AL REEHAN REAL ESTATE INVESTMENT COMPANY

AL REEHAN NEIGHBORHOOD HOUSING PROJECT

RAMALLAH-PALESTINE

FINAL REPORT

April 7, 2010

EARTH LINK AND ADVANCED RESOURCES DEVELOPMENT S.A.R.L.

(ELARD)

IN ASSOCIATION WITH

CENTER FOR ENGINEERING AND PLANNING (CEP)

ELARD LEBANON		
ELARD IN ASSOCIATION WITH CEP	**Document Type:**	Draft
	Project Ref:	
Environmental Impact Assessment	**No. of Pages:**	**115**
	Version	**1**

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LIST OF ACRONYMS

ARIJ	Applied Research Institute of Jerusalem
BPEO	Best Practicable Environmental Options
CEP	Center for Engineering and Planning
EA	Extended Aeration
EAC	Environmental Assessment Committee
EISM	Environmental Impact Severity Matrix
ELARD	Earth Link and Advanced Resources Development
EMP	Environmental Management Plan
EPD	Environmental Planning Directorate
EQA	Environmental Quality Authority
JEDCO	Jerusalem Electricity District Company
JWU	Jerusalem Water Undertaking
MOPIC	Ministry of Planning and International Cooperation
MSDS	Material Safety Data Sheets
NGO	Non Governmental Organization
PEPA	Palestinian Environmental Protection Authority
PIF	Palestinian Investment Fund
PNA	Palestinian National Authority
PPE	Personal Protective Equipment
RBC	Rotating Biological Contactors
UASB	Up-flow Anaerobic Sludge Blanket
STP	Sewage Treatment Plant
VEC	Valuable Ecosystem Component

EXECUTIVE SUMMARY

STUDY AREA LOCATION AND DESCRIPTION

Al Reehan neighborhood housing project is located North-West of Ramallah city at 800m above sea level.

The site is strategically located between the northern areas of Ramallah City (almost 9 km distance) and the south-western areas of Abu Qash Village. The project will be built on a hilltop that overlooks the city of Ramallah and is only 5 minutes driving distance from the municipal boundaries of the twin cities of Ramallah / El Bireh and from the new campus of Birzeit University.

The total project area is around 250,000 m2. The development's proposed land use is predominantly residential/ commercial with approximately 130,000 m2 dedicated to apartments, residential units and villas. The remaining area is dedicated to commercial and community facilities, green open spaces and utilities, and residual land.

LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The Palestinian legislative and legal framework has been developed since the establishment of the Palestinian National Authority, and encompasses relevant environmental laws, by-laws and regulations, and the creation of several environmental institutions, including the Palestinian Environmental Authority (PEA), the Ministry of Environmental Affairs, the Environmental Quality Authority (EQA) and others.

The Palestinian Environmental Law No. (7) and its' objectives are presented in this section as well as the Palestinian Environmental Policy.

The institutional frame work which addresses the municipality responsibilities for providing services is also shown.

ENVIRONMENTAL SETTING OF THE STUDY AREA

This section presents the existing, pre-development environmental conditions within Al-Reehan Neighborhood and surrounding areas, and is divided into the following topics:

- Physical environment
- Biological environment
- Existing Infrastructure

- Socio-economic environment
- Archeology.

The environmental baseline assessment and identification of key sensitive environmental conditions have predominantly been based on primary data collection from various field studies and monitoring and has included (where available) review of secondary data sources.

The study area has considered:

- The project area represented by the area that is to be developed in Al-Reehan Neighborhood;
- The wider study area i.e., the regional context that may potentially be impacted by current and future project activities; and
- The human activities carried out in the region which is potentially vulnerable to impacts from current and future project activities.

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

Impacts are anticipated to surface during the construction and operation phases of the project. Most negative impacts are expected to be short-term. Beneficial impacts are also highlighted form the Project construction activities. This section highlights the different pollution sources and the adequate mitigation measures proposed for the project.

The impacts of the Project on its surrounding environment assuming no mitigation measures are undertaken are summarized in this section, it also presents the EISM of the project when control and mitigation measures are adopted.

ANALYSIS OF ALTERNATIVES

In this section, alternatives have been studied relating to the new development project location including the "no Project" Alternative and others regarding the Sewage Treatment Plant technologies to be used.

COMMUNITY MEETING

This section addresses the community meeting that was held in compliance with the TOR; it summarizes the issues raised during the meeting and clarifies them in reference to the final report.

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Earth Link and Advanced Resources Development (ELARD),of Lebanon, in association with Center for Engineering and Planning (CEP) of Palestine (hereafter referred to as "Consultants") are pleased to submit this EIA report for construction and operation of Al Reehan Neighborhood Housing Project, developed by Al Reehan Real Estate Investment Company Co (hereafter referred to as "Company").

The Al-Reehan housing project is located to the north-west of Ramallah city in Palestine (south west of the town of Abu Qash) on a hill overlooking the city.

The total project area is around 250,000 m^2. The development's proposed land use is predominantly residential/ commercial with approximately 130,000 m^2 dedicated to apartments, residential units and villas. The remaining area is dedicated to commercial and community facilities, green open spaces and utilities, and residual land.

1.2 CLIENT OVERVIEW

Al Reehan Real Estate Investment Company (Al Reehan) is a wholly owned subsidiary of the Palestine Investment Fund, one of the main developers in Palestine. The Palestine Investment Fund (PIF) is an independent Palestinian investment company committed to maximizing the assets value of its main shareholders namely the Palestinian people. Al Reehan has being established as an executive body in order to undertake the establishment of the sub-urban housing project of Al Reehan, the pilot project of PIF's National Housing program. Al Reehan Real Estate Investment Company has an excellent track-record for delivering properties and products of the highest quality, and this experience will be translated in the formulation and implementation of this new development, by promoting sustainable development principles in line with latest environmental regulations.

The Palestine Investment Fund aims to generate high and stable returns through diversified strategic investments that contribute to building an independent and strong Palestinian economy in partnership with international, regional and local partners based on the values of transparency, accountability, commitment and in line with its corporate social responsibility and sustainability objectives.

1.3 SCOPE OF THE EIA

1.3.1 EIA Objectives

The main objectives of the EIA include the following:

- Assess the implications of all applicable national legislation, policies, standards and corporate requirements;
- Provide a detailed description of all Project activities;

- Describe the existing baseline environmental conditions within the EIA study area and its implications to the project;
- Identify and assess the potential impacts on environmental, cultural and social resources associated with the Project;
- Identify and describe the elements of the community and environment likely to be affected by the Project and/or likely to cause adverse impacts on the project, including both the natural and man-made environment;
- Identify any significant cumulative or transboundary impacts of the Project and recommend appropriate actions to mitigate or minimize these impacts during the project execution;
- Identify, assess and specify methods, measures and standards, to be included in the detailed design and operation of the Project that are necessary to mitigate the identified impacts and reduce them to acceptable levels;
- Design and specify appropriate mitigation and monitoring measures for these impacts.
- Identify and analyze alternatives to the project's location and technologies to be used.

1.3.2 EIA Report Structure

The present EIA study report is generally structured as follows:

- Introduction;
- Institutional and Regulatory Framework;
- Project Description;
- Description of the Environment;
- Environmental Impacts and Mitigations;
- Analysis of Alternatives
- Environmental Management Plan (EMP)
- Resources.
- Appendices.

2 LEGISLATIVE & INSTITUTIONAL FRAMEWORK

2.1 HISTORICAL BACKGROUND

The importance of protecting the environment in Palestine has been a major concern of citizens and local authorities for many years. The absence of an effective infrastructure to deal with sewage, water and wastewater treatment and solid waste had exacerbated the environmental situation. Air pollution, open sewers drainage, uncontrolled discharge of wastewater, litter in the streets and the open-air burning of garbage have all been indicative of the state of the environment in Palestine.

Since its establishment in the early 1990s, the Palestinian National Authority (PNA) has recognized the importance of protecting and improving the environment and progressively created the legislative framework and institutional structure to address issues related to the environment in Palestine, particularly in view of the growing number of development projects and activities for housing and other purposes and related infrastructure. The PNA is now committed to developing legal and administrative frameworks to protect the environment.

In 1993 (Oslo I) addressed environmental issues, stating that both Israel and the Palestinian National Authority would adopt, apply and ensure compliance with internationally recognized standards regarding land, air, water and sea pollution, as well as disposal of solid and liquid wastes. Oslo I mentioned a Palestinian Environmental Protection Authority (PEPA), and a draft environmental law was prepared by the Applied Research Institute of Jerusalem (ARIJ) and the Environmental Law Institute of Washington, D.C., in January 1995, with the prospective creation of PEPA in mind.

By 1995 (Oslo 2), the Environmental Planning Directorate (EPD) was established within the Ministry of Planning and International Cooperation (MOPIC). A succession of draft laws provided the basis for a series of inter-ministerial workshops, where comments were provided and revisions were suggested. The main issues that arose in discussing the law were the perceived conflict between increased economic development and environmental protection, as well as the ability of the implementing agency to undertake inspection, licensing, monitoring and enforcement activities.

Early in 1998, the EPD was integrated into a new independent agency, the Palestinian Environmental Authority (PENA), whose main task was to develop a number of specific environmental policies and EIA procedures. In September 1999 the Palestinian Environmental Law No. (7) 1999 was issued, and became the cornerstone of a series of environmental actions at the legal, regulatory, administrative and institutional levels.

2.2 LEGISLATIVE, LEGAL AND REGULATORY FRAMEWORK

The Palestinian legislative and legal framework has been developed since the establishment of the Palestinian National Authority, and encompasses relevant environmental laws, by-laws and regulations,

and the creation of several environmental institutions, including the Palestinian Environmental Authority (PEA), the Ministry of Environmental Affairs, the Environmental Quality Authority (EQA) and others.

2.3 THE PALESTINIAN ENVIRONMENTAL LAW

The Palestinian Environmental Law No. (7) was approved by the Palestinian Legislative Council on July 6, 1999, and issued by the Chairman of the Palestinian National Authority on December 28, 1999. The objectives of this Law were outlined in Article (2) as follows:

1. Protection of the environment against all forms and types of pollution;
2. Protection of public health and welfare;
3. Insertion of the bases of environmental protection in social and economic development plans; and encouragement of sustainable development of vital resources in a manner that preserves the rights of future generations;
4. Protection of biodiversity and environmentally sensitive areas, as well as improvement of polluted areas;
5. Encouragement of collection and publication of environment-related information to raise public awareness of environmental issues and pollution.

In Article (1) of the Law, Environment was defined as the vital surroundings with all forms of life, including air, water, land, the facilities and the interactions among them. Additionally, Environmental impact assessment "EIA" was defined as a detailed study for assessing the environmental impacts as a result of practicing any activity.

Article (5) of the Law main goal is to:

a) Guarantee the right of every individual to live in a sound and clean environment and enjoy the best possible access to health care and welfare; and

b) Guarantee the protection of the country's natural and economic resources, Preservation of the historical and cultural heritage against any harm that is likely to occur sooner or later as a result of the variant industrial, agricultural or construction activities, which will impact the quality of life and basic ecosystems such as air, water, soil; marine resources, animals and plants.

Chapter 1 deals with Land Environment, covering solid waste, hazardous waste, pesticides and fertilizers, quarrying and mining, desertification and land drifting.

Chapter 2 deals with Air Environment and refers to standards to regulate the percentage of pollutants in the air which may cause harm or damage to public health, social welfare and the environment; and requires that each facility, established in Palestine, shall abide by these standards; and that every existing facility shall make necessary changes in a manner that makes it conform to these standards within a period that does not exceed three years (Article 19).

Chapter 2 also deals with environmental nuisance and noise, and stipulates that every entity and individual, upon operation of any machine or equipment, or upon utilization of alarm devices, loud speakers, or during any other activities, shall not be allowed to exceed the permissible sound intensity and

vibration levels (Article 26). It also stipulates that radioactive activities or radioactive substance concentrations emitted by any facility or other activity shall not be allowed to exceed the permissible limits specified by the competent agencies (Article 27).

Chapter 3 deals with the Water Environment and stipulates that the Ministry, in coordination with the competent agencies, shall set standards and norms for collecting, treating, reusing, or disposing waste water and storm water in a sound manner complying with the preservation of the environment and public health (Article 29), and that no person shall be allowed to discharge any solid or liquid or other substance unless such a process conforms to the conditions and standards that the competent agencies would determine (Article 30).

Chapter 4 deals with the Marine Environment and stipulates, among other things, that it shall be forbidden for anyone to perform any action which may cause pollution of sea water in a manner that contradicts with the standards, directives or conditions prescribed for the purposes of marine environment protection against pollution (Article 32).

Chapter 5 deals with the Protection of Natural, Historical and Archeological Areas and stipulates that the Ministry, in coordination with competent agencies, shall prescribe bases and standards for the protection of natural reserves and national parks, monitor and declare them, and establish and designate the national parks and supervise them (Article 40), and that it is prohibited to hunt, kill, or catch birds, marine and wild animals, and fish specified in the bylaw of this law. Moreover, it is prohibited to possess, transport, walk with, sell or offer them for sale neither dead nor alive, or to damage their nests or eggs (Article 41).

Furthermore, the Ministry, in coordination with the competent agencies, shall set the bases and standards that determine the plants, wild and woodland are forbidden by these standards to be, temporally or permanently, picked up, harvested, damaged or cut off to ensure their endurance and continuation (Article 43), and that it shall be forbidden for any person to conduct activities or perform any action that may cause damage to the natural reserves, forests, public parks or archaeological sites, or affect the esthetical aspects of such areas (Article 44).

Article (45) of Part IV of the Law stipulates that the Ministry, 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 (46) of Part IV of the Law stipulates that when authorizing any facility, the competent agencies shall avoid environmental hazards by encouraging transfer to projects that use substances and operations less harmful to the environment, and by giving priority to such projects on the basis of economic development.

Article (47) of Part IV of the Law stipulates that the Ministry, 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.

Article (50) of Part IV of the Law stipulates that the Ministry, in coordination with the competent agencies, shall monitor the variant institutions, projects and activities to verify their compliance with the requirements, standards and directives prescribed for protecting the environment and the vital resources, in compliance with the provisions of this law.

The role of Palestine in the regional and international environmental setting is illustrated in Article (77) which states that according to the provisions of this law, international and regional conventions, treaties, and the provisions of the international entities of which Palestine is a part, or any other law related to the environment applied in Palestine, shall be considered complementary to this law, unless otherwise is stated.

The detailed Palestinian Environmental Law is presented in **Appendix 1**

2.4 ENVIRONMENTAL POLICY

The Palestinian Environmental Policy was articulated in a document issued on April 2004.The policy outlines the goals, objectives and procedures related to Environmental Assessment studies in Palestine.

The Policy is based on the Palestinian Environmental Law, and reiterates the definitions, main goals and objectives of the Law. Article (4) of the Policy identifies the categories of activities that are subject to the Policy and require environmental assessment, including existing and planned public and private development projects and activities.

Article (5) asserts that the Ministry of Environmental Affairs is responsible for the implementation of the Environmental Policy, while Article (6) defines the composition of the inter ministerial Environmental Assessment Committee (EAC), which is chaired by the Ministry of Environmental Affairs, and includes representatives of the ministries of Industry, Local Government, Agriculture, Transportation, Health, Tourism and Antiquities and the Palestinian Water and Energy Authorities. The (EAC) is responsible for ensuring the sufficiency of environmental assessment studies, preparation or approval of terms of reference for these studies, review of EIA studies and recommending actions to the Ministry, and assisting the Ministry in ensuring compliance with EIA approvals.

Article (7) of the Environmental Policy defines two types of environmental assessment studies; a) Preliminary Assessment for projects that may not have major impacts on the environment to ensure that these projects will comply with the legal and regulatory requirements; and b) Detailed Environmental Impact Assessment for projects that has substantial impact on the environment, as may be indicated by the Preliminary Assessment.

The Policy identifies (in Appendix 1) projects for which conducting an Environmental Impact Assessment is compulsory and lists 14 categories including mines and quarries, electrical power generation stations, sewage treatment plants, solid and hazardous waste landfills, industrial zones, roads and others.

Appendix 2 of the Policy defines the criteria for screening projects that would require Preliminary Assessment, detailed EIA, or none of these. These criteria include a) utilization of natural resources; b) dislocation of people or communities; c) proximity to environmentally sensitive areas; d) creation of

adverse environmental impacts; e) causing concern and worries among citizens and f) the potential need for additional development that may result in serious adverse environmental impacts.

Appendix 3 of the Policy explains in detail the requirements of the two categories of environmental impact studies, and the procedures for environmental evaluations and approvals.

More detailed information about The Palestinian Environmental Policy are presented in **Appendix 2**

2.5 EFFLUENT DISCHARGE STANDARDS

PWA has classified Treated effluent quality into 4 types as shown in **Table 2-1**below.

Table 2-1 Treated Effluent Quality Classification According to the Palestinian Standards (PS 742-2003)

CLASS		WATER QUALITY PARAMETERS		
		BOD5 (mg/l)	TSS (mg/l)	FECAL COLIFORM (MPN/100ml)
Class A	High Quality	20	30	200
Class B	Good Quality	20	30	1000
Class C	Medium Quality	40	50	1000
Class D	Low Quality	60	90	1000

In case the treated effluent is planned to be used for restricted irrigation such as gardening and parks inside the development project then it has to comply with the standards set above and fall under class A or else it has to be disposed of into the near wadi.

2.6 INSTITUTIONAL FRAMEWORK

The municipality is responsible for providing the following services:

1. Wastewater collection and treatment.
2. Storm water drainage.
3. Land use planning and zoning (with supervision and approval by MOP and MOLG).
4. Solid waste collection and disposal (Municipality and joint solid waste council when established).
5. Street cleaning.
6. Street lighting.
7. Establishment and maintenance of parks and recreational areas.
8. Industrial and workshop control and monitoring (in cooperation with Ministry of Industry, Ministry of Health, Environmental Quality authority, and the Governorate's Office).
9. Building licensure within municipal jurisdiction.

10. Transportation (in cooperation with the Ministry of Transportation, MOP, MOLG, Ministry of Finance (petroleum cooperation). Road opening, pedestrian areas and transportation centers are specifically the responsibility of the city.

Water, electricity and telecommunication services are beyond municipal control. Electricity and telecommunications are provided by private companies. Water supply is provided by JWU, a non-governmental organization where several municipalities are members. The environmental quality authority is the governmental institution that develops environmental strategies, issues laws, and supervises their enforcement. The MOLG has a role in supervising the local authorities' work and they approve municipal budgets. MOP is also involved in environmental management.

3 PROJECT DESCRIPTION

3.1 PROJECT'S VISION

Al Reehan Neighborhood Project balances between residential/ commercial buildings and open spaces combining them to allow for good quality of living and maintaining a pleasant timeless feeling in one area. The project's vision is to create a modern living environment, offering entertainment, amenities, improved infrastructure consisting of internal and external roads, as well as water, electricity and sewage systems. Furthermore, the project will stress on protecting and preserving the natural environment.

3.2 PROJECT LOCATION AND SCALE

Al Reehan neighborhood housing project is located North-West of Ramallah city at around 750m above sea level.

The site is strategically located between the northern areas of Ramallah City (almost 9 km distance) and the south-western areas of Abu Qash Village. The project will be built on a hilltop that overlooks the city of Ramallah and is only 5 minutes driving distance from the municipal boundaries of the twin cities of Ramallah / El Bireh and from the campus of Birzeit University.

Figure 3-1 shows the overall location of the development project with the main surrounding areas.

Figure 3-1 Site Location

3.3 SPATIAL ALLOCATION SUMMARY AND ANALYSIS

The entire project aims at securing an urban environment that provides its residents and users with maximum potential opportunities to "live-work-stay and play". It is a mixed-use project that comprises residential, retail, and commercial facilities as well as extensive public spaces.

The site of Al-Reehan Housing project entails a land of 2 adjacent parcels totaling 25 Hectares and is strategically located on a hilltop north-west of the City of Ramallah and south-west of the village of Abu Qash. The first parcel with an area of 4.4 Hectares, is part of the master plan of Abu Qash, whereas the second parcel of 20.6 Hectares, is part of Al-Askariiyya Block (Block # 1) of Ramallah territories, but is currently outside the municipal boundaries of the city (See **Figure 4-9**). It has been agreed with Abu Qash Village Council and Ramallah Municipality to consider Al-Reehan development as part of their master plans and to plan to annex it to their municipal boundaries.

Figure 3-2. Land use in the Al Reehan Neighborhood project is mainly residential dedicated to apartments, villas, mixed areas and commercial & community areas which are dedicated to schools, commercial facilities, health care center, mosques, open spaces & walkways, roads, and an archeological site. The project consists of five zones: apartments buildings, schools, commercial, residential villas, and health center in addition to parking areas, open space, parking and roads and a historical area as shown in **Table 3-1**and **Figure 3-3.**

Table 3-1 Land Use and Surface Areas in Al Reehan Project

Land Use	Area (m^2)	Percent from Total Area
Zone 1(Apartments Buildings)	117,547	47.02
Zone 2 (Schools & and Mosque)	12,918	5.17
Zone 3 (Commercial)	10,293	4.12
Zone 4 (Villas)	11,421	4.57
Zone 5 (Health Center)	12,013	4.80
Additional features		
Road Network	48,608	19.44
Open Space (Green Areas & Walkways)	28,585	11.43
Open Space (Historical Area)	8,615	3.45
Total Area	**250,000**	**100**

Figure 3-2 Detailed Master Plan of Al Reehan Neighborhood Project

Figure 3-3 Al Reehan Neighborhood Land Use Map

3.4 PROJECT COMPONENTS

3.4.1 Apartments and Villas Zone

According to the project Master Plan and Land Use map, the Apartments Building are distributed all along the project area and Villas are mainly distributed in the southern part. The residential area covers a total area of approximately 130,000 m^2 which is equivalent to more than 50% of the total surface area, including more than 2,000 housing units.

Apartments in Al Reehan are divided into two main categories: the first category of apartments can be found in the residential area with around five (5) types of apartments forming 38% of the total area.

