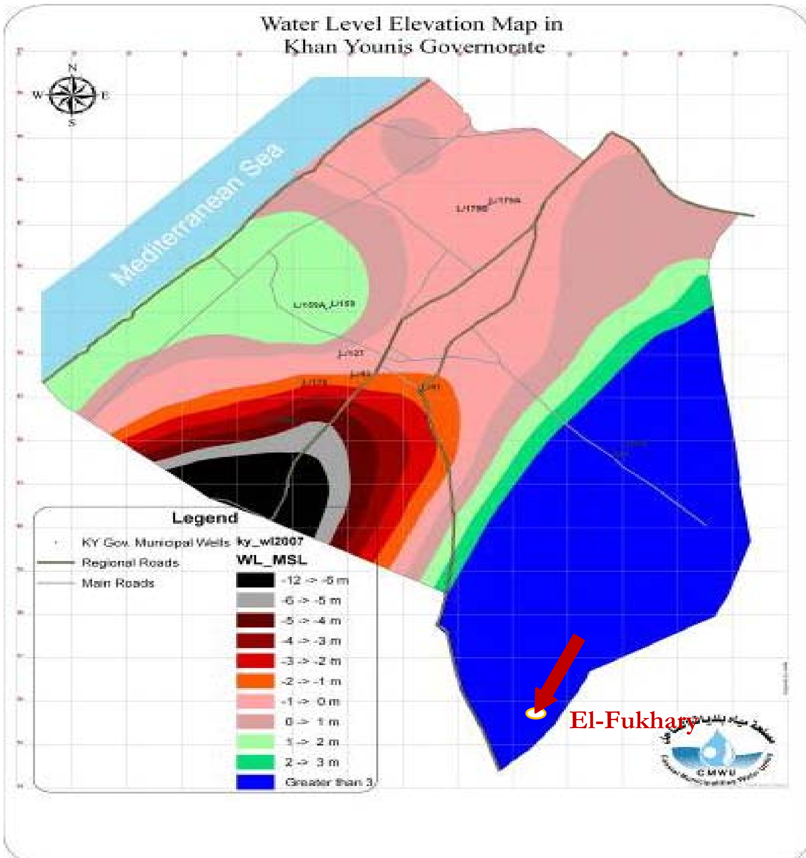


Figure 5A.14 : Water levels in Khan Younis area

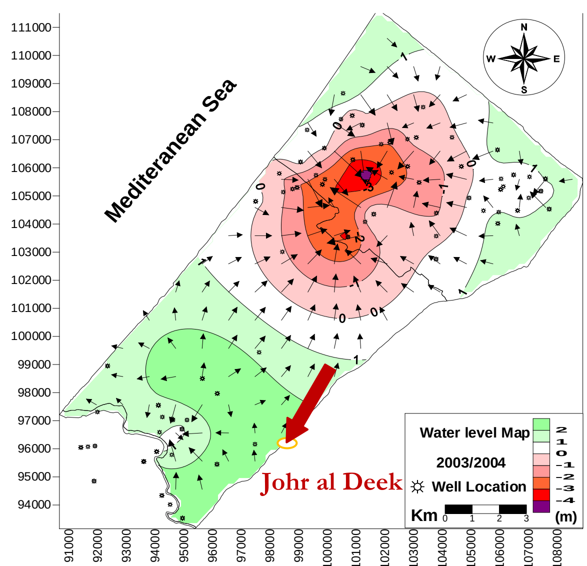
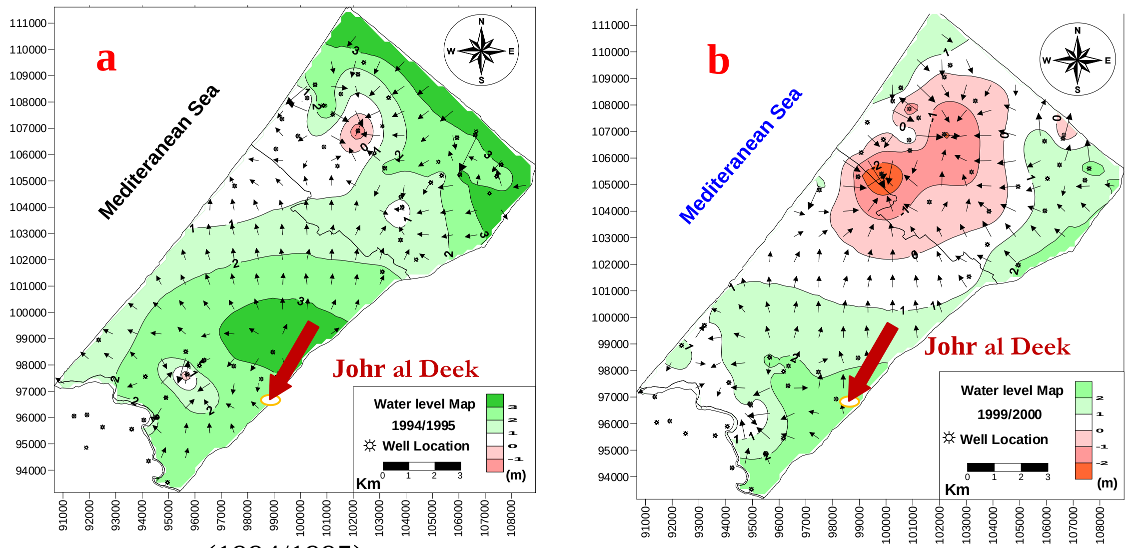


Figure 5A.15: Average groundwater levels and flow direction (2003/2004)



(1994/1995)

(1999/2000)

Figure 5A.16: Average groundwater levels and flow direction for a) Year 1994/1995 and b) Year 1999/2000

5A.7.5 Abstraction and Demand

The aquifer is the only source for fresh water in GS. The water demand has gradually increased as a result of the increasing population, and reached 87 Mcm, for municipal and industrial uses, whilst the agricultural water abstraction reached around 75.25 Mcm abstracted through 145 municipal wells and more than 4600 agricultural wells respectively – among which only 2600 are legally registered.

5A.7.6 Groundwater Quality

PWA and MoA have two different groundwater quality monitoring system; PWA monitors all municipal wells through MoH, and MoA monitors around 150 agricultural wells. All groundwater quality records from both PWA and MoA are transferred to PWA for further monitoring of the groundwater quality.

PWA with coordination with MoH analyzes groundwater samples for a set of chemical parameters which includes Cl^- and NO_3 in addition to TDS, NH_4, SO_4, Ca, Mg, Na, K and F. Annex 5A-h shows the chemical analysis results for representative wells in GS.

MoA monitors groundwater quality using two parameters; chlorides and nitrates. Chlorides are an indication of the water salinity due to upcoming or seawater intrusion, and nitrates are an indication of agricultural activities and/or wastewater presence which directly affect the nitrate content of the groundwater. Figures 5A.17 and 5A.18 show the chloride and nitrate concentration respectively in the groundwater of GS for the hydrological years 2000/2001 and 2007/2008. The data collected has included 1,384 cumulative historical well records for both chlorides and nitrates.

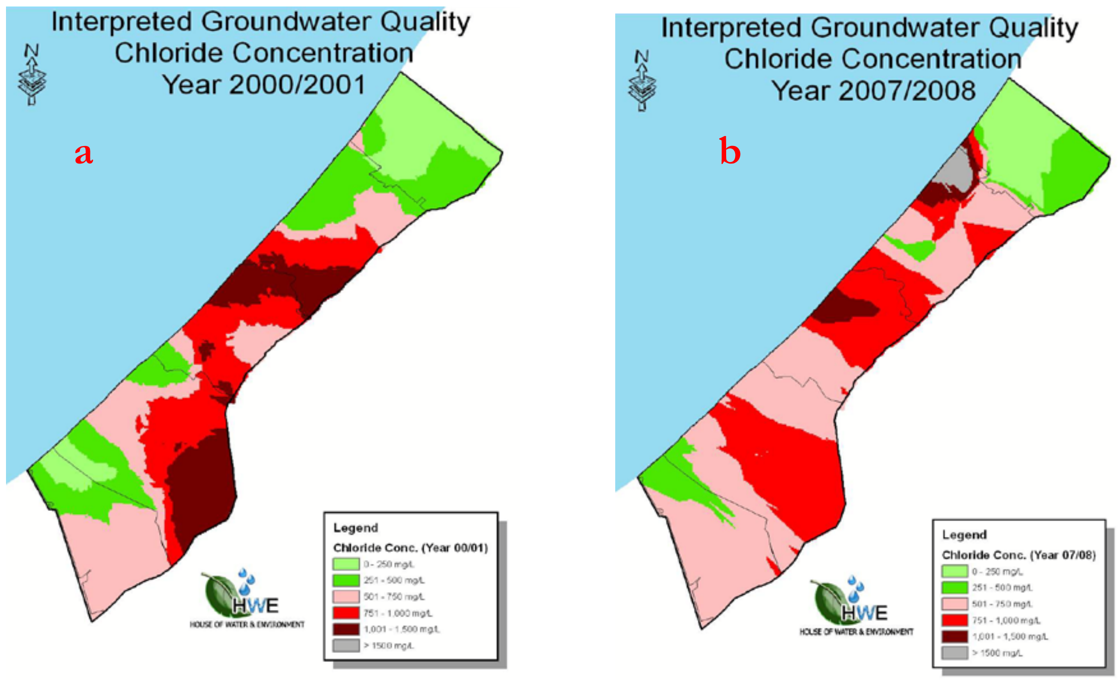


Figure 5A.17: Interpreted Cl^- concentration for a) Year 2000/2001 and b) Year 2007/2008

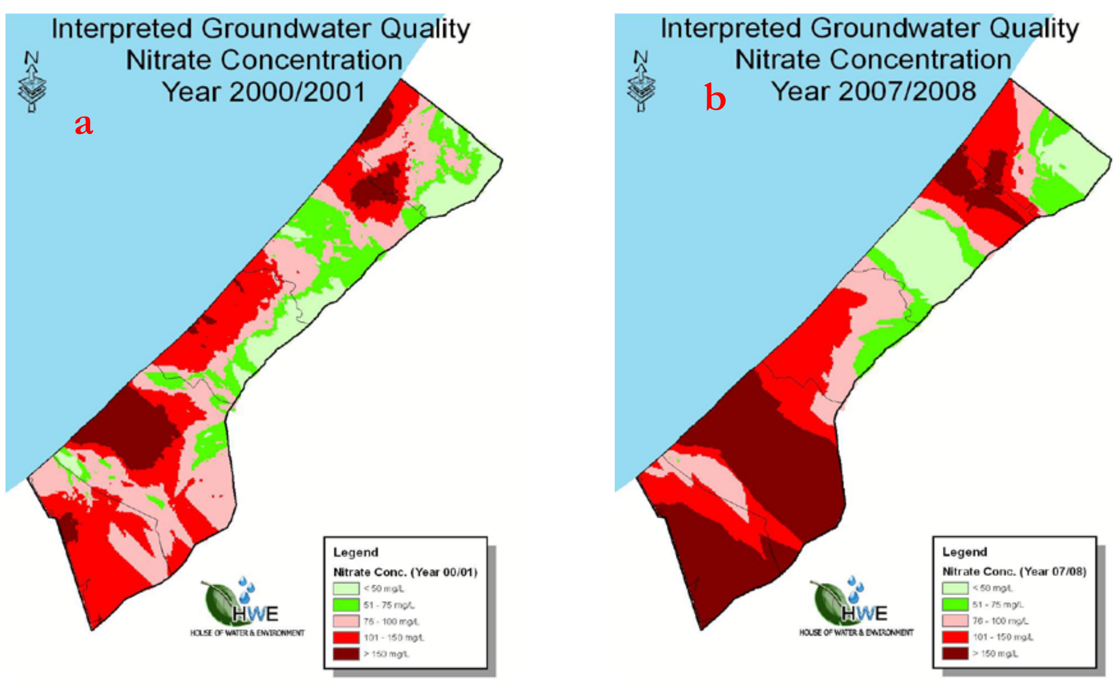


Figure 5A.18: Interpreted NO_3 concentration for a)Year 2000/2001 and b) Year 2007/2008

In most of the wells in Gaza Strip, the chloride content fluctuates between 300 to 1000 mg/l and has reached more than 1000 mg/l in some areas. This exceeds the 250 mg/l limit for Cl^- concentration recommended by the WHO.

Saltwater intrusion varies with the depth and different sub-aquifers exhibit varying degrees of seawater penetration. Trapped water with higher salinity than sea water was found in the deeper aquifer. This was mainly in its western portion and extending up to 2 km from the sea. Currently, salty water intrusion is posing the greatest threat to municipal supply while urban and industrial growth impact water quality.

As for nitrates, the areas of Khan Younis and Rafah had the highest measured nitrate concentration. This may be due to wastewater collection basins, and /or leakage from existing sewage septic tanks.

5A.7.7 Groundwater Vulnerability to pollution

The aquifer vulnerability assessment to contamination in Khan Younis Governorate, Palestine, was conducted in 2011 using the DRASTIC Model within GIS Environment (Hallaq and Elaish 2011). The results show that about 26% and 3% of the study area is under high and very high vulnerability of groundwater contamination, respectively, while more than 43% and 27% of the study area can be classified as an area of moderate and low vulnerability of groundwater contamination, respectively (Figure 5A.19).

It can be observed that the western part of the study area was dominated by high and very high vulnerability classes. East to the western part as well as the south-eastern part have a moderate vulnerability to contamination. In these regions, pesticides which might have heavy metals or nitrate-rich should not be used in the agricultural fields and orchards, since the contaminants may easily leach into the aquifer through the vadose zone. In the central and the eastern part, vulnerability to contamination is low.

The study also showed that the highest risk of contamination of groundwater in the study area originates from the soil media (mean value is 7.98). The impact of vadose zone, depth to water level, and hydraulic conductivity imply moderate risks of contamination (mean values are 5.95, 5.15, and 4.87 respectively), while net recharge, aquifer media and topography impose a low risk of aquifer contamination (mean values are 4.49, 4.37, and 1.44 respectively). The single parameter sensitivity analysis has indicated that the soil media and the impact of vadose zone were the most effective parameters. Figure 5A.19 represents the general DRASTIC Map for Gaza Strip with the locations of Al-Fukhary and Johr al Deek sites indicated on the map.

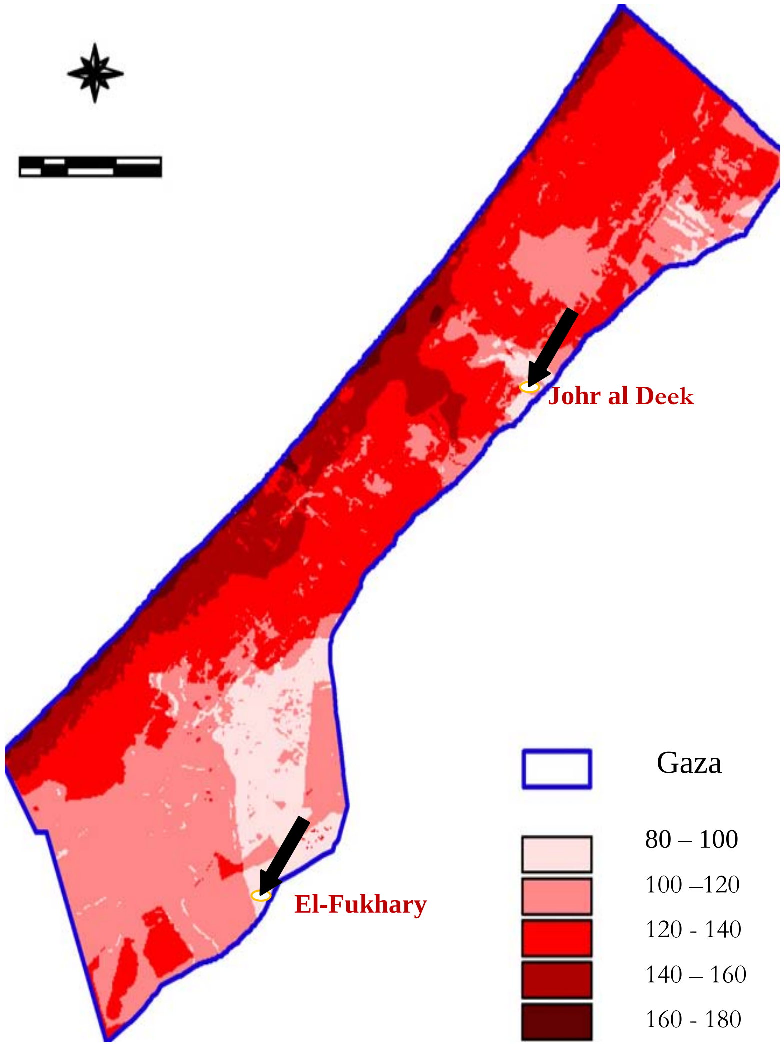


Figure 5A.19: General DRASTIC map for GS. Source(Hallaq and Elaish 2011)

The DRASTIC map of GS shows that the two proposed sites for the project at El-Fukhary and Johr al Deek are both located in areas characterized by low vulnerability to groundwater contamination. The site where Deir El Balah Landfill is located is characterized by moderate vulnerability to groundwater contamination. This agrees with the preliminary selection of El-Fukhary and Johr al Deek sites for the construction of long term sanitary landfills/transfer stations and it also supports the closure plans proposed for Deir El Balah Landfill.

5A.8 Geophysical survey of GS

A geo-electrical model was conducted for Khan Younis and Rafah Areas where the data from the following preceding surveys have been reinterpreted:

- Geophysical survey for Khan Younis conducted in 1997 (Cooperative-International and Gaza 1997)
- Geophysical survey executed in 2000 by Metcalf & Eddy for The CAMP project(Metcalf and Eddy 2000; Palestinian Water Authority and USAID 2000)

The interpretative model is composed of four geo-electrical layers as follows:

- The top layer with high resistivity values (259 ohm.m) with variable thickness ranging from 15 to 5m of sandy dune layer.
- The second layer (10 ohm.m) clay layer with a thickness of about 15m.
- The third layer coincides with resistive sandstone and pebble (50-150 ohm.m) and thicknesses ranging from 60 to 120m.
- The base of the sequence (fourth layer) with very low resistivity (0.1-1 ohm.m) saline marl-clay formation shows a top altitude ranging from 20-65m below sea level and marks the top of the Saqyia Formation.

Seismic reflection and refraction techniques have been used to explore the area. The seismic model for Khan Younis area indicates the lithology description in the studied area and its seismic velocities.

5A.9 Cultural heritage sites

5A.9.1 Tangible cultural Heritage

Gaza has its influential position within the Levant due to a number of religious, historic and commercial factors. The area is considered the birth place of most biblical religions with a good number of religious structures still remaining and functioning. Figure 5A.20 shows the locations of historical sites in the GS. Most of the sites are located within the old city of Gaza such as the Great Umari Mosque. Those historic sites contribute to the tourism of Gaza and are subject to the Ministry of Tourism and Antiquities, no heritage site is located in the vicinity of Johr al Deek or El-Fukhary sites.

Regarding tangible cultural heritage, Johr al Deek is closer to the key heritage sites in GS as compared to Al-Fukhary, which is to be considered if the area undergoes future development.

5A.9.2 Intangible cultural Heritage

Both climate and vegetation contribute to the area being famous for its olive tree implantation. The area's inhabitants' livelihoods depend largely on olive and olive oil production. In addition, many locals have inherited the shepherding profession from their ancestors with all the related traditional activities which come within.

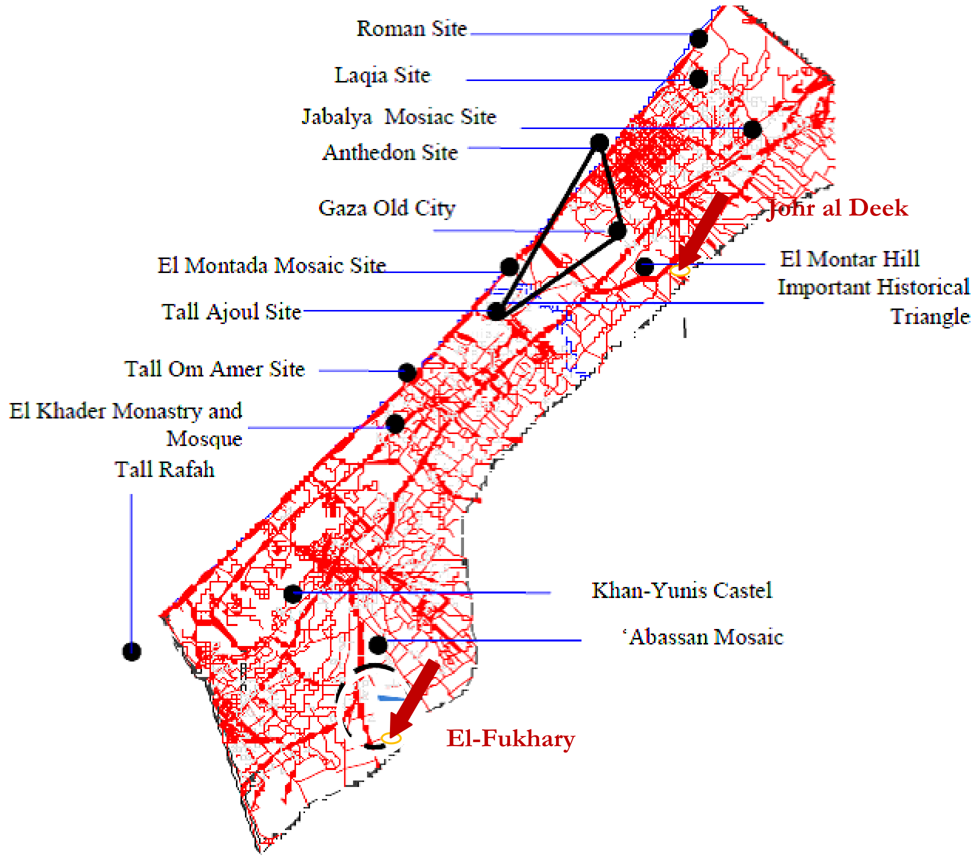


Figure 5A.20: Map for the historical site attractions in the GS. Source (UNDP/PAPP 2009; PWA 2011)

5A.10 Fauna

Faunistic and floristic biodiversity including approximately 540 birds, 120 mammals and 120 herpetofaunistic species in addition to about 2,700 floristic species were known to inhabit Palestine. The frequent visits conducted to the vicinity of Al-Fukhary landfill in addition to the semi-structured interviews conducted with locals and scanvengers revealed a considerable number of faunistic and floristic species. Faunistic survey is presented in this section followed by the floristic survey in the section which follows.

5A.10.1 Wild Mammals

The mammalian species existing in the vicinity of El-Fukhary and Johr al Deek landfills and nearly the whole eastern parts of the GS are described in Table 5A.4. Apart from wild mammals, stray dogs are present near all landfills in the GS. These were observed to rest at special burrows not far away from these landfill and while scavenging on municipal wastes. The populations of some mammalian species such as Hedgehogs, Hares and carnivores were known to diminish due to poaching and hunting activities carried out by locals.

Table 5A.4: Wild mammals recorded in the vicinities of El-Fukhary and Johr al Deek landfills

Family	Scientific Name	Common Name
Erinaceidae	*Hemiechinus auritus*	Long-eared Hedgehog
	Paraechinus aethiopicus	Ethiopian Hedgehog
Pteropoidae	*Rousettus aegyptiacus*	Egyptian Fruit Bat
Canidae	*Canis aureus*	Golden Jackal
Felidae	*Felis silvestris*	Wild Cat
Herpestidae	*Herpestes ichneumon*	Egyptian Mongoose
Spalacidae	*Spalax leucodon ehrenbergi*	Palestine Mole-rat
Muridae	*Mus musculus*	House Mouse
	Rattus spp.	Commensal Rat
Dipodidae	*Jaculus jaculus*	Lesser Egyptian Jerboa
Hystricidae	*Hystrix indica*	Indian Crested Porcupine
Leporidae	*Lepus capensis*	Cape Hare

a) *Hedgehogs* (*Hemiechinus auritus* **and** *Paraechinus aethiopicus*)

Both the Long-eared Hedgehog *Hemiechinus auritus* and the Ethiopian Hedgehog *Paraechinus aethiopicus* exist in different agro-ecosystems in the GS, they are commonly seen at night. Hedgehogs are known to be sometimes eaten by some locals, especially the Bedouin families. Thus, the two species are falling under an actual threat.

b) *Golden Jackal Canis aureus*

Locals of eastern parts of the GS including Al-Fukhary and Johr al Deek confirmed hearing the distinctive animal call at night. Wire cages and leghold traps are commonly used to hunt the Golden Jackal along with other mammals. Hunting mammals may be for the purpose of enriching Gaza zoological gardens with key species (Figure 5A.21-a).

c) *Egyptian Mongoose Herpestes ichneumon*

The Egyptian Mongoose prevails the eastern parts and some western parts of the GS. Many locals were found to kill the Mongoose using different means including rodenticides in order to protect their poultery. The Egyptian Mongoose is a common carnivore species in most Gaza zoological gardens (Figure 5A.21-b).

d) *Palestine Mole-rat Spalax leucodon ehrenbergi*

The Palestine Mole-rat is considered as an actual pest for the Gazan farmers due to its continuous feeding upon roots, bulbs and tubers of the agricultural crops. The earth heaps made by the Palestine Mole-rat have were seen by the Consultant in the vicinity of Al-Fukhary and Johr al Deek landfills and other open and agricultural fields in the GS.

e) *Cape Hare Lepus capensis*

In spite of its diminishing populations, the Cape Hare is a well-known mammalian species throughout the Gaza Strip. Currently, the Cape Hare is facing the danger of disappearance in the area due to over-hunting.


Figure 5A.21: a) The Golden Jackal *Canis aureus,* a common carnivore in Gaza zoological gardens, b)The Egyptian Mongoose *Herpestes ichneumon* in Gaza zoological gardens

f) Palestine Mole-rat Spalax leucodon ehrenbergi

The Palestine Mole-rat is considered as an actual pest for the Gazan farmers due to its continuous feeding upon roots, bulbs and tubers of the agricultural crops. The earth heaps made by the Palestine Mole-rat have were seen by the Consultant in the vicinity of Al-Fukhary and Johr al Deek landfills and other open and agricultural fields in the GS.

g) Cape Hare Lepus capensis

In spite of its diminishing populations, the Cape Hare is a well-known mammalian species throughout the Gaza Strip. Currently, the Cape Hare is facing the danger of disappearance in the area due to over-hunting.

5A.10.2 Birds (Avifauna)

Previous surveys on bird fauna in the GS revealed a considerable number of terrestrial and aquatic bird species. El-Fukhary and Johr al Deek landfills attract a variety of bird species, of which the majority are scavengers in the sense that they feed on organic wastes. Black Kites, Cattle Egrets, Black-headed Gulls, Barn Swallows, Hooded Crows, House Sparrows and White and Yellow Wagtails are commonly seen bird fauna. The bare lands surrounding the El-Fukhary Landfill and the Olive and Plum orchards prevailing north and south of this landfill are home to a variety of bird fauna, especially passerines. In Johr al Deek Landfill, the presence of passerines and non-passerines seems to be higher compared to Al-Fukhary landfill. This may be a result of the following: (1) the landfill at Johr al Deek Landfill in larger in size compared with the landfill at El-Fukhary, (2) the area surrounding Johr al Deek Landfill has a better plant diversity, and (3) the higher rainfall intensity and topography in the vicinity of Johr al Deek Landfill is more appealing to the birds compared with the prevailing desert climate in El-Fukhary. Table 5A.10.5 includes the most common bird species occurring in the vicinities of El-Fukhary and Johr al Deek. Locals mention that bird hunters come to Johr al Deek to hunt birds like raptors, chukars, sparrows and finches.

Table 5A.5: Bird species recorded in the vicinities of El-Fukhary and Johr al Deek landfills

Family	Scientific Name	Common Name
Ardeidae	*Bubulcus ibis*	Cattle Egret
	Ciconia ciconia	White Stroke
Accipitridae	*Milvus migrans*	Black Kite
	Buteo buteo	Common Buzzard
	Buteo rufinus	Long-legged Buzzard
	Aquila heliaca	Imperial Eagle
Falconidae	*Falco naummani*	Lesser Kestrel
	Falco tinnunculus	Common Kestrel
	Falco subbuteo	Eurasian Hobby
Phasianidae	*Alectoris chukar*	Chukar
	Coturnix coturnix	Quail
Burhinidae	*Burhinus oedicnemus*	Stone Curlew
Laridae	*Larus ridibundus*	Black-headed Gull
Columbidae	*Columba livia*	Rock Dove
	Streptopelia decaocto	Collared Dove
	Streptopelia turtur	Turtle Dove
	Streptopelia senegalensis	Laughing Dove
Strigidae	*Athene noctua*	Little Owl
	Tyto alba	Barn Owl
Alcedinidae	*Halycon smyrnensis*	White-breasted Kingfisher
Meropidae	*Merops apiaster*	European Bee-eater
	Coracius garrulus	European Rollar
Upupidae	*Upupa epops*	Hoopoe
Picidae	*Dendrocopos syriacus*	Syrian Woodpecker
Alaudidae	*Galerida cristata*	Crested Lark
	Alauda arvensis	Skylark
Hirundinidae	*Hirundu rustica*	Barn Swallow
Motacillidae	*Motacilla flava*	Yellow Wagtail
	Motacilla alba	White Wagtail
Pycnonotidae	*Pycnonotus xanthopygos*	Yellow-vented Bulbul
Turdidae	*Erithacus rubecula*	European Robin
	Luscinia svecica	Bluethroat
	Phoenicurus phoenicurus	Common Redstart
	Saxicola torquata	Stonechat
	Oenanthe oenanthe	Northern Wheatear
	Oenanthe hispanica	Black-eared Wheatear
	Turdus merula	Blackbird
Sylviidae	*Prinia gracilis*	Graceful Warbler
	Hippolais pallida	Olivaceous Warbler
	Hippolais olivetorum	Olive-tree Warbler
Nectariniidae	*Nectarinia osea*	Palestine Sunbird
Laniidae	*Lanius senator*	Woodchat Shrike

Family	Scientific Name	Common Name
	Lanius nubicus	Masked Shrike
Corvidae	*Corvus corone*	Hooded Crow
Passeridae	*Passer domesticus*	House Sparrow
Fringillidae	*Fringilla coelebs*	Chaffinch
	Serinus serinus	European Serin
	Serinus syriacus	Syrian Serin
	Carduelis chloris	Green Finch
	Carduelis carduelis	Goldfinch
	Carduelis spinus	Siskin
	Carduelis cannabina	Linnet
	Rhodospiza obsoleta	Desert Finch

a) Cattle Egret Bubulcus ibis

Among heron species, the Cattle Egret is the commonest in the GS. It is commonly found in groups in wastewater lagoons and near agricultural fields or in dump places and landfills (Figure 5A.22-a). The bird is counted in tens and sometimes in hundreds in the Al-Fukhary and Johr al Deek landfills and their neighboring areas. Sometimes, the bird was seen flying in small groups to and from roost sites.

b) Black Kite Milvus migrans

The Black Kite, as one of the main raptor species, exists all year round in the GS, particularly in the vicinities of the Al-Fukhary and Johr al Deek landfills as well as other landfill and dump sites. In visits conducted to the Johr al Deek Landfill, at least one thousand of the Black Kite were encountered there either flying over the landfill (Figure 5A.22-b) or resting on the farms surrounding the landfill. As far as Al-Fukhary landfill is concerned, considerably lower number of the species were encountered there. Bird hunters were found to hunt this raptor species along with other falcons in vicinity of Al-Fukhary Landfill and other places in the GS (Figure 5A.23-a) using different means. As many as three black Kites were found dead in the area lying west to Al-Fukhary Landfill. Secondary poisoning is a probable cause.

c) Chukar Alectoris chukar

The bird has never been seen in the close areas surrounding Al-Fukhary and Johr al Deek landfills, instead, it was seen in flocks (7-14 individuals) in the olive fields and citrus orchards prevailing west to these landfills. Chukar, which is a breeding bird in the Gaza environment, is threatened by intensive hunting by locals.

d) *Laughing Dove Streptopelia senegalensis*

Many Dove species have been encountered in the vicinities of Al-Fukhary and Johr al Deek landfills. Sometimes, they were seen flying and crossing the sky of the landfills themselves. The Laughing Dove is the most common and is usually seen year round in all visits conducted to Gaza landfills. The eggs, fledgling and the adults of these species are under continuous threat due to egg collection, nest destruction and over-hunting.

e) Barn Owl Tyto alba
This nocturnal Barn Owl seems to be the commonest owl species in the GS. The bird is known to hunt mice, rats and other preys in the vicinities of the landfills. Landfills attract a variety of rodent and snake species, which in turn may attract predators.

f) Barn Swallow Hirundu rustica
The bird is commonly seen in large numbers in GS including populated areas. It was encountered in considerable numbers at Al-Fukhary and Johr al Deek landfill sites hunting insects. Sometimes, the bird was noticed roosting in groups on telephone wires existing west to Al-Fukhary and Johr al Deek landfill (Figure 5A.23-b).

g) Wagtails Motacilla spp.
Two visitor Wagtail species were recorded at Al-Fukhary and Johr al Deek landfills. They are the Yellow Wagtail *Motacilla flava* and the White Wagtail *Motacilla alba*. They were seen in large numbers searching the ground of the landfills.

h) Palestine Sunbird Nectarinia osea
The Palestine Sunbird is the only endemic bird species in the GS. It takes nectar, often found around flowering trees and shrubs such as Tree Tobacco *Nicotiana glauca*, which is common in GS and the vicinities of Al-Fukhary and Johr al Deek landfills as well.

i) Hooded Crow Corvus corone
This resident species is found everywhere and in every habitat in the GS. It can be easily seen in significant numbers at dump sites including Al-Fukhary and Johr al Deek landfills, shallow wastewater lagoons and the urban and rural areas. It has an ecological role as detritus feeder and environmental cleaner, feeding on detritus, carrions and garbage.

j) House Sparrow Passer domesticus
The House Sparrow is a common resident and breeding bird species in the GS, especially near garbage. The bird is counted in more than hundreds at Al-Fukhary and Johr al Deek landfill sites. It is commonly seen eating grains and insects.

5A.10.3 Reptiles

The vicinities of the Rafah and Johr al Deek landfills, is a home to a variety of reptiles which include such principal categories like snakes, lizards and turtles. Recent investigations and discussions with local people at both landfill sites revealed the presence of many reptilian species as listed in Table 5A.6. Photos of some of these reptiles are shown in Figure 5A.24. No rare or endangered reptile species have been recognized.

Figure 5A.22: a) The Cattle Egret *Bubulcus ibis* is a common bird species in the El-Fukhary landfill (Note the agricultural orchards and human dwellings lying west to the El-Fukhary landfill), b) Hundreds of the Black Kite Milvus migrans were seen flying over the Johr al Deek landfill

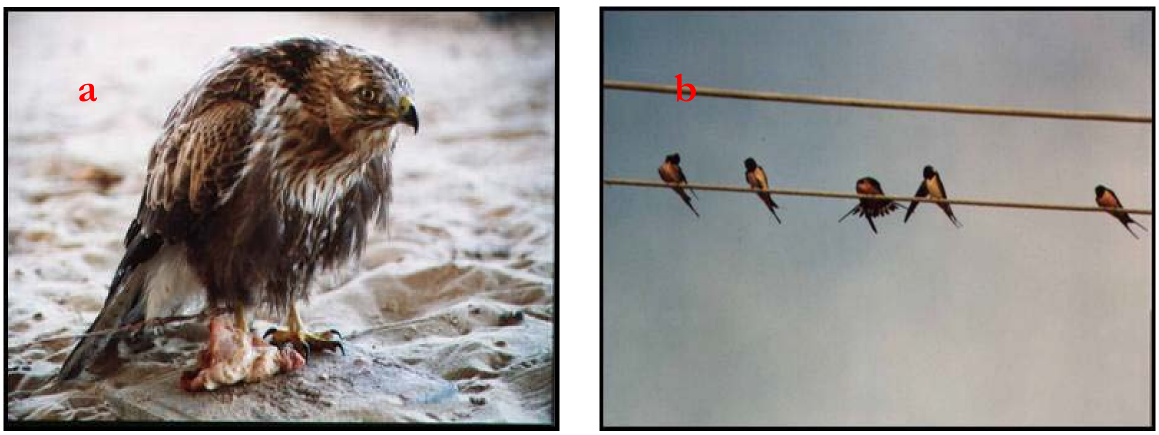


Figure 5A.23: a) The Black Kite *Milvus migrans* after being caught by a bird hunter in the Gaza Strip, b) The Barn Swallow *Hirundu rustica* while roosting on telephone wires near the Johr al Deek landfill

Table 5A.6: Reptiles recorded in the vicinities of Al-Fukhary and Johr al Deek landfills

Family	Scientific Name	Common Name
Testudinidae	*Testudo graeca*	Spur-thighed Tortoise
Varanidae	*Varanus griseus*	Desert Monitor
Scincidae	*Chalcides ocellatus*	Ocellated Skink
Chamaeleonidae	*Chameleo chameleon*	Mediterranean Chameleon
Geckonidae	*Hemidactylus spp.*	Gecko
Lacertidae	*Acanthodactylus boskianus*	Bosc's Lizard
Agamidae	*Agama stellio*	Agama
Colubridae	*Coluber jugularis asianus*	Syrian Black Snake (Arbeed)
	Coluber nummifer	Coined Snake

Family	Scientific Name	Common Name
	Coluber rubriceps	Red Whip Snake
Viperidae	*Vipera palaestinae*	Palestine Viper

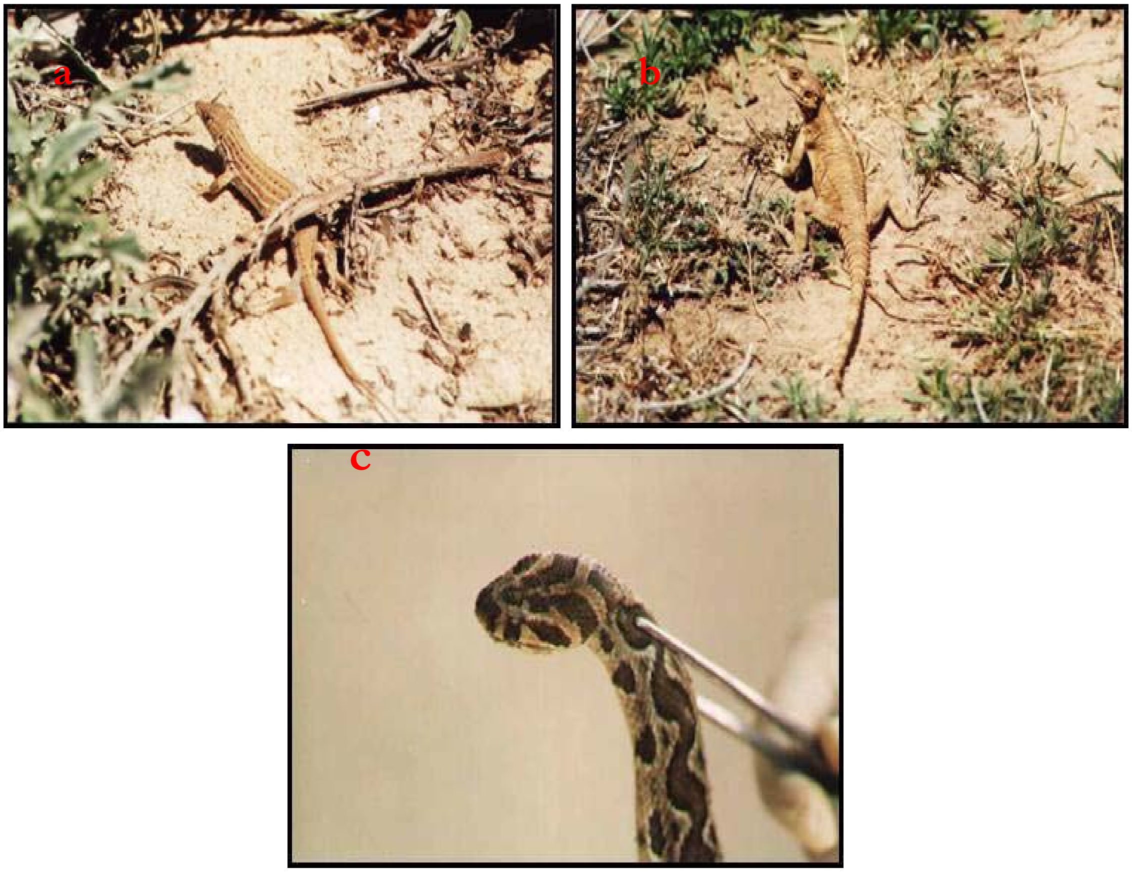


Figure 5A.24: a) The Bosc's Lizard *Acanthodactylus boskianus* in the vicinity of Johr al Deek landfill, b)The Agama *Agama stellio* is adapted to drier habitats of Wadi Gaza and c) The Palestine Viper *Vipera palaestinae* is the most venomous viper species in Palestine

Table 5A.6: Floristic species characterizing the vicinities of El-Fukhary and Johr al Deek landfills (September/October 2011)

Family	Scientific Name	Common Name
Arecaceae	*Phoenix dactylifera*	Date Palm
Cactaceae	*Opuntia ficus-indica*	Tuna Cactus
Asteraceae (Compositae)	*Artemisia monosperma*	Sagebrush
	Silybum marianum	Blessed Milk-thistle
Euphorbiaceae	*Ricinus communis*	Castor Oil Plant
Leguminosae	*Acacia cyanophylla*	Acacia
	Acacia arabica	Gum Arabic Tree
	Alhagi maurorum	Camel-thorn
Moraceae	*Ficus sycomorus*	Sycamore Fig
	Morus sp.	Mulberry

Family	Scientific Name	Common Name
Myrtaceae	*Eucalyptus camaldulensis*	River Red-gum Tree
Polygonaceae	*Polygonum equisetiforme*	Knot Weed
Rhamnaceae	*Ziziphus spina-christi*	Christ's Thorn
Solanaceae	*Solanum, elaeagnifolium*	Silver-leaf Night Shade
	Nicotiana glauca	Tree Tobacco

5A.11 Flora

Despite its small size, Palestine is a host to around 2,700 species of wild plants. The area surrounding Al-Fukhary Landfill is an arid land with very little diversity of wild plants or flora which includes trees, shrubs and herbs as shown in Table 5A.7. The area of the Johr al Deek landfill has diverse flora. The two areas of the landfills were investigated for flora in September and October, 2011. Accordingly, the results may not give holistic conclusions on the type of flaura existing over the year in the two areas.

5A.11.1 Date Palm *Phoenix dactylifera*

The Date Palm is a common plant species in the GS. The fresh or dried date fruits are usually eaten or sold by locals. The long leaves (*Sa'af* or *Jareed*) are used as cleaning tools or in roofing recreational places. The trunks are usually used in building purposes or industry. Many wildlife species use the plant in different ways including nesting or resting

5A.11.2 Tuna Cactus *Opuntia ficus-indica*

Rows of this fruity and spiny plant are usually seen in the close north and south of Al-Fukhary Landfill (Figure 5A.25-a) and other areas surrounding the Johr al Deek landfill. The Tuna Cactus is commonly found planted as a border to agricultural field in the whole GS. This succulent plant thrives the desert and semi-desert climates characterizing the GS. Many bird and reptile species have been encountered using the Tuna Cactus for resting or nesting purposes. Burrows of rats were seen built beneath the plant. In summer months, the fruits are usually harvested for food or sale in local markets.

5A.11.3 Castor-oil Plant *Ricinus communis*

The Castor-oil Plant is a big shrub ranging between 1-4 meters in height. The plant is commonly found in neglected and waste areas. Locals claimed that the species is beneficial in repelling mosquitoes and other annoying insects. The seeds are of great importance in medicine as they are used as laxatives and anti-parasite drugs. The leaves could be boiled and used to treat back pain as claimed by locals.

5A.11.4 Christ's Thorn *Ziziphus spina-christi*

The Christ's Thorn is a relatively big shrub or tree reaching 5-6 meters (Figure 5A.25-b). Many trees of this species were encountered west to Al-Fukhary Landfill near olive orchards prevailing there. In the Johr al Deek area, the species were encountered in high number. It was mainly found among other plant species (e.g. Tuna Cactus and Gum Arabic Tree) forming the borders of many orchards. Many passerine species were found to build their nests on the tree.

5A.11.5 Tree Tobacco *Nicotiana glauca*

The Tree Tobacco is a tall ligneous and a year-round shrub that grows abundantly in the whole GS and the landfill areas as well (Figure 5A.26-a). According to locals, this flowery plant species is not favorable to grazing animals and livestock, due to its toxicity. From an ecological point of view, the Palestine Sunbird (an endemic bird species in Palestine) usually favors the plant and sucks its nectar.

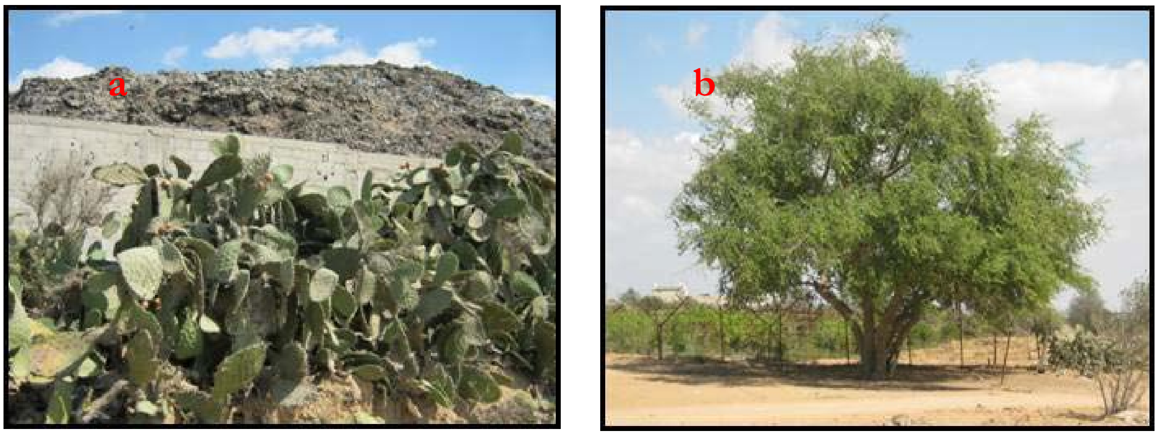


Figure 5A.25: a) The Tuna Cactus *Opuntia ficus-indica* is a commonly found plant species in the vicinity of Al-Fukhary landfill, b) Many Christ's Thorn *Ziziphus spina-christi* trees have been encountered in the vicinity of Al-Fukhary landfill

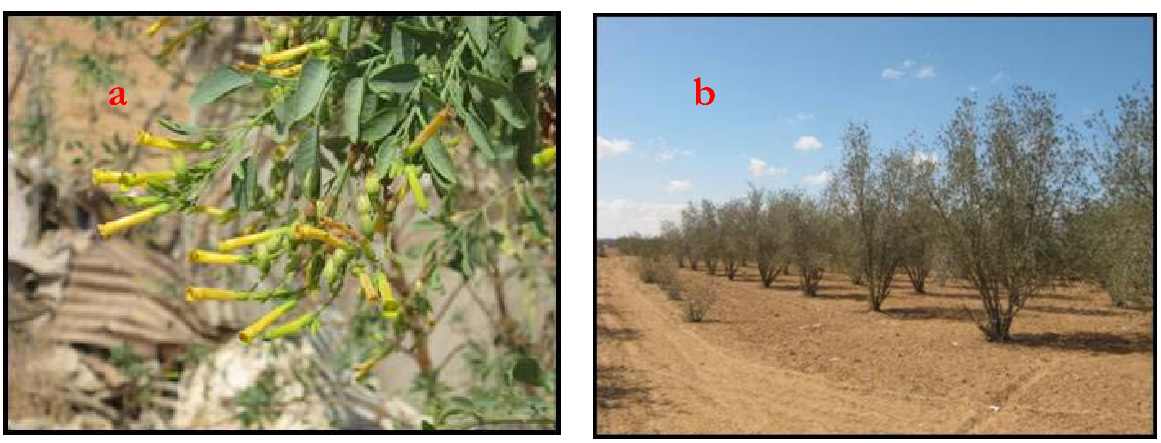


Figure 5A.26: a) The Tree Tobacco *Nicotiana glauca* is a shrubby plant encountered in the vicinity of the Johr al Deek landfill (Note the yellow flowers that are commonly utilized by the Palestine Sunbird), b) Olive orchards are implanted west to El-Fukhary Landfill

5A.11.6 Agricultural Fields

Many Olive, Plum, Almond, Citrus agricultural fields or orchards have been encountered west to the two landfills. Olive trees are usually found arranged in regular rows (Figure 5A.26-b). The harvest of olive fruits starts in September. Many wildlife species; particularly birds were found to inhabit these agro-ecosystems; Chukars, Stone Curlews, Olivaceous Warblers, Olive-tree Warblers, Yellow-vented Bulbuls, Crested Larks and Barn Swallows are some examples.

5A.12 Conclusions

An environmental baseline survey has been presented in this chapter, the results of which should be taken into consideration as part of the selection/assessment criteria of suitable sites for the landfill construction for the long term measures of GSWMP, the baseline study has included the following:

- Geology, structure geology, geomorphology;
- Groundwater investigation including depth to water table, direction of flow, and groundwater vulnerability;
- Fauna and Flora: endangered species and habitat.

5A.12.1 Geology

a) *Structure geology*
No major fault type formations have been observed in GS, according to the surface geological survey and geophysical survey.

b) *Geomorphology*
Wadi Gaza is the major wadi in GS, to which 6 sub-basins drain and discharge their water load directly into the Mediterranean Sea. It was observed that the drainage patterns of the 6 sub-basins are at a considerable distance from El-Fukhary and Johr al Deek landfill locations.

No major impacts from the geologic point of view may affect the proposed landfill sites at El-Fukhary and Johr al Deek.

5A.12.2 Groundwater

a) Depth to water and direction of flow
Changes in water levels reflect changes in recharge to and discharge from an aquifer. Groundwater level can be influenced by many factors, including precipitation, abstraction, lateral flow, intrusion, upcoming of brackish or saline water, return flow from irrigation, wastewater and urban storm water. Water-level changes leads to changes in groundwater flow direction. At El-Fukhary Landfill area, the water table appeared at depth of 46m. At Johr al Deek the water table is more than 50m. Groundwater flow direction at El-Fukhary is in the N-NW direction and at Johr al Deek is in the N-NE direction.

Depth to water is in favor of the proposed sites.

b) Groundwater Vulnerability

Groundwater vulnerability studies performed for GS indicate that the proposed sites of El-Fukhary and Johr al Deek for the landfill construction are among the most favorable locations for such purpose within Gaza as their DRASTIC index is the lowest (80-100) in all GS.

The results of groundwater vulnerability studies do not contradict with the selection of Johr al Deek and El-Fukhary sites.

5A.12.3 Fauna and Flora

No rare, sensitive or endangered fauna or flora species were observed during the visits to the two sites and that would be negatively impacted by the construction and operation activities of the landfill. Only the olive trees near El-Fukhary site need to be protected from possible contamination migration due to their cultural heritage.

Diverse and abundant fauna species currently use the sites for nesting, breeding or feeding. These may be affected by the controlled operation of the landfills as compared with the existing situation. The number of birds observed at El-Fukhary was low as compared with Johr al Deek, this is an important factor to be considered when assessing the impact on the nearby Rafah airport – which is not functioning at the moment.

5B SOCIAL BASELINE DATA

5B SOCIAL BASELINE DATA

5B.1 Introduction

The surface area in Gaza is very limited, with an average land availability of 0.26 dunum[15] per person in 2007. Gaza Strip is a small closed coastal area of a total surface area of 365 Km^2. Gaza Strip is amongst the highest densely populated areas in the world. The environment in Gaza Strip has been suffering from a great deal of abuse and negligence. The limited land resources, large and rapidly growing social and economic sectors, long-term isolation, and negligence as a result of the political circumstances led to the deterioration of the natural resources and resulted in amplification to several environmental shortcomings.

5B.2 Demographic Characteristics

In 1948, Gaza Strip had a population of less than 100,000 people. By 2007, approximately 1.4 million Palestinians lived in Gaza Strip, of whom almost one million were UN-registered refugees. The current population is estimated to be in excess of 1.5 million, distributed across five Governorates. Gaza City, which is the biggest governorate, has about 400,000 inhabitants. The two other main Governorates are Khan Younis (population 200,000) in central Gaza, and Rafah (population 150,000) in the South. The majority of people live in refugee camps[16].

5B.2.1 Population and Population Projections

The population of Gaza Strip according to 2011 statistics is around 1,500,000[17]. Annex 5B. a presents the growth in Gaza Strip population from 2007 until 2014 divided by locality. As could be observed from Table 5.A.1 below, the population growth in Gaza is high and was observed to increase during the last five years. The population projection calculated by the Feasibility Study was based on the assumption that gradual decline in population growth will start to happen starting from 2012. It is anticipated that population growth will reach 1.11% in 2040 after it recorded 3.5% in 2011.

Table 5B.1: Projected population growth in Gaza Strip until 2040

Year	Growth	North Gaza	Gaza City	Deir Al Beilah	Khan Yunis	Rafah	Total
2007		270.336	496.411	205.535	270.979	173.372	1.416.633
2008	3,23%	275.687	504.047	209.014	275.134	176.450	1.440.332
2009	3,25%	286.246	519.027	215.808	283.286	182.448	1.486.815
2010	3,49%	297.269	534.559	222.866	291.736	188.689	1.535.119
2011	3,50%	309.435	551.832	230.689	301.137	195.598	1.588.691
2012	3,48%	322.125	569.714	238.806	310.837	202.776	1.644.258

[15] Land area used in the Ottoman Empire and representing the amount of land that can be plowed in a day; its value varied from 900–2500 m². In many formerly Ottoman regions, it is now defined as exactly one decare (1000 m²) (Wikipedia)
[16] Environmental Assessment of Gaza Strip, following the escalation of hostilities in December 2008 – January 2009 United Nations Environment Programme
[17] PCBS, 2011

Year	Growth	North Gaza	Gaza City	Deir Al Beilah	Khan Yunis	Rafah	Total
2013	3,44%	335.253	588.032	247.150	320.835	210.166	1.701.436
2014	3,41%	348.807	606.749	255.704	331.018	217.757	1.760.035
2015	3,36%	362.772	625.824	264.455	341.393	225.538	1.819.982
2016	3,27%	377.126	645.204	273.381	351.934	233.489	1.881.134
2017	3,18%	389.458	666.302	282.321	363.442	241.124	1.942.648
2018	3,09%	401.843	687.491	291.299	375.000	248.792	2.004.425
2019	3,00%	414.260	708.735	300.300	386.588	256.480	2.066.362
2020	2,91%	426.688	729.997	309.309	398.185	264.174	2.128.353
2021	2,82%	439.105	751.240	318.310	409.773	271.862	2.190.289
2022	2,73%	451.488	772.425	327.286	421.328	279.528	2.252.056
2023	2,64%	463.814	793.513	336.221	432.831	287.160	2.313.538
2024	2,55%	476.058	814.462	345.098	444.258	294.741	2.374.616
2025	2,46%	488.198	835.231	353.898	455.586	302.257	2.435.170
2026	2,37%	500.208	855.778	362.604	466.794	309.692	2.495.076
2027	2,28%	512.063	876.060	371.198	477.857	317.032	2.554.210
2028	2,19%	523.738	896.035	379.661	488.752	324.261	2.612.447
2029	2,10%	535.208	915.658	387.976	499.456	331.362	2.669.660
2030	2,01%	546.448	934.887	396.123	509.945	338.321	2.725.724
2031	1,92%	557.431	953.679	404.086	520.195	345.121	2.780.512
2032	1,83%	568.134	971.990	411.844	530.183	351.747	2.833.899
2033	1,74%	578.531	989.777	419.381	539.886	358.185	2.885.760
2034	1,65%	588.598	1.007.000	426.678	549.280	364.417	2.935.973
2035	1,56%	598.310	1.023.616	433.719	558.343	370.430	2.984.418
2036	1,47%	607.644	1.039.584	440.485	567.053	376.209	3.030.975
2037	1,38%	616.576	1.054.867	446.960	575.389	381.739	3.075.532
2038	1,29%	625.085	1.069.424	453.128	583.330	387.007	3.117.975
2039	1,20%	633.149	1.083.220	458.974	590.855	392.000	3.158.198
2040	1,11%	640.747	1.096.219	464.482	597.945	396.704	3.196.098

Source: Adopted form the Final Feasibility Study for SWM in Gaza Strip, 2011

The Feasibility study built the projections above on two key assumptions. The first assumption was the possibility of economy improvements and the dimming effect on population growth. The second assumption was the possibility of materializing the peace process with Israel and the potential implications on the migration pattern outside GS and the consequent decrease in population growth. On the other hand, the Feasibility study referred to the potential refugees return but did not elaborate on estimates for this probability.

The assumptions made for calculating the projected population growth were characterized by high level of uncertainties in the Feasibility Study. Since this specific indictor is one of the major important basis for the various assumptions relating to the long term actions, including growth in waste quantities and capacities of the facilities, the ESIA will propose monitoring systems for both waste quantities and population growth in order to avoid any potential negative implications on the operation capacity of the planned facilities.

5B.2.2 Average Household Size

The average family size is one of the important indictors of relevance to population growth discussed above. As could be observed from Table 5B.2 below, there is generally a high tendency for large family sizes that exceed 7 persons. This observation supports the increase in the population growth during the last 5 years from 2008 which rose from 3.2% in 2008 to 3.5% in 2011[18]. This tendency is expected to affect the population growth rate during the coming years. Due to the absence of structured systems or interventions (e.g. family planning programmes) to tackle the large population growth, it is predicted that the preference for large family sizes will keep increasing the potential of high population growth.

Table 5B.2: Percentage Distribution of Households by Household Size, Average Household Size and Region, 2009 [19]

Family size in persons	% of the total population
1	2.3
2	7.2
3	6.8
4	10.9
5	11.6
6	12.6
7 +	48.6
	100

In the meantime, literature review and meetings with resource persons showed that the family structure in Gaza is witnessing shift form the domination of the extended family to a higher level of prevalence for the nuclear families which constitutes now more than 80% of the family structure in GS (PCBS, 2010).

5B.3 Socioeconomic Indictors

5B.3.1 Unemployment and Economic Activities

The general unemployment rate in the occupational Palestinian territories (oPt) is considered high with a rate of 23.4% of the labor force. Unemployment rate in Gaza is considered double the rate in the West Bank (37.4% in Gaza against 16.9% in the West Bank in 2010). Gaza City has the lowest unemployment rate in GS (31%)[20].

The various sources of literature and the field observations showed that temporary modes of employment are dominant in Gaza market. Most of the jobs are characterized by daily wages and short term contracts. The national statistics on the level of oPt showed rise in the daily wage rates for workers in 2010 most notably in the West Bank. It also showed a modest increase in Gaza where average daily wages remain only about 70% of wages in the West Bank. In 2010, the average daily wage recorded was NIS 59.5 per day with a low average wage of around NIS 55 per day in Khan Younis and a high average wage of NIS 71 per day

[18] Feasibility Study and Detailed Design for Solid Waste Management in the Gaza Strip, DHV and Enfra Consultants, 2011

[19] Palatine Annual Statistics Book (version 11), PCBS

[20] Socioeconomic Report, January 2011, UNSCO

in Rafah. Although this might be a relatively high wage rate compared to the case in other developing countries, the rate is still too low to allow families to meet the basic needs and daily demands given the relatively high prices as a result of blockade and several economic restrictions.

Table 5B.3: Percentage Distribution of Population (15 Years and Above) in Gaza Strip by Sex, Labor Force Status and Region, 2009[21]

	Percentage of population (15 years old and above)		
Labor force status	Male	Female	Total
In labor force	62.5	12.2	37.6
Outside labor force	37.5	87.8	62.4
Full employment	57.0	50.0	55.9
Underemployment	5.7	4.2	5.5
Unemployment	37.3	45.8	38.6

Table 5B.4 Percentage Distribution of Employed Persons from Gaza Strip by Economic Activity and Sex, 2009 [22]

Economic Activity	Percentage of the work force		
	Male	Female	Total
Agriculture, hunting and fishing	6.5	5.6	6.4
Mining, quarrying and manufacturing	5.9	2.0	5.4
Construction	1.0	-	0.9
Commerce, hotels and restaurants	20.7	4.1	18.3
Transportation, storage and communication	6.3	1.7	5.7
Services and other branches	59.6	86.6	63.3
	100	100	100

As could be observed from Table 5B.4 above, the largest portion of population is working in the services and other branches sector. Economic reports showed that this sector started to grow during the last few years in GS.

5B.3.2 Poverty

The poverty rate according to the monthly consumptions of individuals in Gaza Strip has decreased from around 50% in 2007 to 33% in 2009. However, the poverty rate using the same indictor of monthly consumption is much higher in Gaza Strip than in the West Bank which recorded 20% and 15% in 2007 and 2009 respectively.

[21] Palatine Annual Statistics Book (version 11), PCBS
[22] Palatine Annual Statistics Book (version 11), PCBS

It should be noted that poverty in Gaza is not limited to low levels of income. It is rather characterized by serious shortfalls in other dimensions. There is a serious level of insecurity of income, food, access to infrastructure and vulnerability resulting from the strong reliance on external assistance, with very limited ability to attain sustainability of livelihoods for large portion of households in GS. A Large portion of families is suffering from the implication of war and blockage and are generally overwhelmed by the economic and political situation[23].

The high level of poverty was clearly observed during the field work conducted as part of the ESIA. Some of the observations include the domination of short term employment modes; the high rate of unemployment among youth including university graduates; in addition to the various social implications on the household level. These observations are thought to be the key causes for poverty and insecurity issues. There are several other signs that demonstrate poverty amongst the households; one example to mention is the irregularity of paying the charges of various types of services including electricity, water and SWM. That was observed during surveys and other field investigation activities. This is partially attributed to the families' inability to pay these charges.

5B.3.3 Literacy Rates and Educational Attainment

As could be observed from Table 5B.5, literacy level is generally high in Gaza strip reaching around 95% of the population above 15 years of age. Gender discrepancy is not significant except in the groups above 45 years of age and this could be attributed to an increased level of awareness of the importance of girls' education.

Table 5B.5 Literacy Rates of Gaza Strip Population (15 Years and Above) by Age Groups and Sex, 2009 [24]

Age group	% of literate persons from the population of the age group		
	Male	Female	Total
15 – 19	99.3	99.2	99.2
20 – 24	99.1	98.6	98.9
25 – 34	98.5	98.3	98.4
35 – 44	98.7	96.4	97.6
45+	91.4	70.4	80.6
Total	97.4	92.4	94.9

The level of attained education is shown in Table 5B.6 below. As could be observed, the largest portion of literate population attained preparatory education certificates followed by the secondary education certificate. Relatively high gender equity is also observed in the figures below, where the percentages of male and female attainment for the various educational degrees (including high degrees like associate diploma, bachelor and above) recorded very close figures.

[23] Living Conditions in Gaza Strip, during and after Israel's military campaign in the winter of 2008/2009 Evidence from interviews with 2,000 households, UNFPA, 2009
[24] Palatine Annual Statistics Book (version 11), PCBS

Table 5B.6 Percentage Distribution of Gaza Strip Population (15 years of age and above) by Educational Attainment, Region and Sex, 2009 [25]

Educational Attainment	% of population		
	Male	Female	Total
Illiterate	5.1	7.6	5.1
Can read and write	4.5	4	4.5
Elementary	13.4	12.1	13.4
Preparatory	36	35.8	36
Secondary	25	26.4	25
Associate Diploma	4.8	4.5	4.8
Bachelor and above	11.2	9.5	11.2
	100	100	100

5B.4 Social Aspects Related to the Existing SWM systems

Planning sustainable SWM systems requires an understanding of the complexity of the social issues related to SWM[26]. To ensure public ownership and support, the planners of any investment in a new or improved SWM system will need to involve all important stakeholders having a role in solid waste generation, collection, re-use, transportation, and/or disposal. In general terms, SWM is associated with several social aspects that include but are not limited to health and hygiene impacts related to the various disposal and transfer practices, service fees and various economic implications as well as job creation potentials in SWM projects. Moreover, SWM is one of the main visible issues that could be noticed and observed by different community groups. In many cases, the level of governmental institutions' care for communities is measured by the level of attention to street cleanliness and regularity of waste collection.

In Gaza strip, waste systems are affected by the general political context. In particular, the frequent roadblocks and curfews imposed resulting in the creation of several alternative routes and temporary and emergency disposal sites within urban areas. The location of these transfer stations near residential areas also result in multiple social implications on the local communities including direct negative impacts on health, hygiene and negative visual impacts.

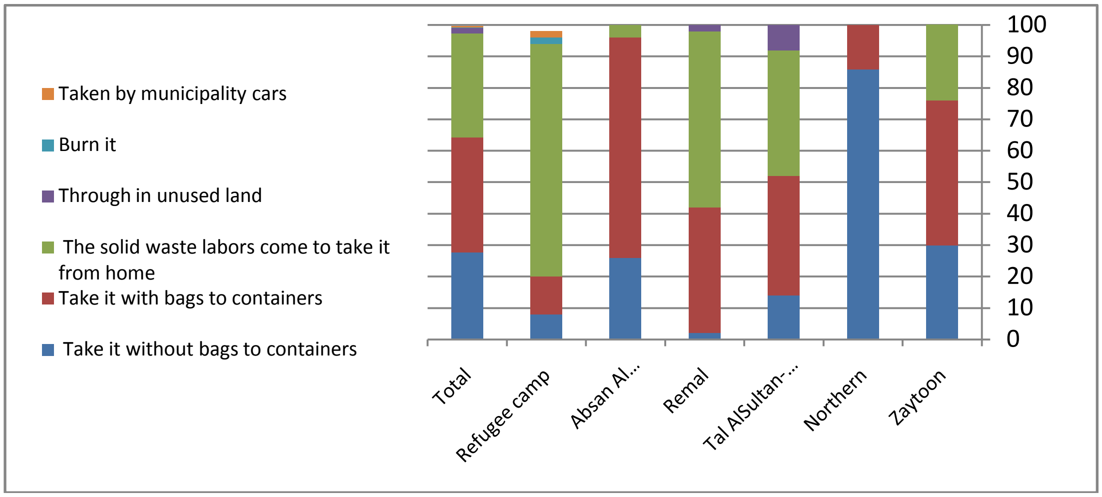
The following section of the report will present the main social aspects related to the existing SWM in GS. The presentation below is driven from the results of the various community consultation activities including the structured survey, SSI, FGDs as well as field observations recorded by the Consultancy team during the various field visits.

[25] Palatine Annual Statistics Book (version 11), PCBS

[26] Toolkit Social Assessment And Public Participation In Municipal Solid Waste Management, World Bank, 2004

5B.4.1 Waste disposal on the household level

The survey results indicated that the majority of household waste is collected from houses or from neighboring containers. Results in figure 5B.1 show that more than 60% of the surveyed households have to take their solid waste to the nearby containers, while around 45% receive house to house collection service.



Source: ESIA Survey Results, 2011

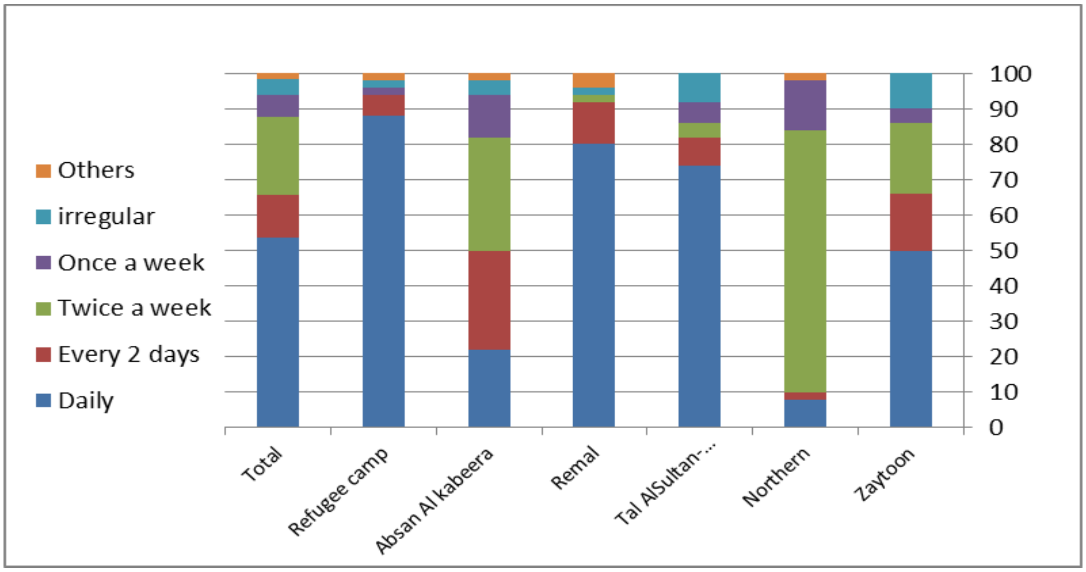
Figure 5B.1 Household waste disposal system

The results indicated significant variation among the selected area as the services quality is significantly better in Al Remal, representing well-off community, where people pay additional cost for workers to get house to house collection service and in Al Buraij camp where the services is provided by UNRWA. Tal Al Sultan also showed relatively good level of services quality as the UNRWA is participating in providing the services. The services are of lower quality in remote areas such as Northern Bedouin Village (Um Alnasser Village) and Abbasan El Kabeera. High populated areas such as Zaytoon also receive lower quality services. In these two areas; i.e. remote areas and high populated areas; the practice of throwing loose waste in the waste containers without bags is quite dominant.

5B.4.2 Frequency of waste collection and Quality of Service

The frequency of service (as shown in Figure 5B.1) supports the same results of El Remal, Al Buraij refugee camp and Tal Al Sultan who receive higher frequency services when compared to the other three localities.

The results of both the survey and the FGDs indicated the need for higher level of attention to remote and densely populated areas as they lack house to house regular services. In rural remote areas such as Abassan, participants in FGD complained from the low services quality as workers do not collect household waste from houses in remote areas. They stated that the municipality does not provide enough containers and collects the containers only twice a week. This causes waste accumulation in the neighborhood and results in health issues and environmental hazards to local communities. Participants in FGD stated that health hazard is a significant concern for them and their children.



Source: ESIA Survey Results, 2011

Figure 5B.2 The Frequency of waste collection

The same concern was revealed by the residence of the Bedouin village (Um Alnasser Village) in Northern Gaza as the FGD participants stated that municipalities' workers do not provide house to house services. The services are restricted to transferring the waste from the containers to the nearby transfer station. Local community participants complained from lack of enough containers, odor and health problems caused by the northern transfer station. The community there stated that the northern transfer station is used as the main landfill, as no transfer to the landfill is conducted. The nearest household is around 400 m away from the transfer station which is located on an area of 10 dunums and a composting facility is established on an area of 5 dunums.

Figure 5B.3 Proximity of residential area to Bet Lahia transfer station

Figure 5B.4 Scavenging activities at Bet Lahia transfer station

The station was planned to be a temporary solution for the lack of municipality resources to transfer the accumulated waste to Johr al Deek landfill. The problem of the lack of resources (mainly the un-maintained broken cars) was not solved and this allows for the accumulation of households' waste in that spot.

Community in Al Zaytoon area receives low quality services. The high population density and limited municipality resources caused significant deterioration to the services quality. Participants in FGD complained that a very limited number of households receive house to house collection service. The majority have to take their household waste to the containers which are placed in far distances and are not emptied regularly. Waste accumulation and overflow from the containers result in foul odors and an increase in mosquitoes and flies. The discussion of the FGD participants was verified by the field observations of the ESIA team.

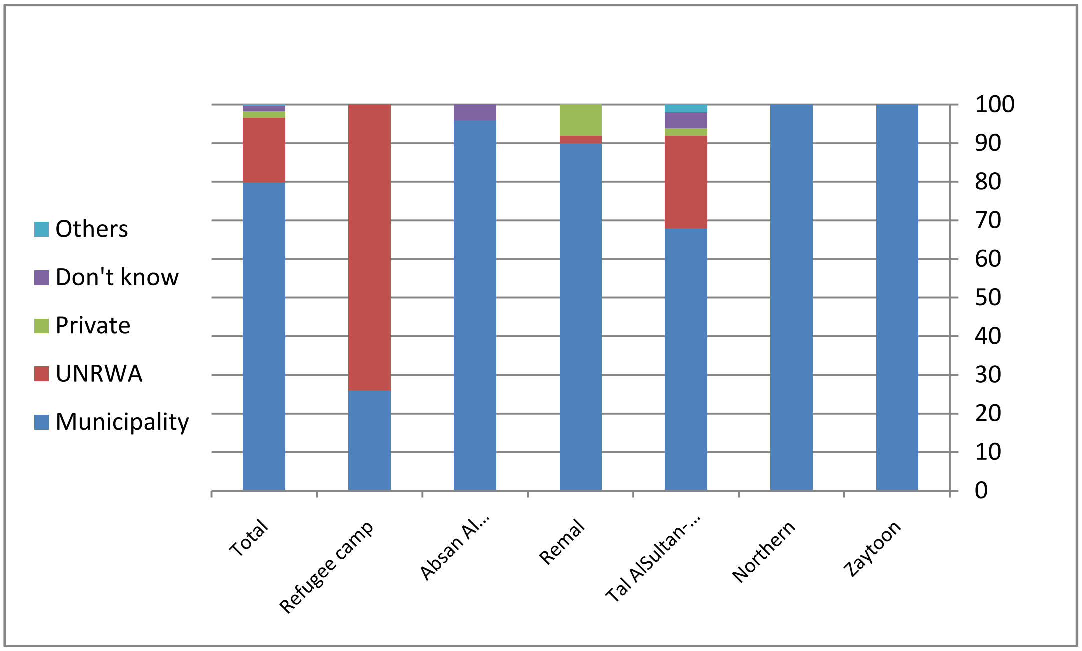
Figure 5B.5 Street containers in Abassan El Kabera

The situation in Alburaij camp was significantly better. Local community was relatively satisfied with UNRWA services. They stated that UNRWA workers provide the services on a daily basis and reach all households.

In Tal Al Sultan, local communities complained from the existing random transfer location which is located very close to the households. They referred to the environmental and health hazards.

5B.4.3 Service Providers

The survey results showed that 80% of the surveyed areas receive their services from the municipalities as shown in Figure 5B.7. Around 17% receive UNRWA services while the rest of the respondents receive the services from other institutions. In some areas services are provided by international institutions such as COOPI. Some of the donkey carts that provide the services come from the municipality and the others are provided by COOPI. Generally, respondents' reaction to the question of service providers reflected high level of awareness.



Source: ESIA Survey Results, 2011

Figure 5B.7 Solid waste services providers in Gaza as seen by community

5B.4.4 Solid Waste Management Services Fees and Affordability Issues

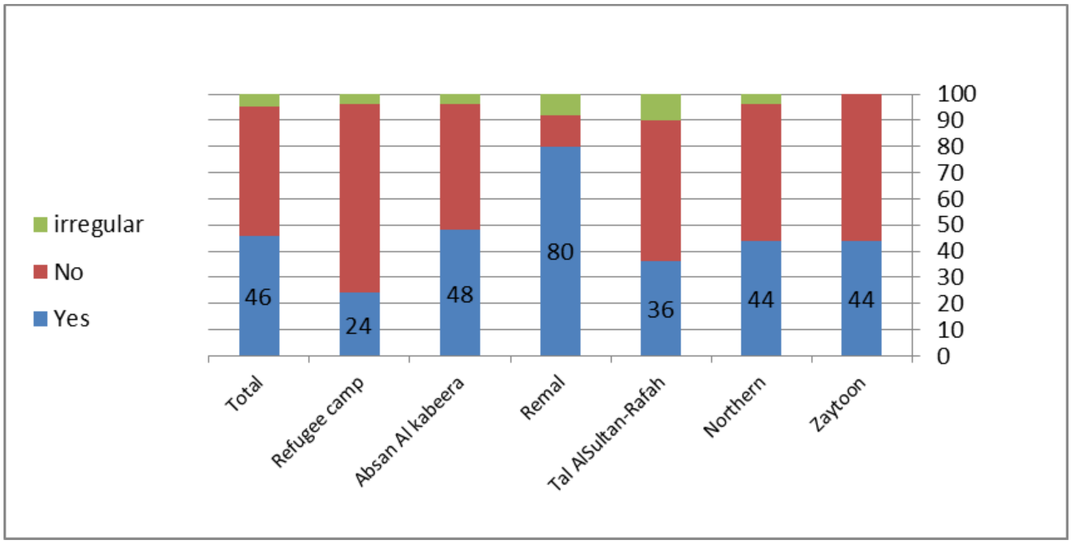
SWM services are known to consume large portion of the budgets of the municipalities. It is also widely recognized that the service fees collected from the beneficiaries of the service (local communities) is in general small and marginal and varies widely from one place to the other. In the Palestinian Territories, there is no adequate legal enforcement system. If bills for SWM services are sent by an entity but not paid, courts will not accept the case made by the local government or private enterprise because of the relatively small amount. Moreover courts might well decide the defaulter is not able to pay[27]. This is creating a serious challenge for the service operators who are not able to meet the financial demands of operating the system. The collection efficiency was found to be as low as 20%: 30% of the total beneficiaries of the system in some municipalities[28]. It has even been reported to be as low as 10: 20% of the real needed costs in non-conflict situations[29].

Results indicated that 46% of population pays for the services. Discrepancy among the targeted localities was observed. As shown in Figure 5B.8, 80% of the Al Remal community pays for solid waste services while the percentage of those who pay for the services was around 45% of the survey sample in each of the other three localities that are served by municipalities. Payment percentage is the lowest in Al Buraij and Tal Al Sultan as the services are partially or completely provided by UNRWA.

[27] Tariff Study for Solid Waste Management in the Governorates of Khan Yunis and Deir El-Balah, Gaza-Strip, Henri Disselkoen (GTZ), August 2000

[28] Interview with Eng. Abdel Rahim Abu El Komboz, Head of the Health and Environment Department, Gaza Municipality

[29] LOGO South Countries Program for the Palestinian Territories, 2006



Source: ESIA Survey Results, 2011

Figure 5B.8 The Status of Waste Collection Payment

The largest portion of the survey sample (around 40%) stated that they pay amounts between NIS 10 to NIS 20. However, it was observed that the monthly payment for solid waste disposal services varies even within the same locality. Figure 5B.8 shows the variation inside the same locality.

According to Habitat, the percentage of the monthly household income that can be freed for SWM in the developing world is 1.0 - 1.5% of the family income and according to some World Bank studies, this could even reach 1 - 3%[30]. No accurate figures were found for the average family income in Gaza Strip. However, according to UNSCO, 2010, the average daily wage in Gaza is NIS 60. Under the assumption that large portion of the population is making a living from daily wages and assuming that only one person per family is working on daily wage basis[31], it could be argued that an average payment of NIS 15/household/month[32] is regarded as a relatively high payment. Although the figure still falls within the World Bank suggested percentage of income, Gaza Strip case should be dealt with very carefully. The large portion of population living below the poverty line, the fact that most of income sources are insecure and of temporary nature add venerability to the households' income and make it possible to suggest that local population might be unable to afford for these service fees.

The majority of the interviewed local community members expressed concern and dissatisfaction with the heavy charges for other services which overload them. This could be, however, interpreted in two different ways. One view may suggest that the other service fees

[30] Bridging the Gap between Public and Private Sectors, International Workshop, Planning for Sustainable and Integrated Solid Waste Management, GTZ, 2000

[31] Based on this assumption, the family income will be around NIS 60/day X 22 working days = NIS 1320, under the assumption that only one person per family is working.

[32] The largest portion of the surveyed population – with the exception of the refugees camps which are served for free- were found to fall under this category.

for gas, electricity, water and sanitation are already too high and in some cases take a significant portion of the family income and this is not an optimal situation in terms of sensitivity to the social issues. However, it could be, on the other hand, argued that the portion paid for SWM is still very limited compared to other services and that local communities should be less reluctant to accept payments for SWM. There is generally a need for raising the awareness with the fact that SWM service involves operational and management costs that could not be covered without setting tariff system and implementing efficient service fees collection system.

"We pay expensive bills for all the services. NIS 70 for gas, NIS 50 for water, NIS 200: 300 for electricity and NIS 25 for sanitation"

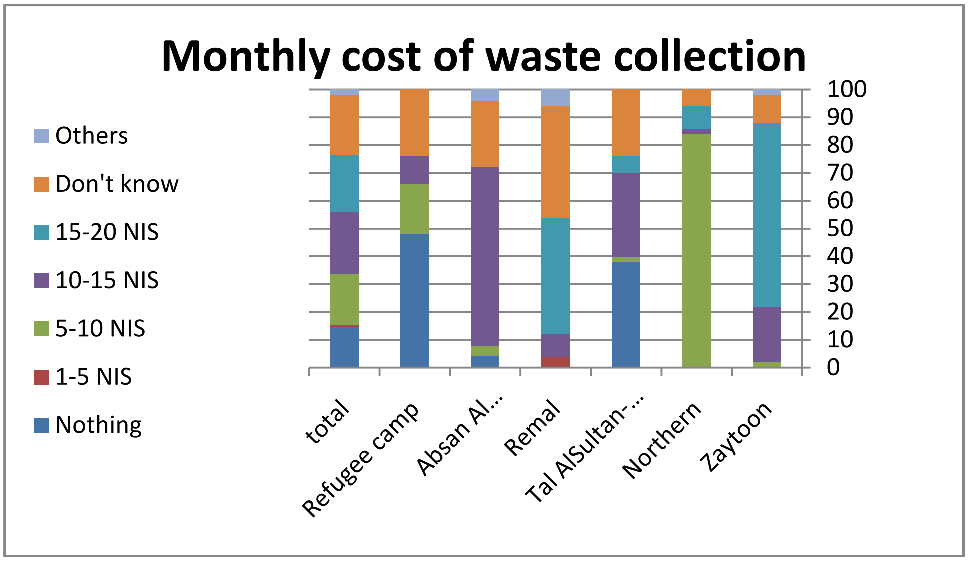
One of the participants in El Yarmouk FGD

The interviewed communities also raised the issues of the indirect costs associated with the system and with mitigating the negative impacts of the system deficiencies and mentioned that these costs are creating additional financial load on the families.