The second category of apartments is located in the mixed-use area with two (2) types forming 9% of the total area.

3.4.2 Commercial Zone

According to the project Master Plan and Land Use map, the commercial offices are located in the southern part of the project and cover a total area of 10,293 m^2, which is equivalent to approximately 4 % of the total available surface area.

Commercial areas are planned to satisfy the immediate needs of the population such as trading products and services. This project has its own plots designated for a major shopping center and several shops.

The following criteria were applied during the planning process:

- The selected site for development was strategically located in the center of the development area in order for it to be close to all surrounding residents.
- Accessible from a major road.
- The designated area has adequate size, suitable shape and moderate inclination.
- Proximity to public transportation.

3.4.3 Community Facilities

Community facilities are distributed within the project site, offering a full range of facilities and amenities to residents, including:

- Care, support and education of children;
- Supplying the residents with consumer goods;
- Personal and home services;
- Ambulance, medical care and pharmaceutical supply for the residents;
- Social and cultural centers for elderly and handicapped people;
- Health centers and gym;

- Entertainment facilities;
- Art creation and art delectation;
- Post and telecommunication services;
- Mosques;
- Graveyard.
- Hospital

3.4.4 Schools

An area 8,551 m^2 has been allocated for two elementary schools and one day care center at the north-eastern part of the neighborhood. The location of the schools has being carefully selected on the site periphery which grants:

- Accessibility by vehicles through a wide road;
- Accessibility by pedestrians through the adjacent walkways;
- Closeness to services plot

The following safety measures were taken into consideration:

- Structural safety;
- Fire safety;
- Health safety;
- Special emergencies;
- Accident protection;
- Handicapped provisions.

3.4.5 Mosque

The plot area assigned for the mosque is 4,366.9 m^2 and built up area equals to 3,442.5 m^2.

3.4.6 Hospital

Al Reehan dedicated an area on the western plot borders for a world-class hospital on the site featuring cutting edge medical practices.

The assigned plot area for the hospital is about 12,000 m^2 with approximately a hundred beds.

3.4.7 Open Spaces and Walkways

The total open spaces and walkways have an area of about 28,500 m^2.

Open spaces are created by Al Reehan in order to:

- Improve the quality of life of the Al Reehan residents;

- Provide accessibility to recreational and sports activities;
- Provide green spaces for public enjoyment;
- Protect the natural environment;
- Provide scenic walkways and bikeways;
- Spaces for children playground.
- Create pleasant, attractive yet functional outdoor spaces;
- Maintain balance and harmony while providing both quit and active zones.

3.4.8 Archeological Site

The archeological site in Al Reehan has an area of about 8,615 m^2 and is a restricted area for any kind of living or transportation uses.

Therefore, Al-Reehan Real Estate company assured keeping it as part of the development main reserved zones and it shall encourage people to learn more about the archeological finds by designing pedestrian access routes to the surrounding natural area and creating the main park zone at which Al-Reehan will preserve the native plants, animals and archeology, and the zone shall become a cultural and tourism destination.

3.4.9 Parking Areas

According to the project Master Plan and Land Use map, the parking areas cover a total area of 3,668 m2 providing an adequate number of parking spaces for residents and visitors, which is equivalent to approximately 1.4 percent of the total available surface area. The project will also provide shaded areas and windbreaks to improve microclimate.

3.4.10 Road Network within the Site

Three types of roads are proposed in the Al Reehan neighborhood project namely;

- 20 meter Main roads which circulate around the project site from the entrance on the eastern side;
- 16 meter distributer roads are envisaged to pass through the project site from south to north. This road is meant to be a secondary road serving part of the residential blocks in addition to the traffic heading towards the neighborhood's commercial center.
- 14 meter roads are to serve the residential blocks and villas.

The proposed road networks are shown in **Figure 3-4.**

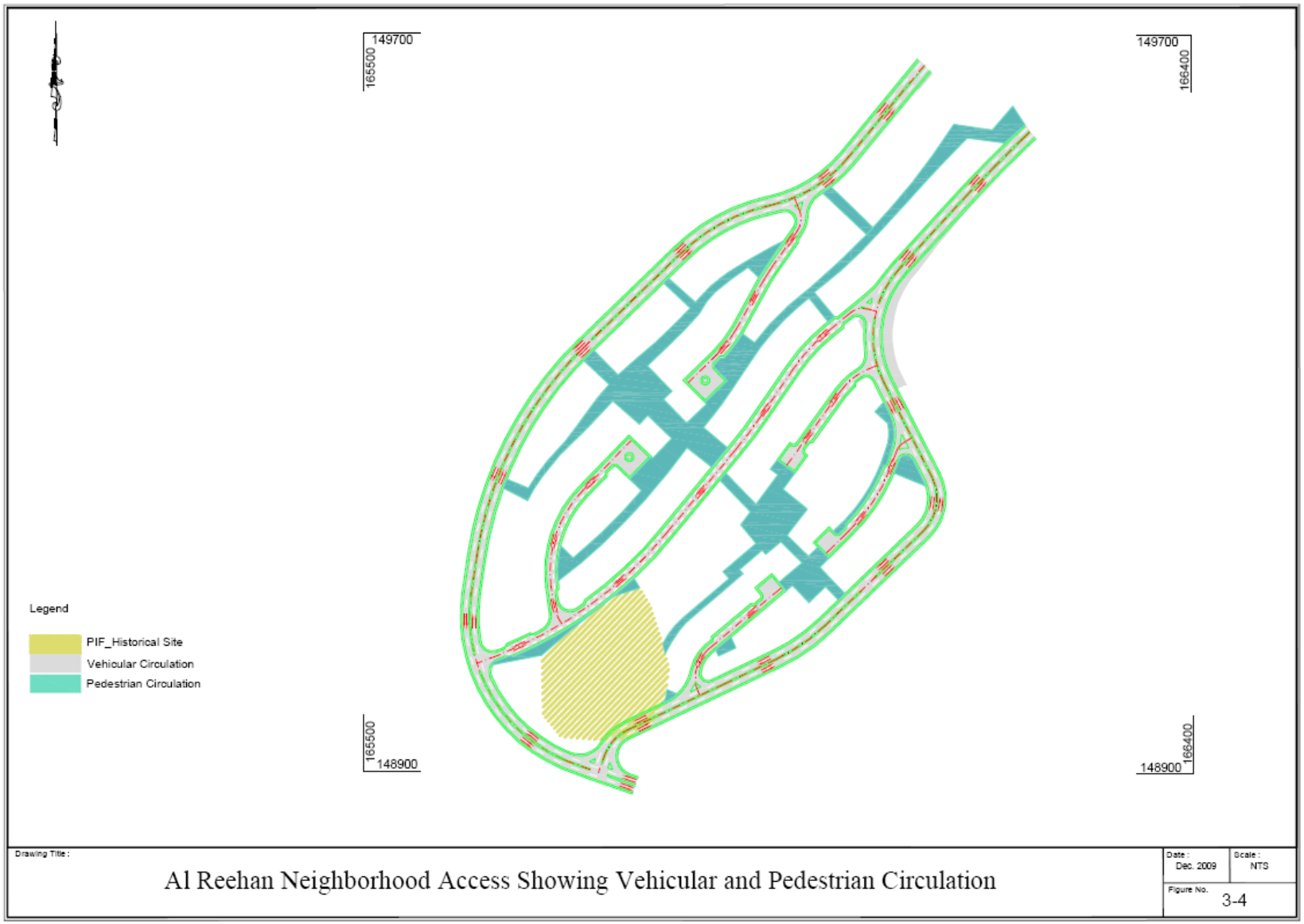


Figure 3-4 Pedestrian and Vehicular Network

3.4.11 Pedestrian Circulation

The project shall:

- Connect all units, parking areas, service areas, communal open space, outdoor amenity areas and public sidewalks with clearly defined walkways;
- Separate pedestrian circulation from vehicular circulation;
- Provide an accessible and comfortable pedestrian environment;
- Provide views and vistas along walkways;
- Located seating and bench/table arrangement to enhance areas for communal social activities;
- Use high quality cost effective building materials;
- Provide hard, non-slippery surfaces other than asphalt for pedestrian pathways; and

Provide pedestrian pathways with moderate slope for accessibility.

3.4.12 Landscaping

Efficient landscape design promotes a positive perception of the urban environment and quality. It plays an important role in creating an attractive successful marketable environment. The landscaping designs for Al Reehan neighborhood housing project is envisioned as a pleasant relaxing multifunction space hosting a wide range of recreational, social, cultural, educational entertainment and sport activities and facilities, taking into consideration and maintains the balance between the privacy of each residential unit users, and the social communal atmosphere at the common out-door spaces.

Landscaped areas are meant to serve the following functions:

- Climate control by providing shade, creating windbreaks, and reducing humidity.
- Improving soil structure and texture.
- Ecological enhancement.
- Visual softening.
- Preserve, augment and enhance the neighborhood character.

The landscaping strategy aims at providing high quality open spaces that display high levels of aesthetic appeal. A "design with nature approach" is used to choose landscapes based on the available natural systems on and around the site.

3.4.13 Utility Connections

In order to design the infrastructure of Al Reehan Neighborhood Project, the design criteria, standards and methodology were used and adopted according to the local authority's requirements and specifications.

Currently there are no established services within the Al Reehan Neighborhood roads. The external connections will later be coordinated with the authorities based on the project's requirements.

3.4.13.1 Potable Water

The total daily water supply requirement for the development is estimated at 1,456 m^3 in the year 2020 and 1,568 m^3 in the year 2030. These estimations comes from the fact that at the years 2020 and 2030, Al Reehan Neighborhood will be fully occupied with around 2,000 housing units, constituting around 11,200 inhabitants, and taking into consideration that, according to PWA, the expected average per capita water consumptions are 130 & 140 L/capita/day for the years 2020 & 2030 respectively.

Domestic water in Ramallah district is supplied from three major sources:

1. Jerusalem Water Undertaken Wells (owned by Palestinians)
2. Purchased Water Sources from West Bank Water Department and Israeli Water Company.
3. Springs.

Water will be distributed in a water supply network built by Jerusalem Water Networking. To this end, the design criteria, standards, minimum residual pressure at the connection points and methodology used are based on the local authority's requirements. The latter are not recommending the use of a storage tank and pumping units.

Figure 3-5 shows the water supply network.

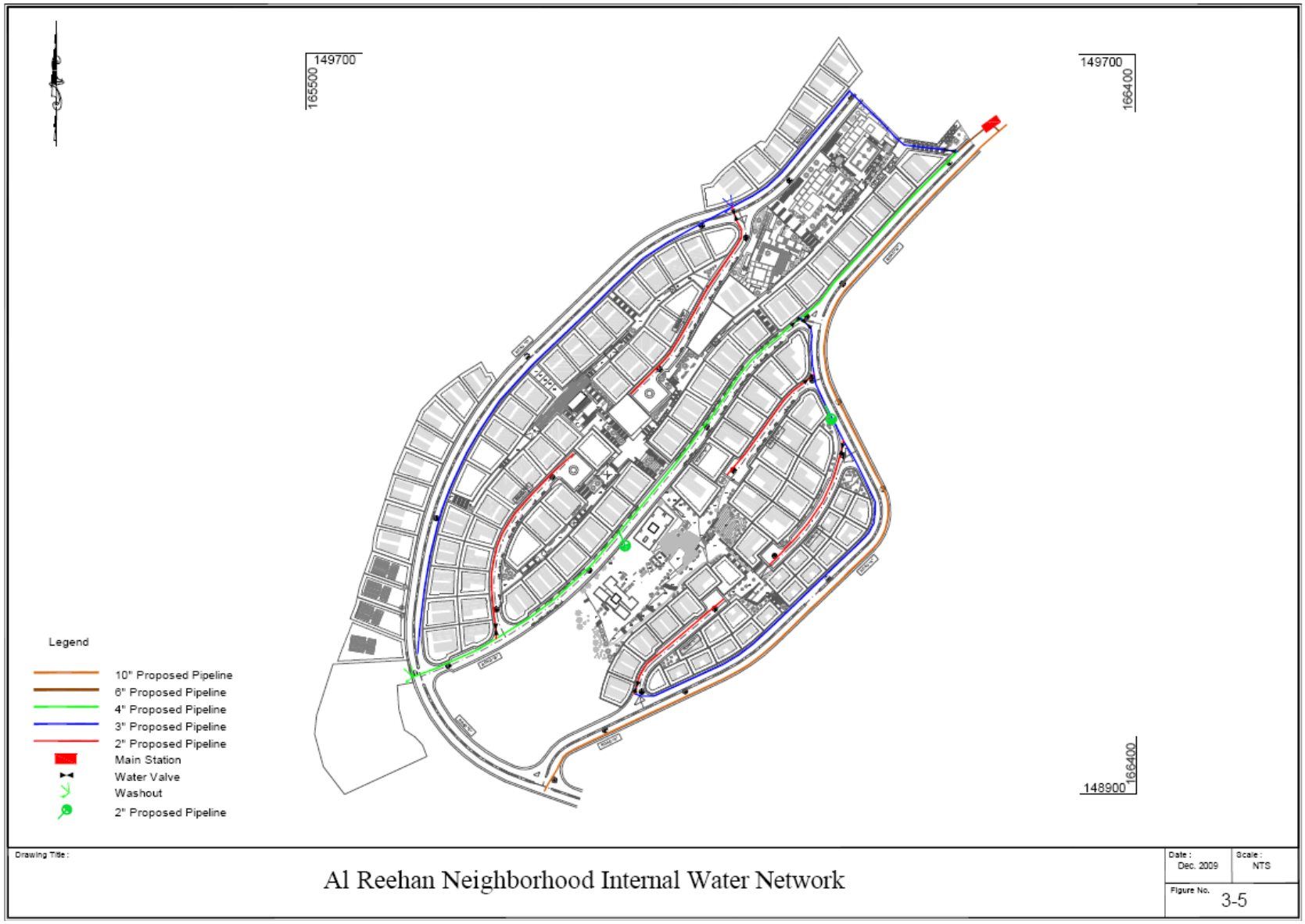


Figure 3-5 Water Supply Network

3.4.13.2 Storm Water Drainage

Storm water drainage girders are provided at the edge of the side walk. The pedestrian areas are provided with storm water flow gradient of 1-2%. Pervious pavements allow storm water to infiltrate directly into the ground below. Sufficient number and volumes of underground storm water storage are provided to supplement the irrigation needs.

3.4.13.3 Wastewater

Currently, no sewage collection network exists around the site of Al Reehan Neighborhood housing Project but the construction of sewer mains is being planned by the relevant authorities. The total population of the planned community of Al Reehan Project is estimated to be 11,200 inhabitants (2,000 housing units x 5.6 person/housing unit). The percentage of wastewater production is estimated to be 85% from the water consumption.

Figure 3-6 shows the entire sewage network scheme.

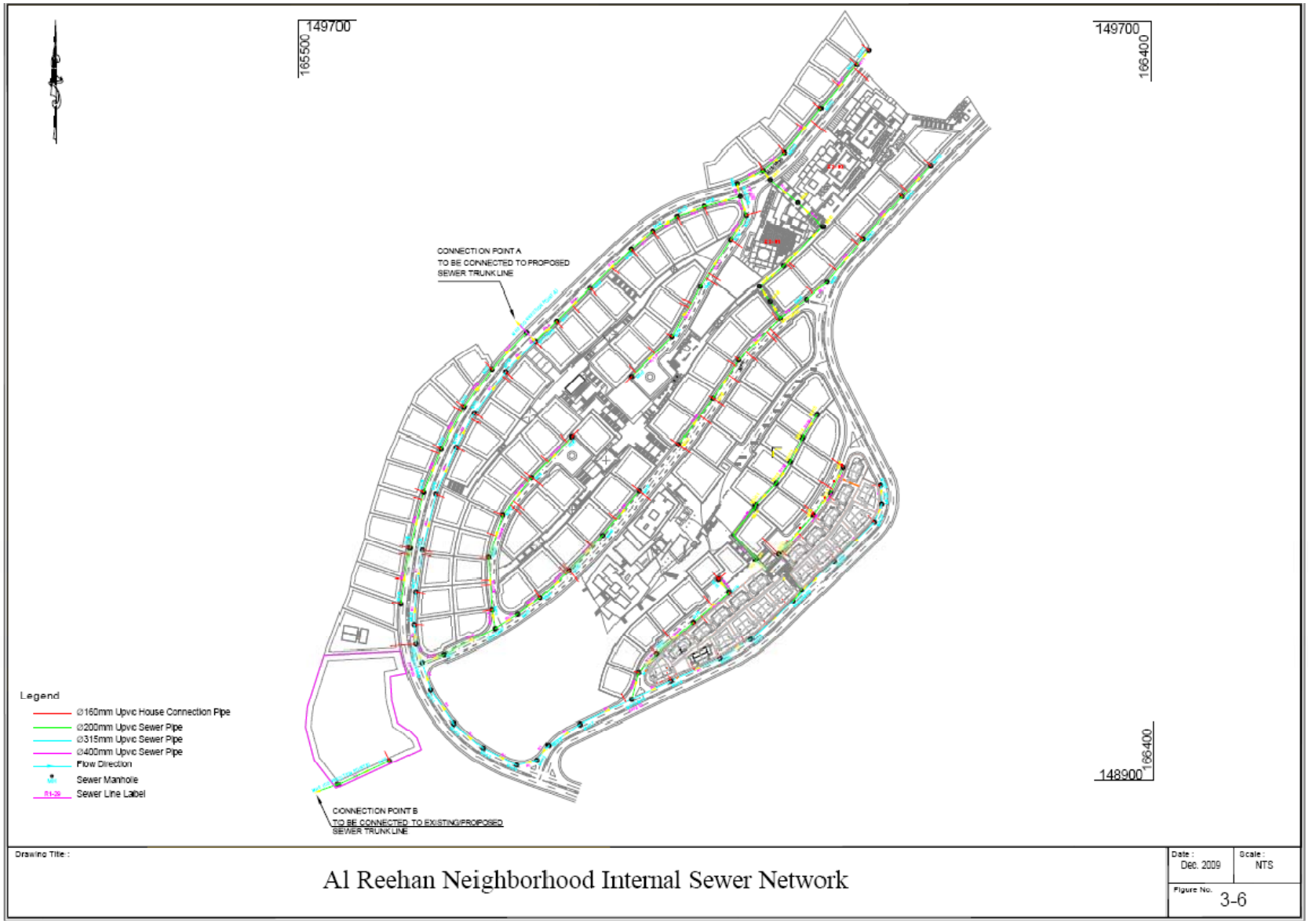


Figure 3-6 Sewerage Network

3.4.13.4 Sewage Treatment Plant

The proposed sewage treatment plant should be designed to comply with the Palestine standards and guidelines. The STP has not yet been commissioned but the feasibility studies have been undergone and treatment process has been finalized. The proposed site location is near Al Waqf land (X=165,200; Y=148,800).

The proposed wastewater treatment plant of Al Reehan Project will comprise a mechanical pre-treatment followed by a biological purification with the extended aeration process for carbon removal and full nitrification / denitrification, as well as sludge treatment with thickening and mechanical sludge dewatering. The mechanical treatment facilities will consist of screens and grit removal chambers as well as flow measurement device of venture meter. The biological treatment units consist of aeration tanks, final clarifiers with distribution chamber and sludge pumping station. The treatment plant will consist of the following unit operation:

- Screening;
- Grit removal;
- Distribution chamber;
- Aeration tanks;
- Final clarifiers;
- Sludge thickener;
- Sludge dewatering;
- Flow measurement flume; and
- UV disinfection unit.

3.4.13.5 Bar Screening

Two screening chambers will be constructed. The first chamber will be equipped with automatic bar screen unit and the other chamber will be equipped with a manual screen and used as standby and bypass chamber.

3.4.13.6 Grit Removal Chambers

The grit removal system has to meet the following requirements:

- Removal of heavy particles like sand with a grain size of 0.2 mm or larger.
- Prevent organic suspended solids from being settled in the grit chamber.

Grit removal will be achieved by velocity controlled grit channels. This type of grit chambers was used due to the small scale of the wastewater treatment plant which makes the adoption of other types like aerated

chamber less favorable from typical design requirements and cost and operational problems. Three parallel grit chambers will be constructed (two in operation and one stand by). Each chamber shall be designed for half of the peak flow.

3.4.13.7 Distribution Chambers

The flow will be distributed into equal flows, one for each of the two aeration tanks.

3.4.13.8 Aeration Tanks

Two aeration tanks will operate in parallel in order to achieve the foreseen carbonaceous and nitrogen removal by simultaneous nitrification / denitrification. The aeration tanks will be fed from the distribution chamber. The aeration tanks will be equipped with horizontal surface aerators of the MAMMOTH-ROTOR type following the concept of deep tanks with separate aeration and mixing. Submersible mixers are foreseen to prevent settlement of sewage and activated sludge. The aeration tanks will be designed as loop-type rectangular tanks with middle separation walls, curved edges and guidance bows for flow stabilization.

3.4.13.9 Final Clarifiers

The effluent from the aeration tanks will be conveyed via distribution chamber to final sedimentation tanks for final clarification. In the final clarifiers, sludge flocculation and floc destruction are of concern, so the clarifiers are designed at rather low surface loading rate. Two final clarifiers will be constructed with 15 m diameter each. Provision for sludge recirculation to the aeration tanks should be considered.

3.4.13.10 Sludge Thickener

The excess sludge shall be thickened by the means of sludge thickener.

3.4.13.11 Sludge Dewatering

Drying beds are the most widely used method of sludge dewatering. Sludge drying beds are typically used to dewater settle sludge from plants using the extended aeration activated sludge treatment process without pre thickening. The principal advantages of drying beds are low cost and infrequent attention is required. The main disadvantages are the large space required and potential odors. After drying the solids are removed and either disposed of in a landfill or used as a soil conditioner.

3.4.13.12 Flow Measurement Flume

The most popular instrument for flow measurement is the Parshal flume. A Parshal flume with 0.3 m width will be used.

3.4.13.13 UV Disinfecting Units

Low pressure low intensity UV lamps generate essentially monochromic radiation at a wavelength of 254 nm wavelength which is considered to be most effective for microbial inactivation. Low pressure low intensity UV lamps are of"slimline" design with an overall length of 0.75 m to 1.5 m and diameters varying from 15-20 mm.

3.4.13.14 Reuse of Treated Wastewater

The treated effluent of the STP or the reclaimed wastewater can be utilized for restricted irrigation. In case that the treated effluent is planned to be used for irrigating parks and gardens, it should be of high quality (Class A) complying with the Palestinian standards for re-use for irrigation purposes.

Reclaimed wastewater can be utilized to irrigate gardens and parks within the project and to irrigate certain crops or for forestry downstream the Wadi or to safely dispose the treated effluent to the adjacent wadi. The quantity of treated wastewater is expected to be around 820 m^3/day (should be 85% of water requirements as per wastewater paragraph above) for the first phase of the project (year 2013) and 1,500 m^3/day for the second phase of year 2020..

3.4.14 Solid Waste Management

Solid waste management sector falls under the jurisdiction of the Municipality. The system that is currently in place and that is being implemented in the surrounding area consists of collection of the solid waste and disposal at a non-sanitary landfill. All types of waste are being collected and dumped including municipal, commercial, industrial and medical which are considered a great hazard to the air, soil and groundwater quality in addition to the visual amenity. The adopted collection system is already overloaded and not efficient. However the municipality of Ramallah is planning to upgrade the system and as a part of its strategy, medical waste shall be separated from other waste streams and autoclaved. (Source: Rapid Urban Environmental Assessment of Ramallah City; 2006).

3.4.15 Raw Material

The types and sources of raw materials that are required for the Al Reehan Project are given in **Table 3.2** below:

Table 3-2 Types and Sources of Raw Materials Required for Al Reehan Project

Material	Description	Source
Stone (Grade A	Shyookh Stone, Birzeit Stone, Industrial Stone	Hebron, Birzeit, Tulkarem
Cement		Israel
Read Mix Concrete	B150, B200. B250, B300	Altarifi Ready Mix Concrete, Abu Mahmoud Shaltaf, Qalandiya

Steel	Fy 420 MPa Grade 60	Hassouneh, Jericho Shadi Abu Ebeid, Ramallah Industrial Zone
Aluminum		Napco, Nablus
Pipes (Grade A)	Sanitary Pipes (UPVC), Potable Water Pipe (CPVC), and Pipes for Electrical wires (PVC):	Royal, Hebron, Palestinian Company for Plastic Products or Alamal Company, Egypt, and Europe
Paints		APC, Nablus Deluxe, Jordan
Bathroom Fixtures		Europe, mainly Germany, France & Spain
Electrical Fixtures		Europe, mainly Italy, Germany & France
Tiles		Porcelain & Ceramic: Europe, mainly Spain and Italy Marble: Turkey Local Marble: Sor Me'in

3.5 PROJECT PHASING

The construction of Al Reehan development project will consist of four (4) main phases with a total estimated time of 4 years for the completion of all phases of the project.

- Phase 1 includes the construction of the
  - South-east lands which will include 42 semi-detached houses and around 500 apartments.;
  - Residential apartments, villas, mixed use buildings, in addition to roads
  - Green spaces and
  - A Hospital on the north of the site.
- Phase 2 includes the construction of all the type (3) apartments, two plots of type (2) apartments, schools, services buildings (mosque), in addition to the roads and green spaces through mentioned areas.
- Phase 3 includes the construction of the rest of type (2) apartments and the rest of the special zoning residential apartments, in addition to roads and green spaces through the mentioned area.
- Phase 4 includes the construction of all building in types (1) and (4) of the residential apartments.

The phasing of the project is shown in **Figure 3-7**.

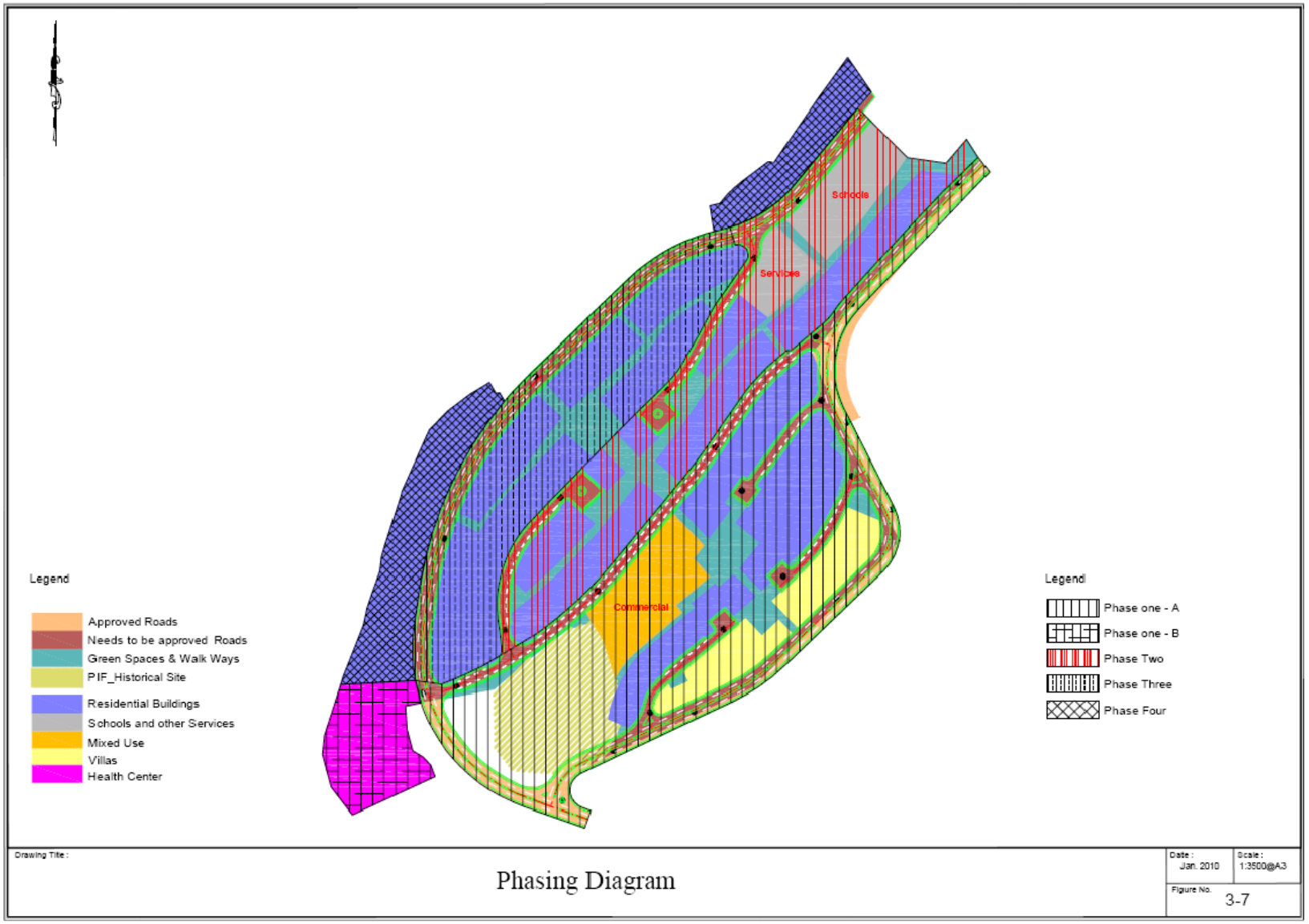


Figure 3-7 Phasing Diagram

4 DESCRIPTION OF THE ENVIRONMENT

4.1 INTRODUCTION

This section presents the existing, pre-development environmental conditions within Al-Reehan Neighborhood and surrounding areas, and is divided into the following topics:

- Physical environment
- Biological environment
- Existing Infrastructure
- Socio-economic environment
- Archeology.

The environmental baseline assessment and identification of key sensitive environmental conditions have predominantly been based on primary data collection from various field studies and monitoring and has included (where available) review of secondary data sources.

The study area has considered:

- The project area represented by the area that is to be developed in Al-Reehan Neighborhood;
- The wider study area i.e., the regional context that may potentially be impacted by current and future project activities; and
- The human activities carried out in the region which is potentially vulnerable to impacts from current and future project activities.

4.2 THE PHYSICAL ENVIRONMENT

4.2.1 Regional Setting

Palestine currently consists of two physically separated landmasses: the West Bank and the Gaza Strip, with a total area of approximately 6,210 km, where West Bank is covering 5,845 km^2 of that area. The West Bank is currently surrounded by Israeli territories from the west, north, south and the Jordan River from the east. It is divided into eleven districts: Jerusalem, Jericho, Ramallah, Bethlehem, Hebron, Nablus, Salfit, Tubas, Qalqiliya, Tulkarm and Jenin.

The proposed Al-Reehan Neighborhood site is located between latitude 31º N and longitude 35º east, within coordinates mentioned in **Table 4-1**. Al-Reehan Neighborhood is located approximately in the centre of Ramallah Governorate as it is located 4.8 Km to the northern west of Ramallah, 20.0 Km to the north of Jerusalem, 1.0 Km to the southern west of Abu-Qash village, and 2.1 Km to the southern west of Birzeit University as shown in **Figure 4-1**& **Figure 4-2**.

Table 4-1 Al-Reehan Location According to Ramallah Governorate

NORTH COORDINATE	EAST COORDINATE
149756.4414	165410.996
149756.4414	165540.9983
148626.4414	165540.9983
148626.4410	165410.996

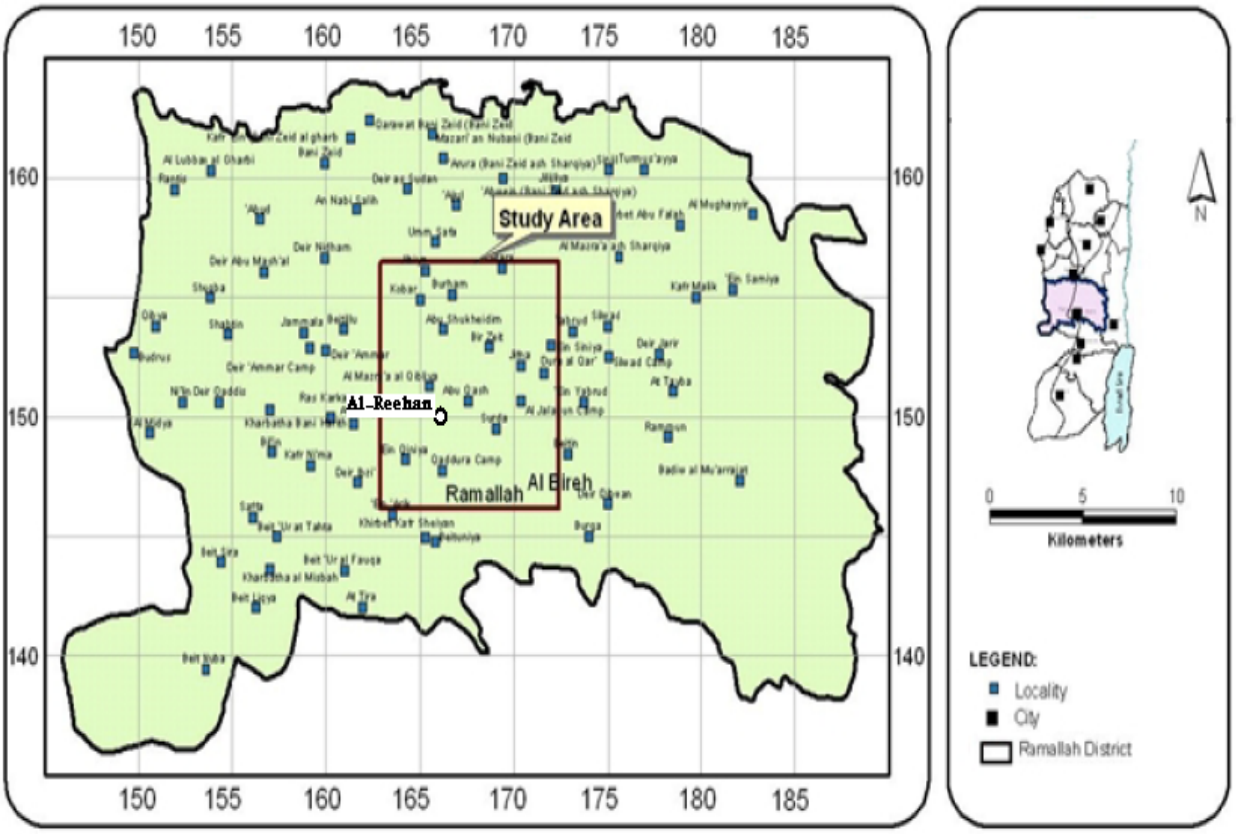


Figure 4-1 Al-Reehan Location Within Ramallah Governorate

Figure 4-2 Al-Reehan Location within the Surrounding Communities

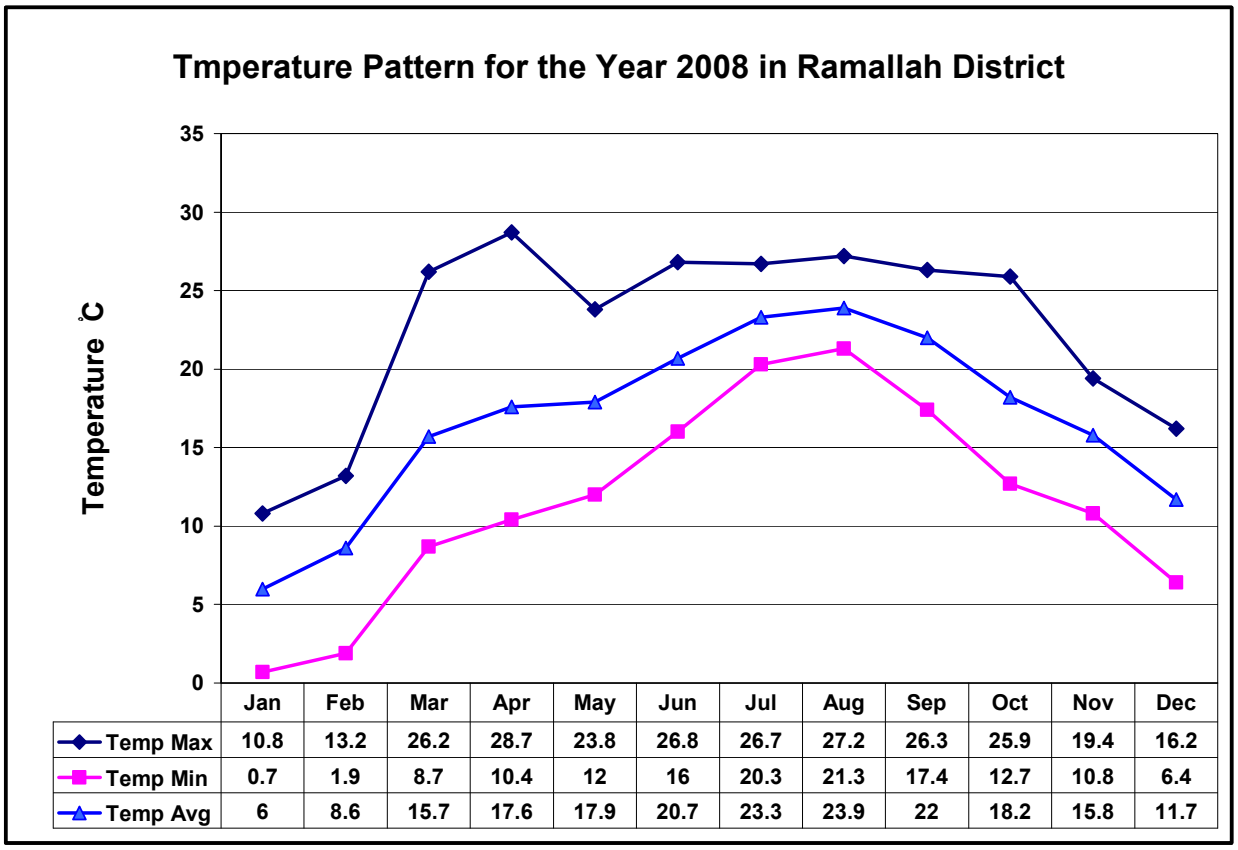
4.2.2 Climate and Meteorology

The climate of Palestine is traditionally described as 'Mediterranean', which is characterized by short, cool rainy winter and long, hot, dry summer. However, there is a great diversity in this climate, since it is modified locally by latitude and altitude which is especially apparent in the West Bank; climatic zones range from extremely arid to humid according to the De Martonne aridity index classification for arid areas.

4.2.2.1 Temperature

Ramallah District is part of the Hilly Regions which are characterized by lower temperatures than other areas in the West Bank. During summer, from June to September, the weather is moderate to hot. The highest temperatures in Ramallah range between 21 and 27°C. During winter, from December to February, the climate is considerably very cold with mid day temperatures ranging from 8 to 22°C and falling to -1 at

night. **Figure 4-3** gives an overall view of the Temperature Patterns of Ramallah during the year 2008, based on the Palestinian Metro-geological Department.

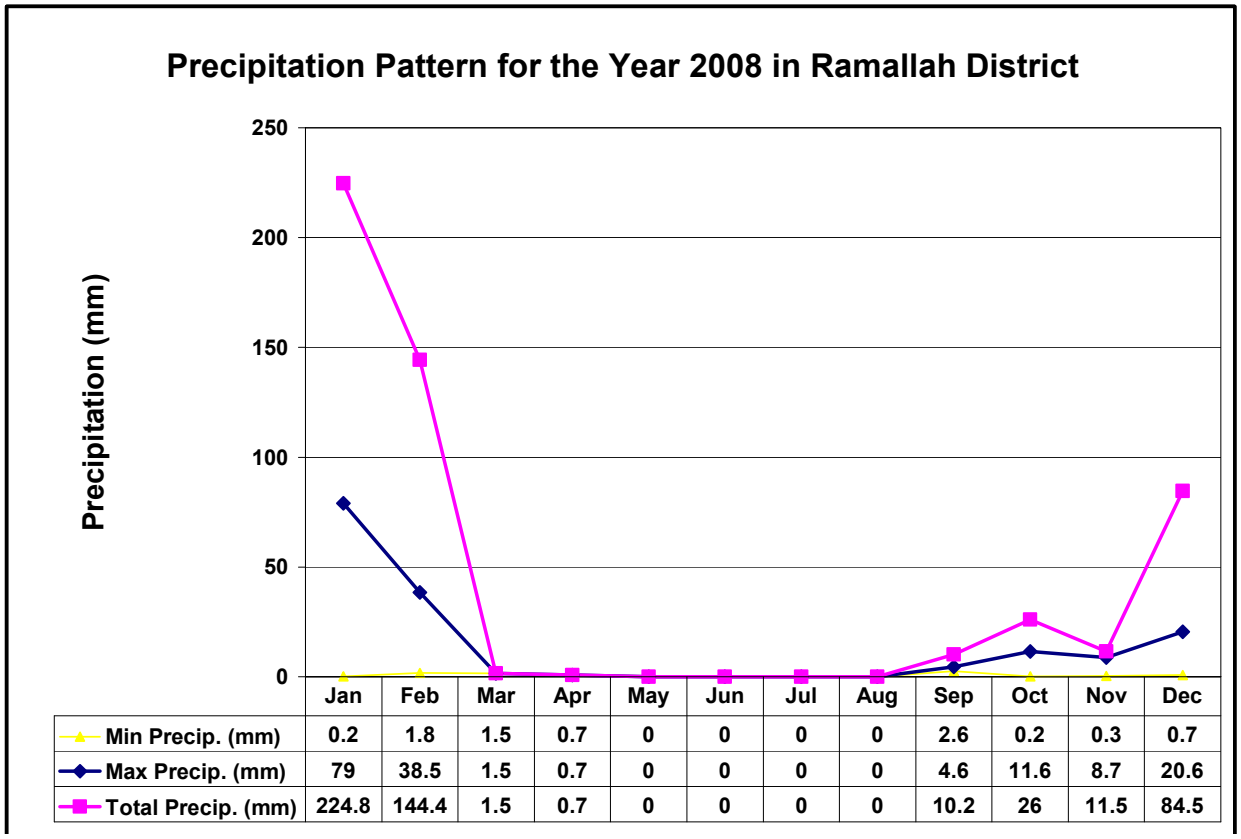


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp Max	10.8	13.2	26.2	28.7	23.8	26.8	26.7	27.2	26.3	25.9	19.4	16.2
Temp Min	0.7	1.9	8.7	10.4	12	16	20.3	21.3	17.4	12.7	10.8	6.4
Temp Avg	6	8.6	15.7	17.6	17.9	20.7	23.3	23.9	22	18.2	15.8	11.7

Figure 4-3 Ramallah District Temperature for the Year 2008(Palestinian Metro-geological Department)

4.2.2.2 Precipitation

Annual rainfall in the West Bank varies according to the climatic zone. In Ramallah area, rainfall season extends from September to March, and the average annual rainfall ranges between 500 and 700 mm. In the year 2008 Ramallah district received 504mm of rain as shown in **Figure 4-4**.