"We buy 40 garbage plastic bags for NIS 15, let alone mosquitoes killer to fight the flies and mosquitoes from the transfer station"

One of the participants in El Yarmouk FGD

Results from FGD in Al Buraij indicated that refugees in the camp pay fees of NIS 8 per month to the municipality for cleaning the camp. This amount is paid on their water monthly payment. This amount is however not paid by the majority of the people as they can not afford it.



Source: ESIA Survey Results, 2011

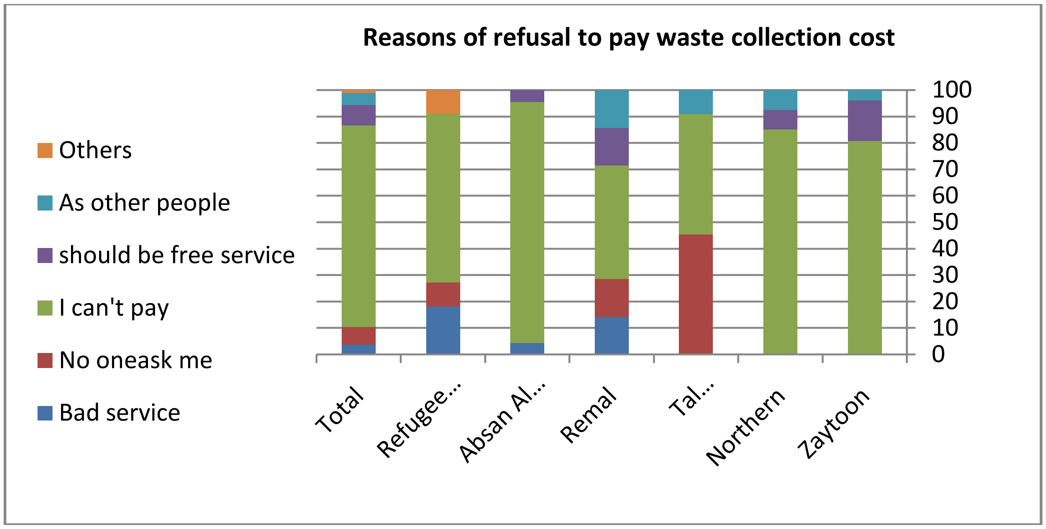
Figure 5B. 9 Variation of Monthly Fees of Solid Waste Services among Localities

Figure 5B.9 above shows the amount that the respondents are asked to pay as the survey results indicated. Survey results showed significant variability among the surveyed communities in the amount they are asked to pay. Municipalities decide on these amounts based on the general economic situation in the area.

As part of the survey, respondents who stated that they do not pay were asked about the reasons for not paying. Key reason for refusing to pay the cost for solid waste services was linked to affordability rather to the poor level of service. Unemployment, insecurity of income and the resulting poverty for families were key issues of concern for the respondents. Survey results shown in figure 5B.10 indicated that the majority of respondents in almost all surveyed areas (except Al Remal) stated that their inability to afford is a reason for not paying the services fees. These results give an indication on the importance of considering the affordability issues and the high level of poverty in planning any service fees schemes.

"I used to work as labor in Israel. Now I am unemployed. I can't find money to feed my children. How can I cover any other cost"

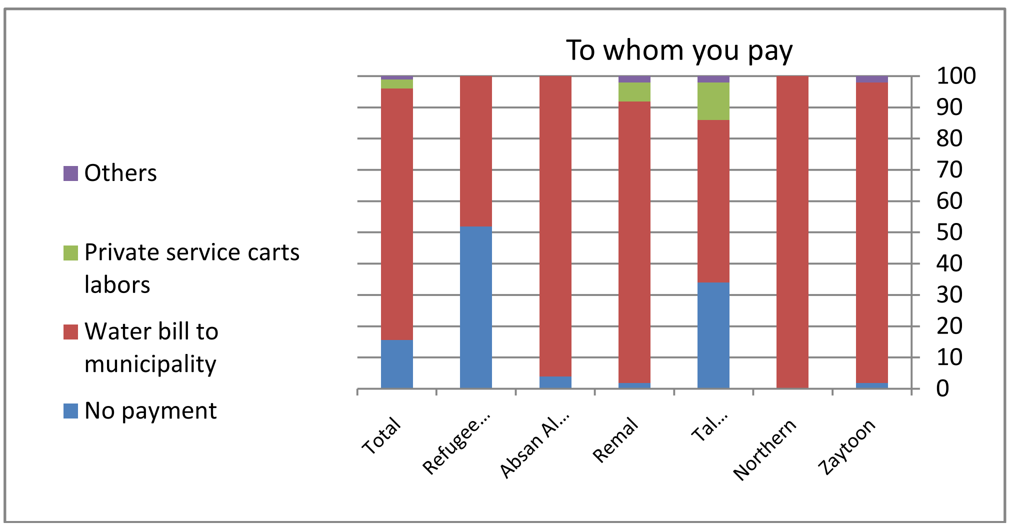
One of Al Zaytoon residents, Men FGD



Source: ESIA Survey Results, 2011

Figure 5B.10 Reasons for not paying the Services Fees

Most of the communities pay the services fees to municipalities. Even in refugee camps where the services are provided by UNRWA For free, the refugees are still requested to pay the cleaning fees of streets to municipalities. Figure 5B.11 shows that collecting fees on the water bill is the most dominating mechanism.

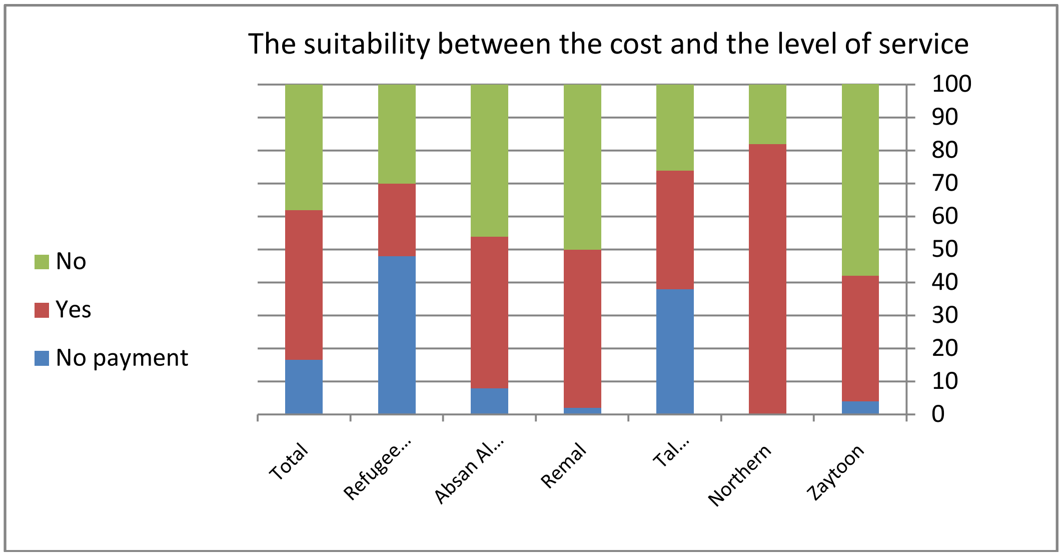


Source: ESIA Survey Results, 2011

Figure 5B.11 The Entity that Collects SWM Fees

5B.4.5 Community views on payment suitability for the offered service

Despite the fact that considerable portion of the surveyed households does not pay the fees as indicted above, 45% of the respondents expressed positive impressions about the suitability of the service fees to the offered service with the current payment while 38% thinks that the payment is too high compared to the level of services provided. The remaining respondents believed that they should not pay for the services and that the service should be provided without charging households. Figure 5B.12 shows the survey sample view about the suitability of the service fees to the current level of service.



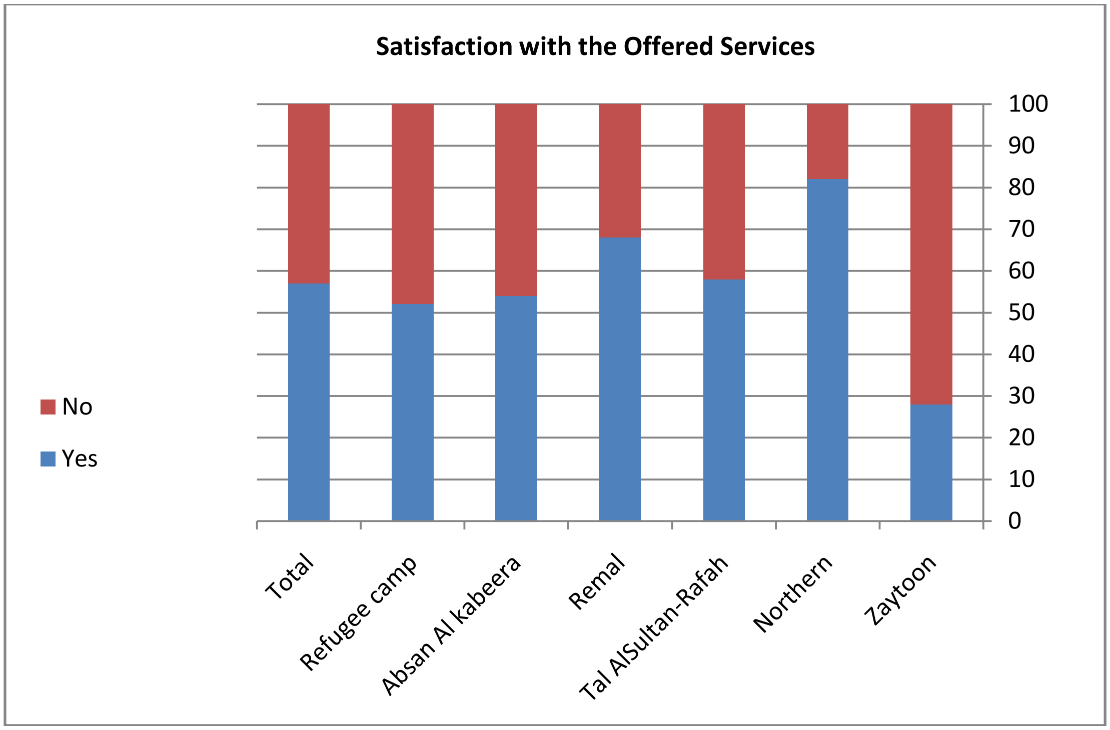
Source: ESIA Survey Results, 2011

Figure 5B.12 Community Views on Payment Suitability

The FGD results showed that although participants are aware of the necessity of fees to cover services costs, in several cases they think that they should not pay because this is the responsibility of the State or because the service is financed by donors' programmes. The free-rider attitude was noticed during various discussions with local communities. This was found to be the case with the FGD in El Yarmouk, Zaytoon area, refugee camps and northern Bedouin village (Um Alnasser Village) . Generally speaking, a high sense of dependence on the government was observed during the survey and other consultation activities. The SWM services are widely perceived to be the responsibility of the Government and the local population strongly believes that they should not be charged for such services. This raises the importance of an increased level of awareness with the associated costs of SWM and the need for resources mobilization to sustain the service.

5B.4.6 Community Satisfaction with the offered service

When asked about their satisfaction with the service, respondents' replies were divided almost by half of the survey sample into satisfied groups and dissatisfied groups As shown in figure 5B.13 below, The results vary among different localities and the highest level of satisfaction were recorded in the Northern Governorate and El Remal locality. It is worth noting that the results of the survey in the Northern Governorate contradicts to a far extent with the FGD results where almost all participants in the latter showed dissatisfaction with the offered service and attributed this to the absence of house to house collection, irregularity of service, absence of street containers and resulting waste accumulations in streets. The intermediary transfer station was also one of the key reasons for the dissatisfaction of the participants in the FGD.

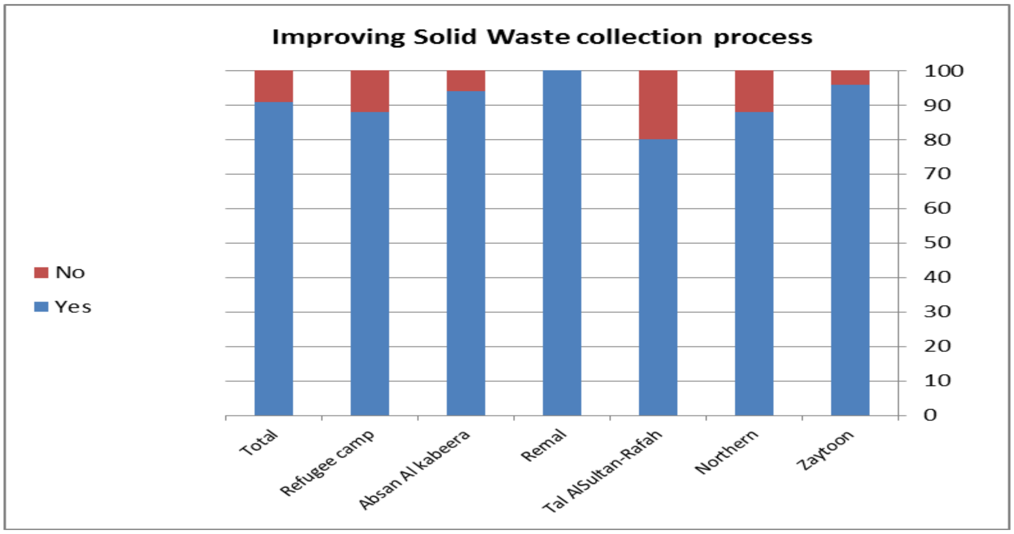


Source: ESIA Survey Results, 2011

Figure 5B.13 Satisfaction with the Offered Services

5B.4.7 Community view on improving the services

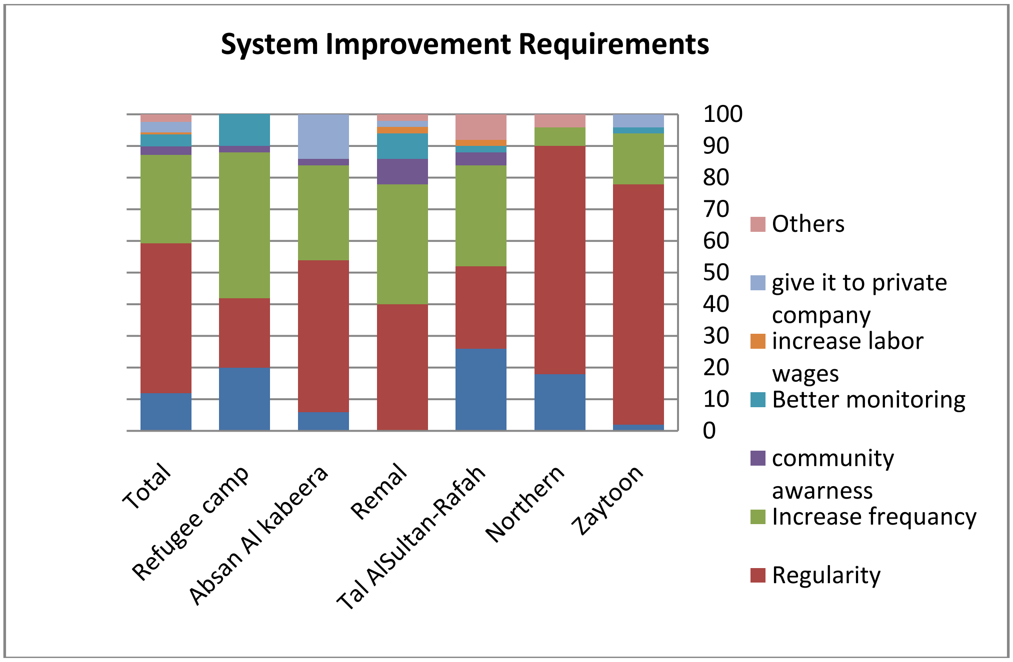
Despite the relatively high level of satisfaction that appeared as a reply on the above question about satisfaction with the service, almost all communities believe that the current system needs to be improved as figure 5B.14 shows. This is applicable even in refugee camps where UNRWA is the service provider. Almost 90% of respondents in Buraij want the system to be improved. This was found also to be true in localities with high level of service like Al Remal. FGD results showed that refugees in the camp are satisfied with the current level of services but they still ask to increase the frequency to more than one shift a day. They also, believe that increasing the number of workers and enhancing the level of field supervision can improve the level of services.



Source: ESIA Survey Results, 2011

Figure 5B.14 Needs for System Improvement

Further analysis on the possible improvements of the system revealed that the community is mainly interested in a more regular service with higher frequency. Other issues were raised as improvement of workers monitoring system, increasing the workers wages in order to stimulate them for better performance, raising the awareness of communities, and engage the private sector in running the system. Figure 5B.15 illustrates communities' views on the needed improvements. The results of FGD supported the survey results as communities in all localities expressed the need for the improvement in the system regularity and frequently. This is strongly expressed in all communities where services are provided by municipalities. In wealthy community as Al Remal, local communities are informally paying the operators of the donkey carts in order to obtain more frequent services. Although respondents in Al Remal believed that frequent and regular service should be offered by the primary service provider who officially collects service fees, they still pay twice in order to obtain better level of service. However, it should be noted that Al Remal should be considered as a special case in affordability and that in other localities where poor communities are receiving low level of service, they can not afford to pay additional payment to obtain better service. Even in Al Buraij camp where UNRWA is providing relatively better daily services, community is still interested in two shifts a day. Improving frequency and regularity were requested in all FGDs.



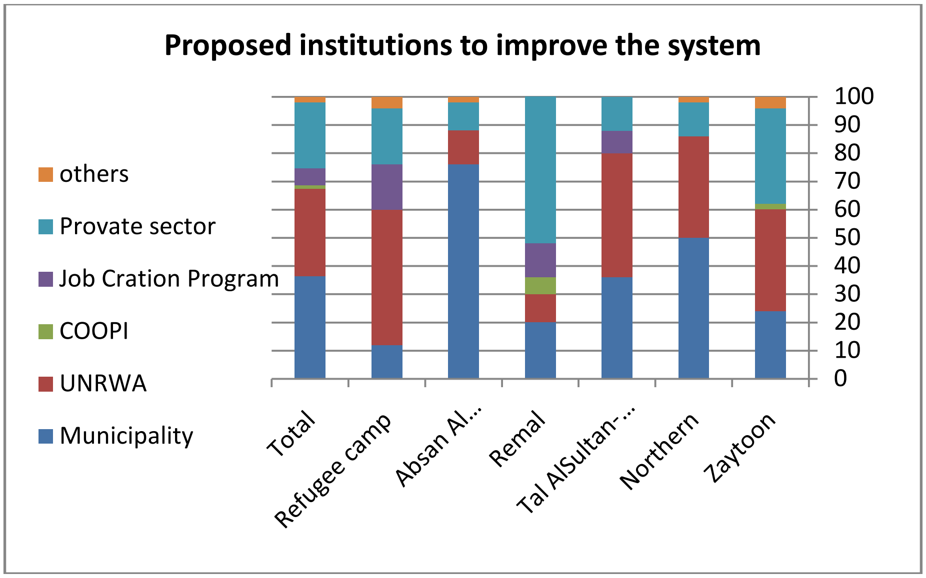
Source: ESIA Survey Results, 2011

Figure 5B.15 System Improvement Requirements

It should be observed that all the proposed improvements are concerned at the primary level of the services. Community in Northern Bedouin village (Um Alnasser Village) and Tal Al Sultan were also interested in improvements at secondary level. Communities in both areas complained from the use of neighboring areas as transfer stations and the fact that these transfer stations were turned into permanent landfill that receive waste from all northern communities. Participants in FGD stated that they complained to the municipality and asked to close this station. They hope to have this station closed as part of the intended improvements. This indicates the relevance of the intended improvements at primary levels.

5B.4.8 Proposed institutions for leading and improved system

Results indicated that around 40% of the survey sample perceived municipalities as suitable institution for system improvements. 31% see that UNRWA can lead the system improvement better while 23% recommended a role for the private sector. Figure 5B.16 shows the variation among the surveyed localities. Second option for non-refugees localities is the UNRWA. This is general trend in Gaza strip as people always hope to receive the UNRWA services, not only for solid waste but also for education and primary health services. UNRWA is known for providing free high quality services. Although JSC is one of the important service providers, it was not mentioned by respondents as such. This could be attributed to lack of institutional awareness that, most likely, resulted in respondents' aggregating all the governmental service providers under "municipality".



Source: ESIA Survey Results, 2011

Figure 5B.16 Proposed institutions for system improvements

FGDs revealed that people see potentialities for improvement by municipalities. They, however, see that UNRWA or private sector is also capable to provide quality service. Communities who receive UNRWA services insist that UNRWA is the optimal institution to improve the system. The private sector was appreciated by all communities that receive the services from municipalities. They however, showed fear that cost will increase as they believe that private operators are more profit oriented and they might not be able to afford the required service fees.

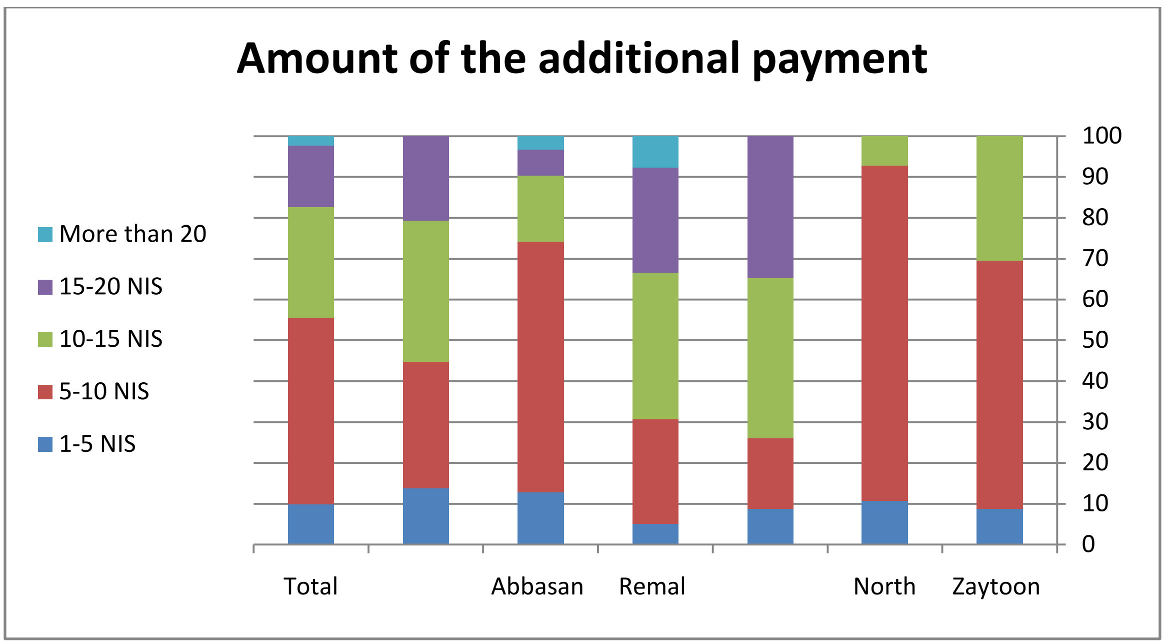
> *"Private sector can achieve significant improvement but the fees will be obligatory. I believe municipality is more flexible when it comes to the fees."*
>
> **One of Al Zaytoon residents, Men FGD**

5B.4.9 Willingness to pay for improved system

Investigating local communities' willingness to pay for an improved level of services was an essential section in the survey and other consultation tools. Results indicated that more than half of the surveyed cases are willing to pay higher cost for improved services. The percentage is the highest in Al Remal (around 80%) and lowest in Al Zaytoon and Tal Al Sultan (around 40 %) while it is almost the same in the other communities (around 60%. Although the results above indicated that 46% of the population does not pay, it should be noted that the low quality services was in many cases the reason for not paying. The results above suggest that local communities will be willing to pay more under the condition of improving the service quality. This is also applicable to the high income areas where they are paying twice to get reasonable level of service. Participants in Al Remal FGD raised the issue of accepting to pay additional fees only for a transit period to allow the system to start composting solid waste and sell products to cover the cost of the primary services.

These results seem, to a far extent, to agree with the results of the Demand Assessment and Willingness to Pay Survey (DAWPS) conducted by the Feasibility Study Consultant. The findings of the DAWPS showed that more than half the sample is willing to pay for SWM services (a total of 62% of the filled questionnaires for community representatives with only 10% agreeing unconditionally on paying for receiving the service while around 50% link between agreeing to pay for a service which is more efficient and under more transparent administrative arrangements).

The amount of additional payment was no major. It was ranging between 5-10 NIS per month which is far below the proposed service fee figure in the feasibility study. As shown in figure 5B.17 around 60% of respondents who are willing to pay more were ready to pay maximum 10 NIS monthly. The remaining 30% were willing to pay a maximum to 20 NIS. This means that communities may be willing to pay additional payment for improved services. These findings draw the attention to the importance of considering the affordability issues and the maximum amounts that households can afford to pay.



Source: ESIA Survey Results, 2011

Figure 5B.17 Amount of Additional Payments that Local Communities are willing to pay

Moreover, it should be carefully noted that the perception of an improved services means, for local communities, improvements in the primary collection services and partially for the secondary collection. In that sense, the development of final disposal infrastructure should be necessarily linked to an improvement in the primary and secondary collection of waste which are the visible stages for local communities. Unless this is attained, it will not be possible to impose additional charges on the local communities.

The poverty context and inability to afford are crucial issues that should be considered. Main reason for not being willing to pay additional costs was poverty as stated in the above section. People in Gaza are used to free or subsidized services. It became part of their culture and causes serious problems for most public services providers. People believe that public services must be covered by the government or donors. This is in particular the case in refugee camps were refugees hold UNRWA responsible for providing all public services for free.

The DAWPS does not ask the beneficiaries about the amount of fees that they are willing to pay for an improved service. Comparison between the social survey of the ESIA and the DAWPS in that specific aspect, thus is not possible.

5B.4.10 Community view on community awareness needs and tools

Majority of respondents believe that awareness campaigns are needed to improve the system. FGD results indicated that communities are interested to improve the local awareness on issues related to solid waste management at household level. Local people showed interest to learn on solid waste separation at-source as major method for reducing the disposed solid waste and attaining a more efficient system. This is already practiced in rural areas where farmers use the bio waste to feed household animals or to be composted as plant nutrients. The respondents supported varied awareness methods and tools such as lectures, masjid speeches, workshops and press campaigns.

5B.5 The Location, Land and Livelihoods Issues of El-Fukhary Landfill

El-Fukhary landfill is located within the administrative jurisdictions of Khan Younis Governorate. Khan Younis Governorate is located in the southern part of Gaza Strip. It consists of seven municipalities: Khan Younis, Bani Suhaila, Abasan El-Kabira, Abasan, El-Saghira, Quarrara, El-Fukhary and the Khuza'a. The largest portion of the Governorate resides in Khan Younis City (52.6% of total Governorate population), followed by Khan Younis Camp (14 % of total Governorate population) [33]. According to the PCBS, 2008, the Governorate has the highest percentage of unemployment (38.8%)

El Fukhary landfill (Sofa) is situated in the southeast of the Gaza Strip, approximately 5 km northeast of the former Gaza Airport and 800 meters from the Israeli border wall. The landfill covers an area of approximately 33,000 m3 (3.3 hectares or 33 dunums). The nearest inhabited house is a single house located approximately 20 meters away, and larger settlements lie at a distance of about 800-1,500 meters[34]. These safety limitations and the nature of the land in the area resulted in limiting the economic or social activities. The area is also defined as buffer no man zone as no man activities are allowed within 300 m from the

[33] PCBS, 2008

[34] Environmental Assessment of the Gaza Strip United Nations Environment Programme, following the escalation of hostilities in December 2008 – January 2009, UNEP, 2009 and the field observation.

border line. The practical cases and the experiences of the landfill guard and waste pickers there showed that even up to 1000 meters from the Israeli boarder is risky.

The landfill location had significant historical importance before the siege on Gaza. It is located at the main Rafah road that drives to Rafah commercial crossing with Israel. This crossing was the main source for all commercial activities in Gaza. The continuous and frequent movement on that road hindered any agricultural activities in the area. The situation was further deteriorated after the war on 2008/2009 when the Israeli troops destroyed around ten houses in the area and forced the families to leave from the area. They also destroyed one baton factory which was the only industrial activity in the area. Agriculture was restricted due to the dust created by the commercial road in the past and now it is not possible because of the security hazard. The field observation suggests that more than 80 % of the land around the landfill is uncultivated while round 20% is cultivated with perennial crops which is growing naturally and does not need any care or attention from the owners.

Figure 5B.18 Grazing activities by El Fukhary Landfill road

Figure 5B.19 Trees near El Fukhary Landfill Location

The land of the existing disposal site is owned by local residents who are leasing the land to the municipality. There are currently very limited activities in the existing disposal site and the surrounding areas. Limited rain-fed farming is taking place in the area. This is either done by very limited land owners (the ARAP consultations showed only two farmers) or by tenants of lands. The field investigations also showed that they are only 3 cases of land tenants and the system is widely managed as part of family business.

The land owners interviewed during the preparation of the ESIA mentioned that the value of their lands drastically decreased as a result of the waste disposal activities at the dumpsite. Security issue was also perceived to be one of the factors for decreasing land value. The ARAP that has been prepared as part of this assignment involved a series of consultation activities with land owners and discussions with them on the compensation that they accept. The initial discussion with one of their representatives showed that they will be willing to reach an agreement to lease the land or to exchange with other land that can be used for agriculture or any other purposes. The tenants will be accepting income replacement compensation. This is explored in more details under the ARAP.

The field observations showed that Al Fokhari city where almost 4000 inhabitants (500 households) reside is the nearest residential community to the landfill. The population density of the city is relatively low and most of the population is working in agriculture. Al Fokhari residents enjoy reasonable access to social health and education services. It is worth noting that sample of Al Fokhari residents have been consulted and invited to participate in the scoping session[35]. They showed concern about the potential impacts from expanding the landfill, particularly since it is doubtful that they will gain any direct benefit that make them tolerate these negative impacts. El-Fukhary residents raised issues about possible negative reaction from their side like cutting roads to obstruct construction and operation. Cancers about reducing land value in the areas around the landfill were also expressed.

Some Bedouins families are practicing limited grazing activities during the day time and usually leave the area before sunset. These specific groups are recognized by the Israelis and not targeted as long as the vision is not affected by the darkness or bad weather.

During the field visits conducted to the site, no waste scavenging activities were observed inside the landfill. Individual waste pickers, however, regularly visit the outer borders of the landfill – where most waste trucks evacuate their loads - to scavenge valuable recyclables items. The interviewed waste pickers and the landfill guard who were interviewed during the field visits mentioned that the amount of recyclables that reach the landfill is generally very limited. The waste pickers who regularly visit the location are around 10 persons from the same family. Picking recyclables is one of the living sources they acquire among other marginal activities like grazing. Recyclables picking activities from this location were perceived to be unfeasible economically. The main reason for this, according to interviews and field observations, was attributed to the increased interest of waste pickers to work at the street containers spots and illegal dumping sites/ transfer stations. This dominant practice negatively affected the quality of recyclables that reach the landfill.

The single household that exists close to the landfill is the house of the landfill guard. The landfill guard is also one of the land owners of an adjacent land to the landfill. The interview with the landfill guard and his family showed that the house is owned by his father who used to be a farmer and owned a land next to the house. The interviewed members of this family[36] expressed dissatisfaction with their living conditions next to the landfill, although this house did not seem to be a permanent residence location for them as they mentioned to have another farer house that they use in case of tensions by the borders. They spoke about the foul odor and the increased number of flies and mosquitoes. The house lacks several basic needs including access to potable waster, electricity and proper hygienic sanitation facility. For this family, the main source of income is the municipality salary that the husband is gaining, in addition to other sources of income form other sources like grazing activities. The case of this family is an identical case for families in Gaza Strip where the main bread winner (the husband) is financially responsible not merely for his immediate family members (wife and children) but also his adult, unemployed brothers and sisters.

[35] A scoping session was conducted in Gaza on 8th December 2011

[36] An informal interview was conducted with Kamal Abu Esnema – the landfill guard and his wife on 27 September 2011.

Figure 5B.20 The cesspit of El-Fukhary Landfill guard house

Figure 5B.21 Animal sheds near El-Fukhary Landfill guard house

5B.6 The Location, Land and Livelihoods Issues of Johr al Deek Landfill

Johr al Deek, located at the eastern border line adjacent to Israel borders. The location is already used as a landfill and the high risk of the landfill was a key issue for various workers and users of the landfill. The area was known historically as arable land, mainly to cultivate rain fed crops that generates relatively low profit. This is due to the lack of water resources (wells). The management office of the landfill include 20 employee including (10) permanent workers, (1) Head of Department, (1) Head of Section, (1) Administrative Assistant, (2) Inspectors, (3) temporary workers and (2) drivers[37].

The field observations showed that scattered Bedouins houses are located on the road to the landfill. The nearest residential area to the landfill is Johr al Deek town which is located more than 1 km. 4000 inhabitants (approximately 500 households) live in the town and their main activities are agriculture and grazing.

The land of the landfill owned by several families and leased by municipality of Gaza. Due to the financial challenges the municipalities are facing, they are finding difficulty in paying the lease to the land owners. This has been the situation since long years now. The land value is significantly getting lower due to the waste disposal operations. Part of the landfill is located in the buffer zone where no man activities are allowed. Even the area beyond this restricted area is ranked as risky area where farmers can't cultivate or graze.

The area also included some industrial activities such as baton factories, animal fodder factory and asphalt factory. These, however, were stopped production in 2006 when the siege was posed on Gaza as they lacked the imported raw material. No commercial activities are reported in the area except a small shop to purchase the recyclables that are collected by the scavengers.

[37] Information collected during the meeting with the landfill management on 26 September 2011

Figure 5B.22 Waste Disposal at Johr al Deek Landfill

Figure 5B.23 Waste Pickers at Johr al Deek Landfill

Agriculture is the major activity in the area. The surrounding arable land is cultivated with perennial crops mainly olives and citrus but also other agricultural annual activities such as vegetables are reported. The production in the area is mainly in the open field with few greenhouses. Livestock production is also reported in the area mainly poultry and sheep production.

Around 5 farming families live in the surrounding farms which are owned by landlords who live in the city. All the families have small residence in the area where they spend most of the day to cultivate the land while they spend the nights in their houses in Gaza city except two families who spend the night there. The area is ranked as dangerous area where the Israelis gun machines may target any moving body. The situation for the farming families there is to some extent different as they are recognized by the Israelis and usually not targeted. The risk is usually higher in cases of low visibility and during the night.

Scavenging activities are practiced in the landfill by a specific group of 20:25 young men who are working on daily basis and could be classified as "full timers". This group increase to around 50 persons during the schools summer holidays[38]. Some of them belong to the same family. In addition to these 20 full timer waste pickers, some Bedouins (both men and women) sometime give causal/irregular visits to the landfill in search for valuable recyclables.

"We tried to prevent them, even called the police for them but they returned again. We left them to work here, knowing that this is their key source of income. They work from 6.00 am to 4.00 pm. They are exposed to enormous heath and physical hazards and risks… expired food, sharp material, Israeli guns … One of them was shot few years ago and few days ago again the Israeli shot their guns, despite the Red Cross instructions. They never adhere to this"

[38] One of the waste pickers at Johr al Deek landfill

One of Johr al Deek Landfill Management Staff

As could be observed from the quote above, waste pickers in the landfill are working in very challenging conditions. This has been emphasized during the interviews with the waste pickers at the landfill who also referred to their adaptation strategies to the physical risks they are exposed to.

"We know where the hospital waste is, yes we recognize and avoid it. Sometime we find human organs and sharp objects but we get used to this."

One of the waste pickers at Johr al Deek Landfill

It was noticed that working in the landfill represents the sole exhaustive source of income for those who are working in daily basis in the landfill. However, the number of working hours varies from one to the other. Other groups who work on temporary basis have other sources of income and are juggling waste picking among other activities to earn additional living.

Regarding the average daily income gained from working in the waste picking activities, conflicting figures have been stated by the waste pickers when they were asked this question. One of the waste pickers stated that he can get NIS 20 if he works for 2 hours. Others referred to a daily income of NIS 40 per full working day. It was obvious that waste pickers tended to state lower figure than what they are actually getting. The discussion with one of the recyclables traders proved that by his statement that the daily income of the waste picker varies from NIS 50: 60.

5B.7 The Neighboring communities to dumpsites and transfer stations

As mentioned above, a number of temporary waste storage sites and transfer stations were created within urban boundaries of four Governorates of GS to mitigate for the challenges the limitations in transport equipment, long haulage distance to official dumpsites and frequent roads blockages that prevents from regular waste transport.

As shown on table 5B.7 below, there are currently 8 existing sites. With the exception of only one site, all these sites are temporary waste storage sites. Only one site is a transfer station (El Yarmouk at Gaza City). Out of the 8 sites, 3sites will be closed and 4 sites will be transformed into a transfer station. Moreover, a new transfer station will be established in Deir El Balah.

Table 5B.7 Summary of existing temporary waste storage sites and transfer stations

Governorate	Site	Existing Situation
North Gaza	Bei Lahia	Temporary Waste Storage Site
	Um al Nasser	Temporary Waste Storage Site
	Beit Hanoon	Temporary Waste Storage Site
Gaza City	Yarmuk Transfer Station	Transfer Station, including temporary storage Site

Governorate	Site	Existing Situation
	Al Maslakhi	Temporary Waste Storage Site
	Al Karama	Temporary Waste Storage Site
Khan Yunis	Al Namsawi	Temporary Waste Storage Site
Rafah	Tel al Sultan	Temporary Waste Storage Site

Site will be transformed into a transfer station		Site will be abandoned	

The interviews and consultation activities conducted as part of the ESIA revealed that local residents adjacent to the intermediary transfer stations and dumpsites are suffering from the negative impacts of these facilities on their health and day-to-day life. The mentioned impacts included:

- Odor and inconvenience resulting from the practice of burning waste on-site,
- Visual implication of the unpleasant scenes of the transfer stations.
- The increase of rats, mosquitoes and flies
- Impacts on the economic activities and the prices of housing units even in high income areas (e.g. the location of Yarmouk transfer stations)

"We can not open the balcony. Mosquitoes are unbearable"

One of the participants in El Yarmouk FGD

Figure 5B.24 El Yarmouk transfer station and the neighboring residential area

Figure 5B.25 Interviewing one of the waste pickers working in El Yarmouk

It worth noting that the investments previously allocated by some organizations like COOPI and other funding agencies to upgrade a number of the transfer stations have never been sensed by the adjacent local population. Local residents of El Yarmouk neighborhood stated that even if COOPI renovation improved the working conditions inside the transfer station, this has not been reflected on the neighboring communities. Suffering from odor, flies and other negative impacts are still felt with the same severity by local communities.

5B.8 Workers in SWM in Gaza Strip

In normal situation, working in SWM is generally low ranked and underestimated from a social prospective. The jobs that involve direct waste handling generally attracts very poor low qualified people. However under the current situation in Gaza with the high levels of poverty and unemployment, such jobs currently attract high qualified young university graduates as a source of income, even on short term basis. It also attracts large number of urban poor who try to find a day-to-day living from informal segregation of valuable recyclables.

5B.8.1 Formal workers

The situation of the formal workers in SWM in GS varies widely from one employer to the other. UNRWA workers enjoy the best working conditions and benefits, including relatively high fixed contracts, job security, very efficient and satisfactory pension system, health insurance and good working conditions. The field observation and stakeholders views showed that the situation of UNRWA workers in general is seen the best optimal employment conditions in Gaza strip. The satisfactory working and compensations conditions of UNRWA workers is reflected in the quality of primary collection services[39] they offer to the communities and the level of communities satisfaction with the offered service as indicted on the survey results above.

Permanent municipalities' workers are contracted on fixed term. Additionally, the municipalities hire temporary workers for shorter term. Permanent workers enjoy the privilege of having a sustainable income as they receive their salaries on monthly basis with some delay when the municipality faces financial problems. They are also covered by health insurance and moderate pension system. When compared to UNRWA workers, the municipality's permanent workers earn lower wages and their working conditions are also poorer.

The numbers of such category differs among governorates as the available capacities and needed work load differ. In Northern Gaza there are 160 employees working on solid waste collection and disposal. 121 of them are workers. In Middle Area and Khan Younis, the total number of employees is 65 while the number of workers is 17. Gaza strip as the biggest producer of solid waste there is around 379 labor working on solid waste collection and disposal. 185 of them are working with municipality cars and mainly with fixed contracts while 194 are with donkey carts and temporary contracts that are covered by donors' cash for work projects.

The third type of formal workers is those who work in temporary projects. In some cases they are contracted and monitored by international institution such as COOPI who runs cash for work programme. The programme hires workers and donkeys to collect the household waste and dispose it in the nearest transfer station. In this case, workers work under direct supervision of COOPI. In other cases the worker and his donkey carts are hired by the municipality while the cost is covered by international donors or implementing agencies that runs temporary programmes. Such programmes usually follow cash for work

[39] Secondary collection services are only provided by municipalities.

or food security programmes. The international donors or implementing agencies do not have any direct supervision on the hired workers. This task is left to the municipality as the implanting partner. Usually the contract period varies from two to six months. Although the salaries under these programmes are relatively high, no job security is assured as they work only for the contract period.

Figure 5B.26 JCP workers in the streets of Gaza City

Figure 5B.27 JCP workers in Yarmouk Transfer Station

Regarding working conditions, health and safety issues, several limitations are facing the workers. Usually, workers are not provided by any health insurance and paid the wages based on the number of days they worked. They do not have leave credit and no excuses are accepted in cases when the workers are absent from work due to heath problems even if this is resulting from work accidents.

Despite these employment limitations, this field is still attractive to a large number of the poor who benefit from the temporary salaries as well as any additional income from the segregation of recyclable items from the collected waste and selling them to traders. It was observed that this activity is widely practiced by various formal and informal workers in the sector.

It was generally observed and concluded that GSWMP should pay careful attention to the health and safety issues of the workers in the sector. More sustainable and secured employment schemes should be developed to ensure the sustainability of crew. This, from one hand, will help in attaining sustainable socioeconomic outcomes on the level of the workers families and will help in sustaining the systems. Although the current operations of the international agencies in Gaza is dominated by the relief and emergency mode, it is anticipated within the coming years and during the course of the long term activities that the political situation may come into more stable situation and the peace process could be pushed ahead. Under this scenario, a more sustainable vision will be needed to address the socioeconomic issues related to SWM.

5B.8.2 Informal Sector Involvement in the SWM Sector

As part of the preparation of the baseline assessment of the ESIA, the involvement of the informal actors in SWM was investigated. It was found that the informal sector is becoming increasingly involved in the sector as a result of various factors, including but not limited to:

- Unemployment
- Availability of waste in street containers, transfer stations and temporary storage sites without proper control or management

- The increased market demand on recyclables (in particular plastics) both locally and regionally particularly in Egypt.
- Poverty context combined with the above factors resulted in the informal waste picking to be a main livelihood strategy for the poorer urban and rural populations segment of the community despite the social stigma associated with it.

The informal sector can be mainly divided into three groups.

A) Waste pickers who work in the main landfill or in the transfer stations for recovering recyclables.
B) Street pickers who collect the recyclables from the waste bags in front houses and from the containers before they are emptied.
C) Informal traders who purchase the sorted recyclables from the previous groups and sell them to the industry for recycling.

The number of **group (A)** is relatively restricted since the number of informal members engaged in the landfills and transfer stations could be roughly quantified from the field observation. The total number of the members of this group could be roughly quantified to be around 200. Waste pickers in landfills and transfer stations are running kind of family business where brothers and cousins are formulating a dominating group to prevent any stranger to work in the family transfer station. In most of the cases, with the exception of El-Fukhary landfill, the workers under this group are making an exhaustive source of income form picking recyclables. This indicates the significance of this business for this family as it is their main income. The team was informed about big struggle between two families over Al Yarmook transfer station which resulted in dominating the transfer station to the winning family. The same situation was noticed in the northern station where two families were the only scavengers there. When they were asked if they will follow the station if it is transferred to Al-Fukhari, they stated that the family who reside there won't allow them to work there.

The members of this group are characterized by their preference for operation in close communities without being visible. They are ashamed of their jobs and are incapable to face the public with their jobs.

"I will speak to you but do not take picture! The other day, a TV interview was conducted here and my aunt watched. It was a scandal in the family. I am ashamed of myself "

Waste picker in Al Yarmouk Transfer Station

It is expected that the daily income from working on full time basis could vary from NIS 30 to NIS 60. This is relatively a reasonable level of income in Gaza strip as the estimated daily wage for unskilled labor is 30 NIS. The informal workers in the landfill stated that deteriorated economic situation and unemployment encouraged the growth of the informal business in SWM.

The informal sector members are generally working under very poor and hazardous working conditions. They reported that they were injured from the hospital waste several times. Additional to this major health risk, they are exposed to safety risk from the Israeli aggression. Despite this risky working environment, landfill and transfer waste pickers

Group (B) of informal sector involves the street pickers who collect the recyclable from street containers or piles in front of the houses. This group works actively during nights and very early in the morning before the municipality shift starts for emptying street containers.

This group is distinguished by being heterogeneous and widely diverse. Operation under this group attracts numerous numbers of the poor from various ages and backgrounds. The group consists widely of school children who help their families in generating additional income. The daily income out of this job can be as low as 5 NIS per day but still can help the family. They are also very sensitive to the social stigma of their business. They feel ashamed to work during the daylight or to be interviewed.

Quantifying this group was found to be very difficult. This mode of informal sector operation under this type is characterized by frequent daily ins and outs of the market. The market is daily attracting hundred of members who seek temporary and quick source of income. Generally speaking, this group of the informal sector does not rely on the income obtained form selling recyclables as the main source of income. They usually have additional sources of income from similar types of marginal activities. It is worth noting that the increased number of informal members of Group B negatively affected the income of members of Group A who are working at landfills and transfer stations. Sorting and recovering recyclables from street containers result in waste arrival to the transfer stations and landfill with lower component of recyclables than it used to be.

"The waste is transferred to the station after it lost all valuable recycles in the way, The situation is the worst during summer school holidays when children collect all recycles from containers"

Scavenger in Northern Gaza transfer station

In several cases the formal waste workers play the role of Group B of the informal sector by recovering and selling recyclables from the collected waste.

Group (C) of the informal sector group involves the traders who purchase the recyclables from the previous groups and sell them to the industries. According to the rough estimation provided by the interviewed traders, around 50 traders are working across Gaza strip. Plastic is the major target for this group as the buy the kilogram for NIS 0.5 and sell it for NIS 0.65-0.8. In the past they were also interested in metal but it is not marketed any more. It is worth noting that the price of recyclables, and accordingly the income of the mentioned groups, is strongly linked and affected by the international price and the surrounding markets. According to COOPI, one of their programmes has been drastically affected due to the unexpected changes in the plastic price which negatively affected the feasibility of the project.

In studying the potential impact of GSWMP on the informal sector, it was found that preventing the various groups from accessing the recyclables will result in negative economic impacts that will vary in its severity according to the type of group. Group (A) will likely be the groups that will seriously be affected. According to this group of the informal sector, preventing access to the landfill and/or transfer station will mean a serious livelihoods impact since picking recyclables is the main source of income to them and their families. The economic crisis and the increasing unemployment problem make their shift to another job, particularly under the limitation of their skills and qualifications, very difficult. Additional problem is the fact that scavengers are unqualified for doing any other jobs. This indicates the need to consider this group in planning for the various actions under the project. There is a need to ensure that various measures are in place to tackle the potential negative impacts on the livelihoods of this group. Potential measures may include the provision of formal job opportunities, building the capacity of these groups on various alternative skills to allow them to get integrated into other kinds of business and integrate them into any intended recycling or composting future activities.

In addition to these measures, there is a general need to raise the profile of SWM in Gaza Strip and increase the awareness of the positive potential of the sector in creating business opportunities. The current low profiles associating with SWM is contributing to the social stigma that the informal sector is suffering from. They feel that they are doing a meaningless and marginalized business.

5B.9 Gender and Children Aspects

Generally speaking, women play a very important and active role in waste management on the household level. They are, in most of the cases, responsible for the issues of packing waste, segregating items that could be reused or sold for recyclables.

Due to cultural issues, the role of women in SWM eliminates when waste is taken to the door step. Here comes the role of men and children in carrying waste to the street containers in case these containers are located far from the houses. In localities were there are no waste containers, children also help in disposing waste on street piles or by the sea side as shown on figure 5B.28 below.

Figure 5B.28: Children role in waste disposal in Gaza Strip

Figure 5B.29 A women working in recovering recyclables from Johr al Deek neighborhood

Moreover, women also play a limited role as informal sector operators. The field observation showed a limited number of women and young girls engaged in recovering recyclables from landfills and transfer stations.

6A ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR THE SOUTHERN SECTION OF THE PROJECT

6A ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR THE SOUTHERN SECTION OF THE PROJECT

The assessment of potential impacts has been done through analyzing different project activities and envisaging possible changes to the environment. Each potential impact was qualitatively analyzed to classify its significance to three degrees: *major impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards, *medium impacts* which are impacts with a reasonable likelihood that are likely to cause violation of applicable standards only in combination with the impact of other sources, and *minor impacts* which are impacts which are not likely to cause violation of applicable standards whether on its own or in combination with other sources.

The project impacts have been categorized to impacts during the construction phase, impacts during the operation phase and impacts after closure of the landfill.

6A.1 Impacts during Construction and Operation Phase

6A.1.1 Impacts Related to Storage of Excavated Soil and Daily Waste Cover

The construction of landfill cells will involve major excavations to reach the design depth. The excavated spoil should be properly managed so as to minimize impacts on the surrounding environment including:

- Limiting the landuse for the areas used to store the spoil,
- changing the topographic features of the area and, hence, changing water drainage properties which could divert surface water drainage streams to un-preferred locations,
- increasing dust emissions caused by wind erosion,
- possibility of blocking landscape view at the site were these amounts of soil are stored in

In addition to the above there are a number of indirect environmental impacts if there is a need to transfer the soil to other locations, including limited increase of traffic volume by transfer trucks, noise and air emissions released from these trucks. According to the results shown in Table

The ideal scenario for the excavated soil from the landfill cells is to use it in the landfill operations. There are two main uses for the spoil: usage as daily cover of waste, and usage in establishing side embankments for containing the waste, in the part of the landfill above-ground[40]. Other possible uses for the soil could be the compensation and re-cultivation layers of the final cover, as other layers (clay sealing layer and filter layer) need to be from homogeneous particles. For maintaining recovery of the excavated soil in the landfill, the amount of spoil should be sufficient for the needed amount in landfill operations. The amount of excavation is proportional to the depth of excavation, and accordingly the design

[40] The embankment will be made of compacted soil and will be surrounding the active waste soil so as to compact the soil against it and to maintain a safe slope for the waste hill above ground level

decision about the excavation depth and correspondent landfill height will be the main factor identifying the soil balance between volume of spoil and recovery in landfill operations.

The proposed design of the landfill indicates that the landfill will have a depth of 20 meters below ground level and a height of 30 meters above ground level. Because the current stage of the design does not include the excavation slope and the requirements for the soil embankments to contain the waste above-ground, the following assumptions were made for calculating the soil balance and identifying the excess or needed waste for the landfill operations:

- The excavation slope will be 1 vertical to 2 horizontal, while the above-ground slope will be 1 vertical to 3 horizontal
- The containment embankments will be 2-meter high, 1-meter wide from top, with outer slope 1:3 and inner slope 1:2
- The daily cover to waste ratio will be 1:9 as recommended by the FS [41]
- The final cover will include, as recommended by the FS, 50cm compensation layer, 50 cm sealing clay layer, 30 cm drainage gravel layer and 70 cm re-cultivation layer.

Table 6A-1: Soil Balance between excavated spoil and usage in landfill operations for landfill depth 20 m and height 30 m

Cell	Area (m^2)	Excavated soil (m^3)	Needs for daily cover (m^3)	Needs for above-ground embankments (m^3)	Needs for compensation and re-cultivation layers (m^3)	Basic soil balance (+/- m^3)*
Cell 1	34,020	542,941	63,322	120,677	28,980	+ 329,962
Cell 2	41,371	747,864	122,512	132,974	38,308	+ 454,070
Cell 3	51,251	853,931	171,114	148,934	42,774	+ 491,108
Cell 4	125,325	2,306,500	487,256	248,693	131,293	+ 1,439,258
Cell 5	131,368	2,236,883	457,881	247,752	161,721	+ 1,369,530
Total	**383,335**	**6,688,119**	**1,302,084**	**899,030**	**403,076**	**+** 4,083,928

* (+) means excess soil and (-) means there is demand for the soil

The soil balance in the above table indicates that for an excavation depth of 20 meters and height 30 meters there will be total excess spoil of about 4 million m3 which is about 60% of the excavated spoil. This spoil could be used in building dams, grading works for construction sites, agriculture or landscaping. During the second Public Consultation one of the participants mentioned that there will be high demand for this soil but the ESIA team was not able, during the preparation of this report, to investigate the demand for such amount of soil.

In all cases the excess spoil will most probably be left in a vacant land besides the landfill, in which a new hill of soil will be gradually developed in five stages correspondent to the excavation of each cell, until it is exported for usage in other locations in Gaza strip

[41] The World Bank Guidelines for estimating landfill volumes recommends using daily cover to waste ratio of 1:6. The assumption of the Feasibility Study has been used in the calculations below to be consistent with the FS calculations, while a more detailed discussion about this is presented later in this Chapter and in the next Chapter

according to the demand. If the excess amount of spoil will be exported outside the landfill site in Heavy Goods Vehicles (HGV) of 30-ton capacity (23m^3 capacity based on a spoil density of 1.3 t/m^3) , then about 170,000 HGV rotation trips need to be taken over the construction or the operational period. This number will rise to 200,000 HGV in case the capacity is 20m3. The following table summarises the total number of trips needed per day (and per hour) distributed over both the operational and construction periods.

Table 6A-1* - Estimated number of trips per day needed to export the excavated soil

Cell	Excavated soil	Number of trips(20m3)	Operational days (based on 5year - period)	Number of days during the construction period (assumed six months and constant for all cells)	Number of trips/day (if distributed over the full length of the operation period)	Number of trips/day (if distributed over the length of the construction period)	Number of trips/hour (assuming only 6 hours per day are designated for such movement of spoil)
1	330000	16500	18560	1856	1	9	2
2	455000	22750	18560	1856	2	13	2
3	492000	24600	18560	1856	2	14	2
4	1440000	72000	18560	1856	4	39	7
5	1370000	68500	18560	1856	4	37	7

According to the assumptions used in constructing the above table, it may be concluded that the impact of hauling the spoil varies between minor and medium. This will depend on the routes being used which are difficult to determine at this stage since this shall depend on the intended use of the spoil. In all ways , consulation with residents affected by the routes shall determine the best possible timing of the day to conduct such activities.

The area required for storage of this will depend on the suitable height that could be maintained, the safe slope and the available area. Assuming the height will be 20 meters, soil Bulking Factor will be 1.3[42], and the spoil will take a cone shape, the required area for the total excess soil will be about 261,000 m2 with a diameter of about 576 meters. As Mentioned earlier, less depth and more height scenario for the landfill would lead to more efficient soil balance for the project as indicated in Table 6A-2 below which has been formulated using the previous assumptions. According to Table 6A-2 a height of about 42.7and depth of about 7.3 would be the most suitable for minimizing the need for excess soil, however, other factors should be investigated when selecting the height and depth of the landfill, such as the overall landfill capacity, stability, visual impacts and security issues, which are further discussed in Chapter 8.

Table 6A-2: Soil Balance between excavated spoil and usage in landfill operations for different heights and depths

[42] Soil Bulking Factor is the rate of expansion of between original volume in the borrow and the volume when stockpiled, it is estimated in clayey soil to be 1.2-1.4

Height and depth (m)	Total Waste Capacity (m3)	Total excavation volume (m3)	Total needs for daily cover (m^3)	Total needs for embankments (m^3)	Total needs for compensation and re-cultivation layers (m^3)	Basic soil balance (+/- m^3)*
H=30 / D=20	11,718,756	6,688,119	1,302,084	899,030	403,076	+ 4,083,928
H=35 / D=15	10,709,047	5,193,572	1,189,894	1,059,314	407,067	+ 2,537,296
H=40 / D=10	9,425,242	3,583,369	1,047,249	1,219,598	404,847	+ 911,674
H=42.7 / D=7.3	9,693,580	2,768,217	1,077,064	1,283,712	401,576	+ 15,685
H=45 / D=5	7,870,830	1,853,512	874,537	1,379,882	396,418	-797,325

* (+) means excess soil and (-) means there is demand for the soil

A sufficient area for storage of the excess spoil would be allocated , until it is exported from the site if there is a demand for it, which should be close to the landfill site as indicated later in the mitigation measures.

Further to the need for an area to store excess spoil, there will be a need for temporary storage of the spoil that will be reused in the landfill operations (daily cover, final cover and side embankments). The excavation of the cells is expected to be carried out once for each cell, but the usage of spoil will be gradual along the expected life span of the cell. Table 6A-3 presents the calculations for the spoil that will be reused, the required areas for storing this spoil and the expected dates for excavation and completing the each of the cells. The calculations in Table 6-3 have been developed using the main assumptions of waste generation in the FS, the expected waste density in the landfill, the areas allocated for each cell and the heights/slopes of the cells which have been mentioned earlier. Because the height of the spoil (for reused soil) is not determined at this stage is has been assumed that it will be 20 meters so as to be less than the landfill height, and, in the same time, the required storage areas will not be excessive.

Table 6A-3: Required areas to for temporary storage of the spoil for reuse in landfill operations

Cell	Excavation Volume (m3)	Spoil to be reused (m3)	Spoil to be disposed (m3)	Area required for reused spoil (m2)	Expected Date of excavation	Expected date of filling
Cell 1	542,941	212,979	329,962	24,964	Before Jan 2018	Jul 2020
Cell 2	747,864	293,794	454,070	31,329	Before Jul 2020	Nov 2024
Cell 3	853,931	362,823	491,108	36,481	Before Nov 2024	Nov 2029
Cell 4	2,306,500	867,242	1,439,258	70,756	Before Nov 2029	Sep 2036
Cell 5	2,236,883	867,354	1,369,530	70,225	Before Sep 2036	Apr 2041

The development of cells will require that before filling each cells, excavation should be carried out for the following cell, this excavation should start in sufficient time to allow for placing the lining system and leachate piping at the bottom of the cell so as to be ready to receive the waste once the preceding cell is full. Because the whole area of the landfill is expected to be available for the project from the project start date, the spoil resulting from excavation of Cell 1, 2 and 3 could be stored at the land allocated for Cells 3, 4 and 5

respectively so as to achieve the double advantage of being close to the active cell and to make efficient use of available area. However, the excavation of Cell 4 will need an external area for storing spoil to be reused as the expected volume of reused soil is 867,242 m3 which will need 70,756 m2 for storage. A part of the area allocated for Cell 5 could be used for storing spoil of Cell 4 that will be reused but it is preferred to have an external area adjacent to the site for this purpose, the main reason for that is to make sure that Cell 5 will be developed in due time before the filling of Cell 4 especially that an external area of land will be required anyway to store the spoil that will be reused in Cell 5 operations. Because the spoil storage will not be fully controlled in terms of slopes and shape, as no side embankments will be established to develop the shape and slope, the areas required for spoil storage will be slightly bigger than the areas calculated in Table 6A-3, and if there will be a buffer area needed to maintain the area borders and to facilitate trucks access to load/unload soil a maximum area of about 80,000 m2 will be required out of the landfill area to accommodate the spoil that will be reused for Cells 4 and 5. Part of the fenced area allocated for the landfill, next to the Short Term area, could be used for this purpose but it will not be sufficient (about 55,000 m2) from one hand, and will be relatively far from Cells 4 and 5 from the other hand. Figure 6-1 shows some suggestions for the areas to be stored for spoil of Cells 1, 2 and 3, and the area required for storing spoil of Cells 4 and 5 and the nearest suggested areas for that, if these areas could be temporary available for the project.
In conclusion this impact is considered of medium to high significance due to the large area required for placing the unused spoil, the degree of significance will depend on whether there will be a demand for using this spoil in other locations and how effective would be the exportation of this spoil. The impacts of storage of the spoil that will be reused in landfill operations are less significant if a sufficient area could be temporary allocated for storage of Cell 4 and Cell 5 spoil. The implementation of the recommended mitigation measures and monitoring activities is expected to minimize these impacts.

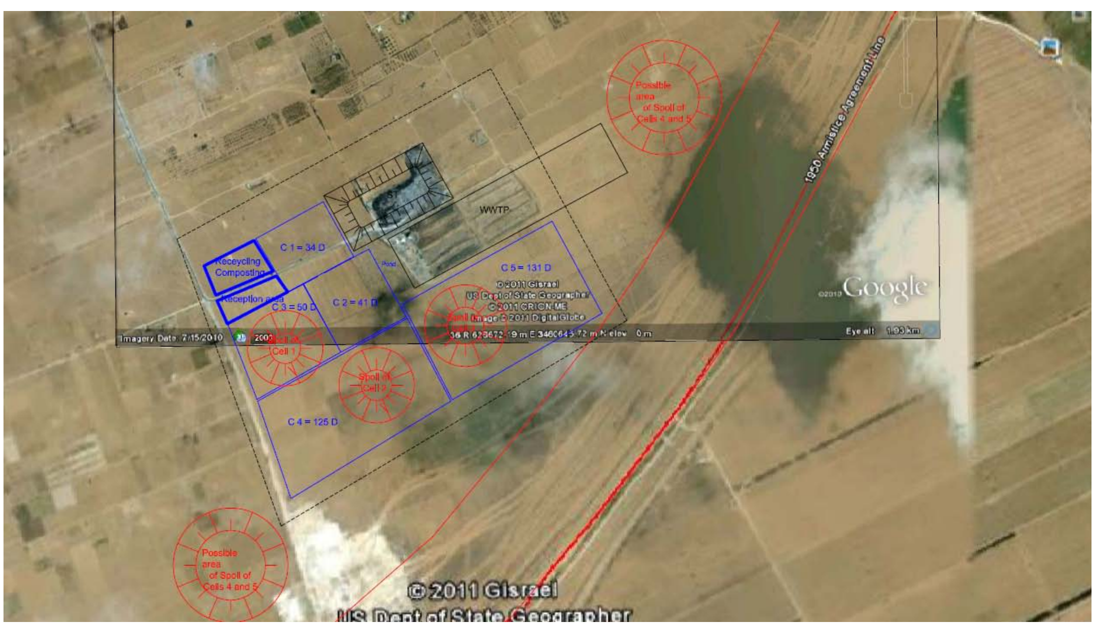


Figure 6A-1: Proposed locations for storing spoil that will be reused in landfill operations

Spoil management
It is to be noted that four main types of soil are expected to be generated during excavation as follows:

- Soil excavated in the direct vicinity of the existing dump site ans this has to be sampled and subjected to chemical analysis to assess the extent of contamination. If found contaminated , then it should not be exported out of the site and shall be used for daily operation.
- The top layer of soil which usually contains more nutrients and biological species as compared with the deeper layers. This type of soil shall be separately stored and better used as a final cultivation layer for the landfill or in cultivation activities.It is not recommended to use such type for construction purposes.
- Clayey silt and fine sand, each has different characteristics, different plasticity index and water content and therefore could be used for different construction applications. It is therefore recommended to differentiate between both types if possible. The most recommended applications would be for construction purposes as follows; 1) sub layer for Asphalt, 2) filling purposes, 3)recycling as aggregates (this shall require further studies to optimize the amount of binder which will be added to the soil and the compaction/extrusion pressure required , 4)recycling as construction bricks/blocks (also, this shall require further studies to optimize the amount of binder and water amount which will be added to the soil and the compaction/extrusion pressure required).

Mitigation Measures:

- Specific areas would be used for storing the excavated spoil, in case there are no sufficient areas adjacent to the landfill, the depth and height of the landfill should be changed to safeguard against such impacts and the effect of this change on the landfill capacity should be determined.
- The area allocated for spoil storage should be selected so that no un-favored pattern of surface water collection should be developed that would cause nuisance to adjacent areas (e.g. development of stagnant water ponds for long times).
- Ensure that the height of the spoil will not cause unaccepted visual impacts to adjacent areas additional to the impacts of the landfill

Monitoring Activities:

- Excavated soil should be recorded in the monthly report by summing excavated volumes from the invoices of excavation contractor.
- In case the soil will be exported from the site, the project management should keep track of the end uses of the soil and the methods of transportation.

6A.1.2 Affecting Air Quality by Dust Emissions of Construction Works

6A.1.2.1 El-Fukhary Landfill Site

Inhalation of dust particles in excessive amounts can be harmful to the health of both workers and nearby residents. Activities likely to eject dust particles into the air during the construction phase include the following:

- earthworks, including excavation and construction of peripheral embankments;
- action of the wind on stored construction materials;
- road works;
- site facility construction;
- installation of the lining system;
- vehicle movement around the site on unfinished roads

Dust emissions will negatively impact ambient air quality, particularly during the initial phases of construction. Residential areas or other occupied buildings are not in the immediate vicinity of the site, i.e farm houses which are not regularly occupied are 700 m away and residential buildings are 1600 m away. The impact will not therefore be strongly felt by nearby inhabitants. However, users of nearby roads and scattered farm houses visitors may experience some disturbances due to dust generation.

If no mitigation measures are undertaken, the impact is expected to be negative with medium significance as previously discussed (Table 6A-1*).

6A.1.2.2 Transfer Stations and Composting Plants

At the transfer station site, some dust may arise during construction due to the action of the wind on stored construction materials, movements of vehicles around the site and some demolition and construction of walls, fences, etc.

The expected impact will be negative with low significance due to the relatively low scale earthworks in transfer stations sites.

<u>Mitigation Measures:</u>

- Spoils of waste that will be reused in the landfill operations should be stored as close as possible from the active cells to minimize distances moved by excavators, trucks and loaders. An example for that is presented in Figure 6-1
- Pavement of the access road and ring road stretch that will be used for the following Cell excavation prior to excavation works. This construction schedule should be included in the tender document of constructions works
- In case of receiving complaints from neighbors, watering of soil before excavation, in landfill and transfer stations sites, should be carried out to minimize dust emissions.

<u>Monitoring Activities:</u>

- Ambient Particulate Matter should be measured at the western border of active waste cell and in the nearest farm houses areas located at the west and north of the landfill site (refer to Figure 6-2 later in this Chapter). The measurements are to be carried out once during the excavation of each cell.

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

6A.1.3 Noise Impacts

6A.1.3.1 El-Fukhary Landfill Site

Construction works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. This will result in raising the background noise levels; this in general will depend on:

- the type of equipment and vehicles used on the site;
- the ambient noise level around the proposed site;
- the proximity of sensitive receptors;
- the length of time over which construction works are undertaken.

The main activities that are associated with high noise emissions are:

- excavation and building works
- Movement of trucks carrying excavated soil and trucks bringing construction materials to the site;
- Operation of standby-generators

Because the nearest receptor (farm houses) is about 700 m away from the site and the nearest residential cluster located approximately 1600m away the noise impacts are not expected to be major, as most of the machinery noise will be effectively attenuated by this distance, especially when excavation and filling works are deep below ground level.

Generally, it is expected that the noise will not be high enough to interrupt sleep or disrupt normal activity. It is anticipated that construction activities will not be operational during the late hours; therefore the impact on evening averages of ambient noise will be little. The impact of noise can be considered negative and of medium significance.

6A.1.3.2 The Transfer Stations and Composting Plants

The noise level during the construction of the transfer stations will not exceed that of a conventional concrete building. The following activities will be responsible for most of noise emissions:

- Excavation of soil
- Demolition of existing pavement
- Vehicles movements
- Standby generators

The impact of noise at transfer station can be considered negative and of medium significance depending on the nature of the neighboring areas.

Mitigation Measures:

- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In case of receiving complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor;
- Construction works should be stopped at night-time;

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill (refer to Figure 6-2 in a following section) should be measured prior to construction works to record the background noise, and during a representative day during the excavation of each Cell.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

6A.1.4 Affecting Air Quality by Equipment and Vehicles Exhaust

Local air quality can be negatively affected by vehicle exhaust emissions from vehicles and machines (generators, loaders, excavators ... etc.) operating in construction. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission.

It was mentioned in a previous Section that the design depth of the landfill will lead to generation of large amount of soil more than the needs of the landfill operations, and if there will be demand on this amount of soil a considerable number of HGV trips will be carried out, which is an indirect cause of the general traffic air emissions in Gaza.

Overall, the impact of such emissions is considered to be negative with medium significance.

Mitigation Measures:

- All vehicles and heavy equipment working in the site should be effectively maintained. Any vehicle that has high smoke emissions visibly detected should be promptly repaired.

6A.1.5 Impacts of Construction Waste Other than Excavated Soil

Impact Significance:

The following waste types, other than excavated soil that was discussed in a previous Section, may potentially be generated from construction activities at both the landfill and transfer stations sites:

- Construction debris including concrete, bricks, sand and gravel.
- Miscellaneous solid wastes, including packaging waste, used drums, wood; scrap metal, empty polypropylene and/or paper sacks.
- Spent oil and oil filters from the servicing of vehicles.
- Wiping cloths fouled with oils, paint, etc….
- Empty paint and chemicals containers.
- Municipal waste of site workers.
- Sewage from offices

According to the European Waste Catalogue, the following are classified as hazardous wastes:

- All types of spent mineral oils , code 013 02
- Paint containers , code 08 01 11 and 08 01 13
- Spent oil filters and wiping cloths containing dangerous substances, code 15 02 02

The hazardous waste streams listed above should be properly handled and safely stored/disposed of. As mentioned later in this Chapter, if there will be no hazardous waste handing site in Gaza by the start of the project it is recommended to establish a hazardous waste cell, in which the generated hazardous waste by the project activities will be a minor contributor the waste received in this cell[43].

Construction debris such as concrete, bricks, sand, gravel, and other solid wastes such as wood and scrap metal can be recycled (by the informal sector) or disposed of in MSW cells, provided they are not contaminated with hazardous substances. While sewage could be pumped out from cesspits and discharged in the adjacent wastewater treatment plant. The impact could be classified of low significance.

Mitigation Measures:

- Spent lubrication oils and paint/chemical containers and other hazardous waste should be separated from other wastes and disposed of/ in approved hazardous waste facility if existing, or in the special cell recommended for the project.
- Other solid wastes are to be collected from different areas of the site and disposed in active cells
- Sewage should be collected from cesspits periodically by tankers and sent to the adjacent wastewater treatment plant.

Monitoring Activities:

- Hazardous waste generated at the site should be classified and documented in monthly reports
- Amounts of collected sewage by tankers should be recorded and documented in monthly reports

[43] This will be applicable to construction works in cells subsequent to establishment of this hazardous waste cell, if this cell is needed

6A.1.6 Risk of Damaging Chance-Find Antiquity Objects

Impact Significance:

Although the landfill site does not have any nearby antiquities or cultural heritage sites, the extensive excavation that will be carried out, up to 20 meters, could lead to finding any antiquity or culturally valuable object. The possibilities for such chance-finds are not high but the long history of the region does not nullify such possibility especially that such excavation depth is not common in the surrounding areas.

Such chance-finds generally needs special care in handling so as to keep their condition that will support the cultural value it represents, therefore in the unlikely finding of such objects the Ministry of Tourism and Antiquities should be informed so as to adequately handle this object. This impact is considered of low significance.

Mitigation Measures:

- In the case of finding any culturally valuable object during excavation works, the works should be stopped by the contractor and the Ministry of Tourism and Antiquities should be contacted to handle the site. If the Ministry of Tourism and Antiquities asked for prolonged holding of excavation works, the following Cell could be excavated instead so as not to cause disturbance to the waste filling plan.

Monitoring Activities:

- In case of chance-finds the type of object, location of finding, photographs of the object and the followed procedures to handle the object should be reported to the PMU

Table 6A-4 below summarizes the impacts of the project during the construction phase and their correspondent significance.

Table 6A-4: Summary of impacts during the construction phase and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts of Excavated Soil	Likely to cause landuse limitations	Medium to high	Minimize the impacts to low
Affecting air quality by dust emissions of construction works	Likely to raise PM in ambient air in the landfill area. Impacts around transfer stations are less likely	Medium at landfill location low at transfer station location	Minimize the impacts and maintain their control

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Noise impacts	Construction works are relatively far from residential areas	Medium	Minimize the impacts and maintain their control
Affecting air quality by vehicles and equipment emissions	Emissions are relatively minor	Low	Minimize impacts and maintain their control
Impacts of construction waste other than excavated soil	Amounts of generated waste could be neglected in comparison to the waste received at the site	Low	Minimize impacts and maintain their control
Risks of damaging chance-find antiquities	Unlikely to find antiquities	Low	Minimize impacts

6A.2 Impacts during Operation Phase

6A.2.1 Odour Impacts

6A.2.1.1 El-Fukhary Landfill Site

The impact of odors is normally considered a mere annoyance, as foul smells can rarely harm health directly. However, due to the nature of landfills, the odors produced can potentially be quite powerful and mainly contains a complex mixture of ammonia and hydrogen sulphide. The odor impacts could be the cause of public opposition to the proposed landfill site, the main sources of odor at the landfill site will be:

- Aerobic decomposition of organic wastes moved around the site and freshly disposed of in both the landfill and the composting/recycling station.
- Anaerobic decomposition of disposed of wastes over extended time periods. This will generate landfill gas which contains malodorous trace components.
- Landfill leachate collected and discharged to the leachate pond.

Some organic waste will begin decomposing prior to reaching the landfill. Movement and placement of such waste within the landfill site will produce relatively more significant odors. Also some special types of waste will be more odorous then others. Once the waste is in place, continued decomposition will result in landfill gas which is a significant source of odor. Although the gas will be collected by a gas collection and flaring/energy recovery system as advocated by the proposed project, odorous gas may still escape the collection system or leaks out, these risks are discussed separately.

Landfill leachate is another source of odors. This will be produced from any moisture that enters the body of the landfilled waste and percolates through, dissolving and entraining environmentally harmful substances through diffusion and/or convection mechanisms. As proposed by the project, a drainage system will be put in place to collect the leachate in a pond for storage and treatment. Odors may therefore arise from the leachate that evaporates from the collection pond.

The nearest residential cluster to the proposed El-Fukhary Long Term landfill was found at around 1600m from the nearest active cell and the nearest scattered house (a farm house which is only used during the morning) is located at a distance of 700-800 m from the nearest active Cell, as shown in Figure 6-2 below.

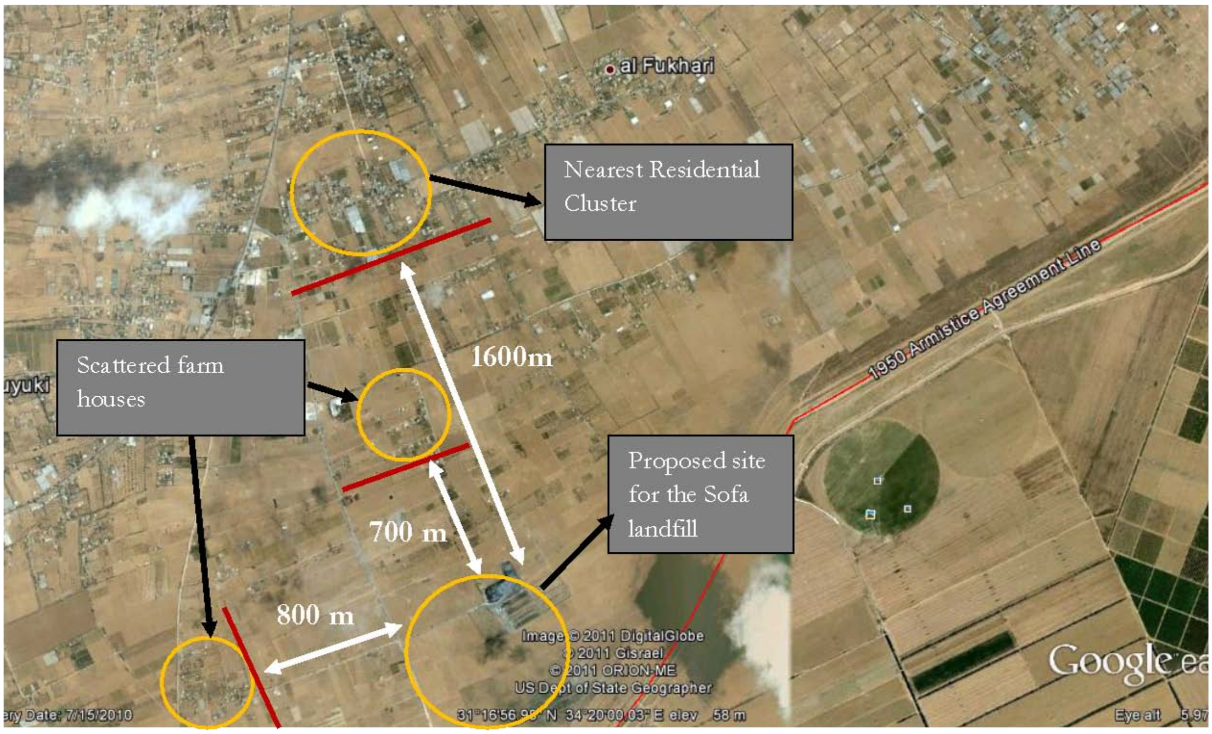


Figure 6A-2: Nearest sensistive receptors to El-Fukhary landfill site

El-Fukhary site hosts at the moment an uncontrolled dump site where waste piles extends to 10-15 m above ground. Waste is at the moment exposed to air, fauna and waste pickers, and the site is characterized by considerable odor emissions, this is mainly because the waste is not covered. The potential odor impacts of the project are not likely to significantly increase the cumulative odors in the area especially with the application of the daily cover in the new landfill operations, accordingly the odor impacts are considered negative with medium significance, which can be reduced to acceptable levels in the proximity of the sensitive receptors by following the landfill operational manual for filling the cells and the mitigation measures proposed below.

6A.2.1.2 The Transfer Stations

Details of the design and operation of the transfer station have been previously presented in Chapter 5. A typical transfer station functions as a site where primary collection vehicles unload their waste load, which is stored and re-loaded onto a larger transport vehicle to be taken to the landfill. The collected waste may begin to decompose prior to arrival and its movement close and around the site can release odorous gas. Potential odor impacts can also result during unloading and transferring waste from the small to the large vehicles or during waste storage on site.

Both Tel al Sultan and Al Namsawi are used at the moment as open waste storage sites. The odor impact will not increase after the implementation of the proposed project and if no mitigation measures are undertaken, the impact could be classified as negative with medium significance and could be reduced by applying the operational manual of the transfer stations and the mitigation measures presented below. Odor will mainly be released during the short exposure of the waste before entering the hopper and while being compacted into the closed container.

Mitigation Measures:

- An operation manual that should include waste progression plan in the cells, requirements for waste compaction in order to reduce the area exposed to air which also reduce aerobic decomposition and adequately apply soil cover with a thickness of around 15 cm in order to prevent prolonged exposure of vulnerable wastes to the atmosphere. Also an operation manual for the transfer stations should include operation manual that will include the process of unloading waste through hoppers.
- In case of receiving complaints from neighboring areas the application of final cover should be modified so as to implement faster compaction and coverage of waste to effectively reduce the odor emissions
- Additional containers should be present at the transfer station site in case of over capacity especially during peak hours or due to a technical problem with the compactors, in order to reduce the waiting period for the vehicles at the site and prevent an accidental overflow of the waste outside the container. The additional capacity containers should safeguard emergency periods where the landfill site may not be accessible.

Monitoring Activities:

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

6A.2.1.3 The Composting Plants

Details of the design and operation of the composting plants have been previously presented in Chapter 5. The proposed locations for the composting plants are either included in El-

Fukhary landfill site or at one of the proposed transfer stations sites such as Deir El Balah or Beit Lahia. This means that the impacts of odor resulting from composting will be added to those resulting from waste transfer or waste disposal activities. The collected waste may actually begin to decompose prior to arrival and its movement close and around the site can release odorous gas which has been already included among the impacts of either the transfer stations or landfills.

In addition to the above, most stages of composting may potentially generate odor. Removal of waste types with significant odour impact is very important and should be done during the screening stage.

Primary composting could be a significant source of odour if aeration is not efficiently performed as this may result in anaerobic decomposition of waste. The conceptual design of the composting plants includes the installation of 24 ventilators for that purpose.

Regular turning of the composting piles during secondary composting will also prevent anaerobic decomposition and reduces odor release.

The process control recommended by the FS is enough to control the odor impact by :

- Installing temperature sensors into the composting piles in order to control the composting temperature. This will ensure the highest rate of composting and aerobic decomposition
- Measuring the level of oxygen in the piles to ensure that aerobic decomposition is taking place.
- Measuring air flow into the piles.

Where the composting plants are constructed in areas of previous waste transfer or disposal activities, the odor impact will not increase after the implementation of the proposed composting activities. If no mitigation measures are undertaken, the odor impact from the composting activities could be classified as negative with medium significance and could be reduced by applying the operational manual of the composting plant including the process control described above and the mitigation measures presented below.

6A.2.2 Impacts of Landfill Gas

The disposal of solid waste in an anaerobic environment causes decomposition of the organic components of the waste to produce landfill gas; this reaction starts gradually after the placement of the waste and is proportional to the moisture content of the waste body. The components of the landfill gas changes over time according to the maturation of the stabilization process of the organic matter, but it is mainly composed of methane, carbon dioxide and other minor constituents including Non-Methane Organic Carbons (NMOC) or Volatile Organic Carbons (VOC), ammonia and hydrogen sulfide.

The generation of landfill gas could cause negative impacts on the environment, including:

- The methane gas when present in air with concentrations between 5-15% it could have an explosion potential which causes a safety risk. Because of the limited amounts of oxygen in the landfill this risk is minimum within the body of the landfill, but the risk would be higher in case the landfill gas migrated to the air with large concentration of methane.

- Ammonia, VOCs and hydrogen sulfide cause nuisance to surrounding areas
- Both methane and carbon dioxide are greenhouse gases where methane has much more global warming potential than carbon dioxide (25 times in 100 years lifetime)
- The migration of the landfill gas through the soil could cause acidification of the groundwater due to the reaction between carbon dioxide in the landfill gas and the water to produce carbonic acid, especially that carbon dioxide is relatively dense gas that tends to move downwards.
- The flaring/combustion of landfill gas causes air emissions of CO_2, CO, NO_x, PM and trace gases that impact the air quality in adjacent areas

During the preparation of the Feasibility Study of the project, the FS team has carried out sampling of the solid waste generated in Gaza, in which 116 samples from different locations of Gaza strip were analyzed, and the results are shown in Table 6A-5 below. If the standard components of the waste were analyzed according to their ratios, different properties of the waste could be worked out as mentioned in the Table below.