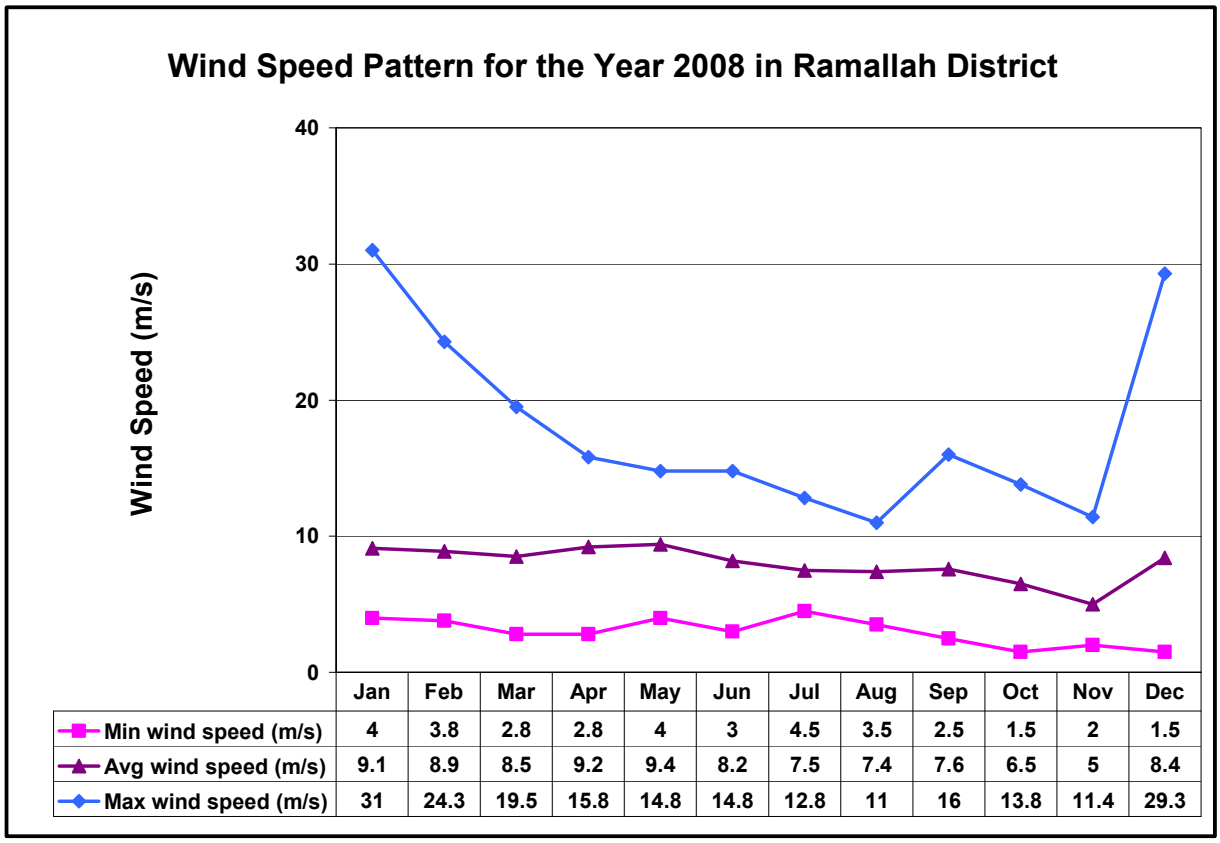


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min Precip. (mm)	0.2	1.8	1.5	0.7	0	0	0	0	2.6	0.2	0.3	0.7
Max Precip. (mm)	79	38.5	1.5	0.7	0	0	0	0	4.6	11.6	8.7	20.6
Total Precip. (mm)	224.8	144.4	1.5	0.7	0	0	0	0	10.2	26	11.5	84.5

Figure 4-4 **Ramallah District Precipitation for the Year 2008 (Palestinian Metro-geological Department)**

4.2.2.3 Wind Regime

During summer, the area is influenced by regional winds with a maximum wind speed reaching 11m/s in August. During winter, the rain-bearing winds move in a general west-east direction with a maximum wind speed reaching 31m/s in January and causing precipitation. Between April and June, the area is influenced by Khamaseen winds which blow frequently from the Arabian Desert, full of sand and dust. This wind brings high temperature and reduced humidity. **Figure 4-5** shows wind speed characteristics of Ramallah District for the year 2008.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Min wind speed (m/s)	4	3.8	2.8	2.8	4	3	4.5	3.5	2.5	1.5	2	1.5
Avg wind speed (m/s)	9.1	8.9	8.5	9.2	9.4	8.2	7.5	7.4	7.6	6.5	5	8.4
Max wind speed (m/s)	31	24.3	19.5	15.8	14.8	14.8	12.8	11	16	13.8	11.4	29.3

Figure 4-5 Ramallah District Wind Speed Characteristics for the year 2008 (Palestinian Metro-geological Department)

4.2.2.4 Humidity

The average annual relative humidity in Ramallah District is 68% and it increases during winter seasons and decreases in summer (Palestinian Metro–geological Department, 2008).

4.2.3 Topography

The West Bank is characterized by a great variation in elevations ranging between 1020 meters above sea level and 375 meter below sea level. The highest point is located near Kherbet Khillan to the north of Hebron City and the lowest point is at the northeast tip of the Dead Sea. West Bank can be divided into four major geomorphologic parts: Nablus Mountains, Jerusalem Mountains, Hebron Mountains and the Jordan Valley. The mountains extend over the central parts of the West Bank from Jenin in the north to Hebron in the south. The drainage and valley systems originate from the mountain range and extend either eastwards or westwards.

Ramallah Mountains can be divided into three parts: the eastern slopes, mountain crests and western slopes (elevation ranging between 250 – 500 meters above sea level). Mountain crests from the watershed line separate the eastern and western slopes. Elevation ranges between 750 and 800 meters above sea

level. The highest point in Ramallah district is 1,022 meters above sea level at Tel A'sour and the lowest elevation is 24 meters below sea level at the southeast corner of the district.

The proposed Al-Reehan Neighborhood site is located in the middle of Ramallah District. Al-Reehan project site is part of Ramallah mountainous area; the topography of the area is characterized as a sloped area with elevation varying between 710m to 645m above sea level with 65 m drop from both sides (north-south section) with a total drop of 9 m as shown in **Figure 4-8.**

4.2.4 Geology

4.2.4.1 Stratigraphy

The geological formations of Ramallah District range from lower Cretaceous to Quaternary, and is mainly covered by sedimentary carbonate rocks of Cretaceous and Tertiary era. **Figure 4-6** shows the geology of the Ramallah District.

The following is a brief description of the stratigraphic units based on geological time sequence and physical properties.

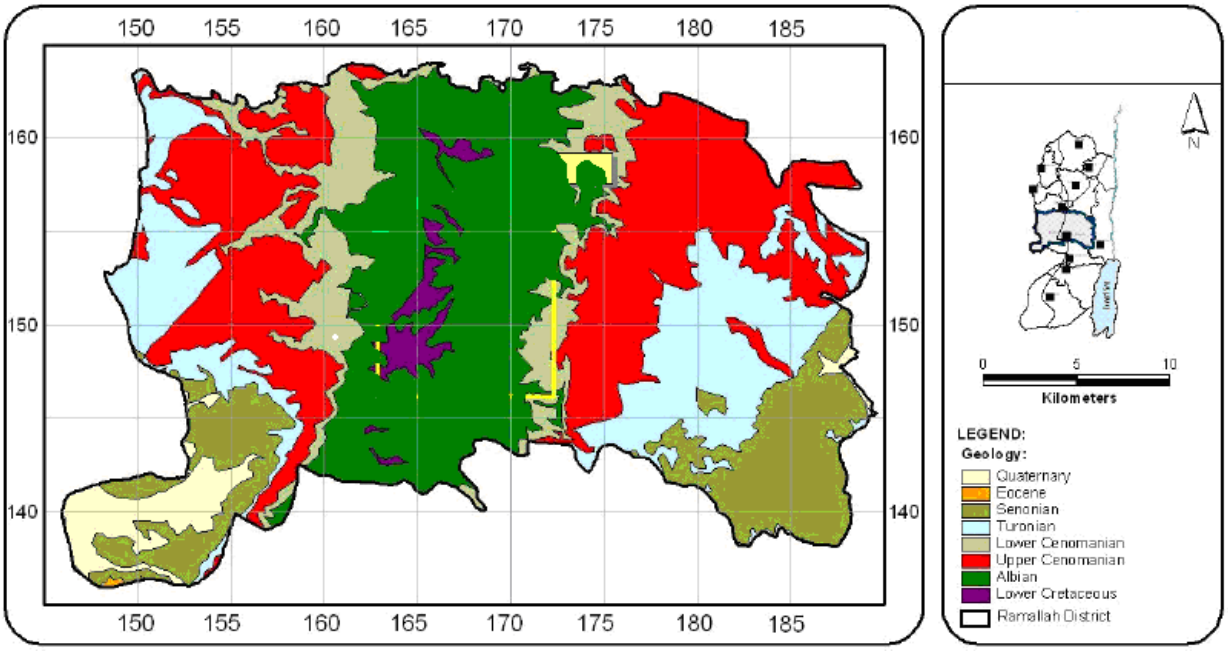


Figure 4-6 Ramallah District Geological Formation (HWE, 2008)

Figure 4-7 shows the stratigraphy of the West Bank.

- Holocene

The Holocene sediments "Recent Formation" are composed of Quaternary alluvium deposits. These unconsolidated alluvial fan deposits have developed along the sides of the major wadis. They overlie the Lisan Formation in Jordan Vally. They are derived from older formations exposed in the adjacent catchment areas. The sediments are mainly composed of limestone, dolomites, chert, basalt boulders, and pebbles with a matrix of sand, silt and clay, (CH2M HILL, 2001).

- Pleistocene

It is also referred to as "Lisan Formation". It covers a large part of the Jordan Valley. In some areas, a characteristic reddish soil cover has developed on top of the formation, ranging in thickness from a few centimeters to 2 meters, (CH2M HILL, 2001).

The geological formations "Holocene, Pleistocene" have been formed in the Neogene (Quaternary) System Period, (CH2M HILL, 2001).

- Pliocene and Miocene

The Pliocene and Miocene sediments are composed of older alluvial fans, valley fill, or talus sediments "Bedia Formation". It consists of well cemented conglomerate whose aggregates are derived from older formations exposed in the catchment areas.

The geological formations "Pliocene and Miocene" have been formed in the Neogene (tertiary) System Period, (CH2M HILL, 2001).

- Paleocene and Meocene

The Eocene sediments "Jenin subseries Formation" are composed of four sub-units of different types of limestone and chalk , (CH2M HILL, 2001).

- ✓ First unit - its thickness ranges from 0 to100 m.
- ✓ Second unit – its thickness ranges from 15 to 200 m.
- ✓ Third unit – its thickness ranges from 0 to 170 m.
- ✓ Fourth unit – its thickness ranges from 0 to 125m.

The geological formations " Paleocene and M.Eocene" have been formed in the Palaeogene (Tertiary) System Period, (CH2M HILL, 2001).

- Senonian (Abu Dis Formation)

The Senonian sediments consists of chalky-marly successions, with brechoid flint layes. This formation is pink, yellow, and cream-colored, and weathers to white, (CH2M HILL, 2001).

- Turonian

The Turonian "Jerusalem Formation" underlies the Abu Dis Formation with a thickness of approximately 70-130 meters. It is composed of limestone and dolomitic limestone that is massive , thick to thinly-bedded. Its surface has a pink color and cream brown or dark blue color throughout, (CH2M HILL, 2001).

- Upper Cenomanian

The Upper Cenomanian "Jerusalem, Bethlehem and Hebron Formation" underlies the Abu Dis Formation.

- ✓ Jerusalem Formation: this formation is divided into 3 sub-formations
  - o The lower part limestone and dolomite
  - o The middle part limestone, massive to cliff-forming course crystalline
  - o The Upper part limestone, fine crystalline
- ✓ Bethlehem Formation:
  - o The lower Part of Bethlehem Formation: composed of limestone and dolomite soft, with marl, rich in faunal remains. Its thickness ranges from 20 to 50 m
  - o The Upper Part of Bethlehem Formation: dolomite, massive, sometimes cliff-forming, coarse crystalline Limestone lenses, well bedded. Its thickness ranges from 25 to100 m
- ✓ Hebron Formation: composed of dolomite, massive sometimes Cliff-forming, hard, medium-coarse crystalline, highly karstic.

- Lower Cenomanian

The Lower Cenomanian rocks consist of three formations: Yatta, Upper Beit Kahil, and Lower Beit Kahil.

- ✓ The Yatta Formation consists primarily of inter-bedded limestone, marl, chalky marlsand some dolomite. The Yatta Formation can be divided into two parts:
  - o The Lower Part of Yatta Formation: dolomite and chalky limestone, fine-medium crystalline, with marly intercalations. Its thickness ranges from 40 m to 150 m.
  - o The Upper Part of Yatta Formation (Moza formation) marl, clay and marly limestone, usually highly enriched with fossilized fauna. Its thickness ranges from 10 to 60 m.
- ✓ The Upper Beit Kahil Formation consists mainly of two parts:
  - o Upper Part of Upper Beit Kahil Formation: dolomite and limestone, massively bedded to cliff formation, usually coarse crystalline, rich in reefal phenomenon. Its thickness ranges from 20 to 35 m.
  - o Lower Part of Upper Beit Kahil: dolomite, fine crystalline, sometimes soft inter-bedded with thin marly layers Thickness is between 60 and 130 m. Its thickness was 113 m at ESW3.
- ✓ The Lower Beit Kahil Formation consists mainly of two parts:
  - o Upper Part of Lower Beit Kahil formation: dolomite, massively bedded fine-coarse crystalline, hard, highly fractured and karstic. Its thickness ranges from 40 to 90 m.

- Lower Part of Lower Beit Kahil formation: limestone, well-bedded, fine crystalline, highly karstic, and sometimes dolomitic in the upper part. Its thickness ranges from 120 to 180 m.

- Albian

The Albian rocks are composed of alternative marls, marly limestones, shale, and clay "Qatana, Ein Qinya, and Tammun Formations". The upper 40-50 meters consist of the imprevious bituminous dark green to gray marls and clay of the Qatana Formation. The middle 70-100 meters consists of the marls and marly limestone of the Ein Qinya Formation. The lower 50-90 meters consist of the clay and the marl of the Tammun Formation, (CH2M HILL, 2001).

4.2.4.2 Site Geology

Al-Reehan Neighborhood geological formation is composed of Albian, Lower Cretaceous and Lower Cenomanian formations; as most of the central area of Ramallah Governorate. These formations form the lower aquifer, which is well known as a very good aquifer. The lithological composition of the formations consists mainly of limestone, dolomite, marl, chalk, cherts and alluvium **(see Figure 4-7)**.

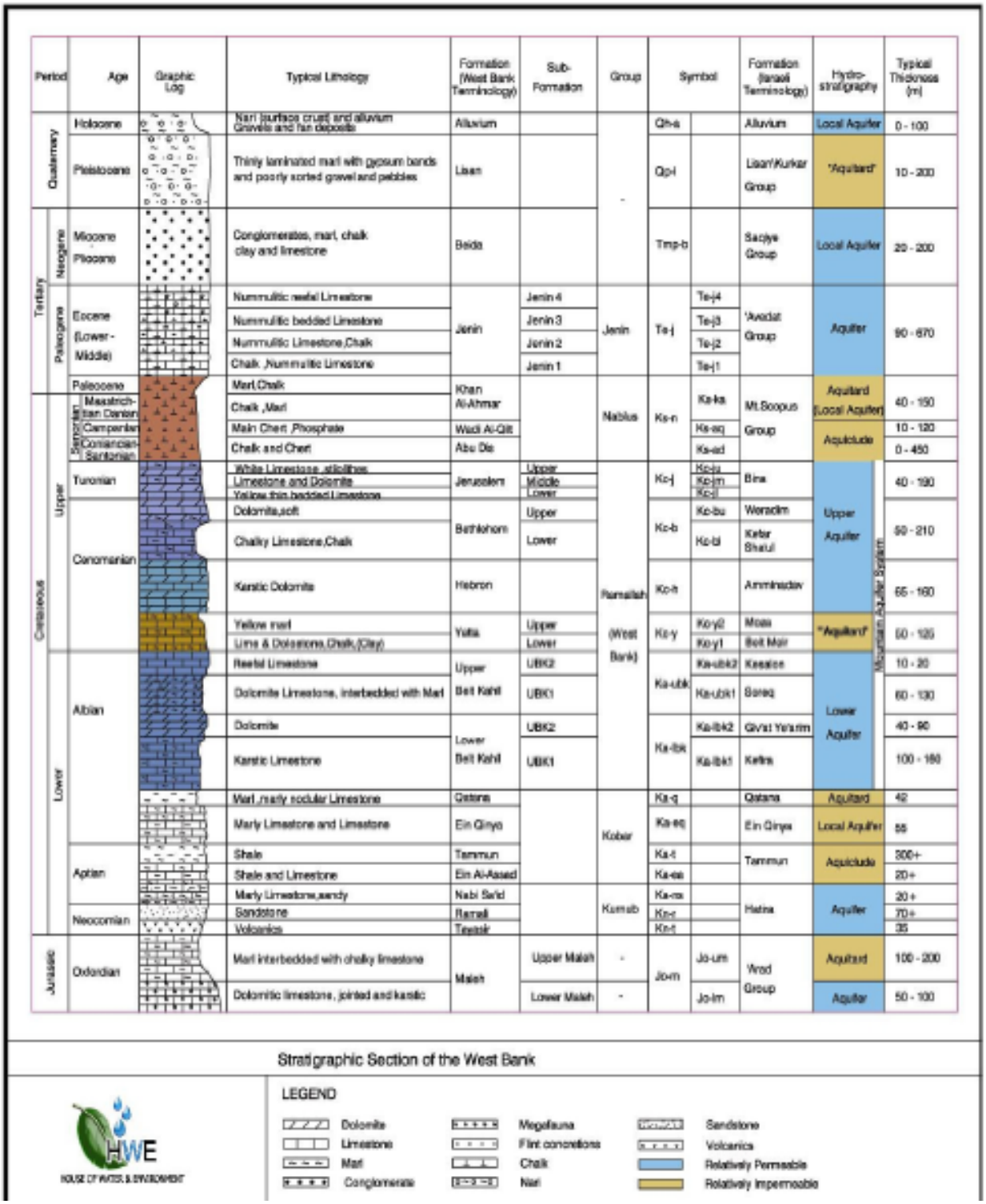


Figure 4-7 Stratigraphic Section of the West Bank (HWE, 2008)

4.2.4.3 Hydrology and Hydrogeology

There are three main Basins in the West Bank:

1. The Eastern Basin located in the eastern part of the West Bank and is largely contained within the political boundaries of the West Bank. It underlies the eastern part of Ramallah District. Water flows towards the east and southeast. The average water levels adjacent to the ground water in the western part of the basin, are as high as + 440 m above sea level. The Eastern Basin is bounded by Western Basin from the west and forming what is so called the axis of the Hebron, Ramallah, and Fari'a Anticline to the west and northeast.
2. The North Eastern Basin extends northward beyond the political boundaries of the west Bank. The Northeastern Basin is bounded by the Fari'a Anticline in the east and in the south. It is bounded from west by the Anabta Anticline in the west, and from the north by the Gilbo's Fault system in the north.
3. The Western Basin underlies about 45% of Ramallah District. Water flows towards the west. Two main aquifers are present in this basin, the upper and the lower aquifers. It is bounded by the political boundary of the West Bank to the south, north, and west. The Western Basin is bounded by Anabta, Ramallah-Nablus, Hebron Anticlines to the east.

4.2.4.4 Aquifer Systems

There are four main aquifer systems in the West Bank (Shallow Aquifer, Upper Aquifer, Lower Aquifer, and Deep Aquifer); three of them in Ramallah district and are found in the following formations:

- The Upper Aquifer System (Jerusalem, Bethlehem, and Hebron Formation)
- The Lower Aquifer System (Yatta, Upper Beit Kahil, and Lower Beit Kahil Formations).
- The Deep Aquifer Systems (Ramali and Malih Formations)

4.2.4.5 Site Hydrogeology

The lower Aquifer is considered as a regional source for drinking water, where water quality is generally good. The Lower Aquifer is utilized by number of wells in Ramallah District, where the Individual well yields across the West Bank, as well as Ramallah District, ranging from 150 to 450 m^3/hr, while wells depth usually vary from 500 to 850m. The high water bearing capacity and productivity is owned to the great thickness of dolomitic limestone and limestone (**See Figure 4-7**).

Ramallah District lies on two main aquifer basins in Palestine which are: The Eastern Aquifer Basin and the Western Aquifer basin, where Ramalla-Hebron anticline passes through the villages Burham, Um Safah, and continues in the north. Al-Reehan Project area located in the Eastern basin, even though its surface water flow is directed to the western valleys which is recharged into the western aquifer.

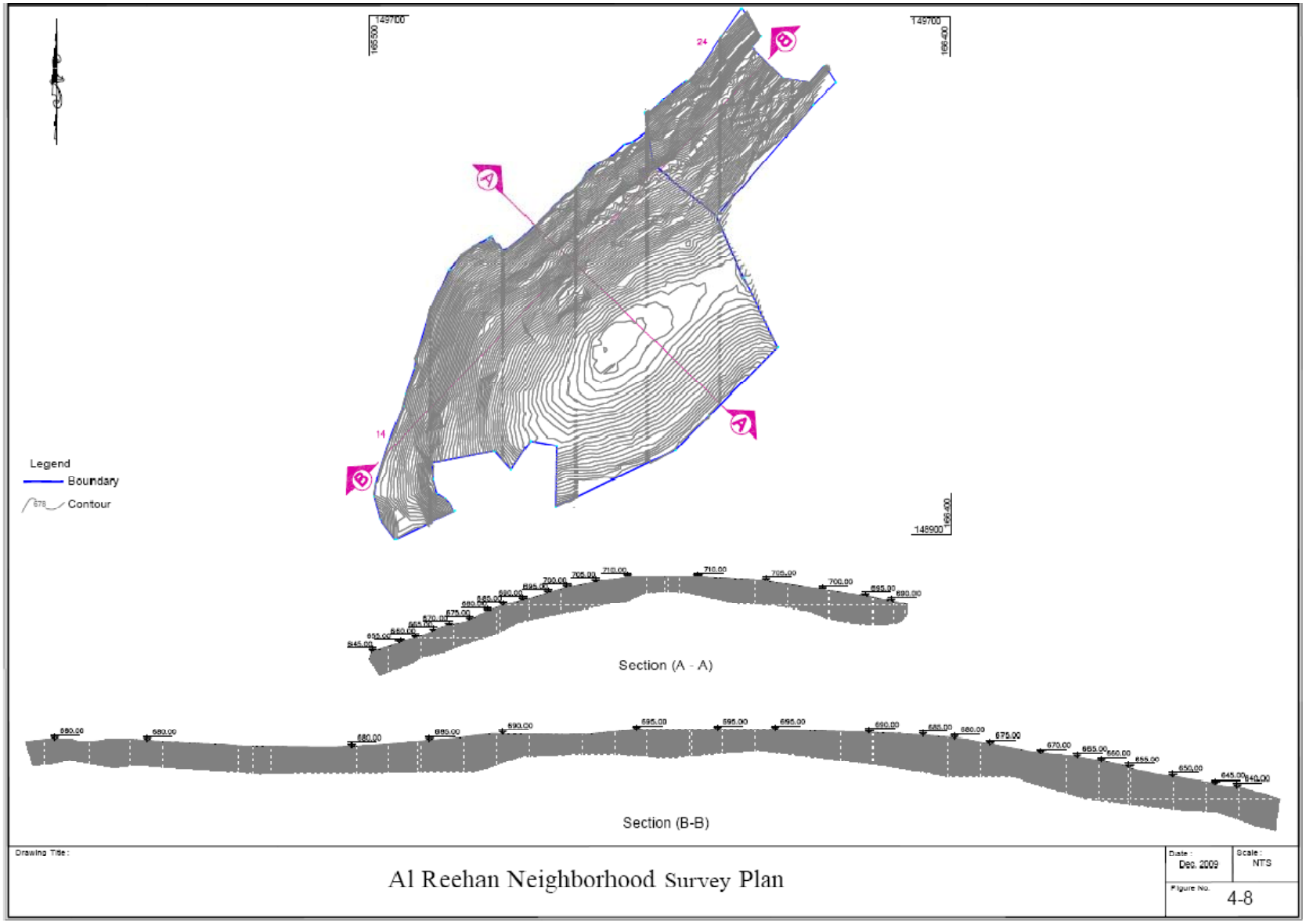


Figure 4-8 Al Reehan Neighborhood Survey Plan

4.2.5 Land Use

4.2.5.1 Site Conditions

Al-Reehan Neighborhood is situated in an area of special natural beauty, characterized by medium height hills with steep valley edges. The hills are generally constituted of solid rocks which out-crop on most of the site. Top soil has been subjected to severe erosion due to negligence of the agriculture land which was the main activity taking place in these areas. (See **Figure 4-10**).

The surrounding area mainly consists of Agriculture lands, Residential and Commercial areas in Ramallah, as shown in **Figure 4-9**.

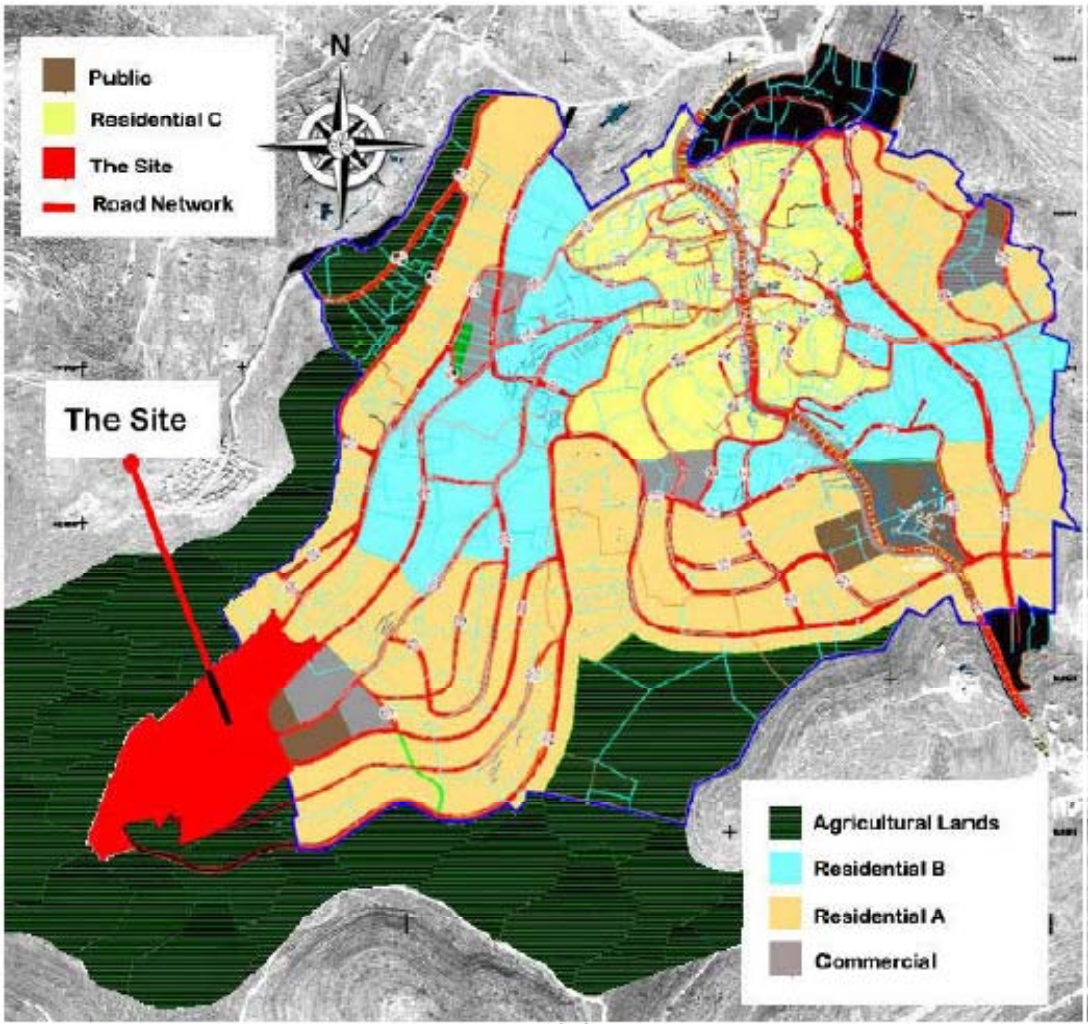


Figure 4-9 Land use Map of the Surrounding Area, Adapted from (Abu Qash Structural Plan)

Figure 4-10 Site Surroundings

4.2.5.2 Site Soil Conditions

The nature of the soil underlying Ramallah district is varying between Grumusols, Terra Rossa, Brown Rendzinas and Pale Rendzina, Brown Rendzinas and Pale Rendzinas, Brown Lithosols and Loessial Arid Brown Soils, Brown Lithosols and Loessial Serozems. The soil type mostly underlying Al-Reehan Neighborhood is Terra Rossa, Brown Rendzinas and Pale Rendzina as shown in **Figure 4-11**.

This soil is characterized by surface horizon, which is thick, dark, and dominated by base forming captions such as calcium and magnesium, high base saturation. The soil depth differs greatly within short distance, so that deep soils occurring in solution pockets or in hollows alternate abruptly with outcrops.

In the Al-Reehan Neighborhood, two Soil Investigations and explorations have been conducted in three different construction sites by drilling boreholes to a depth ranging from 6 to 8m. According to the investigations' results and the geological description for obtained samples, there are similarities and continuities of the subsurface materials; however, some local variations that may not affect engineering

analysis have been noticed along the drilled depth. **Table 4-2** shows summary of the physical and mechanical properties for the encountered materials in the drilled boreholes.

Furthermore, no groundwater was observed at the encountered depth in the drilled boreholes, and no cavities were observed along the drilled boreholes.

Table 4-2 Summary of Material Types Encountered in the Soil Investigations

APPROXIMATE DEPTH (M)			GEOLOGIC DESCRIPTION
Bh no.	From	To	
1	Top	0.20	Brownish clayey soil filled by little grayish cobbles and gravels of lime stone
1	0.20	0.40	Creamy to yellowish stiff marl stone
1	0.40	0.70	Grayish fractured lime stone filling by stiff creamy marl stone
1	0.70	1.00	Yellowish to creamy hard and stiff marl stone filling by grayish fractured lime stone
1	1.00	1.70	Grayish fractured lime stone filling by stiff creamy marl stone
1	1.70	2.00	Yellowish to creamy moist tot dry marl stone filling by grayish fractured cobles and gravels of lime stone
1	2.00	8.0	Grayish fractured lime stone filling by stiff creamy marl stone
2	Top	1	Grayish to whitish limestone, the fractures filling by creamy stiff marlstones
2	1	1.6	Grayish stiff marlstones
2	1.6	2.5	Creamy to yellowish medium stiff marlstones
2	2.5	2.8	Creamy to grayish medium stiff fractured marlstone
2	2.8	3	Yellowish to greenish soft marlstone
2	3	4	Grayish fractured marlstone
2	4	6	Whitish to grayish fractured limestone filling by thin bounds of creamy marlstone
3	Top	1	Grayish to whitish fractured limestone, the fractures filling by creamy stiff marlstone
3	1	1.7	Creamy to yellowish medium stiff marlstone
3	1.7	2.8	Whitish to grayish fractured limestone filling by thin bounds of creamy marlstone

APPROXIMATE DEPTH (M)			GEOLOGIC DESCRIPTION
Bh no.	From	To	
3	2.8	3	Grayish stiff marlstone
3	3	4.1	Creamy to yellowish medium stiff marlstone
3	4.1	4.5	Grayish fractured marlstone
3	4.5	6	Whitish to grayish fractured limestone filling by thin bounds of creamy marlstone

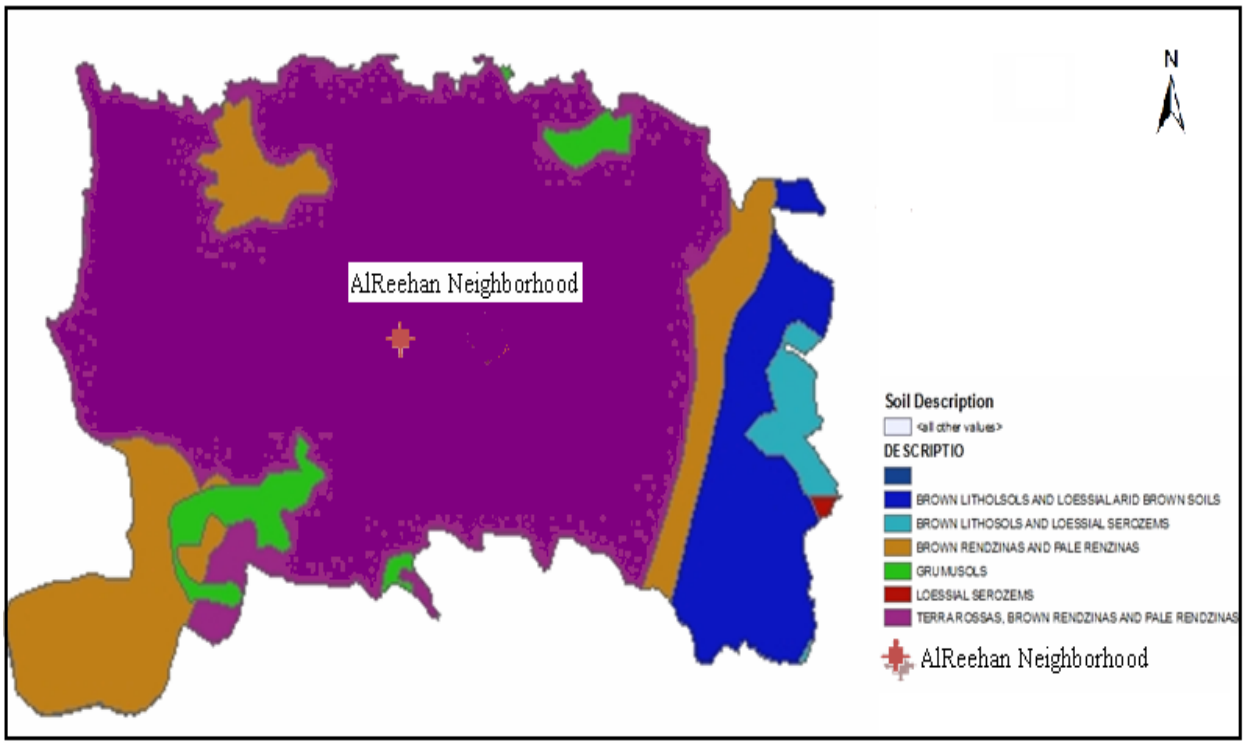


Figure 4-11 Ramallah District Soil Distribution (HWE, 2008)

4.3 BIOLOGICAL ENVIRONMENT

4.3.1 Flora

Palestine is characterized by a rich variety of flora within a small land area. An estimated 2,483 species of higher plants that belong to 700 genera and 114 families exists in the West Bank and Gaza Strip out of which, 1,558 species are concentrated in the Mediterranean zone and 600 in the desert.

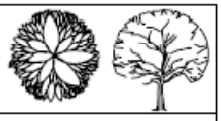
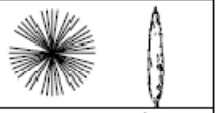
Cypresses, flowers, bushes are the main flora types that exist in mountainous areas, and found in Al-Reehan Neighborhood.

In the Landscape design of Al-Reehan Neighborhood, it was planned to retain as much of the existing vegetation (such as the cypresses trees) as possible to maintain the natural character of the project area. Therefore, different and divert kinds of plant species have been chosen in the landscaping design of Al-Reehan Neighborhood for their ecological compatibility, as illustrated in **Table 4-3**.

Figure 4-12 is a photo taken from Al-Reehan project site that shows the existing vegetation in the site.

Table 4-3 Al-Reehan Neighborhood Plantation Schedule (Al-Reehan Neighborhood Landscape Report)

PLANTING SCHEDULE

	NO.	NAME / SPECIES		QUANTITY	HEIGHT Ø (CM)	SYMBOL
TREES	1	Bauhinia variegata	Bv	89	1.5 / 5	
	2	Brachychiton populneus	Bp	360	1.5 / 5	
	3	Cupressus sempervirens	Cs	70	1.5 / 5	
	4	Phoenix dactylifera	Pd	55	2	
	5	Robinia pseudocacia	Rp	365	1.5 / 5	
	6	Sophora japonica	Sj	695	1.5 / 5	

PLANTING SCHEDULE

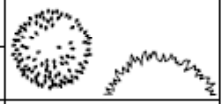
	NO.	NAME / SPECIES		QUANTITY	HEIGHT Ø (CM)	SYMBOL
SHRUBS & GROUNDCOVERS	1	Aeonium haworthii	Ah	90	0.3	
	2	Buxus microphylla	Bm	150	0.3	
	3	Echeveria agavoides	Ea	85	0.5	
	4	Juniperus sabina	Js	45	0.3	
	5	Lantana camara	Lc	55	0.5	
	6	Lavandula angustifolia	La	80	0.3	
	7	Rosemarinus officinalis	Ro	50	0.5	
	8	Santolina chamaecyparissus	Sc	50	0.3	
	9	Yucca aloifolia	Ya	11	1.0	

Figure 4-12 The existing vegetation in Al-Reehan project site (Al-Reehan Neighborhood Landscape Report)

4.3.2 Fauna

The wildlife of Palestine consists of a wide variety of invertebrates, amphibians, reptiles, birds and mammals. The lowest diversity is found to be in amphibians.

Invertebrates are thought to be the most diverse but data about their numbers is limited. Other micro animals also exhibit high diversity. Palestinian wildlife is distributed through 16 zoo-geographical areas.

Eight **amphibian** species have been recorded in West Bank and Gaza, but accurate data is lacking. Important species in West Bank and Gaza are the Salamander, Salamandera maculosa (endangered) and the Triton, Triton vittatus (rare). Three species of frogs exist.

Reptiles in Palestine are well distributed and show high biodiversity in species and habitats. The high diversity is due to the diverse bio-geographical, climatic, topographical and vegetation formations. Reptiles have an important role in the ecological balance as they form an important food source for predators like raptors (e.g. kestrels, buzzards and eagles).

Birds in Palestine are very diverse, with 511 species being recorded of which 80% are migratory birds. 50% of the species are waterfowl and 30% are raptors. Considered as a land bridge between three continents, Palestine is an important migratory route for north Palearctic birds, especially Jordan Valley and Gaza Coastline.

There are 106 terrestrial mammal species in West Bank and Gaza, out of which 28 are bat species. The large number of animal species is attributed to the fact that Palestine is on the migratory route from Europe and West Asia to Africa and vice versa. The number of different species of terrestrial mammals is relatively large for the small area of the country, but the number of individuals has greatly decreased through the years and many of the `animal species became endangered.

Al-Reehan surrounding area merges most of these mentioned creatures, with native creatures mostly of birds, mammals and reptiles. The main birds that can be found in the area are: Goldfinch, Bulbul, owl,

woodpecker, hoopoe, and falcon. The main mammals consider bats, hyena, fox, wolf, dear, rabbits, turtles and rats, other creatures as lizard, snake, scorpion, spiders, pugs, and beetles.

4.4 EXISTING INFRASTRUCTURE

Al-Reehan Neighborhood location has been chosen for strategic purposes. Its close proximity to a major population center and small to medium size towns and villages will facilitate its connection to the existing infrastructure including roads, electricity water and telephone and internet lines, Basic social facilities such as school, hospital, commercial centers and offices are close by.

The existing infrastructure in the project area consists of:

1. Birzeit-Ramallah road is the main regional road between central and Northern areas of West Bank, not limited to that, most of the infrastructure services transmission is already laid in this road.
2. The Existing road connecting Al-Reehan Neighborhood construction site to AbuQash village and Birzeit-Ramallah main road. This road has been constructed recently by Al-Reehan Real Estate Company with a length of 3 km.
3. AbuQash village is the nearest community to Al-Reehan Neighborhood, and it contains 4.4 Hectares (First Parcel) of Al-Reehan Neighborhood within its master plan. The village is already served by electricity, telecommunication, potable water networks that can also be extended to serve the first inhabitants of Al-Reehan Neighborhood.
4. 20.6 Hectares of Al-Reehan Neighborhood is planned to be developed as part of Ramallah municipality's master plan and to annex it to its municipal boundaries.
5. Potable water network: Jerusalem Water Undertaking (JWU) as a service provider owns a 10 inch transmission pipe passing through Ramallah-Birzeit road. Al-Reehan will have its own water network that is planned to be served from that transmission pipeline.
6. Sewage Network: surrounding communities as Birzeit, Abu Qash and Surda are not connected to centralized sewer networks and mainly depend on cesspits as method of collecting sewage. Al-Reehan will have its separate sewage system.
7. Storm water: Natural drainage of storm water from streets is the common approach in Al-Reehan surrounding; However, Al-Reehan Neighborhood project is planned to be provided with an efficient storm water system.
8. Jerusalem Electricity District Company (JEDCO) is the Electricity provider, which is already providing the provisional connection for the construction site. It will provide the electricity for the whole Neighborhood, including its different facilities and uses, with a power of 7.5 M.V.A and a voltage of 11 K.V. This high amount of electricity will be provided from two main proposed sources. The first is the existing station in Al-Tireh Neighborhood in which the capacity of Electrical transformer will be increased from 5 to10 M.V.A with a voltage of 11/ 33 K.V. while the second will be a new proposed station located near Birzeit University, in which a new transformer will be installed with a capacity of 10 M.V.A and with a voltage of 11/33 K.V. The proposed Electrical network and Electrical stations plans are shown in **Figure 4-13, Figure 4-14** and **Figure 4-15**.
9. Telecommunication and Internet is provided via PALTEL group, and Al-Reehan Neighborhood will be connected via it.