Table 6A-5: Analyzed composition of solid waste in Gaza and the correspondent properties

Properties	Organic	Paper & cardboard	Plastics	Glass	metals	Textiles	Yard Waste	Wood	Sand	others
Composition in Gaza %	44.51	7.31	13.95	1.96	2.4	3.72	7.6	0.77	13.44	4.34
Standard Moisture %[44]	70	6	2	2	3	10	60	20	8	10
Standard C % dry	48	43.4	60	0.5	4.5	48	46	49.4	26.3	44.7
Standard H % dry	6.4	5.8	7.2	0.1	0.6	6.4	6	6	3	6.2
Standard O % dry	37.6	44.3	22.8	0.4	4.3	40	38	42.7	2	38.4
Standard N % dry	2.6	0.3	0	0.1	0.1	2.2	3.4	0.2	0.5	0.7
S Standard % dry	0.4	0.2	0	0	0	0.2	0.3	0.1	0.2	0.1
Standard Ash % dry	5	6	10	98.9	90.5	3.2	6.3	1.6	68	9.9

The above ratios have been worked out to estimate the chemical components of the waste, and hence to estimate the ultimate amount and main components of the gas as shown in the following equation:

[44] The moisture content and dry weights of carbon (C), Hydrogen (H), Oxygen (O), Nitrogen (N), Sulfur (S) and ash are standard ratios recommended by Tchobanoglous 1993

$C_{40.68}H_{5.16}O_{24.7}N + 27.79\ H_2O \rightarrow 14.44\ CH_4 + 26.25\ CO_2 + NH_3$ + trace elements

According to the previous equation and the expected amount of waste that will be received at El-Fukhary landfill, the ultimate amount of landfill gas that will be produced is 9.68 million tons (which is estimated by 6,917 million m3) in which methane will be 1.612 million tons (2,456 million m3) carbon dioxide will be 8.061 million tons (4,451 million m3) and ammonia will be 6,980 tons (9.885 million m3) in addition to minor components of trance elements.

The generation of the above amounts will be over more than hundred years. During the first years of landfill operations these amounts will be minor; however towards the last 10 years of operation (from 2030 to 2040) the gas generation rate will reach its peak. For quantifying the amount of gas that will be produced annually the Landfill Gas Emissions Model (LandGEM)[45] was run assuming a methane generating factor (k) of 0.04 and methane generation capacity and ratio in the produced gas was assumed according to the above equitation. The results of the LandGEM run is shown below in Figures 6A-3 and 6A-4 below, while the expected yearly emissions of El-Fukhary landfill gas is presented in Annex 6A.1

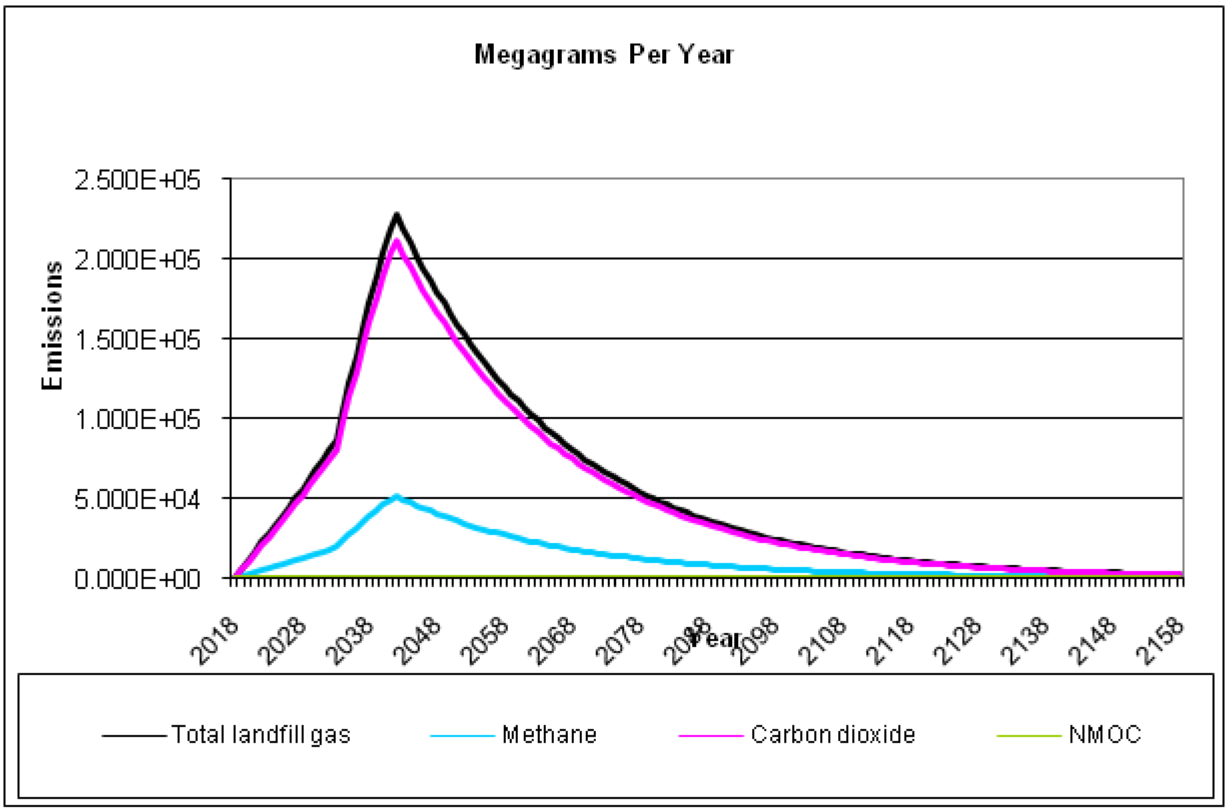


Figure 6A-3: Generation of landfill gas for El-Fukhary (tons/year)

[45] The model was developed by USEPA in 2005

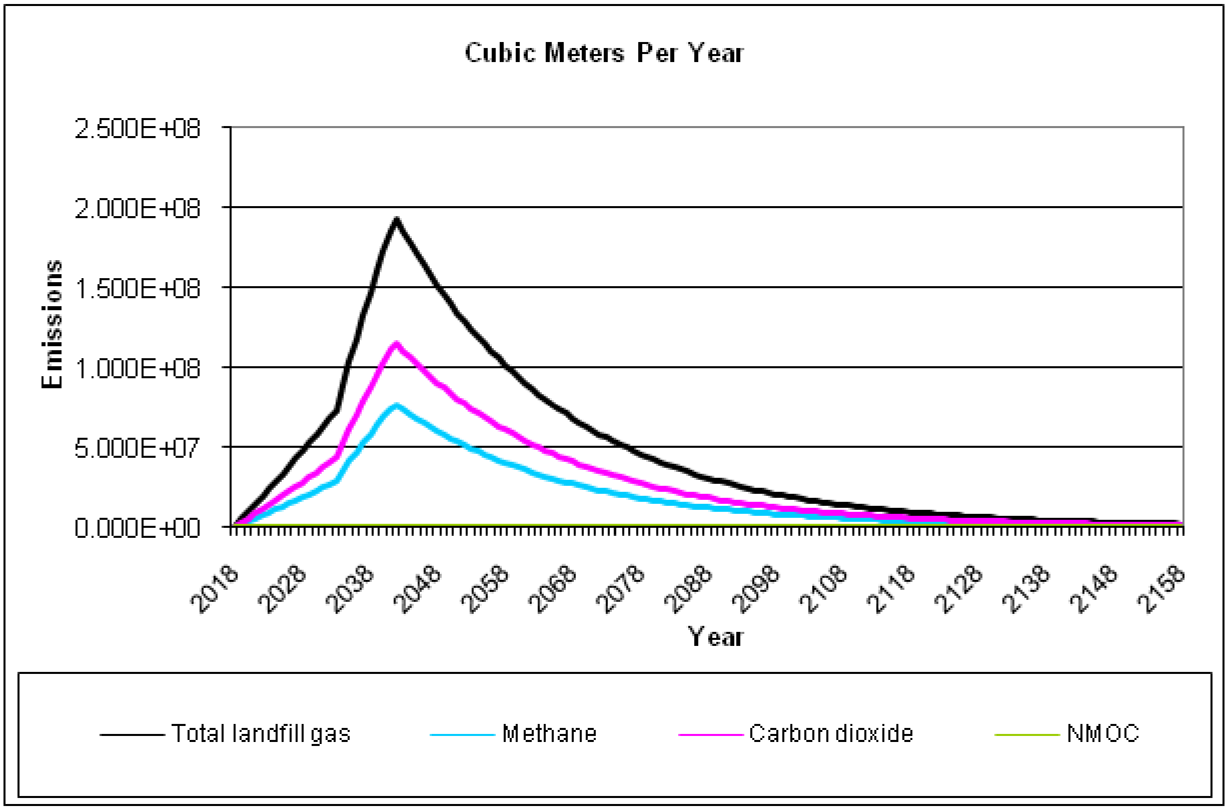


Figure 6A-4: Generation of landfill gas for El-Fukhary (m3/year)

As shown in the above graphs, the generation of the landfill gas will be in small quantities at the beginning of the operation, and it will reach the peak between about year 2030 to 2070 then it will be gradually reduced until the year 2158.

According to the preliminary design of the landfill there will be a degassing system in the landfill through 150 vents, each vent will be formed in a hole of 800 mm diameter that will contain broken stone around PE-HD filter pile, and will be gradually raised during the progression of landfill cells. Each vent will cover an area with a radius of about 30 meters, and all the vents will be collected in PE-HD collection pipes that will be located inside the re-cultivation layer and the ring road around the landfill and will end in a gas compression station. The final fate of the collected gas will be either flaring or recovery in power generation; the two alternatives are further discussed in Chapter 8.

In case of flaring the gas, there will be emissions of CO_2, CO, NOx, PM among other trace gases, these emissions will be proportional with the rate of collected gas and, hence, will be minimum during the first years of landfill operation and will gradually increase until it reaches the maximum then it will gradually decrease. According to the USEPA Emission Factors Guidelines (Document AP-42) the maximum flow of methane gas (which is 77 million m3 during year 2042) will generated an average of 1.6 gm/second of NO_x, 29.3 gm/second of CO and 0.7 gm/second of PM. The impacts of these emissions on the ambient air quality could be quantifiably assessed using air dispersion modeling, but the surrounding area in El-Fukhary does not include major sources of air pollution, except for

transportation on Salaheldin Road 2-km from the landfill, therefore the flaring of the gas is not expected to have large impacts on the ambient air quality.
In both cases, flaring or combustion of landfill gas to generate power, the total CO_2 emissions for the whole combusted methane (1.612 million tons) will be 4.433 million tons over the whole landfill life, with a peak flow rate of 141,204 ton/year in 2042. This makes the total CO_2 emissions from the landfill (CO_2 in landfill gas + combustion of methane) 12.494 million tons.

The planned system for gas collection, along with the HDPE liner and final cover, is considered a good engineering control process for minimizing the migration of landfill gas to the atmosphere or through the soil to the groundwater, the number of vents and radius of influence are believed to be sufficient to cover the whole landfill area as showing in Figure 6A-5 below, which is overlaying 150 vents with 30-meter radius influence over the landfill layout. Therefore the impacts of the landfill gas, given that the above system will be installed, will be mainly the gas emissions of flaring/combustion and venting of CO_2 and some trace elements along with low likelihood of venting dangerous concentrations of methane, or penetrating the thick clay layer and acidify the groundwater. Because the air emissions may, in combination with other future sources not related to the project activities, cause breaching of ambient air quality standards this impact has been classified of medium significance.

Figure 6A-5: Layout of El-Fukhary landfill covered by 150 gas vents at example locations

Mitigation Measures:

- Gradual placing of gas vents and construction of the gas compression station with adequate capacity to receive the maximum flow of gas.
- It is recommended to perform trials to collect the gas early during the landfill operation and before the cell is completely filled. This can significantly reduce odour impact.
- The lining system and final cover of the landfill should be properly maintained to keep their integrity, through ensuring adequate placing, adhering to waste filling plan, avoid overloading landfill cells and regular evacuation of leachate and gas. A maintenance schedule for the degassing system should be prepared and followed by the project operator.

Monitoring Activities:

- Keep records of collected gas through the degassing system
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze ambient air quality at the nearest farm house
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on quarterly basis

6A.2.3 Impacts of Leachate and Surface Water

The leachate could be defined as the liquid that has percolated through solid waste and extracted some waste materials. The leachate is generally characterized by its strong organic load, containing heavy metals and toxic hydrocarbons, its acidic nature and offensive smell. The water can enter the waste body from different sources to formulate the landfill leachate, including:

- The water content of the waste
- The water content of the daily soil cover
- Water entering the waste from precipitation over active waste cells
- Recycled leachate over the landfill body
- Surface water runoff that could enter the landfill body

On the other hand water is being removed from the waste through the following mechanisms:

- Water consumed through fermentation of solid waste for producing landfill gas according to the chemical equation presented in the previous section
- Evaporation during the placement of waste
- Abstraction of the leachate from the landfill body through engineered collection and pumping

The amount of leachate depends on the Field Capacity of the waste and the associated daily cover, which is defined as the quantity of water that could be held within the waste body against the pull of gravity. Accordingly the leachate will only be released from the bottom of the landfill if the water content inside the landfill body is more than its Field Capacity. There are many factors that affect the Field Capacity, in which the most important is the degree of compression that is applied on the waste (i.e. more compressed waste means less Field Capacity). In El-Fukhary landfill, because the waste height (total of 50 meters) the Field Capacity will be relatively low, especially at the bottom layers, which will lead to more leachate generation if the waste height is smaller.

Given the leachate properties, the impacts of leachate generation are mainly:

- The risk of being released to the adjacent soil and reach the groundwater which will cause high organic load and acidic conditions to the reached groundwater
- In case the leachate will be discharged to a wastewater treatment plant there will be high organic loading to the plant, so there will be a risk of overloading the plant.
- The leachate has an offensive odor that will be more intense besides the leachate collection pond
- If the leachate is not properly collected from the landfill body it could form stress on the base lining system, and raise the risk for loss of containment

For estimating the quantities of leachate that would be generated from El-Fukhary landfill, a water balance has been performed using the expected water inputs and outputs from the landfill body using the following assumptions:

- The moisture content of the waste is as estimated in the previous section in Table 6-5
- The moisture content of the daily cover material is 10% which is the average for the 20-meter excavation depth as indicated in the boreholes analysis for the project site.
- The cover to waste ratio is 1:9 as recommended in the FS
- The average precipitation is 237 mm/year and the runoff coefficient for active waste is 0.4
- 80% of the waste will be exposed for evaporation during transportation and during laying in landfill before applying the daily cover.
- The water consumed in chemical fermentation of waste for production of gas was calculated according the chemical equation presented in the previous Section
- The Field Capacity of the waste was estimated by calculating the average weight of 25 layers in each Cell (each layer is 2 meter height and the number of layer is according to yearly waste progression) assuming average waste specific gravity of 1.2 (as mentioned in the FS) and average specific gravity of daily cover is 1.5.
- The whole generated leachate will be collected and recycled after subtracting the evaporation losses in the collection pond (assuming the pond will be 150 x 50 meters as measured in the project layout)

A water balance has been performed for each landfill cell to calculate the expected amount of leachate from the landfill. The results of these calculations are summarized in Table 6A-6 below.

Table 6A-6: Expected amounts of produced leachate in El-Fukhary landfill with and without leachate recirculation

Year of Operation	Active Cell	Received Waste (tons)	Water Held in Waste body (m3)	Produced leachate without recirculation (m3)	Produced leachate after recirculation (m3)
2018	Cell 1	265,229	35,894	27,286	27,286

Year of Operation	Active Cell	Received Waste (tons)	Water Held in Waste body (m3)	Produced leachate without recirculation (m3)	Produced leachate after recirculation (m3)
2019	Cell 1	275,493	24,517	78,427	96,182
2020	Cell 1 until Jul	282,886	20,805	16,647	103,297
2021	Cell 2	285,894	30,258	52,492	52,492
2022	Cell 2	301,399	23,706	74,320	117,281
2023	Cell 2	317,528	30,801	66,747	174,496
2024	Cell 2 until Nov	334,314	37,468	9,666	144,200
2025	Cell 3	347,719	32,328	79,191	79,326
2026	Cell 3	349,093	23,100	83,284	153,079
2027	Cell 3	366,591	23,681	79,888	223,436
2028	Cell 3	384,648	30,858	79,943	293,847
2029	Cell 3 until Nov	403,356	80,105	0 [46]	241,640
2030	Cell 4	422,592	53,955	37,181	37,181
2031	Cell 4	439,686	40,296	29,940	57,589
2032	Cell 4	448,219	33,286	25,158	73,216
2033	Cell 4	1,030,176	62,424	218,620	282,304
2034	Cell 4	1,046,702	56,000	259,233	532,006
2035	Cell 4	1,049,964	60,135	248,425	770,899
2036	Cell 4 until Sep	1,064,930	99,655	41,757	755,912
2037	Cell 5	1,079,168	75,595	288,064	320,290
2038	Cell 5	1,079,425	64,303	273,598	584,356
2039	Cell 5	1,091,906	57,396	272,390	847,215
2040	Cell 5	1,103,549	63,582	262,191	1,099,875
2041	Cell 5 until Apr	823,081	63,582	155,239	1,245,583

The yearly amounts of leachate gradually increase from about 27,000 m3/year to a maximum of about 280,000 m3/year, as indicated in the Table above; the amount will increase significantly after receiving all of Gaza strip waste in 2033 according to the preferred scenario for solid waste management presented in the Feasibility Study. Most of the water in the waste body will come from the moisture content of the received waste (more than 90% of the input water) as the relatively high organic waste ratio leads to high moisture content of the total waste. The leachate generation will theoretically be stopped after applying the final cover above (final cover will include 50 cm clay layer with permeability of 1×10^{-8} m/s) so no new water will enter the covered Cell from waste, daily cover, precipitation, or leachate recycling, and the water already stored in the waste body at its Field Capacity will be consumed in gas production. This theoretical assumption will not be 100 % materialized in reality as some loss of final cover containment might happen so some of the surface water may penetrate the waste body after the Cell closure, but, if happened, this will remain to be minor quantities that could be neglected in leachate calculations, except if a major accident happened and lead to removal of large portions of the final cover for long times, which is beyond the analysis scope of this ESIA.

[46] Because the area of Cell 4 is relatively large, only two layers of waste will be laid, and hence the Field Capacity will be very high so than no new leachate will be produced at this year

The engineering measures recommended to handle leachate include a PE-HD lining system of the Cells base, a drainage layer which will include PE-HD 2/3 perforated pipes embedded in lowest elevation areas of the Cells bottom which will have enough inclination to collect the liquid in the pipes then by gravity to a collection pit at the lowest point of each Cell, then the leachate will be pumped up to a leachate pond then the collected leachate will be recycled to active cells. These engineering measures are believed to be sufficient for controlling the generated leachate according to the best available technologies, given that the system will be designed to handle the relatively large expected quantities of leachate. The pond size (150 x 50 m) is believed to be sufficient to maximize evaporation losses of leachate; however the depth of the pond should be selected to receive maximum amounts of leachate during rainy season so that no risk of overflowing during extreme conditions. The capacity of the pond should also be checked against a worst case scenario for maintenance and repair duration of the pumping system during maximum leachate flow periods.

The selection of recycling leachate over waste body in active cells is believed to be a better option than discharging the leachate to the adjacent wastewater treatment plant, because the organic load of the leachate may cause less treatment efficiency of the treatment plant and consequently low quality final effluent. If the collected leachate has a BOD of 5,000 mg/l (as reported from the existing Gaza Landfill) the Population Equivalent (PE) of the leachate according to the estimated quantities in the above Table will range between about 7,000 and 70,000 PE which is a considerable load. However, the option should be there to discharge emergency amounts of leachate to the adjacent wastewater treatment plant if there will be a risk of overflowing of leachate pond for any unforeseen circumstances.

Because of the nature of the collected leachate in the collection pond, the odor around the pond is expected to be offensive. However, the severity of this odor will be gradually attenuated in proportion with the distance from the pond. Unlike the odor of fresh waste that could be minimized by application of daily cover; the leachate pond could not be managed in such a way. The odor of the leachate pond could be minimized by speeding the recirculation rate so as minimum amount of leachate would be accumulated in the pond (just the amount that will leave a safe free board for the abstraction pumps) and through regular clean up of settled sludge in the pond and transfer it back to the landfill. Generally the selection of leachate pond location right next to the wastewater treatment plant is believed to be a good practice, as this location will be relatively far from the administration building of the landfill (about 250 meters) and from the nearest farm houses (about 1,000 meters).. Accordingly the odor will be limited in the area around the pond and will have relatively little effect on the admin areas and residential clusters especially that if compared with the odor generated by the WWTP it is expected that the contribution of the leachate pond to the cumulative odor will not be large.

According to the borehole soil analysis carried out for the El-Fukhary site, the layers beneath the design depth of the landfill (20 meters) are mainly from clayey nature that is characterized by low permeability. The groundwater table is at 46-meter depth which is 26 meters below the bottom of the landfill, which is a relatively large distance to be passed by liquids to reach the groundwater. Figure 6A-6 below shows a section in the landfill area between the two boreholes that have been performed.

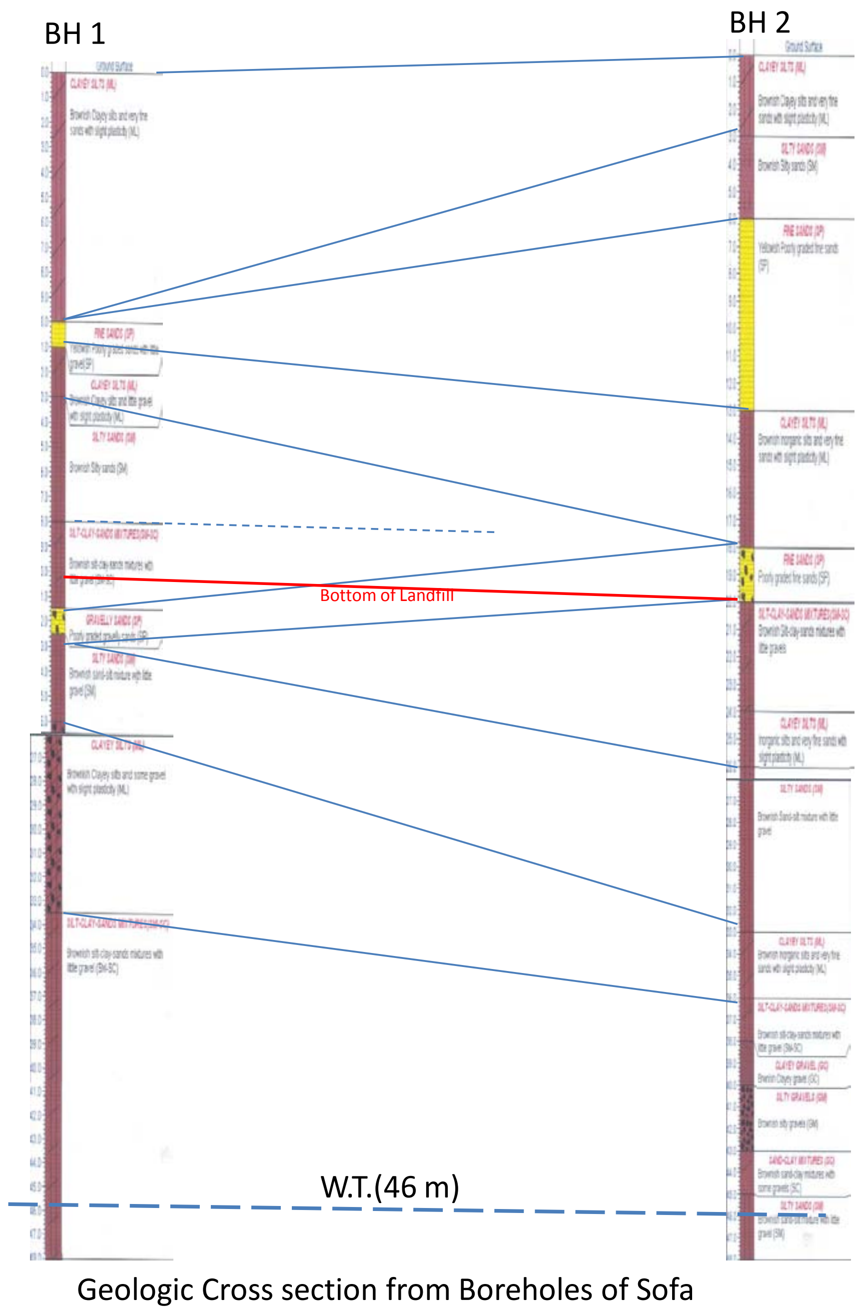


Figure 6A-6: Soil section between the two boreholes performed in El-Fukhary Landfill site

If the permeability of the above layers were estimated using average standard permeability for these types of soil, the minimum time required for 1 m3 of water to percolate the soil and reach the groundwater table is about 6 years, if the soil beneath the landfill is fully saturated, which is not the case according to the boreholes of El-Fukhary sites, this is illustrated in Table 6A-7 below. If the average water content of the soil layers is 10% until a depth of 33 meters then the same amount of liquid will need much more time to reach the saturated level.

Table 6A-7: Estimated liquid percolation properties of the soil in El-Fukhary site

Soil layer	Estimated permeability ($m^3/m^2/day$)	Borehole 1		Borehole 2	
		Depth to GWT in borehole 1 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)	Depth to GWT in borehole 2 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)
Fine sands	1	0	0	1	1
Silt-clay-sand mixture	0.01	1	100	4	400
Poorly graded sand	1	5	5	0	0
Clayey silts	0.001	0	0	4	4000
Silty Sand	0.01	12	1200	7	700
Clayey silts	0.001	0	0	4	4000
Silty-clay-sand mixtuters	0.01	8	800	2	200
Clayey gravel	1	0	0	2	2
Silty gravel	1	0	0	2	2
Total			2105		9305

This section discusses the development of groundwater model to study the potential effect of the proposed landfill on the groundwater regime, flow and direction, and the groundwater quality in the costal aquifer. In order to test the aquifer response to the infiltrated leachate quantity and quality, a three dimensional ground water model is used as a tool for impact presentation. The chosen model was Groundwater Modeling System (GMS V 7.1) and its integrated modules (MODFLOW, ZONE BUDEGET, MODPATH and MT3D). The used model is being calibrated for year 2011.

Hydrological and hydrogeological setup

Figure 6A-7 shows also the hydrology of the study area and the delineated streams, it can be observed that the El-Fukhary Landfill location is nearby Wadi Gaza. Figure 6A-8 shows the topography of the study area, it can be noticed that the proposed location of the Fukhari landfill is situated in a low land area relative to the general topography. Two ridges can be noticed on both sides of the landfill.

As previously mentioned in Chapter 5, the geology of the GS region consists of a series of geological formations sloping gradually westwards. These formations are mainly from the Tertiary and Quaternary ages. The quaternary deposits are underlain by the Saqiya formation of the Pliocene, which constitutes part of the Tertiary formations in the area. The Saqiya formation is mainly composed of impermeable clays. The quaternary deposits consist mainly of the marine and continental Kurkar formation (from Pleistocene age), composed of shell fragments and loamy sand beds (SOGREAH, 2010). 'Kurkar' formation is described here as the porous media located between ground level and Saqyia formation.

Figure 6A-7: Hydrology of Study Area

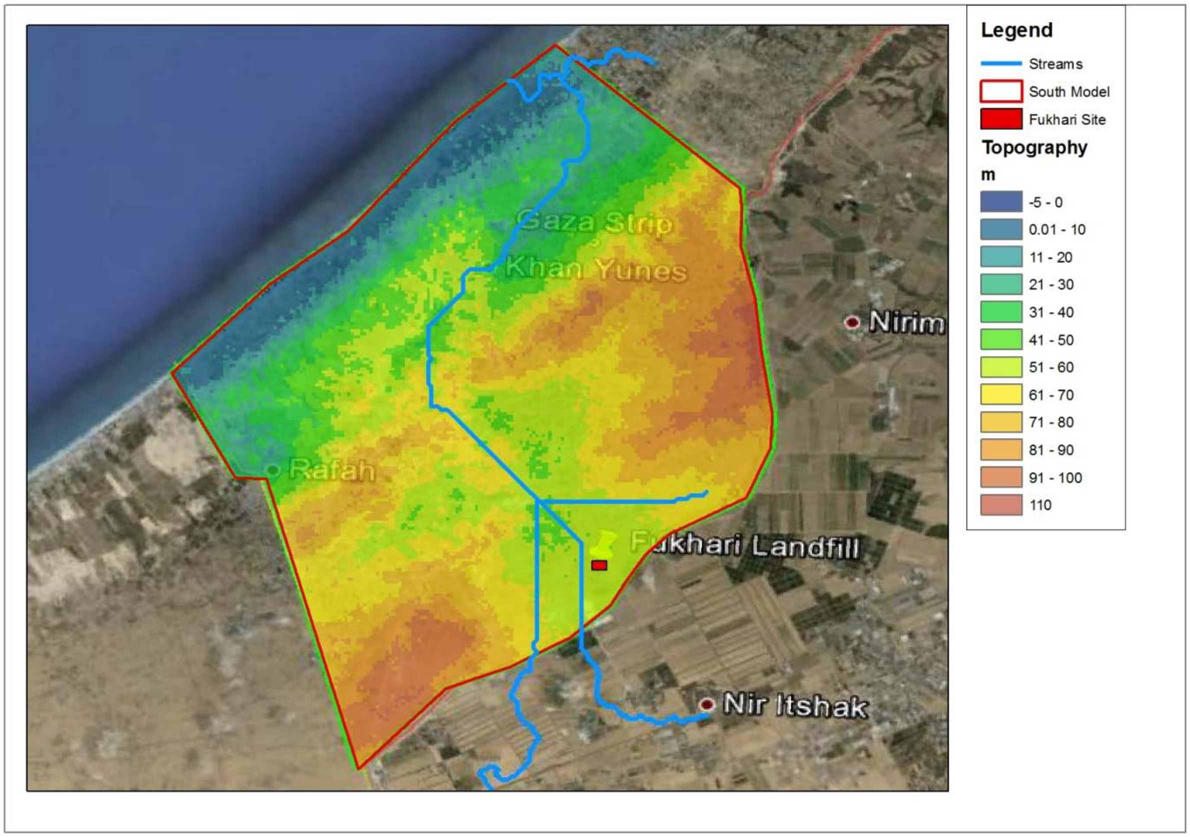


Figure 6A-8: Topography of the Study area

leistocene sedimentary deposits of alluvial sand, gravel, conglomerates, pebbles and mixed soils constitute the regional hydrological system. Intercalated clay deposits separate these deposits and are randomly distributed in the area. Their thickness decreases to the east and basically they can be classified as aquitards. The regional groundwater flow is mainly westward towards the Mediterranean Sea. The maximum saturated thickness of the aquifer range from 120 m near the sea to a few meters near the eastern aquifer boundary. Natural average groundwater heads decline sharply east of the Gaza Strip and then gradually decline towards the sea (SOGREAH, 2010).

Figure 6A-9 shows the subsurface conditions at the site area, it can be seen that the site is underlain by a thick clay layer which will decrease the proposed leachate. Below the clay layer, the Kurkar aquifer is found.

Groundwater modeling

Groundwater flow and transport models were developed and presented in this section. After calibration, the models were used to investigate hydrogeological impact of El-Fukhary landfill on the local groundwater quantity and quality.

To develop such three dimensional groundwater flow and transport model the USGS finite differences groundwater flow model *modflow2000*, the finite differences advection transport model *modpath2000* and the finite differences contaminant transport model *mt3dms* have been utilized. All the input and output files required by these models are prepared by the pre and post processor *GMS 7.1*.

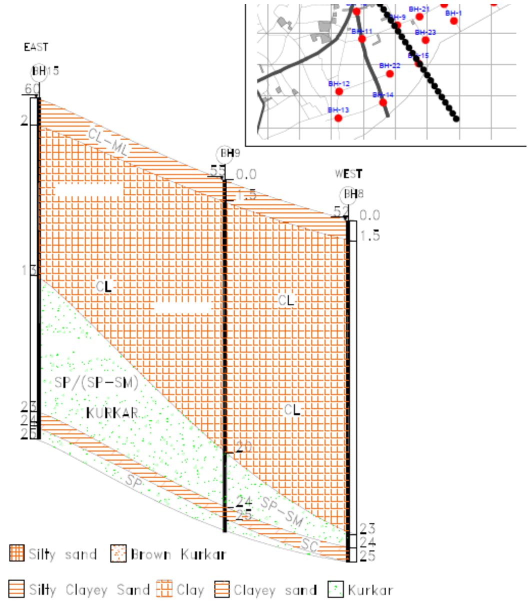


Figure 6A-9: Subsurface Layers at El-Fukhary Landfill Site (AL Madina, 2006)

It is well known that the coastal aquifer in Gaza Strip is subdivided into sub-aquifers at the coast due to the presence of several marine clay layers. However these clay layers pinch out after 2-4 kilometers from the coast resulting in one single free surface aquifer. Therefore and since the proposed locations of the infiltration basins are far away from the coast, the model was developed as one single layer model for simplicity following the recommendation of Al-Madina (2006) study. The generated model structure is shown in Figure 6A-9. The top surface of the model represents the ground surface topography and the bottom surface represents the top surface of the underlying impervious formation SAQIYA.

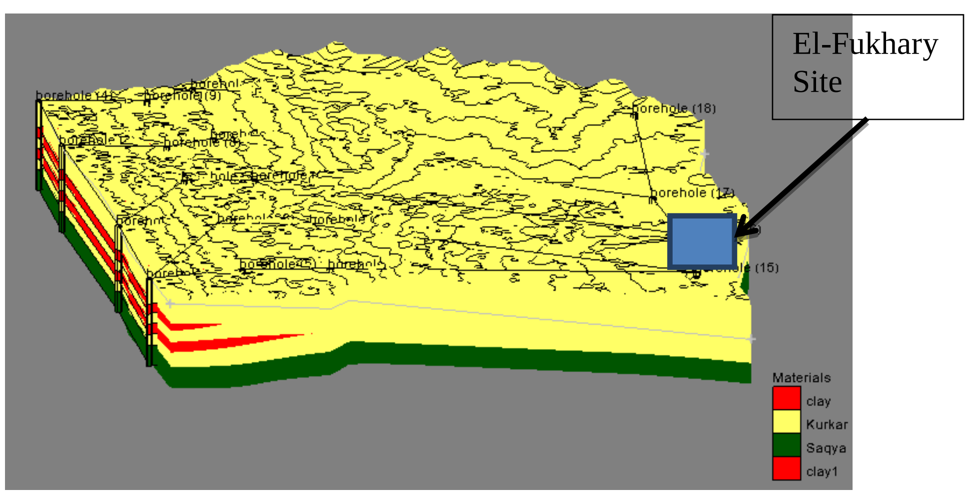


Figure 6A-9: 3D Stratigraphy of the GW model

Based on the groundwater level contour map (AL Madina, 2006 and SOGREAH, 2009) the model domain was selected as shown in Figure 6A-10. Regarding the eastern boundary, it is selected as the eastern boundary of Gaza area (green line). The model domain is about 14 km by 16 km. In plan view, the model grid has non-uniform finite difference mesh with cell sizes of 10 m X 10 m at the landfill and up to 100 m X 100 m. The boundary conditions imposed on the developed three dimensional numerical groundwater flow model are defined as:

Constant Head Boundary: along the Mediterranean Sea
NO Flow Boundary: in the north, east and south.

The northern and southern boundaries are defined as no flow boundaries based on the groundwater level contour maps where groundwater flow is perpendicular to the sea shore line (AL Madina, 2006). For the eastern boundary and since the aquifer thickness is negligible (0-10 meters) (AL Madina, 2006), the boundary is assumed as no flow boundary. The Model extent is shown in Figure 6A-10.

The model has been calibrated for the current situation as year 2011 which is the starting of model simulation using the data provided from AL Madina, 2006. The model was prepared for prediction phase which will present the future conditions in case of applying infiltration in the proposed location of El- Fukhary landfill site. The calibrated heads are shown in Figure 6A-11.

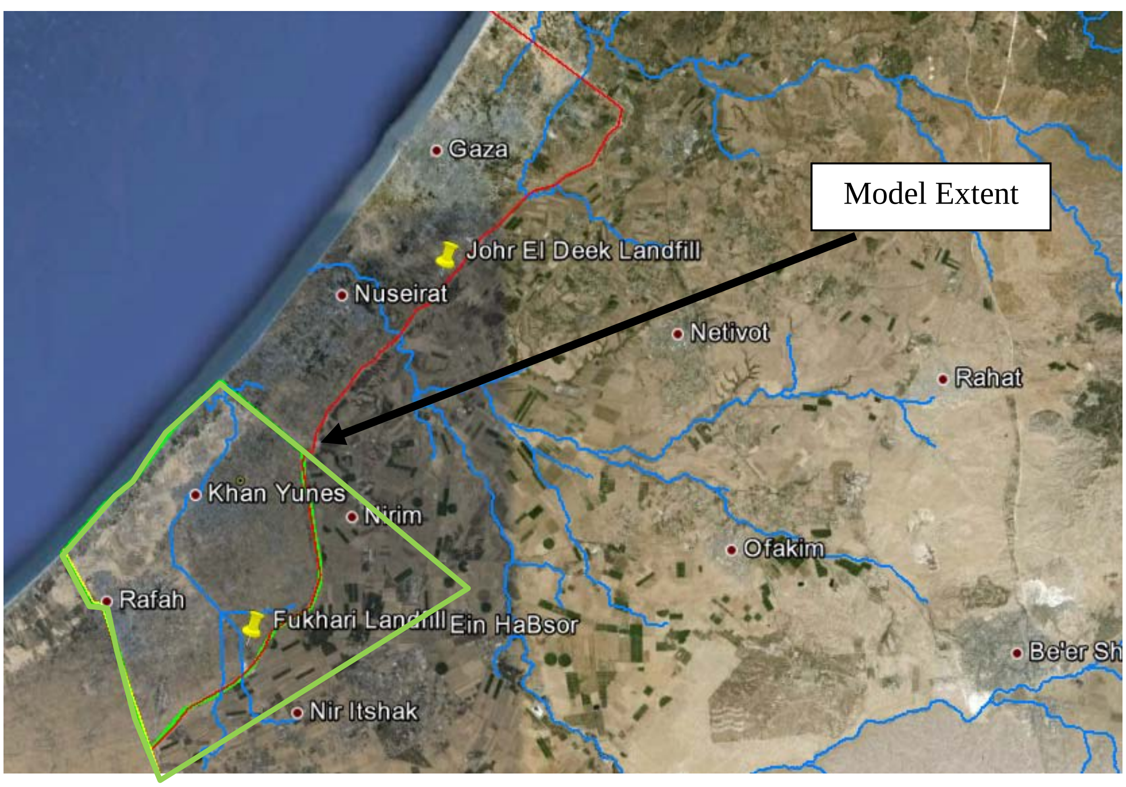


Figure 6A-10: El-Fukhary Landfill Site and GW Model Boundaries

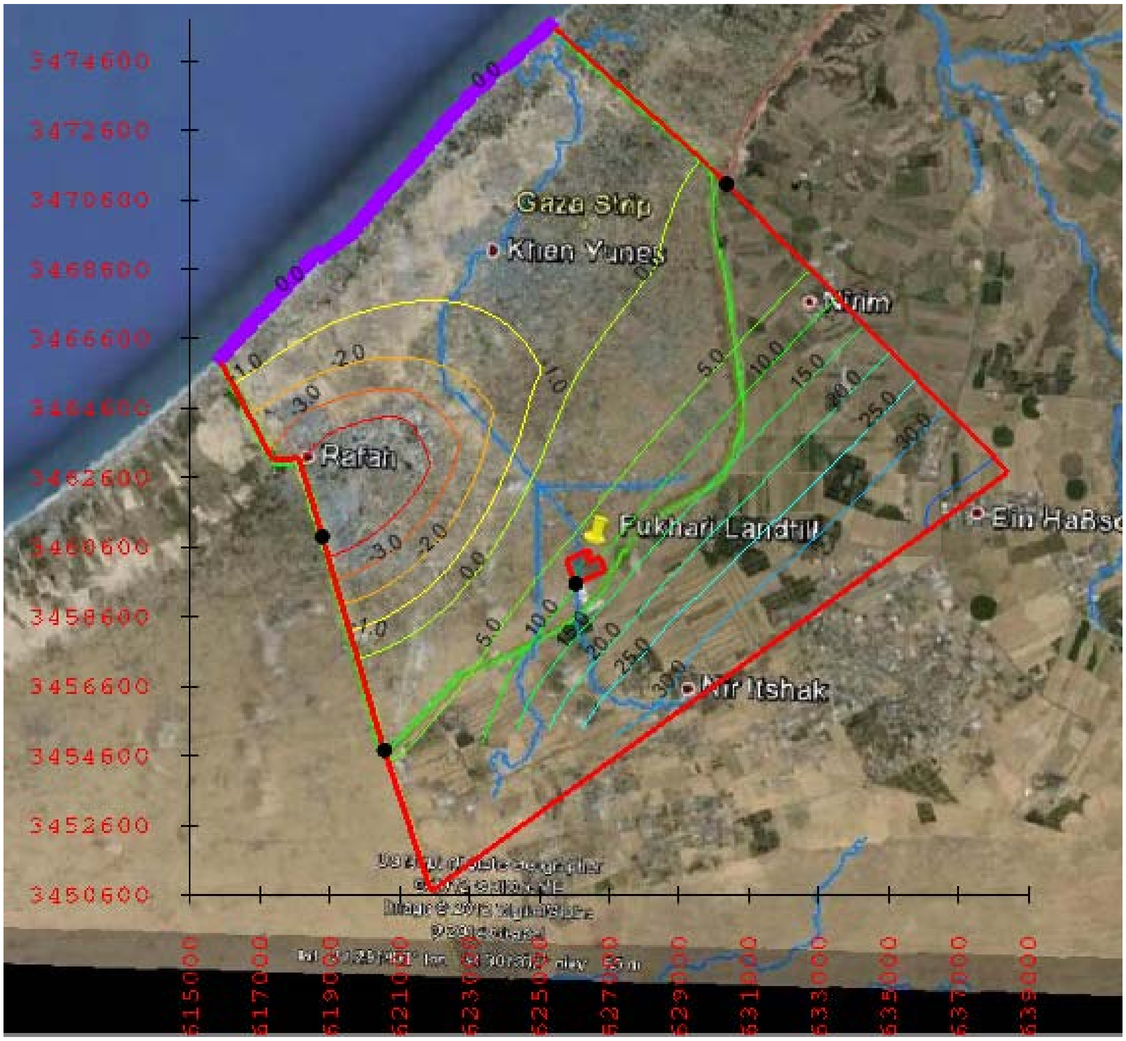


Figure 6A-11: Calibrated GWL for the Study Area at El-Fukhary Landfill Site

Particle Tracking

The objective of this section of the report is to apply the calibrated numerical groundwater flow model to evaluate three pre-selected potential sites to construct rapid infiltration basins system. The regional groundwater flow model will be applied to evaluate the hydrogeological and environmental impacts of the three potential sites on both the groundwater quantity and quality. Based on the simulation results one single site will be selected to construct such rapid infiltration basins.

The impacts of the intended landfill on the aquifer within the model domain, both advection and dispersion contaminant transport models are tested. The advection transport is simulated using the *modpath* to evaluate the extended impact of the infiltrated leachate. Sensitivity analysis for the *modpath* results against aquifer porosity was tested. Three different porosity values were used (0.1, 0.2 and 0.3) to evaluate the sensitivity of the migration of contaminants in the groundwater regime.

The results of the three scenarios are shown in Figures 6A-12 and 6A-13. All the figures show the predicted groundwater level after 30 years. The value of 30 years is adopted as it covers the landfill operation period.

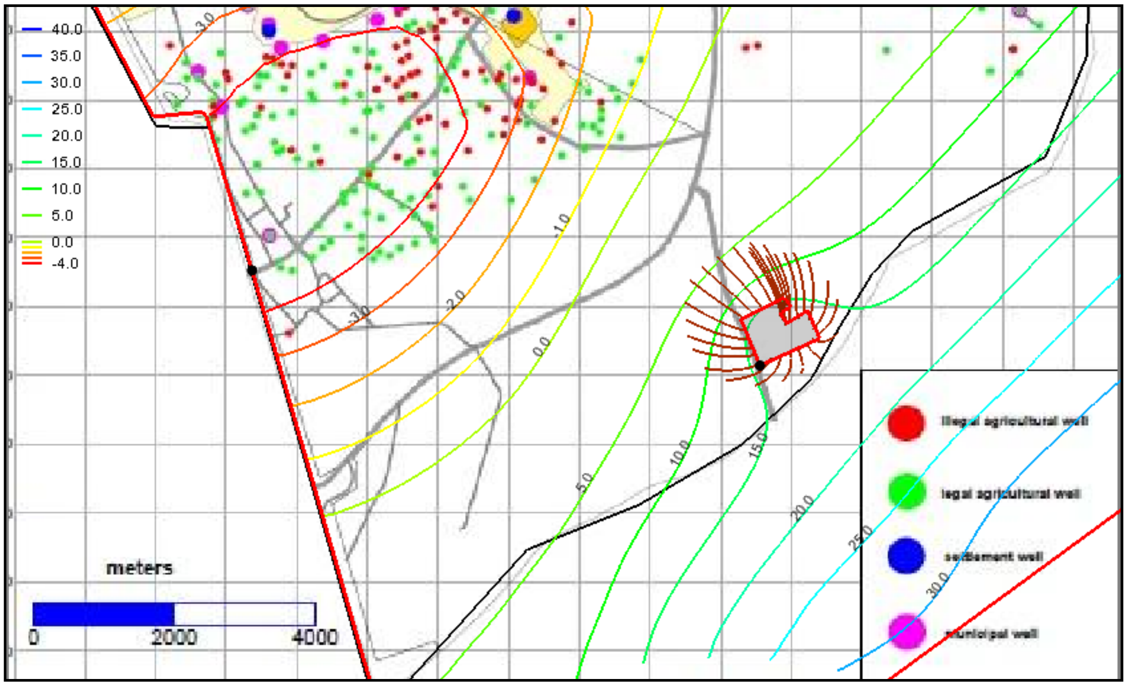


Figure 6A-12: Contaminant Tracks for Porosity Value of 0.1.

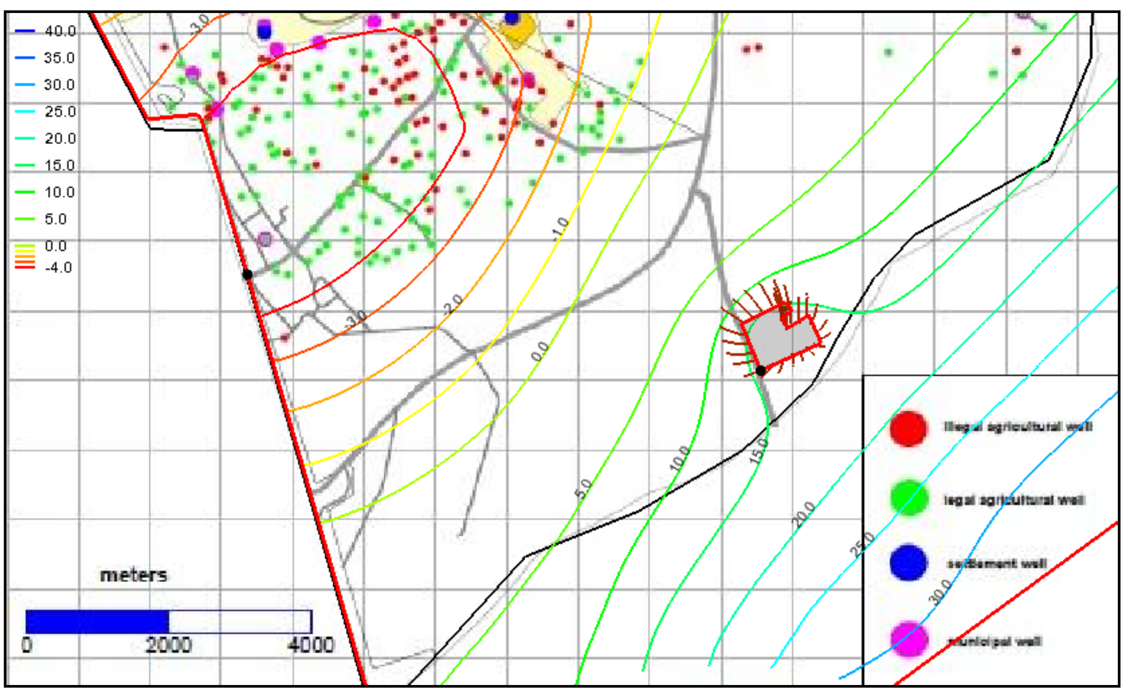


Figure 6A-13: Contaminant Tracks for Porosity Value of 0.3.

It can be observed that the extent of the infiltrated leachate did not migrate far from the landfill, this can be justified because the presence of a thick clay layer below the landfill, big depth to groundwater, the proposed lining that will reduce to a very large limit the infiltration and finally because of the fact that most of the groundwater flow in the landfill location is controlled by the Saqiya formation with low permeability.

Solute Transport

The calibrated groundwater flow and transport model has been applied to evaluate the impact of potential contaminant transport and distribution in the regional groundwater beneath the intended landfill. The conservative chloride parameter has been considered as the contamination source as well as the nitrate. Due to the nonexistence of certain values of the leachate concentration at the groundwater surface an areal concentration of 1500 mg/l for chloride and 500 mg/l for nitrate was assumed (Tamer M.A., 2009). The initial concentration of chloride at the study area is about 500-750 mg/l and the concentration of nitrate is around 150 mg/l. Sensitivity analysis for the aquifer dispersivity (10 m and 100 m) was carried out to evaluate the extent of the plume due to the expected leachate as shown in Figures 6A-14 to 6A-17

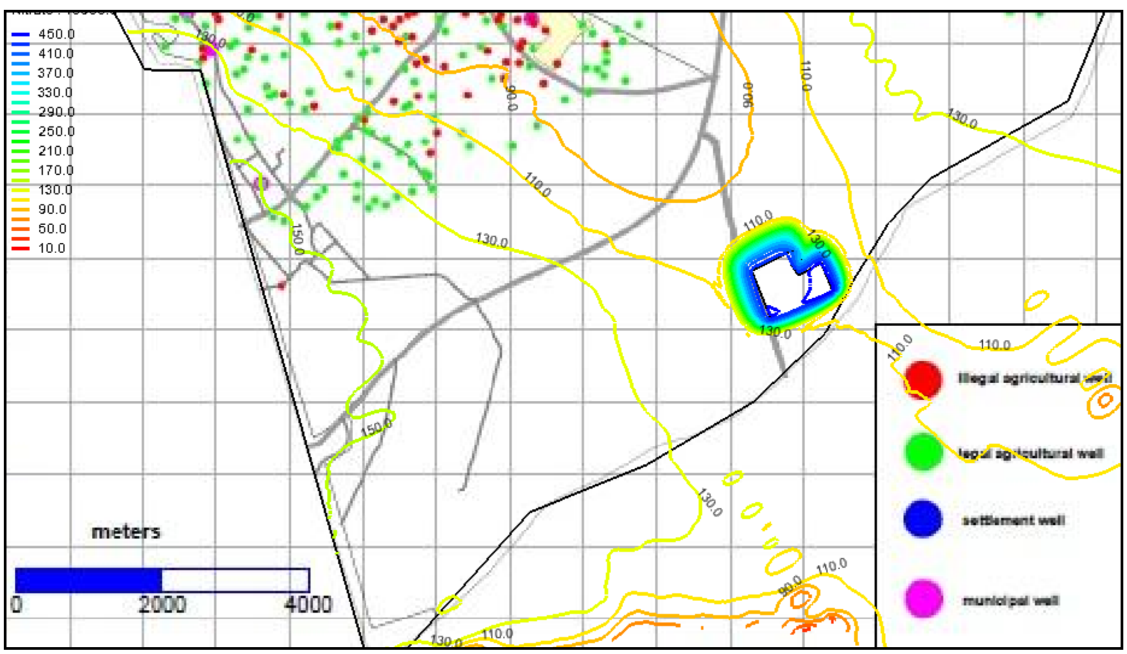


Figure 6A-14: Nitrate Plume at Year 2040 for dispersivity of 10 m.

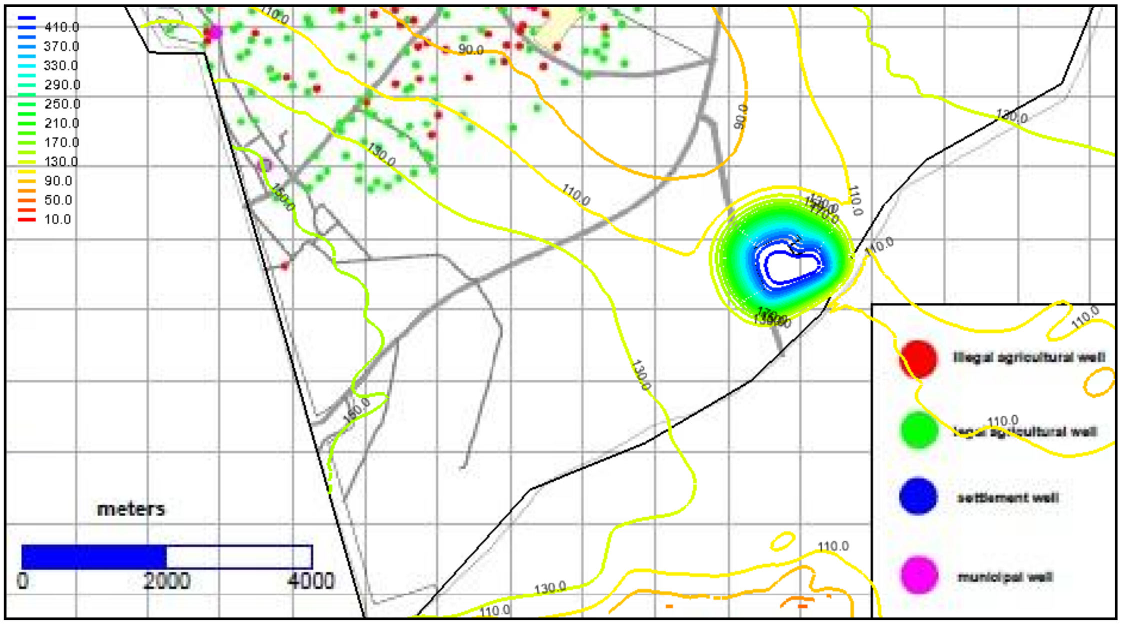


Figure 6A-15: Nitrate Plume at Year 2040 for dispersivity of 100 m.

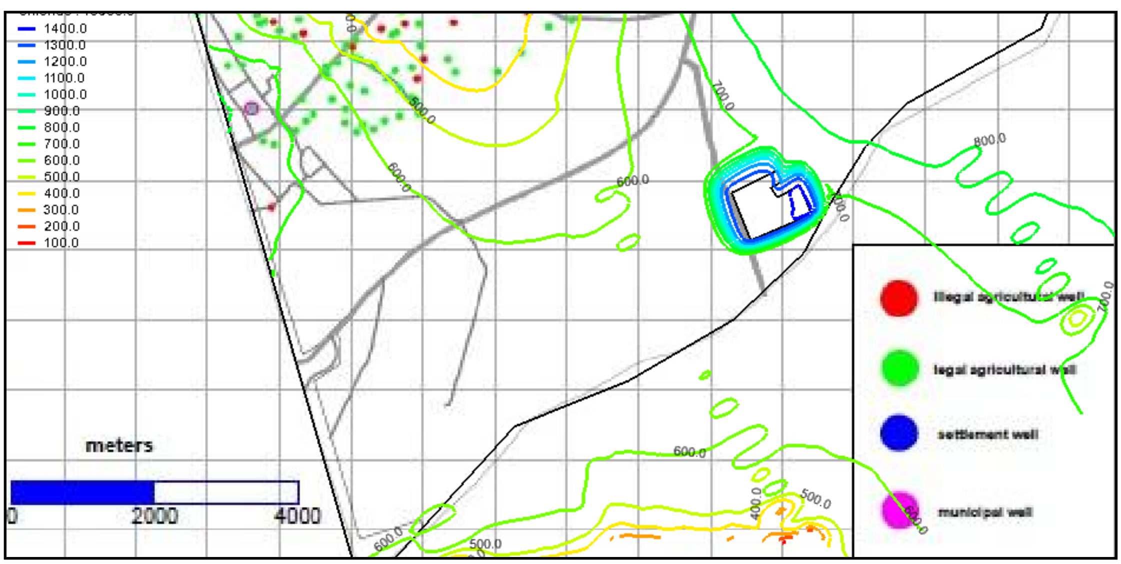


Figure 6A-16: Chloride Plume at Year 2040 for dispersivity of 10 m.

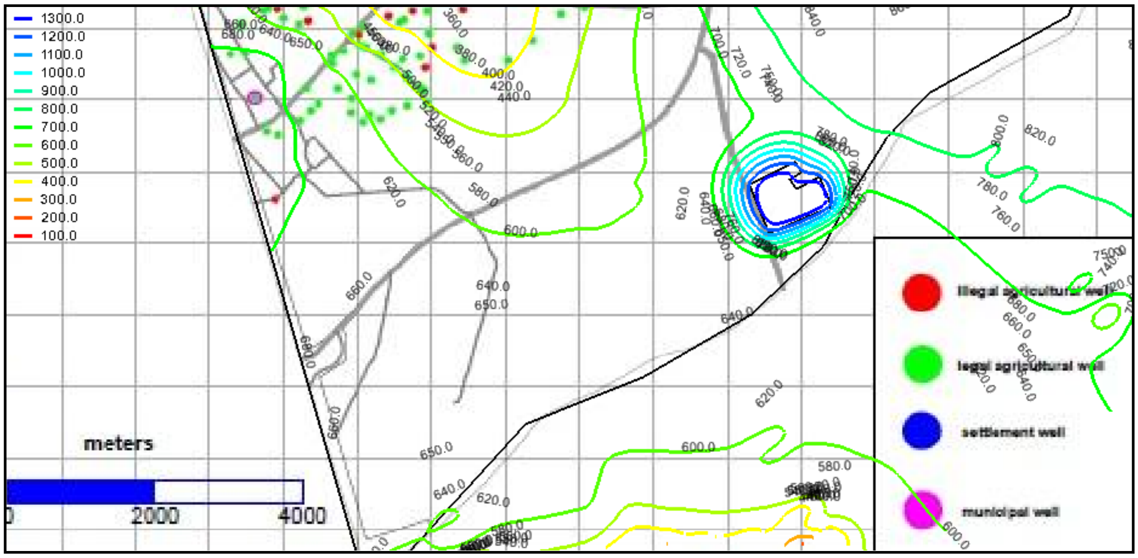


Figure 6A-17: Chloride Plume at Year 2040 for dispersivity of 100 m.

Concerning the potential effect of the proposed landfill at El-Fukhary site, the following can be concluded:

1. In case of liner rupture and as worst case scenario, the maximum yearly amount of leachate from the proposed landfill which is expected to percolate through the landfill liner was estimated at 180,000 m^3/year.
2. Based on the particle tracking simulations and the sensitivity analysis, the contamination tracks will migrate to around 1 km to 2 km away from the landfill within the next 30 years.
3. Based on the current situation, the chloride and nitrate values on the groundwater are exceeding the safe limits of drinking water, the effect of the disposed wastes at the proposed landfill was studied and the proposed landfill increased the chloride and the nitrate concentrations within 1 km to 2 km from the land fill.

Further to the generation of leachate, the rain water that will fall over the non-active Cells should be drained and collected in an adequate manner so as to avoid causing unexpected water collection in low elevations areas of the site. The surface water collection will be done through channels that will be designed so that collected water is discharged by gravity to the lowest points in the sight. During the first years of operation the amount of surface water that will be collected from roads, reception areas and composting plant[47] are expected to be minimum because their correspondent areas only form a small portion of the total landfill area. Therefore the impact of surface water will be more significant during the last years of operation and after closure of the landfill, therefore it is discussed in more details in a later section.

[47] The conceptual design of the composting plant indicates that the plant will have a roof of 230x55 meters that will cover all waste windrows, so that rainwater collected from the composting plant will not be polluted with waste leachate

In conclusion, the impacts of the leachate generation will be generally controlled by the engineering measures recommended in the design of El-Fukhary landfill, the risks of contaminating groundwater in a clayey dominating soil are small, while the risks of odor around the leachate pond could be classified as medium if combined with the odor of the WWTP. This impact has been classified as medium impact.

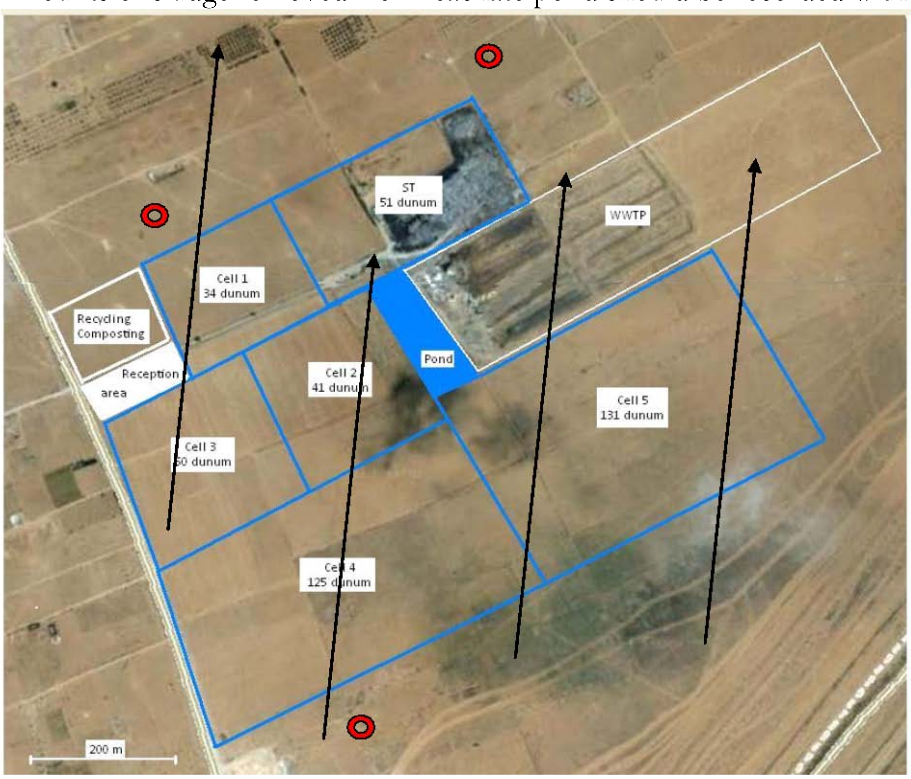
Mitigation Measures:

- Include engineering measures for controlling of leachate, as recommended in the Feasibility Study of the project, these measures should include an adequate liner system, adequate slopes of the Cells bottom, a drainage network comprise pipes from adequate capacity, a collection pit at the lowest point of each cell and an adequate pumping station to lift the leachate from the bottom to the collection pond to the top of the landfill taking into consideration head losses.
- The capacity of the leachate collection pond and the correspondent pumping should be designed so as to receive the maximum amount of leachate with low retention time so as to minimize odor impacts by keeping minimum amount of leachate in the pond. The pond should be surrounded with wind break trees so that to minimize dispersion of odor in the surrounding areas. The leachate pond should be regularly de-sludged and the removed sludge should be transferred back to the landfill The leachate collection pumping station and correspondent piping network should be adequately maintained to ensure smooth operation. The design should include a preventive maintenance schedule which should be followed by the landfill operator.
- . Regular maintenance shall always be planned during the non rainy period. Spare pumps shall be available at the site to be used in the event of accidental breakdown of the operating pumps... The WWTP may use the landfill site for the final reuse or disposal of the resulting sludge. The sludge resulting from the leachate pond should also be analysed and based on the anaylsis the decision to place it in the landfill or reuse it, shall be made. It should be also noted that during the normal operational conditions which will last until 2040, the leachate shall be recirculated to the active cells. The problem will only appear during the after-closure period where the amount of leachate will be significantly reduced and shall then be left to evaporate.
- The three transfer stations serving El-Fukhary Landfill (Tel al Sultan, Al Namsawi and Deir Al Balah) should be designed so that the waste loading/unloading areas are to be covered with an adequate roof to prevent rain from getting into the waste during storage in the transfer stations. The transfer station operator should make sure that no loading/unloading or waste storage operations are taking place in open areas, especially during winter.
- The composting windrows and waste reception areas should be covered to prevent contamination of the run-off from these areas. The same applies to recycling areas.
- The leachate resulting from the own moisture content of the waste received at the composting plants whould be prevented from percolating through the soil by constructing an impervious bottom layer for the different composting stages. A leachate collection system shall be installed which allows for leachate storage and recycling for humidification purposes
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

- The feasibility of constructing an onsite laboratory to perform certain analyses could be studied. This could serve the landfill, composting plant and WWTP.

Monitoring Activities:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream) which should be drilled at least 3 meters below groundwater table, the proposed locations of the monitoring wells are shown in Figure 6A-18 below. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest



Groundwater flow direction

Proposed locations for monitoring wells

Figure 6A-18: Recommended locations of groundwater monitoring wells

6A.2.4 Impacts on Birds and on Gaza Airport

The migrant bird population in any region is correlated with the total bird population in the globe, although precise estimation of migrant bird populations is very difficult. Generally, birds migrate seasonally from northern parts of Iran towards the south. These birds start to migrate in autumn and return to the northern regions in late winter. The situation of migrant birds is also the same in a regional scale. There are also species staying until spring and even summer and breeding. In addition there are birds, which may enter a certain area regardless of the migration season. The migration of birds between Eurasia and sub-Saharan Africa involves almost 200 species where either the whole population or sub-populations are long distance migrants (Moreau 1972). Twice a year, these long-distance migrants move between their breeding areas in Eurasia and wintering areas in sub-Saharan Africa. Uncountable millions of birds are involved. Some species (particularly small ones) perform direct, active flights, while others (particularly large species) are so-called passive migrants that soar on thermals or updrafts. The vast majority of the migrants are small birds, i.e. passerines. Passive migrants in the Middle East have to make an often significant detour around the Black Sea and the Mediterranean Sea, and in order to avoid the Red Sea they concentrate around the Sinai Peninsula as this is the only land-bridge connecting Eurasia with Africa. In spring, the Sinai Peninsula is by far the main gateway to Eurasia for large soaring species having spent the winter in Africa. During autumn, the species have an alternative, which is to fly down the Arabian Peninsula making the final flight into Africa across the narrow strait of Bab el Mandeb at the southern end of the Red Sea.The flight height of the migrant birds is of particular importance. Migration flights appear to be at some 150 to 3600 m above sea level. However migrant birds dominantly fly at a height of about 1200 m and less above sea level.

Determination of the path and population of migrant birds is practically impossible at a provincial level and it is usually carried out at a regional scale and on a country-to-country basis. Although there is no information available on the migration path in the study area, evidently the area can be considered in the direction of some birds' migration paths. Generally, the habitats of the migrant birds (such as Aquila heliacal and Falco tinnunculus) include wetlands, lakes, riverbanks, vegetative cover along coastline, forests, etc. Since none of these features exist around the proposed landfill site, there will be a very limited population of migrant birds in this area. However, landfills can become preferable food sources for birds and will attract both migrant and local birds. Larus ridibundus is a particular species that is commonly attracted to landfills. Other migrant species are less commonly attracted to landfills, but may still be encountered.

The environmental impacts that could be associated with attracting birds on the landfill site depends whether there are risks of collision between birds and objects that could not be observed during speed aviation, such as high tension lines, or not. Such accidents result in loosing populations of rare and endangered birds species. Generally no rare and endangered species are recorded in the area and the landfill location does not include any high tension lines and, accordingly no existing risks from attracting birds on the site. However, the risk factor that may arise is the nearby (about 4.5 km away) Gaza International Airport, which is currently not operating.

The Gaza International Airport occupies the elevated ridge in the southeastern part of Rafah, approximately 40 m above the proposed landfill site. The ridge's elevation reaches as high as 90 meters AMSL. Between the two ridges, a depression area exists which is known as El-Fukhary area. The airport has a runway of 3 km with 01-19 direction; it was constructed in 1998 and operated for 3 years before being bombed by the Israeli army in 2001. Since that time the airport is not operating.

Generally speaking the accumulation of birds near an airport is a more risk to aircraft aviation than on specific bird's species. Although civil aircrafts fly at a relatively lower speed and generate a higher noise level than military aircrafts, which increase the ability of birds flying in front of such airplanes to hear the noise and change their direction, collisions may still occur most commonly during landing and takeoff, when there can be a sudden occurrence of bird swarms and limited time for appropriate maneuvering. Both the migrant and local birds are susceptible to these collisions. Although migrant birds are less common, they are usually larger and can potentially cause greater damage to aircraft.

The World Bank Guidelines for "Sanitary Landfill Design and Siting Criteria" stipulates that no landfills should be less than 3 km from turbojet airports, according to the Guidelines if a landfill is located less than 8 km from an air port, then a written permission from the aviation authority, stating that it considers the landfill location as not threatening air safety, should be obtained.

Although the airport is not currently operating, there are possibilities that it will be reopened during the expected project lifetime, accordingly ensuring the safety on aircraft aviation will be an important issue. The Consultant has conducted meetings with the Director General of the Palestinian Airlines, Chairman of the Palestinian Civil Aviation Authority and Director of Planning and Training at the Authority,

The following were concluded from the meetings:

1- In the short term, there will be no significant negative impact from the proposed landfill at El-Fukhary on the airport, even if the airport reoperated. In the long term, there is vision to expand the airport and add run ways, in light of these the impact of the landfill shall be investigated. However this is not going to be clear or implemented anytime in the near future, first due to the political ban, and second due to the potential opposition of landowners.

2- There will be no notable effects from the emissions of the landfill; mainly the ammonia (NH_3) and methane (CH_4). The construction of the landfill will not have any impact on the wind direction and movement. According to the International Civil Aviation Organisation (ICAO) Annex 14, the minimum buffer zone for avoiding emissions around the airport shall be 2500m.

3- The landfill is not likely to penetrate into the airport cone (From zero radius at the center of the airport on earth surface level, up to 18,000 feet.) Normally airports and runways are provided with instuments called Red Y instrumetns which helps in repelling birds. The abundance of scavenging birds at the landfill would not therefore be one of the PCAA concerns.

4- At the time of landfill operation in the future, a written official approval from the PCAA shall be required.

It is considered in this ESIA that obtaining the approval of the Palestian Civil Aviation Authority will make this impact acceptable; therefore obtaining this approval should be done during the design phase of the project.

Mitigation Measures:

- Implemented any conditions that may be included in the approval of the Palestinian Civil Aviation Authority during construction and operation of the project.
- Establishing a fire fighting system
- It should be included in the Landfill emergency plan that the airport shall be immediately contacted (the contact mean shall be indicated)in the event of any fire resulting in significant smoke emissions at the landfill site.

Monitoring Activities:

- Complaints and correspondence with the Palestinian Civil Aviation Authority should be documented and reported in the monthly report

6A.2.5 Risks of Receiving Hazardous Wastes

In 2008 it was estimated that approximately a total of 800 tons of hazardous waste was produced in the GS, generated by different economic sectors. From an international perspective this is a very low figure, taking into account a total population of around 1.5 Million, or half a kg generation of hazardous waste per person per year. While the landfill will not officially accept hazardous waste, it is possible that the waste dumped will accidentally contain hazardous components, or that illicit dumping will take place. Co-mixing hazardous waste with MSW and/or disposing of hazardous waste at the landfill site can cause different risks to workers on the site, waste pickers, or generally anyone who may come into contact with the waste during its journey from the source of generation to the landfill.

There are different types of hazardous wastes that are currently mixed with domestic waste; the most common are healthcare waste, which is commonly found in garbage bins and dumpsites, and hazardous construction waste, such as asbestos and contaminated rubble with different chemicals, such as PAHs[48]. It is well defined in the project objectives that it deals with domestic non-hazardous wastes, but the fact that there are no sufficient places currently available which receives hazardous waste, except for a hazardous waste cell in Johr El Deek and a healthcare waste incinerator in Gaza Hospital, raises the risk of receiving such waste at El-Fukhary landfill.

[48] The UNEP report on the War of 2008-2009 indicated that the bombing of medicine stores has lead to generation of considerable quantities of rubble contaminated with PAH ash

The main risks of receiving hazardous waste at the El-Fukhary landfill could be summarized in the following:

- Waste sorters at the recycling and plant could get injured by infectious sharps mixed with municipal and possibly infected by blood transmitted diseases
- End product of the composting plant may have some hazardous components, such as broken glass, that could be difficult to separate and could cause injuries to packing workers and end users
- Handling of friable asbestos and PAH ash could cause hazardous to the workers at the landfill and possibly neighboring areas
- Some hazardous chemicals could be corrosive and could cause health risks to landfill workers if exposed to these chemicals through skin contact, eye contact or breathing

It would be ideal that an effective hazardous waste facility could exist in Gaza before the start of the Long-Term El-Fukhary Landfill, however, if this did not happen the question would be: is it more advantageous to make a strict admission control on the received waste or to possibly approve the admission of some hazardous waste items? The answer to this question could be complicated, but it generally depend on how these types of waste could be handled in other areas, it will definitely be for the direct benefit of the project to strictly prohibit the admission of any type of hazardous waste, but this might not be a strategic benefit in light of absence of other hazardous waste facilities.

In light of the above discussion the mitigation measures for this impact have been based on taking preparatory measures for the possibilities of receiving hazardous waste, and on the same time push, on a strategic level, for the establishment of a hazardous waste treatment facility in Gaza. Because the current situation of open dumping of waste already associate exposure to mixed hazardous and municipal waste, the situation after the implementation of the project is not expected to deteriorate. The impact of hazardous wastes is classified as of medium significance.

Mitigation Measures:

- The project proponents in the MLDF should negotiate with other Palestinian authorities and the donor community to initiate a project for hazardous waste management that would be operational before 2018
- All workers of the landfill, transfer station, recycling and composting plants should receive adequate training on the types of hazardous waste that could be handled, the type of hazards and the appropriate methods of handling
- In case the Long Term landfill will start operation before having a hazardous waste facility in Gaza, a special cell/container for hazardous waste disposal will be needed to allow for safe hazardous waste storage/disposal and reduce the risk of co disposing of hazardous waste with non-hazardous wastes, this cell could be developed (or a container could be placed) on the north east corner of the site (next to the Short Term Landfill) and would need to be lined as other cells and used for disposal of dry waste with immediate coverage.
- Asbestos waste should be wetted once admitted in the landfill and immediately covered

- Flammable and explosive waste should be strictly forbidden from admission in the landfill. The landfill operation manual should include a list of acceptable and non-acceptable waste in the landfill.
- Awareness of hazardous waste generators regarding the sorting at source in order to avoid a mixing of hazardous and non-hazardous waste.
- All workers in the landfill, recycling plant and composting plant should be provided with anti-puncture gloves, steel-toe shoes, overalls and masks. Strict supervision on the compliance of hand sorters to this should be practiced
- Prepare a documented emergency response plan to any spills or fires, there should be enough tools for fire extinguishing.

Monitoring Activities:

- Amounts of identified hazardous waste received in the landfill should be documented and reported in the monthly progress report
- Amounts of flammable and explosive wastes that have been refused from admission
- Topographic survey of the special cell and estimation of the amount of received waste
- Health records for the project staff including any occupational injury and any infection case that could be related to waste handling.

6A.2.6 Risks to Occupational Health and Hygiene

Besides the risks of exposure to hazardous waste discussed in the previous Section, potential impacts on the health and hygiene of both the general public and on-site workers exists as a result of the nature of the waste, these are equally applicable to both the landfill site and transfer stations. The main impacts associated with the project arise from the following:

- Low hygiene conditions
- Vermin attracted to the site (birds, rodents and insects) which can act as disease vectors.
- Risk of fires, explosions, subsidence, spills and accidents;

Waste pickers face particular risks from direct contact with the waste, especially when they are not wearing personal protective clothing. Waste sorters at the recycling plant, in addition to regular staff in the landfill and transfer stations, are in direct contact with the waste and accordingly are exposed to unhygienic conditions from the prolonged exposure to waste, dust and vermin.

The situation at the existing uncontrolled disposal site is associated with resident populations of vermin which are factors for increasing nuisances to humans and the spread of disease, and disrupting the natural ecosystem. The adoption of high standards for the new landfill, through compaction and daily coverage, will limit the potential for the development of resident populations of vermin and pests, however, it will not be totally eliminated as the waste will be exposed in the landfill for some time before being covered, and some insects and rodents will still be able to tunnel through the cover and reach the waste. The impact on health and safety of workers and the general public is considered negative with high significance and the following mitigation measures should be applied in order to control the impact.

Mitigation Measures:

- Particular attention will be paid to the health and safety of workers at the sites by worker training of safe working methods and good hygiene practices; the use of personal protective equipment, as required, when working on-site and provision of first aid facilities. Showers, washing basins, clean toilets, changing rooms, and different cleansing equipment should be available at the landfill offices as well as the recycling/composting plants
- Unauthorized entrance to the landfill site should be prevented
- Control of vermin, insects and birds by compaction of deposited waste and application of cover materials according to the waste filling plan.
- If needed and responding to complaints from neighbors, the pests could be combated by sanitary measures such as application of insecticides and pesticide and for rodent control. The leachate collection pond and the surface water pond, when it is not dry, should be applied to effective pesticide to minimize mosquitoes breeding. The preference will be for biological pesticides, but in the current situation of borders closure it is doubtful that such pesticides could be applicable; therefore the application of pesticides should be by an expert that should select the pesticide that has negligible effects on human and minimum effect on non-targeted species and the natural environment.

Monitoring Activities:

- Type, quantity, date, location and method of application for all pesticides should be well documented and reported to the PMU in the periodic monthly reports
- The complaints about insects and rodents from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

6A.2.7 Noise Impacts

6A.2.7.1 El-Fukhary Landfill Site

Operation works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. This will result in raising the background noise levels; depending, as mentioned earlier in this Chapter, on:

- the type of equipment and vehicles used on the site;
- the ambient noise level around the proposed site;
- the proximity of sensitive receptors;
- the length of time over which construction works are undertaken.

The main activities that are associated with high noise emissions are:

- Movement of RCVs in and out of the landfill site;
- Placement and compaction of waste;

- Application of daily cover material for waste.
- Operation of standby-generator
- Operation of convey belts and trommel separators in the recycling plant
- Operation of loaders and windrows moving machines in the composting plant

As mentioned earlier during discussing construction noise, the nearest receptor is a farm houses about 700 m away from the site and accordingly noise impacts are not expected to be major. It is recommended to plant wind break trees around the landfill borders, especially in the northern and western borders around the recycling/composting plant, to maximize noise attenuation and, in turn, minimize noise impacts to neighboring areas.

It is anticipated that operation activities will not be operational during the late hours; therefore the impact on evening averages of ambient noise will be little. The impact of noise can be considered negative and of medium significance.

6A.2.7.2 The Transfer Stations

During operation, noise at the transfer station may result from the following:
- increased vehicle traffic;
- loading and unloading of waste, and
- operation of the compactor.

In terms of traffic noise the expected traffic load addition is approximately 50 cycles, which is expected to be a minor contributor to the traffic noise around transfer stations. The compactors noise is not expected to be high, while the loading/unloading noise is intermittent and accordingly their contribution to the ambient noise is not expected to be generally significant. The impact of noise at transfer station can be considered negative and of low significance.

Mitigation Measures:

- Key noisy equipment (such as generators, trommels, conveyor belts … etc.) should be selected with minimum noise;
- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In case the landfill manager received complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Landfilling and operations of the recycling/composting plant should be stopped at night-time.
- Planting of a wind break trees where appropriate to act as a noise buffer.

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill (refer to Figure 6-2 in a following section) should be measured frequently in an annual basis.

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

6A.2.8 Affecting Air Quality by Vehicles Exhaust

Local air quality can be negatively affected by vehicle exhaust emissions from vehicles and machines (generators, loaders, compactors ... etc.) operating at the landfill and RCVs used to transport waste. The bad conditions of the existing vehicles which have been observed during the assessment of the current waste management situation and the lack of regular maintenance will increase the potential impact of exhaust emissions. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission.

Overall, the potential impact of vehicle emissions resulting from the landfill and transfer stations -related traffic is not expected to increase as compared with the current situation since the chosen locations for transfer stations and the landfill have been previously occupied for the same purpose. If no mitigation measures are undertaken, the impact is considered to be negative with low significance.

Mitigation Measures:

- All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Monitoring Activities:

- CO_2 emission rate of all vehicles used in the project should be documented from the manufacturer, the distance and fuel consumption should be documented and reported on monthly basis.

6A.2.9 Visual Impacts and Aesthetics

6A.2.9.1 El-Fukhary Landfill Site

The solid waste accumulation is an unfavorable seen, especially when it is with large quantities as the case in landfills, and also transfer stations and composting / recycling plants. The operation of landfills, transfer stations and composting/recycling plants is also associated with litter dispersion by wind which adds to the negative visual impacts. The operation of landfill equipment and generated dust from the earthworks also adds to the bad scene at the site.

The most effected groups by the visual impacts of the landfill, transfer stations and composting/recycling plants are the inhabitants of the close neighborhood who can see the waste from their places. Also the users of roads that could view the landfill could be also impacted by the low aesthetic value of the area. Furthermore, if the Gaza Airport is operated during the project life, the aircraft passengers would see the landfill operations from low altitude during take-off and landing, but this issue is not foreseen in the near future so it could be regarded as negligible impact.

In El-Fukhary landfill during the filling of underground portions of waste cells, the operations will be totally hidden from neighboring areas and nearby roads. Also during the operation on layers above the ground it will be expected that active layers will be surrounded by embankments so that waste on the Cells edges would be compacted against them and the height of the landfill will be maintained with a safe slope, so these embankments will also hide waste filling operations from surroundings.

The remaining impacts would be the interrupting of the horizon seen by the spoil hill which will not be reused in the landfill operation, if left in site without being exported for uses outside the landfill area, and the final landfill hill (after applying final cover). Because the development of both hills, landfill and spoil, will be gradual the final visual impacts of those two hills will be maximum after closure of the landfill, therefore they are discussed in more detailed in a following Section.