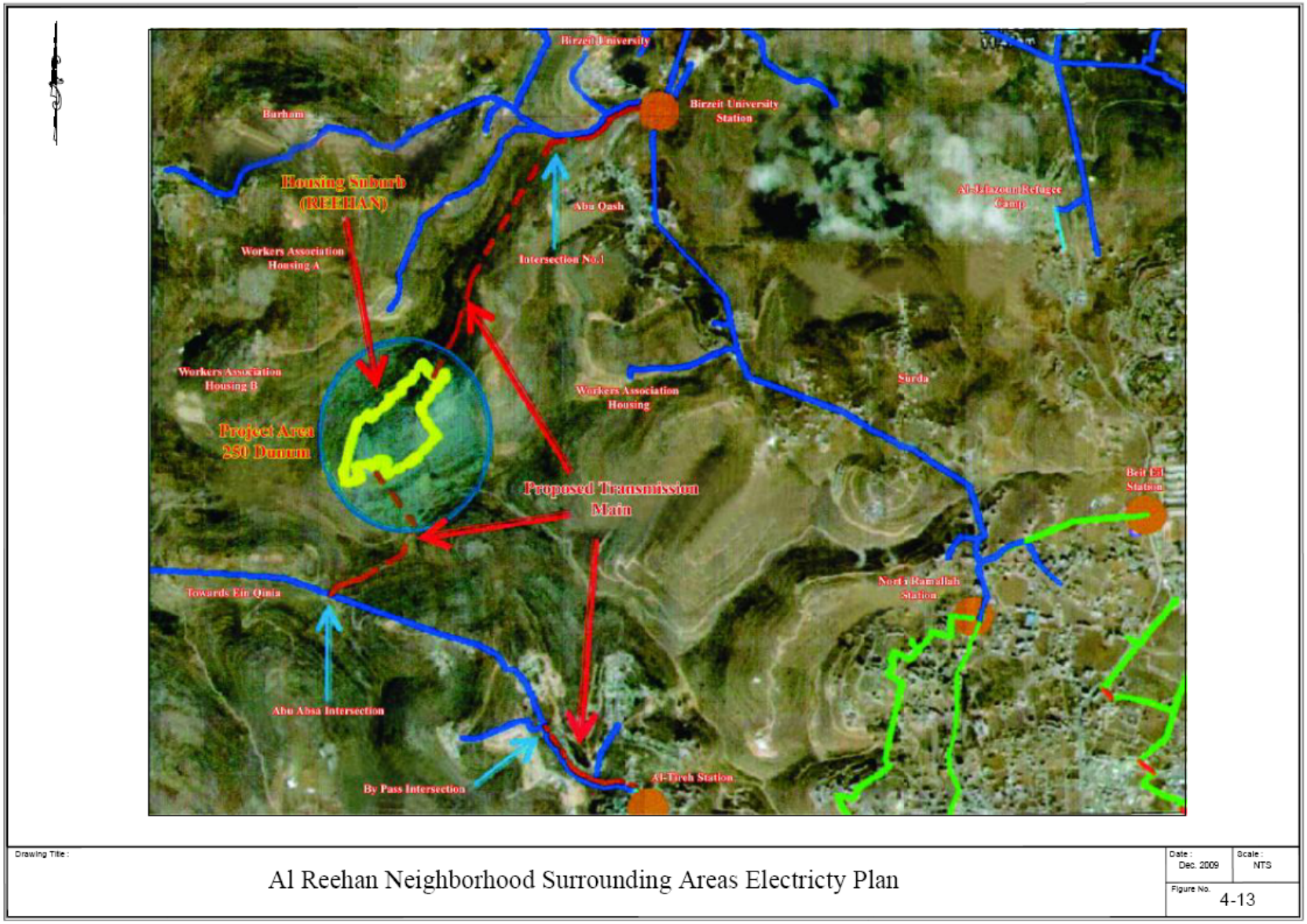


Figure 4-13 Site Plan for the Proposed Electrical Mainlines and Electrical Stations

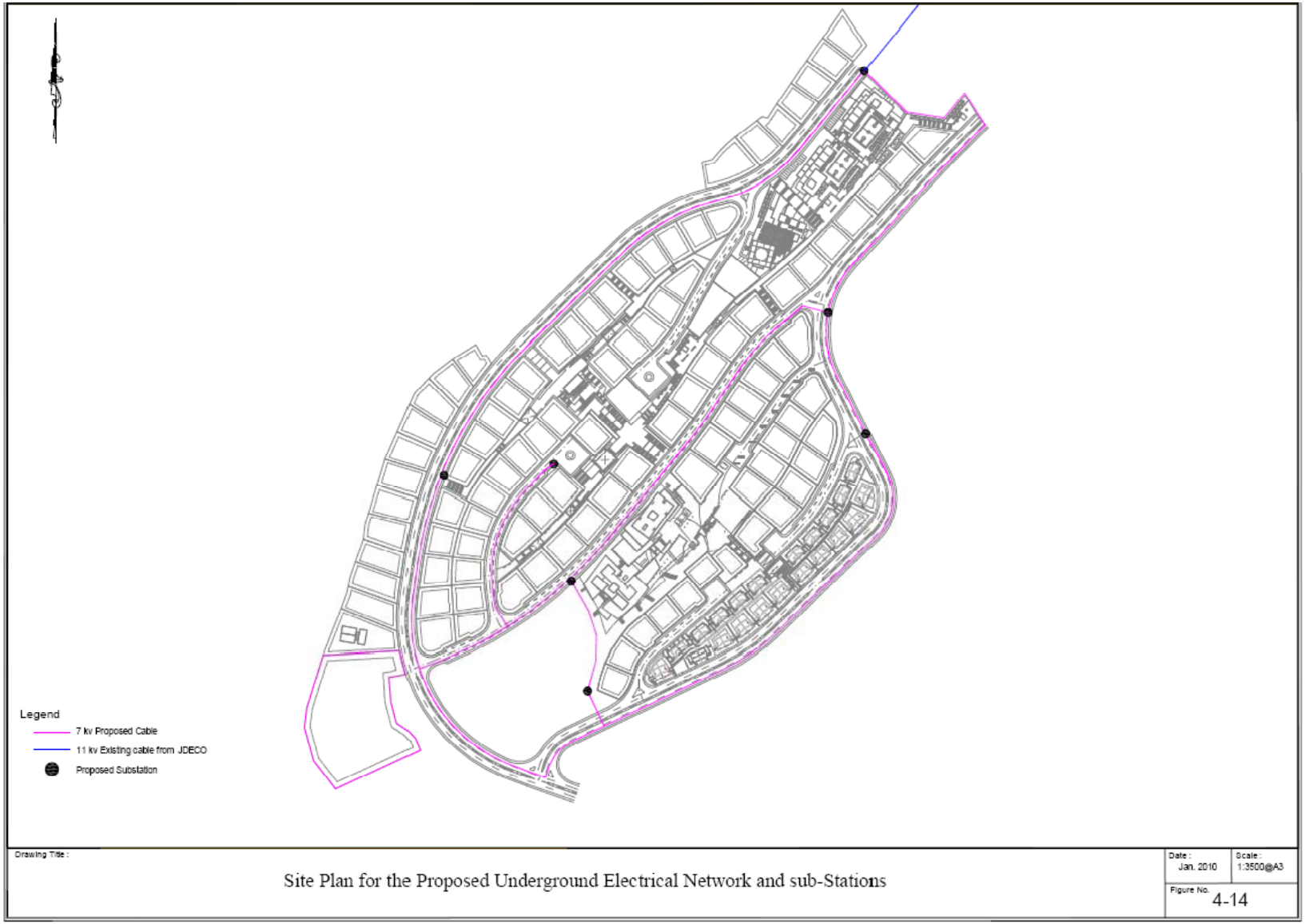


Figure 4-14 Site Plan for the Proposed Underground Electrical Network and Sub-Stations

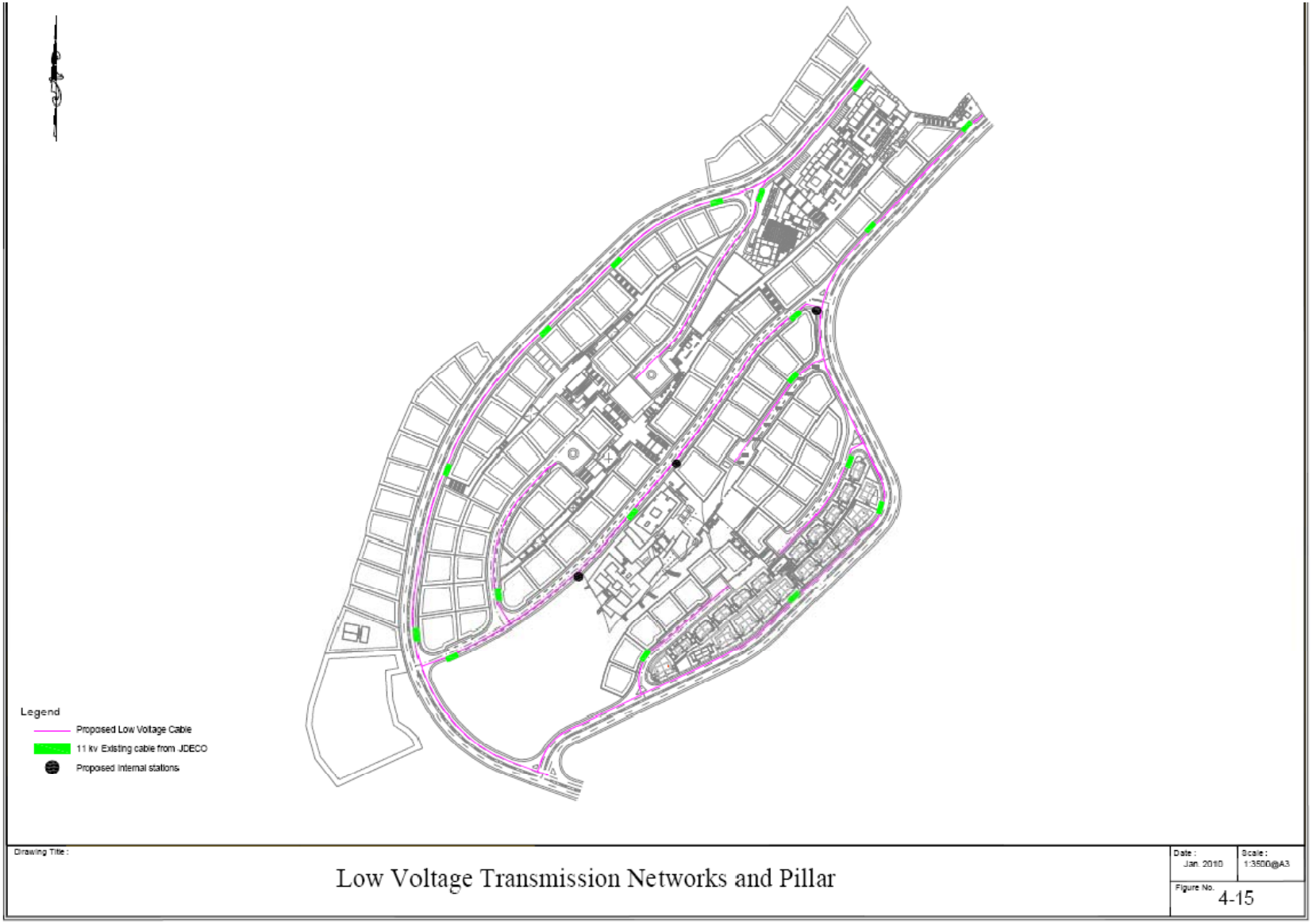


Figure 4-15 Site Plan for the Proposed Underground Low Voltage Electrical network and Pillars

4.5 SOCIO ECONOMIC ENVIRONMENT

4.5.1 Education

The West Bank region is equipped with a full educational system from primary level to university, with education being provided free of charge through government schools, while it is highly charge for private sector schools. Furthermore, for colleges and universities, there are no public universities only private. Education from primary to secondary level is compulsory, and literacy rates are comparable to the norm in developed countries.

Al-Reehan master plan views two elementary schools, and one day care center to cover the community needs. For Secondary schools, it's proposed that Al-Reehan students will travel to Birzeit, Abu Qash, Surda, Ramallah or any of the surrounding areas schools which are relatively close to the neighborhood.

For Higher Education; as a practical choice, students can join Birzeit University that is very close to the neighborhood and will afford them various specializations. Moreover Ramallah combine AlQuds Open University, and a variety of community colleges

4.5.2 Health Care

In Ramallah district, health care is provided through more than five private hospitals and one governmental hospital that are located in the city. These hospitals accommodate the need for health care services in Ramallah District. In addition, there are several numbers of health care centers and clinics distributed in Ramallah City and surrounding areas that deal with small and not critical cases.

Al-Reehan Neighborhood is proposed to have a hospital that would serve its community and the surrounding areas. The total area for the health care zone exceeds 12,000 m^2 and will include around 100 beds referral hospital.

4.5.3 Population Characteristics

West Bank is composed of 11 governorates. The population of the West Bank is estimated over 2.345 million (including Israeli-occupied East Jerusalem) according to the 2007 census.

Ramallah Governorate is unique for its social, economic and political mixtures, and it is considered as an economic and political capital, since all ministries and governmental departments are located in it, in addition to the high numbers of private companies, factories, NGOs...etc, which are creating jobs for numerous residents of West Bank. The population in Ramallah District is mainly engaged in private business, Governmental posts, NGOs jobs and in various companies.

Al-Reehan Neighborhood as a new high quality, affordable development will attract different type of people who will be willing to redeploy their life to another level, especially young Palestinian families seeking a good quality for living within affordable budget.

Al-Reehan Neighborhood is expected to sustain social and financial stability and also enhance the attachment of its residents to Palestine.

4.5.4 Employment

The development of Al-Reehan Neighborhood project at this site is expected to improve the socio-economic pattern of the area. The project will make the area suitable for human settlements and will support a range of residential, commercial and touristic activities which will generate economic and amenity benefits.

Al-Reehan will provide thousands of different types of jobs for people who live in the surrounding communities during the construction phases, and will also support enhancing the economical situation as new work opportunities will be available after the development of the city, especially that it will include commercial areas, offices and entertainments centers.

4.5.5 Transport Infrastructure/ Traffic

4.5.5.1 Regional Access

Al-Reehan Neighborhood is located approximately in the centre of Ramallah Governorate, which is an area that will experience substantial development during the upcoming years, both in terms of transportation/ accessibility and new land uses.

Al-Reehan Neighborhood is located close to one of the major roads in West Bank (Ramallah-Birzeit Road), which connects the northern governorates to the central and southern areas.

The development project is planned to have three access points to the external road network. The number of access points should be sufficient to accommodate the number of trips likely to be generated from the planned mix and density of land uses.

Two of the access roads are connected to Ramallah- Birzeit road, and the third to the bypass road reaches Ramallah city through Al Tierieh neighborhood (**Figure 3-4**).

During the preparation for the development of Al-Reehan site area, which began back in June 2009, the company has constructed a 3km long access road that leads to the site from Ramallah Birzeit road and begun excavation for streets that will be part of the project's first phase.

4.5.5.2 Local Access

Currently one single paved road, with a length of 3 km, is available to access the site, which connects with Ramallah-Birzeit road at a point located at Abu-Qash village. The second access road will be accomplished during construction period and will connect with the main road at Al-Nigmeh Care Center; while the third access road is planned to be connected to the bypass road after getting the approval or permit from Israeli side(**Figure 3-4**)

Al-Reehan Neighborhood project presents modern and wide roads network for the neighborhood and the adjacent communities.

While in the same time it gives almost separated internal roads networks for the project residents and visitors, which guarantees high level of privacy for different zones and area in the neighborhood.

4.6 ARCHAEOLOGY

The area of Al-Reehan Neighborhood has an important historical and cultural significance, characterized by the remains of archaeological sites and vernacular buildings. The archeological site in Al-Reehan has an area of about 8,615.06 m² and is a restricted area for any kind of living or transportation uses.

The Archeological findings in Al-Reehan area mainly consist of some pottery, walls buried underground; an old water mill situated just below the project site, and many stone terraced orchards that still exist regardless of the long negligence due to security reasons. The primary investigation classified these findings as remains from the Greek age, since they clearly differ from the Roman theme of tombs, walls, pottery findings that were discovered in the surrounding villages.

5 IMPACT PREDICTION & EVALUATION

5.1 SCOPE AND METHODOLOGY

5.1.1 General Approach

The type, nature (positive, negative, direct, indirect), magnitude, timing (during design, construction, operation or decommissioning), duration (short term/temporary, long term/permanent) and significance of impacts that could result from the Al Reehan Neighborhood Project are assessed in this section. The evaluation approach implemented in this study is a Receptor-Specific Analysis approach addressing the various sources of impacts from the development project.

The analysis covers all potential fields of impacts and/ potential receptors:

- Ambient Air Quality.
- Water resources;
- Soil;
- Biodiversity;
- Noise;
- Waste generation;
- Socio-economic Impacts; and
- Occupational health and safety.

The general evaluation process will include the following stages:

- **Step 1:** Identification of project activities (sources) and environmental aspects;
- **Step 2:** Identification of potential impacts to people and the environment;
- **Step 3:** Evaluation and assessment of the related unmitigated impact significance;
- **Step 4:** Identification of Best Practicable Environmental Options (BPEO); and
- **Step 5:** Re-evaluation and assessment of the mitigated impact significance

5.1.2 Impact Evaluation Pre-Screening Level

The screening methodology that is adopted for the purpose of this EIA comprises a preliminary screening process followed by a more delicate and detailed secondary screening process.

The pre-screening process includes an intensive literature research and review of community development projects implemented in other parts of the world as well as in Palestine. The pre-screening highlighted some of the major impacts that might be associated with normal operations based on the literature research and the nature of the surrounding environment.

The key issues identified were investigated and evaluated based on planned project operations including proposed activities, time duration, national regulations, and the social and environmental baseline evaluated. Given the data gathered by ELARD & CEP team, the results were channeled to a secondary screening process.

5.1.3 Impact Evaluation Secondary Screening Level

A secondary screening level systematically screens the wide range of possible sources and potential previously highlighted impacts. This screening level also assesses the impacts in terms of their significance, duration, reversibility, likelihood of occurrence and geographical extent. In the secondary screening level, consequence criteria were ranked into six levels of significance listed in **Table 5-1.** Then, the likelihood of the occurrence of the impact was rated according to the criteria outlined in **Table 5-2.** Based on the level of significance, and likelihood of occurrence, the impact severities (risk) are determined.

The assigned impact severity assessment was first undertaken assuming that no project control and mitigations were applied (**Table** 5-14). Following investigation and presentation of proposed project mitigations and identification of the BPEO, the impact severities for the mitigated project activities are then presented in **Table** 5-14.

Table 5-1 Secondary Screening Consequence Level Criteria

CRITERIA	CONSEQUENCE
Massive impact over a large area resulting in extensive, potentially irreparable damage to a VEC*. Has a measurable effect on the livelihood of those using a resource over a period of years. Massive impact over a large area resulting in extensive, potentially irreparable damage to a site of social and/or cultural importance.	5. Catastrophic
Long term or continuous impact resulting in substantial adverse changes in a VEC, well outside the range of natural variation. Unassisted recovery could be protracted. Area of effect is extensive and/or encompasses an area that supports a statistically significant proportion of a VEC population or ecosystem. Has a measurable effect on the livelihood of those using a resource over a period of months. Significant damage / impact to a site of social and/or cultural importance.	4. Significant

CRITERIA	CONSEQUENCE
Moderate adverse changes in a VEC or area that supports a VEC population. Changes may exceed the range of natural variation though potential for recovery within a few years without intervention is good. Area of effect encompasses an area that supports either a moderate or minor proportion of a VEC population or ecosystem. Long term (> 5 yrs) changes over an area which is not considered to be a VEC. Has a measurable effect on the livelihood of those using a resource over a period of weeks. Moderate damage to a site of social and/or cultural importance.	3. Moderate
Minor adverse changes in a VEC. Changes will be noticeable but fall within the range of normal variation and be typically short-lived, with unassisted recovery possible in the near term. However, it is recognized that a low level of impact may remain. Medium term impact (1-5 yrs) in an area that does not encompass a VEC or whose impact is highly localized within a VEC. Long term impact over a discrete, small area which does not support a VEC. May be noticed but does not affect the livelihood of those utilising a resource. Minor impact to a site of social and/or cultural importance.	2. Minor
Short term changes in an ecosystem that are unlikely to be noticeable (i.e. fall within the scope of natural variation). Area of effect is restricted to the immediate vicinity of the source. Has no discernible effect on the environmental resource as a whole and is likely to go unnoticed by those who already use it. Negligible impact to a site of social and/or cultural importance.	1. Negligible
Changes that result in a net positive impact to an ecosystem, environment or population.	Beneficial

* VEC means Valuable Ecosystem Component, used to refer to components of the environment that are considered to be of commercial and/or ecological importance.

Table 5-2 Likelihood Evaluation Criteria

LIKELIHOOD TO OCCUR	CATEGORY	SCORE
Impact is highly likely or certain to occur under normal operating/ construction conditions	High	C
Impact may possibly occur under normal operating/construction conditions.	Medium	B
Impact is unlikely to occur under normal operating/construction conditions but may occur in exceptional circumstances.	Low	A

Table 5-3 Impact Assessment Management Matrix

CONSEQUENCE RATING	LIKELIHOOD RATING A	LIKELIHOOD RATING B	LIKELIHOOD RATING C
1	1A	1B	1C
2	2A	2B	2C
3	3A	3B	3C
4	4A	4B	4C
5	5A	5B	5C

KEY

Consequences		Likelihood	Acceptability	
1 - Negligible	4 - Significant	A - Low		Negligible with minor mitigation
2 - Minor	5 - Catastrophic	B - Medium		Minimize Impacts
3 - Moderate	6 - Beneficial	C - High		Unacceptable

5.1.4 Listing of Environmental Impact Severity

Having identified and characterized the potential significant impacts during each phase using the screening procedure identified above, a single table (Environmental Impact Severity Matrix) was developed to summarize all identified impacts during each phase of the Project.

5.2 SUMMARY OF POTENTIAL ENVIRONMENTAL IMPACTS & PATHWAYS

Based on the methodology described in 5.1.2, the various impacts of the project were pre-screened according to the phase of the project activity as well as the pathway of the impact. Summarizing the results of the prescreening process, **Table 5-4** lists the potential adverse and beneficial environmental and socio-economic impacts that could result from the Project.

Table 5-4 Summary of Potential Environmental and Socio-Economic Impacts

RECEPTOR / MEDIA	PHASE	POTENTIAL IMPACT
Air Quality	Construction	Combustion and exhaust emissions from machinery and transport vehicles
	Construction	Dust emissions from soil disturbance and excavation
	Operation	Combustion and exhaust emissions from vehicular traffic

	Operation of STP	Odor Emission
Soil & Water	Construction	Physical disturbance of the soil during site leveling and excavation
	Construction and Operation	Consumption of water resources
	Operation	Wastewater Generation
Waste	Construction	Generation of Excavation and organic Waste
	Operation of STP	Generation of Sludge
	Operation	Generation of Municipal Solid Waste and medical waste
Biodiversity	Construction	Disturbance of Flora and Fauna during Site Clearance
	Operation of landscaped area	Impact on flora
Socio-Economy	Construction & operation	Noise Generation
	Construction & operation	Visual Impact
	Construction & operation	Traffic generation
	Construction & operation	Creation of new work opportunities
Worker Health & Safety	Site preparation & Construction	General Safety (Heat, noise, etc.)
	STP operation	

5.3 IMPACT ON AMBIENT AIR QUALITY

The primary sources of air pollutants from the various Project activities consist of:

→ Combustion and exhaust emissions from equipment and vehicles for raw materials transport during the construction phase;

→ Airborne particulates (dust) from soil disturbance during site clearance and excavations;

→ Combustion and exhaust emissions from vehicular traffic during operation phase; and

→ Air pollution and Odor emission from temporary STP operation.

5.3.1 Air Quality Impacts during Construction

Construction is a source of dust emissions and gases that can have temporary impacts on local air quality. Construction emissions would result from earthmoving (fugitive dust) and heavy equipment use (vehicle exhaust). These emissions would be generated from land clearing, ground excavation, cut and fill operations, and the construction of the project facilities in additional to vehicular movement. Dust emissions would vary from day to day depending on the level of activity, the specific operations, and the prevailing weather. In addition to particulate emissions from earth moving, combustion emissions from fuel-powered construction equipment, such as PM_{10}, $PM_{2.5}$, NO_X and CO, may create a temporary impact on local air quality.

Potential combustion emission sources for the construction phase of the Project are listed in **Table 5-5**. Any electric power needs during the construction phase shall be supplied by Jerusalem Electricity District Company (JEDC); hence the Project will have no associated generator emissions during this phase. **Table 5-6** illustrates the impacts associated with the associated air emissions. **Table 5-7** illustrates the potential impacts associated with dust generation.

Table 5-5 Sources of Combustion and Exhaust Emissions during Project Construction

CONSTRUCTION EQUIPMENT	TRANSPORTATION VEHICLES
Loader and truck	Trucks for materials and equipment transport
Excavator	Construction worker transportation to the site
Mobile crane	
Forklift	
Pumps	
Concrete pump and trans-mixer	

Table 5-6 Environmental Impacts of Major Air pollutants from Combustion Sources

EMISSION	ENVIRONMENTAL IMPACT
Oxides of Nitrogen – NOx	NO_2 is a toxic gas, even at relatively low concentrations. NOx also contributes to the formation of acidic species, which can be deposited by wet and dry processes. NOx can also augment the formation of ozone at ground level when mixed with VOCs in the sunlit atmosphere. NO is relatively innocuous species, but is of interest as a precursor for NO_2.
Sulphur Dioxide – SO_2	SO_2 is a toxic gas, and is known to contribute to acid deposition (wet (SO_2) and dry), which may impact ecosystems. Direct health effects potentially causing respiratory illness.
Particulates –PM10	Particulate matter is a complex mixture of organic and inorganic substances present in the atmosphere in either solid or liquid form. Particulate matter is inhaled and deposited within the respiratory pathways, leading to a variety of health effects. PM10 (i.e. particulate matter with a diameter of less than 10 µm) is able to penetrate deeply into the lung. An association has been established between elevated concentrations of PM10 and excess short term mortality and morbidity rates.
Carbon Monoxide – CO	Carbon monoxide (CO) is a colorless, odorless gas that is slightly less dense than air. When inhaled, the gas is absorbed into the bloodstream and combines with hemoglobin in the blood to form carboxyhaemoglobin (COHb). The affinity of haemoglobin for CO is more than 200 times greater than for oxygen. The result is that CO acts as a poison by reducing the amount of O_2 that can combine with hemoglobin.

Table 5-7 Potential Impacts from Dust

TARGET	POTENTIAL IMPACT
Human Health	- asthma
	- nose and throat diseases
	- eyes irritation
	- skin irritation
Environment	- low visibility and haze formation
Infrastructure	- grime deposits
	- metal corrosion
	- material deterioration

Given the lack of detailed information on the project construction schedules, equipment to be used, activity rates and other important parameters; it is generally difficult to estimate the future concentrations of PM_{10} and CO during construction.

The air emissions associated with the construction activities are likely to be of a **Moderate Effect**. This impact is of a **high** likelihood, yet of a medium to short-term duration and reversible nature. Accordingly, with no mitigation measures in place, this activity is likely to have a Moderate impact **(3C)** on the overall air quality within the project area.

It is expected that localized air pollution will occur, and higher levels of pollutants could be noticed close to areas experiencing intensive rates of works. Several mitigation measures can be adopted to reduce air quality impacts from construction activities:

- Sprinkle with water all active construction areas at least twice daily.
- Cover all trucks hauling soil, sand, and other loose materials, and maintain at least 60 cm of freeboard.
- Pave, to the extent possible, unpaved access roads, parking areas, and staging areas at construction sites.
- Sweep daily (with water sweepers) all paved access roads, parking areas, and staging areas at construction sites and sweep streets daily (with water sweepers) if visible soil material is deposited onto the adjacent roads.
- Hydroseed or apply non-toxic soil stabilizers to inactive construction areas (i.e., previously graded areas that are inactive for ten days or more).
- Enclose, cover, sprinkle with water twice daily, or apply non-toxic soil binders to exposed stockpiles (dirt, sand, etc.).
- Limit traffic speeds on any unpaved roads to 30 km/h.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.
- Limit the area subject to excavation, grading and other construction activity at any one time.
- Suspend construction activities that cause visible dust plumes to extend beyond the construction site.
- Install Diesel Particulate Filters on Construction Equipment
- Continual usage of properly designed, maintained and operated equipment/vehicles by the contractor, such as proper engine fuel mixtures, regularly serviced exhaust emission systems and proper engine tuning.
- Avoid idling vehicles and equipment engines that are left running unnecessarily;
- Maintain and report monthly fuel consumption records;
- Purchase diesel fuel with low sulfur content (5% per weight sulfur content) by the contractor whenever available, in order to reduce excessive emissions of sulfur dioxides.

Implementing the above mentioned mitigation measures is likely to reduce the emissions of particulate matter (PM_{10}), NO_x, SO_x, and CO. It can consequently minimize the effect of exhaust and combustion emissions during site preparation and construction to **Negligible (1C)** on the overall air quality within the project area.

5.3.2 Impact from STP Air and Odor Emissions

The operation of the proposed STP would potentially result in the increase of emission of toxic air contaminants. A list of typically regulated air contaminants can be found in **Table** 5-8.

Table 5-8 Toxic Air Contaminants of Concern (Source AES, 2006)

TOXIC AIR CONTAMINANTS OF CONCERN	
Benzene	Perchloroethylene
Chlorine	Trichloroethylene
Chloroform	Xylenes
Dichlorobenzene	Hydrogen Sulfide
Methylene chloride	

Odors emitted by the wastewater treatment works may cause potential nuisance to the public. Inlet works, grit channels, screening and grit handling, aeration tanks, and sludge holding and drying units are the main sources of odor at a wastewater treatment facility. The main malodorous substances are summarized in **Table** 5-9.

Table 5-9 Summary Of The Main Malodorous Substances

SUBSTANCE	ODOR
Hydrogen sulfide (H_2S)	Rotten eggs
Ammonia NH_3	Sharp pungent
Indoles; Skatoles	Faecal nauseating
Mercaptanes	Unpleasant, decaying garbage, skunk-like
Amines	Putrid, fishy
Cl_2	Pungent suffocating
O_3	Irritating when > 2mg/l

While selecting the location for the STP, the proponent has taken into consideration the distance from the nearest receptors and the wind direction (downwind to receptors) to minimize the effect of odor emissions. It is recommended to adopt an odor control system inside the STP to minimize odor emissions at the main sources, to minimize the impact on occupational Health,.

By adopting the above mentioned measures, the consequence and the impact from air and odor emissions is likely to be **minor (2A).**

5.3.3 Impact from Vehicular Traffic Air Emissions during Operation

During operation, vehicular traffic will be generated by the project. Automobile exhausts typically account for the majority of the CO emissions. CO is a non-reactive air pollutant that dissipates relatively quickly, so ambient CO concentrations generally follows the spatial and temporal distributions of vehicular traffic.
Currently there is not sufficient information on expected traffic volumes to evaluate air quality impacts from traffic. Based on experience with other similar projects, it is however unlikely that impacts will be significant. The scope of work for the EIA did not account for air quality simulation studies and only professional judgment can be used at this stage.

The consequence of air quality emissions from vehicular traffic during operation is likely to be minor with a high likelihood to occur. The impact is of **minor effect (2C)**.

5.4 IMPACT ON SOIL, GEOLOGY AND LANDSCAPE

The main impacts on the soil, geology and landscape generated by the neighborhood housing project include:

- Physical disturbance of the soil during site leveling and excavation activities;
- Soil contamination associated with waste generation/management during construction;
- Soil contamination from STP;
- Reuse of treated wastewater for irrigation.

5.4.1 Impacts from Physical Disturbance of the Soil

The impacts on soil include physical compaction, erosion, and reduction in productivity and loss of permeability and flow irrigation.
Excavation works would result in direct disturbance of soil including localized alteration of the soil profile within the excavation footprint, soil compaction in the immediate vicinity as a result of vehicle and construction equipment operations.

However since the excavated soil will be reused for leveling/ land re-fills, it will significantly reduce the soil transportation trips and impacts of soil dumping outside the project area.

Consequently, the likelihood of the occurrence of the impact of preparation activities on soil is **High** with **a Moderate Effect (3C).**

Mitigation measures to reduce the effect of physical soil disturbance include:

- Stockpiling the topsoil removed during the excavation works, and using it as cover material when possible.
- Determining the location of the topsoil stockpiles before starting the construction activities.
- Planning vehicle routing to favor shortest possible routes when feasible.
- Adopting minimum safe operating width and using existing tracks whenever possible to minimize impacted area size.
- Planning and marking access routes.
- Upon completion, reuse of excavated soil for site restoration to avoid physical and chemical disturbance of the soil.

This impact can be reduced to a **Minor** effect of **Low** occurrence **(2A)** when the above mitigation measures are implemented.

5.4.2 Impacts from Solid Waste and Liquid Waste Generation during Construction

Soil quality may also be impacted during the construction phase by littering (wood and metal debris, concrete blocks, empty cement bags, empty paint containers and canisters, plastics from extension of electricity cables) that can be avoided by proper housekeeping and behavioral practices.

Soil pollution may also occur by intentional or accidental leakage of used chemicals, fuel, or oil products (from equipment and vehicles) on construction sites. Such practices should be strictly avoided and the utmost precautions and workmanship performance should be adopted for the disposal of such hazardous products.

Potential soil contamination may also be associated with waste handling and disposal practices during the course of the construction works.

The development area is mainly covered by sedimentary carbonate rocks which are characterized by a high absorption and infiltration rate. Therefore, leaching pollutants will adsorb readily to the soil. Waste spillages might either be entrapped within the surface soil cover, or penetrate to the subsurface formations, with a decreasing viscosity and surface tension.

Unmitigated impacts on soils associated with waste disposal are highly likely to occur when no precautionary or control measures are in place. Moreover, these impacts could potentially be of **Significant** effect (**4C**).

In general, for the waste management practices, Al Reehan shall ensure that:

- The loads of all waste streams will be recorded and reported monthly by the subcontractor on an environmental sheet as per the subcontractor environmental policy.
- The subcontractor shall supervise the transportation of waste from site to disposal facility.
- Dump trucks will not be fully filled to avoid waste loss during transportation.
- Quantity of waste is reduced at the source by applying waste reduction measures such as purchasing restrictions to ensure the selection of supplies that generate less waste.
- Waste is reused to the maximum extent possible.
- Waste mixing is avoided and waste segregation is adopted to facilitate recycling, reuse and disposal, and to prevent interaction among various types of waste as follows:
  - ✓ inert (cleaned soil)
  - ✓ organic (food remnants),
  - ✓ non hazardous (metal, glass, concrete, plastic etc…), and
  - ✓ hazardous (Paints, solvents, oils, batteries, medical waste)
- All personnel shall be responsible for ensuring that standards of "good housekeeping" are maintained. This will include clearance of all rubbish and work associated debris;
- On site, domestic and general waste shall be segregated into combustible (paper, food, cardboard, and wood) and non-combustible waste (metals, glass, rubble) streams using suitably labeled containers for safe collection, segregation and handling of all waste streams generated.
- Al Reehan could envisage transporting only the combustible material to the local landfill. Material suitable for recycling such as combustible or non combustible material such as scrap material identified upon solid waste segregation shall be transported to licensed facilities.
- Non-combustible wastes which are not suitable for recycling (and not hazardous, such as rubble, etc.) shall be collected by a licensed service provider for disposal in a licensed landfill;
- Hazardous waste such as waste oil, solvents, used batteries and medical waste will be sent for recycling or disposal through a licensed service provider.
- Medical waste will be handled as per Palestinian guidelines for health care waste management.
- No untreated sanitary wastes or wastewaters will be discharged to the land.
- Mixed wastewater shall be stored in holding tanks and the sewage shall be transported out whenever the tanks are filled to avoid wastewater overflow.

With the appropriate controls and mitigation measures listed above, the likelihood of these impacts will be reduced to **Moderate**, and the effect to **Minor (2B).**

Materials and equipment used on site will generate packaging and container wastes. Introduction of these wastes into the environment will not be permitted. If left over it will deteriorate the visual scenery. The volume of construction site wastes generated will be dependent on the Contractor's operating procedure and practices and cannot be quantified at this stage.

5.4.3 Impacts from STP Operation

The main concern during operation of the plant is related to soil quality rather than soil quantity, and is primarily attributed to generated sludge management. However, since the sludge generated from the STP will be landfilled and not used as soil amendment for agriculture, it would not cause direct damage to soil fertility in the case of mismanagement.

The likelihood of the occurrence of soil contamination from Sludge generation is **low** and the effect of the impact is considered **Minor (2A)**

5.4.4 Impact of Reuse of Treated Wastewater for Irrigation on Soil Quality

The impacts of treated wastewater on soil quality are:

- Increase in soil salinity
- Reduction of the soil ability to absorb and retain water due to increased sodium adsorption ratio
- Increase in soil alkalinity due to the presence of sodium, potassium and calcium salts

However, since the STP shall be designed to meet Palestinian standards for re-use in irrigation, impacts on soil quality will be negligible with low likelihood to occur (**1A**).

This requires however continuous monitoring of treated wastewater quality as well as the provision of storage capacity in case of plant upset to avoid discharging insufficiently treated wastewater directly into the environment.

5.5 WATER RESOURCES IMPACT

The identified sources of potential impact on groundwater in the project include:

- Wastewater discharge and reuse in irrigation
- Accidental oil and fuel spills during the construction phase of the project.
- Water consumption during construction

5.5.1 Impacts from Wastewater Discharge and Reuse in Irrigation

During operation, the main activities that could possibly affect water resources are the effluent management practices. Proper management of both the treated wastewater and the generated sludge is essential.

The tertiary treated effluent is expected to, at a minimum; meet the Maximum allowable limits for wastewater discharge into land as for Irrigation of landscaped area.

The likelihood of these impacts to occur is considered to be medium with Impact effect to be **negligible (1B)** given that standards are met.

5.5.2 Impacts from Accidental Spills during Construction

No major on-site impacts on water resources are anticipated during the construction phase. Care should be exercised when handling fuel and oil (hydraulic, transmission, engine, etc.) to power and maintain the different machinery and equipment on site. Measures should be taken to avoid spillage of such material to the ground, as these contaminants would eventually leach and contaminate the groundwater and are persistent in the environment.

Unmitigated impacts on soils associated with fuel and oil spills have a Moderate likelihood of occurrence especially when no precautionary or control measures are in place. Impacts from such spills on soil quality are considered of **Significant** Effect (**4B**).

Source specific mitigation measures include:

- Storage: Fuel, oil and chemicals shall be stored in specific designed areas on site particularly on an impermeable base within a suitability contained area.

All storage tanks will be positioned to minimize the risks of damage by impact; All storage tanks will be of sufficient strength and structural integrity; No storage tank will be used for the storage of fuel, oil or chemicals unless its material and construction are compatible with the type of materials to be stored and storage conditions (e.g. pressure and temperature); Drip trays will be installed underneath equipment such as diesel generators, transformers to contain leakage. The drip trays will be maintained and kept drained of rainwater;

All fuel and oil will be inventoried and use recorded.

- Refueling: Procedures for refueling include control and supervision of refueling at all times appropriate personnel, checks to fill valves, hoses and nozzles for signs of wear and tear prior to operation and checks to tank levels prior to delivery to prevent overfilling through side glass or manually by dipstick logs.

Additional measures include locating fill pipes within the containment (unless shut-off valves are fitted); grounding of tanks and vehicles during fuel transfers; ensuring the availability of a supply of suitable absorbent materials at re-fuelling points for use in dealing with minor spills. If a leak or spill occurs during loading or offloading operations, the operations will be stopped and the spill will be contained and cleaned up.

- Chemicals: Personnel handling chemicals will be trained in their handling and use and aware of the associated hazards including the personnel protective equipment requirements through pre-task instruction;

Material Safety Data Sheets (MSDS) for all concerned chemicals will be available at the storage area, the point of use and by the site medical staff and site safety officer; Safety signage will be in place;

All chemical deliveries (loading and unloading operations) shall be supervised at all times and transferred to a secure storage area without delay;

Storage of chemicals will be sited on designated areas at the site; an inventory of all chemicals on site will be kept and use will be recorded. Chemicals shall be properly packaged, labeled and stored; Dangerous/hazard chemicals shall be stored separately;

Chemical storage drums will be in good condition and with sealed bungs. All used drums will be washed down with water and pierced before leaving the site to prevent local use and subsequent exposure to contaminants if they are not able to be returned to the original supplier.

All tanks and containers will be clearly labeled with the nature of the contents and placarded with the MSDS. The storage of chemical products in containers or on palettes equipped with plastic dust cover against severe weather. Chemicals that require shade shall be shaded. Chemical storage drums and packaging are to be returned to the original supplier in an orderly fashion, i.e. palletized and shrink wrapped.

- Diesel: In the field, diesel will be stored in sealed tanks in bunded areas. The bunds should be designed to contain one and half times the total diesel tank volume so as to minimize the impacts from possible tank rupture. Containment procedure shall be provided to contain any oil spill during fuel transfers to road tankers.

Refueling procedure shall be developed to include:

- Refueling on **hard standing** or **compacted/lined** soils;
- Supervision of refueling at all times by appropriate personnel;
- Checking fill hoses, valves and nozzles for signs of wear and tear prior to operation; and
- Checking tank levels through side glass or manually by means of dipstick logs prior to delivery as to prevent overfilling.

With the above mitigation measures and contingency plan in place, the potential leaks and spills associated with normal project activities and accidental incidents are expected to have a **Low** likelihood and **Minor** effect (**2A**).

5.5.3 Impacts from Water Consumption during Construction

Water will be required during the construction phase. Quantities of water required for construction are low and impacts are considered to be small. The required water will be sourced from Lower aquifers in Ramallah district.

The impacts of the project during construction on the water resources of the area are in general short-termed and reversible and of a moderate likelihood of occurrence. The effect of the impact, due to the capacities and usage of the underlying aquifers, is considered **Negligible** (**1B**).

Although the construction activities will have a negligible impact on local water resources, the highest possible efficiency of water use shall be ensured by 1) encouraging water conservation measures by employees and 2) by reusing water whenever possible e.g. use of wash water to damp down unsealed roads and reduce airborne dust generation.

5.6 IMPACT ON BIODIVERSITY

The main sources of potential impact on biodiversity in the project include:

- Impacts from construction phase
- Impacts from landscaped area
- Impacts from reuse of treated wastewater on plants

5.6.1 Impacts from Construction Phase

Palestine is characterized by a rich variety of flora within a small land area. Cypresses, flowers, bushes are the main flora types that exist in mountainous area and found in Al Reehan Neighborhood project area. The removal of the vegetation cover will increase surface run-off and sheet flow after heavy rain. Furthermore, the development of the Al Reehan area is likely to result in the loss of all species from the area, especially if the ground is leveled prior to development. This effectively removes the habitat for all species.

Potential negative impacts affecting biodiversity during project construction are summarized in **Table 5-10.**

Table 5-10 Potential Negative Impacts on Biodiversity

IMPACT	CAUSE
Habitat loss or destruction	Construction works
Altered abiotic/site factors	Soil compaction, erosion
Mortality of individuals	Destruction of vegetation
Loss of individuals through emigration	Following disturbance or loss of habitat
Habitat fragmentation	Habitat removal and/or introduction of barriers like roads
Disturbance	Due to construction noise, traffic, or presence of people
Altered species composition	Changes in abiotic conditions, habitats…
Vegetation loss	Soil contamination due to disposal of oils and hazardous material

The main construction activities having negative results on the biodiversity are earth-moving activities, construction waste material and effluent discharges.

Impact effects from uncontrolled physical disturbance on terrestrial habitats could have **medium** and long-term impact on the natural vegetation in the area. The likelihood of occurrence of the impact is **moderate (3B)**.

However, the following mitigation measures have been taken in order to reduce the impact on biodiversity:

- Translocation of the wildlife from the project site to a nearby conservation authority, if applicable
- The project includes an ecosystem rehabilitation plan through landscaping a large area which will improve vegetative cover and add to airshed purification functions.

With the proposed mitigation measures in place, the impact on biodiversity is minimized even leading to positive impacts on the landscaping level (**1A**).

5.6.2 Impact from Landscaped Area

It is planned to retain as much as of the existing vegetation (such as cypresses trees) as possible to maintain the natural character of the project area. Different and divert kinds of plant species have been chosen in the landscaping design of Al Reehan for their ecological compatibility which will have a positive impact on the air quality, noise reduction, visual amenity, public health improvement and land use.

Thus the overall impact is positive, of high occurrence and long term nature beneficial **(6C).**

5.6.3 Impact of Reuse of Treated Wastewater on Plants

Use of treated wastewater irrigation can be beneficial to plants because the effluent contains nutrients that enhance plant growth such as nitrogen and phosphorus. However, the water also contains sodium, chloride and peroxide which are harmful to plant growth. High sodium levels can cause discoloration and burning of leaves, increase soil alkalinity, prevent calcium from reaching the plants, and disturb the soil ability to absorb water. High Sodium Adsorption Ratio might result in soil with reduced permeability and aeration and degradation of the soil structure. Therefore accumulation of sodium from treated wastewater might reduce the soil's ability to support plants on the long term.

As a result, the impact from wastewater reuse on plant health and growth is **high moderate 3C**.

The following mitigation measures can be used to reduce this impact:

- Plants should be monitored regularly for symptoms of damage.
- Water quality and nutrients used for irrigation should be monitored and applied at a rate to meet the demand of the plant. Higher rates of water might cause surface runoff and/or groundwater contamination.

- If signs of plant damage appear, the use of treated wastewater for irrigation must be interrupted or diminished.
- Direct application of the treated water to the foliage must be discouraged.
- Treated wastewater should not be used for the irrigation of seedlings and young plants because they are more sensitive to the impurities than well-established plants.

By following the mentioned mitigation measures, impact of treated wastewater on plant health and growth will be reduced to low minor, **2A**.