Currently considerable visual impacts are caused by the existing Short Term landfill at El-Fukhary which is about 15-meter high and uncovered, so waste is exposed at a high altitude which is a relatively high visual impact. The Short Term measures that will be implemented in El-Fukhary landfill, prior to the construction of the Long Term landfill subject of this ESIA, includes that the height of of the landfill will be elevated to about 30 meters above-ground and the waste will be covered. The overall impact of the Short Term measures at El-Fukhary Landfill is expected to be positive, even though the landfill height will increase, due to covering and profiling the existing waste body. If the new landfill operations are added to the existing Short Term hill the additional impact on the area, during the operational phase, is expected to be minor.

For the composting/recycling plants the windbreak trees that will be around the plant site and the roof over the compost piles will hide the waste and the trommel separators to most of the surrounding areas, especially that the nearest residential clusters are relatively far and their average height is relatively low (one or two stories), accordingly the visual impacts are expected to be low.

6A.2.9.2 Transfer Stations

The design of the transfer stations recommends that the fence will be wire netting fence which will prevent littering dispersion outside the site but will not hide the inside waste scene, however because the waste will be contained inside the containers there will be low visual impacts on the surrounding ground level areas, while the impact will be higher on elevated neighboring buildings. However, because at least two of the transfer stations, Tal Al Sultan and Namsawi, are currently used as open waste collection areas, new additional visual impacts would be added due to the transfer operations. Accordingly the impact has been classified of low significance.

Mitigation Measures:

- The composting/recycling plant should be fenced with windbreak trees to minimize hide negative waste scene from the view of the neighboring areas.

Monitoring Activities:

- Complaints of neighbors from littering dispersion or about the general aesthetic value of the area should be reported to the PMU in the monthly progress report of the site.
- Provide adequate fence, windbreak trees and roof for the composting/recycling plants

6A.2.10 Risks of Unforeseen Exceeding of Landfill Capacity

The Feasibility Study of the project has calculated the design capacity of El-Fukhary landfill based on the selected scenario for the integrated waste management in Gaza Strip, in which it is planned to use the Short Term El-Fukhary landfill until 2017. The Long-Term El-Fukhary Landfill, subject of this ESIA is expected to start operation by the beginning of 2018 and will receive waste from Deir Al Balah, Khan Younis and El-Fukhary Governorates from the beginning of operation. Starting from 2033 the landfill of Johr Al Deek will be generally closed, and the waste of North Gaza and Gaza City will start to be transferred to El-Fukhary Landfill. According to the calculations made on the El-Fukhary landfill areas and expected waste volumes the capacity of the landfill would enable it to receive waste until April 2041 as indicated earlier in Table 6-3 earlier in this Chapter.

The calculation basis introduced in the Feasibility Study for estimating the life-expectance of the project include some assumptions that, if not materialized during the operation of the project, may lead to shorter life expectancy for the project. The main effective assumptions on the life expectancy of the landfill are:

- The population growth of Gaza Strip will show a regressive growth trend from 2011 onwards.
- The waste will be compacted from 0.35 ton/m3 in the primary collection, to 0.7 ton/m3 in container transport, to 1 ton/m3 immediately after disposal in the landfill, and finally to 1.2 ton/m3 after settling in the landfill. The average used waste density in the landfill body is 1.2 t/m3
- The average waste that will be recycled/composted will start from 5% in 2018, will gradually increase to 18% in 2038, and then will be maintained at the same range until the end of the project in 2041
- The waste to daily cover ratio in the landfill will be 9:1 by volume

This assumption of regressive population growth has been made by the PCBS in 2007, it has been used by the FS as it goes according to the UN estimates that predicts that the world population will be stabilized by the end of this century. The FS identified two important aspects that are expected to be effective in having a regressive population growth in the coming thirty years, these factors are:

- The hard economic circumstances in Gaza that could hardly become worse and is a factor that have a dimming effect on the population growth
- The limited surface area of Gaza and the high population density (0.26 dunum per person in 2007) so that once the expected border restrictions are loosened immigration from Gaza will be effective in reducing population growth

The above factors are believed to be indeed effective in the population growth pattern during the life of the project, however, the ESIA consultants believes that there are, in addition to the above factors, other factors that could make an opposite effect, which is the existing very high birth rate in Gaza regardless of the difficult economic situation, and the special political situation in Gaza that may encourage people to keep their existing birth rate in the near future. Accordingly the decreasing pattern of the growth rate used in the FS as basis for calculating solid waste quantities may be more optimistic than the situation on the ground which is very difficult to accurately speculate. If the growth rate of population during the project duration was stable, not decreasing, more waste quantities will be received at El-Fukhary landfill than expected then the site will be full earlier than expected. If population growth kept its rate in 2011 (3.5%) unchanged the correspondent effect on landfill capacity will be as presented in Table 6.x below.

The second issue is the average waste density used for estimating the landfill volume that will be filled with waste which is 1.2 ton/m3. The density of the waste in the landfill will be different along the height, as it will be proportional with the overburden waste above it, so the waste will be very dense at the bottom of the landfill and will be relatively light at the top of it. The World Bank Guidelines for estimating the landfill volume recommends that the final density of the waste in the landfill will be in the range 0.8-1 ton/m3 for a landfill that is 10-25 meters deep. Because the height of the waste column in El-Fukhary landfill will be 50 meters the 1.2 ton/m3 assumption in the Feasibility Study seems justified. However, some parts of the landfill will be located in the side slopes areas in which the overburden weight above it will be much smaller, also getting to 1 ton/m3 directly after placement in the landfill using available compactors in Gaza may not be fully implemented. Accordingly there may be some risks that the average density of waste in the landfill may be less than 1.2 ton/m3 and consequently the landfill will be full earlier than expected. If the average density of the landfill will be 1 ton/m3, with all other factors unchanged, the effect on the landfill capacity is presented in Table 67 below.

The third assumption regarding composting from 5-18% of the waste will largely dependent on the market demand and the quality of the project. If the composing plant showed high profits it will grow as expected, but if the project showed low feasibility due to low demand or low quality of product this will have a direct effect on the waste quantities getting to the landfill. The fragile political situation in Gaza raises the economic risks and increase the area of uncertainties in the economic analysis, and accordingly there are possibilities that the expected amount of composted wastes could not be actually achieved, and that a surplus waste stream will get to the landfill. In case that for unforeseen reasons the composted amount of waste kept stable on 5% the effect on the landfill capacity is presented in Table 6A-8 below.

Finally the waste to cover ratio that have been used in the FS, 9:1, may require to be slightly decreased to be 6:1 according to the World Bank Guidelines for estimating landfill capacities. This will have a beneficiary factor for consuming more soil in the cover material, so as to reduce the amount of un-used spoil, but on the other hand will reduce the waste capacity of the landfill. The effect of using 6:1 waste to cover ration is shown in Figure 6.8 below.

Table 6A-8: Impacts of some different assumptions on the landfill capacity

Changing assumption	Original assumptions	Population growth stable at 3.5%	Average waste density 1 ton/m3	Composting is 5% of waste	Waste to Cover is 6:1
Cell 1 Expected filling date	Jul 2020	Apr 2020	Feb 2020	Jul 2020	May 2020
Cell 2 Expected filling date	Nov 2024	Dec 2023	Oct 2023	Aug 2024	Jul 2024
Cell 3 Expected filling date	Nov 2029	Dec 2027	Mar 2028	Apr 2029	May 2029
Cell 4 Expected filling date	Sep 2036	Mar 2034	Apr 2035	Dec 2035	Apr 2036
Cell 5 Expected filling date	Apr 2041	Nov 2036	Feb 2039	Nov 2039	Aug 2040
Equivalent number of years to be taken out of the expected age of the landfill		4.5	2	1.5	0.67
Total equivalent number of years if all factors were combined		9 , accordingly the expected filling date would be in 2032. However, this is the worst case scenario and it may not be realistic to adopt it			

In conclusion, there are factors that may lead to less landfill capacity than planned, and the impact of this is limited to planning issues as if the landfill capacity monitoring indicated that the filling rate is faster than expected, planning authorities should start planning for expanding the site or use another site. The impact is considered of low significance.

Mitigation Measures:

- According the results of landfill capacity measurements the planning authorities should start studying expanding the El-Fukhary site through obtaining adjacent lands, or search for new sites.

Monitoring Activities:

- A topographic survey should be carried out for the landfill site on yearly basis to identify the used area and waste height.

Based on the topographic survey, the weight of the waste being dumped should be recorded and used for the calculation of the virtual density.

6A.2.11 Impacts on Flora and Non-Avian Fauna

Impact Significance:

The baseline study of the project concluded that the El-Fukhary landfill site lacks any presence of significant wetlands of important biodiversity or reproductive value. Furthermore, there is no presence of environmentally rare or endangered species breeding areas, habitats or protected living areas. However, it was found that diverse and abundant fauna species currently use the site for nesting, breeding or feeding. These may be affected by the controlled operation of the landfill as compared with the existing uncontrolled situation where there is a direct contact between birds and animals with the waste.

The noise and daily work of landfill construction and operation could disturb the area's birds and wild mammals. End of life closing plans for the landfill will include a restoration of the site for agricultural purposes. The top soil will constitutes a good ecological host for soil organisms as compared with the current situation. The site restoration in general including any baffles and vegetative screens will create a variety of new habitats.

The impact on fauna and flora is negative with low significance due to the expected interruption of daily breeding, and feeding which take place at the moment as a result of the proposed site control measures and daily waste covering. However, regarding the pollution and accumulation of contaminants in the terrestrial ecosystem which result from feeding on the waste, and the expected decrease in the number of stray dogs visiting the site, the impact is considered positive since this will cease to take place.
Table 6A-9 below summarizes the impacts of the project during the construction and operation phases and their correspondent significance.

Table 6A-9: Summary of impacts during the construction and operation phases and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Odour impacts	Odor impacts of the existing landfill and transfer stations are unlikely to be considerably higher than the existing situation due to the engineering control activities of the project	Medium	Minimize the impacts and maintain their control
Impacts of landfill gas	Likely to cause some impacts to ambient air quality, with low likelihood for causing explosions or penetrating to the groundwater	Medium	Minimize the impacts and maintain their control
Impacts of leachate and surface water	Unlikely to contaminate groundwater or overload WWT with the taken engineering measures. More likely to cause odor impacts	Medium	Minimize the impacts and maintain their control
Impacts on Birds and on Gaza Airport	Unlikely to cause loss of rare or endangered species, risks on civil aviation to be identified by the Palestinian Civil Aviation Authority	Low on birds biodiversity, un-identified on civil aviation	Minimize the impacts

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Risks of hazardous wastes mixed with municipal waste	Likely to have workers exposure to hazardous waste if no hazardous waste facility is established before the project operation	Medium	Minimize the impacts
Risks to occupational health and hygiene	Likely to have populations of insects and rodents but not necessarily in conditions worse than the existing condition	Medium	Minimize the impacts
Noise impacts	Landfill operations are far from residential areas, the noise of the recycling/composting plant is closer and more likely to cause slight raise of the ambient noise in the area	Medium for landfill site and low for transfer stations	Minimize the impacts and maintain their control
Affecting air quality by vehicles emissions	Most of the impacts are not site specific	Low	Minimize impacts and maintain their control
Visual impacts and aesthetics	Unlikely to add significant visual impacts to the existing situation of the Short Term Landfill and transfer stations	Low	Minimize impacts and maintain their control
Risks of unforeseen exceeding of landfill capacity	There are possibilities that the landfill may be saturated earlier than expected	Low	Minimize impacts and provide early warning
Risks on flora and non-avian fauna	Likely to disturb the existing feeding habits of stray animals	Low, with positive impact on the overall food chain	No mitigation measures required

6A.3 Impacts after Landfill Closure

6A.3.1 Impacts of Landfill Gas

Impact Significance:

The impacts of landfill gas, during operation phase, were discussed in details in a previous section. It was mentioned that the generation of landfill gas will continue after closure of the landfill. The closure year, and the few years afterwards, will be associated with peak generation of landfill gas, and accordingly the impacts that were discussed earlier will be at its maximum effect.

Although the proposed degassing system is believed to be sufficient in controlling the impacts and minimizing risks of gas migration to the environment, a new risk will be associated with the after closure phase as there are possibilities that the site will become un-manned especially if there will be no adjacent extension after 2040. Accordingly the monitoring activities for ensuring that the gas is under control may not continue during the after closure phase, therefore the recommended mitigation measures below are to provide mechanisms for continuing the monitoring activities and to adequately handle any detected gas leakage during the after closure phase.

Mitigation Measures:

- If the landfill location will be abandoned after the closure of the landfill, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for gas monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting any gas leaks, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

The monitoring activities that were recommended in Section 6.1.5 should be continued after closure of the landfill, until generated gas quantities from the landfill could be considered negligible. These activities are:

- Keep records of collected gas through the degassing system
- Analyze composition of the landfill gas against main components on annual basis.
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on annual basis

6A.3.2 Impacts of Leachate and Surface Water

Impact Significance:

After 2041 leachate generation will theoretically be zero, as mentioned earlier because no more water will enter from the waste, daily cover, precipitation and leachate recycling after placing the final cover. However, there will remain two main leachate issues after closure of the landfill: the amount of leachate that will remain in the leachate pond after closure of Cell 5 and the amount of leachate that will remain inside the landfill body after closure. Because water in the landfill body is expected to take time to percolate through the whole depth of the landfill until it reaches the collection pit at the bottom of the landfill according to the permeability of the waste, the water that entered the active Cell short time before its closure will be collected some time after its closure. Accordingly the first one or two years after the landfill closure will still receive large quantities of leachate. Also, the containment of the landfill may not remain totally tight, therefore some surface water may still enter to the waste body and, accordingly, the landfill should be evacuated from collected leachate inside the Cells whenever it is needed.

The recirculation of collected leachate (large quantities in the first two years and small quantities afterwards until the total stabilization of the landfill) will not be possible after closure of the landfill.Considering the semi-dry climate the leachate will be left for natural evaporation. The small quantities that will be collected after the first two years after closure of the landfill could be left to evaporate in the pond, if the quantities are less than the evaporation rate in the region.

The surface water collection will have special importance after the closure of landfill cells, both during operation and after closure of the landfill phases. This is because the natural drainage features of the landfill location will be changed due to the existence of a new non-permeable hill in the area so that the collection areas of rain water will be changed and may cause the following impacts:

- Collection of large amounts of water in lower areas of the landfill causing pressure over the final cover
- High velocity movements of surface run off which may cause soil and landfill cover erosion
- Collection of large amount of water that will remain stagnant in low elevation areas of the site which may cause aesthetic and public health concerns

The Feasibility Study includes engineering measures for the smooth drainage of surface water from the landfill ring road and closed cells, designing the final cover so that an adequate slope will be maintained to drain surface water to the surrounding ring road and then to a channel that will collect all surface water in a pond at the lowest elevation area of the site. The design of the channels (and possibility associated culverts) is based on a maximum rainfall intensity of 30 mm/hr. These measures are believed to be sufficient to manage the surface water and collect it in a sound manner. However, the collection pond should be designed with a sufficient area to evaporate the collected water during maximum hourly rainfall. Because the surface layer of soil is from clayey silts, the percolation of collected storm water to the ground will be rather slow (estimated permeability 1 mm/day) so that the water will mainly be removed from the collection pond by evaporation, so that if the water surface area of the pond is very small, the water will remain in the pond from the rainy season to the following rainy season and will ultimately overflow.

In a trial to estimate the minimum area of the pond that will cause effective evaporation of the surface water over the landfill area of closed Cells and ring road, it was assumed that a 30 mm of rain fallen over the landfill during December (worst case scenario for evaporation rate) for one hour runoff, the coefficient is 0.9 over roads and paved composting and reception areas and 0.2 over final cover, the soil percolation rate is 1 mm/day and the average monthly precipitation and evaporation rates are as indicated in Table 6A-10 below. The results are shown in the following Table.

Table 6A-10: Estimated remaining surface water (m3) in the collection pond after evaporation and percolation if a maximum rain water fallen over the site during December

Accumulated volume (m3) at correspondent month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Average precipitation (mm/month)	62.8	25.6	5.1	16.8	13.0	0.0	0.0	0.0	0.0	6.9	11.4	95.4
Average evaporation (mm/month)	83.7	84.0	109.2	128.8	154.0	176.4	173.6	173.6	159.6	123.2	100.8	75.6
Surface area 1,000 m2	3,665	3,576	3,442	3,300	3,129	2,923	2,719	2,516	2,326	2,180	2,060	3,716
Surface area 2,000 m2	3,604	3,427	3,159	2,875	2,533	2,120	1,713	1,305	926	634	395	3,706
Surface area 2,250 m2	3,588	3,390	3,088	2,768	2,384	1,919	1,461	1,003	576	247	0	3,703
Surface area 3,000 m2	3,543	3,277	2,875	2,449	1,936	1,317	706	95	0	0	0	3,695
Surface area 4,000 m2	3,481	3,128	2,591	2,023	1,339	514	0	0	0	0	0	3,685
Surface area 5,000 m2	3,420	2,978	2,308	1,598	743	0	0	0	0	0	0	3,675
Surface area 6,000 m2	3,359	2,829	2,024	1,172	146	0	0	0	0	0	0	3,665
Surface area 7,000 m2	3,298	2,679	1,740	747	0	0	0	0	0	0	0	3,655
Surface area 8,000 m2	3,237	2,530	1,457	321	0	0	0	0	0	0	0	3,645
Surface area 9,000 m2	3,176	2,380	1,173	0	0	0	0	0	0	0	0	3,634
Surface area 10,000 m2	3,115	2,231	889	0	0	0	0	0	0	0	0	3,624

The calculations in the above table shows that, using the above assumptions, the minimum surface area of the storm water collection pond should be 2,250 m2 so that the water will be evaporated and percolated to the soil before the following winter, and that if it would be desired to keep the pond dry during summer to minimize the area of stagnant surface water in the area the minimum area required for the pond is 5,000 so that the pond will be dry by June. This will again raise a land-use issue, especially that the area available within the landfill perimeter will be in the north east corner, next to the Short Term landfill, and this area is not necessarily the lowest elevation area. Accordingly this issue should be addressed in the final design of the landfill.

As mentioned in a previous section, one more issue related to the management of leachate and surface water will be added during the after closure of the landfill phase, which is implementing the ESMP measures if the site will be unmanned after closure of the landfill. This is again should be addressed by the landfill operator before closure of the landfill the site according to the following mitigation measures and monitoring activities.

Mitigation Measures:

- Identification of a sufficient low elevation area for the collection of storm water after closing the landfill cells. The minimum area identified by the assumptions made in this ESIA is 2,250 m2 and would preferably be more than 5,000 m2 to maintain a dry period for this pond.
- It is recommended to investigate the possibility of resuing of the collected water for irrigation purposes.
- The staff of the leachate pumping station should not leave the site after closure of the landfill except after abstracted leachate quantities could be neglected. This would be decided by the PMU-EM through his review of the leachate monitoring activities reports..
- If the landfill location will be abandoned after closure of the landfill, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for leachate monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

The monitoring activities that were recommended in Section 6.1.6 should be continued after closure of the landfill, until generated leachate quantities from the landfill could be considered negligible. These activities are:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream), as shown in Figure 6-6. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest

6A.3.3 Visual Impacts

The visual impacts after closure of the landfill will be the obstruction of the landscape with two new hills: the covered landfill and the un-used spoil if not exported for other uses. The design height of the landfill is 30 meters in which will be the same height for the existing Short Term landfill but for a larger area. The height and area of the remaining un-used spoil is not finally defined as it depends on the depth of excavation, but using the assumptions previously made in this ESIA an area of about 250,000 m2 would be used to place a spoil of 20-meter height. In all cases it is recommended that the spoil height should not exceed the final height of the landfill to minimize the visual impacts.

The visual impacts of the new two hills that will be developed by the project are expected to affect only few houses in the clusters that are located west of the project site (about 800 meters) and the nearest cluster located to the north (also about 800 meters). The only affected houses will be those houses that are located in eastern and southern end respectively of the two clusters, as the houses in the first row will hide the scene from other houses in the correspondent direction. Also few houses that are located in the first south row of Al Fukhari and Khuzaa villages (about 2.5 km to the northeast) may also see the hills after reaching their maximum height. However, in all cases the view of the hills will only be a minor addition to the existing Short Term hill which will slightly affect all these areas before the construction of the Long Term landfill. Furthermore, the more distance from the landfill site the less will be the visual impact.

The impact is considered of minor significance and the planned plantation of the final covered landfill may actually improve the aesthetic value of the area. In addition to planting the final cover, no feasible additional use of the landfill site could be proposed.

Mitigation Measures:

- Carry out and maintain plantation of the final covered landfill cells

Monitoring Activities:

- Keep records of the green areas planted over the final cover of the landfill

6A.3.4 Stability Impacts

The excavation and gradual progression of the landfill cells will work in changing the original structural stresses on the soil underneath the landfill. After closure of the landfill, the biochemical reactions that will take place will cause changes to the overall density of the landfill and will cause other changes to the stresses over the soil underneath. The landfill site is generally stable as there is no major fault type formation, as mentioned earlier in Chapter 5, with medium seismic activity, accordingly the stability risks are classified as low, however, the stability issues should be put into consideration as mentioned in the mitigation measures below.

Mitigation Measures:

- Stresses both on the soil and on the waste body should be considered during different stages of the operation and after closure of the landfill. The heights, slopes and protection measures should take these factors into consideration

Table 6A-11 below summarizes the impacts of the project after closure of the landfill and their correspondent significance.

Table 6A-11: Summary of impacts after closure of the landfill phase and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts of landfill gas after closure of the landfill	Likely to cause some impacts to ambient air quality, with low likelihood for causing explosions or penetrating to the groundwater	Medium	Minimize the impacts and maintain their control
Impacts of leachate	Unlikely to contaminate groundwater with the taken engineering measures. More likely to cause odor impacts	Medium	Minimize the impacts and maintain their control
Visual impacts	Unlikely to add significant visual impacts to the existing situation of the Short Term Landfill	Low	Minimize impacts
Stability impacts	Unlikely to cause dangerous stresses on the soil after taking this into consideration	Low	Minimize impacts

6B SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR THE SOUTHERN SECTION OF THE PROJECT

6B SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR THE SOUTHERN SECTION OF THE PROJECT

6B.1 Introduction

The analysis of social impact examines the potential social risks associated with a project and explores how to address them so as to achieve the project's development objectives. It is generally characterized by being of subjective nature. Potential social impacts may range from the obvious, such as involuntary resettlement as well as social and political tensions, to more subtle impacts, such as institutional reforms that affect access to goods and services. The social management plan also included measures to maximize the potential positive impact and ensure that they are reaching the most needy groups. These measures are included in more details in the ESMP, while others are structured as separate set of recommendations by the end of the ESMP Chapter.

Due to this subjectivity that associates with the social impacts, the level of significance of the impacts was not done on numerical basis and was determined based on the Consultant technical judgment. The analysis of the impacts gave special attention to the concerns of stakeholders as part of the various consultation activities. The significance of the impacts was assessed based on the expected duration of the impact, the level of damage it may cause and the asset (s) that will be potentially affected. In assessing the significance of the impact distinction was made based on the impacts that are of most concern (need to be avoided, mitigated or compensated) and those that are considered to be less important because they are of temporary nature or because the affected groups will be able to cope with them.

6B.2 Potential Socioeconomic Impacts of the project of the Southern Section of the Project

GSWMP is developed with the main general and core objective of protecting the public health and environment through developing and implementing a sustainable, cost effective SWM system on the level of both the short and long term across GS. The project is expected to result in several positive socioeconomic impacts on GS population during both construction and operation. The most significant positive impacts are expected to relate to the improvement of the public health, environmental condition in the residential areas and creation of economic opportunities of the poor segment of the population through creating number of job opportunities that can accommodate low and medium skilled labor.

However, the project is also expected to result in a number of negative socioeconomic impacts during both construction and operation. Resettlement impacts as a result assets taking to secure land for the landfills and affecting the livelihoods of a marginalized segment of the population who are acquiring a living from sorting recyclable items form waste are among the most important negative impacts of the project. Sustaining the new SWM system will require the introduction of an updated tariff and service fees system which is predicted, also, to have negative impacts in particular on the poor segment of the population who can not afford to pay.

The following sections of this Chapter will present a description of the predicted socioeconomic impacts of the project. Some of the explored impacts go beyond the limitation of the long term investments of the project to cover more generic impacts predicted from the project as a whole. The impacts are divided by the project phase, namely construction and operation.

Management plan to address the potential significant negative impacts will also be illustrated below setting monitoring plan and institutional responsibilities for implementing the mitigation measures.

6B.2.1 Impacts During Construction

6B.2.1.1 Creation of temporary job opportunities

The construction phase of the various components of the project will involve creation of a variety of short-term jobs. The job opportunities that will be created as part of the construction works are predicted to result in improvement for the economic conditions of certain segment of the population including poor people with low and medium skills. Moreover, highly qualified professionals in engineering and other professions will also be required during this phase. The construction works will create short term temporary job opportunities for the local population who are available in the local market and are the cheapest and most economic option for the project contractor. In addition to the direct benefit of these opportunities on the local economy and local businesses, they will help in temporarily elevate the family poverty for those who will benefit form the created jobs.

Impact Significance:

Such job opportunities will have positive temporary impact of high significance on the livelihoods of local people. Despite its temporary nature, these jobs will contribute to poverty elevation of the poor families who will benefit from these jobs. The temporary intervention goes in line with the emergency and relief action that dominates the scene in the work of the various aid and development agencies in GS. The section on "Additional recommendations to maximize the social benefits of the project" below will suggest a number of measures to maximize the local communities' potential benefits from these opportunities.

6B.2.1.2 Inconvenience to local communities

The construction process of the landfill expansion and the associated TSs will involve site works including movement of heavy vehicles, transferring construction material and influx of high number of construction workers to the construction site. The construction works will affect the traffic on the roads and are expected to result in temporary inconvenience to the neighboring communities. The following are the key impacts divided by the project site:

- **From the construction of the landfill**

The surrounding community for the proposed El-Fukhary landfill comprises agriculture with a population density of less than 10 per hectare. El-Fukhary and Al Buyuki are the closest residential communities/cluster are located at a distance of around 1600 m. and 1700 m.

respectively. It is, thus expected that physical construction works will be located at least 1 km from occupied residences. This phase will have some temporary negative impact due to noise and dust from using heavy machines during excavation and leveling. These activities are note expected to result in high level of inconvenience to the local communities due to the far distances to the nearest villages.

Transferring the construction materials will involve high pressure on the main road with several heavy trucks movements. The increased traffic pressure may result in delays for the users of the road and increase in the risk of road accidents.

Impact Significance:
Due to the low population density of the site and the relative far distance to populated areas, the significance of this impact is not expected to be sensed by large number of population. Thus it could be classified as an impact of low significance

- **From the construction of the transfer stations**

During the construction phase of the TSs, the same activities mentioned above are expected to take place. Due to the different nature of the locations of the TSs within residential areas, the impacts are expected to be sensed by local communities who will be temporarily encountering impacts from construction phase, including noise, dust and traffic impacts in the neighborhoods. Communities that will be suffering from these impacts are those located near Al Namsawi and Tal El Sultan waste storage site that will be upgraded to TS. Deir El Balah planned TS may create similar impacts in cases it is located near residential area.

Impact Significance:

This impact is characterized by being a temporary moderate significance impact

Mitigation measures

Commitment to the various environmental measures stated on the ESMP will help in mitigating the potential negative impact on public health. Moreover, the following measures should be considered to mitigate the potential health impacts:

- Assist local communities in establishing community- based monitoring committees in order to follow up and report feedback on the construction process and impacts on the communities to the PMU in order to ensure that the locals concerns are communicated and addressed by the contractor..
- Communicate information about the hours of construction with the local population
- Establishing and enforcing a clear complaints system and ensure complaints are well and promptly addressed.
- Restricting construction works, particularly the noisy activities, during nights hours and weekends to minimize the level of inconvenience.
- Full restriction from access to the site by local communities, waste pickers and any other group outside the construction team.

6B.2.1.3 Resettlement Impacts

According to the World Bank OP 4.12 on involuntary resettlement, the concept of resettlement goes beyond the mere physical relocation of people as a result of the implementation of development projects. The policy covers the direct economic and social impacts that result from Bank-assisted projects and are caused by:

- The **involuntary taking of land** resulting in relocation or loss of shelter, loss of or access to productive assets, or loss of sources of income or means of livelihood, whether or not the affected persons must move to another location; or,
- The **involuntary restriction of access to legally designated parks and protected areas** resulting in adverse impacts on the livelihoods of the displaced persons.

The analysis of the social impact of GSWMP showed that the WB policy on involuntary resettlement will be triggered as part of the project. OP 4.12 emphasizes that involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs. However, avoiding the resettlement impacts under GSWMP was not possible due to the following reasons:

- **Land scarcity** issues associated with the high population density and the lack of available state-owned land make it impossible to avail land for the various investment components without acquisition for privately owned land.
- The current health and hygienic situation of waste pickers in the landfills and transfer stations and the **high level of exposure to hazards should be terminated by the project**. Restricting the random access of the informal sector individuals to landfills and transfer stations will terminate their access to a core source of livelihoods. However, this restriction is unavoidable in order prevent the current unhygienic picking practices and maintain the safety and management requirements of the disposal site as part of the project operation.

Involuntary resettlement (IR) resulting from development projects will, if unmitigated, give rise to difficult economic, social, and environmental risks that may lead to a variety of unacceptable impacts. These impacts may include the loss of important assets that could lead to the impoverishment of people particularly in the cases when their productive assets or income sources are lost.

The Resettlement impacts of GSWMP project could be mapped as follows:

- **Impact on the livelihoods of the informal waste pickers**
  - Complete loss of sources of income
  - Partial loss of sources of income
- **Impacts of loss of privately owned land**

Well-designed and well-implemented resettlement programs may represent good development opportunities for the Project Affected Persons (PAPs). By providing proactive mitigation measures, OP 4.12 is used to ensure that PAPs are not negatively affected by Bank-financed projects. The Bank's involuntary resettlement policy is a road map to be used by practitioners in the identification, preparation, and implementation of Bank-funded programs with a focus on minimizing negative social and economic impacts on individuals and communities.

Since OP 4.12 on involuntary resettlement will be triggered as part of GSWMP, ARAPs[49] for the landowners of El-Fukhary landfill as well as the waste pickers working in El-Fukhary current final disposal site will be prepared. Moreover, mitigation measure will be mentioned as part of the ESIA (the section below) in order to ensure that negative impacts are minimized and that the resettlement process is converted into a development opportunity to the PAPs particularly the poor and vulnerable groups of the waste pickers.

A) Impact on the livelihoods of the informal waste pickers

Complete loss of sources of income

As indicted in the Baseline Chapter, the majority of those working in transfer stations (TSs) and final disposal site are working exhaustively in waste picking activities and in many cases the business is dominated by specific families. It is expected that security system will be established to control the landfills and transfer stations for safety purposes. Access to the facilities will be restricted to licensed operators and the number of informal waste pickers currently benefiting from the sites will not be allowed to have access to recyclables as it is currently the case. Restricting these groups who are currently entering freely from reaching the landfills and the TSs will result in significant negative impact on these groups' source of livelihoods. The field work clearly revealed that the informal sector groups, particularly those who are working in an exhaustive mode, cannot tolerate negative impacts on their sole source of income. Affecting the livelihoods of these groups will not merely result in increased level of poverty and vulnerability, but might have unpredictable and serious social implications including violent reactions. Due to their low level of education and skills base, they will be unlikely qualified to acquire alternative source of livelihoods. The implications of this situation could be reflected on one or more of these manifestations:

- Family impoverishment and high risk of deprivation from food and other basic needs.
- Vulnerable groups like women and children are more exposed to the negative implications of restricted access to food, education and health services as a result of limited family income.
- Social unrest and violence might appear as reactions from the affected groups

Complete loss of sources of income the informal workers in El-Fukhary Landfill

The social survey conducted as part of preparing the ESIA and the ARAP showed that 18 waste pickers are working in El-Fukhary proposed location for the landfill. 11 of them stated that they are working as full timers and are totally dependent on sorting recyclables from the waste as the only source of income. As the case in other waste disposal locations, the landfill is dominated by certain families. Most of the waste pickers (13 waste pickers) in El-Fukhary belong to El Najar family. Additionally, around 3 waste pickers belong to Abu Senema

[49] ARAP is prepared when less than 200 PAPs are affected by the sub-project

family who is one of the key landowners of the site. Only 2 of the waste pickers come form a third family.

Figure 6B.1 A discussion between one of the social surveyors and the waste pickers in El-Fukhary **site.**

Figure 6B.2 One of the female waste pickers working in El-Fukhary **site during the ARAP inventory survey**

The following are the key issues covered by the inventory survey of waste pickers for the preparation of the ARAP:

- Name , basic and contacting information of the waste picker
- Mode of work in the disposal site (full time versus part time)
- Role in the family and if the waste picker is the main bread winner
- Other occupations and skills base of the waste picker
- Alternatives that they suggest after being restricted from recovering recyclables informally
- The responsible agencies, from the waste pickers' point of view, that should assist in providing alternatives

The following are the key findings from the ARAP survey and the discussion with El-Fukhary waste pickers:

- The average age of the waste pickers ranges from 14 years old to 65 years old
- Only 3 of the waste pickers are below 16 years old and 3 are above 60, one of those above 60 years old is a lady
- The educational status of the waste pickers range from illiterate to graduates from high schools. Waste pickers below 16 attend schools and work in the site during school holidays and in the weekends
- Almost all the waste pickers are contributing to the family income including the children below 16.
- The number of years that the waste pickers spent working in the site ranges from 1 year to 15 years.
- Only 8 waste pickers are the main and only bread winner for the family

- When asked about the average daily income from their work in the site, the answers ranged from NIS 15 /day to NIS 60/ day depending on the number of working hours and the number of years of experience of the waste picker.
- 10 of the waste pickers defined their work mode as "full time".
- With the exception of the children below 16, all waste pickers were clear in defining the main fields for spending their income from the recyclables selling. They were specific in mentioning food, medicine and clothes. Waste pickers below 16 years mentioned that they contribute to the family income, in general.
- When asked about the potential damage (impact) from restricting them from using the disposal site, 14 of the waste pickers mentioned that they will suffer from full loss of income.
- The alternatives that the waste pickers suggested for jobs included a variety of options as a first preference. All these options were far from the work in recyclables. This included, raising livestock, driving or working in mechanical workshops.
- All waste pickers, including the lady, showed readiness to work as official employees in the landfill or the associated sorting or composting facilities. They wish that the employment is a full time, well- paid and secured jobs.

Complete loss of sources of income for the informal workers in the temporary waste storage sites and transfer stations

Two existing temporary waste storage sites serving El-Fukhary landfill, namely Al Namsawi and Tal El Sultan, will be upgraded, improved, and converted into TSs. Restrictions will be imposed on the informal groups working in these TSs. The following are the key findings from the ARAP inventory survey:

Tal El Sultan

- Currently around 16 waste pickers are working in Tal El Sultan. 10 of them are the main breadwinners in the family. 7 of the waste pickers are below 16 years old. Only one case among these 7 children is heading the family. His older sons were detained and his father does not work.
- The site is relatively restricted to these individuals who do not usually allow further waste pickers to come and share the benefits from the recovered recyclables. The duration of working in the site varied from 4 years to 12 years. The daily income for the waste pickers was mentioned to vary from a minimum of NIS 10 to a maximum of NIS 30.
- Working in sorting recyclables from Tal El Sultan waste storage site seemed to be a very important source of income to these individuals. This returns to several reasons and different circumstances that varied from one case to the other. However, the key common reason among all cases is obtaining a living and fulfilling a responsibility towards other dependants within the household whose numbers vary from 2 to 10 individuals.
- It was clear from interviewing the waste pickers that several of the cases are suffering from the consequences of the war. Some cases had the family head killed in the war, houses demolished or other family members detained or had serious permanent disability.
- Similar to waste pickers in other places, the case of Tal El Sultan clearly showed that the serious financial need along with absence of skills and education bases were the main

reasons that pushed waste pickers to work within the waste storage site. The choices for them, accordingly, are very limited.

Figure 6B.3 Waste Pickers at Tal El Sultan

Al Namsawi

The field work showed that the site is dominated by only 5 middle aged waste pickers with an only one exception of a child of 15 years old. It was observed that the number of working hours of the waste pickers within the site is relatively limited compared to other site and that the profit made is relatively higher than other sites. The maximum daily income mentioned was NIS 50.

Impact Significance:

The group of waste pickers who will experience full loss of income as a result of project is generally among the most vulnerable groups of GS communities. The main reason for the vulnerability of these groups is the limited choices they can make in life due to the lack of assets including both physical assets (financial assets) as well as non-physical assets like education and skills. This was an important consideration that the Consultant used in determining the significance of this impact as a negative impact of high significance.

Partial loss of sources of income

Partial loss of income will be encountered by the informal sector groups who give visits to the landfills and TSs on part time or irregular basis to make an additional/complementary income. These groups will also be restricted from access to the sites and this restriction will result in partial negative impact on their sources of income. In El-Fukhary landfill some individual waste pickers visit the outer borders of the landfill to sort recyclables from the waste which waste transfer vehicles frequently dispose outside the official borders of the site. Recyclables, generally, reach the landfill with limited quantities due to the prevalence of waste pickers around street containers and intermediate waste disposal sites.

Some of the waste pickers were found to work as part timers in El-Fukhary landfill. They also work in other marginal, risky and un-stainable activities to acquire additional income. Sorting recyclables is one of the economic activities that they juggle in order to survive.

School students where also observed in the landfill site during the schools holidays or days off.

For other informal groups who are working in waste picking as part timers in waste containers and collection spots in streets, they will unlikely be affected from the project unless additional restriction is imposed on them by municipalities and/ or JSC as service operators in order to eliminate the nuisance they cause to the streets image and the difficulties they add to the collection process by scattering waste around. It was not clear until the production of the ESIA if imposing this kind of restriction on street waste picking activities will be considered or not.

Impact Significance:

The severity of the project direct impacts on the part timer waste pickers is not expected to be of major significance. This returns to the fact that they have other alternative sources of income that they use to maintain a living. This impact, thus, could be classified as a negative impact of moderate significance. However, and due to the marginal nature of their activities and the un-sustainability and risks associating with their works, the ESMP and the final study recommendations will propose a number of actions that may help in empowering these groups economically.

Mitigation measures

Waste pickers, particularly those fully engaged in the business as a main source of income, have been identified as the most seriously affected by the project. Unless structured sustainable interventions are designed to empower the informal sector groups, including waste pickers, any monetary compensation schemes might be unsustainable option.

The fact that waste-pickers are already enjoying accumulated experience in waste separation and recycling suggests that integrating them within the formal system should be a key primary suggestion to utilize them as a valuable labor resource for the formal operations inside the project (including the landfill and the TSs) as well as the private companies investing in waste separation while also mitigating the potential economic impact they will be encountering as a result of the project. This measure will create a win-win situation for both the project and the affected waste pickers.

The mitigation plan for this group has been designed to include several measures on both the short and long term basis. This plan aims to eliminate the immediate negative impact resulting from the project while assisting the affecting groups in building a more sustainable asset base that enable them and their families to cope with the economic hardships and family financial demands in a more sustainable and resilient manner.

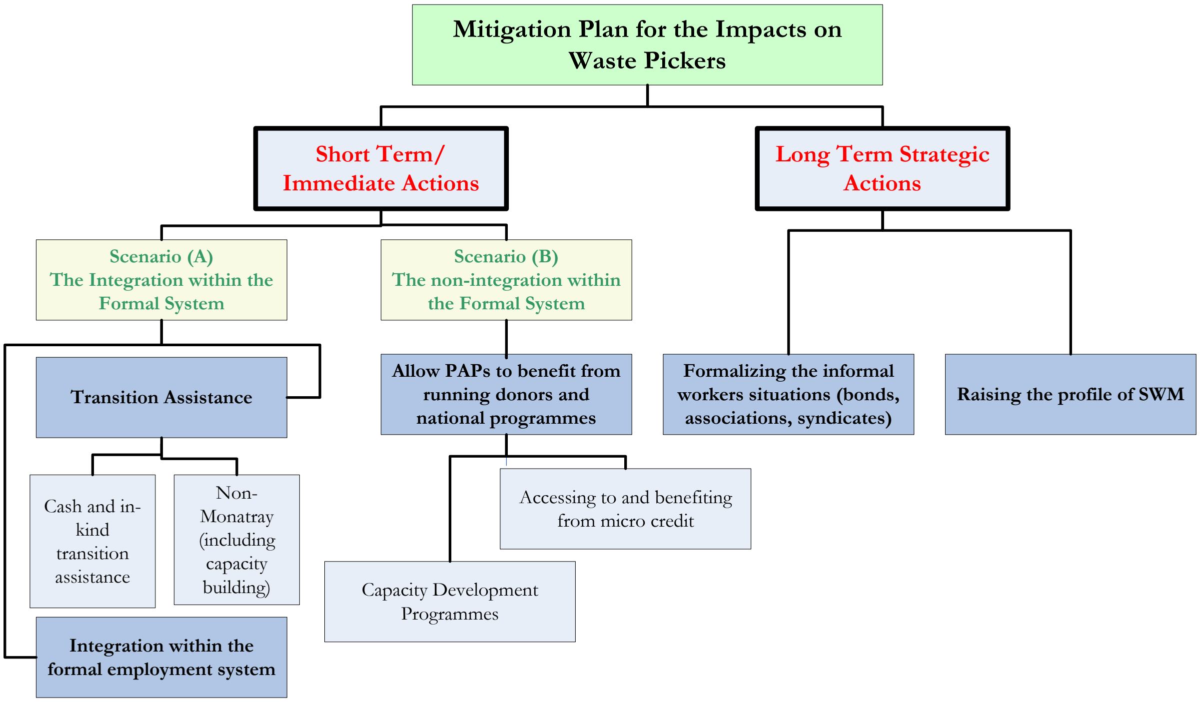


Figure 6B.4 Summary of the mitigation measures for the waste pickers

The ESIA, and more specifically the section on social management plan, aims to specify actions and provide guidance for future application with waste pickers and their families. The set of mitigation measures is not a uniform one model that should apply to all sub-groups within waste pickers. For instance, the affected children below 16 years old who dropped from the formal education system should be integrated into schools or any alternative education system and further assistance should be provided to their families to help them in reaching sustainable source of income. Mitigation measures appropriate for middle aged waste pickers may not suit the elderly ones above 60 who still will be affected from the project.

An ARAP has been prepared for El-Fukhary waste pickers was prepared including a compensation scheme for the affected individuals. The ARAP along with other documented consultation activities[50] conducted in Tal El Sultan and Al Namsawi as part of preparing this ESIA should be treated as a solid database and foundation for starting the mitigation plan of this group.

Short term mitigation measures

Scenario (A) The integration scenario

The integration scenario of the informal sector involves structured interventions to ensure minimizing of the negative impacts of cutting the income of these groups through working

[50] It should be noted that the ESIA Consultant has conducted structured survey in all the sites and interviewed all the available waste pickers working in landfills and waste temporary storage sites. Data sheets including answers on all the questions will be submitted as part of the ESIA and ARAP. This will significantly help in understanding the waste pickers profile, compensation preferences and appropriate alternative for every group.

to integrate the individuals who are capable to maintain work in waste sorting and recycling within the formal Municipality system. Moreover, some of the individual waste pickers can also be integrated within the other non-municipality waste management works as explained below. In all cases, it is predicted that the integration measures can not coincide with the restriction of the informal waste pickers from accessing to the sites. This mainly returns to the fact that they will be restricted from reaching the sites before the construction phase starts. This raises the need for transition measures to be considered to these groups with the main objective of preparing them for the integration into the system through building their capacity and providing temporary cash and in-kind assistance.

The Consultant assumes that the restriction of waste pickers from access to El-Fukhary landfill site will be made within the short term measures and will continue during the operation of the short term, construction of the long term components and operation of the long term components. It is, thus, believed that the integration scenario might not be the appropriate option to El-Fukhary waste pickers unless if they have been integrated in other formal SWM systems and work in other places outside El-Fukhary landfill. The following are the key justifications for not considering this scenario with El-Fukhary waste pickers:

- The transition period until they can be integrated into the official system after the operation of the landfill and the composting plant (the only facility that can accommodate their input) will be very long
- It is not feasible economically and not recommended from a social point of view to allow El-Fukhary waste pickers to benefit from transition assistance for long years until they are officially integrated into the system. This is also threatening to create a sense of dependence among these individuals and their families.
- They all showed flexibility to start different kind of business as long as capital cost (if applicable) and skills are available.

Accordingly, the Consultant recommends considering the integration scenario with the waste pickers in the TSs and consider Scenario (B) The non-integration scenario with El-Fukhary waste pickers.

Scenario (A) 1- Transition Assistance

During the construction of the project, the informal waste pickers will be restricted from reaching the sites. To mitigate the impacts on them during this phase, the following is recommended:

- Provide technical assistance and capacity building in recycling related fields to allow them to start the jobs once the project starts. Training programmes may include hands-on training on sorting and working on the compositing plants as well as training on the health and safety measures as part of operating the plants and sorting lines.
- Providing cash and in-kind temporary assistance to assist the targeted families. Cash allowances for the waste pickers working in the waste temporary storage site will be considered as part of the project budget. Cash and in kind assistance could also be

obtained through networking with other organizations targeting the poor families and operating safety nets like the Ministry of Social Affairs.

Scenario (A) 2- Provision of Job opportunities

- Formalize waste picking/separating activities through initiating recycling or composting facilities at the landfill and the TSs and hire the appropriate individuals of waste pickers by the municipality. These components should work to integrate the informal waste pickers and formalize their employment conditions and measures should be considered to give them priority in benefiting from the job opportunities. Waste pickers can also be integrated to the existing systems as street sweepers using barrows or animal carts.
- Apart from Rafah Municipality and the formal governmental jobs as part of the project, other agencies working in the primary and secondary collection like UNRWA, COOPI and JCP should also work to integrate the informal waste pickers within their formal systems. This should be done in full coordination with the PMU and Rafah Municipality.

Scenario (B) The non-integration scenario

For the cases where the integration scenarios will not be applicable, it is still recommended to consider other kinds of measures in order to empower the affected groups and their families. This could be attained by allowing the affected groups to benefit from running donors and national programmes in order to minimize the negative impacts on them and help in empowering them. The Consultant consulted with several national NGOs that are involved in implementing emergency and development projects in Gaza. MAAN[51] is one the interviewed organization that runs wide range of project that targeting vulnerable communities. MAAN is responsible for 3 family centers in Rafah area. Two of them are from UNICEF program and the third is funded from GIZ. **The consulted organizations/programmes also include the "Deprived families Economic Empowerment Program" (DEEP)[52] which can help eligible families, especially those with working children in establishing businesses by making small soft loans available.** UNICEF can also help in reintegrating children who dropped from schools and facilitate the families access to health care and nutrition programmes. Additionally, **the national Social Safety Net Program through the Ministry of Social Affairs** may assist in including eligible households in their programs particularly the needy cases with permanent disabilities.

[51] MA'AN Development Center is an independent Palestinian development and training institution established in January,1989, registered by law as a non-profit organization. MA'AN's work is informed by the necessity of creating independent, self-reliant initiatives that lead to the development of human resources for sustainable development, which incorporate values of self-sufficiency and self-empowerment.

[52] The United Nations has launched The Deprived families Economic Empowerment Program (DEEP). DEEP is working with local NGOs and Microfinance Institutions (MFIs) to provide a comprehensive package of financial and non-financial services to meet the needs of the poor and very poor families in Palestine . It hopes to thereby transform chronic and hard hit poor families from being economically dependent, to independent providers of income.

Benefit from these running programmes include the following:

- Capacity development programmes in various areas like vocational training programmes or other fields should be considered either directly for the waste picker or other individuals within their families.

- Facilitate access of informal sector groups and their families particularly women to micro-grants and sources of finance for improving livelihoods. Of the important fields/micro projects mentioned by large number of the interviewed waste pickers are livestock and poultry breeding projects, opening groceries, fruit and vegetables shops and driving. It is strongly recommended that the financing agency for the micro-grant help the beneficiary in selecting the type of project that meets his/her and the markets' needs.

Long term and strategic mitigation measures

- Legalizing the conditions of the informal sector groups through providing assistance for them to establish associations, bonds or networks to help in advocating and promoting for their rights.
- Raising the profile of waste management by considering the various measures explained under the "Additional recommendations to maximize the social benefits of the project". This will help in improving the situation of the workers in the sector and reducing the social stigma associated with working in the waste. Raising the profile of SWM also involves more recognition for waste as a resource. This carries the potential of improving the revenue form the sector, improving the working conditions and wages of the workers and open new economic opportunities from the improved and more efficient system.

B) Impacts of loss of privately owned land

For El-Fukhary Landfill

The establishment of the landfill will involve permanent land acquisition of around 460 dunums. This includes extending the existing El-Fukhary disposal site from 12 dunums to 472 dunums. Before the project construction phase, land for the expansion in the landfill site needs to be secured. Since the needed land is privately owned, arrangements for securing the land and providing satisfactory compensation to land owners should be considered during the project planning phase. Some of the land that will be acquired already has access restrictions by Israeli imposed security buffer zone.

As part of the ESIA and the ARAP preparation, an inventory survey for the land owners has been conducted in order to assess the numbers of affected persons and the needed compensation. The survey also meant to assess PAPs readiness to accept the project. Moreover, discussion with the land owners has been conducted to brief PAPs about the project and record their main concerns.

The following are the key issues covered by the inventory survey of landowners for the preparation of the ARAP:

- Land owner name, martial status and family size
- Other contact information and ID number
- Land owner occupation
- Land share size and borders
- Ownership registry documents
- Current purpose of land use
- Average annual income from using the land
- Acceptance for the project and land acquisition as part of the project
- Preference in compensation (cash or exchange with land of similar value)

The following are the key findings from the ARAP survey and the discussion with the land owners:

- The landfill site is on marginal desert land with no inhabitants
- Land is generally dry and unproductive and the price of land in this area is very low due to the existence of the landfill and the security risks as a result of the land location very close to the Israeli boarders.
- The majority of the land in the location is used for rain-fed agriculture including trees and other cultivations which generates low revenues
- The required land is owned privately by around 70 owners who own (441 hectare).


Figure 6B.5 The discussion with the land owners

- The land plots shares vary in size from few dunums that do not exceed 6.25 to a maximum of 120 dunums.
- Land ownership within the project site is called (HBAL EL SABAA') and the only source of documentation for the land ownership is with the Ministry of Finance which collect the land taxation from people who are having control over the land.
- There are generally uncertainties with confirming private land titles in the south of Gaza. The large number of persons inheriting land is expected to create conflict over land entitlements and ownership. This raises a need for the involvement of legal experts in the compensation process.
- Land is mostly used in farming watermelon, maize, wheat and olives. 3 of the landowners mentioned that they do not use the land due to the existing disposal site and security restrictions.

- Only 3 of the landowners are working exhaustively as farmers and they have land in other places. The rest of landowners have other economic occupations.
- The annual revenue form the land varied according to the land share and productivity. It was observed that land owners tended to overestimate the annual revenue from the land.
- The interviewed representatives for the landowners showed acceptance to the project under the condition that fair compensations will be provided.
- 10 of the interviewed landowners preferred to have their compensation in the form of exchanged land with the same size and value. The rest of landowners preferred to have cash compensation according to the market price.
- The land for compensation will be offered by the Land Authority according to land availability and land values in consultation with PAPs as recommended by the ARAP. The concept is accepted by the land owners in general as they stated that they accept to exchange their land with other land based on the land value.

<u>For the transfer stations</u>

With the only exception of Deir El Balah landfill, the rehabilitation of the two temporary waste storage sites of Tal El Sultan and Al Namsawi (Khanyounis) is not expected to result in land acquisition for any privately owned land. In case land expansion is needed, the surrounding lands of the current waste storage sites are state- owned land. In the case of Al Namsawi, the land surrounding the current waste storage site from all side is state owned. In To the western border of Tal El Sultan, Municipality owns a piece of land as machines parking and maintenance.

The exact location of the new transfer station southern Deir El Balah has not been determined until the production of the ESIA. It was not also clear if the land of this transfer station is state-owned land or a private ownership. The ESIA should therefore be updated and re-disclosed once the site is identified and prior to construction contract signing.

<u>Impact Significance:</u>

The land that will be acquired as part of the project is of marginal nature. Its value is generally low due to the existence of the current final disposal site and the proximity to the buffer zone. It appeared to be the interest of the land owners to have their land exchanged with other land in other place, particularly since none of them is making a significant profit out of it.

Despite the sensitive nature of the impacts related to affecting assets, in the case of this project and out of the previously mentioned justifications, this impact could be classified as an impact of moderate significance. The compensation plan as part of the ARAP will minimize the impact the impact to minor.

<u>Mitigation measures</u>

For El-Fukhary **Landfill**

An abbreviated Resettlement Plan has been prepared and will be implemented in order to ensure a fair economic compensation for the affected landowners through a consultative and mutually agreeable process. Land owners were consulted as part of the preparation of the ARAP and the consultation showed that landowners are generally willing to give their land in return for fair compensation in the form of cash compensation or exchange of land with the same market value.

The ARAP covers the following elements:

- A census survey of affected persons and valuation of assets conducted in December 2011;
- Description of compensation and other resettlement assistance to be provided;
- Institutional arrangements and consultations with affected people about acceptable alternatives;
- Existing legal and policy framework for land acquisition;
- Institutional responsibility for implementation and procedures for grievance redress;
- Arrangements for monitoring and implementation; and
- A timetable and budget.

The consultation with the landowners showed that they are in favor of selling all the land plots that they own within the project area instead of selling only the parts that the project need. It worth noting that securing additional land around the project area (exceeding what will actually be needed by the project) is a favorable option according to the ESIA and the mitigation plan. Certain environmental impacts will require securing land outside the landfill fences in order to apply the mitigation measure. The following table summarize the expected costs of land acquisition as presented in the ARAP of land owners:

Table 6B.1 Summary of the cost of compensation for securing the landfill land

Compensation Parameter	El-Fukhary central SW landfill Costs (USD)
Land Acquisition for the first phase* (216 dunums @ USD 20,000 per dunum)	4,320,000
Land Acquisition for the second phase* (256 @ USD 20,000/dunum)	5,120,000
Land Acquisition for the first phase in case of compensating the whole owned land not the intended location only[53]	8,826,500
External M&E consultation costs	50,000

***** The first phase is the first three cells from 1:3 which require 216 dunums and the second phase is for cells 4 and 5 which requires 256 dunums.

[53] The FS described the area needed for extending the existing landfill, recycling station, and the 6 cells for future. It, however, did not include any additional area that must be allocated for the other services attached to the work of the landfill as spaces to park and clean the cars. This indicates potentialities to exchange the whole land owned by owners and solve the expected problem which will emerge when the owners refuse to give part of their land for the project and to keep the rest.

There is a need to eliminate any potential disputes over land in the future by considering the legal situation of the land. During the RAP application, the project proponent should consider appointing legal expert as part of the compensation committee to provide legal assistance in verifying land titles by checking land ownership documents.

Measures that should be considered in selecting the TS site for Deir El Balah

As a general mitigation measure to eliminate any potential negative impact related to land issue in the selection of Deir El Balah TS site, the following should be considered:

- Give priority to the selection of state owned land and try to prevent privately owned land.
- In case if privately owned land acquisition is unavoidable, the lands that forms crucial source of living for poor or vulnerable groups should be avoided.
- In all cases, fair compensation should be provided in case of privately owned land acquisition. The developed ARAP is providing a replicable model that could be adapted in further land acquisition and compensation cases.

6B.2.1.4 Impacts on cultural heritage

There is no cultural heritage sites located within the site of El-Fukhary (Sofa) landfill. The closest cultural site of significance is located around 2 kilometers away from the site. This is also applicable to the sites of the two existing TSs that will be rehabilitated as part of the project.

No decisions were made regarding the site of the new TS in Deir El Balah, accordingly it is not possible to determine the level of impact on the cultural heritage from establishing Deir El Balah TS.

However, there is still the likelihoods of potential accidental finds within the various project sites during the construction of the project.

<u>Impact Significance:</u>

This impact is classified as an impact of low significance but enhancement measure will be suggested within the social management plan in order to minimize any potential impacts on the cultural heritage

<u>Mitigation Measures:</u>

- Monitoring of site excavations
- In case of finding information or signs about archeological sites or in cases of incidental finds the concerned agency, namely, the Ministry of Tourism and Antiquities should be informed and reporting should be made immediately to these agencies. The provisions and terms of the Contract with the Contractor include a provision for dealing with this case.

Table 6B.2: Assessed significance of expected impacts during the construction phase

Impact	(+/-)	Likelihood	Significant	Mitigation Measures Effects
Creation of temporary job opportunities	+	High likelihood	Positive impact of high significance	No mitigation measures required
Inconvenience to local communities from the construction of the landfill	-	Low likelihood	Negative impact of low significance	Reduce significance to minor
Inconvenience to local communities from the construction of the transfer stations	-	Medium likelihood	Negative temporary impact of moderate significance	Reduce significance to minor
Resettlement Impacts **Impact on the livelihoods of the informal waste pickers** **- C**omplete loss of sources of income	-	High likelihood	Negative impact of high significance.	Reduce the severity of the impact
Resettlement Impacts **Impact on the livelihoods of the informal waste pickers** - Partial loss of sources of income	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Resettlement Impacts related to the **loss of privately owned land**	-	High likelihood	Negative impact of moderate significance	Reduce significance to minor
Impacts on cultural heritage	-	Low likelihood	Negative impact of low significance	Reduce significance to minor

6B.2.2 Impacts During Operation

6B.2.2.1 Reduction of the negative health and safety impact

- *On the informal sector groups*

As discussed under the Baseline Chapter, the informal workers in the SWM across Gaza Strip are working under very low level of health and hygiene considerations. They are having direct contacts with waste materials mixed with hazardous content without using any kind of protective tools. Although the informal sector actors get adapted to these working conditions and are not concerned about the hazards they are facing everyday, it is notable that this way of handling waste is posing a serious daily threat on their health and safety.

Restricting the informal sector groups from the random access to waste in the landfills and transfer stations will likely reduce the health hazards they are currently exposed to.

- **On *Workers*:**

Several risks to workers from solid waste disposal can be greatly reduced by good operational practices at the landfill and transfer station sites. As part of the project, it is expected that safe working methods and good hygiene practices will be introduced. This could include introducing personal protective equipment during working on the sites, introducing health insurance coverage including regular checks as well as preparing the sites and ensuring the preparation, enforcement and monitoring of an emergency and contingency plan.

- *On local communities (as general)*

The visual and health impact of the current inefficient primary and secondary collection systems appeared to be an issue for the local communities consulted during the preparation of the ESIA. There is a potential positive impact on the health of the local communities as a result of the improved collection service planned as part of GSWMP. Moreover, the hygienic operation of the landfill site will result in improvements and protection for the environment including the valuable resource of ground water which is the main source of drinking water in Gaza Strip. This is considered to be one of the key positive returns predicted from the project operation. This is expected to have a positive impact on health of population and the protection of the natural resources.

- *On the neighboring communities to the landfill*

Currently El-Fukhary disposal site is very poorly managed with no machinery used in the site for regular covering of waste and no fences or any control measure to limit access to the hazardous material inside the dumpsite. The dumpsite is currently exceeding its maximum volume capacity and wind blown waste and odor are concerns to the neighboring communities and the users of the road leading to the dumpsite. It is expected that the sanitary condition of the new landfill and the various environmental measures that will be considered will result in improving the conditions within the landfill and will be reflected on the neighboring area.

- *On the neighboring communities to the existing waste storage sites*

Most of the existing temporary waste storage sites are located within residential areas. These sites are used as waste disposal sites where waste is accumulated for very long time and in most of the cases the sites are rarely cleaned. It is predicted that positive health, hygiene and visual impacts from the planned upgrading and rehabilitation activities of the existing waste storage site, namely Al Namsawi and Tal El Sultan, will be sensed by the neighboring communities. It is predicted that the general operation conditions will be more hygienic and more attention will be paid to the regular cleaning of the site. Waste will also be removed more regularly and frequently to El-Fukhary landfill. However, the previous experience with El Yarmouk transfer station suggests that the upgrading activities should be carefully planned and designed in order to ensure that they are well- sensed by the residents of the neighborhood.

Impact Significance:

The reduction of the negative health and safety impact resulting from the current poor collection and disposal practices of solid waste is one important positive impact of high value to the local communities who will be the main receptors of these benefits. The impact could be classified as a positive impact of high significance.

6B.2.2.2 Creation of Job Opportunities

The improvement of the SWM system as a whole in Gaza Strip will involve several capital cost investment in upgrading the existing infrastructure and fleet or establishing and preparing new locations and introducing new equipment. The operation of the different investment components including the newly introduced sites (including landfills and transfer stations) of the project will require additional human resources of various backgrounds and qualifications

From the landfill

The operational of the landfill site needs technical and administrative staff. Junior staff member with low and medium qualifications could be recruited from communities close to the location since this option will ensure a socially sensitive approach and will be more efficient economically. Moreover, the composting plant planned as part of El-Fukhary landfill will possibly accommodate the waste pickers who are currently making a living from separating recyclables from the waste in El-Fukhary disposal site. The investment in the landfill and associated composting facility will have a positive impact on local employment in this relatively remote area in GS. However, contractual measures should be considered in order to ensure that local communities will be given priority in benefiting from the created jobs.

From the transfer stations

The transfer station will employ a few staff members to manage and operate the station and to manage and operate the hauling trucks. Additionally for Tal El Sultan TS, a composting facility will be operated. The planned rehabilitation is expected to have a positive impact on employment. However, as mentioned above, contractual condition should be in place to ensure that staff recruitment policies will give priorities to neighboring communities in benefiting economically from the project.

It worth noting that working formally in SWM services was observed to be an acceptable business that several university graduates accept, as the case of workers with JCP. This observation suggests that the created opportunities will be widely accepted and encouraged by the large portion of unemployed young men. Moreover, the interviewed waste pickers working in El-Fukhary site, as part of preparing the ESIA and the ARAPs, showed willingness to work formally in the project.

Impact Significance:

In the dominating poverty of GS where unemployment is a serious challenge, local communities would benefit greatly from the creation of a number of job opportunities that will associate with the improvements of primary and secondary collection services and the other project components as part of GSWMP. This is considered as positive impact of high significance to the local communities. Moreover, integrating the informal waste pickers within the formal system would also be a positive socioeconomic impact of high significance.

6B.2.2.3 Stimulation for economic growth in the area

The project is predicted to improve the infrastructure provision in the marginal area of El-Fukhary. The infrastructure improvement is expected to encourage introduction of economic activities including industrial and commercial activities. The development of the area, despite security limitations, will help in creating several job opportunities to the local population and the population from other places. In particular, the recyclables business will be attracted to the site around the landfill. This type of business is expected to absorb number of the local population and more specifically the informal sector individuals who used to work in this business.

Impact Significance:

This impact is considered to be a positive socioeconomic impact of moderate significance to the local communities and the local economy.

6B.2.2.4 Changes in land use

It is predicted that several land use changes will occur as a result of the project. Some of the changes in the land use will involve positive impacts on land use. This is applicable on the case of improving the conditions of exiting waste storage sites of Al Namsawi and Tal El Sultan and existing part of the final disposal in El-Fukhary which will be rehabilitated, engineered and better managed.

For the land that will be acquired for the establishment of the TS to the southern of Deir El Balah and since the location of the TS was not determined until the production of the ESIA, the Consultant found difficulty in assessing the potential impact resulting from the change in land use.

Some of the changes in land use involve negative impacts like the case in El-Fukhary landfill site. The establishment of the landfill will result in a loss of the options for alternative land use and thus represents a permanent commitment of land resources. This is in particular true since some of the land that will be acquired involves rain-fed farming. However, and although the loss of optional uses for the land in the future is considered to be a negative impact, in this specific case of El-Fukhary site, land value is very low and marginal in terms of alternative agricultural or residential use due to land proximity to the eastern border.

Impact Significance:

The change in the land use as a result of the project is a combination between positive and negative impacts depending on the nature of change occurring to the land use. Both the positive and negative impacts could be classified as impacts of moderate significance.

Mitigation Measures:

To mitigate for the negative social and economic impacts related to the project and in addition to the preparation of ARAP to handle land ownership and compensations issue, adherence to the other mitigation measures listed under various parts of the ESMP will help in ensuring that the sites are properly managed.

6B.2.2.5 Traffic Impact

From the Landfill

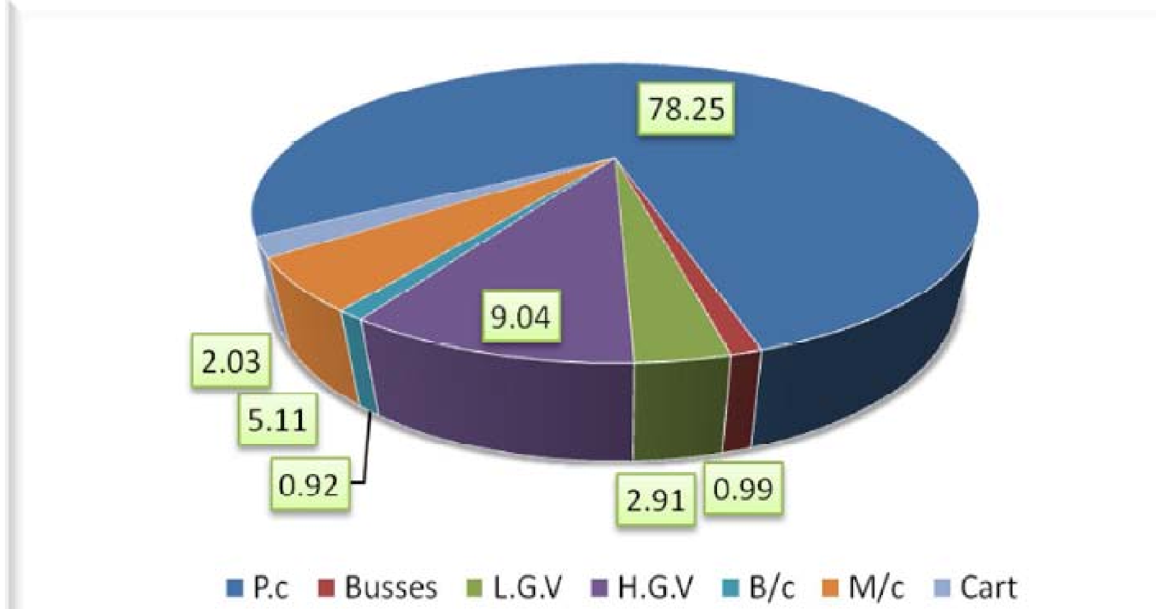
The traffic and transport sector is one of the key sectors that suffered from the attacks of Israel on GS. Before the Israeli withdrawal from the GS in 2005, roadblocks frequently were enforced by the Israeli military forces. This used to lead to the division of the Gaza Strip into 2 or 3 separated parts. The increased frequency of this action raised an urgent need to use alternative routes to transport the solid waste or the use of temporary dumps for solid waste collection during this roadblocks.

Although this phenomenon is not applicable under the present situation, the roads network in Gaza, in general terms is still suffering from a number of challenges related to the institutional set-up, poor law enforcement and land and other resources scarcity. The fact that the roads is the sole network connecting different parts of the Strip and the absence of other networks (air or railway) increases the level of pressure on roads[54].

Given the importance and sensitivity of the traffic sector in GS,, the potential traffic impact of the project, particularly this southern section, is one of the important impacts that should be carefully considered.

A road network already exists in the GS with Salah El Dein linking the South to the North passing through the five governorates with a length of 42.6 km. the width of the road varies between 10 to 30 m. Salah El Dein Road is one of two main regional roads. The second is Haroun El Rasheed (the Coastal Road). Both are the main two main regional roads in GS. The condition of the road according to recent reports from the Traffic Authority ranges between poor and reasonable.

[54] Source: Sectoral Planning related to the Traffic section (2012- 2020), Ministry of Planning



PC	Private Cars
LGV	Light goods vehicles
HGV	Heavy goods vehicle
B/c	Bicycle
M/c	Motorbike

Figure 6B.5: Average percentage of vehicles using Salah El Dein Road, 2010

Average daily traffic (ADT) of the road, according to a recent survey, was estimated at 11,827 vehicle/day. The observation of the annual increase in ADT suggests a 2.2% annually[55].

It is not indicted what is the exact load caused by the waste transport vehicles but it should be falling inside the percentage of 12% of the current traffic load.

Transportation of waste from the north to the south of GS is one of the key current challenges causing an impact on all roads. The current bad conditions and high traffic load of Salah El Dein road accompanied by the bad conditions of the trucks make regular transportation of waste to the final disposal sites a big challenge.

For El-Fukhary landfill, which is located in the southern east of Gaza Strip, the main access road leading to the landfill is Salah El Dein Road. The Southern Governorates are expected to be served by three transfer stations that will accommodate waste temporarily until waste is transferred to El-Fukhary landfill. The distance between Al Namsawi and El-Fukhary is around 8.7 km. Most of this distance is located in internal roads. On the other hand the distance between Tal El Sultan at Rafah and El-Fukhary landfill is around 10.25 km, of which around 4 km is located on Salah El Dein Road. The exact location of Deir El Balah

[55] Source: Sectoral Planning related to the Traffic section (2012- 2020), Ministry of Planning

TS has not been determined. However, it is anticipated that the majority of the traveling distance from Deir El Balah to El-Fukhary will be across Salah El Dein Road.

All along the road there are residential units, social services including schools and health units as well as densely populated refugees camps. Although it is assumed that bulk transport of waste from transfer stations will reduce the number of trucks traveling long distances to final disposal sites, traffic congestion is a common daily problem in Salah El Dein Road during the rush hours which is not merely attributed to the waste transport vehicles but rather to the high traffic load of other vehicles. The location of the densely populated gatherings, associated services and economic activities on this road suggests that negative traffic and safety impacts from hauling the waste and more frequent use of heavy transfer truck is anticipated and might pose serious safety challenge on this important and vital road.

The risk on the safety of the road users particularly unattended children who use the road to go to schools is one of the key impacts that should be considered. The road is also used by both private and public means of transportation to travel between Governorates.

From the Transfer Stations

It is generally expected that the access of the vehicles to the transfer stations will result in increased pressure on both side and main roads with the cities/villages where the transfer stations will be located. In the meantime, the improvement in the primary and secondary services will result in increase in the number of collection vehicles and donkey carts reaching the TSs.

Upgrading the two current waste storage locations to TSs will involve improvement in the locations to ensure smooth access of vehicles and allow for sufficient internal parking spaces that minimizes any potential traffic conjunction impacts on the neighboring communities and the street surrounding the TS.

In the meantime, a third transfer station will be established southern of Deir El Balah. The location of this transfer stations has not been determined yet. The severity of the traffic impact as a result of this new transfer stations could not be determined during this stage.

Impact Significance:

It is expected that a rehabilitation plan will be implemented for Salah El Dein Road before 2021. This was one of the issues raised during the Scoping session, Public Consultation and mentioned in the Feasibility Study. According to the Design Report of Salah El Dein Road Rehabilitation, a property section had been in the most southern section of Salah Al-Din Road, extending from El-Fukhary Border Crossing northward to Bani Suhaila Intersection for 12.96 km. For this section, design was prepared for the reconstruction of the road to be a four-lane divided facility with a median, paved shoulders, storm water drainage system, road lighting, pedestrian facilities, as well as traffic control devices. It is expected that the rehabilitation of this priority section of Salah El Dein road will be taking around 14 months. UNDP and the Islamic Development Bank are among the funding agencies involved in the rehabilitation. The rehabilitation of this section of the road is expected to mitigate the potential negative traffic impact of the southern part of the project.

Moreover, the feasibility of establishing a new road parallel to Salah El Dein Road is currently under examination. These actions are regarded as important mitigation measures that can significantly help in reducing the significance of the negative impact. Based on that, the impact of the landfill on traffic load and safety could be classified as moderate negative impact.

This is also applicable to the traffic impacts from the TSs which could be mitigated with number of design and management measures that will be explained below.

Mitigation Measures

For the landfill

- Implementation for the project of Rehabilitating Salah El Dein Road and close coordination between the implementing agencies of the roads rehabilitation project and GSWMP.
- After operation, restrict transport trucks travel to the hours outside the rush hours.
- Strict monitoring to the road accidents as part of the monitoring plan to be implemented by the Traffic Authority.
- Regular information sharing about the times of travel of the transport vehicles with the communities and establishments located by the road.

For the Transfer Stations

- Selecting appropriate model of means of waste transport including small trucks that can easily maneuver in narrow streets and do not form serious obstacle inside the TSs.
- Arrange the times of transporting waste to and from the TS to avoid traffic rush hours.
- Assist local communities in establishing community- based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PMU

6B.2.2.6 Higher Cost to Beneficiary Communities Particularly the Poor

The operation of the long term activities will require significantly higher revenues for SWM in order maintain and sustain the system. Currently solid waste fees are around NIS 10: 12 per household per month. The refugee camps are exempted from waste charges. The efficiency of the service fees collection is a main challenge facing municipalities.

Based on the FS recommendations, NIS 4 per person per month, or 24 NIS per household per month (assuming a household size of 6 persons) will need to be collected in order to ensure covering the needed operation cost. The survey prepared as part of the ESIA clearly showed that local residents in high income districts are more willing to pay in order to receive a better and more efficient level of service. Although some of these high income areas are already paying twice to receive reasonable level of service, they are still even willing to pay more for service improvements.

It worth noting that the largest portion of the survey sample (around 60% of respondents) who showed willingness to pay more stated that they can pay a maximum 10 NIS monthly. This draws the attention to the importance of considering an appropriate level of payment that local residents can afford. Affordability is an important issue that should be carefully considered in drawing the tariff strategy for SWM. Within the poverty context in Gaza, the unsecured income and the relative high cost of other services. The economic interests of the local population, particularly the poor, should be taken into consideration before proposing any fees system that may overload them economically.

Impact Significance:

From a socially sensitive perspective, and particularly within the poverty conditions in Gaza, the project impact that hits the poor economically should be classified as negative impact of high significance. It should be noted, however, that several official and unofficial mechanisms are in place to exclude the poor from paying the service fees (e.g. Services provided by UNRWA to the refugees' camp). In several cases, the poor fees collection efficiency by the municipalities was attributed to the economic hardships that Gaza residents are facing. This leads the municipalities in many cases to drop some service fees from poor families, although this is not done within a structured official policy. The proposed mitigation measures below are expected to reduce impacts significance to a less severe level while working to attain a long term sustainable financial operation for the project through introducing new techniques.

Mitigation measures

There is a need to tailor socially sensitive programmes for the fees charging system related to SWM to ensure that poor communities are benefiting, not overloaded financially and also to eliminate the sense of dependency on the government and donor agencies and replace it with a sense of ownership to the service and recognition for the financial commitments that it entails.

The mitigation measures below are divided into short term immediate measure and strategic or longer term measure. The section below also presents number of crosscutting measure that would help in attaining financial sustainability by engaging local communities.

A) Short term measures

Municipalities and JSC to maintain the system of exempting/subsidizing poor families

It is recommended that municipalities and JSC should maintain mechanisms to target poor families. Families who can afford should be paying for the service and the poor families who can not afford should be exempted. The current approach of subsidizing the service to poor families or exempting the poorest should be sustained until the economic situation of the poor families is improved in the future. Current targeting mechanisms by UNRWA and other social solidarity and safety nets (e.g. the Ministry of Social Affairs) should also be maintained.

Moreover introducing different-rates for the charging system is also a favorable mitigation measure that could be considered. As recommended by the Feasibility Study of the project, volume based fees are considered fairer since neighborhoods with limited waste generation, which are the poorer neighborhoods, are considered to subsidize the services in neighborhoods where larger amounts of waste are produced. This is one example of how different rates could be introduced in a way that serves the project financial sustainability and reduce the financial load from the poor families.

B) Strategic measures

Design plans to stimulate further economic instruments for SWM revenues

SWM revenues should not be limited to the service fees as the main source. It rather should explore additional economic instruments and tools in order to enhance the collected revenues. Economic instruments generally refer to policies or tools that can be used to influence people's behaviour through financial incentives or disincentives to control pollution and improve cost effectiveness of environmental protection[56]. There are a number of innovative financial and economic instruments that should be considered strategically in order to gradually introduce different culture related to financial sustainability. There is a need to develop a comprehensive plan for these instruments. The development of the plan requires starting with assessment for the tariff system in GS and how to obtain cost recovery. Ideas related to the financial instruments include, but are not limited to:

- The producer responsibility or the **"extended producer responsibility" (EPR**) which assumes that producers are not only responsible for selling their products into the market, but also for ensuring the responsible management such product and materials following their useful life. Despite the limited production market in Gaza Strip. Initiating such instrument in the future with the potential increase in the number of local small industry is suggested.
- **Encourage the local recyclables market and the involvement of the informal sector**: the existing local private market in Gaza Strip for manufacturing recyclables should be encouraged and the role of the informal and the private sector should be stimulated in order to maximize the social returns of these activities. Providing subsidies, grants or micro/meso-finance to establish small and medium recycling industries should be considered. An active recyclable market would encourage other initiative like waste sorting at source and in this case local communities could benefit from reduced service fees or from selling the sorted recyclables. Although initiating a model for separation at source could be regarded as an inapplicable activity to the local communities in Gaza, the increased level of awareness with SWM related issues may stimulate a future potential for the success of such initiative in the future.
- Encourage **the principle of the 'Polluter Pays Principle' (PPP)** and engaged relevant organizations including the municipality and the Environmental Quality Authority

[56] Reference: National Solid Waste Management Programme Report, 2011, ERM and EcoConServ

(EQA) in enforcing this instrument. This instrument will help in improving the public behaviors in waste disposal issues and, in the meantime, will mobilize additional revenues for waste management.

C) Crosscutting measure:

In addition to above mentioned measure, additional crosscutting activities can help significantly in eliminating the negative implication of this impact.

- Awareness raising and building local communities' knowledge about issues related SWM and the associated costs and the roles of local communities in sustaining the systems.
- Raising the profile of SWM including strengthening the recyclables market and encouraging community based initiative in segregation at source

Further details about these measures are included under the section "Additional recommendations to maximize the social benefits of the project" below.

6B.2.2.7 Depressing Property Value

From the Landfill

The establishment of the landfill in the proposed site of El-Fukhary where the current final unmanaged disposal site locates is expected to result in certain economic implications for the land and assets value within the site. This is potentially the case in the neighborhoods where such waste disposal facilities are located. However, it has been widely recognized recently that today's state-of-the-art landfills provide a variety of economic, employment and community-enhancement benefits that typically may contribute to property values. Although the potential negative impact on land and property value was one of the issues raised during the consultation activities conducted as part of preparation for the ESIA and the RAP, it worth noting that other conditions are playing a role in lowering the price of land in this specific area, particularly the proximity to the green line with Israel. In that sense, the low property value can not be regarded as a direct negative impact from the project.

From the Transfer Stations

The impact of the TSs on the value of land and assets in the TSs' neighborhood could be divided into two main types:

- The impacts on land and assets in the neighborhood of the current waste storage sites that will be rehabilitated in Al Namsawi and Tal El Sultan is not expected to be of high negative significance. On the contrary, the rehabilitation of these sites, improving the operation, more frequent cleanliness, improving working conditions and the efficiency of work in the station will likely result in reducing the negative impacts of the waste storage site, including odor, increase in the numbers of flies and mosquitoes and the negative visual impact. These improvements might help in restoring the prices of assets and properties in the neighborhoods after the decrease encountered as a result of the existence of the random and unmanaged waste storage sites.

- As explained above, the proposed location of the TS in Deir El Balah has not been determined. Accordingly, the relevance of this impact to the neighborhood of Deir El Balah can not be decided.

Impact Significance:

For the landfill, the negative effect on the prices of land and property as a result of the establishment of the landfill is considered as an impact of low significance. This mainly returns to the fact that the low price of land in the project area can not be regarded as a direct impact of the project as explained above but return to other factors.

Due to the different nature of the surrounding areas around the TSs and the prevalence of residential gathering abd economic activities around the site, the nature of this impact is expected to be more serious than the case in the landfill site. However, rehabilitating the site and introducing improved design and more environmentally friendly management system to the TS will likely improve the situation in the neighborhood. The impact could be classified as an impact of moderate significance assuming that strict management measures will be applied in the site. This is elaborated in more details under the mitigation measure

Mitigation Measures

The project is not expected to provide direct compensation for the predicted reduction in the price of property value as a result of the project. However, strict hygienic practices within the locations are expected to eliminate the severity of such impact. The following are the key measures proposed:

- Apply strict measures and best practices in managing the sites. This involves full adherence to the mitigation measures mentioned as part of the environmental management and monitoring plan
- Assist local communities in establishing voluntary community- based monitoring committees (CBMC) in order to follow up and report feedback on the management system and impacts on the communities to the PMU. The CBMC should conduct regular community survey and consultation activities to measure local communities feedbacks about the sites management.

In the meantime, the areas that will be potentially affected by the location of the landfill should be placed as priority sites for receiving attention from the Government and donors programmes who can provide services and projects to these communities and this might play the role of indirect compensation for the local population. This issue has also been suggested by stakeholders during the public consultation. The PMU can play the role of advocator for this idea by coordinating with relevant agencies and transferring the priority needs of the local communities.

6B.2.2.8 Potential impact on the social and economic activities of the neighboring communities

From the landfill

Due to the limited social and economic activities within the surrounding area of El-Fukhary landfill, it is not expected that any major impacts will be encountered by the local population as a result of eliminating social and economic activities within the site. Apart from the land acquisition and impacts on land ownership, the only social and economic activities that could be affected is the limited grazing activities within the area as well as the limited farming activities. However, this is expected to be an impact of minor significance since the area around the landfill is still an open area for grazing and no restrictions will be imposed and due to the fact of limited farming activities, the low level of revenues to landowners and the fact that land owners will be fairly compensated for this land which they perceive to be unfavorable land for several motioned factors.

From the Transfer Stations

The neighborhood of the TSs might encounter some limitations for the social and economic activities as a result of the location of the TSs with all the associated waste-related activities and the potential odour and visual impact. However, and with the only exception of Deir El Balah TS, the sites are currently used as a temporary waste storage sites in both Tal El Sultan and El Namsawi. The two sites are currently operating with a minimum level of control and are causing serious disturbance to the neighboring communities. Despite the fact that the existence of the TS may impose lots of limitations on the social and economic activities within the neighborhood, this is not expected to be more serious than the current case. It is expected that better management and control for the site after the rehabilitation will potentially reduce the sensed negative impact and accordingly will have limited impact on the social and economic activities

Impact Significance:

This impact from the landfill is expected to be an impact of low significance. The same impact related to social and economic activities resulting from the establishment of the TSs is still uncertain impact and could be classified as an impact of moderate significance.

Mitigation Measures

- In order to mitigate this impact, adherence to the proper management practices in various sites should be strictly considered in order to minimize transferring any negative impacts – to the extent possible - from outside the borders of the landfill and TSs. Full adherence to the management practices will help in reducing the negative impacts on the surrounding social and economic activities.
- Assist local communities in establishing community- based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PMU
- Community surveys and consultation to monitor the project impact on social and economic activities.

Table 6B.3 Assessed significance of expected impacts during the operation phase

Impact	(+/-)	Likelihood and Severity	Significant	Mitigation Measures Effects
Reduction of the negative health and safety impact	+	High likelihood	Positive impact of high significance	No mitigation measures required
Creation of Job Opportunities	+	High likelihood	Positive impact of high significance	No mitigation measures required
Stimulation for economic growth in the area	+	Medium likelihood	Positive impact of moderate significance	
Changes in land use	+/ -	High likelihood	Combination of positive and negative impact of moderate significance	Reduce the severity of the impact
Traffic Impact From the Transfer Stations	-	High likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Traffic Impact From the Landfill	-	High likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Higher Cost to Beneficiaries Communities particularly the poor	-	Medium likelihood	Negative impact of high significance	Reduce the severity of the impact
Depressing Property Value From the Landfill	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Depressing Property Value From the Transfer Stations	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Impacts on the social and economic activities From the landfill	-	Low likelihood	Negative impact of low significance	Reduce the severity of the impact
Impacts on the social and economic activities From the Transfer Stations	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact

In addition to the specified mitigation measures above that aim to eliminate the severity of negative socioeconomic impacts of the project, Chapter 7B of this ESIA also presents additional recommendations to maximize the social benefits of the project. These recommendations are elaborated in details under section 7B.3

CHAPTER 7 ENVIRONMENTAL AND SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR JOHR EL DEEK LANDFILL

CHAPTER 7 ENVIRONMENTAL AND SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR JOHR EL DEEK LANDFILL

7A ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

As mentioned in Chapter 6, the assessment of potential impacts has been done through analyzing different project activities and envisaging possible changes to the environment. Each potential impact was qualitatively analyzed to classify its significance to three degrees: *major impacts, medium impacts, and minor impacts*. This depend on the likelihood to cause violation of applicable standards whether on its own or in combination with other sources.

The same classification of project impacts as that followed with El Fukhary Landfill is followed in this chapter. The impacts have been categorized to impacts during the construction phase, impacts during the operation phase and impacts after closure of the landfill.

7A.1 Impacts during Construction

7A.1.1 Impacts Related to Storage and Use of Excavated Soil and Daily Waste Cover

The recommended depth for Johr al Deek's landfill is 20m , which will produce considerable amount of spoil. The excavated spoil should be properly managed so as to minimize impacts on the surrounding environment including:

- Limiting the land use for the areas used to store the spoil,
- changing the topographic features of the area and, hence, changing water drainage properties which could divert surface water drainage streams to un-preferred locations,
- increasing dust emissions caused by wind erosion,
- possibility of blocking landscape view at the site were these amounts of soil are stored in

In addition to the above there are a number of indirect environmental impacts if there is a need to transfer the soil to other locations, including limited increase of traffic volume by transfer trucks, noise and air emissions released from these trucks.

The excavated soil from the landfill cells can be used; 1) as daily cover of waste, and to establish side embankments for containing the waste, in the part of the landfill above-ground[57]. Other possible uses for the soil could be the compensation and re-cultivation layers of the final cover, as other layers (clay sealing layer and filter layer) need to be from homogeneous particles. For maintaining recovery of the excavated soil in the landfill, the amount of spoil should be sufficient for the needed amount in landfill operations and ideally no additional spoil would remain on site to the extent of causing unwanted impacts as listed above. The amount of excavation is proportional to the depth of excavation, and accordingly the design decision about the excavation depth and correspondent landfill height will be the main factor identifying the soil balance between volume of spoil and recovery in landfill operations.

[57] The embankment will be made of compacted soil and will be surrounding the active waste soil so as to compact the soil against it and to maintain a safe slope for the waste hill above ground level

The proposed design of the landfill indicates that the landfill will have a depth of 20 meters below ground level and a height of 30 meters above ground level. Because the current stage of the design does not include the excavation slope and the requirements for the soil embankments to contain the waste above-ground, the following assumptions similar to those measured from the final layouts for El-Fukhary Landfill were made for calculating the soil balance and identifying the excess or needed waste for Johr al Deek landfill operations:

- The excavation slope will be 1 vertical to 2(2.5) horizontal, while the above-ground slope will be 1 vertical to 2(3) horizontal
- The containment embankments will be 2-meter high, 1-meter wide from top, with outer slope 1:3 and inner slope 1:2
- The daily cover to waste ratio will be 1:6[58]
- The final cover will include, as recommended by the FS, 50cm compensation layer, 50 cm sealing clay layer, 30 cm drainage gravel layer and 70 cm re-cultivation layer.

Table 7A-1: Soil Balance between excavated spoil and usage in landfill operations for Johr al Deek landfill based on a depth of 20 m and a height of 30 m

Cell	Area (m^2)	Excavated soil (m^3)	Potential Volume above ground	Total capacity of cell (m^3)	Needs for daily cover (m^3)	Needs for above-ground embankments (m^3)	Needs for compensation and re-cultivation layers (m^3)	Basic soil balance (+/- m^3)*
Cell 1	56,980	1,091,760	911,154	2,002,914	286,131	109,210	73,521	622,898
Cell 2	61,077	1,122,567	1,185,838	2,308,405	329,772	114,765	94,693	583,336
Cell 3	65,972	1,234,152	1,121,856	2,356,007	336,572	118,216	103,427	675,937
Total	**184,029**	**3,448,479**	**3,218,847**	**6,667,326**	**952,475**	**342,191**	**271,641**	**1,882,171**

* (+) means excess soil and (-) means there is demand for the soil

The soil balance Table 7A-1 shown above indicates that for an excavation depth of 20 meters and height 30 meters there will be total excess spoil of about 1.9 million m^3 which is about 55% of the amount of excavated spoil. This spoil could be used in building dams, grading works for construction sites, agriculture or landscaping. There may exist a high demand for this soil but the ESIA team was not able, during the preparation of this report, to investigate the demand for such amount of soil.

In all cases the excess spoil will most probably be left in a vacant land besides the landfill, in which a new hill of soil will be gradually developed in three stages correspondent to the excavation of each cell, until it is exported for usage in other locations in GS according to the demand. If the excess amount of spoil will be exported outside the landfill site in Heavy Goods Vehicles (HGV) of 20 m3 capacity, then about 95,000 HGV rotation trips need to be taken over the construction period.

[58] The AFD has recommended the use of 1:6 a a ratio for the daily cover to waste. The World Bank Guidelines for estimating landfill volumes recommends the same ratio which has been used in the calculations. However , the Feasibility Study has been used a ratio 1:9 in the calculations which was seen by AFD as a very high ratio that would generate leachate lakes in the body of the landfill.

Table 7A-2*: Estimated number of trips per day needed to export the excavated soil

Cell	Excavated soil	Number of trips(20m3)	Operational days (based on 5year - period)	Number of days during the construction period (assumed six months and constant for all cells)	Number of trips/day (if distributed over the full length of the operation period)	Number of trips/day (if distributed over the length of the construction period)	Number of trips/hour (assuming only 6 hours per day are designated for such movement of spoil)
1	630000	31500	18560	1856	2	17	3
2	590000	29500	18560	1856	2	16	3
3	680000	34000	18560	1856	2	19	4

According to the assumptions used in constructing the above table (Table 7A-1*), it can be concluded that the impact of hauling the spoil varies between minor and medium. This will depend on the routes being used which are difficult to determine at this stage since this shall depend on the intended use of the spoil. In all ways , consultation with residents affected by the routes shall determine the best possible timing of the day to conduct such activities with minimal annoyance.

The area required for storage of the excavated soil will depend on the suitable height that could be maintained, the safe slope and the available area. Assuming the height will be 20 meters, soil Bulking Factor will be 1.3[59], and the spoil will take a cone shape, the required area for the total soil to be reused will be about 99,000 m^2 with a diameter of about 275 meters. The required area for the total excavated soil if stored as a cone shape would be 200,000 m^2. As shown in Table 7A-1, the area for the whole site is 185,000 m^2 which necessitate one of the following two actions:

- A good management of the excavated and excess soil which will be used in landfill operations.
- Optimization of landfill depth as to reduce the excess soil which has to be exported from the site.

Generally the logistics of allocating a sufficient area for storage of the excess spoil should be considered, until it is exported from the site if there is a demand for it, which should be close to the landfill site as indicated later in the mitigation measures.

Further to the need for an area to store excess spoil (spoil to disposed of), there will be a need for temporary storage of the spoil that will be reused in the landfill operations (daily cover, final cover and side embankments). The excavation of the cells is expected to be carried out once for each cell, but the usage of spoil will be gradual along the expected life span of the cell. Table 7A-2 presents the calculations for the spoil that will be reused, the required areas for storing this spoil and the expected dates for excavation and completing the each of the cells. Table 7A-3 presents the same data but for the excess spoil which will need to be exported from the site. The calculations in Tables 7A-2 and 7A-3 have been developed using the main assumptions of waste generation in the FS, the expected waste density in the landfill, the areas allocated for each cell and the heights/slopes of the

[59] Soil Bulking Factor is the rate of expansion of between original volume in the borrow and the volume when stockpiled, it is estimated in clayey soil to be 1.2-1.4

cells which have been mentioned earlier. Because the height of the spoil for reused soil is not determined at this stage is has been assumed that it will be 20 meters so as to be less than the landfill height, and, in the same time, the required storage areas will not be excessive.

Table 7A-2: Required areas to for temporary storage of the spoil which will need to be reused in landfill operations

Cell	Spoil to be reused	D	Area required for spoil storage (m^2)	Expected Date of excavation	Expected date of filing
1	468,862	131	35,000	before Jan 2018	January-23
2	539,231	144	39,500	before Feb 2023	July-28
3	558,215	147	40,500	before July 2028	December-32
	1,566,308				

Spoil management

It is to be noted that four main types of soil are expected to be generated during excavation as follows:

- Soil excavated in the direct vicinity of the existing dump site ans this has to be sampled and subjected to chemical analysis to assess the extent of contamination. If found contaminated , then it should not be exported out of the site and shall be used for daily operation.
- The top layer of soil which usually contains more nutrients and biological species as compared with the deeper layers. This type of soil shall be separately stored and better used as a final cultivation layer for the landfill or in cultivation activities.It is not recommended to use such type for construction purposes.
- Clayey silt and fine sand, each has different characteristics, different plasticity index and water content and therefore could be used for different construction applications. It is therefore recommended to differentiate between both types if possible. The most recommended applications would be for construction purposes as follows; 1) sub layer for Asphalt, 2) filling purposes, 3)recycling as aggregates (this shall require further studies to optimize the amount of binder which will be added to the soil and the compaction/extrusion pressure required , 4)recycling as construction bricks/blocks (also, this shall require further studies to optimize the amount of binder and water amount which will be added to the soil and the compaction/extrusion pressure required).

In all ways , the excavated spoil will need to be temporarily stored on site which will be discussed in details below.

Table 7A-3: Required areas for temporary storage of the spoil which will be disposed of/exported from the site

Cell	spoil to be disposed of	D	Area required for spoil to be disposed of (m^2)	Expected Date of excavation	Expected date of filing
1	622,898	158	44,500	before Jan 2018	January-23
2	583,336	152	42,000	before Feb 2023	July-28
3	675,937	166	47,500	before July 2028	December-32
	1,882,171.25				

The development of cells will require that before filling each cell, excavation should be carried out for the following cell, this excavation should start in sufficient time to allow for placing the lining system and leachate piping at the bottom of the cell so as to be ready to receive the waste once the preceding cell is full. Because the whole area of the landfill is expected to be available for the project from the project start date, the spoil resulting from excavation of Cell 1 could be stored as follows (Figure 7A-1);
a) the portion which will be reused will be stored at the land allocated for Cell 2, this would require an area of 35,000 m2 (diameter of 131m); b) the excess portion of the soil which will need to be exported is 623,000 m3 and will require a storage area of 44,500 m2. This amount could be temporarily stored at the land allocated for cell 3.

The spoil resulting from excavation of Cell 2 has to be completely exported from the site (expected before February 2023). The excess spoil of cell1 which has been previously stored at the land allocated for cell 3 can be used for cell 2 operations.

The spoil resulting from excavation of Cell 3 could be stored as follows; a) the portion of soil which will be reused will need to be stored at an external land adjacent to the site , this requires an area of 41,000 m2 (diameter of 150m) ; b)The excess portion of the soil which constitutes 680,000 m3 will need to be immediately exported from the site.

Because the spoil storage will not be fully controlled in terms of slopes and shape, as no side embankments will be established to develop the shape and slope, the areas required for spoil storage will be slightly bigger than the areas calculated in Tables 7A-2 and 7A-3. The minimum area required for an external land adjacent to the site is therefore around 45,000 to 50,000 m^2. This will include a buffer area needed to maintain the area borders and to facilitate trucks access to load/unload soil.
Figure 7-1 shows some suggestions for the areas to be stored for spoil of Cells 1, 2 and 3. An area of 100,000 m2 would be needed if the excess soil could not be exported from the site and was stored in one conical shape..

In conclusion this impact is considered of medium to high significance due to the large area required for placing the unused spoil, the degree of significance will depend on whether there will be a demand for using this spoil in other locations and how effective would be the exportation of this spoil. The impacts of storage of the spoil that will be reused in landfill operations are less significant if a sufficient area of 50,000 m^2 as mentioned above adjacent to the site could be temporary allocated for storage of excess spoil. The implementation of the recommended mitigation measures and monitoring activities is expected to minimize these impacts.

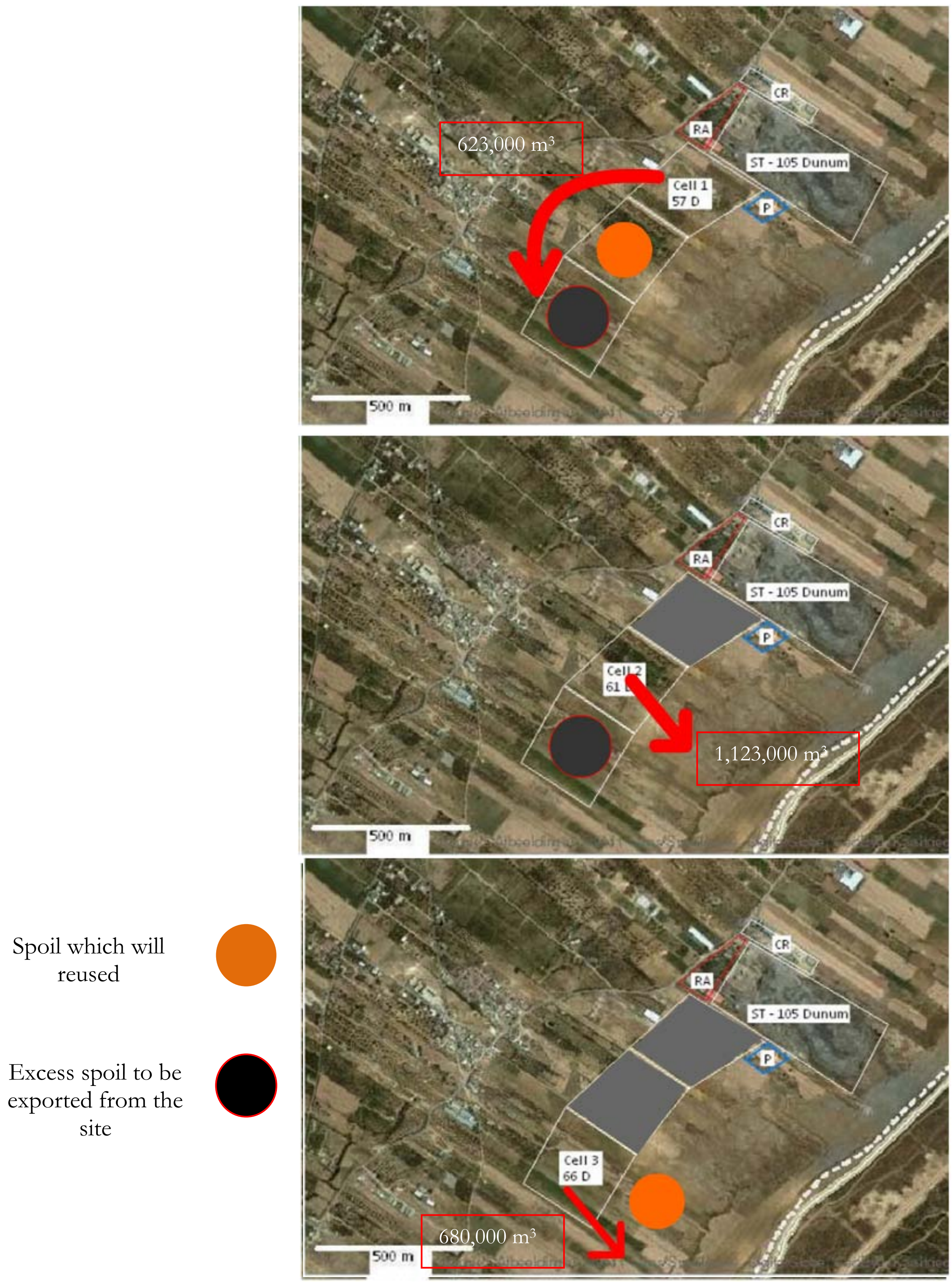


Figure 7A-1: Proposed locations for storing spoil that will be reused in landfill operations

Risk of excavated soil being contaminated

The soil in the vicinity of the landfill has been subjected to uncontrolled leachate impact during the previous years. This may have affected the soil quality especially if uncontrolled disposal of hazardous wastes has been practiced in the past at the uncontrolled landfill disposal area.

In the event the soil is of good quality, the previously described scenario (or an optimized one) for the storage of excess soil shall be sufficient. However, in the event the soil has been found to be contaminated with hazardous substances then the contaminated soil shall not be allowed to be exported from the site. In such case, reduction of landfill depth or optimization of landfill capacity would be a good sustainable solution which eliminates the excess soil to be generated at the first place. This will be key, particularly if soil contamination was found to be spread all over the proposed site. The following section presents an attempt to investigate the effect of reducing the landfill depth on the amount of soil produced.

Changing landfill depth and/or height to minimize excess spoil
An attempt is presented in this section to investigate the feasibility of changing the landfill depth and/or height . This may need to be further optimized based on the final design components of the landfill. First the excavation depth has been reduced and the waste capacity, amount of excavated soil calculated. While maintaining a height of 50m , it was found that the minimum depth which could be achieved is 14m in order to be able to maintain a height of 50m using the proposed over-ground slope. At a depth of 14m, the amount of excess spoil were reduced by around 50% as shown in Table 7A-4 and Figure 7A-2.

Table 7A-4: Effect of reducing the landfill depth on the soil balance

Depth	soil balance	waste capacity	excavated soil	Comments
20	1,880,510	6,673,980	3,448,479	
19	1,728,564	6,553,248	3,288,262	
18	1,576,239	6,427,538	3,126,689	
17	1,423,534	6,296,935	2,963,771	
16	1,270,450	6,161,520	2,799,519	
15	1,116,987	6,021,380	2,633,947	
14	963,143	5,876,598	2,467,065	
13	725,990	6,053,782	2,298,887	For these depths o be achieved, the slopes have to be increased which may not be structurally feasible.
12	568,313	5,908,229	2,129,423	
10	251,919	5,602,349	1,786,689	
8.4	2,172	5,343,654	1,508,901	

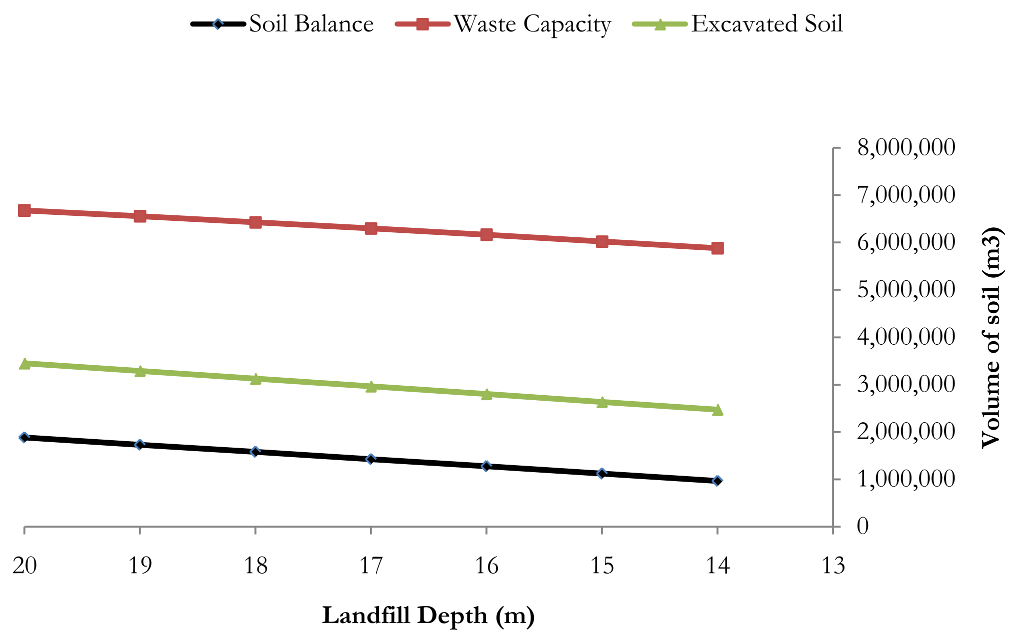


Figure 7A-2 Effect of reducing the landfill depth on the soil balance and waste capacity for a total landfill height of 50m

In order to be able to reduce the depth beyond 14m , the height of the landfill over ground level has to be maintained at 35-36m. In such case, the depth could be reduced down to 7.5m at which the excess soil is almost eliminated. However the waste capacity would be significantly reduced as shown in Table 7A-5 and Figure 7A-3.

Table 7A-5: Effect of reducing the landfill depth on the soil balance for an over-ground landfill height of 35m

Depth	soil balance	waste capacity	excavated soil
13	818990.5472	5708419.551	2298886.771
10	379964.2629	5196222.219	1786689.439
9	231467.311	5022975.776	1613442.995
8	81910.07339	4848492.332	1438959.551
7.5	6737.061718	4760790.485	1351257.704
7.4	-8328.927474	4743213.497	1333680.717
7.3	-23405.35495	4725624.332	1316091.551
7	-68697.16424	4672783.888	1263251.107

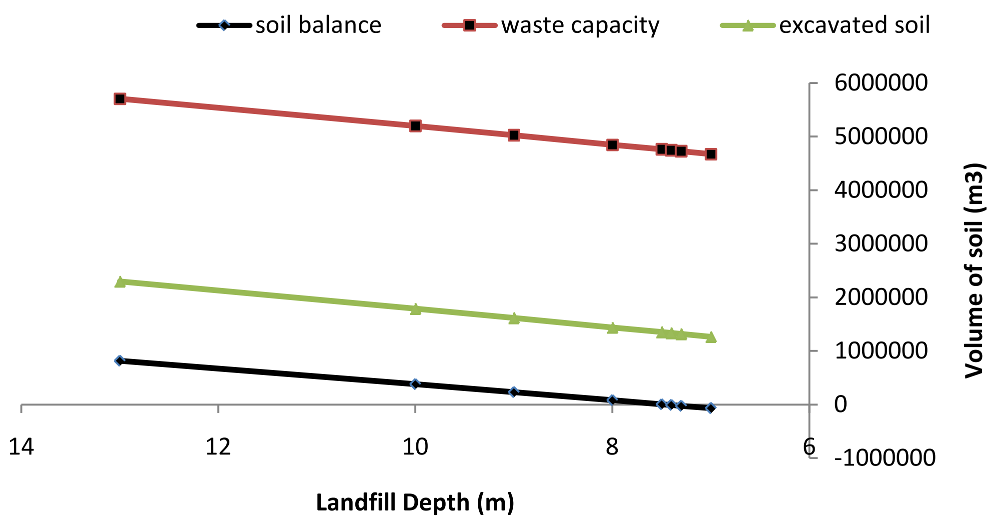


Figure 7A-3 Effect of reducing the landfill depth on the soil balance and waste capacity for an over-ground landfill height of 35m

Mitigation Measures:

- Identification for the areas that would be used for storing the excavated spoil, in case there are no sufficient areas adjacent to the landfill, the depth and height of the landfill should be changed to safeguard against such impacts and the effect of this change on the landfill capacity should be determined as shown above using a simple methodology.
- The area allocated for spoil storage should be selected so that no un-favored pattern of surface water collection should be developed that would cause nuisance to adjacent areas (e.g. development of stagnant water ponds for long times).
- Ensure that the height of the spoil will not cause unaccepted visual impacts to adjacent areas additional to the impacts of the landfill.

Monitoring Activities:

- Excavated soil should be recorded in the monthly report by summing excavated volumes from the invoices of excavation contractor.
- Soil sampling should take place at random samples and contaminants of potential concern presented in this section analyzed for. If found to contain hazardous components , the soil should not be exported from the site.
- In case the soil will be exported from the site, the project management should keep track of the end uses of the soil and the methods of transportation.

7A.1.2 Affecting Air Quality by Dust Emissions of Construction Works

7A.1.2.1 Johr al Deek Landfill Site

Inhalation of dust particles in excessive amounts can be harmful to the health of both workers and nearby residents. Activities likely to eject dust particles into the air during the construction phase include the following:

- earthworks, including excavation and construction of peripheral embankments;
- action of the wind on stored construction materials;
- road works;
- site facility construction;
- installation of the lining system;
- vehicle movement around the site on unfinished roads

Dust emissions will negatively impact ambient air quality, particularly during the initial phases of construction. Residential areas or other occupied buildings are not in the immediate vicinity of the site, i.e residential buildings are 400-600 m away. The impact will not therefore be strongly felt by nearby inhabitants. However, users of nearby roads and scattered farm houses visitors may experience some disturbances due to dust generation.

If no mitigation measures are undertaken, the impact is expected to be negative with medium significance.

Figure 7-4 Nearest residential buildings to the proposed site for Johr al Deek landfill

7A.1.2.2 Transfer Stations and composting plants

At the transfer station site, some dust may arise during construction due to the action of the wind on stored construction materials, movements of vehicles around the site and some demolition and construction of walls, fences, etc.

The expected impact will be negative with low significance due to the relatively low scale earthworks in transfer stations sites.

Mitigation Measures:

- Spoils of waste that will be reused in the landfill operations should be stored as close as possible from the active cells to minimize distances moved by excavators, trucks and loaders. An example for that is presented in Figure 7A-1
- Pavement of the access road and ring road stretch that will be used for the following Cell excavation prior to excavation works. This construction schedule should be included in the tender document of constructions works
- In case of receiving complaints from neighbors, watering of soil before excavation, in landfill and transfer stations sites, should be carried out to minimize dust emissions.

Monitoring Activities:

- Ambient Particulate Matter should be measured at the western border of active waste cell and in the nearest residential building located at the south west of the landfill site (refer to Figure 7A-4). The measurements are to be carried out once during the excavation of each cell.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

7A.1.3 Noise Impacts

7A.1.3.1 Johr al Deek Landfill Site

Construction works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. This will result in raising the background noise levels; this in general will depend on:

- the type of equipment and vehicles used on the site;
- the ambient noise level around the proposed site;
- the proximity of sensitive receptors;
- the length of time over which construction works are undertaken.

The main activities that are associated with high noise emissions are:

- excavation and building works
- Movement of trucks carrying excavated soil and trucks bringing construction materials to the site;
- Operation of standby-generators

Because the nearest residential cluster is located approximately 400-600m away the noise impacts are not expected to be major, as most of the machinery noise will be effectively attenuated by this distance, especially when excavation and filling works are deep below ground level.

Generally, it is expected that the noise will not be high enough to interrupt sleep or disrupt normal activity. It is anticipated that construction activities will not be operational during the late hours; therefore the impact on evening averages of ambient noise will be little. The impact of noise can be considered negative and of medium significance.

7A.1.3.2 The Transfer Stations and composting plants

The noise level during the construction of the transfer stations will not exceed that of a conventional concrete building. The following activities will be responsible for most of noise emissions:

- Excavation of soil
- Demolition of existing pavement
- Vehicles movements
- Standby generators

The impact of noise at transfer stations can be considered negative and of medium significance depending on the nature of the neighboring areas.

Mitigation Measures:

- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In case of receiving complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor;
- Construction works should be stopped at night-time;

Monitoring Activities:

- Ambient noise at the nearest residential areas from landfill has been recorded as part of the environmental baseline study – refer to Chapter 5A. These should be considered as the background noise. Noise should be recorded during a representative day during the excavation of each Cell and compared against the baseline noise levels.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

7A.1.4 Affecting Air Quality by Equipment and Vehicles Exhaust

Local air quality can be negatively affected by vehicle exhaust emissions from vehicles and machines (generators, loaders, excavators ... etc.) operating in construction. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission.

It was mentioned in a previous Section that the design depth of the landfill will lead to generation of large amount of soil more than the needs of the landfill operations, and if there will be demand on this amount of soil a considerable number of HGV trips will be carried out, which is an indirect cause of the general traffic air emissions in Gaza.

Overall, the scale of such emissions is considered minor and, therefore, the impact is considered to be negative with low significance.

Mitigation Measures:

- All vehicles and heavy equipment working in the site should be effectively maintained. Any vehicle that has high smoke emissions visibly detected should be promptly repaired.

7A.1.5 Impacts of Construction Waste Other than Excavated Soil

Impact Significance:

The following waste types, other than excavated soil that was discussed in a previous Section, may potentially be generated from construction activities at both the landfill, transfer stations and composting plants sites:

- Construction debris including concrete, bricks, sand and gravel.
- Miscellaneous solid wastes, including packaging waste, used drums, wood; scrap metal, empty polypropylene and/or paper sacks.
- Spent oil and oil filters from the servicing of vehicles.
- Wiping cloths fouled with oils, paint, etc….
- Empty paint and chemicals containers.
- Municipal waste of site workers.
- Sewage from offices

According to the European Waste Catalogue, the following are classified as hazardous wastes:

- All types of spent mineral oils , code 013 02
- Paint containers , code 08 01 11 and 08 01 13
- Spent oil filters and wiping cloths containing dangerous substances, code 15 02 02

The hazardous waste streams listed above should be properly handled and safely stored/disposed of. As mentioned later in this Chapter, if there will be no hazardous waste handing site in Gaza by the start of the project it is recommended to establish a hazardous waste cell, in which the generated hazardous waste by the project activities will be a minor contributor to the waste received in this cell[60].

Construction debris such as concrete, bricks, sand, gravel, and other solid wastes such as wood and scrap metal can be recycled (by the informal sector) or disposed of in MSW cells, provided they are not contaminated with hazardous substances. While sewage could be pumped out from cesspits and discharged in the adjacent wastewater treatment plant. The impact could be classified of low significance.

[60] This will be applicable to construction works in cells subsequent to establishment of this hazardous waste cell, if this cell is needed

Mitigation Measures:

- Spent lubrication oils and paint/chemical containers and other hazardous waste should be separated from other wastes and disposed of/ in approved hazardous waste facility if existing, or in the special cell recommended for the project.
- Other solid wastes are to be collected from different areas of the site and disposed in active cells
- Sewage should be collected from cesspits periodically by tankers and sent to the adjacent wastewater treatment plant.

Monitoring Activities:

- Hazardous waste generated at the site should be classified and documented in monthly reports
- Amounts of collected sewage by tankers should be recorded and documented in monthly reports

7A.1.6 Risk of Damaging Chance-Find Antiquity Objects

Impact Significance:

Johr al Deek site is close to come cultural heritage sites as previously discussed in Chapter 5. The extensive excavation that will be carried out, up to 20 meters, could lead to finding any antiquity or culturally valuable object. The possibilities for such chance-finds are not high but the long history of the region does not nullify such possibility especially that such excavation depth is not common in the surrounding areas.

Such chance-finds generally needs special care in handling so as to keep their condition that will support the cultural value it represents, therefore in the unlikely finding of such objects the Ministry of Tourism and Antiquities should be informed so as to adequately handle this object. This impact is considered of low significance.

Mitigation Measures:

- In the case of finding any culturally valuable object during excavation works, the works should be stopped by the contractor and the Ministry of Tourism and Antiquities should be contacted to handle the site. If the Ministry of Tourism and Antiquities asked for prolonged holding of excavation works, the following Cell could be excavated instead so as not to cause disturbance to the waste filling plan.

Monitoring Activities:

- In case of chance-finds the type of object, location of finding, photographs of the object and the followed procedures to handle the object should be reported to the PMU

Table 7A-6 below summarizes the impacts of the project during the construction phase and their correspondent significance.

Table 7A-6: Summary of impacts during the construction phase and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts of Excavated Soil	Likely to cause landuse limitations	Medium to high	Minimize the impacts to low
Affecting air quality by dust emissions of construction works	Likely to raise PM in ambient air in the landfill area. Impacts around transfer stations are less likely	Medium at landfill location low at transfer station location	Minimize the impacts and maintain their control
Noise impacts	Construction works are relatively far from residential areas but is considered more critical as compared with El-Fukhary landfill	Medium	Minimize the impacts and maintain their control
Affecting air quality by vehicles and equipment emissions	Emissions are relatively minor	Low	Minimize impacts and maintain their control
Impacts of construction waste other than excavated soil	Amounts of generated waste could be neglected in comparison to the waste received at the site	Low	Minimize impacts and maintain their control
Risks of damaging chance-find antiquities	Unlikely to find antiquities	Low	Minimize impacts

7A.2 Impacts during Operation Phase

7A.2.1 Odor Impacts

7A.2.1.1 Johr al Deek Landfill Site

The impact of odors is normally considered a mere annoyance, as foul smells can rarely harm health directly. However, due to the nature of landfills, the odors produced can potentially be quite powerful and mainly contains a complex mixture of ammonia and hydrogen sulphide. The odor impacts could be the cause of public opposition to the proposed landfill site, the main sources of odor at the landfill site will be:

- Aerobic decomposition of organic wastes moved around the site and freshly disposed of in both the landfill and the composting/recycling station.
- Anaerobic decomposition of disposed of wastes over extended time periods. This will generate landfill gas which contains malodorous trace components.

- Landfill leachate collected and discharged to the leachate pond.

Some organic waste will begin decomposing prior to reaching the landfill. Movement and placement of such waste within the landfill site will produce relatively more significant odors. Also some special types of waste will be more odorous then others. Once the waste is in place, continued decomposition will result in landfill gas which is a significant source of odor. Although the gas will be collected by a gas collection and flaring/energy recovery system as advocated by the proposed project, odorous gas may still escape the collection system or leaks out, these risks are discussed separately.

Landfill leachate is another source of odors. This will be produced from any moisture that enters the body of the landfilled waste and percolates through, dissolving and entraining environmentally harmful substances through diffusion and/or convection mechanisms. As proposed by the project, a drainage system will be put in place to collect the leachate in a pond for storage and treatment. Odors may therefore arise from the leachate that evaporates from the collection pond.

The nearest residential cluster to the proposed Johr al Deek Long Term landfill was found at around 400-600m from the nearest active cell as previously mentioned (Figure 7A-4).

Johr al Deek site hosts at the moment an uncontrolled dump site where waste piles extends to around 15 m above ground. Waste is at the moment exposed to air, fauna and waste pickers, and the site is characterized by considerable odor emissions, this is mainly because the waste is not covered. The potential odor impacts of the project are not likely to significantly increase the cumulative odors in the area especially with the application of the daily cover in the new landfill operations, accordingly the odor impacts are considered negative with medium significance, which can be reduced to acceptable levels in the proximity of the sensitive receptors by following the landfill operational manual for filling the cells and the mitigation measures proposed below.

7A.2.1.2 The Transfer Stations

Details of the design and operation of the transfer station have been previously presented in Chapter 5. A typical transfer station functions as a site where primary collection vehicles unload their waste load, which is stored and re-loaded onto a larger transport vehicle to be taken to the landfill. The collected waste may begin to decompose prior to arrival and its movement close and around the site can release odorous gas. Potential odor impacts can also result during unloading and transferring waste from the small to the large vehicles or during waste storage on site.

Both Beit Lahya and Al Maslakh used at the moment as open waste storage sites. The latter will be transferred to a nearby location. The odor impact will not increase after the implementation of the proposed project and if no mitigation measures are undertaken, the impact could be classified as negative with medium significance and could be reduced by applying the operational manual of the transfer stations and the mitigation measures presented below. Odor will mainly be released during the short exposure of the waste before entering the hopper and while being compacted into the closed container.

7A.2.1.3 The Composting Plants

Details of the design and operation of the composting plants have been previously presented in Chapter 5. The proposed locations for the composting plants are either included in Johr al Deek/El-Fukhary landfill sites or at one of the proposed transfer stations sites such as Deir El Balah or Beit Lahia. This means that the impacts of odor resulting from composting will be added to those resulting from waste transfer or waste disposal activities. The collected waste may actually begin to decompose prior to arrival and its movement close and around the site can release odorous gas which has been already included among the impacts of either the transfer stations or landfills.

In addition to the above, most stages of composting may potentially generate odor. Removal of waste types with significant odour impact is very important and should be done during the screening stage.

Primary composting could be a significant source of odour if aeration is not efficiently performed as this may result in anaerobic decomposition of waste. The conceptual design of the composting plants includes the installation of 24 ventilators for that purpose.

Regular turning of the composting piles during secondary composting will also prevent anaerobic decomposition and reduces odor release.

The process control recommended by the FS is enough to control the odor impact by :

- Installing temperature sensors into the composting piles in order to control the composting temperature. This will ensure the highest rate of composting and aerobic decomposition
- Measuring the level of oxygen in the piles to ensure that aerobic decomposition is taking place.
- Measuring air flow into the piles.

Where the composting plants are constructed in areas of previous waste transfer or disposal activities, the odor impact will not increase after the implementation of the proposed composting activities. If no mitigation measures are undertaken, the odor impact from the composting activities could be classified as negative with medium significance and could be reduced by applying the operational manual of the composting plant including the process control described above and the mitigation measures presented below.

Mitigation Measures:

- The detailed design of the landfill should include an operation manual which includes waste progression plan in the cells, requirements for waste compaction in order to reduce the area exposed to air which also reduce aerobic decomposition and adequately apply soil cover with a thickness of around 15 cm in order to prevent prolonged exposure of vulnerable wastes to the atmosphere. Also the detailed design of the transfer stations should include operation manual that will include the process of unloading waste through hoppers.
- In case of receiving complaints from neighboring areas the application of final cover should be modified so as to implement faster compaction and coverage of waste to effectively reduce the odor emissions
- Additional containers should be present at the transfer station site in case of over capacity especially during peak hours or due to a technical problem with the compactors, in order to reduce the waiting period for the vehicles at the site and prevent an accidental overflow of the waste outside the container. The additional capacity containers should safeguard emergency periods where the landfill site may not be accessible.

Monitoring Activities:

- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

7A.2.2 Impacts of Landfill Gas

As discussed for El-Fukhary landfill, the generation of landfill gas could cause negative impacts on the environment, including:

- The methane gas when present in air with concentrations between 5-15% it could have an explosion potential which causes a safety risk. Because of the limited amounts of oxygen in the landfill this risk is minimum within the body of the landfill, but the risk would be higher in case the landfill gas migrated to the air with large concentration of methane.
- Ammonia, VOCs and hydrogen sulfide cause nuisance to surrounding areas
- Both methane and carbon dioxide are greenhouse gases where methane has much more global warming potential than carbon dioxide (25 times in 100 years lifetime)
- The migration of the landfill gas through the soil could cause acidification of the groundwater due to the reaction between carbon dioxide in the landfill gas and the water to produce carbonic acid, especially that carbon dioxide is relatively dense gas that tends to move downwards.
- The flaring/combustion of landfill gas causes air emissions of CO_2, CO, NO_x, PM and trace gases that impact the air quality in adjacent areas

During the preparation of the Feasibility Study of the project, the FS team has carried out sampling of the solid waste generated in Gaza, in which 116 samples from different locations of Gaza strip were analyzed, and the results were shown in Table 6A-5. The table showed different properties of the waste.

As calculated for El-Fukhary Landfill and considering the expected amount of waste that will be received at Johr al Deek landfill, the ultimate amount of landfill gas that will be produced is estimated at 1.97 million tons (which is estimated by 1,410 million m3) in which methane will be 0.330 million tons (500 million m3); carbon dioxide will be 1.642 million tons (907 million m3) and ammonia will be 1,431 tons (2.015 million m3) in addition to minor components of trance elements.

According to the preliminary design of the landfill there will be a degassing system in the landfill through 40 vents, each vent will be formed in a hole of 800 mm diameter that will contain broken stone around PE-HD filter pile, and will be gradually raised during the progression of landfill cells. Each vent will cover an area with a radius of about 30 meters, and all the vents will be collected in PE-HD collection pipes that will be located inside the re-cultivation layer and the ring road around the landfill and will end in a gas compression station. The final fate of the collected gas will be either flaring or recovery in power generation.

In case of flaring the gas, there will be emissions of CO_2, CO, NOx, PM among other trace gases, these emissions will be proportional with the rate of collected gas and, hence, will be minimum during the first years of landfill operation and will gradually increase until it reaches the maximum then it will gradually decrease. The flaring of the gas is not expected to have large impacts on the ambient air quality.

In both cases, flaring or combustion of landfill gas to generate power, the total CO_2 emissions for the whole combusted methane (0.33 million tons) will be 0.908 million tons over the whole landfill life. This makes the total CO_2 emissions from the landfill (CO_2 in landfill gas + combustion of methane) 2.55 million tons.

The planned system for gas collection, along with the HDPE liner and final cover, as also noted for El-Fukhary landfill is considered a good engineering control process for minimizing the migration of landfill gas to the atmosphere or through the soil to the groundwater, the number of vents and radius of influence will be sufficient to cover the whole landfill area as showing in Figure 7-5 below, which is overlaying 45-50 vents with 30-meter radius influence over the landfill layout. Therefore the impacts of the landfill gas, given that the above system will be installed, will be mainly the gas emissions of flaring/combustion and venting of CO_2 and some trace elements along with low likelihood of venting dangerous concentrations of methane, or penetrating the thick clay layer and acidify the groundwater. Because the air emissions may, in combination with other future sources not related to the project activities, cause breaching of ambient air quality standards this impact has been classified of medium significance.

Figure 7A-5: Layout of Johr al Deek landfill – Long term phase covered by 50 gas vents at example locations

Mitigation Measures:

- Gradual placing of gas vents and construction of the gas compression station with adequate capacity to receive the maximum flow of gas
- The lining system and final cover of the landfill should be properly maintained to keep their integrity, through ensuring adequate placing, adhering to waste filling plan, avoid overloading landfill cells and regular evacuation of leachate and gas. A maintenance schedule for the degassing system should be followed by the project operator.

Monitoring Activities:

- Keep records of collected gas through the degassing system
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on quarterly basis

7A.2.3 Impacts of Leachate and Surface Water

As discussed in section 6A.2.3, the leachate could be defined as the liquid that has percolated through solid waste and extracted some waste materials. The leachate is generally characterized by its strong organic load, containing heavy metals and toxic hydrocarbons, its acidic nature and offensive smell. The water can enter the waste body from different sources to formulate the landfill leachate, including:

- The water content of the waste
- The water content of the daily soil cover
- Water entering the waste from precipitation over active waste cells
- Recycled leachate over the landfill body
- Surface water runoff that could enter the landfill body

On the other hand water is being removed from the waste through the following mechanisms:

- Water consumed through fermentation of solid waste for producing landfill gas according to the chemical equation presented in the previous section
- Evaporation during the placement of waste
- Abstraction of the leachate from the landfill body through engineered collection and pumping

The amount of leachate depends on the Field Capacity of the waste and the associated daily cover. In Johr al Deek landfill, similar to El-Fukhary landfill because the waste height (total of 50 meters) the Field Capacity will be relatively low, especially at the bottom layers, which will lead to more leachate generation as compared with the case if the waste height were smaller.

Given the leachate properties, the impacts of leachate generation are mainly:

- The risk of being released to the adjacent soil and reach the groundwater which will cause high organic load and acidic conditions to the reached groundwater
- In case the leachate will be discharged to a wastewater treatment plant there will be high organic loading to the plant, so there will be a risk of overloading the plant.
- The leachate has an offensive odor that will be more intense besides the leachate collection pond
- If the leachate is not properly collected from the landfill body it could form stress on the base lining system, and raise the risk for loss of containment

For estimating the quantities of leachate that would be generated from Johr al Deek landfill, a water balance has been performed using the expected water inputs and outputs from the landfill body using the following assumptions:

- The moisture content of the waste was estimated as previously shown in Table 6A-5
- The moisture content of the daily cover material is 10% which is the average for the 20-meter excavation depth as indicated in the boreholes analysis for the project site.
- A cover to waste ratio of 1:6 is recommended.
- The average precipitation is 400 mm/year and the runoff coefficient for active waste was taken 0.4 for the over-ground layers.
- 80% of the waste will be normally exposed for evaporation during transportation and during laying in landfill before applying the daily cover. A worst case scenario of maintaining the original moisture content of the waste has been adopted.

- The water consumed in chemical fermentation of waste for production of gas was calculated according the chemical equation previously presented in Section 6A.2.2
- The Field Capacity of the waste was estimated by calculating the average weight of 25 layers in each Cell (each layer is 2 meter height and the number of layer is according to yearly waste progression) assuming average waste specific gravity of 1.2 (as mentioned in the FS) and average specific gravity of daily cover is 1.5.
- The whole generated leachate will be collected and recycled after subtracting the evaporation losses in the collection pond (assuming the pond will be 70 x 70 meters as measured in the project layout)

A water balance has been performed for each landfill cell to calculate the expected amount of leachate from the landfill. The results of these calculations are summarized in Table 7A-7 below.

Table 7A-7: Expected amounts of produced leachate in Johr al Deek landfill with and without leachate recirculation

Year of Operation	Active Cell	Received Waste (tons)	Produced leachate without recirculation (m^3)	Produced leachate after recirculation (m^3)
2018	Cell 1	383562	0	0
2019	Cell 1	394894	9648	9648
2020	Cell 1	401929	36317	44518
2021	Cell 1	395502	49280	87120
2022	Cell 1	406119	66154	139660
2023	Cell 1 until Jan	416655	0	139660
2024	Cell 2	427089	21747	21747
2025	Cell 2	432541	46072	64557
2026	Cell 2	422702	60237	115110
2027	Cell 2	432147	78900	176743
2028	Cell 2 until July	441414	85735	235966
2029	Cell 3	450482	11886	11886
2030	Cell 3	459331	38230	50116
2031	Cell 3	467941	54536	104652
2032	Cell 3	470688	74226	178877

The yearly amounts of leachate gradually increase until reaching a maximum of about 85,000 m3/year, as indicated in the Table above; Most of the water in the waste body will come from the moisture content of the received waste (more than 90% of the input water) as the relatively high organic waste ratio leads to high moisture content of the total waste. The leachate generation will theoretically be stopped after applying the final cover above (final cover will include 50 cm clay layer with permeability of 1×10^{-8} m/s) so no new water will enter the covered Cell from waste, daily cover, precipitation, or leachate recycling, and the water already stored in the waste body at its Field Capacity will be consumed in gas production. This theoretical assumption will not be 100 % materialized as also explained for El-Fukhary landfill because in reality some loss of final cover containment might happen so some of the surface water may penetrate the waste body after the Cell closure, but, if happened, this will remain to be minor quantities that could be neglected in leachate calculations, except if a major accident happened and lead to removal of large portions of the final cover for long times, which is beyond the analysis scope of this ESIA.

The engineering measures recommended to handle the leachate are the same as those designed for El-Fukhary landfill which were described in Section 6A.2.3. The collected leachate will be pumped up to a leachate pond then the collected leachate will be recycled to active cells. These engineering measures are sufficient for controlling the generated leachate according to the best available technologies, given that the system will be designed to handle the relatively large expected quantities of leachate. The pond size (70 x 70 m) which is still in conceptual design phase is believed to be of sufficient size to maximize evaporation losses of leachate; however the depth of the pond should be selected to receive maximum amounts of leachate during rainy season so that no risk of overflowing during extreme conditions. The capacity of the pond should also be checked against a worst case scenario for maintenance and repair duration of the pumping system during maximum leachate flow periods.

The selection of recycling leachate over waste body in active cells is believed to be a better option than constructing a leachate treatment plant, due to reasons explained earlier in Section 6A.2.3 Added to that that there is no WWTP in the vicinity of Johr al Deek landfill which could be used for such purposes. This emphasizes the importance of designing the leachate pond capacity for the worst case scenario as no alternative emergency option exist if there will be a risk of overflowing of leachate pond for any unforeseen circumstances.

Because of the nature of the collected leachate in the collection pond, the odor around the pond is expected to be offensive. However, the severity of this odor will be gradually attenuated in proportion with the distance from the pond. Unlike the odor of fresh waste that could be minimized by application of daily cover; the leachate pond could not be managed in such a way. The odor of the leachate pond could be minimized by speeding the recirculation rate so as minimum amount of leachate would be accumulated in the pond (just the amount that will leave a safe free board for the abstraction pumps) and through regular clean up of settled sludge in the pond and transfer it to the sludge handling facilities in the nearby wastewater treatment plant in the north of GS. Generally the selection of leachate pond location is believed to be good, as this location will be relatively far from the administration building of the landfill (about 250 meters) and from the nearest residential cluster (about 400-600 meters), Accordingly the odor will be limited in the area around the pond and will have relatively little effect on the admin areas and residential clusters.

According to the borehole soil analysis carried out for the Johr al Deek site, the layers beneath the design depth of the landfill (20 meters) are mainly from clayey nature that is characterized by low permeability. The groundwater table is at more than 50-m depth which is more than 30 meters below the bottom of the landfill, which is a relatively large distance to be passed by liquids to reach the groundwater. Figure 7A-6 below shows a section in the landfill area between the two boreholes that have been performed.

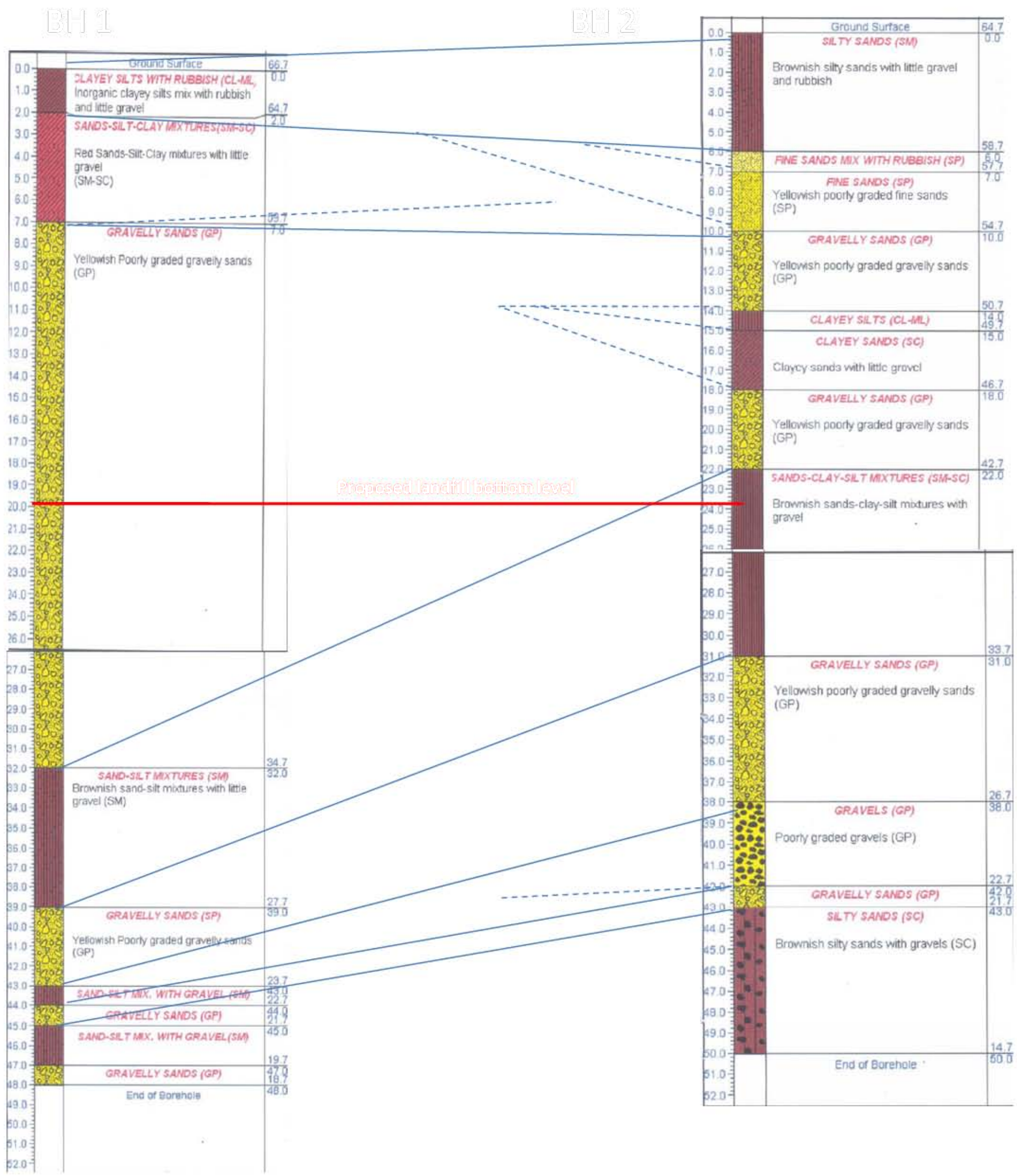


Figure 7A-6 Soil section between the two boreholes performed at Johr al Deek landfill site

If the permeability of the above layers were estimated using average standard permeability for these types of soil, the minimum time required for 1 m^3 of water to percolate the soil and reach the groundwater table is about 3.5 years, if the soil beneath the landfill is fully saturated, which is not the case according to the boreholes of Johr al Deek sites, this is illustrated in Table 7A-8 below. If the average water content of the soil layers is 10% until a depth of 33 meters then the same amount of liquid will need much more time to reach the saturated level. If the landfill depth is reduced to 8m , the vertical migration of leachate would take around 6.5 years to reach groundwater level. The three years difference corresponding to using the two investigated depths is relatively short. This would not favor the selection of an 8m over the 20m depth.

Table 7A-8: Estimated liquid percolation properties of the soil in Johr al Deek site corresponding to a landfill depth of 20m

Soil layer	Estimated permeability ($m^3/m^2/day$)	Borehole 1		Borehole 2	
		Depth to GWT in borehole 1 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)	Depth to GWT in borehole 2 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)
Fine sands	1	18	18	12	12
Silt-clay-sand mixture	0.01	0		7	700
Poorly graded sand	1	0		0	
Clayey silts	0.001	0		0	
Silty Sand	0.01	10	1000	7	700
Silty-clay-sand mixtuters	0.01	0		0	
Clayey gravel	1	0		0	
Silty gravel	1	0		0	
Total			1018		1412

Table 7A-9: Estimated liquid percolation properties of the soil in Johr al Deek site corresponding to a landfill depth of 8m

Soil layer	Estimated permeability ($m^3/m^2/day$)	Borehole 1		Borehole 2	
		Depth to GWT in borehole 1 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)	Depth to GWT in borehole 2 (m)	Minimum Time for a m3 of water to percolate through a m2 layer (days)
Find sands	1	24	24	22	22
Silt-clay-sand mixture	0.01	0		9	900
Poorly graded sand	1	0		0	
Silty Sand	0.01	10	1000	7	700
Clayey silts	0.001	2	2000	1	1000
Silty-clay-sand mixtuters	0.01	0		0	
Clayey gravel	1	0		3	3
Silty gravel	1	0		0	
Total			3024		2625

The horizontal particle tracking and solute transport for nitrates and chlorides have been modeled at the moment and the results are presented below. .

This section discusses the development of groundwater model to study the potential effect of the proposed landfill on the groundwater regime, flow and direction, and the groundwater quality in the costal aquifer.In order to test the aquifer response to the infiltrated leachate quantity and quality, a three dimensional ground water model is used as a tool for impact presentation. The chosen model was Groundwater Modeling System (GMS V 7.1) and its integrated modules (MODFLOW, ZONE BUDEGET, MODPATH and MT3D). The used model is being calibrated for year 2011.

Hydrological and hydrogeological setup

Figure 7A.7 shows also the hydrology of the study area and the delineated streams. Figure 7A.8 shows the topography of the study area, it can be noticed that the proposed location of the Johr al Deek landfill is situated in a relatively high land area relative to the general topography over the wadi area.

As previously described , the geology of the GS region consists of a series of geological formations sloping gradually westwards. These formations are mainly from the Tertiary and Quaternary ages. The quaternary deposits are underlain by the Saqiya formation of the Pliocene, which constitutes part of the Tertiary formations in the area. The Saqiya formation is mainly composed of impermeable clays. The quaternary deposits consist mainly of the marine and continental Kurkar formation (from Pleistocene age), composed of shell fragments and loamy sand beds (SOGREAH, 2010). Figure 7A.9 shows a typical geological cross-section of the GS. In this scheme, 'Kurkar' formation is described here as the porous media located between ground level and Saqyia formation.

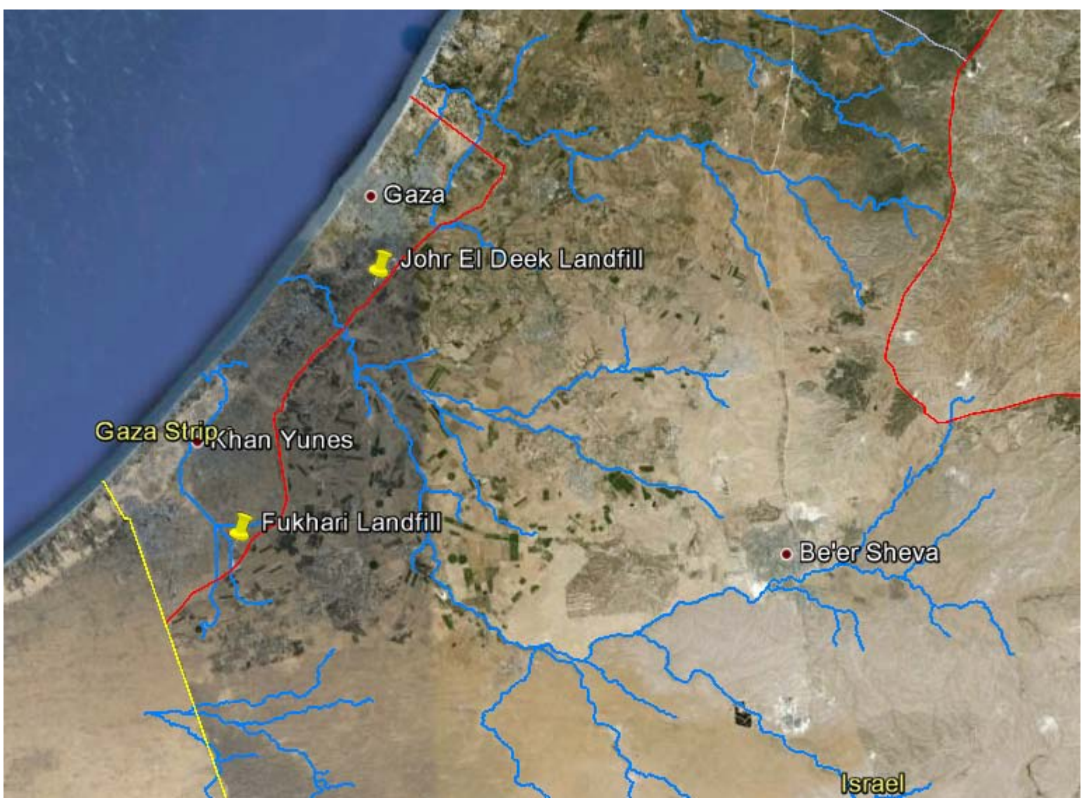


Figure 7A.7 Hydrology of Study Area

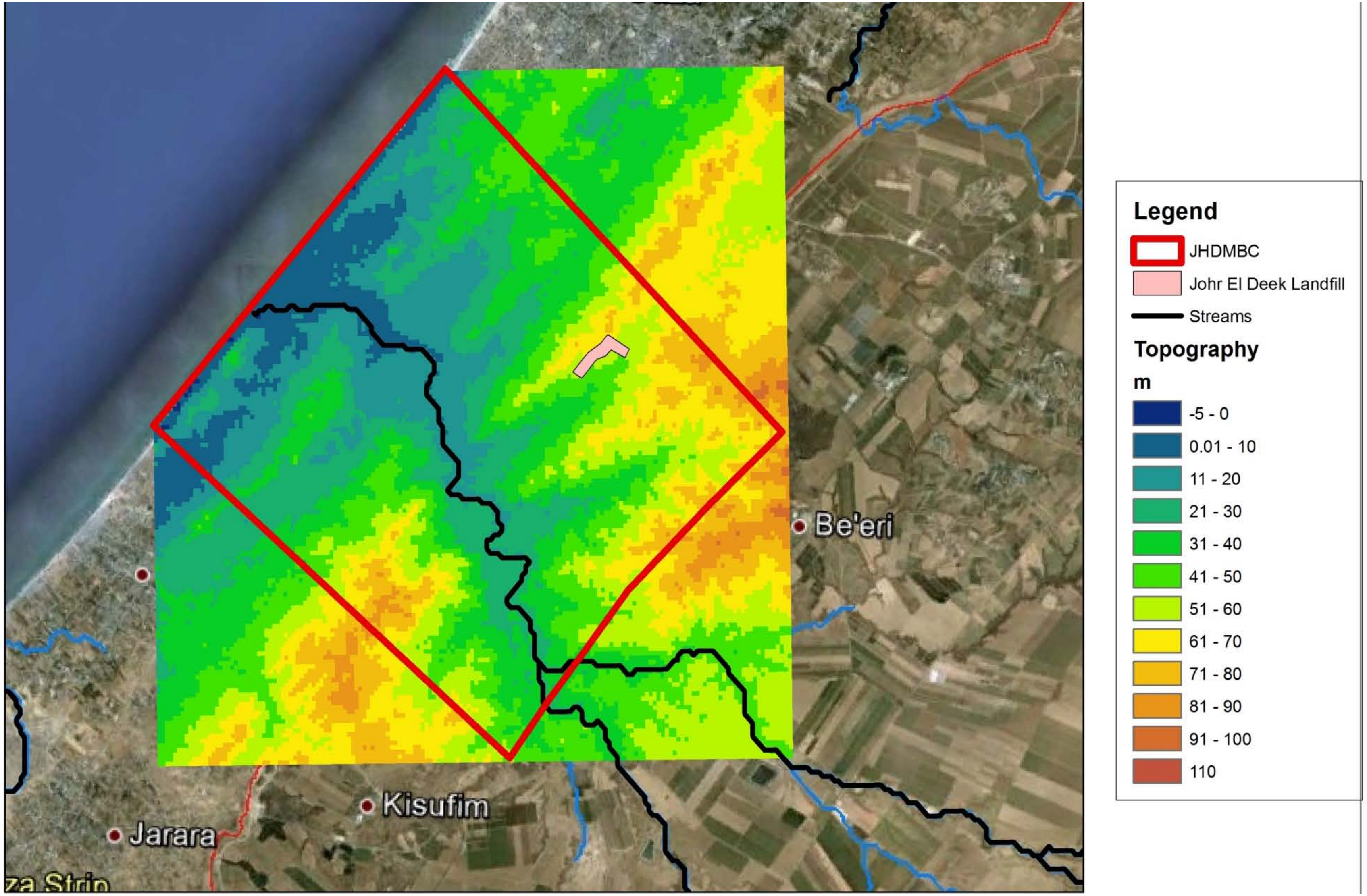


Figure 7A.8 Study Area Topograpy

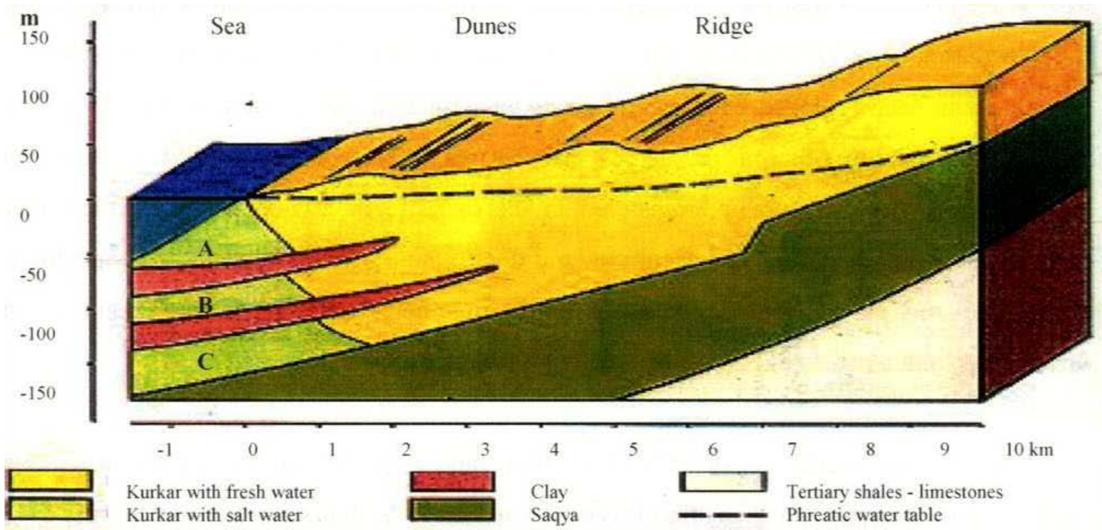


Figure 7A.9 Schematic diagram across the Gaza Strip (Gaza Environmental Profile, 1994).

Pleistocene sedimentary deposits of alluvial sand, gravel, conglomerates, pebbles and mixed soils constitute the regional hydrological system. Intercalated clay deposits separate these deposits and are randomly distributed in the area. Their thickness decreases to the east and basically they can be classified as aquitards. The regional groundwater flow is mainly westward towards the Mediterranean Sea. The maximum saturated thickness of the aquifer range from 120 m near the sea to a few meters near the eastern aquifer boundary. Natural average groundwater heads decline sharply east of the GS and then gradually decline towards the sea (SOGREAH, 2010).

Moe, et al. (2001) developed a three dimensional groundwater model for GS, it described that the Kurkar coastal aquifer thickness is about 100 m in the south of GS and increases to about 200 m at Gaza City near Johr al Deek Landfill. The coastal aquifer thickness also decreases from the west at the sea shore to the east at the border line as shown in Figure 7A.10. These cross sections were used to develop the model stratigraphy in the study area.

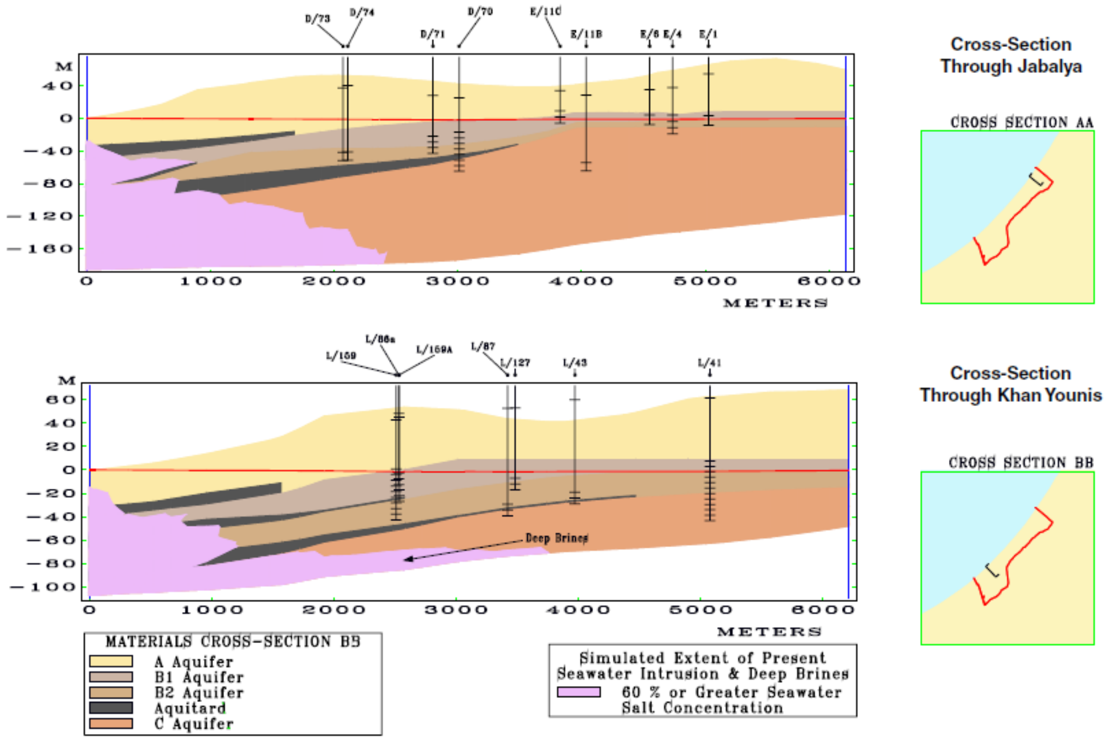


Figure 7A.10 Subsurface Layers Gaza Strip (Moe, et al., 2001)

Figure 7A.6 showed the subsurface conditions at the site area, it can be seen that the site is underlain by successive layers of gravely sands, clays, silts. Due to the existence of the gravely sand layers the leachate reaching the groundwater is expected to be high as compared with El-Fukhary landfill area.

Groundwater modeling

In this study groundwater flow and transport models were developed. After calibration, the models were used to investigate hydrogeological impact of proposed landfill near Gaza city on the local groundwater quantity and quality.

To develop such three dimensional groundwater flow and transport model the USGS finite differences groundwater flow model *modflow2000*, the finite differences advection transport model *modpath2000* and the finite differences contaminant transport model *mt3dms* have been utilized. All the input and output files required by these models are prepared by the pre and post processor *GMS 7.1*.

It is well known that the coastal aquifer in GS is subdivided into sub-aquifers at the coast due to the presence of several marine clay layers. However these clay layers pinch out after 2-4 kilometers from the coast resulting in one single free surface aquifer (Figure 7A.10). Therefore and since the proposed locations of the infiltration basins are far from the coast, the model was developed as one single layer model for simplicity following the same assumption of Weinthal, et al. (2005) study. The generated model mesh is shown in Figure 7A.11. The top surface of the model represents the ground surface topography and the bottom surface represents the top surface of the underlying impervious formation SAQIYA.

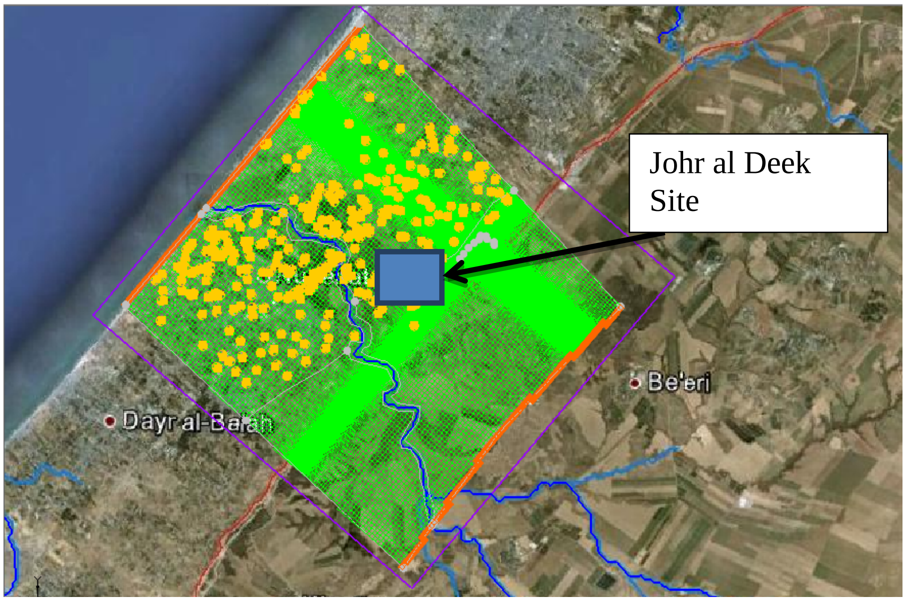


Figure 7A.11 GW Model Grid Layout

Based on the groundwater level contour map (Moe, et al., 2001), the model domain was selected as shown in Figure 7A.11. Regarding the eastern boundary, it is selected as the eastern boundary of Gaza area (green line). The model domain is about 10 km by 9 km. In plan view, the model grid has non-uniform finite difference mesh with cell sizes of 10 m X 10 m at the landfill and up to 100 m X 100 m.

The boundary conditions imposed on the developed three dimensional numerical groundwater flow model are defined as:

Constant Head Boundary: along the Mediterranean Sea and the eastern boundary.
NO Flow Boundary: in the north and south.

The north and south boundaries are defined as no flow boundaries based on the groundwater level contour maps where groundwater flow is perpendicular to the sea shore line (Moe, et al., 2001). For the eastern boundary and since the aquifer thickness is not negligible (40-50 meters) (Moe, et al., 2001), the boundary is assumed as constant head flow boundary. The Model extent is shown in Figure 7A.11

The model has been calibrated for the current situation as year 2011 which is the starting of model simulation using the piezometers data at the study area. The model was prepared for prediction phase which will present the future conditions in case of leachate infiltrating in the proposed location of Johr al Deek landfill site. The calibrated heads are shown in Figure 7A.12.

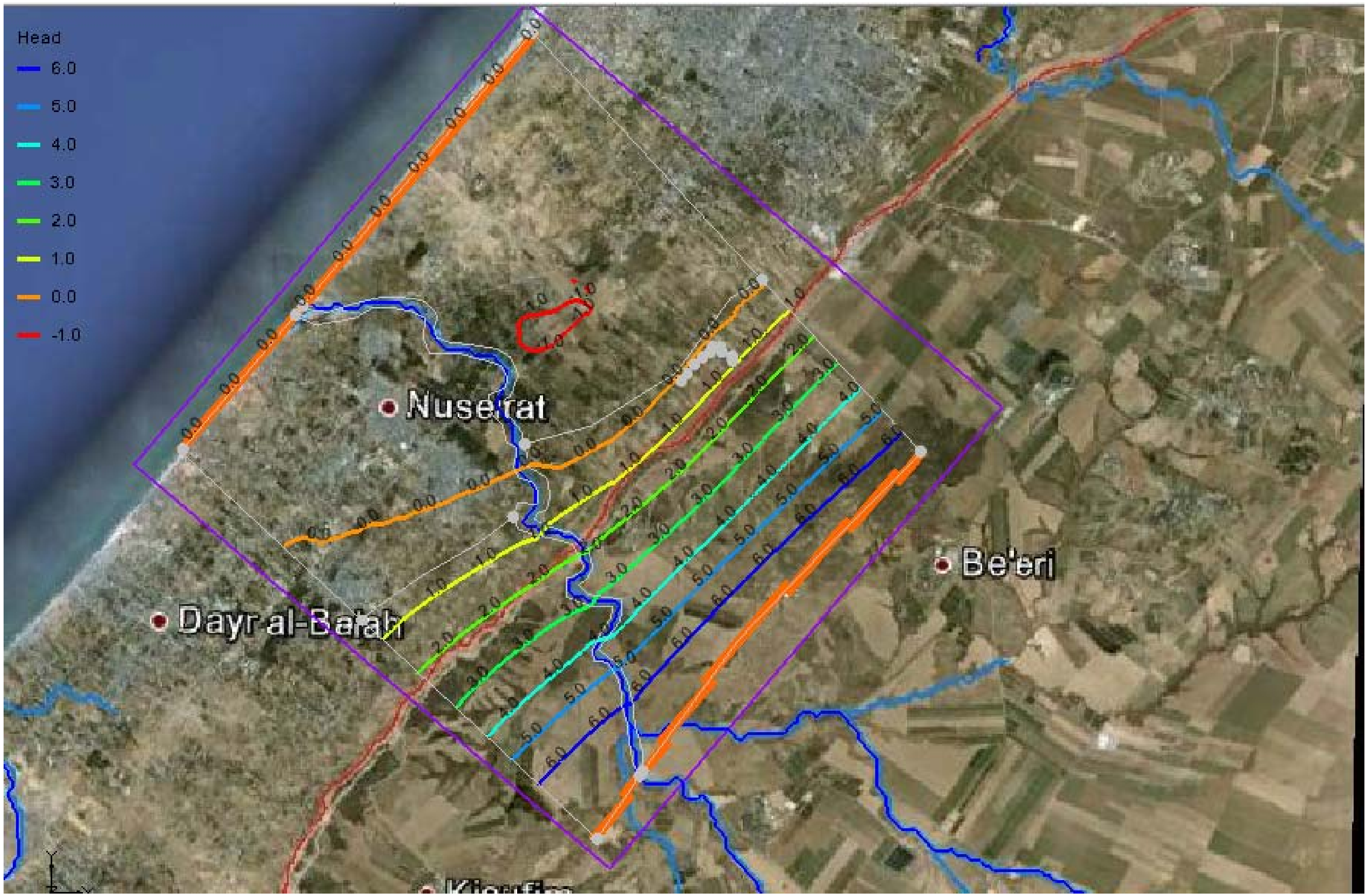


Figure 7A.12 Calibrated GWL for the Study Area at Johr al Deek Landfill Site

Particle Tracking

The objective of this section of the report is to apply the calibrated numerical groundwater flow model to evaluate pre-selected potential site to construct the landfill. The regional groundwater flow model will be applied to evaluate the hydrogeological and environmental impacts of the potential site on both the groundwater quantity and quality.

The impacts of the intended landfill on the aquifer within the model domain, both advection and dispersion contaminant transport models are tested. The advection transport is simulated using the *modpath* to evaluate the extended impact of the infiltrated leachate. Sensitivity analysis for the *modpath* results against aquifer porosity was tested. Three different porosity values were used (0.1, 0.2 and 0.3) to evaluate the sensitivity of the migration of contaminants in the groundwater regime.

The results of the 0.1 and 0.3 porosity scenarios are shown in Figures 7A.13 and 7A.14 respectively, to represent the minimum and maximum migration conditions of the leachate. The Figures show the predicted groundwater level after 15 years. The value of 15 years was adopted to represent the expected life period of the landfill.

The blue arrows in Figures 7A.13 and 7A.14 show also three estimated extent of the leachate over 5 years intervals (i.e. at 5 years, 10 years and 15 years).

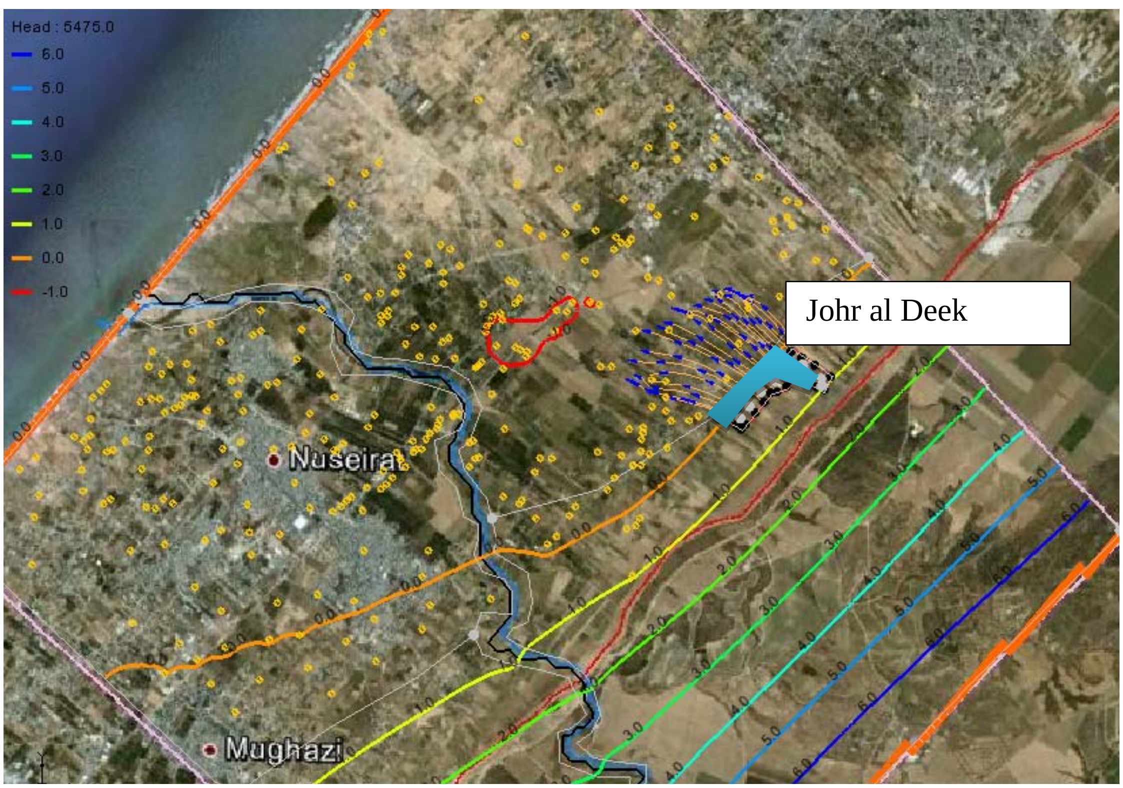


Figure 7A.13 Particles Tracks for Porosity Value of 0.1.

Figure 7A.14 Particles Tracks for Porosity Value of 0.3.

It can be observed that the extent of the infiltrated leachate migrated around 1- 2 km far from the landfill, and that the extent of the leachate will reach the nearby wells. The leachate travels fast due to many reasons, the landfill is located relatively within the saturated part of the Kurkar coastal aquifer with higher permeability (i.e. velocity) than the west part that is governed by the permeability of the Saqiya formation, the expected leachate is high as compared with El-Fukhary as no continous thick clay layer is present underneath the landfill, and the existeence of many abstraction wells in this area which will increase the speed of leachate migration.

Solute Transport

The calibrated groundwater flow and transport model has been applied to evaluate the impact of potential contaminant transport and distribution in the regional groundwater beneath the intended landfill. The conservative chloride parameter has been considered as the contamination source as well as the nitrate. Due to the nonexistence of certain values of the leachate concentration at the groundwater surface an areal concentration of 6000 mg/l for chloride and 500 mg/l for nitrate was assumed (Tamer M.A., 2009). The initial concentration was used from the previous studies.

It can be noticed that the initial concentration of chloride at the study area is about 500-750 mg/l and the concentration of nitrate is around 50 mg/l which is very high (Weinthal, et al. (2005)). Sensitivity analysis for the aquifer dispersivity (10 m and 100 m) where carried out to evaluate the extent of the plume due to the expected leachate (Figure 7A.15 to Figure 7A.26)

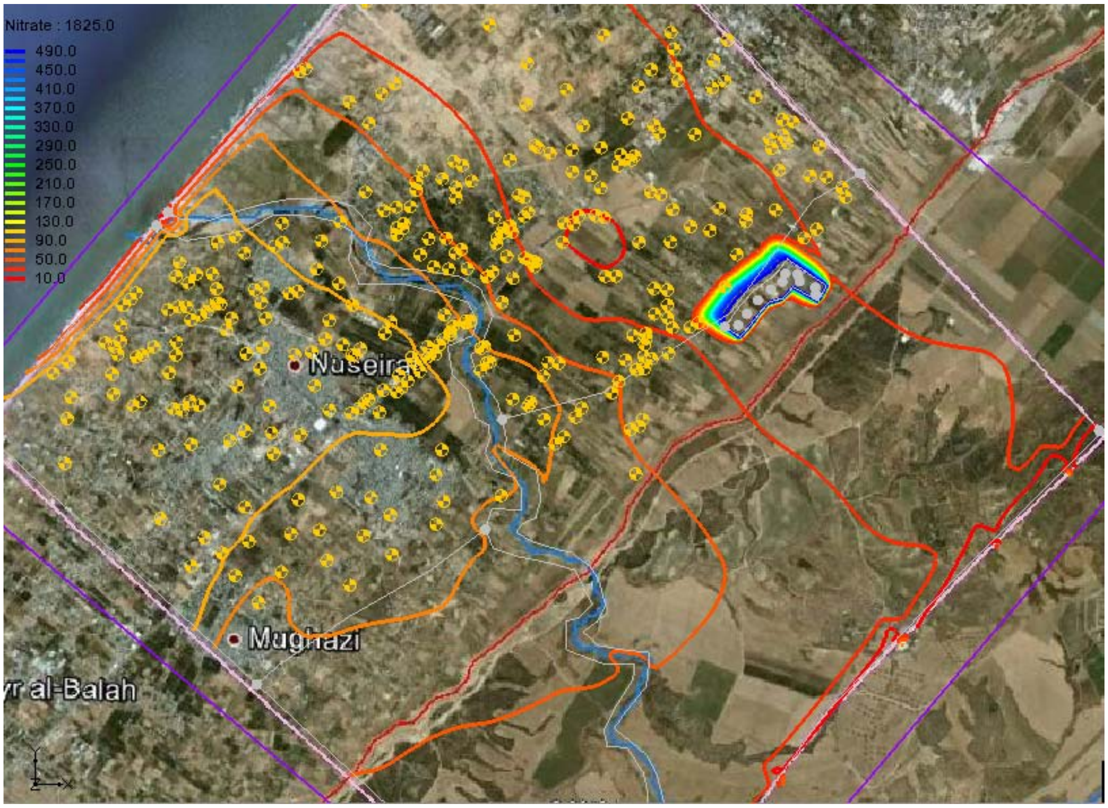


Figure 7A.15 Nitrate Plume after 5 Years for dispersivity of 10 m.

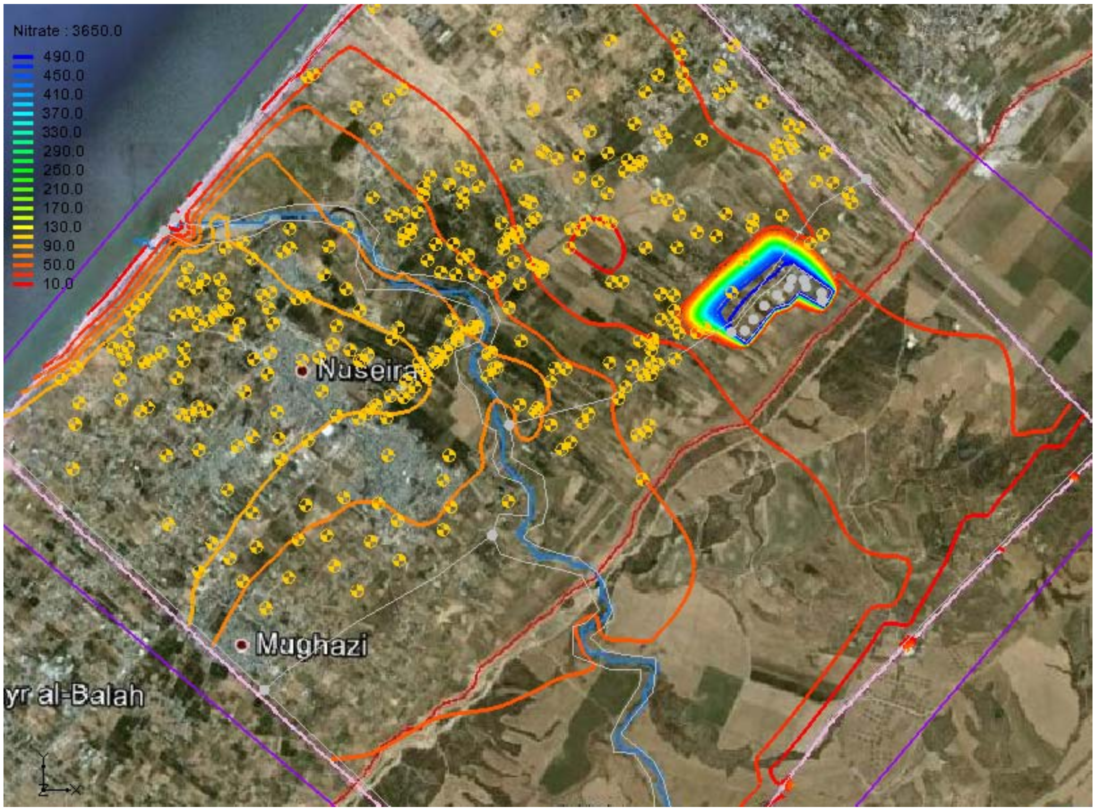


Figure 7A.16 Nitrate Plume after 10 Years for dispersivity of 10 m.

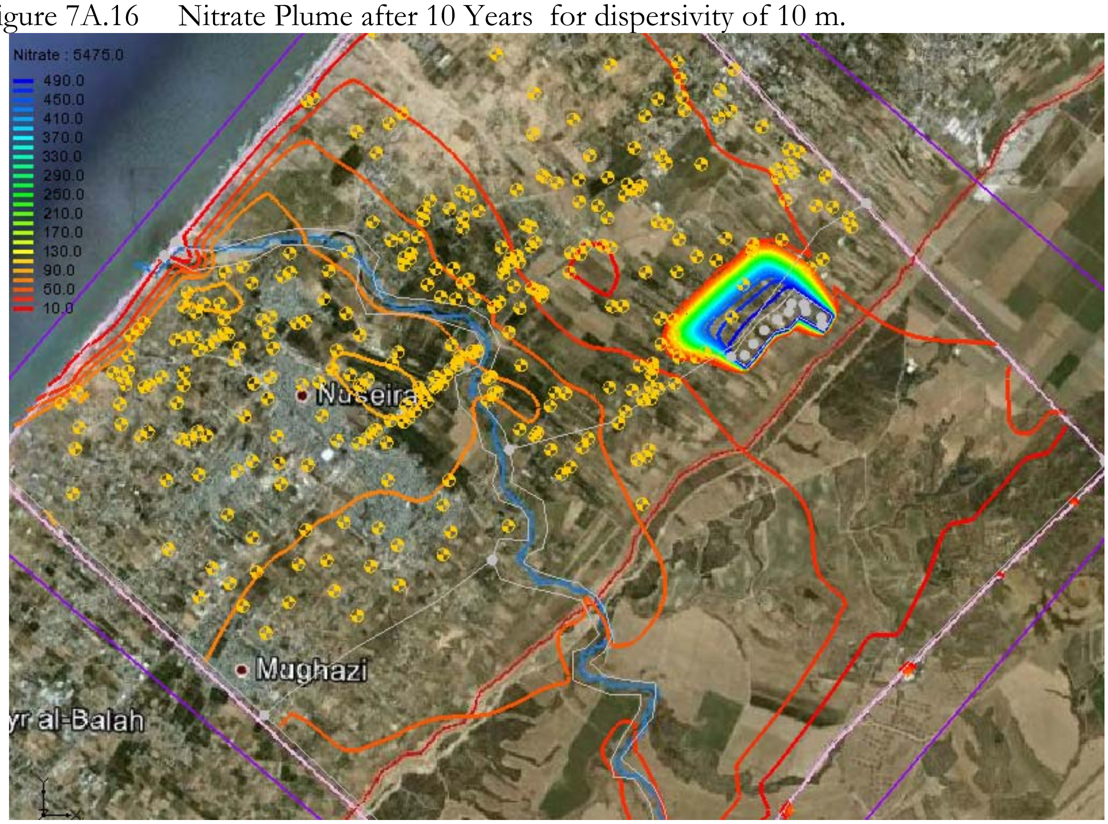


Figure 7A.17 Nitrate Plume after 15 Years for dispersivity of 10 m.

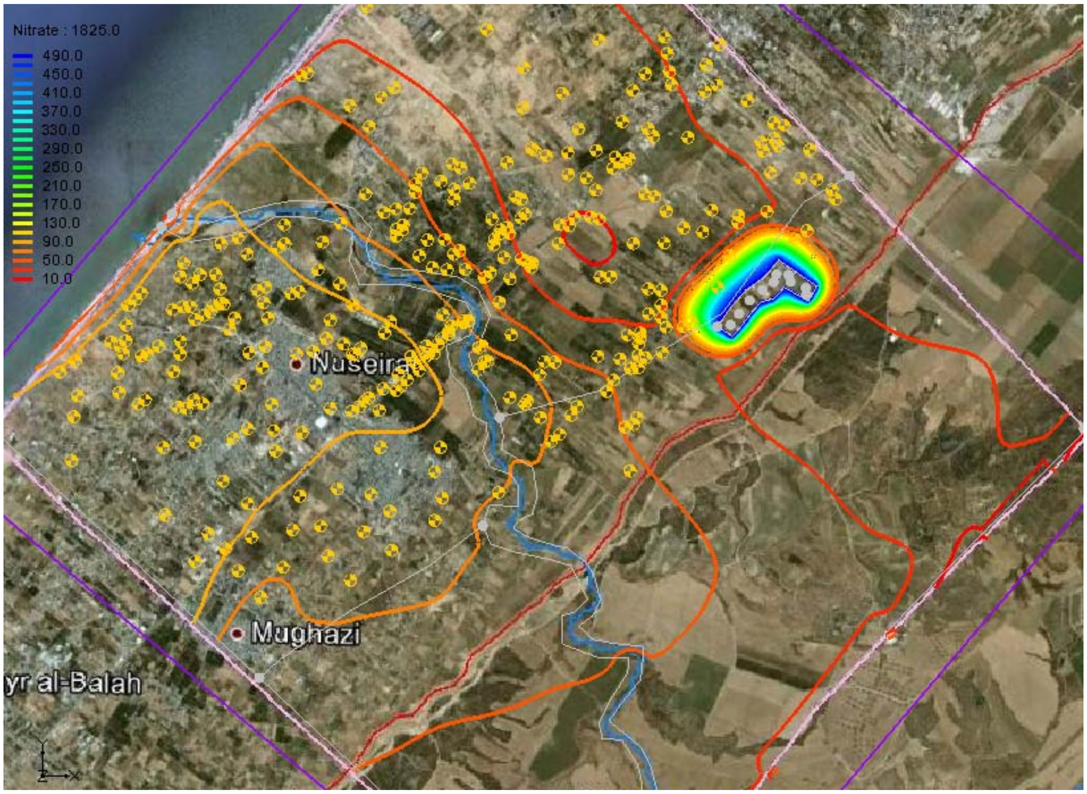


Figure 7A.18 Nitrate Plume after 5 Years for dispersivity of 100 m.

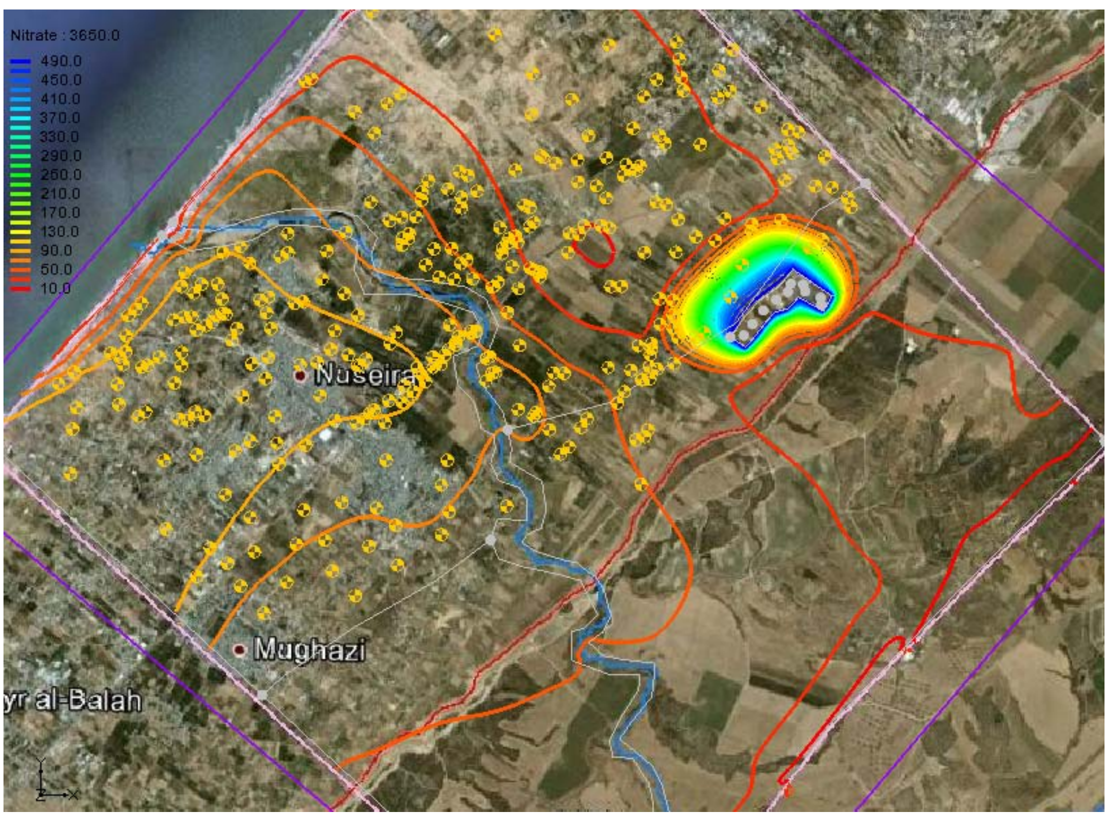


Figure 7A.19 Nitrate Plume after 10 Years for dispersivity of 100 m.

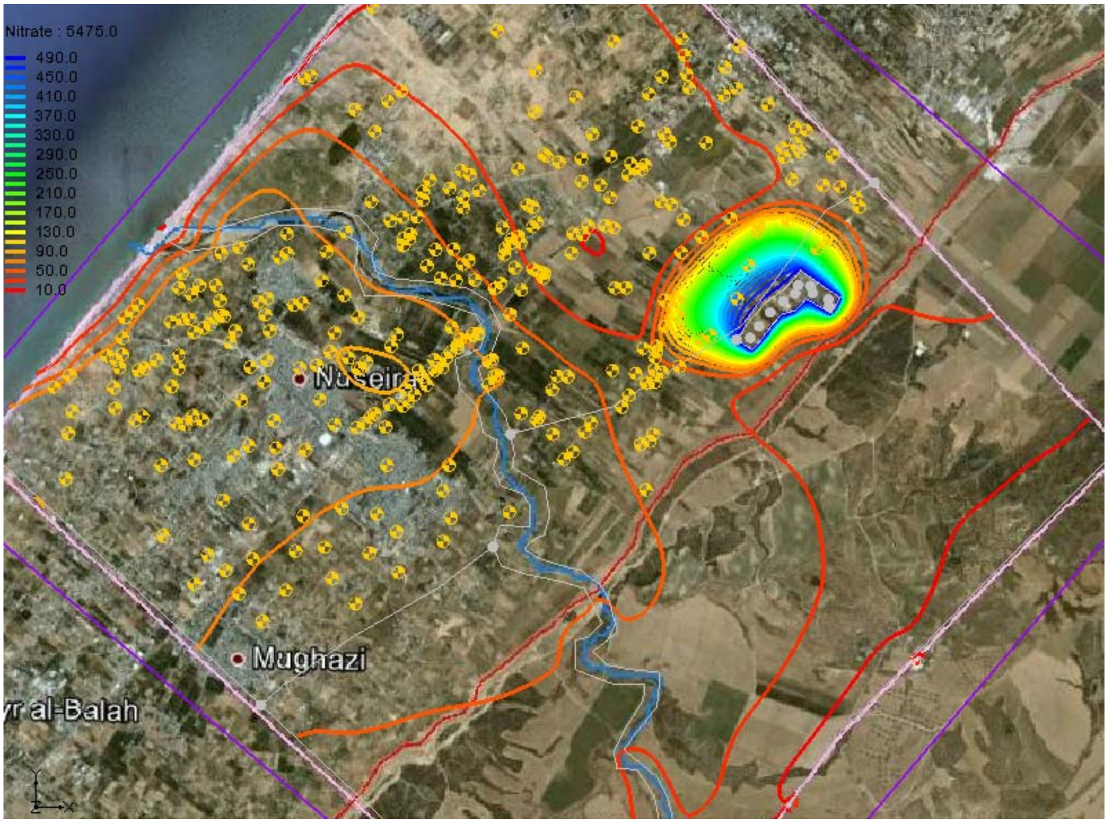


Figure 7A.20 Nitrate Plume after 15 Years for dispersivity of 100 m.

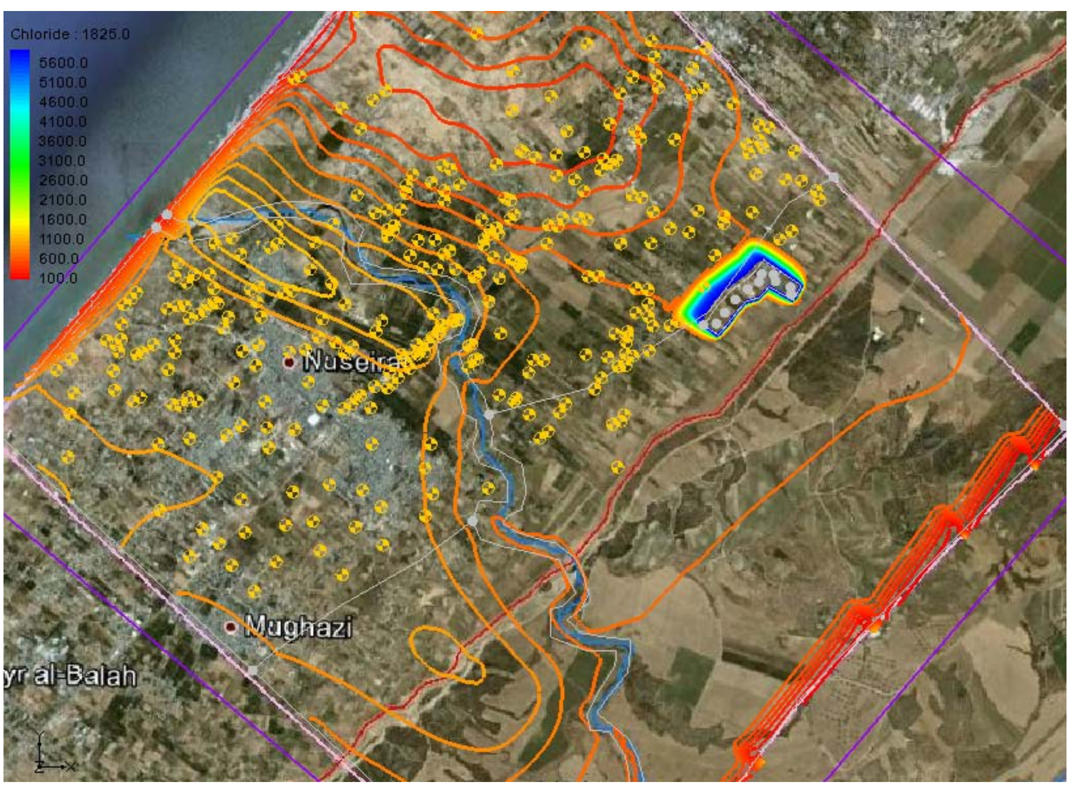


Figure 7A.21 Chloride Plume after 5 Years for dispersivity of 10 m.

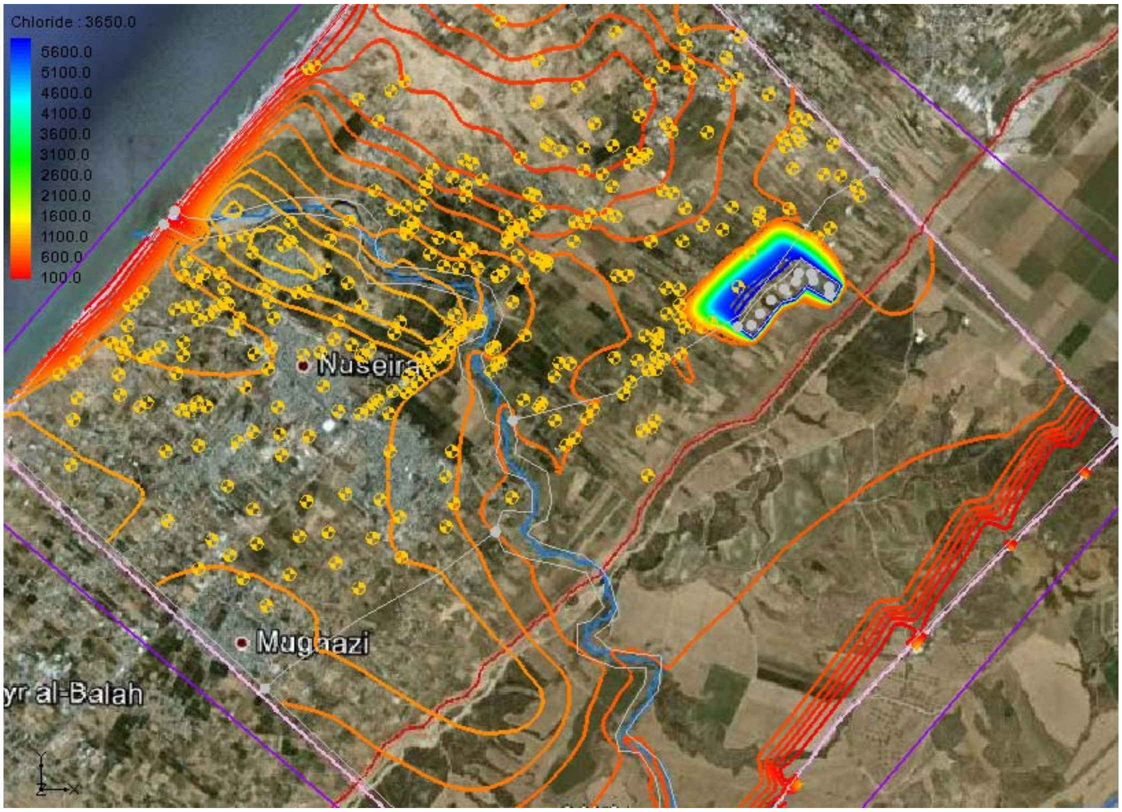


Figure 7A.22 Chloride Plume after 10 Years for dispersivity of 10 m.

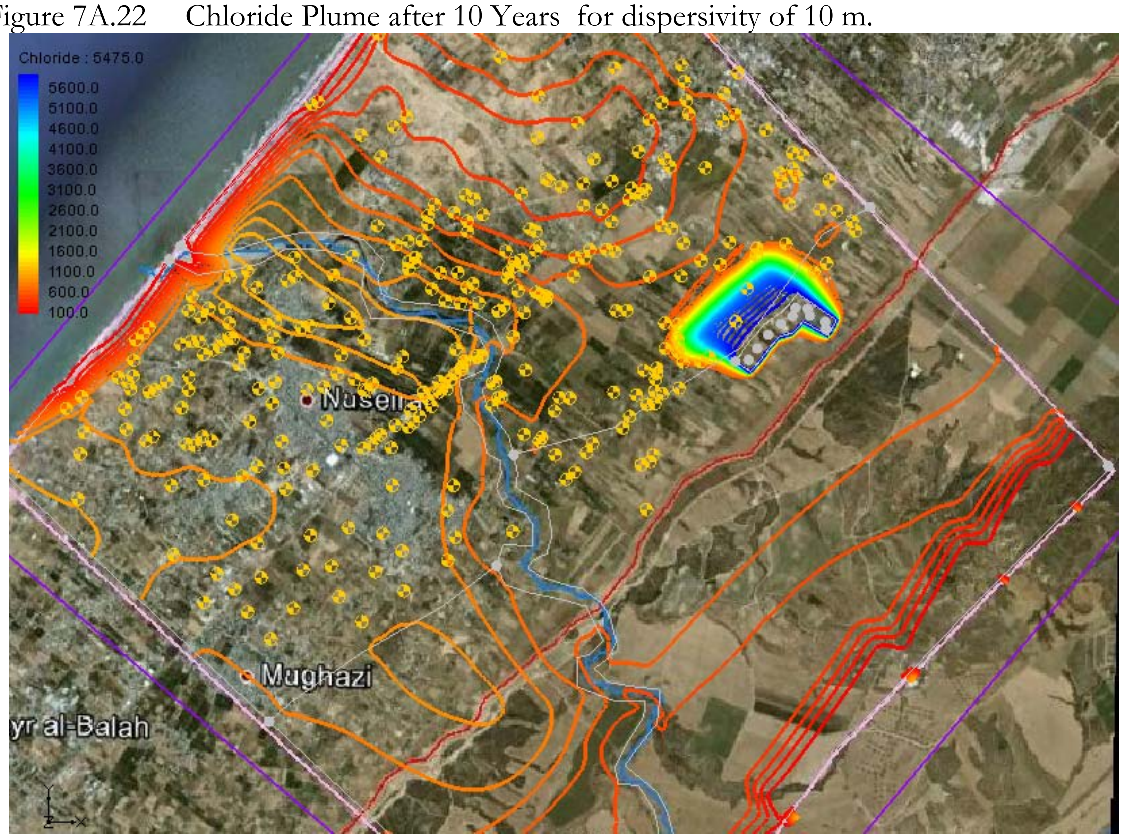


Figure 7A.23 Chloride Plume after 15 Years for dispersivity of 10 m.

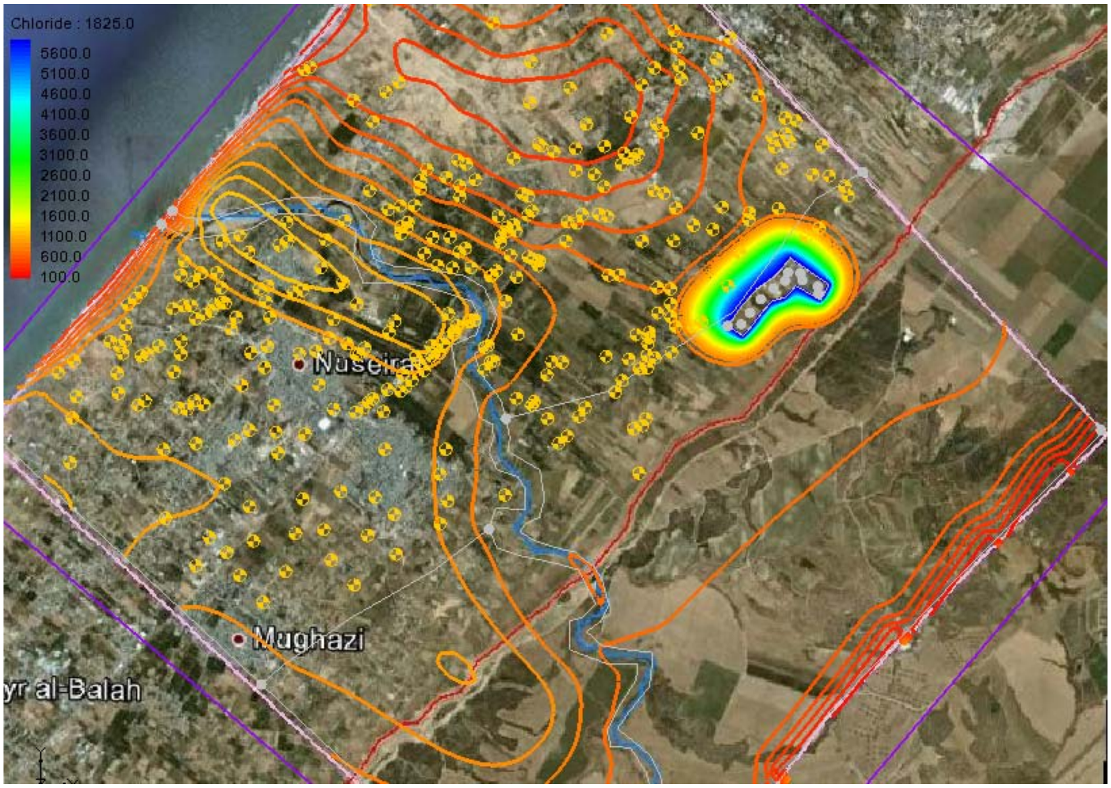


Figure 7A.24 Chloride Plume after 5 Years for dispersivity of 100 m.

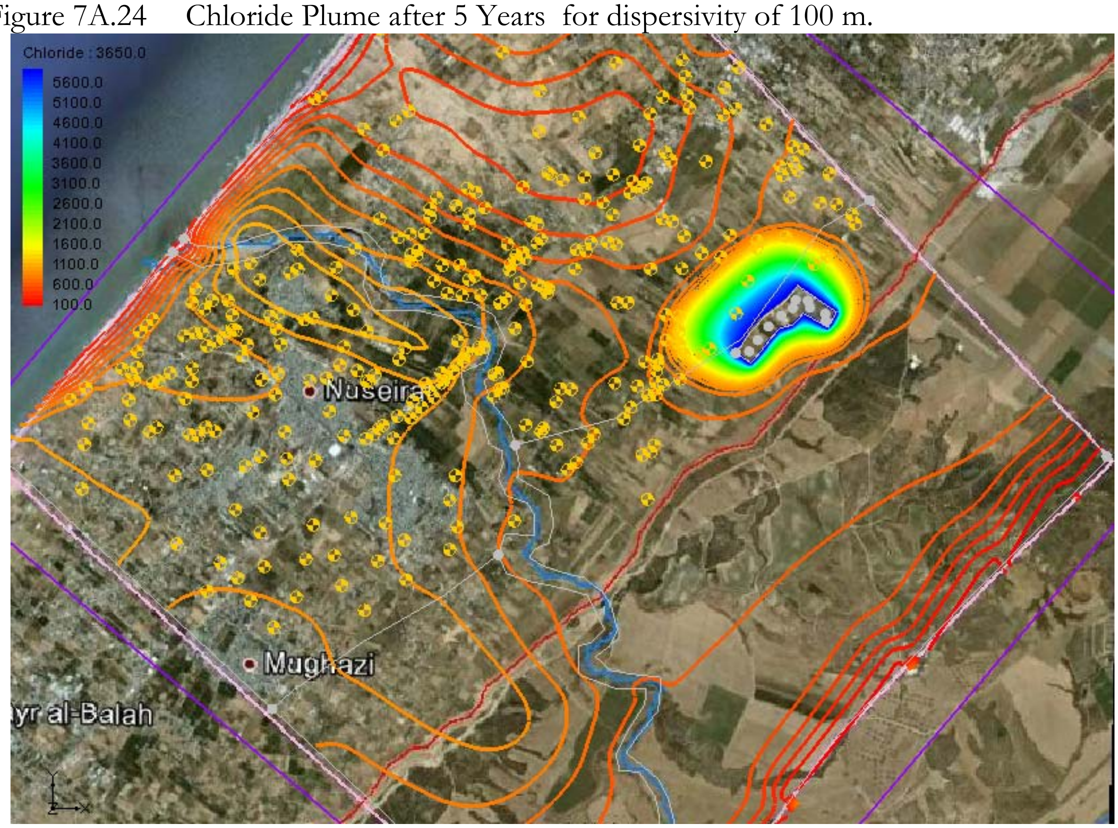


Figure 7A.25 Chloride Plume after 10 Years for dispersivity of 100 m.

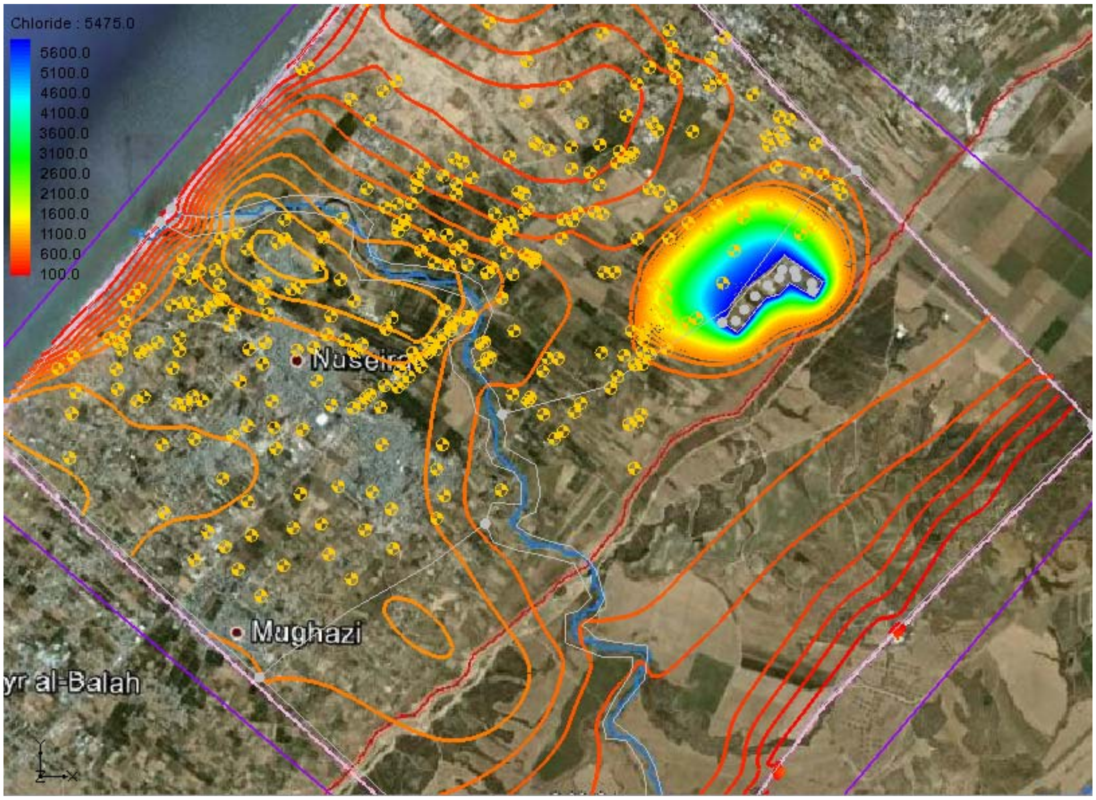


Figure 7A.26 Chloride Plume after 15 Years for dispersivity of 100 m.

Based on the particle tracking simulations and the sensitivity analysis, the contamination tracks will migrate to around 1 km to 2 km away from the landfill within the next 15 years, and that the extent of the leachate may reach the nearby wells. The leachate travels fast due to many reasons; the landfill is located relatively within the saturated part of the Kurkar coastal aquifer with higher permeability (i.e. velocity) than the west part that is governed by the permeability of the Saqiya formation; no continous thick clay layer is present underneath the landfill; and the existence of many abstraction wells in this area.

Based on the current situation, the chloride and nitrate values of the groundwater exceed the safe limits for drinking water quality, the effect of the disposed of wastes at the proposed landfill was studied and the proposed landfill would increase the chloride and the nitrate concentrations within 1 km to 2 km around the land fill.

Mitigation measures should be considered to minimize the leachate accumulated and percolating to local aquifer such as installing landfill liner and final cover as will be discussed below.

Further to the generation of leachate, the rain water that will fall over the non-active Cells should be drained and collected in an adequate manner so as to avoid causing unexpected water collection in low elevations areas of the site. The surface water collection will be done through channels that will be designed so that collected water is discharged by gravity to the lowest points in the sight. During the first years of operation the amount of surface water that will be collected from roads, reception areas and composting plant[61] are expected to be minimum because their correspondent areas only form a small portion of the total landfill area. Therefore the impact of surface water will be more significant during the last years of operation and after closure of the landfill, therefore it is discussed in more details in a later section.

In conclusion, and based on the available data, the impacts of the leachate generation at Johr al Deek could be seen as relatively high as compared with El-Fukhary due to the reasons stated above. This supports the decision made by the FS of using Johr al Deek for a limited period only up until 2032. A shorter duration, if technically and economically feasible would be also recommended. However, the impacts of the leachate generation will be generally controlled by the engineering measures recommended in the design of Johr al Deek landfill, these will reduce the risks of contaminating groundwater, while the risks of odor around the leachate pond could be classified as medium . This impact has been classified as medium impact.

<u>Mitigation Measures:</u>

- As recommended in the Feasibility Study of the project, Engineering measures for controlling of leachate should include an adequate liner system, adequate slopes of the Cells bottom, a drainage network comprise pipes from adequate capacity, a collection pit at the lowest point of each cell and an adequate pumping station to lift the leachate from the bottom to the collection pond to the top of the landfill taking into consideration head losses.
- The capacity of the leachate collection pond and the correspondent pumping should be designed so as to receive the maximum amount of leachate with low retention time so as to minimize odor impacts by keeping minimum amount of leachate in the pond. The pond should be surrounded with wind break trees so that to minimize dispersion of odor in the surrounding areas. The leachate pond should be regularly de-sludged and the removed sludge should be transferred to sludge treatment facilities in the nearest WWTP.
- The leachate collection pumping station and correspondent piping network should be adequately maintained to ensure smooth operation. The design should include a preventive maintenance schedule which should be followed by the landfill operator.
- The two transfer stations serving Johr al Deek Landfill (Beit Lahya and Al Maslakh) should be designed so that the waste loading/unloading areas are to be covered with an adequate roof to prevent rain from getting into the waste during storage in the transfer stations. The transfer station operator should make sure that no loading/unloading or waste storage operations are taking place in open areas, especially during winter.
- The composting windrows and waste reception areas should be covered (already considered in the conceptual design)to prevent contamination of the run-off from these areas. The same applies to recycling areas.

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[61] The conceptual design of the composting plant indicates that the plant will have a roof that will cover all waste windrows, so that rainwater collected from the composting plant will not be polluted with waste leachate

- The leachate resulting from the own moisture content of the waste received at the composting plants would be prevented form percolating through the soil by constructing an impervious bottom layer for the different composting stages. A leachate collection system shall be installed which allows for leachate storage and recycling for humidification purposes.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.
-

Monitoring Activities:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis.
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream) which should be drilled at least 3 meters below groundwater table, the proposed locations of the monitoring wells are shown in Figure 7A-27 below. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest signed from the nearest WWTP.

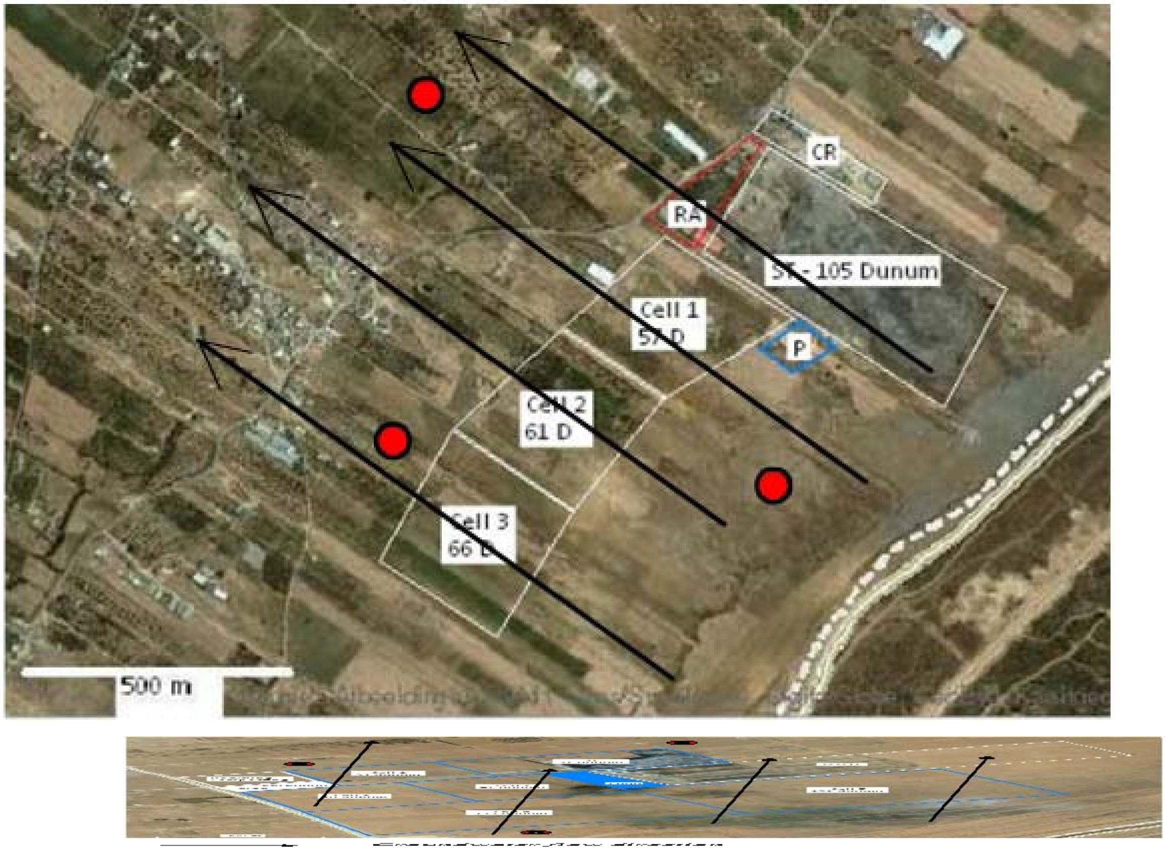

Figure 7A-27: Recommended locations of groundwater monitoring wells for Johr al Deek

7A.2.5 Risks of Receiving Hazardous Wastes

Kindly refer to Section 6A.2.5 and to the mitigation measures listed below

Mitigation Measures:

- The project proponents in the MLDF should negotiate with other Palestinian authorities and the donor community to initiate a project for hazardous waste management that would be operational before 2018.
- All workers of the landfill, transfer station, recycling and composting plants should receive adequate training on the types of hazardous waste that could be handled, the type of hazards and the appropriate methods of handling
- In case the Long Term landfill will start operation before having a hazardous waste facility in Gaza, The special cell for hazardous waste disposal which already exists at Johr al Deek shall resume operation (there are plans to replace it with a new cell) and be used for interim safe hazardous waste storage/disposal which will reduce the risk of co disposing of hazardous waste with non-hazardous wastes in the landfill cells.

- Asbestos waste should be wetted once admitted in the landfill and immediately covered
- Flammable and explosive waste should be strictly forbidden from admission in the landfill. The landfill operation manual should include a list of acceptable and non-acceptable waste in the landfill.
- All workers in the landfill, recycling plant and composting plant should be provided with anti-puncture gloves, steel-toe shoes, overalls and masks. Strict supervision on the compliance of hand sorters to this should be practiced
- Prepare a documented emergency response plan to any spills or fires, there should be enough tools for fire extinguishing

Monitoring Activities:

- Amounts of identified hazardous waste received in the landfill should be documented and reported in the monthly progress report
- Amounts of flammable and explosive wastes that have been refused from admission
- Topographic survey of the special cell and estimation of the amount of received waste
- Health records for the project staff including any occupational injury and any infection case that could be related to waste handling.

7A.2.6 Risks to Occupational Health and Hygiene

Kindly refer to Section 6A.2.6

7A.2.7 Noise Impacts

7A.2.7.1 Johr al Deek Landfill Site

Operation works include noisy activities related to machine operation in addition to the noise generated from the trucks entering or leaving the site. This will result in raising the background noise levels; depending, as mentioned earlier in this Chapter, on:

- the type of equipment and vehicles used on the site;
- the ambient noise level around the proposed site;
- the proximity of sensitive receptors;
- the length of time over which construction works are undertaken.

The main activities that are associated with high noise emissions are:

- Movement of RCVs in and out of the landfill site;
- Placement and compaction of waste;
- Application of daily cover material for waste.
- Operation of standby-generator
- Operation of convey belts and trommel separators in the recycling plant
- Operation of loaders and windrows moving machines in the composting plant

As mentioned earlier during discussing construction noise, the nearest receptor is a residential cluster located about 400-600 m away from the site and accordingly noise impacts are not expected to be major. It is recommended to plant wind break trees around the

landfill borders, especially in the northern and western borders around the recycling/composting plant, to maximize noise attenuation and, in turn, minimize noise impacts to neighboring areas.
It is anticipated that operation activities will not be operational during the late hours; therefore the impact on evening averages of ambient noise will be little. The impact of noise can be considered negative and of medium significance.

7A.2.7.2 The Transfer Stations

During operation, noise at the transfer station may result from the following:

- increased vehicle traffic;
- loading and unloading of waste, and
- operation of the compactor.

In terms of traffic noise the expected traffic load addition is expected to be a minor contributor to the traffic noise around transfer stations. The compactors noise is not expected to be high, while the loading/unloading noise is intermittent and accordingly their contribution to the ambient noise is not expected to be generally significant. The impact of noise at transfer station can be considered negative and of low significance.

<u>Mitigation Measures:</u>

- Key noisy equipment (such as generators, trommels, conveyor belts … etc.) should be selected with minimum noise;
- Optimize the use of machines and noisy equipment (i.e. switching off when idle);
- In case the landfill manager received complaints from neighboring areas regarding noisy operations acoustic barriers should be placed between the noise source and the location of the complaining neighbor.
- Landfilling and operations of the recycling/composting plant should be stopped at night-time.
- Planting of a wind break trees where appropriate to act as a noise buffer.

<u>Monitoring Activities:</u>

- Ambient noise at the nearest residential areas from landfill (refer to Figure 7A)should be measured frequently in an annual basis.
- The complaints from neighboring residents from both the landfill and the transfer stations should be documented by the each site manager, and he should report these complaints to the PMU in the periodic monthly reports.

<u>7A.2.8 Affecting Air Quality by Vehicles Exhaust</u>

Local air quality can be negatively affected by vehicle exhaust emissions from vehicles and machines (generators, loaders, compactors ... etc.) operating at the landfill and RCVs used to transport waste. The bad conditions of the existing vehicles which have been observed during the assessment of the current waste management situation and the lack of regular maintenance will increase the potential impact of exhaust emissions. However, these represent moving point sources, and under normal conditions any effects witnessed on a local-scale will be of a temporary nature and restricted to the immediate point of exhaust emission.

Overall, the potential impact of vehicle emissions resulting from the landfill and transfer stations -related traffic is not expected to increase as compared with the current situation since the chosen locations for transfer stations and the landfill have been previously occupied for the same purpose. If no mitigation measures are undertaken, the impact is considered to be negative with low significance.

Mitigation Measures:

- All vehicles and heavy equipment working in the project should be maintained according to the maintenance schedule recommended by the manufacturer/supplier. Any vehicle that has high smoke emissions visibility detected should be promptly repaired.

Monitoring Activities:

- CO_2 emission rate of all vehicles used in the project should be documented from the manufacturer, the distance and fuel consumption should be documented and reported on monthly basis.

7A.2.9 Visual Impacts and Aesthetics

7A.2.9.1 Johr al Deek Landfill Site

The solid waste accumulation is an unfavorable seen, especially when it is with large quantities as the case in landfills, and also transfer stations and composting / recycling plants. The operation of landfills, transfer stations and composting/recycling plants is also associated with litter dispersion by wind which adds to the negative visual impacts. The operation of landfill equipment and generated dust from the earthworks also adds to the bad scene at the site.

The most effected groups by the visual impacts of the landfill, transfer stations and composting/recycling plants are the inhabitants of the close neighborhood who can see the waste from their places. Also the users of roads that could view the landfill could be also impacted by the low aesthetic value of the area.

In Johr al Deek landfill during the filling of underground portions of waste cells, the operations will be totally hidden from neighboring areas and nearby roads. Also during the operation on layers above the ground it will be expected that active layers will be surrounded by embankments so that waste on the Cells edges would be compacted against them and the height of the landfill will be maintained with a safe slope, so these embankments will also hide waste filling operations from surroundings.

The remaining impacts would be the interrupting of the horizon seen by the spoil hill which will not be reused in the landfill operation, if left in site without being exported for uses outside the landfill area, and the final landfill hill (after applying final cover). Because the development of both hills, landfill and spoil, will be gradual the final visual impacts of those two hills will be maximum after closure of the landfill, therefore they are discussed in more detailed in a following Section.

Currently considerable visual impacts are caused by the existing Short Term landfill at Johr al Deek which is about 15-meter high and uncovered, so waste is exposed at a high altitude which is a relatively high visual impact. The Short Term measures that will be implemented in Johr al Deek landfill, prior to the construction of the Long Term landfill subject of this ESIA, includes that the height of the landfill will be elevated to about 30 meters above-ground and the waste will be covered. The overall impact of the Short Term measures at Johr al Deek Landfill is expected to be positive, even though the landfill height will increase, due to covering and profiling the existing waste body. If the new landfill operations are added to the existing Short Term hill the additional impact on the area, during the operational phase, is expected to be minor.

For the composting/recycling plants the windbreak trees that will be around the plant site and the roof over the compost piles will hide the waste and the trommel separators to most of the surrounding areas, especially that the nearest residential clusters are relatively far and their average height is relatively low (one or two stories), accordingly the visual impacts are expected to be low.

7A.2.9.2 Transfer Stations

The design of the transfer stations recommends that the fence will be wire netting fence which will prevent littering dispersion outside the site but will not hide the inside waste scene, however because the waste will be contained inside the containers there will be low visual impacts on the surrounding ground level areas, while the impact will be higher on elevated neighboring buildings. However, because the transfer stations, Beit Lahya and Al Maslakh, are currently used as open waste collection areas, new additional visual impacts would be added due to the transfer operations. Accordingly the impact has been classified of low significance.

Mitigation Measures:

- The composting/recycling plant should be fenced with windbreak trees to minimize hide negative waste scene from the view of the neighboring areas.

Monitoring Activities:

- Complaints of neighbors from littering dispersion or about the general aesthetic value of the area should be reported to the PMU in the monthly progress report of the site.
- Provide adequate fence, windbreak trees and roof for the composting/recycling plants

7A.2.10 Impacts on Flora and Non-Avian Fauna

Impact Significance:

The baseline study of the project concluded that the Johr al Deek landfill site lacks any presence of significant wetlands of important biodiversity or reproductive value. Furthermore, there is no presence of environmentally rare or endangered species breeding areas, habitats or protected living areas. However, it was found that diverse and abundant fauna species currently use the site for nesting, breeding or feeding. These may be affected by the controlled operation of the landfill as compared with the existing uncontrolled situation where there is a direct contact between birds and animals with the waste.

The noise and daily work of landfill construction and operation could disturb the area's birds and wild mammals. End of life closing plans for the landfill will include a restoration of the site for agricultural purposes. The top soil will constitutes a good ecological host for soil organisms as compared with the current situation. The site restoration in general including any baffles and vegetative screens will create a variety of new habitats.

The impact on fauna and flora is negative with low significance due to the expected interruption of daily breeding, and feeding which take place at the moment as a result of the proposed site control measures and daily waste covering. However, regarding the pollution and accumulation of contaminants in the terrestrial ecosystem which result from feeding on the waste, and the expected decrease in the number of stray dogs visiting the site, the impact is considered positive since this will cease to take place.

Table 7A-10 below summarizes the impacts of the project during the construction and operation phases and their correspondent significance.

Table 7A-10: Summary of impacts during the construction and operation phases and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Odour impacts	Odor impacts of the existing landfill and transfer stations are unlikely to be considerably higher than the existing situation due to the engineering control activities of the project	Medium	Minimize the impacts and maintain their control

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts of landfill gas	Likely to cause some impacts to ambient air quality, with low likelihood for causing explosions or penetrating to the groundwater	Medium	Minimize the impacts and maintain their control
Impacts of leachate and surface water	Unlikely to contaminate groundwater with the taken engineering measures. More likely to cause odor impacts	Medium	Minimize the impacts and maintain their control
Risks of hazardous wastes mixed with municipal waste	Likely to have workers exposure to hazardous waste if no hazardous waste facility is established before the project operation	Medium	Minimize the impacts
Risks to occupational health and hygiene	Likely to have populations of insects and rodents but not necessarily in conditions worse than the existing condition	Medium	Minimize the impacts
Noise impacts	Landfill operations are far from residential areas, the noise of the recycling/composting plant is closer and more likely to cause slight raise of the ambient noise in the area	Medium for landfill site and low for transfer stations	Minimize the impacts and maintain their control
Affecting air quality by vehicles emissions	Most of the impacts are not site specific	Low	Minimize impacts and maintain their control
Visual impacts and aesthetics	Unlikely to add significant visual impacts to the existing situation of the Short Term Landfill and transfer stations	Low	Minimize impacts and maintain their control
Risks of unforeseen exceeding of landfill capacity	There are possibilities that the landfill may be saturated earlier than expected	Low	Minimize impacts and provide early warning
Risks on flora and non-avian fauna	Likely to disturb the existing feeding habits of stray animals	Low, with positive impact on the overall food chain	No mitigation measures required

7A.3 Impacts after Landfill Closure

7A.3.1 Impacts of Landfill Gas

Impact Significance:

Although the proposed degassing system is believed to be sufficient in controlling the impacts and minimizing risks of gas migration to the environment, a new risk will be associated with the after closure phase as there are possibilities that the site management will be reduced especially after changing the main activity of the site to only transferring waste to El-Fukhary Landfill. Accordingly the monitoring activities for ensuring that the gas is under control may not continue during the after closure phase, therefore the recommended mitigation measures below are to provide mechanisms for continuing the monitoring activities and to adequately handle any detected gas leakage during the after closure phase.

Mitigation Measures:

- Beyond year 2032 and particularly following the closure of El-Fukhary site in 2040, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for gas monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting any gas leaks, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

The monitoring activities that were recommended in Section 7A.2.2 should be continued after closure of the landfill, until generated gas quantities from the landfill could be considered negligible. These activities are:

- Keep records of collected gas through the degassing system
- Analyze composition of the landfill gas against main components on annual basis.
- Analyze ambient air quality at the landfill borders on annual basis
- Analyze the acidity and hardness of groundwater taken from monitoring wells upstream and downstream of the groundwater flow on annual basis

7A.3.2 Impacts of Leachate and Surface Water

Impact Significance:

After 2032 leachate generation will theoretically be zero, as mentioned earlier because no more water will enter from the waste, daily cover, precipitation and leachate recycling after placing the final cover. However, there will remain two main leachate issues after closure of the landfill: the amount of leachate that will remain in the leachate pond after closure of Cell 3 and the amount of leachate that will remain inside the landfill body after closure. Because water in the landfill body is expected to take time to percolate through the whole depth of the landfill until it reaches the collection pit at the bottom of the landfill according to the permeability of the waste, the water that entered the active Cell short time before its closure will be collected some time after its closure. Accordingly the first one or two years after the landfill closure will still receive large quantities of leachate. Also, the containment of the landfill may not remain totally tight, therefore some surface water may still enter to the waste body and, accordingly, the landfill should be evacuated from collected leachate inside the Cells whenever it is needed.

The recirculation of collected leachate (large quantities in the first two years and small quantities afterwards until the total stabilization of the landfill) will not be possible after closure of the landfill, therefore, all collected amounts should be discharged and left to evaporate in the pond.

The surface water collection will have special importance after the closure of landfill cells, both during operation and after closure of the landfill phases. This is because the natural drainage features of the landfill location will be changed due to the existence of a new non-permeable hill in the area so that the collection areas of rain water will be changed and may cause the following impacts:

- Collection of large amounts of water in lower areas of the landfill causing pressure over the final cover
- High velocity movements of surface run off which may cause soil and landfill cover erosion
- Collection of large amount of water that will remain stagnant in low elevation areas of the site which may cause aesthetic and public health concerns

The Feasibility Study includes engineering measures for the smooth drainage of surface water from the landfill ring road and closed cells, designing the final cover so that an adequate slope will be maintained to drain surface water to the surrounding ring road and then to a channel that will collect all surface water in a pond at the lowest elevation area of the site. The design of the channels (and possibility associated culverts) is based on a maximum rainfall intensity of 50 mm/hr. These measures are believed to be sufficient to manage the surface water and collect it in a sound manner. However, the collection pond should be designed with a sufficient area to evaporate the collected water during maximum hourly rainfall. Because the surface layer of soil is from clayey silts, the percolation of collected storm water to the ground will be rather slow (estimated permeability 1 mm/day) so that the water will mainly be removed from the collection pond by evaporation, so that if the water surface area of the pond is very small, the water will remain in the pond from the rainy season to the following rainy season and will ultimately overflow.

Based on the calculations presented in Section 6A.2.2 and considering the higher precipitation rate of the north of GS as compared with the south, it is estimated that minimum surface area of the storm water collection pond should be 5,000 m^2 so that the water will be evaporated and percolated to the soil before the following winter. An area located within the landfill perimeter at the lowest elevation area should be used. Accordingly this issue should be addressed in the final design of the landfill.

As mentioned in a previous section, one more issue related to the management of leachate and surface water will be added during the after closure of the landfill phase, which is implementing the ESMP measures if the site will be unmanned after closure of the landfill in the south in 2042. This is again should be addressed by the landfill operator before closure of the landfill the site according to the following mitigation measures and monitoring activities.

Mitigation Measures:

- A sufficient low elevation area for the collection of storm water should be identified after closing the landfill cells. The minimum area identified by the assumptions made in this ESIA is 5,000 m^2
- The staff of the leachate pumping station should not leave the site after closure of the landfill except after abstracted leachate quantities could be neglected. This would be decided by the PMU-EM through his review of the leachate monitoring activities reports.
- If the landfill location will be abandoned after closure of the landfill, the JSC should transfer the laboratory and the trained personnel to the new location for disposal of solid wastes. The trained personnel whom were responsible for leachate monitoring activities during the operation phase should continue their work after closure of the landfill and the JSC should provide the logistics necessary for those personnel to continue their monitoring activities.
- In case of detecting pollution of the groundwater monitoring wells, the JSC should investigate, either by its staff or by third party, the reason for the leak and take prompt actions to mitigate the situation.

Monitoring Activities:

The monitoring activities that were recommended in Section 7A.2.3 should be continued after closure of the landfill, until generated leachate quantities from the landfill could be considered negligible. These activities are:

- Leachate pumped amounts should be reported on monthly basis from the records of the pumping station
- leachate analysis (COD, BOD, pH, TDS, total N, total P, heavy metals, TPH) should be carried out on annual basis, while pH, COD and BOD should be carried out on quarterly basis
- Groundwater analysis from 3 monitoring wells (one upstream of groundwater flow and two downstream), as shown in Figure 7.7. Samples from the monitoring wells should be collected on quarterly basis and analyzed against BOD, COD, pH and hardness. Analysis of total N, total P heavy metals and TPH should be carried out on annual basis.
- Amounts of sludge removed from leachate pond should be recorded with a manifest signed from the nearest WWTP

7A.3.3 Visual Impacts

The visual impacts after closure of the landfill will be the obstruction of the landscape with two new hills: the covered landfill and the un-used spoil if not exported for other uses. The design height of the landfill is 30 meters in which will be the same height for the existing Short Term landfill but for a larger area. The height and area of the remaining un-used spoil is not finally defined as it depends on the depth of excavation, but should be minimized by directly or gradually exporting form the site during the operating life cycle of the landfill or just completely eliminated by reducing the depth of the landfill as previously discussed.

The visual impacts of the landfill hill that will be developed by the project is expected to affect only few houses in the clusters that are located south west of the project site (about 400-600 meters). In all cases the view of the hills will only be a minor addition to the existing Short Term hill which will slightly affect all these areas before the construction of the Long Term landfill. Furthermore, the more distance from the landfill site the less will be the visual impact.

The impact is considered of minor significance and the planned plantation of the final covered landfill may actually improve the aesthetic value of the area.

Mitigation Measures:

- Carry out and maintain plantation of the final covered landfill cells

Monitoring Activities:

- Keep records of the green areas planted over the final cover of the landfill

7A.3.4 Stability Impacts

The excavation and gradual progression of the landfill cells will work in changing the original structural stresses on the soil underneath the landfill. After closure of the landfill, the biochemical reactions that will take place will cause changes to the overall density of the landfill and will cause other changes to the stresses over the soil underneath. The landfill site is generally stable as there is no major fault type formation, as mentioned earlier in Chapter 5, with medium seismic activity, accordingly the stability risks are classified as low, however, the stability issues should be put into consideration as mentioned in the mitigation measures below.

Mitigation Measures:

- Stresses both on the soil and on the waste body should be considered during different stages of the operation and after closure of the landfill. The heights, slopes and protection measures should take these factors into consideration

Table 7A-11 below summarizes the impacts of the project after closure of the landfill and their correspondent significance.

Table 7A-11: Summary of impacts after closure of the landfill phase and their correspondent significance

Impact	Likelihood and severity	Significance	Mitigation Measures Effects
Impacts of landfill gas after closure of the landfill	Likely to cause some impacts to ambient air quality, with low likelihood for causing explosions or penetrating to the groundwater	Medium	Minimize the impacts and maintain their control
Impacts of leachate	Unlikely to contaminate groundwater with the taken engineering measures. More likely to cause odor impacts	Medium	Minimize the impacts and maintain their control
Visual impacts	Unlikely to add significant visual impacts to the existing situation of the Short Term Landfill	Low	Minimize impacts
Stability impacts	Unlikely to cause dangerous stresses on the soil after taking this into consideration	Low	Minimize impacts

7B SOCIAL IMPACTS AND PROPOSED MITIGATION MEASURES FOR THE NORTHERN SECTION OF THE PROJECT

7B.1 Introduction

As explained above under section 6B.1, the analysis of social impact examines the potential social risks associated with a project and explores how to address them so as to achieve the project's development objectives. The social management plan also included measures to maximize the potential positive impact and ensure that they are reaching the most needy groups. These measures are included in more details in the ESMP, while others are structured as separate set of recommendations by the end of the ESMP Chapter. The level of significance, for this section of social analysis of the impacts, was not also done on numerical basis and was determined based on the Consultant technical judgment. Attention was given to the concerns of stakeholders as part of the various consultation activities. The significance of the impacts was assessed based on the expected duration of the impact, the level of damage it may cause and the asset (s) that will be potentially affected. In assessing the significance of the impact distinction was made based on the impacts that are of most concern (need to be avoided, mitigated or compensated) and those that are considered to be less important because they are of temporary nature or because the affected groups will be able to cope with them.

7B.2 Potential Socioeconomic Impacts of the Northern Section of the Project

The following sections of this Chapter will present a description of the predicted socioeconomic impacts of the northern section of the project. As mentioned under section 6B.2, GSWMP is developed with the global general and core objective of protecting the public health and environment through developing and implementing a sustainable, cost effective SWM system on the level of both the short and long term across GS. This applies also on the northern section of the project, where the various components are expected to result in several positive socioeconomic impacts, including, improvement of the public health, environmental condition in the residential areas and creation of economic opportunities of the poor segment of the population through creating number of job opportunities that can accommodate low and medium skilled labor. However, the project is also expected to result in a number of negative socioeconomic impacts during both construction and operation. Resettlement and increased service tariff on poor population are among the most important negative impacts of the project. The impacts below are divided by the project phase, namely construction and operation. Management plan to address the potential significant negative impacts will also be illustrated below setting monitoring plan and institutional responsibilities for implementing the mitigation measures.

It worth noting that most of the socioeconomic impacts of the project under this section of the ESIA has big similarities with the ones described under the analysis of the socioeconomic impacts of the southern part to the project. Most of the social impacts has global nature with the only few exceptions where the exact location makes difference like the case in resettlement impacts.

7B.2.1 Impacts During Construction

7B.2.1.1 Creation of temporary job opportunities

One of the key global positive socioeconomic impacts of the project is the creation of job opportunities during the construction phase of the project. As explained under the analysis of the ESIA of the southern part of the project, the construction phase of the various components of the project will involve creation of a variety of short-term jobs that will result in improvement for the economic conditions of certain segment of the population including poor people with low and medium skills. Moreover, highly qualified professionals in engineering and other professions will also be required during this phase. This will result in direct benefit on the local economy and local businesses and will help in temporarily elevate the family poverty for those who will benefit form the created jobs.

Impact Significance:

Such job opportunities will have positive temporary impact of high significance on the livelihoods of local people. Despite its temporary nature, these jobs will contribute to poverty elevation of the poor families who will benefit from these jobs.

7B.2.1.2 Inconvenience to local communities

As explained under section 6B.2.1.2, the construction process of the landfill expansion and the associated TSs will involve site works including movement of heavy vehicles, transferring construction material and influx of high number of construction workers to the construction site. The construction works are expected to result in temporary inconvenience to the neighboring communities. The following are the key impacts divided by the project site:

- **From the construction of the landfill**

The surrounding community for the proposed Johr al Deek landfill is composed of scattered Bedouins houses which are located on the road to the landfill. The nearest residential area to the landfill is Johr al Deek town which is located more than 1 km. 4000 inhabitants (approximately 500 households) live in the town and their main activities are agriculture and grazing. The area also included some industrial activities such as baton factories, animal fodder factory and asphalt factory. These, however, were stopped production in 2006 when the siege was posed on Gaza as they lacked the imported raw material. No commercial activities are present in the area except a small shop to purchase the recyclables that are collected by the scavengers

As the case in Fukhari landfill, transferring the construction materials will involve high pressure on the main road with several heavy trucks movements. The increased traffic pressure may result in delays for the users of the road and increase in the risk of road accidents.

Impact Significance:

The area is considered relatively denser in population compared to the landfill in southern Gaza. Despite this, this impact can still be classified as an impact of low significance due to its temporary nature and the relative low population density of the site and the relative far distance to populated areas. The significance of this impact is not expected to be sensed by large number of population.

From the construction of the transfer stations

During the construction phase of the TSs that will be rehabilitated, namely Al Maslakh and Beit Lahia, the same activities mentioned above are expected to take place. Due to the different nature of the locations of the TSs within residential areas, the impacts are expected to be sensed by local communities who will be temporarily encountering impacts from construction phase, including noise, dust and traffic impacts in the neighborhoods. This impact will be of less significance for the communities near the sites of El Karama, Um El Nassr, Beit Hanoun that will be cleaned and closed as part of the project.

Impact Significance:

This impact is characterized by being a temporary moderate significance impact for the neighboring communities to the TSs that will be rehabilitated.

Mitigation measures

The mitigation measures for tackling this potential negative impact is proposed to be similar to the measures explained for the same impact under the southern part of the study. Commitment to the various environmental measures stated on the ESMP will help in mitigating the potential negative impact on public health. Moreover, additional participatory measure that aim to engage local communities and share information transparently with them are also recommended, including establishing community- based monitoring committees, transparent and regular communication for information, establishing and enforcing a clear complaints system and ensure full access full restriction from access to the site by local communities, waste pickers and any other group outside the construction team.

More details about the group of these measures are explained above under section 6B.2.1.2

7B.2.1.3 Resettlement Impacts

As indicted under section 6B.2.1.3 for introducing this impact, potential involuntary resettlement by both acquiring privately owned land for the project components as well as affecting the livelihoods of poor individuals of waste pickers is perceived to be one of the key negative socioeconomic impacts predicted from GSWMP.

This section of the report will focus on the potential resettlement impact related to northern part of the project.

A) Impact on the livelihoods of the informal waste pickers

Complete loss of sources of income

The same explanation about the complete loss of income of number of the waste pickers as explained under the southern part of GSWMP is applicable on the northern part of the project, including the portion of the waste pickers working in both Johr al Deek final disposal site and the associated TSs, namely, namely Al Maslakh, Beit Lahia, El Karama, Um El Nassr and Beit Hanoun who are fully reliant on waste picking as the sole livelihoods source. It is expected that security system will be established to control the landfills and transfer stations for safety purposes. Restricting these groups who are currently entering freely from reaching the landfills and the TSs will result in significant negative impact on these groups' source of livelihoods. The negative implications of discussed under the impacts analysis for the southern part of the project including family impoverishment and social unrest are also potential risks for the northern part of the project.

Complete loss of sources of income the informal workers in Johr al Deek Landfill

The social survey conducted as part of preparing the ESIA and the ARAP showed that 33 waste pickers are working in Johr al Deek proposed location for the landfill. Only 2 of the waste pickers stated that they are working as part timers and 31 are full timers and are totally dependent on sorting recyclables from the waste as the only source of income.

As the case in other waste disposal locations, the landfill is dominated by certain families. Most of the waste pickers (17 waste pickers) in Johr al Deek disposal site belong to El Khaldey family. The rest of waste pickers belong to other 4 families.

Figure 7B.1 A discussion between one of the social surveyors and the waste pickers in Johr al Deek site.

Figure 7B.2 Children working in Johr al Deek final disposal site

As indicted above, an inventory survey covered the waste pickers in various intermediary collection and final disposal sites. The following are the key findings from the ARAP survey and the discussion with Johr al Deek waste pickers:

- The average age of the waste pickers ranges from 16 years old to 42 years old
- Other children of younger age make irregular visits to the disposal site searching for day-to-day livelihoods from recovering recyclables.
- The educational status of the waste pickers range from the category of those who did not attain the primary education to the level of university students.
- Almost all the waste pickers are contributing to the family income.
- The number of years that the waste pickers spent working in the site ranges from 3 year to 20 years.
- 25 of the 33 waste pickers are the sole bread winner for the family
- When asked about the average daily income from their work in the site, the answers ranged from NIS 20 /day to NIS 80/ day depending on the number of working hours and the number of years of experience of the waste picker.
- Only 4 of the waste pickers defined their work mode as "part time".
- All waste pickers were clear in defining the main fields for spending their income from the recyclables selling. They were specific in mentioning food.
- When asked about the potential damage (impact) from restricting them from using the disposal site, all the waste pickers mentioned that they will suffer from full loss of income, with the exception of only 3 who are working on part time mode.
- The alternatives that the waste pickers suggested for jobs included a variety of options as a first preference. All these options were far from the work in recyclables. This included, raising livestock, driving or working in mechanical workshops, groceries, frozen food and mobile shops.
- All waste pickers showed readiness to work as official employees in the landfill or the associated sorting or composting facilities. Two of them expressed a need for full time contact.

Complete loss of sources of income for the informal workers in the temporary waste storage sites and transfer stations

Currently two existing temporary waste storage sites serving Johr al Deek landfill, namely Al Maslakh and Beit Lahia will be upgraded, improved, and converted into TSs. Moreover, three further smaller collection sites, namely, El Karama, Um El Nassr and Beit Hanoun will be cleaned and closed as part of the project. The field observations showed that waste pickers operate in relatively large numbers and regular basis only in Al Maslakh and Beit Lahia. For the other three sites that will be closed, no waste pickers are working permanently in these sites since they tend to be more like large street collection points where limited waste is disposed of and is cleaned on more frequent basis than the other collection points

Figure 7B.3 El Karama waste collection point

Figure 7B.4 Beit Hanoun waste collection point

For the sites that will be rehabilitated, restrictions will be imposed on the informal groups working in these TSs. The following are the key findings from the ARAP inventory survey:

Al Maslakh

- Currently around 16 waste pickers are working in Al Maslakh. All the waste in Al Maslakh stated that they are the main breadwinners in the family. Only one of the waste pickers is 16 years old and the age of the rest of the groups vary between 19 to 45.
- The users of the site are not restricted to one family. However, it seemed that the 16 interviewed waste pickers are the only waste pickers who are acquiring regular livelihoods source through the site.
- The duration of working in the site varied from few months experience to 20 years. The average daily income estimated by the waste pickers was between NIS 30 to NIS. Few exceptions referred to a daily income as low as NIS 10: NIS 15 and other mentioned a high income that reaches NIS 17 pre day
- All the interviewed waste pickers stated that they are taking care of dependants in their families. This is either because the waste pickers are the main bread winner in the family (12 out of 16) or because they are largely assisting in the family income. The number of dependants varies from 4 to 13 members.
- Two of the female interviewees stated that that work in recyclables recovery from the site with their husbands.
- For all the interviewed cases, lack of financial base and skills to start other business were the main reasons for getting involved in the job of recyclables recovery. Even the single case that mentioned experience in rising livestock, referred to lack of resources to start up an enterprises in this field.

Figure 7B.5 Waste Pickers at Al Maslakh

<u>Beit Lahia</u>

- The field work showed that the site is dominated by only 16 waste pickers. All of them is responsible for dependants within their families. Only three of them have other breadwinners within the families
- They are widely denominated by the age group of 30-40 with few exceptions of below 20 and only one lady widow above 50.
- The waste pickers belong to four families and their educational background varied from unaccomplished primary education to unaccomplished secondary education.
- The average daily income mentioned by the waste pickers ranges from NIS 20 to NIS 35.
- The majority of them stated that they work from 5: 6 hours per day. Only two of the waste pickers mentioned that they work 10 : 11 hours per day.

The analysis conducted as part of the ESIA and the ARAP showed big similarities between the potential impacts of the project on the waste pickers working in the southern part of GS and those groups working in the northern part of GS. This returns to similarities in characteristics of the two groups and their working mode. The group of waste pickers who will experience full loss of income as a result of project is generally among the most vulnerable groups of GS communities. The main reason for the vulnerability of these groups is the limited choices they can make in life due to the lack of assets including both physical assets (financial assets) as well as non-physical assets like education and skills. The difference that was observed is the recyclables picking activities tend more to be family oriented business in the southern part of GS than the case in the northern part. This suggests that handling waste pickers in terms of capacity building and compensation schemes for the northern part might be relatively more challenging due to the prevalence of individualistic spirit among the group.

Vulnerability of these groups as explained above was on of the important consideration that the Consultant used in determining the significance of this impact as a negative impact of high significance.

As explained under the impacts analysis of the southern part of the project, partial loss of income will be encountered by the informal sector groups who give visits to the landfills and TSs on part time or irregular basis to make an additional/complementary income. These groups will also be restricted from access to the sites and this restriction will result in partial negative impact on their sources of income. It was noticed that part time mode in the northern part is still limited than in the south. The impact on full timer waste pickers will likely be higher and more serious in significant since this is their single source of income and in most of the cases they are using this source of income in fulfilling basic needs of dependants that they are responsible for.

For other informal groups who are working in waste picking as part timers in waste containers and collection spots in streets (including El Karama, Um El Nassr and Beit Hanoun), they will unlikely be affected from the project unless additional restriction is imposed on them by municipalities and/ or JSC as service operators in order to eliminate the nuisance they cause to the streets image and the difficulties they add to the collection process by scattering waste around. It was not clear until the production of the ESIA if imposing this kind of restriction on street waste picking activities will be considered or not.

Impact Significance:

The severity of the project direct impacts on the part timer waste pickers is not expected to be of major significance. This returns to the fact that they have other alternative sources of income that they use to maintain a living. This impact, thus, could be classified as a negative impact of moderate significance. However, and due to the marginal nature of their activities and the un-sustainability and risks associating with their works, the ESMP and the final study recommendations will propose a number of actions that may help in empowering these groups economically.

For waste pickers who are working on full time basis, the significance of the potential impact is considered to be more serious on their and their families' livelihoods.

Mitigation measures

Under section 6B.2.1.3 of this ESIA comprehensive mitigation plan for tackling the potential negative impact on the livelihoods of waste pickers was elaborated in details. Further analysis and details for implementing this plan has been included in the ARAP of Fukhari landfill.

The developed mitigation plan and the proposed short and long team measures under the southern section of the project could be adapted and applied on the waste pickers working in the northern part of the project. Moreover, more specific information about the affected waste pickers from the northern part of the project, namely Johr al Deek landfill, is presented in the ARAP for waste pickers that has been developed for the northern section of the project.

B) Impacts of loss of privately owned land

For Johr al Deek Landfill:

The establishment of the landfill including the various component until 2040 will involve permanent land acquisition of around 250 additional dunums. This includes extending the existing Johr al Deek disposal site from 195[62] dunums to 445 dunums. Before the project construction phase, land for the expansion in the landfill site needs to be secured. Since the needed land is privately owned, arrangements for securing the land and providing satisfactory compensation to land owners should be considered during the project planning phase. Some of the land that will be acquired already has access restrictions by Israeli imposed security buffer zone.

As part of the ESIA and the RAP preparation, an inventory survey for the land owners has been conducted. The following are the key steps taken and the main challenges faced:

- The land that will be needed is owned by much higher number of owners compared to the case in the southern landfill. The number of owners is expected to reach to around 600 individual.
- The Consultant tried to conduct informal interviews with sample of the land owners to check willingness to sell land. This included meetings with representatives of trustworthy representatives from the families who were able provide information about the landowners including those who might not be available.
- Approaching 100% of the land owners of the proposed landfill was proved to be too difficult due to the fact that portion of them live outside Gaza and another portion has probably already sold the land without registration so tracking it will be difficult.
- The ARAP meant to provide guidance and foundation for an up-to-date ARAP that should be developed by the PMU or the local authority as part of the project implementation.
- Most of the land plots and land ownership is registered at the Land Ownership Department and official document was obtained form the Land Authority in march 2012 (attached in Annex 7B)
- The attached list of owners, however, does not necessarily reflect the actual ownership situation since the case is likely that several owners have sold land to municipalities without official registration.
- Land value in this area is higher than land in the south and the owners are more reluctant to give land to the project. Land is more fertile and productive and is likely providing higher income to the owners than the case in the south. This will be further checked as part of the RAP.

As explained under section 6B.2.1.3, the same aspects covered by the inventory survey for the land owners in the southern section of the project will be covered by the sample of the landowners who will be approached as part of the RAP preparation.

<u>For the transfer stations</u>

[62] The actual current used space in the landfill is only 120 dunums and not 195 since large portion of the land is located inside Israeli borders or not used to keep the security buffer zone.

The two temporary waste storage sites Al Maslakh and Beit Lahia are not expected to result in land acquisition for any privately owned land. In the case of Al Maslakh where upgrading will likely involve relocating the site, the newly selected location will be very close to the old one and is state- owned land.

Impact Significance:

The land that will be acquired as part of the project is of relative low value due to proximity to the current final disposal site and the buffer zone with Israel. However, the land is relatively more fertile and productive and farming activities are taking place around Johr al Deek location. Despite the sensitive nature of the impacts related to affecting assets, in the case of this project and out of the previously mentioned justifications, this impact could be classified as an impact of moderate significance. The compensation plan as part of the RAP will minimize the impact to minor.

Mitigation measures

For Johr al Deek Landfill

A RAP will be prepared and will be implemented in order to ensure a fair economic compensation for the affected landowners through a consultative and mutually agreeable process. Consultation with land owners has started as part of the preparation of the RAP. This will be further progressed until the RAP is produced and the ESIA is finalized. The compensation for securing the land needed for the landfill will be determined upon RAP completion.

7B.2.1.4 Impacts on cultural heritage

Important cultural heritage sites are located near Johr al Deek site. Opposed to the situation with Rafah landfill, the location is considered more sensitive from heritage sites perspective. There are 3 sites located to the north of the site, namely, Roman site, Laqia site and Jabalia Mosaic site. In addition to an important historical triangle located to the west of the site. This needs to be considered during the various stages of the project.

There is also still the likelihoods of potential accidental finds within the various project sites during the construction of the project.

Impact Significance:

This impact is classified as an impact of medium significance but enhancement measure will be suggested within the social management plan in order to minimize any potential impacts on the cultural heritage

Mitigation Measures:

As recommended under section 6B.2.1.4., monitoring of site excavations is an essential mitigation measure and the involvement of the Ministry of Tourism and Antiquities as a key stakeholder should be ensured and maintained. In case of finding information or signs about archeological sites or in cases of incidental finds the concerned agency, namely, the Ministry of Tourism and Antiquities should take immediate action. The provisions and terms of the Contract with the Contractor should also include a provision for dealing with this case.

Table 7B.2: Assessed significance of expected impacts during the construction phase

Impact	(+/-)	Likelihood	Significant	Mitigation Measures Effects
Creation of temporary job opportunities	+	High likelihood	Positive impact of high significance	No mitigation measures required
Inconvenience to local communities from the construction of the landfill	-	Low likelihood	Negative impact of low significance	Reduce significance to minor
Inconvenience to local communities from the construction of the transfer stations	-	Medium likelihood	Negative temporary impact of moderate significance	Reduce significance to minor
Resettlement Impacts **Impact on the livelihoods of the informal waste pickers** **- C**omplete loss of sources of income	-	High likelihood	Negative impact of high significance.	Reduce the severity of the impact
Resettlement Impacts **Impact on the livelihoods of the informal waste pickers** - Partial loss of sources of income	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Resettlement Impacts related to the **loss of privately owned land**	-	High likelihood	Negative impact of medium significance	Reduce significance to minor
Impacts on cultural heritage	-	Low likelihood	Negative impact of medium significance	Reduce significance to minor

7B.2.2 During Operation

7B.2.2.1 Reduction of the negative health and safety impact

GSWMP, in general, is expected to result in significant improvement for the SWM system and accordingly for the environmental conditions and human health. The current health and hygiene impacts from the uncontrolled practices in collection, handling recyclables are expected to be eliminated as a result of adapting controlled measure throughout the various stages of waste management.

As explained under section 6B.2.2.1 above, a potential positive impact on the health conditions of the informal sector groups, the workers in SWM and the local communities in general are expected to be attained from the project implementation. This positive impact is regarded as one of the potential global outcomes of the project implementation.

Moreover, there are potential positive impacts on the neighboring communities to the dumpsite and the transfer stations. Currently Johr al Deek disposal site is poorly managed with no machinery used in the site for regular covering of waste. It is expected that the sanitary condition of the new landfill and the various environmental measures that will be considered will result in improving the conditions within the landfill and will be reflected on the neighboring area.

Moreover, most of the existing temporary waste storage sites are located within residential areas. These sites are used as waste disposal sites where waste is accumulated for very long time and in most of the cases the sites are rarely cleaned. It is predicted that positive health, hygiene and visual impacts from the planned upgrading, rehabilitation activities or closure of the existing waste storage site will be positively sensed by the neighboring communities. It is predicted that the general operation conditions will be more hygienic and more attention will be paid to the regular cleaning of the site. Waste will also be removed more regularly and frequently to Johr al Deek landfill.

Beit Lahia and Al Maslakh disposal sites are located 200 m from the nearest residential area. Around 80-100 tons of solid waste that reaches the station every day. Waste is not transferred regularly is accumulated for over one year to reach volume of waste to nearly 50 thousand tons. The inefficient and low capacity equipment along with shortage in fuel prevent regular transfer to the main final disposal site of Johr al Deek.

Additionally the current disposal sites of al Karama, Um El Nassr and Beit Hanoun will be closed. The surrounding communities to these locations will likely sense positive impacts for the closure of these sites.

However, the previous experience with El Yarmouk transfer station suggests that the upgrading activities should be carefully planned and designed in order to ensure that they are well- sensed by the residents of the neighborhood as explained under the ESIA of the southern part of the project.

<u>Impact Significance:</u>

The reduction of the negative health and safety impact resulting from the current poor collection and disposal practices of solid waste is one important positive impact of high value to the local communities who will be the main receptors of these benefits. The impact could be classified as a positive impact of high significance.

7B.2.2.2 Creation of Job Opportunities

As explained under section 6B.2.2 above, the improvement of the SWM system as a whole in Gaza Strip will involve several capital cost investment in upgrading the existing infrastructure and fleet or establishing and preparing new locations and introducing new equipment. The operation of the different investment components including the newly introduced sites (including landfills and transfer stations) of the project will require additional human resources of various backgrounds and qualifications. This is applicable on Johr al Deek landfill where the site will need technical and administrative staff. Junior staff member with low and medium qualifications could be recruited from communities close to the location since this option will ensure a socially sensitive approach and will be more efficient economically. Moreover, the composting plant planned as part of Johr al Deek landfill will possibly accommodate the waste pickers who are currently making a living from separating recyclables from the waste in the site, or part of these waste pickers. The investment in the landfill and associated composting facility will have a positive impact on local employment. As recommended in the ESIA for the southern part of the project, contractual measures should be considered in order to ensure that local communities will be given priority in benefiting from the created jobs.

Apart for the landfill, the transfer station that will be upgraded namely Beit Lahia and Al Maslakh will employ a few staff members to manage and operate the station and to manage and operate the hauling trucks. Additionally for the composting facilities that will be operated, job opportunities will be created and could be of special benefit to the informal sector groups. The planned rehabilitation is expected to have a positive impact on employment. The same measure should, however, be taken into consideration to ensure that staff recruitment policies will give priorities to neighboring communities in benefiting economically from the project.

Working formally in SWM services was observed to be a socially acceptable business and large portion of waste pickers showed willingness to officially join this business.

Impact Significance:

This is considered as positive impact of high significance to the local communities particularly within the prevailing percentage of unemployment in GS. Moreover, integrating the informal waste pickers within the formal system would also be a positive socioeconomic impact of high significance if this is carefully considered during the project implementation.

7B.2.2.3 Changes in land use

It is predicted that several land use changes will occur as a result of the project. Some of the changes in the land use will involve positive impacts on land use. This is applicable on the case of improving the conditions of exiting waste storage sites of Beit Lahia and the existing part of the final disposal in Johr al Deek which will be rehabilitated, engineered and better managed.

Moreover, the closure of El Karama, Um El Nassr, Beit Hanoun and the current location of El Maslakhi will involve making land plots in central and important residential areas available for various potential services that could be of big importance to the local communities.

Some of the changes in land use involve negative impacts like the case in Johr al Deek landfill where additional land plot will be added to the current space of the disposal sites in order to allow additional spaces for cells and other landfill facilities. This land is currently used in various economic activities including farming. Accordingly, there is a potential loss of productive land. The establishment of the landfill will result in a loss of the options for alternative land use and thus represents a permanent commitment of land resources.

Impact Significance:

The change in the land use as a result of the project is a combination between positive and negative impacts depending on the nature of change occurring to the land use. Due to the relatively higher value of land in the northern area of GS, the impact of land loss and the changes in land use is regarded as a negative impact of medium significance.

Mitigation Measures:

To mitigate this impact related and in addition to the preparation of RAP to handle land ownership and compensations issue, adherence to the other mitigation measures listed under various parts of the ESMP will help in ensuring that the sites are properly managed.

7B.2.2.4 Traffic Impact

From the Landfill

A road network already exists in the GS with Salah El Dein linking the South to the North passing through the five governorates. Salah El Dein Road and the Coastal Road are the main two main roads in GS. Transportation of waste from the north to the south of GS is one of the key current challenges causing an impact on all roads. The current bad conditions and high traffic load of Salah El Dein road accompanied by the bad conditions of the trucks make regular transportation of waste to the final disposal sites a big challenge.

For Johr al Deek landfill, which is located in the east of Gaza Governorate, the main access road leading to the landfill is Salah El Dein Road and Al Karama Road (Eastern Road) .The 2 Governorates (Gaza and North Governorates) are expected to be served by two transfer stations that will accommodate waste temporarily until waste is transferred to Johr al Deek landfill. The distance between Beit Lahia TS and JaD landfill is around 17-18 km. Most of this distance is located in Al Karama road. On the other hand the distance between Al Maslakh TS and Johr al Deek landfill is around 5 km, of which around 4 km is located on Al Karama Road. It is, thus, anticipated that the majority of the traveling distance from the 2 transfer station to Johr al Deek landfill will be across Al Karam Road. The impact is expected to be limited because all along the eastern road (Al Karama road) there are limited residential units, industrial services.

Figure 7B.6 The Road from Beit Lahia TS to Johr al Deek and from Al Maslakh **TS to Johr al Deek**

<u>Impact Significance:</u>

As indicted above the traffic impact as a result of waste haulage from Beit Lahia TS to Johr al Deek and from Al Maslakh TS to Johr al Deek is not expected to result in significant negative implications on the roads users and the neighboring communities due to the relative low density on the road that will be used. The impact could be, thus classified, as an impact of low significance.

<u>Mitigation Measures</u>

Although the significance of this impact is expected to be low, some of the mitigation measure proposed under the impacts analysis for the southern part of the project should also be considered as part of this section of the project. This includes:

- After operation, restrict transport trucks travel to the hours outside the rush hours.
- Strict monitoring to the road accidents as part of the monitoring plan to be implemented by the Traffic Authority.
- Regular information sharing about the times of travel of the transport vehicles with the communities and establishments located by the road.

Moreover, the following mitigation measures, as recommended above under the impacts analysis for the southern part of the project, should be considered in order to minimize any potential traffic impact within residential areas in transferring waste from street containers and collection points to the TS:

- Selecting appropriate model of means of waste transport including small trucks that can easily maneuver in narrow streets and do not form serious obstacle inside the TSs.
- Arrange the times of transporting waste to and from the TS to avoid traffic rush hours.
- Assist local communities in establishing community- based monitoring committees in order to follow up and report feedback on the management system and impacts on the communities to the PMU

7B.2.2.5 Higher Cost to Beneficiary Communities Particularly the Poor

Poverty and income insecurity are key socioeconomic characteristics across GS. No geographic distinctions between the north and south were detected during the survey and interviews across the Strip. What applies to the southern Governorate in terms of some disparities among families and households in the level of income applies also to the northern Governorates. It is thus safe to assume that the potential impact on poor families from the increase in SWM service fees is predicted to be of the same nature and severity on the families in North GS as the case with the families in the south.

As explained under section 6B.2.2.6 above, the operation of the long term activities will require significantly higher revenues for SWM in order maintain and sustain the system. Currently poor families in refugees camps are exempted from waste charges, while fees per other non-refugees household arranges between NIS 10 to NIS 12 per household per month. One of the serious problems related to the service fees is the lack of efficiency in collection which is among the main challenge facing municipalities.

Based on the FS recommendations, NIS 3.8 per person per month, or 19 NIS per household per month (assuming 5 persons per household) will need to be collected in order to ensure covering the needed operation cost. Around 60% of the WTP survey respondents, representing the largest portion of respondents to this question, showed willingness to pay more with a maximum NIS 10 monthly. The impacts analysis of the northern part of the project emphasized the importance of considering an appropriate level of payment that local residents can afford. The economic interests of the local population, particularly the poor, should be taken into consideration before proposing any fees system that may overload them economically.

Impact Significance:

This impact could be classified as an impact of high significance. It should be noted, however, that several official and unofficial mechanisms are in place to exclude the poor from paying the service fees (e.g. Services provided by UNRWA to the refugees' camp, exempting non-refugee poor families from service fees by municipalities).

Mitigation measures

As explained under section 6B.2.2.6 above, the main objective of the mitigation measures developed under this section is to ensure that poor communities are benefiting, not overloaded financially and also to eliminate the sense of dependency on the government and donor agencies and replace it with a sense of ownership to the service and recognition for the financial commitments that it entails. Moreover, the ESIA has developed two sets of mitigation measures that have been divided into short term immediate measure and strategic or longer term measure. Additionally a number of crosscutting measure that would help in attaining financial sustainability by emphasizing the role of local communities and the importance of participation were also elaborated. Moreover, the conducted WTP survey as part of the ESIA study and the FS should be used as guidance in developing service fees schemes. Further consultations with stakeholders will need to take place along the process of project planning. More details about these mitigation measures are explained under section 6B.2.2.6 in the impacts analysis as part of the impacts analysis for the southern part of the project.

7B.2.2.6 Depressing Property Value

From the Landfill

The establishment of the landfill in the proposed site of Johr al Deek where the current final limitedly managed disposal site locates is expected to result in certain economic implications for the land and assets value within the site. This is also the case in the neighborhoods where such waste disposal facilities are located. However, it has been widely recognized recently that today's state-of-the-art landfills provide a variety of economic, employment and community-enhancement benefits that typically may contribute to property values. This potential negative impact on land and property value was one of the issues raised during the consultation activities conducted as part of preparation for the ESIA and the RAP. Moreover, some of the interviewed land owners and owners of business in the area where too concerned about the future of the area to the extent that they stated that they will not allow for the establishment of the landfill if this will affect their business negatively.

Although the proximity to the green line with Israel is lowering the price of land in this specific area, yet land value is relatively high compared to the case in southern Gaza.

From the Transfer Stations

The impact of the TSs on the value of land and assets in the TSs' neighborhood could be divided into two main types:

- The impacts on land and assets in the neighborhood of the current waste storage sites that will be rehabilitated like the case in Beit Lahia disposal site. This is not expected to be of high negative significance. On the contrary, the rehabilitation of these sites, improving the operation, more frequent cleanliness, improving working conditions and the efficiency of work in the station will likely result in reducing the negative impacts of the waste storage site, including odor, increase in the numbers of flies and mosquitoes and the negative visual impact. These improvements might help in restoring the prices of assets and properties in the neighborhoods after the decrease encountered as a result of the existence of the random and unmanaged waste storage sites.
- The same applies to Al Maslakh disposal site which will be closed and relocated in a close by location. The impact of this will likely be on the same neighboring residential communities. However, constructing the TS on engineered and controlled basis will likely eliminate any potential negative impacts.
- For the sites that will be closed, namely, El Karama, Um El Nassr, Beit Hanoun, the locations will be improved and the assets values will accordingly be enhanced.

Impact Significance:

For the landfill, the negative effect on the prices of land and property as a result of the establishment of the landfill is considered as an impact of medium significance since land is relatively of higher value than the northern part of GS. This also applies to the impacts on assets in the surrounding areas around the TSs. However, rehabilitating the TSs site and introducing improved design and more environmentally friendly management system to the TS will likely improve the situation in the neighborhood. The impact could be eliminated in case if strict management measures are applied in the site.

Mitigation Measures

As explained under section 6B.2.2.7 above, the project is not expected to provide direct compensation for the predicted reduction in the price of property value as a result of the project. However, strict compliance with the proposed mitigation measures including hygienic practices within the locations as well as establishing community-based mechanisms to ensure that local communities are channeling their concerns, complains and feedbacks about the site management.

Additionally, these affected areas should be given priority in receiving support from Government and donors programmes. The PMU can play the role of advocator for this idea by coordinating with relevant agencies and transferring the priority needs of the local communities.

7B.2.2.7 Potential impact on the social and economic activities of the neighboring communities

From the landfill

The area of Johr al Deek Landfill includes some industrial activities such as baton factories, animal fodder factory and asphalt factory. These, however, were stopped production in 2006 when the siege was posed on Gaza as they lacked the imported raw material. No significant commercial activities were reported in the area except a small shop to purchase the recyclables that are collected by the scavengers. This is not expected to be negatively affected particularly if business cooperation is established between the owner and the landfill.

Livestock, poultry and sheep production stations were detected near the area of the landfill. Moreover, agriculture is also one important activity in the area. Due to the nature of these activities and the fact that they do not require permanent interaction with customers (like the case of markets inside residential areas), it is not expected that the project will result in negative impacts on their customers' influx. The limited grazing activities in the landfill location are not expected to be negatively affected since the area around the landfill is still an open area for grazing and no restrictions will be imposed.

However, there is a potential socioeconomic impact as a result of land acquisition to secure space for the landfill. This is examined in more details under the RAP and the impacts under construction above.

From the Transfer Stations

The neighborhood of the TSs might encounter some limitations for the social and economic activities as a result of the location of the TSs with all the associated waste-related activities and the potential odour and visual impact. However, the sites are currently used as a temporary waste storage sites in both Beit Lahia and Al Maslakh (which will be relocated but will still be within the same area). The two sites are currently operating with a minimum level of control and are causing serious disturbance to the neighboring communities. Despite the fact that the existence of the TS may impose lots of limitations on the social and economic activities within the neighborhood, this is not expected to be more serious than the current case. It is expected that better management and control for the site after the rehabilitation will potentially reduce the sensed negative impact and accordingly will have limited impact on the social and economic activities

<u>Impact Significance:</u>

This impact from the landfill is expected to be an impact of low significance. The same impact related to social and economic activities resulting from the establishment of the TSs is still uncertain impact and could be classified as an impact of low to moderate significance.

<u>Mitigation Measures</u>

To mitigate this potential impact, the same mitigation measure illustrated under section 6B.2.2.8 for the ESIA of the southern part of the project are recommended to be used. This includes full adherence to the proper management practices in various sites as well as introducing community-based mechanisms for channeling local communities' feedbacks, concerns and complaints.

Table 7B.3 Assessed significance of expected impacts during the operation phase

Impact	(+/-)	Likelihood and Severity	Significant	Mitigation Measures Effects
Reduction of the negative health and safety impact	+	High likelihood	Positive impact of high significance	No mitigation measures required
Creation of Job Opportunities	+	High likelihood	Positive impact of high significance	No mitigation measures required
Changes in land use	+/ -	High likelihood	Combination of positive and negative impact of moderate significance	Reduce the severity of the impact
Traffic Impact From the Transfer Stations	-	Medium likelihood	Negative impact of low significance	Reduce the severity of the impact
Traffic Impact From the Landfill	-	Medium likelihood	Negative impact of low significance	Reduce the severity of the impact
Higher Cost to Beneficiary Communities Particularly the Poor	-	Medium likelihood	Negative impact of high significance	Reduce the severity of the impact
Depressing Property Value From the Landfill	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Depressing Property Value From the Transfer Stations	-	Medium likelihood	Negative impact of moderate significance	Reduce the severity of the impact
Impacts on the social and economic activities From the landfill	-	Low likelihood	Negative impact of low significance	Reduce the severity of the impact
Impacts on the social and economic activities From the Transfer Stations	-	Medium likelihood	Negative impact of low significance	Reduce the severity of the impact

7B.3 General Additional recommendations to maximize the social benefits of GSWMP

7B.3.1 Raising the Profile of SWM

The waste management sector is positioned within a low profile in Gaza Strip, like the case in many countries of the developing world. The following are the key reasons for the low SWM profile:

- Waste is not recognized as a precious asset except by those who are working closely and making a livelihood out of handling recyclables.
- The various initiatives that encourage reducing, reusing, recycling waste and "at-source-segregation" have been relatively limited and attained limited success. Thus local communities are still underestimating the value of waste and waste management services
- Although the sector is employing hundreds of the poor and is creating a source of living to a large number of low-income families, working in this sector is still perceived as a stigmatized job. Workers in this sector are generally low- paid and are receiving a minimum level of health security and safety considerations during their work. Few of the SWM actors in Gaza has successfully managed to change this image (e.g. JCP) and attracted university graduates to this sector. JCP model, thus, worth considering in studying the possible action for raising the profile of SWM jobs.
- Generally, local communities have long perceived waste collection as an easy service that should be provided by the Government and overlooked the costs associated with various SWM steps after the primary collection which is the only visible step to local communities. There is a general tendency to underestimate the importance of SWM as a service In most of the cases, ordinary residents are not aware of what comes next after the collection of their waste from their doors or street corners.

It is believed that working to improve the SWM system on long term basis in Gaza Strip should associate with immediate strategy to enhance SWM profile in order to help various stakeholders to acknowledge the sector potentials, challenges and needs. There is a need to design and enforce a comprehensive programme with the main objective of enhancing the SWM profile in Gaza. Actions should target local communities and the formal and informal workers in the sector. The strategy promotion should engage important and influential stakeholders like donors, media and community leaders.

7B.3.2 Awareness raising

Local population and waste are connected by definition. It is people that produce waste, fund the management of waste and are the principal beneficiaries of good waste management through improved sanitation, public health and an enhanced civic landscape. Citizens also have the greatest influence on the success or the failure of waste strategies and investment in infrastructure, as the most fundamental aspect of any waste service is waste generation and its preparation for collection. Low level of public awareness with the issues of SWM which result in negative practices and weak public participation in SWM projects. Any improvement to waste management services, strategies and infrastructure development done in isolation of the recognition of this will never attain the level of success that would otherwise be achieved. For this reason, behavioural change is of central importance in waste management strategies and services development.

Strategic awareness raising programmes should be designed and applied across Gaza Strip on SWM related issues. The following are key issues with very high importance:

- SWM cycle and performance in GS and the main reasons for the defects in certain phases
- The value of recyclables and the potential of the recycling sector in strengthening the economy and assisting the poor families
- The role of the workers in SWM, their work dynamics and what could be done to facilitate their jobs
- Role of the community in an improved SWM including waste disposal behaviors, the possibility of at source segregation which might be regarded as an important option in the future; and role of community members in sustaining the systems technically and financially
- Informal recycling business and the role it plays in elevating poverty.
- Waste management and the associated costs

7B.3.3 Ensuring the benefits are granted to the Local population

As indicted in the impact analysis above, the creation of temporary and permanent job opportunities is one of the key positive social impacts predicted from the project. To maximize the benefit from these jobs, efforts should be made to ensure that these opportunities are directly bridged to the local population like the local people of El-Fukhary The following are key measures to attain this benefit:

- Contract Documents prepared for firms bidding to work on major project construction activities including the construction of the landfill, the construction of the transfer station should set binding contractual obligation that specifies assigning local, population to the created opportunities and give them the priority in getting the created jobs.
- Local firms should be encouraged to participate in tenders
- Transparent information sharing about the created opportunities and fair evaluation in the candidates selection

7B.3.4 Reducing potential occurrence of work accidents

The potential occurrence of work and occupation accidents during the construction phase is a risk that should be considered by enforcing the needed mitigation measures. The full adherence to the ESMP measures, in general, will reduce this potential risk. In particular the following should be considered to protect the safety of construction crew and local people around the construction sites:

- Strict supervision and control over the performance of the construction workers including their adherence to various health and safety measures. This should be and explicit obligation on the Contractor and the bidding and contracting documents should state clear terms to ensure the contractor full commitment to this aspect.
- Strict supervision and control over , machinery, operating times, methods of working.

7B.3.5 Improving the Primary and Secondary Collection systems

Special attention should be give to the primary collection system being the most visible part of the service and the stage that strongly affect the views and perceptions of local communities about the provided service.

There is a crucial importance for accompanying the improvements of the final disposal systems with improvements for the primary and secondary collection of waste. The various consultation activities and the carried out social survey came out with the main features of local communities expectations from an improved system and their willingness to pay for that. It is recommended to benefit from the findings of this survey in designing the improved collection systems with the standards that meet the local communities' expectations. The diversity of the conditions, places and socioeconomic situation within each of the Governorates should also be highly considered in designing the various systems. Thus, The ESIA recommendations should be dealt with as starting points for further surveys and community consultation activities that should precede projects' designs. Community-based Organizations should be widely integrated into these activities.

7B.3.6 Working Conditions of the workers in the SWM sector

There is a need to enhance the various working conditions for the formal workers in SWM as part of improving the whole system and raising the SWM profile in GS. Measure for this should include the following:

- Legal recognition for waste management & recycling (formal and informal) as a sector of employment;
- Work to secure additional financial allocation for the salaries and incentives of the temporary and permanent workers;
- Pay the due attention to the safety consideration of the workers by providing the needed protective equipment, training and orientation;
- Mobilize various civil society organizations to assist in the provision of non-financial benefits including capacity building programmes, improving the living conditions of the workers and implementing supportive interventions for the families of the workers;
- Raising community awareness to change the negative attitude towards the workers in this sector.

7B.3.7 Training and Capacity Development

Capacity building progrmmes for all those involved in SWM in the level of the workers, drivers and supervisors. The social issues related to SWM and how they are affecting local communities' health and economics and how waste constitute and important source of income for poor and vulnerable groups are all issues that should be considered in the capacity building. In addition to that, other technical capacity building modules proposed under the ESMP should also be considered.

Of particular importance to this project is the capacity development of the waste pickers in order to allow them to contribute to the project positively as productive labour force. This has been explained in details above under mitigating the resettlement impact on waste pickers.

CHAPTER 8 ANALYSIS OF ALTERNATIVES

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

8.1 No Project Alternative

The objectives of the GSWMP is basically to improve the environmental and public health conditions in Gaza strip, accordingly it is expected, by definition, that the environmental and social benefits will overweigh the impacts.

The main benefits that are expected by the projects include:

- Closure of open dumpsites around Gaza Strip and upgrade the environmental and public health conditions in their surrounding areas
- Prevent open burning of solid waste in dumpsites and in waste containers to allow for more room for additional waste, this practices are expected to be stopped, or minimized, with more reliable collection of waste.
- Prevent uncontrolled contaminated water leaching from waste in dumpsites to the fragile groundwater aquifer in Gaza Strip
- Provision of important facilities for safe and sanitary management of solid waste generated in Gaza Strip for a long-term time horizon, which shall play an important role in the sound development of the Strip
- Improve the possibilities of recovering organic waste and recyclables in the solid waste, which would reduce waste disposal quantities and achieve socioeconomic benefits.
- Provide work opportunities for the people of Gaza in the project and indirect services for contractors and entrepreneurs, which would help in alleviating unemployment problems

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

8.2 Alternatives of proposed treatment technologies

With regards to the limited land available in the GS, landfilling may not be regarded as the optimum solution for the waste management. However, the most important two alternatives are 1) waste minimization and recycling and 2)Waste incinration or waste to energy, and both have major disadvantages as discussed below.

Only relying on waste minimization and attempting to achieve a 100 % recycling/reuse rates wouls be impossible to achieve on the short term. This is based on similar experiences in both developed and developing countries. However, this should be regarded as the long term target for the waste management in GS and strategic measures should be put in place to achieve such desired results. On the other hand, waste to energy, which is being successfully implemented in many countries across Europe is characterized by high capital and maintenance costs as well as the need of high expertise which are not available in GS at the moment.

A good solution would be to construct engineered landfills over the short and medium terms as suggested by the current project . During the\is period, measures to increase recycling rates, recycling factories and recycling awareness should be implemented. Same goes for waste minimization and smart design of processes and products. The composting/recycling plants which will be constructed as part of the current SWMP aims to achieve similar targets and these are supported by the ESIA Consultant as a beneficial treatability study during the coming years. The compost quality may not be good enough, in such case alternatives usages for the organic wastes shall be sought such as waste to diesel technologies.

8.3 Alternatives of Integrated Waste Management Scenarios

The Feasibility Study of the project has studied five alternative locations for the landfill, which are:

- A location in Tuffah district in Gaza Gocernorate
- A location in Qarara district in Khanyounis Governorate
- Johr El Deek location in Gaza Governorate
- A location in Abasan in Khanyounis Governorate
- El-Fukhary location in Rafah Governorate

The FS introduced exclusion criteria for the location, which included exclusion of any site within less than 200 meters from residential areas, and exclusion of any site within 500 meters from any water well. This exclusion criteria has excluded the three locations other than Johr al Deek and El-Fukhary. This exclusion is totally agreed by the ESIA team.

Following the exclusion process the FS has presented three scenarios for the integrated waste management in Gaza Strip as follows:

- Scenario one: Gaza Strip will be served by two landfills, Johr al Deek and El-Fukhary, until year 2040. Johr al Deek will serve North Gaza and Gaza City and El-Fukhary will serve Deir El Balah, Khan Yunis and Rafah.

- Scenario two: North Gaza and Gaza City will be served by Johr al Deek landfill until 2020, then Johr al Deek will be closed and the whole Gaza Strip will be served by El-Fukhary, landfill.
- Scenario three: North Gaza and Gaza City will be served by Johr al Deek landfill until 2015, then Johr al Deek will be closed and the whole Gaza Strip will be served by El-Fukhary, landfill.

The Feasibility Study made different technical, logistical, environmental and social comparisons between the scenarios and concluded that the preferred scenario is, as described earlier in this ESIA, to operate Johr al Deek serving North Gaza and Gaza City until 2032, where additional waste may breach the minimum distance of 200 meters from adjacent houses, then the whole Gaza Strip will be served by El-Fukhary.

From an environmental and social perspective El-Fukhary, site seems to be generally less sensitive than Johr al Deek in terms of proximity of residential areas, sensitivity of groundwater, less land prices and surrounding land use which may allow for future expansion. Some exceptions to this may be effective such as the proximity to Gaza International Airport, which has been shown in the course of impact evaluation not to be considered as a major impact.

On the other hand, the political situation in Gaza which leads to repeated invasions by the Israeli army and separating between the north and south of Gaza gives environmental importance for having two engineered landfills with sufficient volumes to effectively serve all Governorates of Gaza during emergencies, otherwise waste will unacceptably be accumulated in uncontrolled locations leading to many environmental shortcomings. Also from the social perspective it will be a social balance if each area will include the disposal site for its waste, and if, on contrary, all the waste of Gaza Strip is disposed in one location the inhabitants of the surrounding area of this location may have some negative feelings about the project if they are not convinced about the its benefits.

A final clear preference from the environmental and social perspective between scenarios could not be ascertained, but the more usage of El-Fukhary, site with available area in Johr al Deek to receive waste in emergencies may be slightly preferable from the environmental and social perspective.

In conclusion, there are no environmental and social objections on the preferred scenario in light of the impacts assessment presented in the previous Chapter and the recommended mitigation measures and monitoring activities.

8.4 Alternatives of Landfill Height and Depth

The proposed design of El-Fukhary and Johr al Deek landfills indicates that the landfill depth below ground level will be 20 meters and the height above ground will be 30 meters. This will involve a calculated excavation volume of about 6.7 million m3 of soil for El-Fukhary and 1 , if the excavation slope is 1:2, in which about 40% of this amount will be needed for the landfill operations according to the assumptions presented in Chapters 6A and 7A. The spoiling of such large amount of soil, if will not be utilized by other users, will need large area of land which will be difficult to develop and will also increase the dust emissions in the area as result of wind erosion.

On the other hand if less depth and more height have been selected for the landfill, to compensate for the volume, there might be security issues from the Israeli side as the landfill is very close to the borders in addition to less landfill capacity as the excavation slope is expected to be steeper than the above-ground slope, this will add to the landfill capacity issues as presented in the previous Chapter.

An ideal situation will be to have an optimum depth and height for the landfill that will make no, or few, excess soil that will not be reused which is calculated by about 8-9 meter depth excavation and 42-43 meters height as presented in the previous Chapter" the area that could be needed to store the spoil could be used as another landfill cell that will compensate a 20% less landfill capacity resulted from the shallower depth. But, again, this ideal situation may be theoretical if did not have a security approval.

In case a 40-meter height of the landfill is not logistically possible, a detailed investigations of possible uses of excavated soil should be explored or a sufficient land should be allocated for storing this spoil as mentioned in the previous Chapter.

8.5 Alternatives of Gas Management

There are two alternatives for the handling of collected landfill gas: to flare it, or to use it for power generation. The environmentally preferred alternative will normally be to use the gas for power generation as this will be utilization of a non-fossil fuel source in power generation which will cause some savings of the precious fuel resources in Gaza Strip, especially during the period where the borders are not freely open. However, the installation of power turbines at the landfill location will need to be economically feasible so that the project will be sustainable so that it is assured that the gas will be utilized and will not be left unused.

Given the estimated gas generation rates and methane contents, which were presented in the previous chapter, it is expected that the gas volumes may only be feasible during the peak period of gas generation. Accordingly it may not be feasible at the first years of the project operation to use the gas for power generation, and it may be more suitable to flare it. Assuming the heat value of methane is 1000 Btu/ft3 and that the heat power efficiency of the turbine that will be installed will be 25%, the following table gives indication of the power that could be recovered from the gas at different years of the gas generation

Table 0-1: Electric power that could be recovered from the landfill gas at different years assuming 25% power efficiency

Year	Amount of landfill gas (m3)	Amount of methane gas (m3)	Electric power that could be recovered (KW)
2020	9,376,131	3,750,452	31.4

Year	Amount of landfill gas (m3)	Amount of methane gas (m3)	Electric power that could be recovered (KW)
2025	32,645,067	13,058,027	109.2
2030	57,088,669	22,835,467	191.0
2035	103,322,068	41,328,827	345.7
2040	172,364,461	68,945,784	576.6
2045	170,652,686	68,261,074	570.9
2050	139,718,602	55,887,441	467.4
2055	114,391,916	45,756,766	382.7
2060	93,656,180	37,462,472	313.3
2065	76,679,195	30,671,678	256.5
2070	62,779,615	25,111,846	210.0
2075	51,399,601	20,559,840	172.0
2080	42,082,434	16,832,974	140.8
2085	34,454,183	13,781,673	115.3
2090	28,208,699	11,283,480	94.4
2100	18,908,857	7,563,543	63.3
2110	12,674,986	5,069,994	42.4
2120	8,496,297	3,398,519	28.4

In conclusion, the decision about utilization of the landfill gas in power generation should be based on an economic feasibility study considering the amounts of gas that will be collected and the power transmission requirements, but during the first years of operation when the gas recovery will not be feasible it should be thermally destructed through flaring.

CHAPTER 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

CHAPTER 9: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The Environmental and Social Management Plan (ESMP) presented in this chapter reflects the implementation procedures and mechanisms for the mitigation measures and monitoring activities of the expected impacts previously discussed in Chapter 6 and 7. The ESMP assigns certain tasks for different stakeholders according to their roles and responsibilities in the project. The roles of supervision and monitoring for the implementation of the various impacts are presented in the matrixes/tables from 9.2 to 9.17. Generally, the information presented in these matrices applies to both the southern and northern sites. Where specific impacts and mitigation measure relate to certain specific site, it is mentioned in the matrix.

The ESMP is adding on the FS recommendation for the project management, which comprise the following main features:

- A Project Development and Safeguards Unit (PDSU) will be established for managing the investments and provide overall supervision on the project progress. The FS recommends that the PDSU shall be under the auspices of the UNDP-PAPP or the MLDF.
- Two Joint Services Councils (JSC) will be responsible for the project operation during the first years of operation, one will be for North Gaza and the other will be for South Gaza including Deir Al-Balah and Rafah (JSC-DBR). The North Gaza JSC (JSC-NG) will be responsible for the operation of the solid waste management system (collection, transfer and disposal at Johr El Deek landfill) for the waste of North Gaza, Gaza Municipality and UNRWA camps in correspondent areas. While the JSC-DBR will be responsible for the operation of solid waste management system (collection, transfer, composting/recycling and disposal at El Fukhary landfill) for the waste of Deir Al Balah, Khan Yonus, Rafah and UNRWA camps in correspondent areas.

It would be expected that the PDSU will assign a contractor, at the first stages of the project, for construction of landfills service areas (administration building, leachate pond, parking area and truck washing area) recycling/composting plants and transfer stations, in addition to excavation of the first cell of the two long-term landfills (and subsequently other cells in due course), preparing the roads, placing the liners and digging the monitoring wells. The work shall be under supervision of engineering consultants who shall approve the contractor's performance for releasing his payments. The PDSU is expected also to procure landfill equipment, transfer and collection trucks and different electrometrical components from correspondent suppliers. The operation of the system shall be carried out by the two JSCs as mentioned earlier.

The roles and responsibilities of the ESMP have been recommended based on the previous setting.

9.1 Institutional Setting of the ESMP

The PDSU shall include an Environmental Manager (PDSU-EM) who will have the overall responsibility for implementing the ESMP and shall report directly to the PDSU Manager. During the construction phase (before starting the operation) the contract of the Engineering Consultant (EC), who will supervise construction work, should include supervision component on the relevant mitigation measures that will be implemented by the construction contractor. The EC representative in each construction site should report directly to the PDSU-EM about the performance of the contractor in implementing ESMP measures during his work, the approval of the contractor's invoices should include the signature of the PDSU-EM based on the reports he receives about the contractor performance in implementing the ESMP measures. The PDSU-EM should not totally depend on the reports he receives from the EC, but he should also make site visits on regular basis to confirm the reports he receives about the implementation of the ESMP measures by the construction contractor.

The two JSCs would be under the supervision of a Ramallah – (West Bank-) basedSWM Development Committee (DC). It would include representatives of the ministries, UNDP, MDLF, JSC and other key stakeholders.

Efficient implementation for the social management plan should involve tailored efforts for maximizing the positive social impacts and ensuring that they are reaching the local communities and minimizing the negative impacts that may hit the poor and vulnerable groups. The potentially-affected groups (particularly waste pickers, land owners and communities near the proposed facilities) should be consulted along the process in order to ensure that their views are considered and that suitable measures are in place to eliminate the severity of negative impacts. Efficient consultations with stakeholders and high level of participation are seen as a prerequisite for a successful ESMP. it is strongly recommended to appoint a Social Development Officer (SDO) within the PDSU. The SDO should be leading the various participatory activities.

During the operation phase each of the two JSC managers (JSCM) of the landfill sites will generally be responsible for implementing mitigation measures and monitoring activities. During the first six years of operation, the two JSCMs will supervise the ESMP measures at the two sites in addition to the correspondent transfer stations and the composting/recycling plants., they will report to the PDSU-EM. Following the first six years of operation , it is expected that the PDSU will cease to operate and its responsibilities will be transferred to the JSC.
During the after closure phase the two JSC should provide the resources sufficient of timely implementing monitoring activities.

The monitoring activities referred to above represent self or internal monitoring , it is expected that compliance/regulatory monitoring will be also performed by MEnA or other relevant ministries as will be indicated later in Tables 9-3 to 9-14.

9.2 Roles and Responsibilities for Implementation and Supervision

The mitigation measures and monitoring activities that were recommended in Chapter 6 and 7 shall be implemented according to the above-mentioned institutional set-up. Environmental Management and Monitoring matrices have been prepared for the actions to be carried during design, construction, operation and after closure phase. The matrices present the responsibilities of different stakeholders for mitigation measures and monitoring activities for both the landfill site (including the composting/recycling plants) and the related transfer stations. These matrices are presented in Tables 9-3 to 9-14.

The reporting of ESMP measures should be done on monthly basis during construction, operation and after closure phases, and should be prepared either by the EC or the JSCM for correspondent phase of the project. The monthly reports will be presented to the PDSU-EM who shall make sure that the ESMP measures are implemented in due course according to the progress report. The PDSU-EM should report for the PDSU Manager and the project Steering Committee on annual basis. In case a corrective action is needed the PDSU-EM should ask the PDSU Manager for the resources to take this corrective action and should adequately report this corrective action. These reports should include the following components:

- Monthly reports prepared by EC and submitted to PDSU-EM:
- Monthly reports prepared by JSCM and submitted to PDSU-EM:
- Annual report prepared by the PDSU-EM and submitted to the PDSU Manager and the Steering Committee.

The specific roles and responsibilities of the SDO planned to be appointed under the PDSU are presented in Box 9.1 Below.

Box 9.1 Key responsibilities of the Social Development Officer (SDO)

- Establish dialogue with project affected groups, including local communities in the TS and landfills sites, landowners and waste pickers and ensure the project is implemented in a socially sensitive manner that consider the interests of these groups.
- Monitor the project performance and report challenges and propose measures to improve project performance.
- Design and implement awareness raising campaigns
- Facilitate the formation of various community based mechanisms including community-based monitoring committee and social committee as part of implantation of the ARAP.
- Prepare ToRs for the formed community based mechanisms, share with the members of the committees and follow the performance of these committees.
- Close facilitation for the execution of the ARAP and ensuring that compensations are reaching the PAPs.
- Maintain databases and efficient records for the PAPs as part of the ARAP
- Maintain database and efficient records of the waste pickers and work to integrate them in the various programmes and interventions to minimize the potential negative impact on them.
- Prepare ToRs for external consultants that could be needed during the project cycle and follow up on the delivery of the consultancy service.
- Assist in developing strategies for the implementing the long term measures (e.g. raising the profile of SWM, develop and enforce financial sustainability instruments)
- Ensure adapting participatory mechanisms in monitoring the project impacts and evaluating outcomes
- Prepare quarterly progress reports and raise it to the PDSU and report to the World Bank where applicable.

Coordinate with other successful models (e.g. the model of Al-Menya Landfill in the West Bank) to benefit from the experience and lesson learnt

The SDO should have a degree in social science or social development practice. He/she should be familiar with work in projects with similar scope and has very high communication and facilitation skills. Local university graduates, particularly women, should be encouraged to apply. To enable the SDO to efficiently fulfill his/her responsibilities, the capacity building and training modules presented in Box 9.2 are proposed. The SDO should receive these capacity building programmes before start of the construction phase of the project.

Box 9.2 Proposed Capacity Building Programmes for the SDO

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

Moreover, the implementation of the ESMP involves other voluntary community-based mechanisms to assist the SDO in reaching local communities and to facilitate access to information and feedbacks. It is suggested to benefit from existing mechanisms like the voluntary "Districts Committees" by involving them and activating their roles wherever applicable. These committees are composed of trustworthy individuals in their communities. The members should also be motivated and willing to contribute to the project with time and effort. It is suggested to form 1 voluntary Community- Based Monitoring committees in the area of Al Fukhary landfill and work to activate the role of exiting "Districts Committees" in the other 3 communities near the transfer stations. Moreover, additional voluntary Community- Based Monitoring committees in the area of Johr al Deek landfill and other 2 communities near the transfer stations are also recommended to be formed. The PDSU should facilitate the establishment/activation of the following voluntary community based committees:

1. Voluntary Community- Based Monitoring Committee from El-Fukhary and Al Buyuki community near El-Fukhary Landfill.
2. Voluntary Community- Based Monitoring Committee from Al Namsawi
3. Voluntary Community- Based Monitoring Committee from Tal El Sultan
4. Voluntary Community- Based Monitoring Committee from Deir El Balah (from the nearest area close to the TS site after it is identified)
5. Voluntary Community- Based Monitoring Committee from Johr al Deek neighboring community to the Landfill.
6. Voluntary Community- Based Monitoring Committee from Beit Lahia
7. Voluntary Community- Based Monitoring Committee from Al Maslakh

The nomination and selection of the Committee members should be done in coordination between the municipalities/JSC and the PDSU. The section should also be done in consultation with the neighboring communities. The appropriate selection mechanisms for the Committees should be designed by the SDO of the PDSU. It is suggested that every voluntary Community- Based Monitoring Committee should include a balanced representation of various community groups including trustworthy community leaders, residents representing different economic and professional background, various age groups (including youth), representatives of commercial activities, NGOs, women, schools and other educational institutes health care institutes …etc.

It worth noting that the formed committees with the assistance of the PDSU will play the role of the non- technical monitoring including all the monitoring aspects related to communities feedbacks, complaints and measuring satisfaction levels.

Box 9.3 Key responsibilities for the Community- Based Monitoring committees

- Facilitate the PDSU and the SDO access to the local communities
- Conduct various surveys and consultation activities as part of engaging local communities in monitoring the project various phases and assessing various impacts.
- Assist in the delivery of awareness raising campaigns
- Facilitate the consultancy assignments arranged for different purposes during the project cycle through the provision of data and assistance and connecting consultants to local communities
- Coordinate with local organizations to facilities the access of the neighborhoods near the project sites to services.

It should be the responsibility of the PDSU to work to strengthen the capacity of the members of these committees in order to enable them to fulfill their proposed responsibilities above. It is recommended that the SDO invests time in providing hands-on training and transferring experience to the committees' members. Subjects of the hands-on training may include, but are not limited to, communication and community surveying skills, delivering of awareness messages, measuring changes in behavior and writing report.

Moreover and as part of the supervisory role anticipated by the Palestinian regulatory authority, it is recommended that capacity building and training programmes be developed to target the staff that will be involved in supervising the project. Box 9.4 blow presents a generic list of the topics that could be included in the capacity building modules for regulatory authority.

Box 9.4: Generic tentative list of the key capacity building modules for regulatory authorities

- SWM cycle and relation to environment and local communities
- ESMP implementation for SWM projects
- Inspection on landfill sites
- Labour standards and conducting site inspections
- Health and safety standards and conducting site inspections

9.3 ESMP Budget

The ESMP matrices presented in Tables 9-3 to 9-14 includes many items that needs to be allocated in the final budget of the project. Because the project is basically an environmental project the distinction between the budget for engineering works and environmental safeguard measures is difficult because ultimately the whole project will have clear environmental and social benefits. For distinguishing the ESMP budget from other cost items needed to implement the project, it has been assumed that all the measures included in Tables 9-3 to 9-14 are included in the project budget except for the following items (related to project management, capacity building, consultancy awareness and compensations for the resulting involuntary resettlement) presented in Table 9-2, that may be considered distinct from the pure engineering components of the project.

Table 9 -1: Proposed Budget for the ESMP

Category	Item	Budget (US $)

Project management[63]	Salary of the PDSU Manager in 6 years X 2 offices	**216,000**
	Salary of the PDSU-EM in 6 years X 2 offices	**144,000**
	Salary for the SDO in 6 years X 2 offices	**144,000**
Capacity building	Capacity Development for the SDO	**20,000**
	Training courses on Hygiene and Hazardous Waste Management for project staff	**40,000**
	Capacity building and training activities for staff of the regulatory Ministries including MEnA, MoH, MoL, MDLF	**100,000**
Consultancy	Contracting consulting firm for carrying out environmental/social audit for the project performance and recommending improvement measures (3 audits in 6 years)	**200,000**
	Allowance for contracting experts in some needed ESMP measures, such as pesticides consultant, groundwater expert, energy expert, safety expert … etc.	**120,000**
	Consultancy services (strategy for raising SWM profile in GS and strategies for developing financial instruments)	**200,000**
Awareness	Designing and implementing awareness raisin campaigns	**80,000**
Compensations	Transition assistance for the waste pickers of Al Namsawi and Tal El Sultan (southern section)	**126,420** [64]
	Transition assistance for the waste pickers of Al Maslakh and Beit Lahia (northern section)	**192,640**[65]
	ARAP for landowners at El-Fukhary landfill	**8,876,500** [66]
	ARAP for landowners at Johr al Deek landfill	8,660,000[67]
	ARAP for waste pickers in El-Fukhary landfill	**228,600**[68]

[63] The implementation of Gaza SWMP will be divided into two separate projects; El Fukhary implemented by the MDLF and JaD implemented by the UNDP which requires two separate PDSUs that needs to be mentioned and considered in the required personnel of the PDSUs and in turn the cost.

[64] This was calculated on the basis of :

- **C) Cash Assistance:** 21 waste picker x USD 230/ month (as transition allowance) x 24 month (transition period) = USD 115,920
- **D) Capacity development (hands on training):** 21 waste picker x USD 500/training = USD 10,500

[65] This was calculated on the basis of :

- **B) Cash Assistance:** 32 waste picker x USD 230/ month (as transition allowance) x 24 month (transition period) = USD 176,640
- **B) Capacity development (hands on training):** 32 waste picker x USD 500/training = USD 16,000

[66] This figure was suggested by the ARAP against calculating not only the areas needed for the project but the actual areas owned by landowners who showed interest in selling to the project. Securing additional land is recommended from environmental and social point of view. The figure also counted for an amount of USD 50,000 for external monitoring to be provided for the resettlement process

[67] This include the estimated cost of average market price for purchasing the land space needed for the landfill, estimated figure for compensation for the rest of land located adjacent to the buffer zone and will not be used by the project and an amount of USD 50,000 for external monitoring to be provided for the resettlement process

	ARAP for waste pickers in Johr al Deek landfill	**419,100**[69]
	Total	**19,767,260**

It is worth noting that the following ESMP related items are already included in the project budget presented in the Feasibility Study:

- Base sealing and leachate collection and recirculation
- Surface sealing, final cover and re-cultivation layer
- Gas collection and flaring
- Surface water collection and retention
- Internal roads preparation and pavement
- Groundwater monitoring wells
- Roofs for waste areas in the recycling plant, composting plant and transfer stations
- Landfill vehicles and equipment for waste and cover laying (loaders, compactors … etc.)
- Project management costs including staff salaries, consumables and O&P of equipment

The following items are also expected to be included in the project budget, however, they are not specifically identified in the Feasibility Study

Areas for spoil storage	Considered above
Additional waste containers to safeguard against emergency situation when access to the landfill is denied	two containers 14,000$
Windbreak trees surrounding the landfill site and the leachate evaporation pond	30,000$
Adequate PPE for the staff	6,000 $/year
Firefighting equipment	90,000$
Application of pesticides	10,000$
Possible need for movable acoustic barriers	3,000$
Project management costs, staff salaries, consumables and O&P of equipment after the closure of the two landfills	300,000 $/year
Source of water for possible need for watering the soil before excavation works	Stored surface/run-off water
Laboratory to carry out soil, gas and noise monitoring activities recommended in the ESMP – during the construction phase as part of the project budget.	7500$
Laboratory to carry out leachate, groundwater, gas and noise monitoring	7500$/year

[68] This allocation could be provided by several projects and it will be the responsibility of the PDSU with the assistance of community based mechanisms to ensure that they are assisting the affected waste pickers in finding an institution that can secure funds for assisting the waste pickers
This was calculated on the basis of: Initial cost for micro grants for the PAPs to start small business: USD 10,000 x 18 waste pickers = 180,000 + Monthly salary of 450 US$ for 6 moths transition period x 18 families = 48,600 (Total = **228,600)**

[69] **This was calculated on the basis of:** Initial cost for micro grants for the PAPs to start small business: USD 10,000 x 33 waste pickers = 330,000 + Monthly salary of 450 US$ for 6 moths transition period x 33 families = 89,100 (Total = **419,100)**

activities recommended in the ESMP as part of the project budget.	
Construction of six groundwater wells (three at each landfill)	24,000 $

Table 9-2: Environmental management matrix for the landfill site during design phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
Impacts of Excavated Soil	Allocate adequate areas for spoil storage in the final design	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
	Ensure that the spoil will not cause un-favored changes to surface water drainage	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
	The spoil height should be designed so as to have acceptable visual impacts	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
Odour impacts	Detailed design to include landfill operation manual identifying waste progression in cells, waste compaction requirements and daily cover (at least 15 cm)	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
Impacts of landfill gas	The detailed design and tender documents of the degassing system should be designed to handle the maximum gas volumes with operational manuals for handling low gas volumes and implementing maintenance schedules	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
Impacts of leachate and surface water	Include the proposed leachate collection system in the design and tender documents. The design should include maintenance schedule for the system	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
	The leachate collection pond and the pumping station should be designed to receive maximum expected leachate quantities with minimum retention time	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
	Transfer stations and composting/recycling plants should have adequate roofs to prevent rain water from getting to the waste	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
Impacts on Birds and on possible future operation of Gaza Airport	Obtain written approval from the Palestinian Civil Aviation Authority stating that El Fukhary landfill site is considered to be non-hazardous to civil aviation	MDLF and JSCs (This has been investigated by EcoConServ as shown in)	ECS	MDLF, UNDP, JSCs	Review written approval and include any conditions in the detailed design
Risks of receiving hazardous wastes mixed with municipal waste (these measures shall be in	Coordinate with planning authorities and the donor community to initiate a project for hazardous waste management	MDLF	ECS	MDLF, UNDP, JSCs	Review reports and progress meetings
	The landfill operation manual should include list of accepted and non accepted waste	Design consultant	ECS	MDLF, UNDP, JSCs	Review design and tender document

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
case that the project will operate with no parallel hazardous waste project)	In case that the landfill will operate without parallel hazardous waste facility a special cell should be constructed. The cell already existing at Johr al Deek shall resume operation.	Design consultant	ECS	MDLF, UNDP, JSCs	Review design and tender document
Noise impacts of recycling/composting plant	Tender documents should include noise specification for trommel, conveyors and compost mixing equipment	Design consultant	ECS	MDLF, UNDP, JSCs	Review tender document
Impacts of surface water	Identify a sufficient low elevation area to evaporate collected storm water	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents
Stability impacts	Detailed design should take into consideration the stresses on soil and on the waste body	Design Consultant	ECS	MDLF, UNDP, JSCs	Review of final design and tender documents

Table 9-3: Environmental management matrix for transfer station sites during design phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
Odour	Detailed design to include	Design	ECS	MDLF,	Review of

impacts	transfer station operation manual identifying waste unloading procedure through a hopper	Consulta nt		ECS, UNDP, JSCs	final design and tender documents
	Detailed design of the transfer station to include area for additional containers to accommodate waste in case of over capacity and emergency situations where there may be no access to the landfill	Design Consulta nt	ECS	MDLF, ECS, UNDP, JSCs	Review of final design and tender documents
Impacts of leachate and surface water	Transfer stations should have adequate roofs to prevent rain water from getting to the waste	Design Consulta nt	ECS	MDLF, ECS, UNDP, JSCs	Review of final design and tender documents

Table 9-4: Environmental management matrix for composting plants during design phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
Odour impacts	Detailed design to include composting plant process control identifying temperature and air flow control methodology and tools as well as measurement tools for the oxygen availability in the composting piles.	Design Consultant	ECS	MDLF, ECS, UNDP, JSCs	Review of final design and tender documents
Impacts of leachate and	Composting plants should be designed to have adequate roofs to	Design Consultant	ECS	MDLF, ECS, UNDP, JSCs	Review of final design and tender documents

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of indirect supervision (During the course of the ESIA study)	Responsibility of direct supervision	Means of supervision
surface water	prevent rain water from getting to the waste. A leachate collection and stoage system should be incorporated into the design.				

Table 9-5: Environmental management matrix for the landfill site during construction phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
Affecting air quality by dust emissions of construction works	Spoil of soil to be reused should be stored as near as possible from active cell	Contractor	EC	N/A	Field supervision
	Pavement of access road and ring road prior to usage in construction of each cell	Contractor	EC	N/A	Field supervision
	Watering soil before excavation if there were complaints from neighbors	Contractor	EC	MEnA (EQA)	Field supervision
Noise impacts	Optimize the use of noisy equipment	Contractor	EC	MEnA (EQA)	Field supervision
	Use acoustic barriers as necessary if complaints from neighbors were received	Contractor	EC	MEnA (EQA)	Field supervision
	Construction works should be stopped during night	Contractor	EC	MEnA (EQA)	Field supervision
Impacts of landfill gas	Ensure the lining system is adequately placed and tested	Contractor	EC	MEnA (EQA)	Field supervision
Impacts of	Leachate	Contractor	EC	MEnA (EQA)	Field

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
leachate and surface water	collection pond should be surrounded by wind barrier trees				supervision
Risks of hazardous wastes	Coordinate with planning authorities and the donor community to initiate a project for hazardous waste management	MDLF	MDLF	N/A	Review reports and progress meetings
	In case that the landfill will operate without parallel hazardous waste facility a special cell should be constructed	Design consultant to prepare specs and contractor to implement	MDLF	N/A	Review design and tender document
Affecting air quality by vehicles and equipment emissions	Implement preventive maintenance program for vehicles and equipment working in the site and promptly repair vehicles with visibly high exhaust	Contractor	EC	MEnA (EQA)	Field supervision
Impacts of construction waste other than excavated soil	Hazardous waste should be segregated and sent to a hazardous waste facility,	Contractor	EC	MEnA (EQA)	Field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
	if existing, or to the special cell				
	Other non hazardous waste to be collected and sent to the active cells	Contractor	EC	MEnA (EQA)	Field supervision
	Sewage should be periodically collected and sent to the adjacent WWTP	Contractor	EC	MEnA (EQA)	Field supervision
Risks of damaging chance-find antiquities	In case of chance-find the excavation should be stopped, the Ministry of Tourism and Antiquities	Contractor	EC	Ministry of Tourism and Antiquities	Field supervision

Table 9-6 Environmental management matrix for transfer station and composting plant sites during construction phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
Affecting air quality by dust emissions of construction works	Watering soil before excavation if there were complaints from neighbors	Contractor	EC	MEnA (EQA)	Field supervision
Noise impacts	Optimize the use of noisy equipment	Contractor	EC	MEnA (EQA)	Field supervision
	Use acoustic barriers as necessary if	Contractor	EC	MEnA (EQA)	Field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
	complaints from neighbors were received				
	Construction works should be stopped during night	Contractor	EC	MEnA (EQA)	Field supervision
Affecting air quality by vehicles and equipment emissions	Implement preventive maintenance program for vehicles and equipment working in the site and promptly repair vehicles with visibly high exhaust	Contractor	EC	MEnA (EQA)	Field supervision
Impacts of construction waste	Hazardous waste should be segregated and sent to a hazardous waste facility, if existing, or to the special cell	Contractor	EC	MEnA (EQA)	Field supervision
	Other non hazardous waste to be collected and sent to the active cells	Contractor	EC	MEnA (EQA)	Field supervision
	Sewage should be periodically collected and sent to WWTP	Contractor	EC	MEnA (EQA)	Field supervision

Table 9-7: Environmental monitoring matrix for the landfill site during construction phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	
					Self (Internal)	Regulatory (External)
Impacts of Excavated soil	Volume of excavated soil	Site of landfill	Review invoices of excavation contractor	To be recorded after the excavation of each cell and documented in the next monthly report	EC	N/A
	COD, BOD, pH, TDS, total N, total P, heavy metals (Pb,Cd,Cr,Cu,Hg, Ni, Zn), TPH of the soluble content of excavated soil	Site of the landfill	Active collection of undisturbed soil samples and laboratory analysis	Once prior to the excavation of each cell	Landfill laboratory	MEnA (EQA)
	Volume of soil exported from the site and end use of this volume	Site of landfill	Keeping these records from the exporting entity	Annual	PDSU-EM,	N/A
Affecting air quality by dust emissions of construction works	Ambient PM	Border of active cell and the two farm houses areas at the north and west	Active collection of samples and laboratory analysis	Once during the excavation of each cell	Landfill laboratory	MEnA (EQA)
	Dust complaints from neighbors	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM,	MEnA (EQA)
Noise	Ambient noise	The two	Portable	Once	Landfill	MEnA

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	
					Self (Internal)	Regulatory (External)
impacts		farm houses areas at the north and west	noise meter to take representative average noise and background noise before construction works	before construction and once during the excavation of each cell	laboratory	(EQA)
	Noise complaints from neighbors	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM,	MEnA (EQA)
Impacts of construction waste other than excavated soil	Amounts of hazardous waste generated	Landfill location	Visual estimation of the hazardous waste weight by type	Monthly	Contractor	MEnA (EQA)
	Amounts of evacuated sewage	Landfill location	Number of truck loads multiplied to the truck capacity	Monthly	Contractor	MEnA (EQA)
Risks of damaging chance-find antiquities	Type, location, condition of antiquity object and followed procedures	Landfill	Documentation of data and photography	Once in case of chance-finds	EC	Ministry of Tourism and Antiquities

Table 9-8: Environmental monitoring matrix for transfer station and composting plant sites during construction phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	
					Self (Internal)	Regulatory (External)
Affecting air quality by	Dust complaints	Transfer station	Recording and documentation	Monthly	PDSU EM	MEnA(EQA)

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	
dust emissions of construction works	from neighbors	location	of complaints			
Noise impacts	Noise complaints from neighbors	Transfer station location	Recording and documentation of complaints	Monthly	PDSU EM	MEnA(EQA)
Impacts of construction waste	Amounts of hazardous waste generated	Transfer station location	Visual estimation of the hazardous waste weight by type	Monthly	Contractor	MEnA(EQA)
	Amounts of evacuated sewage	Transfer station location	Number of truck loads multiplied to the truck capacity	Monthly	Contractor	MEnA(EQA)

Table 9-9: Environmental management matrix for the landfill site during operation phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision (Internal)		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
Odour impacts	Upgrade the rates of compaction and application of soil cover in case of receiving complaints	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Impacts of landfill gas	Ensure the waste filling schedule is followed, the gas vents are progressively placed, the final cover is adequately maintained and the degassing system is adequately maintained	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Impacts of leachate and surface water	Leachate evaporation pond should be surrounded by wind barrier trees	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Implement preventive maintenance schedule for the leachate collection system	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision (Internal)		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
	For El-Fukhary landfill , in case some leachate amounts will need to be discharged to the WWTP a prior coordination with the WWTP management should be maintained. This should be also done for sludge being removed from evaporation pond and sent to WWTP	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and correspondence with WWTP
	In case the monitoring wells indicated high pollution loads that could be related to leak of leachate, this leak should be identified and adequately handled	JSC experts or an external consultant	PDSU -EM	JSC	MEnA (EQA)	Review monitoring reports after repair
Impacts on Birds and on possible future operation of Gaza Airport	For El- Fukhary landfill, implement any conditions to distract birds that might be included in the approval of the Palestinian Civil Aviation Authority	JSCM	PDSU -EM	JSC	Palestinian Civil Aviation Authority	Review of progress reports and field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision (Internal)		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
Risks of receiving hazardous wastes mixed with municipal waste (these measures shall be in case that the project will operate with no parallel hazardous waste project)	Provide hazardous waste training to staff working in the project	Hazardous waste safety consultant	PDSU -EM	JSC	MEnA (EQA) MoL	Review training reports and attendance sheets
	Asbestos waste should be wetted once received in the landfill	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Flammable and explosive waste should be prevented from admission	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Provide workers with PPE and make sure they are adequately using it	JSCM	PDSU -EM	JSC	MEnA (EQA) MoL	Review of progress reports and field supervision
	Prepare an emergency response plan for spills or fires	JSCM	PDSU -EM	JSC	MEnA (EQA) MoL	Review of the plan
Risks to occupational health and hygiene	Provide hygiene training to the staff working in the project and provide suitable PPE, showers, washing and cleansing facilities	JSCM	PDSU -EM	JSC	MEnA (EQA) MoL	Review of progress reports and field supervision
	Prevention of unauthorized admission to the landfill, recycling/composting and transfer stations	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision (Internal)		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
	Effective application of the waste filling plan and daily cover	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Apply pesticides as needed through an application plan that would give preference to biological pesticides, then to other pesticides with negligible impact on humans and minimum impact on untargeted species and the environment	Pesticides Expert	JSCM and PDSU -EM	JSC	MEnA (EQA)	Review of pesticides plan and field supervision
Noise impacts	Optimize the use of noisy machines	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Use acoustic barriers as necessary if complaints from neighbors were received	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
	Landfill operations and the recycling/composting plants should be stopped during night	JSCM	PDSU -EM	JSC	MEnA (EQA)	Review of progress reports and field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision (Internal)		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
	Planting wind break trees around the landfill	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Affecting air quality by air emissions of vehicles and equipment	Implement preventive maintenance program for vehicles and equipment working in the site and promptly repair vehicles with visibly high exhaust	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Visual impacts and aesthetics	Surrounding composting/recycling plant with windbreak trees	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Risks of unforeseen exceeding of landfill capacity	If landfill capacity monitoring shown rapid filling, early planning for new site should be initiated	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review monitoring reports

Table 9-10: Environmental management matrix for transfer station sites during operation phase

Potential	Proposed Mitigation	Institutional	Responsibility of direct supervision	Responsibility of	Means of supervisi

Impact	Measures	Responsibility for Implementation	(Internal)		regulatory supervision	on
			During the first 6 years	Beyond the first 6 years		
Odour impacts	Provide additional waste containers at the transfer station to ensure smooth operation and reduce vehicles waiting time	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Impacts of leachate and surface water	Ensure that waste is unloaded in covered areas during rain	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports
Risks to occupational health and hygiene	Provide hygiene training to the staff working in the project and provide suitable PPE, showers, washing and cleansing facilities	JSCM	PDSU-EM, MoH, MoL	JSC	MEnA (EQA) MoL and MoH	Review of progress reports and field supervision
	Prevention of unauthorized admission to the transfer stations	JSCM	PDSU-EM	JSC	MoL and MoH	Review of progress reports and field supervision
	Apply pesticides as needed through an application plan that would give preference to biological pesticides, then to other pesticides with negligible impact on humans and minimum impact on untargeted species and the environment	Pesticides Expert	JSCM and PDSU-EM	JSC	MEnA (EQA)	Review of pesticides plan and field supervision

Table 9-11: Environmental management matrix for composting plant sites during operation phase

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
Odour impacts	Provide a list of the types of wastes that should be screened out from the input stream. Ensure a process control is in place for the following: • Temperature control • Air flow control	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports and field supervision
Impacts of leachate and surface water	Ensure that the composting plant is roofed and that the leachate collection and storage system is in place. An impervious floor should be contructed with suitable slopes to allow for leachate collection.	JSCM	PDSU-EM	JSC	MEnA (EQA)	Review of progress reports
Risks to occupational health and hygiene	Provide hygiene training to the staff working at the composting plant and provide suitable PPE, showers, washing and cleansing facilities	JSCM	PDSU-EM	JSC	MEnA (EQA) MoL	Review of progress reports and field supervision

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision		Responsibility of regulatory supervision	Means of supervision
			During the first 6 years	Beyond the first 6 years		
	Prevention of unauthorized admission to the composting plant	JSCM	PDSU-EM	JSC	MoL	Review of progress reports and field supervision

Table 9-12: Environmental monitoring matrix for the landfill site during operation phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/Compliance Monitoring Responsibility
					During the first 6 years	Beyond the first 6 years	
Odour impacts	Odor complaints from neighbors	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)
Impacts of landfill gas	Volume of collected landfill gas	Gas compression station	Gas flow meter	Continuous monitoring with monthly collection of records	Landfill laboratory	Landfill laboratory	MEnA (EQA)
	CH_4, CO_2, NH_3, H_2S and VOCs in ambient air	Samples to be collected from the western border of the landfill	Active collection of samples and laboratory analysis	Annual	Landfill laboratory	Landfill laboratory	MEnA (EQA)
	Acidity and hardness of	Monitoring wells	Pumping out samples	Quarterly	Landfill laboratory	Landfill laboratory	MEnA (EQA)

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/Compliance Monitoring Responsibility
					During the first 6 years	Beyond the first 6 years	
	groundwater						
Impacts of leachate and surface water	Amount of collected and recycled leachate amounts	Leachate collection pond	Level measurement of the leachate pond and records of pumping station	Monthly	JSCM	JSCM	MEnA (EQA)
	COD, BOD, pH, TDS, total N, total P, heavy metals, TPH of leachate	Leachate collection pond	Representative grap sampling and laboratory analysis	Quarterly for COD, BOD and pH and annually for the rest	Landfill laboratory	Landfill laboratory	MEnA (EQA)
	COD, BOD, pH, TDS, total N, total P, heavy metals, TPH of groundwater	3 groundwater monitoring wells	Pumping from monitoring wells and laboratory analysis	Quarterly for COD, BOD and pH and annually for the rest	Landfill laboratory	Landfill laboratory	MEnA (EQA)
	Amounts of collected sludge	Leachate collection pond	Records of sludge pump	Once upon de-sludging event	JSCM	JSCM	MEnA (EQA)
Impacts on Birds and on possible future operatio	Complaints from the airport about imprope	Al Fukhary Landfill location	Recording and documentation of complaints	Monthly	PDSU EM,	JSCM	MEnA (EQA)

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/Compliance Monitoring Responsibility
					During the first 6 years	Beyond the first 6 years	
n of Gaza Airport	r operational practices						
Risks of hazardous wastes	Amounts of hazardous waste received	Landfill location	Visual estimation of the hazardous waste in relation to the truck capacity	Daily	Admission staff	Admission staff	MEnA (EQA)
	Amounts of flammable and explosive waste refused	Landfill location	Visual estimation of the hazardous waste in relation to the truck capacity	Daily	Admission staff	Admission staff	MEnA (EQA)
	Area and volume of hazardous waste placed in special cell	Special cell	Topographic survey	Annual	Survey consultant	Survey consultant	MEnA (EQA)
	Health records about occupational injuries and infectious diseases among workers	Clinic contracted by the project	Medical reporting on received cases	Quarterly	Occupational health clinic	Occupational health clinic	MEnA (EQA) MoL

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/Compliance Monitoring Responsibility
					During the first 6 years	Beyond the first 6 years	
Risks to occupational health and hygiene	Type, quantity, date, location and method of application of pesticides	Landfill and transfer station	Documentation of data	Monthly	Pesticides Expert	Pesticides Expert	MEnA (EQA)
	Complaints from neighbors about insects and rodents	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)
Noise impacts	Ambient noise	The two farm houses areas at the north and west	Portable noise meter to take representative average noise	Annual during operation	Landfill laboratory	Landfill laboratory	MEnA (EQA)
	Noise complaints from neighbors	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)
Affecting air quality by vehicles emissions	Average CO_2 emissions, traveled distance and consumed fuel of vehicles	Landfill and transfer station locations	Keeping traveled distance and consumed fuel records from vehicle datasheet and multiply in	Monthly	PDSU-EM	JSCM	MEnA (EQA)

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/Compliance Monitoring Responsibility
					During the first 6 years	Beyond the first 6 years	
			the average CO2 emissions identified by the manufacturer				
Visual impacts	Complaints from neighbors about littering	Landfill location	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)
Risks of unforeseen exceeding of landfill capacity	Filled area and height of active cells	Landfill location	Topographic survey	Annual	Survey consultant	Survey consultant	MEnA (EQA)

Table 9-13: Environmental monitoring matrix for transfer station and composting plant sites during operation phase

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Self Monitoring Responsibility		Regulatory/ Compliance Monitoring Responsibility
					During the frist 6 years	Beyond the first 6 years	
Odour impacts	Odor complaints from neighbors	Transfer stations and composting plant locations	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)
Risks of hazardous wastes	Health records about occupational injuries and infectious diseases among workers	Clinic contracted by the project	Medical reporting on received cases	Quarterly	Occupational health clinic	Occupational health clinic	MEnA (EQA) MoL
Risks to occupational health and hygiene	Type, quantity, date, location and method of application of pesticides	Transfer station only	Documentation of data	Monthly	Pesticides Expert	Pesticides Expert	MEnA (EQA)
	Complaints from neighbors about insects and rodents	Transfer station and composting plants	Recording and documentation of complaints	Monthly	PDSU EM	JSCM	MEnA (EQA)

Table 9-14: Environmental management matrix after landfill closure

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
Impacts of landfill gas	Assign the responsibility for monitoring landfill gas to the same trained personnel who were responsible during the operation phase	JSC	PDSU Manager	MEnA (EQA)	Review institutional arrangements
	In case the monitoring indicated gas leak the reason for the leak should be identified and adequately handled	JSC experts or an external consultant	JSC	MEnA (EQA)	Review monitoring reports after repair
Impacts of leachate	Staff of leachate pumping station should continue their work after closure of the landfill so that maintenance and coordination with WWTP activities will be continued until leachate amounts are negligible	JSC	PDSU Manager	MEnA (EQA)	Review institutional arrangements
	Assign the responsibility for monitoring landfill leachate to the same trained personnel who were responsible	JSC	PDSU Manager	MEnA (EQA)	Review institutional arrangements

Potential Impact	Proposed Mitigation Measures	Institutional Responsibility for Implementation	Responsibility of direct supervision	Responsibility of regulatory supervision	Means of supervision
	during the operation phase until leachate amounts are negligible				
	In case the monitoring wells indicated high pollution loads that could be related to leak of leachate, this leak should be identified and adequately handled	JSC experts or an external consultant	JSC	MEnA (EQA)	Review monitoring reports after repair
Visual impacts	Plantation of adequate plants over the final cover of the landfill and maintain it	JSC	PDSU Manager	MEnA (EQA)	Review institutional arrangements

Table 9-15: Environmental monitoring matrix after landfill closure

Potential Impact	Monitoring Indicator	Monitoring Location	Monitoring Methods	Monitoring Frequency	Monitoring Responsibility	
					Self (Internal)	Regulatory (External)
Impacts of landfill gas	Volume of collected landfill gas	Gas compression station	Gas flow meter	Continuous monitoring with monthly collection of records	Landfill laboratory	MEnA (EQA)
	CH_4, CO_2, NH_3, H_2S and VOCs in ambient air	Samples to be collected from the western border of the landfill	Active collection of samples and laboratory analysis	Annual	Landfill laboratory	MEnA (EQA)
	Acidity and hardness of	Monitoring wells	Pumping out samples	Annual	Landfill laboratory	MEnA (EQA)

	groundwater					
Impacts of leachate	Amount of collected and recycled leachate amounts	Leachate collection pond	Level measurement of the leachate pond and records of pumping station	Monthly	JSCM	MEnA (EQA)
	COD, BOD, pH, TDS, total N, total P, heavy metals, TPH of leachate	Leachate collection pond	Representative grap sampling and laboratory analysis	Quarterly for COD, BOD and pH and annually for the rest	Landfill laboratory	MEnA (EQA)
	COD, BOD, pH, TDS, total N, total P, heavy metals, TPH of groundwater	3 groundwater monitoring wells	Pumping from monitoring wells and laboratory analysis	Quarterly for COD, BOD and pH and annually for the rest	Landfill laboratory	MEnA (EQA)
	Amounts of collected sludge	Leachate collection pond	Records of sludge pump	Once upon de-sludging event	JSCM	MEnA (EQA)
Visual impacts	Green areas planted over the final cover	Landfill completed cells	Visual estimation of the green cover % of the completed cells	Annual	JSCM	MEnA (EQA)

Table 9-16: Social management plan matrix during the construction phase

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
Inconvenience to local communities	Full adherence to the various environmental measures stated on the ESMP	Construction	Contractor	PDSU	Refer to relevant sections in the ESMP
	Establishing community-based monitoring committees (CBMC)	Pre-Construction	PDSU (SDO)	PDSU WB, MDLF, UNDP	MoMs CBMC reports
	Communicate information with local population	Construction	CBMC	PDSU (SDO)	Reports and other documentations
	Enforcing a clear complaints system	Construction	CBMC	PDSU (SDO)	Reports on actions taken to address complaints
	Restricting construction works during certain hours in the day	Construction	Contractor	PDSU	Site supervision
	Full restriction from access to the site	Construction	Contractor	PDSU	Site supervision
Impact on the livelihoods of the informal waste pickers	**<u>Short term mitigation measures</u>**				
	Scenario (A) The integration scenario				
	A-1 Transition Assistance	Pre-Construction	PDSU (SDO) in coordination with other relevant organizations	PDSU WB, UNDP, MDLF	Implementation of training Assessments of training Provision of cash and in kind assistance to PAPs
	A-2 Provision	Operation	Municipalities,	PDSU (SDO)	

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
	of Job opportunities		JSCs and other relevant operators		
	Scenario (B) The non-integration scenario				
	B-1 Capacity development programmes in various areas outside SWM	Pre-Construction	DEEP, COOPI, MAAN, UNICEF, NGOs	PDSU (SDO)	Training reports Beneficiaries evaluation
	B-2 Facilitate access to micro-grants and sources of finance for improving livelihoods	Pre-Construction	UNDP (DEEP), COOPI, MAAN, UNICEF,	NGOs	Number of beneficiaries from micro-grants Outcome of the project on the family
	Long Term and Strategic Mitigation measures				
	Assist informal sector groups in legalizing the conditions	Operation	PDSU (SDO) in coordination with the Labour Authority and other relevant organizations	PDSU (SDO)	Number of bonds/networks established
	Raising the profile of waste management	Operation	CBMC External Consultant	PDSU (SDO)	Awareness raising strategy prepared and implemented
Impacts of loss of privately owned land	Implementation of the prepared ARAP	Pre-Construction	PLA in cooperation with Rafah Municipality	PDSU (SDO)	Compensation documents
Impacts on cultural heritage	Monitoring of site excavations	Construction	Contractor	PDSU, municipalities, JSCs	Site supervision
	Immediate information sharing with concerned organizations in case of	Construction	Contractor	PDSU, municipalities, JSCs	Site supervision

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
	finding information, signs or incidental finds				
	The provisions and terms of the Contract with the Contractor include a provision for dealing with this case.	Pre-Construction	Contractor	PDSU, municipalities, JSCs	Site supervision

Table 9-17: Social management plan matrix during the operation phase

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
Changes in land use	Implementation of the prepared ARAP	Pre-Construction	PLA in cooperation with Rafah Municipality	PDSU (DSO)	Compensation documents
	Adherence to the other mitigation measures listed under various parts of the ESMP to ensure efficient site management	Construction and operation	Municipalities and JSC	PDSU	Site supervision reports
Traffic Impact	**- For El Fukhary Landfill**				
	Implementation for the project of	Not finally identified	This will be done as part of a separate project		

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
	Rehabilitating Salah El Dein Road[70]				
	Restrict transport trucks travel to the hours outside the rush hours.	Operation	Landfill management	PDSU	Day to day supervision
	Strict monitoring to the road accidents as part of the monitoring plan	Operation	Landfill management in coordination with the Traffic Authority	PDSU (SDO)	Traffic Authority records
	Information sharing with the communities and establishments located by the road.	Operation	CBMC	PDSU (SDO)	Reports and other documentations
	Conduct monitoring survey to get the feedback of roads users and address any concerns	Operation	CBMC	PDSU (SDO)	Reports and other documentations
	- For the Transfer Stations				
	Selecting appropriate model of waste transport vehicles	Pre-construction (design)	Municipalities and JSCs	PDSU	PDSU to participate in the selection of the collection vehicles
	Arrange the times of transporting waste to and from the TS to avoid traffic rush hours	Operation	TSs management in coordination with the Traffic Authority	PDSU	Field observations Community complaints
	Establishing CBMC	Pre-Construction	PDSU (SDO)	PDSU WB, UNDP	MoMs CBMC reports
	Conduct monitoring survey	Operation	CBMC	PDSU (SDO)	Surveys results

[70] This mitigation measure is relevant only to the southern section of the project since more stress on Salah El Dein raod will result from the operation of Al Fukhary landfill and associuated TSs

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
	to get communities' feedback and address any concerns				Actions to address communities concerns
Higher cost to beneficiary communities particularly the poor	**A) Short term measures**				
	A-1 Municipalities and JSC to maintain the system of exempting/subsidizing poor families	Pre-Construction[71]	Municipalities/JSC in coordination with various relevant institutions	PDSU (SDO)	Follow up with the various relevant institutions
	B) Strategic measures				
	Design plans to stimulate further economic instruments for SWM revenues	Pre-Construction[72]	External Consultant	PDSU (SDO)	Consultancy reports New financial instruments communicated and introduced
	C) Crosscutting measures				
	C-1 Awareness raising and building local communities' knowledge about issues related SWM	Operation	CBMC External Consultant	PDSU (SDO)	Awareness raising strategy prepared and implemented
	C-2 Raising the profile of SWM including strengthening the recyclables market and encouraging community based initiative in segregation at source	Operation	CBMC External Consultant	PDSU (SDO)	Strategic plan developed (consultancy service) and actions enforced on various levels
Depressing	Strict measures and	Constructio	Contractor	PDSU,	Site

[71] Planning for this measure should start early before construction while the actual enforcement for the measure will be during project operation
[72] Planning for this measure should start early before construction while the actual enforcement for the measure will be during project operation

Potential Impact	Proposed Mitigation Measures	Project Phase	Institutional Responsibility for Implementation	Responsibility of direct supervision	Means of supervision
property values	best practices in managing the sites	n and operation		municipalities, JSCs	supervision
	Assist local communities in establishing community- based monitoring committees	Pre-Construction	PDSU (SDO)	Head of PDSU WB, UNDP	MoMs CBMC reports
	Community surveys and consultation to measure feedbacks about the sites management	Construction and operation	CBMC	PDSU (SDO)	Surveys results Actions to address communities concerns
Potential impact on the social and economic activities of the neighboring communities	Adherence to the other mitigation measures listed under various parts of the ESMP to ensure efficient site management	Construction and operation	Municipalities and JSC	PDSU	Site supervision reports
	Assist local communities in establishing community- based monitoring committees	Pre-Construction	PDSU (SDO)	Head of PDSU WB, UNDP	MoMs CBMC reports
	Community surveys and consultation to monitor the project impact on social and economic activities	Operation	CBMC	PDSU (SDO)	Surveys results Actions to address communities concerns

CHAPTER 10. THE PUBLIC CONSULTATION

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The project is characterized by the importance and considerable weight given to socio-economic dimensions. The ESIA, thus, was produced in a highly participatory manner that managed to fully engage stakeholders groups. The ESIA is particularly sensitive to the interests of the primarily affected vulnerable groups like land owners, waste pickers who will be restricted from access to their source of livelihoods and the local population near the waste disposal sites including TSs and landfills. Moreover, the ESIA gave high attention to the beneficiaries of the SWM, being the primary targeted groups for the potential improvements of the system, key players in maintaining the sustainability of the system and also a key group that could be affected economically from the increased service fees.

Consultation and participatory techniques were employed during the process of the ESIA and the ARAPs preparation. As indicted under Chapter 2 of the ESIA, the methodology of the preparation of the ESIA and the ARAPs involved a bottom-up approach that depended on a diverse range of tools to serve the objectives of the various parts of the ESIA. The Consultant accessed large amounts of quantitative and qualitative information from various primary and secondary sources.

The key consultation activities during the course of the project could be divided into the following:

10.1 During the Scoping and preparation of the ESIA and ARAPs

<u>10.1.1 Plenary session</u>

As part of the preparation of the ESIA for Gaza SWM Project, a scoping session was conducted in Gaza on Thursday 8th December, 2011. The Scoping session was attended by a wide range of stakeholders including various municipalities, JSC from different Governorates of Gaza Strip, MDLF, SWMC, Palestinian Water Authority, Environmental Quality Authority, NGOs, academics, Consultants and neighboring communities to the landfills who were invited through individual invitations. Copy of the workshop invitation is attached in Annex 9-a and list of the session participants is attached in Annex 9-b. The scoping session aimed to present the project, scope of work and methodology of the ESIA for the long term activities and obtain participants feedbacks on the issues that the Consultant should pay attention to during the course of the ESIA including design related issues.

10.1.1.1 Key Conclusions from the Scoping Session:

The following wraps up the main issues and recommendations raised during the discussion. These conclusions were shared with the participants of the session before closing the workshop and will be considered in preparing the ESIA.

- Solid Waste Management solutions should be developed as integrated solutions involving primary collection, secondary collection, and intermediary transfer until final disposal

- The success of any project is conditioned with the implementation of comprehensive awareness raising campaigns across Gaza Strip. There is also a need to set and enforce a legal measures as well as institutional set-up. When these measure and set-up are established, capacity building for the human resources involved in the sector should be highly considered along with the provision of equipment, machineries and vehicles.
- Historically, the private sector proved to be more efficient compared to governmental organizations. The role of the private sector in SWM should be intensely examined. Private sector may participate in the primary collection, secondary collection, composting etc.
- The ESIA for Al-Fukhary landfill should carefully consider the waste water treatment plant which is located near the project site. These two projects are strongly linked to each other.
- Even if the public interest suggests the establishment of a central landfill in Al-Fukhary, the interests of the disadvantaged community of El- Fukhary should be highly considered. They may strongly oppose the project. Their interests could be considered through giving them priority in benefiting from the job opportunities that will be created during the construction and operation phases. Moreover, they should be fairly compensated for their lands that will be acquired as part of the project.
- The final institutional and administrative structure has not been agreed on yet. The final institutional and administrative framework will be agreed on among the municipalities and the SWMC. A new draft By-law is being considered by he authorities to expand the Deir Al-Balah JSC to include Rafah Governorate in southern Gaza Strip.
- It is important to engage farmers being important stakeholders for the project success, particularly in the compost production and marketing. It is important to ensure quality product and set restrictions on importing compost and study the possibility of exporting compost to Egypt.

Figure 9.1 Part of the scoping session participants

Figure 9.2 Presenting the ESIA methodology and scope during the scoping session

- Due to the unpredictable deterioration in the security situation that could be suddenly encountered, it is crucial to determine temporary waste storage spots in cases of any emergencies or accessibility restrictions.

- Salah El Dein road will not absorb the increased traffic as a result of the heavy transfer trucks. It is suggested to establish a parallel alternative road for the specific purpose of transferring waste.

- It is very important to coordinate with the Urban Planning Departments at the Municipalities to ensure that the proposed lands are consistent with the urban structural plans.

- Local communities are more interested and attentive to the stage of primary collection than the stage of final disposal. They do not care too much about the rehabilitation of final disposal sites or landfills. Accordingly, local communities will not be willing to pay more service fees.

- Local communities should sense an improvement in the situation of primary and secondary collection. This is the way to stimulate the sense of value of the project, particularly since landfills rehabilitations is not an issue of concern for local communities.

- This project is not limited to domestic waste. It rather includes all types of waste.

The raised issues during the scoping session were considered by the ESIA team in the preparation of the study and findings of the scoping session were incorporated in the ESIA wherever applicable and valid.

10.1.2 Other Consultation through surveying and participatory tools

Consultation with various groups of stakeholders has been carried out during the scoping period through a comprehensive structured survey, in-depth interviews and FGDs with various types of stakeholders as explained in more details under Chapter 2 on the ESIA methodology. The information describing the current situation of SWM in GS as well as the predictions of the negative and positive impacts of the project were gleaned from active contributions of different stakeholders. The findings of the survey, FGDs and SSIs are presented in details in Chapter 5B and the main findings from the consultation activities are briefly summarized in Box 10.1 below

Box 10.1 Summary of the key issues abstracted from the consultation activities

- SWM is not one of the pressing issues for the local communities compared to other services like drinking water and electricity.
- The most important components of SWM for the local residents is the primary collection including the removal of waste from their houses.
- Local communities are concerned about secondary collection only when it causes nuisance and inconvenience to their neighborhoods.
- The location of temporary storage and waste collection points within residential areas is one major problem for most of the interviewed communities.
- Service fees is an issue of concern particularly with the poverty and unsecured income that

large portion of the family are suffering from.
- Culture of dependency on the government for the provision of the service
- The informal sector related to the SWM is widely prevailing in GS and is working under various modes of work
- The informal waste picking is attracting one of the most poor and vulnerable groups in GS. They suffer from lack of both financial and non-financial assets
- Restricting these groups from access to their source of livelihoods, unless accompanied by structured assistance would leave serious impacts on these individuals and their families.

Landowners inventory survey

As part of planning and mitigating for the resettlement issues, an inventory survey was conducted to the land owners of the project proposed area for the landfill in El- Fukhary. The survey aimed to put a foundation for the preparation of an ARAP. A structured questionnaire was designed to collect information about various issues related to land owners, shares, land uses, income from the land and the preferred type and amount of compensation. The preparation of the ARAP did not merely engage land owners through the survey, it rather involve other relevant stakeholders particularly those who will be involved in the actual application of the ARAP, including but not limited to the Municipality, the Land Authority and the Ministry of Finance.

Waste pickers inventory survey:

For the same purpose of planning resettlement, waste pickers survey in El- Fukhary site has been conducted to collect information on the impacts of restricting this group from accessing to the landfill. The survey also meant to investigate the appropriate type of compensation that this group suggests in order to mitigate for the negative impacts on them and their families. The survey also targeted waste pickers in other waste temporary storage sites, namely Al Namsawi and Tal El Sultan

10.2 After Drafting the ESIA and during the review of findings

10.2.1 For the Southern Part of the Project

After submitting the Draft ESIA, a public consultation workshop was held on the 18th January 2012 with the aim of reviewing the findings of the ESIA for the southern part including El- Fukhary. landfill and associated components and incorporating the stakeholders' comments into the relevant sections of the report. This action came in accordance with the WB policy requirements for availing operational information to the public as stated in OP 17.50 on “Disclosure” out of recognition for the fundamental importance of transparency and accountability to the development process. MDLF and the Consultant announced for the event and personal invitations were sent in advance to stakeholders with different affiliations. Rafah Municipality hosted the public consultation in one of the conference rooms. The venue selection was convenient to the stakeholders related to the southern part of the project. Annex 9 includes a set of documentation for the public consultation (invitation, workshop participants, comments sheets, …etc).

The participants of the workshop included different stakeholders from Governmental organizations (municipalities, JSC, Land Authority, Ministry of Finance, EQA, MDLF, Ministry of Social Affairs, Ministry of Labour) University Professors, donor agencies, NGOs and neighboring communities including land owners. The workshop was a useful opportunity for the different stakeholders to come together, review and comment on the assessment. It involved sufficient time for comments, questions and open discussion. Comments sheets were distributed on participants who were asked to put their comments in writing in order to efficiently and precisely consider the various concerns. An Arabic Executive Summary of the ESIA was made available to invited stakeholders. Moreover, non-technical Arabic presentations were given during the event. Generally speaking, the key findings were well received by different stakeholders. Different issues raised during this workshop were considered during the production the updated version of the ESIA.

Figure 10.3 Part of the participants in the Public Consultation

Figure 10.4 Receiving and replying on stakeholders comments

Table10.1 below presents the main comments received from stakeholders and the key replies from the Consultant's team.

Table 10.1: Comments and Responses during the Public Consultation January 18th, 2012

Comment	Response by ESIA Team
No transfer stations will be in Nemsawy, because the current location is not suitable because it is next to a graveyard	Location of the transfer station to be accurately identified in following updates
Mitigation measures seem to be idealistic and may not be implemented in reality, such as low noise equipment and daily cover	It was clarified that ESMP requirements in the tender will be included in the tender documents and will have score in the tenders evaluation, so the winning bid will include equipment with all possible requirements that could be obtained in Gaza, a modification for low noise equipment has been added to Section 6A.1.3. For the

Comment	Response by ESIA Team
	daily cover it was clarified that this will be an operation condition and soil will be available
The extra spoil will not be a problem because there will be high demand for it, and it could be sold	This comment has been added to Section 6A.1.1 Storage areas which will be needed for spoil has been reduced to only the amount which will be used in landfills. This has been the approach originally being followed but was confirmed during the public consultation. It was assumed accordingly that the landfill will be contacted by different contractors to collect the spoil with minimal marketing efforts.
Receiving hazardous waste is not only a possibility but it is most probable	The ESIA has focused on this aspect and recommended measures to safeguard against this possibility. Also, among the recommendations, was to urge the relevant authorities to support initiating a hazardous waste project in Gaza.
Transfer stations should have extra capacities in case the landfill is destroyed or access is denied	Transfer stations will have extra containers for possible delays in transportation as well as in cases where landfill access is denied, this is clarified in Section 6A.2.1. But designing the transfer station as a small landfill in case of intentional destroying of the original landfill is not believed to be within the scope of normal planning being analyzed in the ESIA
There should be identification for the types of waste that is allowed to enter the landfill	This will be part of the operational plan of the landfill. This is indicated in Section 6A.2.5
The ESMP budget does not include budget for monitoring physical indicators	The project budget includes the establishment of a laboratory that will carry out these analysis, this is emphasized in Section 8-3. Dr. Ali Barhoom added that there are preliminary plans to have a common lab for the landfill and the WWTP
The WWTP representative mentioned that there were security restrictions on the WWTP buildings height as not to be more than one floor, how would the landfill be with a 30-meter height?	It was the understanding of the ESIA team that the Israeli Authorities have approved the landfill height and location near the borders
Salaheldin Road is currently under upgrade plans, so the waste trucks weights and capacity should be integrated in the plans of the concerned agencies. Traffic should be during night and alternative roads should be investigated	This has been considered under section 6B2.2.4 and reference was made to the agencies involved in the rehabilitation project and the need to coordinate closely with them.
There should be facilities for fire extinguishing in the landfill	Added in Section 6A.2.5 as part of the contingency plan

Comment	Response by ESIA Team
Birds could also affect agriculture not only the airport	It was clarified that most of the birds attracted to the landfill will be birds of prey, which are not feeding on agriculture seeds. The current situation of exposed waste is attracting more birds than the situation with the engineered landfill
The ESMP should be translated to Arabic so the EQA could follow up its implementation	This will be considered

10.2.2 For the Northern Part of the Project

A public consultation was conducted in Gaza City for presenting the results of the ESIA and the ARAP for the northern section of the project on May 5th 2012. This has also been done to comply with the disclosure requirement of the national law and the international standards. Stakeholders who participated were give the chance to comment on the results of the ESIA and the comments were documents to be presented in this chapter and have been considered in the production of the final ESIA.

The event was hosted by MDLF and representative of various groups of stakeholders including Governmental authorities, namely Ministry of Health, Palestinian Water Authority (PWA), Ministry of Local Development, Municipalities, JSCs, as well as NGOs and donors representatives participated actively in the public consultation.

The same approach adopted for the public consultation for the southern part of the project was used in this public consultation. The event allowed different stakeholders to comment on the findings of the study. As in the southern part public consultation, comments sheets were distributed on participants to make sure comments are well recorded. Moreover, participants were given the chance of sharing verbal comments that was responded to by the team of consultants.

Figure 10.5 Introductory speeches at the start of the public consultation

Figure 10. Presenting the environmental impacts of the project

Table 10.2 below presents the main comments received from stakeholders and the key replies from the Consultant's team. It should be noted that number of the questions below were shared verbally by the participants during the open discussion session. In addition to these questions, additional comments and/or questions were recorded in the comments sheets. The Consultant answered the questions that were shared verbally and the answers are presented below. However, for questions that were shared through comments sheet, answers are not included in the table below but rather were considered in the relevant sections of the ESIA where applicable. Moreover, the Consultant welcomed all the comments and concerns of the participants. However, it was made clear that the ESIA worked to cover a specific determined scope and many concerns might be out of the limited scope of the ESIA.

Table 10.2: Comments and Responses during the Public Consultation May 5th , 2012

Comment	Response by ESIA Team
Transfer Station at Yarmouk has a particular sensitivity	Transfer stations
We need to emphasize the need for considering to increase the height of the landfill in case there is a limitation in the allowed depth.	This has been studied by the ESIA. From economic point of view the decreased depth and excavation will reduce the capacity of the landfill. This in turn will decrease the life span and/or increase the disposal cost. We are obliged to consider the restriction imposed on the area which is located close to the green line with Israel. The maximum allowed height within this area is 30 m. This requires coordination and approval from the Israeli side which is currently underway. Alternative in design and location could be considered if coordination and approvals from Israeli side has not been successful. If approvals on increased height did not work, this will mean that life span of the landfill will be decreased.

Expanding the composting activities will play a role in reducing the needed areas, the amount of waste that will be landfilled and the leachate.	However, if the feasibility of the composting facilities and the opportunities for marketing the product have not been carefully studied, composting plans could be transferred into a financial load that needs to be subsidized by the Government rather than a solution and this is the case in several Arab countries. In Egypt the feasibility of the plants is a serious challenge and the quality of the product is too poor due to the low quality of waste and organic matter that reaches the landfills. The FS suggested increasing the composting production from 1% to 18% until 2040. The local market can absorb this amount and UNDP has previous experience in Rafah and Bet Lahia that the project could benefit from. Moreover, an additional study was recommended to assess the compost quality and the local market needs.
The environmental aspects for the short term components of the project have not been covered in the presentation of the consultant	The main scope of this ESIA was the long term actions and the short term were separately considered in another ESIA by the FS team.
Are there specific standard allowed distance between the landfill and the nearest residential communities	The WB standards for establishing lanfills suggested 300m distance from the nearest house. In that sense, the distance is still within the acceptable standards.
What are the reasons for closing Deir El Balah engineered landfill although it is the single engineered landfill in Gaza.	There is no possibility for expanding the landfill due to the proximity of the residential areas (less than 100 m). The realistic conditions of the landfill and the limitations related to the location strongly suggest the closure of this landfill.
Has the study investigated the impacts on roads from transferring waste	This has been considered in the ESIA.
The Government should still be covering part of the operational costs in order to avoid overloading the local residents particularly the poor families. The government should still subsidize 30% of the cost of the service.	The ESIA suggested that the current mechanisms that provide subsidized service for poor families should be maintained. Parallel to this and in order to allow for better cost recovery in the future more loner terms mechanisms were proposed including raising the awareness and raising the profile of SWM. There is a general finding that local communities are more concerned and attentive to the components related to collection and they are less willing to pay for safe disposal of waste. This emphasizes the need to improve the collection service.

Feasibility study for the use of Methane should have been considered. What is the experience of Egypt in this regard?	Gases will be collected but the feasibility of the collection process is the responsibility of the feasibility study and not the ESIA. In Egypt, old landfills do not have gases collection systems. This has only been considered in the new landfills.
Will the transfer station in El Sharea El Geded be closed	Yes it will in cooperation with UNDP.
What is the possibility of treating the leachate through a small treatment unit as the case with the industrial waste before directing it to the treatment facility.	These are expensive options and studying them suggested that this not be feasible solutions.
The sludge resulting from drying the leachate: what is the feasibility of its disposal with the sludge resulting from the treatment plant. It may, however, affect its quality particularly since it will used in producing compost.	There is no close by treatment plant and accordingly the option might not be unfeasible.
Has there been coordination between the ESIA and the FS teams	There has been continuous collaboration between the two teams and also the views of other stakeholders have been taken into consideration. The final version of the FS is completely different from the first version and this is the result of the ongoing consultation and the close collaboration between the two teams.
The excavated soil could be sold and added to the economic feasibility of the project.	This has been considered in the ESIA
Is it expected that the odour impact may affect the neighboring farms and what are the measure to mitigate the impact	The landfill will generally has an impact on these neighboring activities but there is no need to change any of the current land uses including the land use in farming. Mitigation measures include waste compaction and applying daily cover for the waste.
Land scarcity in Gaza is one main concern. It is too difficult, thus, to use 100 dunums will be closed every 10 years. Concentrating on recycling to reduce needed space, odour, and other impacts.	This has been considered by the designer of the project to reduce the amount directed to the landfill. Composting option will also be considered but the feasibility of this option should be examined.
Is there a possibility to consider recyclables separation as part of the project. This is anticipated to add to the economic feasibility of the project.	This is already considered and will be helping from social point of view in empowering the informal sector.

How the rights of landowners will be protected	The consultancy service included, in addition to the ESIA, the preparation of ARAPs for the land owners whose lands will be acquired as part of the project. The ARAP considered the interests and the rights of the land owners and it aims to emphasize on the local authorities the importance of considering the land owners rights. It studied the local legislations and the international standards related to land rights. The ARAPs also emphasized the need for setting community based mechanisms for monitoring. Municipalities are generally concerned about the interests of the land owners and the compensation process will be made within a sensitive framework for handling these issues.
Consultation and negotiation with the affected land owners should start as soon as possible and not left until 2018. This applies in particular to the groups of land owners who have business in the area	This will be considered by the ARAP and the municipalities
The ESIA presented rich and invaluable information and reflected the situation in Gaza Strip	
The study is very transparent on the level of both the environmental and social aspects. We are proud of the results	

10.3 How the Consultations Contributed to the Design of the ESIA and ESMP

The various steps along the preparation of the ESIA and the ARAPs involved consultation with wide range of stakeholders as explained above. One of the key purposes of the consultation was to ensure that the concerns and recommendations of the consulted stakeholders are recognized and considered in the development of the study and more specifically in the preparation of the mitigation measure and ESMP.

Table 10.3 below, briefly presents that main concerns that was shared by stakeholders and have been reflected in the design of the ESMP. It worth noting, however, that the table below includes only the most important concerns/recommendations and that the majority of the raised issues were carefully considered in the ESIA.

Table 10.3 Brief Presentation for how the consultations contributed to the design of the ESIA and ESMP

Concern shared by Stakeholders during the consultations	How this was addressed
Awareness raising as a key issue for planning a successful SWM system. This was a clear message that was communicated by various stakeholders including beneficiaries as well as the various practitioners in the field.	This concern has been considered and reflected along the ESIA and in designing the mitigation measure and was also considered as one of the important additional recommendations and one of the key tasks for the proposed SDO as part of the PMU. The various surveys and consultation activities also aimed to measure the needed topics for awareness raising. **(Particularly addressed under: 5B.4.10, 6B.2.2.6, 7B.3.2 and Chapter 9)**
Fees and service fee system and the recommendation to maintain the subsidized fees for poor families.	This was considered under the potential negative economic impact on poor families and mitigation measures were drawn based on the discussion and recommendations of stakeholders. **(Particularly addressed under: 5B.4.4, 6B.2.2.6, 7B.2.2.5 and Chapter 10)**
Attention to the primary and secondary collection of SWM since this is a core interest for local community and is perceived as much more important than final disposal.	This was one of the key concerns for SWM service beneficiaries. The survey and the various consultations reflected this clearly. The Consultant has communicated this concern to the designer of the project and made it explicit in the ESIA that without improving primary and secondary collection, local communities' satisfaction level will not increase and they will not be willing to pay more for the service. **(Particularly addressed under: 5B.4, 6B.2.2.1 and 7B.3.5)**
The compensation process and the interests of land owners	This has been fully considered through analysis of the impact as part of the ESIA and preparation of ARAP for land owners **(Particularly addressed under: 6B.2.1.3, 7B.2.1.3, Chapter 9 and the ARAPs)**
Appropriate alternatives for the waste pickers from their prospective and based on actual	This has been fully considered through analysis of the impact on the livelihoods of these groups as part of the ESIA and preparation of ARAP for waste pickers including different scenarios to mitigate the negative economic impact on the livelihoods of these groups. **(Particularly addressed under: 6B.2.1.3, 7B.2.1.3, Chapter 9 and the ARAPs)**
Creating consultation mechanisms with local communities in order to ensure channeling concerns and responding to complaints during both construction and operation of the project.	Under the ESMP, several mechanisms were envisaged to ensure that communication channels with local communities and participatory monitoring activities will be considered. This includes appointing SDO with specific tasks and responsibilities related to community consultation and engagement and forming Voluntary Community- Based Monitoring Committees. Allocation

Concern shared by Stakeholders during the consultations	How this was addressed
	for the consultation activities and the survey including consultancy fees was also proposed under the ESMP. **(Particularly addressed under: 6B.2.2.6, 7B.2.2.6 and Chapter 9)**
Capacity Building for the human resources that will be in charge of managing the project	Capacity building was proposed for the SDO including a preliminary list of modules that should be considered in order to enable the SDO to efficiently fulfill his/her role. **(Particularly addressed under: Chapter 9)**
Unplanned restriction for the waste pickers to the sources of income without finding alternative may result in unfavourable impacts	This concern form the stakeholders has been fully appreciated and recognized and special attention to the waste pickers being on of the most vulnerable groups to the project was considered. **(Particularly addressed under: 6B.2.1.3, 7B.2.1.3, Chapter 9 and the ARAPs)**
Transfer stations	According to the ToRs, the ESIA approach was to give more focus on the two landfills as the two key components of the project. Following comment s on transfer stations during the public consultation and from stakeholders, more focus has been given to transfer stations and their locations have been thoroughly studied including proximity to sensitive receptors. And the maximum possible mitigation measures were taken (Particularly addressed in chapters 6A and 7A)

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) FOR SOLID WASTE MANAGEMENT IN GAZA

ANNEXES

REFERENCES

CMWU (2008). "Hydrogeological Assessment for the Causes of Groundwater Level Rise and Seepage in Al Mawasi Area (Khan Younis)."

Cooperative-International, S. S. P. and W. R. C. Gaza (1997). "Geophysical Study of the Southern Sector of the Gaza Strip (Khan Younis area), Gaza, Palestine." Unpublished.

Hallaq, A. A. and B. A. Elaish (2011). "Assessment of Aquifer Vulnerability to Contaminationin Khan Younis Governorate, Gaza Strip, Palestine, using the DRASTIC Model within GIS Environment." An - Najah Univ. J. Res (N.Sc.) Vol. 25, 2011.

Metcalf and Eddy (2000). "Geophysical surveys in the Gaza Govornorates, unpublished report. Gaza, Palestine
".

Palestinian Water Authority and USAID (2000). "Coastal Aquifer Management Program (CAMP), Integrated Aquifer Management Plan (Task-3), Gaza."

PWA (2011). Internal Report of the Palestinian Water Authority on Rainfall Intensity in Gaza Strip for the Year 2010/2011.

PWA/USAID (2000a). "Coastal Aquifer Management Program (CAMP), Integrated."

PWA/USAID (2000b). "Coastal Aquifer Management Program (CAMP), Integrated Aquifer Management Plan (Task-7), Palestinian Water Authority, Gaza, Palestine.
."

UNDP/PAPP (2009). "Provisions of Consultancy Service for the Detailed Design for the Construction of Khan Younis Wastewater Treatment Plant in Gaza Strip, Environmental Impact Assessment, Final Report (SOGREAH UNIVERSAL GROUP TECC). Accessed online November 2011 at http://www.undp.ps/en/focusareas/engenv/kywwtp/EIAstudy.pdf."

UNDP/PAPP (2011). "Feasibility Study and Detailed Design for Solid Waste Management in the Gaza Strip. Draft Final (DHV ENFRA TECC)."

UNEP (2009). "Environmental Assessment of the Gaza Strip. Accessed online November 2011 at http://www.unep.org/PDF/dmb/UNEP_Gaza_EA.pdf."

BIBLIOGRAPHY

Almasri, M. N., 2006. Regional assessment of groundwater vulnerability to contamination in Gaza Strip. [A report submitted to UNESCO.] Water and Environmental Studies Institute, An-Najah National University, Nablus, Palestine, 2006

Assessment of Solid Waste Dumpsites in Gaza Strip, Japanese International Cooperation and Agency Environment Quality Authority, March, 2007

Assessment of Solid Waste Sorting and Recycling in the northern and southern West Bank, and identification of suitable pilot projects for implementation in Hebron and Bethlehem Governorates, IMG Consultants, European Commission, 2010

Beneficiary Assessment of Zahret Al-Finjan Landfill Project, UG Consultants, 2009

Beneficiary Impact Assessment of Southern West Bank Solid Waste Management Project, Baseline Report, Universal Group and ERM Consultants, 2010

Country Report – Palestine, GTZ-ERM-GKW International Consortium, World Bank and Mediterranean Environmental Technical Assistance Program (METAP), 2004

Environmental Assessment of the Gaza Strip, United Nations Environment Programme (following the escalation of hostilities in December 2008 – January 2009), United Nations Environment Programme, 2009

Environmental and Social Impact Assessment Report for the al-Menya Landfill, Southern West Bank Solid Waste Management Program, MDLF, World Bank, 2009

Environmental Impact Assessment of Khan Younis Wastewater Treatment Plant in Gaza Strip, Sogreah Consultants and UG Gaza, 2010

Evaluating the Impact of Landfill Leachate on Groundwater Aquifer in Gaza Strip Using Modeling Approach [A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Engineering - Water Resources Engineering], The Islamic University – Gaza, Deanship of Graduate Studies, Faculty of Engineering, Water Resources Engineering, 2009

Feasibility Study and Detailed Design for Solid Waste Management, Gaza Strip, Inception Report and 8 July 2011 Progress Report, DHV and Enfra Consultants, 2011

Feasibility Study Detailed Design for Solid Waste Management, Gaza Strip, Terms of Reference, RFP-2011-03 and Addendum No.2, UNDP, 2011

Mediterranean Environmental Technical Assistance Programme, Country Report, Palestine, (Final), GTZ – ERM – GKW, 2004

National Strategy for Solid Waste Management in the Palestine Territory, Palestinian National Authority, 2010-2014

Palestinian Environmental Assessment Policy, Environmental Quality Authority, 2000

Palestinian Environmental Law, the Palestinian Authority, issued on 28/12/1999

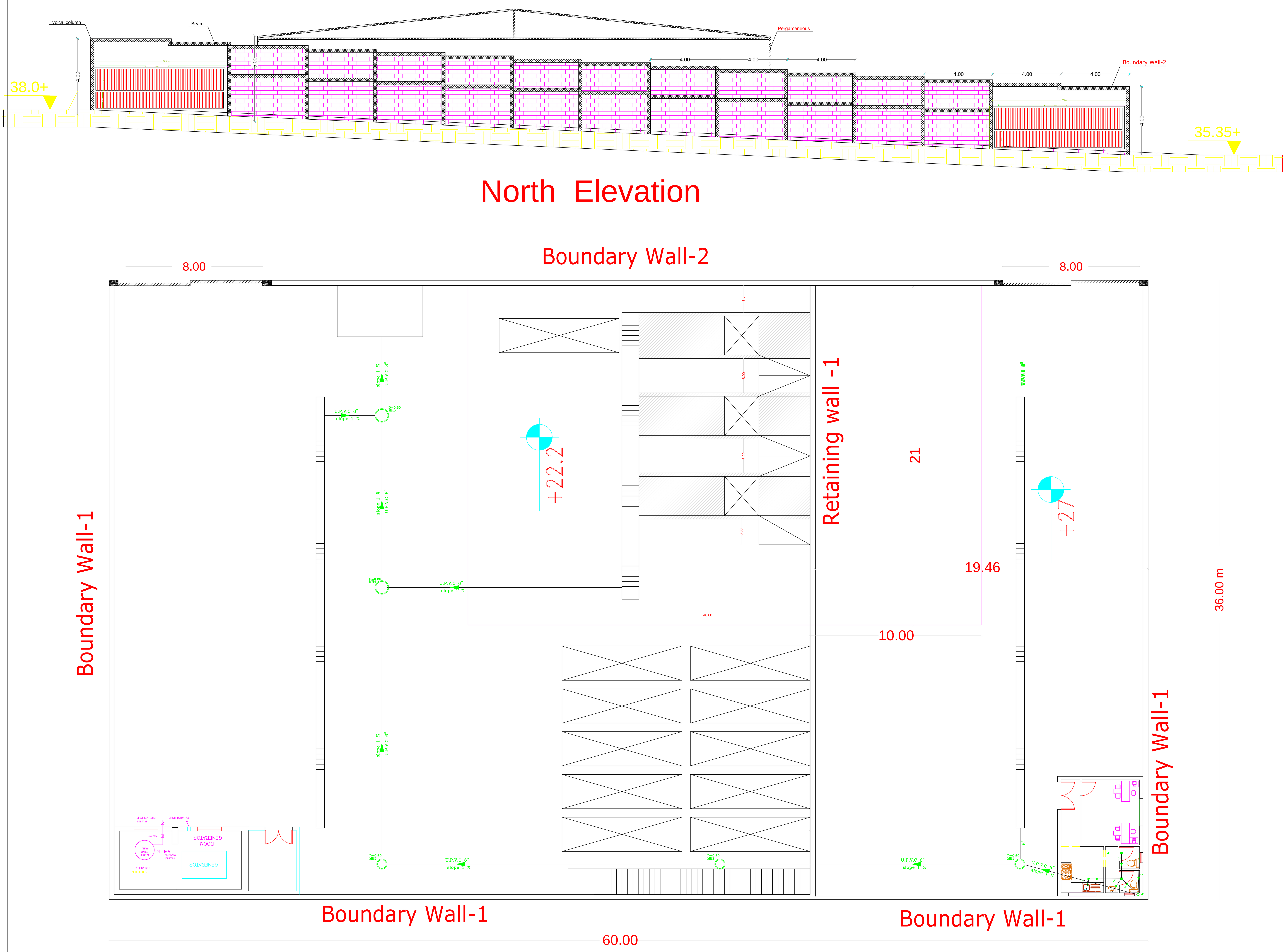
Resettlement Action Plan for Waste Pickers and Herdsmen, Proposed Sanitary Landfill Al-Menya (site 12), Southern West Bank Solid Waste Management Project, DHV Netherlands – PHG Palestine, 2009

Setting - up Groundwater Protection Plan of the Coastal Aquifer of Gaza Strip. House of Water and Environment, Palestinian Water Authority, World Bank (Project number PWA - WB - GEWP - 01/09)., Palestine, 2010

Socio-Economic Reports of the occupied Palestinian territory (oPt), Office of the United Nations Special Coordinator for the Middle East Peace Process, January-April, 2011

Solid waste management in the Gaza Strip, Case Study, Husni Al-Najar, Ministry of Health, Gaza, 2007

Annex 4A : Tender Documents for Transfer Stations



FEASIBILITY STUDY AND DETAILED DESIGN FOR SOLID WASTE MANAGEMENT IN THE GAZA STRIP

CLIENT	UNDP - Program of Assistance to the Palestinian People
FUNDING AGENCY	
DESIGNER	DHV, Enfra, TECC
PHASE	Final Design
LOCATION	Gaza Site - Gaza Strip

Transfer Station Design

CHANGES	SIGNATURE	DATE
1.)		
2.)		
3.)		

SCALE	PLAN NUMBER	DATE	SIGNATURE
1:200	02	2012-03-15	

DHV BV,
Laan 1914 No. 35
3818 EX Amersfoort

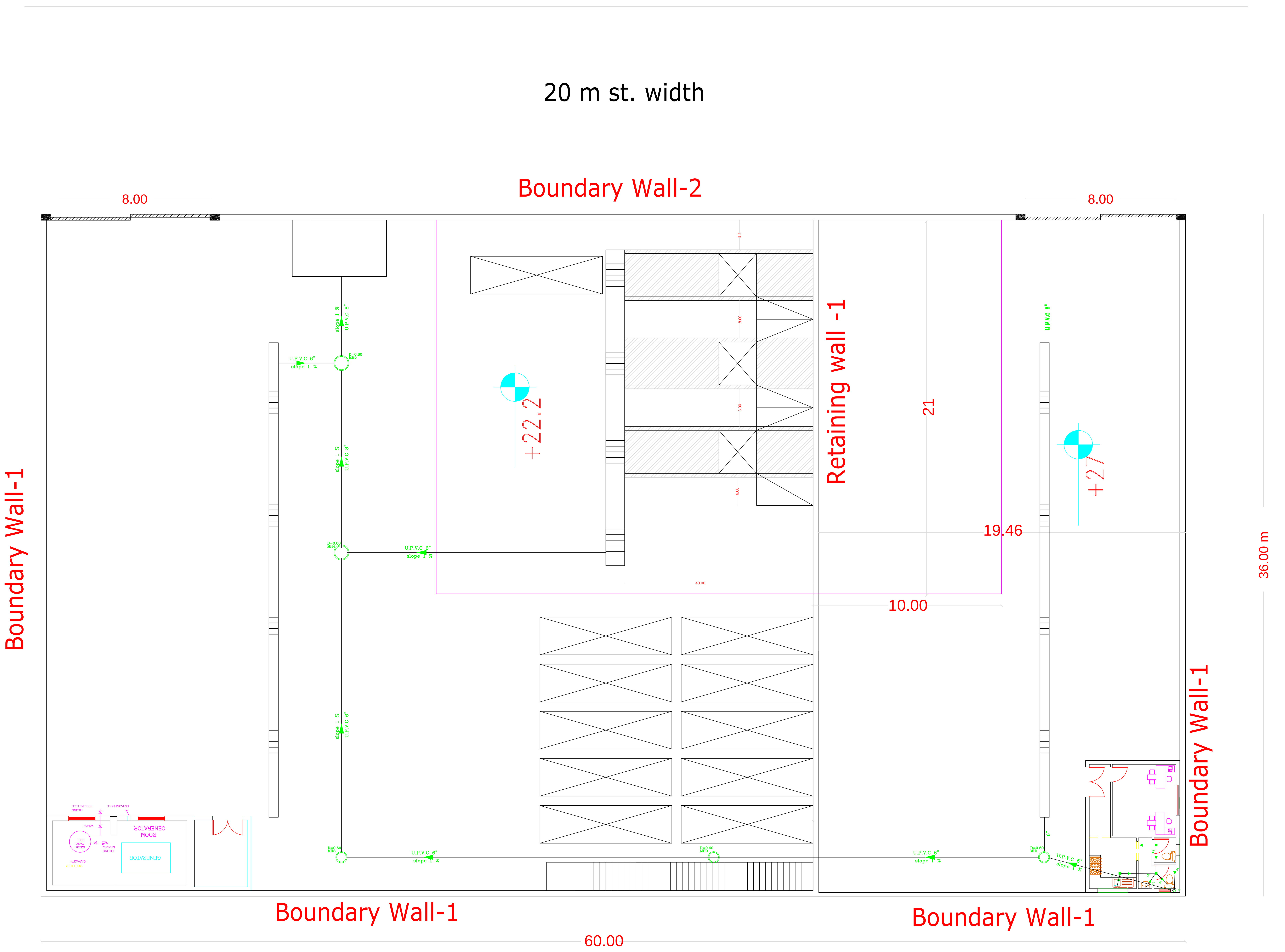
Industriestraße 10
84137 Vilsbiburg / Germany
Tel.: +49.8741.96040
Fax: +49.8741.960499
www.sehlhoff.eu

ENFRA Consultants

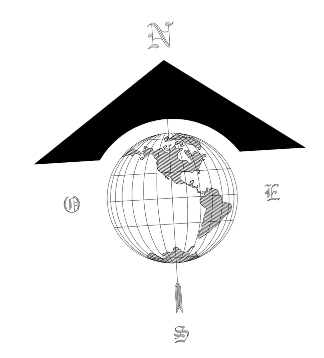
TECC

Architectural - 01

General Transfer Station Layout



General Transfer Station Layout



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CLIENT	UNDP - Program of Assistance to the Palestinian People
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DESIGNER	DHV, Enfra, TECC
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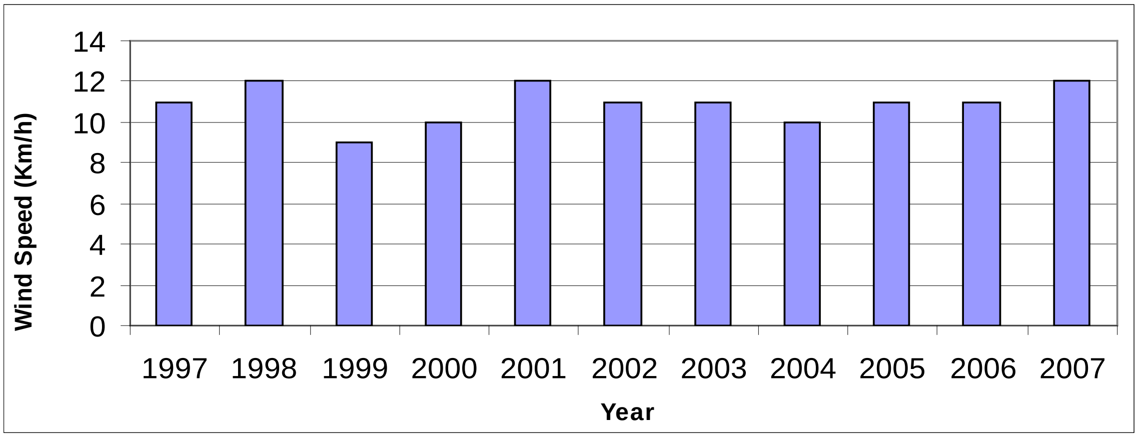
Annex 5A: Annexes of Chapter 5A

nnex 5A-a: Average temperature for Gaza Station for year 2006. Source (Gaza Station meteorological data)

DATE	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEB**	**OCT**	**NOV**	**DEC**	*AER.*
1	16.0	16.0	18.5	17.4	20.2	24.3	27.0	27.0	27.8	26.0	23.2	17.7	
2	15.6	17.9	16.5	18.2	20.8	25.1	27.7	26.8	27.1	25.0	21.1	16.6	
3	17.6	16.8	15.7	18.0	20.1	25.9	27.6	27.2	26.4	25.3	21.2	16.6	
4	20.1	16.4	17.2	19.3	19.5	26.9	27.0	27.3	26.9	25.2	22.0	16.1	
5	19.5	16.4	16.1	16.2	19.9	27.9	26.7	27.5	27.2	25.5	19.0	16.0	
6	16.8	15.9	15.6	18.1	21.1	27.1	26.4	27.5	26.5	25.6	17.1	16.3	
7	16.6	18.6	21.7	18.8	23.5	25.6	26.6	27.9	26.7	25.9	17.7	15.7	
8	14.6	15.1	17.4	22.2	19.7	24.8	26.7	27.9	27.1	24.9	18.7	16.0	
9	13.9	13.5	14.3	20.0	19.6	23.8	26.5	27.5	26.7	24.1	18.6	18.5	
10	13.5	14.2	12.8	18.1	19.3	23.6	26.3	26.5	27.8	25.5	19.1	17.8	
11	13.4	14.0	14.8	18.3	19.4	23.5	26.3	26.9	27.8	26.7	19.1	16.4	
12	13.6	15.5	16.3	18.2	20.4	23.6	27.5	27.7	27.2	27.3	19.0	15.3	
13	12.4	16.1	18.2	20.3	20.2	24.0	26.9	27.5	26.9	26.0	18.9	15.9	
14	11.4	14.6	18.8	22.7	21.6	24.4	26.8	27.0	27.0	24.8	18.7	16.3	
15	11.2	13.9	16.7	19.8	21.0	23.9	26.7	26.7	26.8	24.1	18.0	16.5	
16	12.9	13.5	15.9	16.7	20.8	23.8	26.4	27.1	26.6	23.1	19.2	14.3	
17	13.6	13.8	15.7	20.4	20.9	23.7	26.7	27.8	27.1	23.3	19.0	13.1	
18	13.9	16.3	15.8	21.4	21.0	23.8	27.3	27.9	28.4	25.7	18.6	14.3	
19	14.1	17.9	19.0	22.2	20.6	24.9	27.1	29.1	27.9	24.4	18.7	15.4	
20	15.5	16.3	17.1	22.8	21.3	25.2	26.9	28.8	27.0	22.9	18.8	15.3	
21	16.1	16.2	20.1	20.8	21.4	25.2	26.6	28.9	26.8	23.1	18.5	15.5	
22	15.0	16.8	17.4	26.4	22.2	25.8	26.0	29.3	25.9	23.3	18.2	16.4	
23	16.8	17.9	19.8	20.5	22.4	26.0	26.3	29.3	25.6	22.9	18.1	14.5	
24	16.1	23.4	19.8	19.7	23.2	26.3	27.3	28.8	25.5	23.1	18.1	13.2	
25	15.3	18.5	16.8	19.8	24.9	26.3	27.0	28.9	25.6	22.5	19.0	12.7	
26	13.9	16.6	16.7	20.0	25.9	26.3	26.8	28.1	25.1	22.7	18.7	13.0	
27	13.8	16.3	16.6	19.4	25.2	26.0	27.6	27.5	25.2	22.9	19.0	12.0	
28	14.6	16.5	16.8	22.5	23.9	26.4	26.9	27.2	26.8	18.6	18.0	10.8	
29	12.9		17.2	24.7	24.0	26.6	26.8	28.3	28.7	18.6	17.1	11.0	
30	12.6		17.5	20.1	24.3	26.9	27.3	28.3	27.1	21.7	17.1	13.2	
31	13.1		18.6		24.8		27.5	27.6		23.6		11.8	
AVR.	14.7	16.2	17.1	20.1	21.7	25.2	26.9	27.8	26.8	24.0	18.9	15.0	21.2

Annex 5A-b: Wind speed averages for year 1997-2007 in km/h - Source (UNDP/PAPP 2009)



Annex 5A-c: Average yearly precipitation in Khan Younis Governorate from 1999-2009. Source (Ministry of Agriculture, 2009)

	1999/ 2000	2000/ 2001	2001/ 2002	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	Avg. yearly precipi -tation
Khan Younis station (mm/year))	191.8	381	311.7	298	204.4	373	270.5	252	178	309	276.94
Khuza'a station (mm/year)	142.2	284.3	258.5	261.2	184.0	367.7	214.0	256.1	137.8	261.8	236.69
Average (mm/year)											263.5

Annex 5A-d Cumulative Annual Rainfall in Gaza Strip at the different meteorological stations for the period 1973-2007. Source (Gaza meteorological stations data)

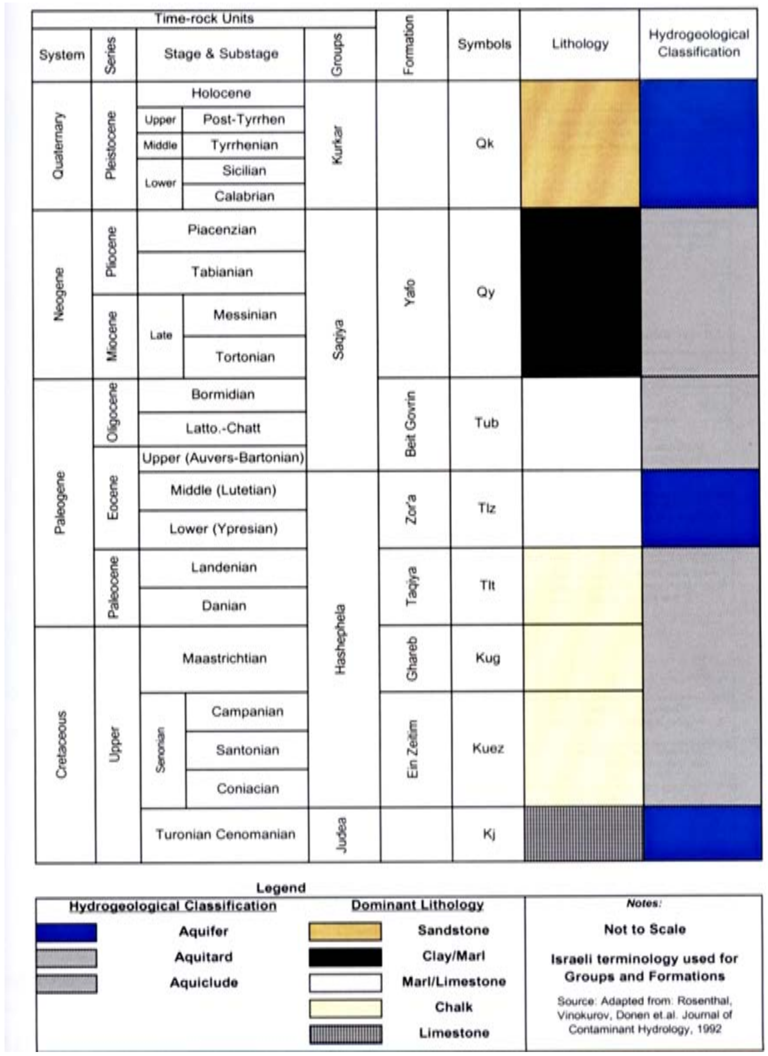
Hydrological Year	Beit Hanoun	Beit Lahia	Shati	Gaza City	Nussir ate	Deir El Balah	Khan Younis	Rafah	Gaza South	Jabalia	Tuffah	Khuzaa
(73/74)	578.1	473.1	494.2	560.0	534.0	421.0	322.3	376.5	528.7	423.9	481.1	384.0

(74/75)	209.8	189.5	213.9	222.0	209.4	233.8	153.7	166.5	222.0	174.8	197.0	172.2
(75/76)	225.3	262.9	210.8	246.0	206.2	220.1	176.2	163.0	198.8	192.5	214.3	175.5
(76/77)	393.8	442.1	366.3	247.4	350.8	331.3	223.5	197.5	348.5	297.4	305.6	228.4
(77/78)	299.8	335.5	299.6	380.2	286.5	300.5	245.5	206.0	287.5	270.9	304.5	232.2
(78/79)	284.5	379.5	315.9	318.5	277.8	231.5	188.5	162.5	292.5	272.4	288.9	189.1
(80/81)	509.3	484.1	397.6	373.1	493.8	471.0	379.7	339.4	209.5	344.7	386.7	362.6
(81/82)	358.0	319.5	357.7	304.0	304.4	314.0	306.7	190.0	233.0	275.7	297.9	236.6
(82/83)	666.0	634.0	561.3	511.0	521.2	457.5	471.6	360.0	391.0	470.7	511.3	410.1
(83/84)	276.5	255.5	278.5	202.8	173.4	189.5	109.7	129.0	153.0	207.3	216.5	137.4
(84/85)	263.5	245.7	235.4	214.0	159.4	172.4	150.2	193.5	146.4	191.3	211.4	182.7
(85/86)	215.5	258.0	232.0	228.5	204.5	240.0	301.2	150.2	166.1	194.9	212.6	196.4
(86/87)	666.1	676.2	648.4	588.7	595.3	617.1	465.1	262.8	446.9	527.6	561.0	366.5
(87/88)	390.8	486.5	435.6	303.2	282.8	275.0	263.7	173.7	242.2	337.0	341.0	219.0
(88/89)	425.3	474.0	407.3	318.0	357.1	289.5	339.4	263.2	263.5	330.7	350.4	293.2
(89/90)	510.6	537.5	576.6	421.0	349.2	245.6	259.2	275.0	303.0	426.9	442.8	287.9
(90/91)	442.0	435.5	446.8	365.6	370.7	324.6	348.6	241.5	282.0	347.7	371.0	286.5
(91/92)	652.6	839.2	669.8	636.2	540.5	470.2	541.0	350.0	635.8	579.5	609.1	434.1
(92/93)	506.2	529.5	501.5	461.5	457.5	318.0	419.2	293.5	571.6	415.7	444.3	347.7
(93/94)	306.3	330.0	196.4	193.2	236.5	229.1	140.5	113.0	225.4	195.3	206.7	140.1
(94/95)	618.1	679.5	580.9	601.3	628.0	596.5	536.6	487.3	466.8	505.8	564.9	515.6
(95/96)	455.0	460.2	480.6	433.7	412.5	371.1	331.0	249.2	208.5	376.5	407.2	291.9
(96/97)	294.7	333.5	228.1	296.7	304.0	314.6	340.4	313.1	282.1	229.8	269.9	315.5
(97/98)	303.5	277.0	212.5	250.9	242.0	216.5	174.2	193.9	162.0	199.7	228.0	195.0
(98/99)	161.5	164.8	133.7	157.5	26.0	132.0	88.6	61.5	183.5	115.5	112.0	78.2
(99/00)	406.4	390.5	425.1	334.8	278.5	256.7	191.8	198.5	368.3	388.5	357.2	142.2
(00/01)	497.5	490.4	478.9	511.9	558.3	550.5	381.0	308.0	563.6	540.0	533.4	284.3
(01/02)	548.4	542.0	522.1	544.4	545.5	390.6	311.7	241.7	660.5	565.5	604.3	258.5
(02/03)	844.4	766.0	661.2	617.0	476.2	401.4	322.7	242.8	873.7	732.5	694.8	285.3
(04/05)	358.7	320.6	296.6	310.7	405.0	345.5	369.5	360.2	323.6	345.5	350.7	368.0
(05/06)	368.9	363.8	317.2	322.4	295.0	257.0	270.5	203.0	274.4	345.4	363.5	214.0
(06/07)	160.4	139.0	181.2	212.0	172.0	161.0	104.7	139.3	169.7	185.9	239.1	81.5

Annex 5A-e: Daily average evaporation rate in Gaza station in mm/day (1999-2005)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVR
1999	1.9	2.7	4.7	5.0	6.0	6.3	6.7	6.0	5.3	4.0	3.2	2.6	4.5
2000	2.6	2.7	3.6	4.3	5.2	5.8	5.8	5.9	5.1	4.4	4.8	3.5	4.5
2001	3.7	3.8	4.7	5.1	5.8	8.4	6.4	6.8	6.1	5.0	3.8	3.1	5.2
2002	3.1	3.4	3.8	4.5	5.5	6.2	6.1	6.0	5.8	4.0	3.4	2.5	4.5
2003	2.5	3.2	3.4	4.7	5.4	5.8	6.0	6.0	5.7	4.0	3.1	2.2	4.3
2004	2.6	2.8	3.5	4.7	5.4	6.1	6.6	7.1	6.2	4.5	3.4	2.7	4.6
2005	2.8	2.7	3.4	4.0	5.0	5.7	5.8	5.8	5.4	4.5	3.3	2.1	4.2
AVR.	2.7	3.0	3.9	4.6	5.5	6.3	6.2	6.2	5.7	4.4	3.6	2.7	4.6

Annex 5A-f: A summary for the geological history of the area (PWA, 2000a).



Annex 5A-g : Hydraulic Conductivity and Transmissivity

Ag. well #	Surveyed X	Surveyed Y	Transmissivity (T) (m^2/day)	Hydraulic Conductivity (K) m/day
F/191	94959.45	98950.77	2650	83
G/50	93155.69	98410.06	1790	27
R/162E	98247.77	104479.26	1070 - 2070	22 - 44
R/162L	98441.98	104037.25	4000	73
R/272A	99389.61	98469.80	1760	59
R/272B	99828.00	98063.03	2260	75
R/272C	99941.95	98343.81	2870	72
K/19	86461.66	88591.60	2200	60
L/181	81360.61	82373.25	1220 - 1370	35 - 40
P/146	80946.91	81867.06	820	60
L/159A	82677.99	85081.92	2800	70
L/182	81859.44	82927.54	950 - 1630	30 - 52
G/49	91376.81	96448.36	410 - 1100	21 - 55
S/71	92675.57	91699.97	480 - 1180	32 - 79
T/46	91983.82	90272.48	190 - 1860	75
A/180	102458.90	107032.67	6000	140
C/128	106476.91	104891.17	1500	27
C/79	105349.29	105095.31	1740 - 2100	60 - 70
D/73	101036.47	106827.37	960	18 - 23
E/1	103273.91	104898.92	530 - 1760	25 - 80
A/188	104058.34	108119.05	1460	38
P/124	077598.02	079413.99	1100	15
P/145	079368.62	079856.37	1600	50
P/147	080133.03	080166.44	530 - 1130	21 - 47

Source: PWA and CAMP Project

Annex 5A-h : Chemical analysis results for representative wells in GS

	Maximum (mg l^{-1})	Minimum (mg l^{-1})	Mean (mg l^{-1})	SD*
East (27 wells):				
Mg	91	16	55.22	19.90
Ca	314	25	83.78	57.68
Na	930	80	508.70	281.68
K	10	1	4.59	2.65
SO_4	710	15	261.96	215.92
NO_3	500	45	164.92	128.26
HCO_3	469	122	279.22	94.63
Cl	1778	175	749.30	469.64
West (25 wells):				
Mg	160	22	71.83	41.75
Ca	218	38	116.67	52.14
Na	700	19	224.21	202.85
K	37	0	6.54	9.65
SO_4	625	10	184.79	172.91
NO_3	450	10	105.42	94.07
HCO_3	406	83	202.92	63.37
Cl	1470	42	438.46	384.05
North (90 wells):				
Mg	328	12	50.85	35.79
Ca	178	11	77.12	32.97
Na	600	4	123.45	132.58
K	33	1	2.90	4.20
SO_4	1676	6	74.93	178.17
NO_3	550	25	133.07	98.49
HCO_3	510	30	242.47	89.49
Cl	889	35	218.51	192.56
South (58 wells):				
Mg	160	17	50.48	26.68
Ca	314	23	82.64	53.11
Na	960	30	413.26	273.44
K	37	1	5.95	5.47
SO_4	710	7	227.47	192.81
NO_3	550	10	173.26	146.63
HCO_3	448	83	213.22	70.74
Cl	1778	84	590.72	417.75

* SD: standard deviation.

Annex 5B: Annexes of Chapter 5B

Annex 5.B. a: The Growth in Gaza Strip Population from 2007 until 2014 Divided by Locality

Source: PCBS, 2007

* Locality Type (1: Urban, 2: Rural, 3, Camps)								
Locality Name	**Locality Type ***	**Year**						
		2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Ash shati Camp	3	34.176	35.181	36.227	37.311	38.516	39.764	41.043
Gaza	1	443.095	456.131	469.687	483.742	499.374	515.558	532.132
Madinat Ezahra	2	3.043	3.132	3.226	3.322	3.429	3.541	3.654
Al mughraqa (Abu	2	6.448	6.638	6.835	7.039	7.267	7.502	7.744
Juhor ad Dik	2	2.880	2.965	3.053	3.144	3.246	3.351	3.459
Urban Total		443.095	456.131	469.687	483.742	499.374	515.556	532.132
Rural Total		12.371	12.735	13.113	13.506	13.942	14.394	14.857
Camps Total		34.176	35.181	36.227	37.311	38.516	39.764	41.043
Total Gaza Gov		489.642	504.047	519.027	534.558	551.832	569.714	588.32

* Locality Type (1: Urban, 2: Rural, 3, Camps)								
Locality Name	**Locality Type ***	**Year**						
		2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
An Nuseirat Camp	3	27.677	28.569	29.497	30.462	31.531	32.641	33.781
An Nuseirat	1	36.123	37.287	38.499	39.758	41.153	42.601	44.090
Al Bureij camp	3	23.652	24.413	25.207	26.031	26.945	27.893	28.868
Al Bureij	1	9.702	10.015	10.340	10.678	11.053	11.442	11.842
Az Zawayda	1	16.688	17.226	17.786	18.367	19.012	19.681	20.369
Deir al Balah Camp	3	6.343	6.547	6.760	6.981	7.226	7.480	7.742
Al Maghazi Camp	3	15.836	16.346	16.877	17.429	18.041	18.676	19.329
Al Maghazi	1	6.441	6.649	6.865	7.089	7.338	7.596	7.862
Deir al Balah	1	53.633	55.360	57.160	59.029	61.101	63.252	65.461
Al Musaddar	2	1.845	1.905	1.967	2.031	2.102	2.176	2.252
Wadi as Salqa	1	4.552	4.698	4.851	5.010	5.185	5.368	5.555
Urban Total		127.140	131.234	135.500	139.932	144.844	149.940	155.179
Rural Total		1.845	1.905	1.967	2.031	2.102	2.176	2.252
Camps Total		73.508	75.875	78.341	80.903	83.743	86.690	89.719
Total Deir al Balah Gov		202.493	209.014	215.808	222.866	230.689	238.807	247.150

* Locality Type (1: Urban, 2: Rural, 3, Camps)		
Locality Name	**Locali**	**Year**

	Locality Type *	2007	2008	2009	2010	2011	2012	2013
Um al-nnaser (A Qaraya al Badawiya al Maslakh	2	2.763	2.868	2.977	3.092	3.219	3.351	3.487
Beit Lathiya	1	63.347	65.755	68.273	70.902	73.804	76.831	79.962
Beit Hanun	1	37.392	38.813	40.300	41.851	43.564	45.351	47.199
Jabalya Camp	3	41.211	42.777	44.416	46.126	48.014	49.983	52.020
Jabalya	1	120.881	125.474	130.280	135.297	140.834	146.609	152.585
Urban Total		221.620	230.042	238.853	248.051	258.202	268.791	279.746
Rural Total		2.763	2.868	2.977	3.092	3.219	3.351	3.487
Camps Total		41.211	42.777	44.416	46.126	48.014	49.983	52.020
Total North Gaza Gov.		265.594	275.687	286.246	297.269	309.434	322.124	335.253

* Locality Type (1: Urban, 2: Rural, 3, Camps)

Locality Name	Locality Type *	Year						
		2007	2008	2009	2010	2011	2012	2013
Al Qarara	1	19.500	20.072	20.667	21.283	21.969	22.679	23.406
Khan Younis Camp	3	37.192	38.283	39.417	40.593	41.901	43.255	44.642
Khan Younis	1	140.697	144.824	149.115	153.584	158.512	163.634	168.880
Bani Suheila	1	31.272	32.189	33.143	34.132	35.231	36.370	37.536
Abasan al Jadida (as Saghira)	2	5.984	6.159	6.341	6.531	6.741	6.959	7.182
Abasan al Kabira	1	18.163	18.695	19.249	19.824	20.462	21.123	21.801
Khuza'a	2	9.023	9.287	9.562	9.848	10.165	10.493	10.830
Al Fukhkhari	1	5.464	5.624	5.791	5.963	6.155	6.354	6.558
Urban Total		215.096	221.405	227.965	234.765	242.330	250.160	258.181
Rural Total		15.006	15.446	15.904	16.378	16.906	17.452	18.012
Camps Total		37.192	38.283	39.417	40.593	41.901	43.255	44.642
Total Khan Younis Gov		267.294	275.134	283.286	291.737	301.138	310.868	320.835

* Locality Type (1: Urban, 2: Rural, 3, Camps)

Locality Name	Locality Type *	Year						
		2007	2008	2009	2010	2011	2012	2013
Rafah	1	119.895	123.936	128.150	132.533	137.385	142.427	147.618
Rafah Camp	3	34.025	35.172	36.367	37.611	38.988	40.419	41.892
Al-nnaser (Al Bayuk)	2	6.211	6.420	6.638	6.865	7.117	7.378	7.647
Shokat as Sufi	1	10.566	10.923	11.294	11.680	12.108	12.552	13.010
Urban Total		130.462	134.858	139.443	144.213	149.493	154.979	160.627
Rural Total		6.211	6.420	6.638	6.865	7.117	7.378	7.647

* Locality Type (1: Urban, 2: Rural, 3, Camps)								
Locality Name	**Locality Type ***	**Year**						
		2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Camps Total		34.025	35.172	36.367	37.611	38.988	40.419	41.892
Total Rafah Gov		170.697	176.450	182.449	188.690	195.598	202.776	210.166

Annex 6: Annexes of Chapter 6

Annex 6A-a: LandGEM Results for Sofa Landfill

	Total gas		Methane		CO2		NMOC	
	t/y	m3/y	t/y	m3/y	t/y	m3/y	t/y	m3/y
2018	0	0	0	0	0	0	0	0
2019	5,543	4,689,267	1,251	1,875,707	5,150	2,813,560	10	2,814
2020	11,084	9,376,131	2,502	3,750,452	10,298	5,625,678	20	5,626
2021	16,561	14,009,929	3,739	5,603,972	15,387	8,405,958	30	8,406
2022	21,887	18,515,209	4,941	7,406,084	20,335	11,109,125	40	11,109
2023	27,328	23,117,967	6,169	9,247,187	25,390	13,870,780	50	13,871
2024	32,893	27,825,416	7,425	11,130,166	30,561	16,695,250	60	16,695
2025	38,590	32,645,067	8,712	13,058,027	35,854	19,587,040	70	19,587
2026	44,344	37,512,738	10,011	15,005,095	41,200	22,507,643	81	22,508
2027	49,901	42,213,835	11,265	16,885,534	46,363	25,328,301	91	25,328
2028	55,606	47,039,967	12,553	18,815,987	51,664	28,223,980	101	28,224
2029	61,465	51,996,104	13,876	20,798,442	57,107	31,197,663	112	31,198
2030	67,485	57,088,669	15,235	22,835,467	62,700	34,253,201	123	34,253
2031	73,671	62,321,636	16,631	24,928,654	68,448	37,392,981	134	37,393
2032	79,972	67,651,652	18,053	27,060,661	74,302	40,590,991	145	40,591
2033	86,204	72,923,526	19,460	29,169,410	80,092	43,754,116	157	43,754
2034	104,354	88,277,733	23,558	35,311,093	96,955	52,966,640	190	52,967
2035	122,138	103,322,068	27,572	41,328,827	113,479	61,993,241	222	61,993
2036	139,293	117,834,186	31,445	47,133,675	129,417	70,700,512	253	70,701
2037	156,088	132,041,871	35,237	52,816,748	145,021	79,225,123	284	79,225
2038	172,522	145,944,205	38,947	58,377,682	160,290	87,566,523	314	87,567
2039	188,317	159,305,963	42,512	63,722,385	174,966	95,583,578	343	95,584
2040	203,754	172,364,461	45,997	68,945,784	189,308	103,418,677	371	103,419
2041	218,828	185,116,773	49,400	74,046,709	203,314	111,070,064	398	111,070
2042	227,450	192,410,366	51,347	76,964,146	211,324	115,446,220	414	115,446
2043	218,532	184,865,848	49,333	73,946,339	203,038	110,919,509	398	110,920
2044	209,963	177,617,154	47,399	71,046,862	195,077	106,570,292	382	106,570
2045	201,730	170,652,686	45,540	68,261,074	187,428	102,391,611	367	102,392
2046	193,820	163,961,298	43,755	65,584,519	180,079	98,376,779	353	98,377
2047	186,220	157,532,284	42,039	63,012,914	173,018	94,519,370	339	94,519
2048	178,918	151,355,355	40,391	60,542,142	166,233	90,813,213	326	90,813
2049	171,903	145,420,626	38,807	58,168,250	159,715	87,252,376	313	87,252
2050	165,163	139,718,602	37,285	55,887,441	153,453	83,831,161	300	83,831
2051	158,686	134,240,157	35,823	53,696,063	147,436	80,544,094	289	80,544
2052	152,464	128,976,525	34,419	51,590,610	141,655	77,385,915	277	77,386
2053	146,486	123,919,283	33,069	49,567,713	136,100	74,351,570	267	74,352
2054	140,742	119,060,339	31,772	47,624,136	130,764	71,436,203	256	71,436
2055	135,224	114,391,916	30,527	45,756,766	125,637	68,635,150	246	68,635

	Total gas		Methane		CO2		NMOC	
	t/y	m3/y	t/y	m3/y	t/y	m3/y	t/y	m3/y
2056	129,921	109,906,545	29,330	43,962,618	120,710	65,943,927	236	65,944
2057	124,827	105,597,048	28,180	42,238,819	115,977	63,358,229	227	63,358
2058	119,933	101,456,528	27,075	40,582,611	111,430	60,873,917	218	60,874
2059	115,230	97,478,361	26,013	38,991,344	107,060	58,487,017	210	58,487
2060	110,712	93,656,180	24,993	37,462,472	102,863	56,193,708	201	56,194
2061	106,371	89,983,868	24,013	35,993,547	98,829	53,990,321	194	53,990
2062	102,200	86,455,550	23,071	34,582,220	94,954	51,873,330	186	51,873
2063	98,193	83,065,580	22,167	33,226,232	91,231	49,839,348	179	49,839
2064	94,342	79,808,532	21,298	31,923,413	87,654	47,885,119	172	47,885
2065	90,643	76,679,195	20,463	30,671,678	84,217	46,007,517	165	46,008
2066	87,089	73,672,560	19,660	29,469,024	80,915	44,203,536	158	44,204
2067	83,674	70,783,818	18,889	28,313,527	77,742	42,470,291	152	42,470
2068	80,393	68,008,345	18,149	27,203,338	74,694	40,805,007	146	40,805
2069	77,241	65,341,699	17,437	26,136,680	71,765	39,205,020	141	39,205
2070	74,212	62,779,615	16,753	25,111,846	68,951	37,667,769	135	37,668
2071	71,302	60,317,991	16,096	24,127,196	66,247	36,190,794	130	36,191
2072	68,507	57,952,889	15,465	23,181,155	63,650	34,771,733	125	34,772
2073	65,820	55,680,523	14,859	22,272,209	61,154	33,408,314	120	33,408
2074	63,240	53,497,259	14,276	21,398,903	58,756	32,098,355	115	32,098
2075	60,760	51,399,601	13,716	20,559,840	56,452	30,839,761	111	30,840
2076	58,377	49,384,194	13,179	19,753,678	54,239	29,630,516	106	29,631
2077	56,088	47,447,812	12,662	18,979,125	52,112	28,468,687	102	28,469
2078	53,889	45,587,357	12,165	18,234,943	50,069	27,352,414	98	27,352
2079	51,776	43,799,851	11,688	17,519,940	48,105	26,279,911	94	26,280
2080	49,746	42,082,434	11,230	16,832,974	46,219	25,249,461	91	25,249
2081	47,795	40,432,358	10,790	16,172,943	44,407	24,259,415	87	24,259
2082	45,921	38,846,983	10,367	15,538,793	42,666	23,308,190	84	23,308
2083	44,121	37,323,771	9,960	14,929,508	40,993	22,394,263	80	22,394
2084	42,391	35,860,285	9,570	14,344,114	39,385	21,516,171	77	21,516
2085	40,729	34,454,183	9,194	13,781,673	37,841	20,672,510	74	20,673
2086	39,132	33,103,215	8,834	13,241,286	36,357	19,861,929	71	19,862
2087	37,597	31,805,220	8,488	12,722,088	34,932	19,083,132	68	19,083
2088	36,123	30,558,119	8,155	12,223,248	33,562	18,334,871	66	18,335
2089	34,707	29,359,918	7,835	11,743,967	32,246	17,615,951	63	17,616
2090	33,346	28,208,699	7,528	11,283,480	30,982	16,925,220	61	16,925
2091	32,038	27,102,620	7,233	10,841,048	29,767	16,261,572	58	16,262
2092	30,782	26,039,911	6,949	10,415,965	28,600	15,623,947	56	15,624
2093	29,575	25,018,872	6,677	10,007,549	27,478	15,011,323	54	15,011
2094	28,415	24,037,868	6,415	9,615,147	26,401	14,422,721	52	14,423

	Total gas		Methane		CO2		NMOC	
	t/y	m3/y	t/y	m3/y	t/y	m3/y	t/y	m3/y
2095	27,301	23,095,330	6,163	9,238,132	25,366	13,857,198	50	13,857
2096	26,231	22,189,749	5,922	8,875,899	24,371	13,313,849	48	13,314
2097	25,202	21,319,676	5,689	8,527,870	23,415	12,791,806	46	12,792
2098	24,214	20,483,720	5,466	8,193,488	22,497	12,290,232	44	12,290
2099	23,265	19,680,542	5,252	7,872,217	21,615	11,808,325	42	11,808
2100	22,352	18,908,857	5,046	7,563,543	20,768	11,345,314	41	11,345
2101	21,476	18,167,430	4,848	7,266,972	19,953	10,900,458	39	10,900
2102	20,634	17,455,075	4,658	6,982,030	19,171	10,473,045	38	10,473
2103	19,825	16,770,651	4,475	6,708,261	18,419	10,062,391	36	10,062
2104	19,047	16,113,065	4,300	6,445,226	17,697	9,667,839	35	9,668
2105	18,301	15,481,262	4,131	6,192,505	17,003	9,288,757	33	9,289
2106	17,583	14,874,233	3,969	5,949,693	16,336	8,924,540	32	8,925
2107	16,894	14,291,006	3,814	5,716,403	15,696	8,574,604	31	8,575
2108	16,231	13,730,648	3,664	5,492,259	15,080	8,238,389	30	8,238
2109	15,595	13,192,262	3,520	5,276,905	14,489	7,915,357	28	7,915
2110	14,983	12,674,986	3,382	5,069,994	13,921	7,604,991	27	7,605
2111	14,396	12,177,992	3,250	4,871,197	13,375	7,306,795	26	7,307
2112	13,831	11,700,486	3,122	4,680,195	12,851	7,020,292	25	7,020
2113	13,289	11,241,704	3,000	4,496,682	12,347	6,745,022	24	6,745
2114	12,768	10,800,910	2,882	4,320,364	11,863	6,480,546	23	6,481
2115	12,267	10,377,401	2,769	4,150,960	11,397	6,226,440	22	6,226
2116	11,786	9,970,497	2,661	3,988,199	10,951	5,982,298	21	5,982
2117	11,324	9,579,548	2,556	3,831,819	10,521	5,747,729	21	5,748
2118	10,880	9,203,929	2,456	3,681,571	10,109	5,522,357	20	5,522
2119	10,453	8,843,037	2,360	3,537,215	9,712	5,305,822	19	5,306
2120	10,044	8,496,297	2,267	3,398,519	9,331	5,097,778	18	5,098
2121	9,650	8,163,152	2,178	3,265,261	8,966	4,897,891	18	4,898
2122	9,271	7,843,071	2,093	3,137,228	8,614	4,705,842	17	4,706
2123	8,908	7,535,539	2,011	3,014,216	8,276	4,521,324	16	4,521
2124	8,559	7,240,067	1,932	2,896,027	7,952	4,344,040	16	4,344
2125	8,223	6,956,180	1,856	2,782,472	7,640	4,173,708	15	4,174
2126	7,901	6,683,424	1,784	2,673,370	7,340	4,010,054	14	4,010
2127	7,591	6,421,363	1,714	2,568,545	7,053	3,852,818	14	3,853
2128	7,293	6,169,578	1,646	2,467,831	6,776	3,701,747	13	3,702
2129	7,007	5,927,665	1,582	2,371,066	6,510	3,556,599	13	3,557
2130	6,732	5,695,238	1,520	2,278,095	6,255	3,417,143	12	3,417
2131	6,468	5,471,925	1,460	2,188,770	6,010	3,283,155	12	3,283
2132	6,215	5,257,367	1,403	2,102,947	5,774	3,154,420	11	3,154
2133	5,971	5,051,223	1,348	2,020,489	5,548	3,030,734	11	3,031

	Total gas		Methane		CO2		NMOC	
	t/y	m3/y	t/y	m3/y	t/y	m3/y	t/y	m3/y
2134	5,737	4,853,162	1,295	1,941,265	5,330	2,911,897	10	2,912
2135	5,512	4,662,867	1,244	1,865,147	5,121	2,797,720	10	2,798
2136	5,296	4,480,033	1,196	1,792,013	4,920	2,688,020	10	2,688
2137	5,088	4,304,368	1,149	1,721,747	4,727	2,582,621	9	2,583
2138	4,889	4,135,592	1,104	1,654,237	4,542	2,481,355	9	2,481
2139	4,697	3,973,433	1,060	1,589,373	4,364	2,384,060	9	2,384
2140	4,513	3,817,632	1,019	1,527,053	4,193	2,290,579	8	2,291
2141	4,336	3,667,941	979	1,467,176	4,028	2,200,764	8	2,201
2142	4,166	3,524,119	940	1,409,648	3,871	2,114,471	8	2,114
2143	4,003	3,385,936	904	1,354,374	3,719	2,031,562	7	2,032
2144	3,846	3,253,172	868	1,301,269	3,573	1,951,903	7	1,952
2145	3,695	3,125,613	834	1,250,245	3,433	1,875,368	7	1,875
2146	3,550	3,003,056	801	1,201,222	3,298	1,801,834	6	1,802
2147	3,411	2,885,304	770	1,154,122	3,169	1,731,183	6	1,731
2148	3,277	2,772,170	740	1,108,868	3,045	1,663,302	6	1,663
2149	3,149	2,663,472	711	1,065,389	2,925	1,598,083	6	1,598
2150	3,025	2,559,035	683	1,023,614	2,811	1,535,421	6	1,535
2151	2,906	2,458,694	656	983,478	2,700	1,475,217	5	1,475
2152	2,792	2,362,287	630	944,915	2,594	1,417,372	5	1,417
2153	2,683	2,269,661	606	907,864	2,493	1,361,797	5	1,362
2154	2,578	2,180,666	582	872,266	2,395	1,308,400	5	1,308
2155	2,477	2,095,161	559	838,064	2,301	1,257,097	5	1,257
2156	2,380	2,013,009	537	805,203	2,211	1,207,805	4	1,208
2157	2,286	1,934,077	516	773,631	2,124	1,160,446	4	1,160
2158	2,197	1,858,241	496	743,296	2,041	1,114,945	4	1,115

التاريخ : 07 - 12- 2011

السيد / السيدة : ......المحترم،،،

دعوة خاصة

تحيه طيبة وبعد،

تحت إشراف صندوق تطوير و إقراض البلديات (MDLF) وبتمويل من الوكالة الفرنسية للتنمية (AFD) و في إطار مشروع إدارة النفايات الصلبة في قطاع غزة

يدعوكم التحالف الاستشاري: إكوكنسرف EcoConServ/ معالم UG و المسئول عن إعداد دراسة تقييم الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة لحضور ورشة عمل بعنوان :

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

والتي ستنعقد بمشيئة الله يوم الخميس الموافق 08- 12- 2011 في قاعة قاعة فندق القدس الدولي (غزة 4 شارع عمر المختار – دوار الميناء) وذلك في تمام الساعة التاسعة صباحا وفقاً للأجندة المرفقة.

و إننا لنتطلع لمشاركة سيادتكم

و تفضلوا بقبول وافر الاحترام و التقدير ،،،

التحالف الاستشاري

إكوكنسرف EcoConServ/ معالم UG

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

اليوم : الخميس الموافق 08- 12- 2011

المكان: قاعة فندق القدس الدولي (غزة 4 شارع عمر المختار – دوار الميناء) .

أجندة الجلــســـــة

09:00 – 09:30	تسجيل الحضور
09:30 – 09:40	كلمة صندوق **تطوير و إقراض** البلديات (م. معتز محيسن)
	الجزء الأول : مداخلة الاستشاري المصمم للمشروع (ENFRA / DHV/TECC)
09:40 – 10:15	**مكونات وعناصر المشروع و تحليل البدائل**
	(د.عبد المجيد نصار)
	الجزء الثاني:مداخلة استشاري دراسة الأثر البيئي و الاجتماعي (EcoConServ / UG)
10:15- 10:45	**مناقشة نطاق دراسة تقييم الأثر البيئي والاجتماعي للمشروع و منهجية الاستشاري**
	(د. عبد الحميد بشارة و د.أحمد أبو شعبان)
10:45 – 11:00	استراحة
11:00 – 12:00	**الجزء الثالث : نقاش مفتوح وإجابة عن الاستفسارات**
	(المنسق/ د.أحمد أبو شعبان)
12:00 – 12:30	**الجزء الرابع : الخلاصة و التوصيات**
	(المنسق/ م.مأمون بسيسو)
12:30 –13:00	صلاة الظهر و وجبة الغذاء

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2011-12-08

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
1	د. عبد الحميد ابو سمرة	بلدية دير البلح	2530085	9418806	—
2	د. هاشم طه العاصي	MDLF		9349866	—
3	أسامة النابلسي	MDLF		9672203	
4	محمد عطوان	MDLF		8880675	
5	عبد الله سمور	MDLF		0599301101	
6	صبحي ابو رضوان	بلدية رفح		0597090006	
7	د. خالد صوصو	بلدية غزة	2145196	9/815100	
8	د. نزار ابو هيم	[illegible]	9603232		
9	د. محمد الشرشير	ENFRAG	0599131357		Shamad@ingaza.edu
10	عبد الحميد ابو [illegible]	بلدية خانيونس	0599815548		am.abdu@hotmail.com
11	د. يوسف الشير	بلدية خانيونس		0599813547	Dr-shbair@hotmail.com
	أنور الجندي	بلدية [illegible]	8906050		anwaralgendy@hotmail.com

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2011-12-08

البريد الإلكتروني E-mail	رقم الجوال Mobile	رقم الهاتف Telephone	المؤسسة Organization	الإسم Name	ر.م S.N
msalem@gov.ps		9-603527	سلطة جودة البيئة	منذر شحدة سالم	
bahaa.alagha@gmail.com		0599-254763	//	بهاء الأغا	
saedazzam@hotmail.com		٠٥٩٩٣٨٨٧٧	//	سائد العزام د.	
		[illegible]	مجلس إدارة النفايات الصلبة	حسن أبو أموسى	
fsashour@cmwu.ps	0599189260		مصلحة مياه بلديات الساحل	م. فريد سعيد عاشور	
monthersh@cmwu.ps	0599267108	08-2881446	مصلحة مياه بلديات الساحل	م. منذر شبلاق	
fukhari2005@yahoo.com	0599409901	2068193	بلدية الفخاري	د. أحمد الغرا	
fukhari2005@yahoo.com	0599862636	2068194	بلدية الفخاري	د.م. صالح شراب	
adardona@mdlf.org.ps	0599855970		MDLF	م. أحمد دردونة	
eng-mashour@hotmail	-	059-2108023	Enfra	م. مصطفى عاشور	
dhamad@iugaza.edu	—	059-9131357	Enfra.	د. محمد شتيوي	
			UG	نادر سليو	

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2011-12-08

البريد الإلكتروني E-mail	رقم الجوال Mobile	رقم الهاتف Telephone	المؤسسة Organization	الإسم Name	ر.م S.N
Y.Ghalia@yahoo	0599601094	2473241	[illegible]	يوسف [illegible]	
Kurdkhalil@gmail.com	9483027	=	=	خليل الكرد	
naib.naib9@gmail	91202126	2069065	جمعية التجار	[illegible]	
			الجمعية الفلسطينية الزراعية	وفاء جودة	
wjouda82@gmail.com		0599908125	PACEP الحماية البيئية		

3

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

جلسة تشاورية أولية لاستطلاع الآراء حول التأثيرات البيئية والاجتماعية لمشروع إدارة النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2011-12-08

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
	عمران ربيع الخروبي	UNDP	0599 992616		amran.elkharouby@undp.org
	محمد جواد الفرا	رئيس بلدية خانيونس	—	—	—

4

التاريخ : 16 - 01- 2012

السيد / السيدة : ....المحترم،،،

دعوة خاصة

تحيه طيبة وبعد،

تحت إشراف صندوق تطوير البلديات (MDLF) وتمويل الوكالة الفرنسية للتنمية (AFD) وضمن مشروع إدارة النفايات الصلبة في قطاع غزة

يدعوكم التحالف الاستشاري: إكوكنسرف/ معالم (EcoConServ/ UG) لحضور ورشة عمل بعنوان :

استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع ادارة مكبات النفايات الصلبة في قطاع غزة

والتي ستعقد يوم الأربعاء القادم الموافق 18- 01- 2012 في قاعة مكتبة بلدية رفح وذلك في تمام الساعة التاسعة صباحا وفقاً للأجندة المرفقة.

و أننا لنتطلع لمشاركتكم الفعالة في الورشة

مع وافر الاحترام و التقدير ،،،

التحالف الاستشاري
إكوكنسرف / معالم

ورشة عمل بخصوص استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة

اليوم: الأربعاء الموافق: 18 -01- 2012

المكان: قاعة مكتبة بلدية رفح- مدينة رفح-

الأجنـــــــــدة

09:30 – 09:00	**تسجيل الحضور**
09:35 – 09:30	**كلمة صندوق البلديات**
	الجزء الأول: مداخلة الاستشاري الأولى (عرض نتائج الدراسة البيئية)
10:05 – 09:35	**استعراض نتائج الجانب البيئي من الدراسة** **(د. محمد قنديل)**
	الجزء الثاني : مداخلة الاستشاري الثانية (عرض نتائج الدراسة الإجتماعية)
10:45-10:05	**إستعراض نتائج الجانب الاجتماعي من الدراسة** **(أ. أمل فلتس و د. أحمد أبو شعبان)**
11:00 – 10:45	**استراحة شاي**
13:00- 11:00	**الجزء الثالث: نقاش مفتوح وإجابة عن الاستفسارات + التوصيات**

(**المنسق/ م. مأمون بسيسو**)

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project (GSWMP)

ورشة عمل بخصوص استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة

كشـــف الحضـــور

المكان: مكتبة بلدية رفح

الأربعاء الموافق: 18-01-2012

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
١	د. علي برهوم	بلدية رفح	2145196	9/815100	barhoumali@yahoo.com
٢	د. زياد أبو هين	UG	0599603232		
٣	م. أنور الجندي	بلدية غزة	8906050	2821270	anwaralgendy@hotmail.com
٤	د. يوسف [illegible]	بلدية خانيونس		0599815547 8498988	[illegible]-shbair@hotmail.com
٥	د. أحمد أبو شباك	UG			
٦	م. فاخر الكرد	بلدية دير البلح	0599-994450	2530026	faakher2011@hotmail.com
٧	م نائل أبو ماضي	[illegible]	2531499	9815040	
٨	م/ ابراهيم الحلبي	" "	2052793	9815044	
٩	[illegible]	[illegible]	٠٥٩٩٥٤٥٠٧٩ ٢٨٦٤١٣	٠٥٩٩٥٤٥٠٧٩	—
١٠	عبد الله [illegible]	متقاعد	٢٨٦٤١٣	٠٥٩٩٩٠٨٤٦٩	—
١١	محمد عبدالله [illegible]	مدرس	—	٠٥٩٠٧٧٩٢٠٤	safi.wael_@gmail.com ~~[illegible]~~
١٢	م. وائل صافي	مهندس بلديات		9298511	
١٣	ماهر [illegible]	UCAS/ECO		9/222607	
١٤	م. زهدي عبد الرحمن [illegible]	وزارة الحكم المحلي	الوزارة	9/884395	eng.zahdy@hotmail
١٥					

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project (GSWMP)

ورشة عمل بخصوص استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة

كشـــف الحضـــور

الأربعاء الموافق: 2012-01-18 المكان: مكتبة بلدية رفح

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
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20	محمد زعرب	الشئون الاجتماعية			
21	م. محمد حماد	مؤسسة كوبي الإيطالية	~~0599~~	0599884482	
22	محمد أبو خضرة		٢٠٥٠٤٨٨	٩٢٥٢٧٠٩	
23	هشام عبد العال		٢٠٥٢٧٩٠	٩٤٤٨٥٠	
24	[illegible] لبنان	صاحب أرض مجاورة	٢٠٦١٢٥٢	٩٤٠١٣٢	
25	[illegible]	صاحب أرض مجاورة	٢٠٦٧٠٩٧	٠٥٩٨٨٥٤٤٠	
26	[illegible] الويته	[illegible]	٩٤١٠٤٤٤	٢٩٤١٠٤٤٤	
27	محمد أبو زيد	UNDP	971233Z		Mohammad.Mezyad@undp.org
28	[illegible]	[illegible]	٠٥٩٧٧٩٩٧٦٣		
29	[illegible]		٠٥٩٩٩٠٣٣١٤		

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project (GSWMP)

ورشة عمل بخصوص استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة

كشـــف الحضـــور

الأربعاء الموافق: 18-01-2012

المكان: مكتبة بلدية رفح

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
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التاريخ : 02 - 05- 2012

السيد/ المحترم ,,,

دعوة خاصة

تحيه طيبة وبعد،

تحت إشراف صندوق تطوير البلديات (MDLF) وتمويل الوكالة الفرنسية للتنمية (AFD) وضمن مشروع إدارة النفايات الصلبة في قطاع غزة

يدعوكم التحالف الاستشاري: إكوكنسرف/ معالم (EcoConServ/ UG) لحضور ورشة عمل بعنوان :

استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع ادارة مكبات النفايات الصلبة في قطاع غزة

والتي ستعقد يوم الثلاثاء القادم الموافق 08- 05- 2012 في قاعة فندق القدس الدولي (غزة 4 شارع عمر المختار- دوار الميناء) وذلك في تمام الساعة التاسعة صباحا وفقا للأجندة المرفقة.

و أننا لنتطلع لمشاركتكم الفعالة في الورشة

مع وافر الاحترام و التقدير ،،،

التحالف الاستشاري
إكوكنسرف / معالم

ورشة عمل بخصوص استعراض نتائج دراسة الأثر البيئي و الاجتماعي لمشروع إدارة النفايات الصلبة في قطاع غزة

اليوم: الثلاثاء الموافق 08 -05 -2012
المكان: فندق القدس الدولي **(غزة 4 شارع عمر المختار- دوار الميناء)**

الأجندة

09:00 – 09:30	تسجيل الحضور
09:30 – 09:35	كلمة صندوق البلديات
	الجزء الأول: مداخلة الاستشاري الأولى (عرض نتائج الدراسة البيئية)
09:35 – 10:05	**استعراض نتائج الجانب البيئي من الدراسة**
	الجزء الثاني : مداخلة الاستشاري الثانية (عرض نتائج الدراسة الإجتماعية)
10:05-10:45	**إستعراض نتائج الجانب الاجتماعي من الدراسة**
10:45 – 11:00	استراحة شاي
11:00 -13:00	**الجزء الثالث: نقاش مفتوح وإجابة عن الاستفسارات + التوصيات**

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

ورشة عمل لاستعراض نتائج دراسة الأثر البيئي والاجتماعي لمشروع إدارة مكبات النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2012-05-08

ر.م S.N	الإسم Name	المؤسسة Organization	رقم الهاتف Telephone	رقم الجوال Mobile	البريد الإلكتروني E-mail
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١١	د. زهدي صالح	UNRWA	2815448	2887358	z-saleh@unrwa.org

Project: Environmental and Social Impact Assessment for Gaza Solid Waste Management Project

ورشة عمل لاستعراض نتائج دراسة الأثر البيئي والاجتماعي لمشروع إدارة مكبات النفايات الصلبة في قطاع غزة

كشف الحضور

التاريخ: 2012-05-08

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			UNDP.	محمد ابو كويك	
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		٥٠٣١٤٩٩	مجلس إدارة النفايات الصلبة	المعتز أبو سلطان	
	٠٥٩٩٠١٦٤١٦	٥٠١١٤٩٩	محافظتي خانيونس ورفح	صلاح أبو اموشة	