5.7 IMPACTS FROM NOISE GENERATION

The primary sources of noise impacts arise from the following project activities:

- Construction phase
- STP operation

5.7.1 Noise Generation during Construction

The main sources of noise associated with the transportation activities include the delivery of raw material. Typical noise levels associated with trucks are reported at 74 dB (A) according to the British Standard for Noise and Vibration Control on Construction and Operation Sites (BS5228:1997). These levels are normal in general construction sites (that can go up to 85-90 dB (A)).

Noise will also be generated by the equipment associated with the construction activities mainly site leveling and excavation. The impacts are also temporary in nature. Typical sound level pressures recorded from various equipments at a construction site are illustrated in **Table 5-11** for indicative purposes.

Most construction phases would generate average noise levels that would be about 10 to 19 dBA Leq (h) higher than ambient daytime or nighttime traffic noise when these activities occurred within about 20 meters of an adjacent land use. Pile driving activities would generate average noise levels approximately 26-29 dBA higher than ambient daytime or nighttime noise conditions. Maximum instantaneous noise levels generated by construction would typically be 5 to 10 dBA above existing maximum noise levels generated by traffic with the exception of construction phases including the use of a hoe ram or impact pile driver when maximum instantaneous noise levels could exceed existing conditions by 20 to 25 dBA.

Table 5-11 Typical Sound Pressure Levels Reported from Construction Equipment (BS5228:1997)

CONSTRUCTION TYPE	MACHINES	NOISE LEVEL (DBA)*
Earth Moving	Compactors	78
	Front Loaders / Bull Dozers	88
	Backhoes	76
	Tractors	71

	Scrapers	82
	Caterpillar Graders	84
	Pavers	74
	Dump Trucks	74
	Excavators	78
Material Handling	Concrete Mixer	76
	Concrete Pumps	81
	Cranes	81
Stationary	Pumps	82
	Generators	82
	Compressors	85

With the short duration of the construction period the impacts during the construction phase are anticipated to be **moderate** of highly likelihood to occur (**3C**).

To reduce the potential for noise impacts resulting from project construction, the following measures should be implemented during project construction. The proposed measures should adequately mitigate the noise impact to a less-than significant level to receptors, particularly workers:

- Equip all internal combustion engine driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment.
- Unnecessary idling of internal combustion engines within 35 meters of residences should be strictly prohibited.
- Avoid staging of construction equipment within 60 meters of residences and locate all stationary noise-generating construction equipment, such as air compressors and portable power generators, as far practical from noise sensitive receptors.
- All construction equipment should be required to conform to any applicable sound control requirements of the project specifications.
- Avoid nighttime construction work within 150 meters of sensitive land uses where feasible.
- Demolition and pile driving activities should be limited to daytime hours only. If nighttime, impulsive work is required, implement a construction noise monitoring program and provide additional mitigation as necessary (in the form of noise control blankets or other temporary noise barriers, etc.) for affected receivers.

With the above mitigation measures in place, noise impacts generated during construction will be reduced to **minor** with medium likelihood to occur **(2B).**

5.7.2 Noise Impacts from STP Operation

Noise is expected during the operation phases of the STP with sources of noise generated from the operation of plant machinery such as pumps, generators and sludge thickening rooms. **Table** 5-12 presents noise levels measured with a sound level meter in areas that are common to STP's. This table however is not inclusive of all areas in STP's that may have potentially hazardous noise levels but it shall serve as a guide for pinpointing areas that may have potentially hazardous noise levels.

Table 5-12 Estimated Noise levels at STP (29 CFR 1910.95)

AREA	DB(A)
Generator Rooms	77-91
Pump Rooms	77-100
Vacuum Pump Trucks	74-92
Sludge Thickening Rooms	63-98

In addition to auditory problems, health impacts associated with exposure to noise include non-auditory repercussions such as fatigue, stress, emotional disturbances, vertigo, and vasoconstriction of the blood vessels in the extremities. **Table** 5-13 presents the permissible durations to certain noise levels. If administrative or engineering controls do not reduce levels below those presented in the table below, hearing protection must be provided to employees by the employer.

Table 5-13 Permissible Occupational Exposure Levels (29 CFR 1910.95)

DURATION (HOURS)	DB(A)
8	90
6	92
4	95
2	100
1	105
0.5	110
0.25	115

With noise control ancillary equipment implemented to air blowers (main concern for noise), impacts from noise generation will be reduced to **Minor** with a **Low** likelihood of occurrence **(2A)**.

5.8 WASTE GENERATION

The identified sources of solid waste generation in the project are:

- Construction phase works
- Households, commercial and hospital

5.8.1 Waste Generation during Construction

This has been covered in section 5.4.2.

5.8.2 Waste Generation from Households, Medical, Commercial and Retails

Concerning Al Reehan project, the main sources of solid waste generation are:

- Plastic bottles, tin cans, glass bottles from the kitchen, bar and restaurant
- Paper bags, plastic bags or polyethylene bags from office and house cleaning
- Green waste from gardening and landscaping
- Organic waste from kitchen and restaurant
- Scrap metal and wooden boxes from stores
- Sludge from the STP
- Hazardous medical waste from the hospital

To minimize the impacts, Al Reehan should develop a Waste Management Plan and implement it as part of the Environmental Management Plan to control the production and disposal of all wastes. It is highly recommended that AL Reehan advocates using the principle of the "5Rs" subject to local environmental regulations and availability of resources to handle waste. These "5Rs" are as follows:

- **Reduce**- Generation of less waste in their original form
- **Reuse-** Reuse of materials in their original form
- **Recycle**- Conversion of waste back into a usable material
- **Recover-** Extraction of materials or energy from a waste for other uses
- **Residue-** Implementation of a waste disposal method (landfilling, incineration, etc.) for the unavoidable waste residue. (In case of landfilling, the landfill should be licensed).

It is also highly recommended to promote sorting at the source practices among residents.

Hazardous waste generated from the Hospital should be handled with care to avoid contamination and autoclaved.

Another potential source of solid waste that might end up in the environment comes from littering and windblown waste from inadequate waste containers in the parking lot. Proper sealed waste containers and litter bins should be allocated along the entire project. "No littering" signage should be installed along the entire project site.

With a waste management plan in place, the impact from solid waste generation is considered as minor with a **medium** likelihood to occur (**2B**).

5.9 SOCIO-ECONOMIC IMPACT

5.9.1 Impact on Traffic Congestion

The main sources of impact on traffic congestion are:

- The transportation of raw material and waste during construction phase
- Vehicular traffic

5.9.1.1 Impact from raw material and waste transportation during construction phase

Traffic impacts during construction phase will be of temporary nature and not considered to be significant. However appropriate measures should be taken to reduce traffic impacts including proper schedule of activities and control of timing of materials transportation avoiding traffic times to the extent possible.

5.9.1.2 Impact from vehicular traffic

Traffic inside the project is likely to be impacted by the presence of the schools, hospitals and will receive visitors from inside and outside the Al Reehan Project boundaries.

Measures were already taken in the Master Plan to insure proper traffic circulation, larger roads and proper parking facilities. This is likely to maintain a **minor** impact on traffic generation **2A**.

5.9.2 Impact on Land Use and Visual Amenity

The existing undeveloped land will be transformed into a beautiful landmark providing a complete range of residential, commercial, archaeological and community facilities (Mosques playgrounds, schools parks).

Thus the impact resulting from this development project is of high likelihood, long term duration, **beneficial** (**6C**).

5.9.3 Creation of New Job Opportunities

Employment opportunities are created during all project phases (site preparation and Construction phase, STP operation, community facilities).

Thus the project is considered as **highly beneficial** on the short and long term levels (**6C**).

5.10 POTENTIAL IMPACT ON ARCHAEOLOGY

Other than the archaeology site located in the development area, no surface archeological findings was identified. Nevertheless, the risk of finding buried artefacts during excavation and land clearance activities is still possible, given the importance of the Study Area.

Impacts from excavation works could potentially affect archaeological receptors (if any) due to direct physical damage. Therefore, during excavation any finding that is suspected to be archaeologically

important should be reported by the Contractor to Al Reehan who shall in his turn reported to the Department of Antiquities.

Accordingly, with no mitigation measures in place, the likelihood of an impact on archeology is **Low**. The effect of this impact is considered to be **minor (2A).**

5.11 OCCUPATIONAL HEALTH AND SAFETY IMPACT

The main sources of impact on occupational health and safety are:

- The site preparation and construction phase
- The STP

5.11.1 Impact from Site Preparation and Construction Phase

Working on the Project in a mountain and undeveloped environment entails several health and safety risk factors that need to be addressed ahead of the influx of the construction workers. The main sources of safety and health risk impacts include physical injuries from fire or hazards, in addition to workers' exposure to dust and noise.

Hazards of nature in the study area are related to the extreme weather conditions; sun light, snakes and wild animals. Improper disposal of solid waste attracts dogs, vermin and rodents. Heat, light and vibration attract snakes and scorpions.

With no mitigation measures in place, the impacts on the occupational health and safety from the construction phase are of short term nature, high likelihood to occur and **significant** effect (**4C**).

In order to avoid adverse impacts on workers' safety and health, the following measures are recommended.

- Long working hours under bad weather conditions should be avoided since they could result in heat stress, burns and exhaustion;
- The sun is a natural hazard, and the use of long trousers, long sleeves, head protection, sunglasses and sunscreen can help alleviate the effects of the sun;
- Daily burning of organic waste or cover it with at least 5 cm of soil each day. When available, use quicklime to accelerate the waste decomposition;
- Prevention is best way to avoid snake bites;
- Crew members should be very cautious during walking (especially at night) and during lifting rocks or clearance of vegetation;
- Identified hazards should be communicated to crew members during the site specific orientation at the start of the job and trained on medical emergency response; and
- Adequate signs should be posted throughout the Study Area, especially at visible locations, indicating type of operation and other information and appropriate medical / emergency action response.

By adopting the above proposed mitigation measures, impacts on occupational health and safety are predicted to become minor with **medium** likelihood to occur **(2B)**.

5.11.2 Impact from STP

During the operational phase of the plant, occupational safety is at a higher risk than public safety since they are exposed to toxic air contaminants, malodorous substances, noise and other safety hazards.

Generally, the likelihood of the occurrence of Air pollution and safety hazards impacts on occupational health and safety is high. The impact is considered of **Moderate effect (3C)** due to its short-term nature.

Fortunately, various mitigation measures can be easily adopted to minimize occupational hazards.

Mitigation measures that can significantly suppress the likelihood of impacts on public and occupational safety include:

- Restricting unattended public access to the STP by proper fencing, gate and guarding
- Use of personal protective equipment (PPE) mainly air masks for STP workers and/or visitors who intend to occasionally be near the odor control units;
- Ensure that the room doors of the influent lifting station, headworks, and sludge dewatering remain closed with a notice warning from high levels of hydrogen sulphide. Workers shall as well wear gas masks prior to entering the room. Properly labeling and storing chemicals (Chlorine gas or powder), oils, and fuel to be used on-sites
- Emphasizing safety education and training for system staff. Enforcing adherence to safety procedures
- Providing appropriate safety equipment, fire protection measures, and monitoring instruments
- Providing hand railing around all open treatment units, except where sidewalls extend ≥1.1 meters above ground level.
- Properly rating electrical installations and equipment and, where applicable, protecting them for use in flammable atmosphere.
- Providing sufficient lighting that should comply with zoning requirements.

As a conclusion, proper supervision, high workmanship performance, and provision of adequate safety measures will alleviate public and occupational risks. Accordingly the effects of this impact would become **minor** with a medium likelihood to occur **(2B)**.

5.12 IMPACT SUMMARY

Table 5-14 summarizes the impacts of the Project on its surrounding environment assuming no mitigation measures are undertaken in an Environmental Impact Severity Matrix (EISM) while,

Table 5-15 presents the EISM of the project when control and mitigation measures are adopted.

Table 5-14 Impact Summary Table with No Mitigation Measures in Place

ACTIVITY / SOURCE OF THE IMPACT	RECEPTOR								SOCIO-ECONOMIC			
	SOIL QUALITY	AIR QUALITY	NOISE & VIBRATION	DUST	GROUNDWATER	FLORA	FAUNA	LAND USE	ARCHAEOLOGY	EMPLOYMENT	VISUAL AMENITY	OCCUPATIONAL HEALTH & SAFETY
Site Preparation- Construction Phase												
Excavation	3C	3C	3C	3C		3B	3B	2C	2A	6C	2B	4C
Earth filling/ Cutting	3C	3C	3C	3C		3B	3B					4C
Equipment operation	3C	3B	3C	3C		3B	1A					4C
Vehicular movement		2C				2A						
Waste generation	4C	4C			4B	3B	3B	4C			4C	2B
Water consumption					1B							
Accidental spills	4B	3B			4B							
STP	2A	2A	3B		3B	2B	2C	2B		6C	3C	3C
Traffic congestion		2A										
Solid waste generation	2B	2B			1A	2A	2B					
Treated wastewater used for irrigation	1A				1B	1A						
Landscaped zone	6C	6C	6C		6C	1B 6C	1B 6C	6C		6C	6C	

Likelihood	Acceptance		Significance
A - Low	1-Negligible	4 - Significant	Beneficial
B - Medium	2- Minor	5 - Catastrophic	Negligible with minor mitigation
C - High	3- Moderate	6 - Beneficial	Minimize Impacts
			Unacceptable

Table 5-15 Impact Summary Table With Mitigation Measures In Place

ACTIVITY / SOURCE OF THE IMPACT	RECEPTORS											
	SOIL QUALITY	AIR QUALITY	NOISE & VIBRATION	DUST	GROUNDWATER	FLORA	FAUNA	LAND USE	ARCHAEOLOGY	SOCIO-ECONOMIC: EMPLOYMENT	SOCIO-ECONOMIC: VISUAL AMENITY	OCCUPATIONAL HEALTH & SAFETY
Site Preparation- Construction Phase												
Excavation	2A	1C	2B	1C	2A	1A	1A	2A	2A	6C	2B	2B
Earth filling/ Cutting	2A	1C	2B	1C	1A	1A	1A					
Equipment operation	2A	1B	2B	1B		1A	1A					
Vehicular movement		2C	2B			1A						
Waste generation	2B	2B			1A	1B	1B	2B			2B	2B
Water consumption					1B							
Accidental spills	2A				2A							
STP	2A	2A	2A		1A	1B	1B	1B		6C	1B	2B
Traffic congestion		2A	2A									
Solid waste generation	2B	2B			2A						2A	
Treated wastewater used for irrigation	1A				1B	2A						
Landscaped zone	6C	6C	6C	6C		1B 6C	1B 6C	6C		6C	6C	

Likelihood	Acceptance		Significance
A - Low	1-Negligible	4 - Significant	Beneficial
B - Medium	2- Minor	5 - Catastrophic	Negligible with minor mitigation
C - High	3- Moderate	6 - Beneficial	Minimize Impacts
			Unacceptable

6 ANALYSIS OF ALTERNATIVES

This section consists of a comparative evaluation of the proposed project with alternatives to the project, including the No Action Alternative.

Three alternatives to the development have been identified - these are:

- The No Action Alternative
- The Proposed Development
- The Proposed Development with modifications (modified project location)

- No Action Alternative

The "No Action" Alternative would see the discontinuation of the project plans and designs, by other means, the project area would not be subject to any type of development and the site retained in its existing form.

The No Action alternative would result in no additional environmental impacts compared to the proposed project. This alternative would not increase potential impacts associated with soil, water quality, biodiversity, traffic and circulation, air quality, noise, aesthetics and national utilities.

However if this alternative would be adopted, it will likely have the greatest implications on the socioeconomic environment. This action would result in the loss of a major direct and indirect employment generating activity and foreign exchange revenue; benefits associated with the construction industry and potentially significant business opportunities for existing and new tourism support businesses. In addition, the site is likely to undergo erosion, which may be a possibility due to natural effects that are already taking place at the site.

- The Proposed Development

This alternative would see the construction of the development project as proposed by the developers. It would provide positive benefits such as employment during construction and operation. Additionally, the multiplier effect of this type of development would result in noticeable economic benefits for the the region. The proposed project will also make a positive contribution to social infrastructure, overall residential development, upkeep and renewal of the residential community while maintaining natural environment in as many areas as possible.

- The proposed development with modifications

No other locations could be considered in conjunction with the proposed location for implementation of this project since the present property offers many advantages over any other potential locations to be considered, including land size, view, geographical position, infrastructure and permits.

A feasibility study for the Sewage Treatment Plant (STP) has been prepared by Al Reehan Real Estate Investment Company, studying alternatives to the proposed STP site location in addition to alternatives to the proposed technology.

Several alternatives to the Sewage treatment Plant location have been considered:

- Location 1: On the Mountain southwest to the Reehan Development project (X= 165,600; Y= 148,900)
- Location 2: On the mountain south of the Reehan Development Project (X= 165,950; Y=148,875)
- Location 3: Also on the mountain south of the Reehan Development Project (X= 165,800; Y=148,800)
- Location 4: Near the first proposed location for the regional STP in the waqf land (X= 165,200; Y=148,800)

Based on the following criteria analysis, location 4 was selected as the optimal location.

1. Vulnerability of the site to pollution from wastewater;
2. Availability of the required land for the desired type of STP and for future expansion;
3. Accessibility to the site by vehicles using the nearby roads;
4. Topography of the site to minimize the quantity of excavation;
5. Cost of land acquisition;
6. Availability of electric power and water resources;
7. Distance between the STP and the nearest buildings;
8. Wind direction in relation to the STP site and the Development project;
9. Possibility of re-use of treated effluent or the safe disposal;
10. The site being in area(B) or area(C) according to Oslo agreement; and
11. Future expansion of the housing development project and establishment of new nearby housing projects.

Additionally, the following alternatives to the proposed technology had been also considered by the proponent:

- Alternative 1: Extended Aeration (EA)
- Alternative 2: Up-flow Anaerobic Sludge Blanket Reactor (UASB) combined with Trickling Filters (TF)
- Alternative 3: UASB combined with Rotating Biological Contactors

Alternative 1 was selected to be the optimal treatment technology being the most compact, the cheapest, least possibility for odor emissions and its effluent quality compliant with the Palestinian standards for re-use for restricted irrigation purposes.

- Secondary Treatment Alternative

This alternative if adopted would decrease the investment and operation cost, however the quality of treated wastewater generated from the plant would not comply with the standards adopted for the safe re-use for irrigation purposes and thus the treated effluent could only be disposed of into surface water.

- The Proposed Sewage Treatment Technology Alternative

This alternative if adopted will reduce the environmental impacts induced from the disposal of wastewater into the environment and the quality of the effluent would comply with the standards adopted for the re-

use for irrigation purposes which would relieve the pressure on water resources and would be considered as an alternative for the irrigation of the landscaped area inside the development project. The resulting sludge could also be used as a soil conditioner or even landfilled.

7 ENVIRONMENTAL MANAGEMENT PLAN AND MITIGATION

7.1 INTRODUCTION

This section presents the Environmental Management Plan (EMP) for Al Reehan Neighborhood project. This EMP will address the main impacts that were identified in the Impact Assessment, in particular:

- Mitigation measures to be implemented during the project's construction and operational phases;
- Waste stream management and disposal methods;
- Accidents and spill control;
- References to control guidelines and standards;
- Responsibilities for the implementation of the plan;
- Verification, monitoring and training requirements; and
- Reporting requirements.

The overall objectives of the EMP are to ensure Project compliance with Palestine legislation and international standards; to provide the client along with the relevant subcontractors with guidelines to undertake the appropriate monitoring activities and compliance inspection programs; as well as assist Al Reehan in the implementation of mitigation and monitoring plans. It may be subject to updates and modifications throughout the Project lifetime.

7.2 ENVIRONMENTAL MANAGEMENT STRUCTURE

Roles and responsibilities of the different project entities are proposed in

Table 7-1. Both the contractors and operators of the project should have an HSE manager at a minimum and additional environmental officers as needed. All staff in the project should be trained and induced to understand the requirements of the EMP.

Table 7-1 Roles and Responsibilities in EMP Implementation

ROLE	ENVIRONMENTAL RESPONSIBILITIES
Owner Representative (OR)	• Responsible to enforce EMP implementation to contractors
HSE Manager	• Implement, review and update the EMP. • Ensure all reporting and monitoring required under EMP is undertaken, documented and distributed as needed • Conduct environmental site training (tool box talks) and inductions with the support of an environmental consultant. • Conducts environmental audit at work site with the support of environmental consultant. • Close out all non-conformances. • Ensure materials being used on site are environmental friendly and safe.
The Enviornmental Authority	• Approve the EMP and any amendments to the EMP. • Approve reports of environmental issues and non-conformances as issued. • Review and approve environmental reports submitted as part of EMP implementation
Environmental consultant	• Conduct and monitor actions required by the EMP if required • Conduct environmental site training (tool box talks) and inductions if assistance is required • Conducts environmental audit at work site • Ensure materials being used on site are environmental friendly and safe.
Site Engineers	• Control and monitor actions required by the EMP. • Report all environmental issues to HSE Manager. • Ensure documented procedures are followed and records kept on site. • Ensure any complaints are passed onto the management within 24 hours of receiving the complaint.
Workers	• Follow requirements as directed by site engineers. • Report any potential environmental issues to site engineer/project manager, indicating spilt oil, excess waste, excessive dust generation, dirty water running off the site and other possible non-conformances

7.3 ENVIRONMENTAL MITIGATION PLAN

Mitigation measures for the negative impacts identified in the impact analysis are summarized in this section. These are based on information that is reported in the existing literature for similar case studies, and on area specific features.

The mitigation plan is based on a source and sensitivities approach, allowing the identification and proposition of protective measures for tackling the problems facing each.

Table 7-2 Project Environmental Mitigation Plan

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
Site preparation	Land Utilization	▪ All equipment should be located within the premises of the project only.	Contractors
	Construction Visual Impairment	▪ The site will be fenced from general view and all parts of the site will be kept in good order, with excess equipment and materials expeditiously removed.	Contractors
	Access	▪ Working access to the site will be agreed with the relevant authorities. Warning signs will be posted along the adjacent road and lighting will be provided during the hours of darkness.	Contractors
Construction	Soil erosion, loss of natural	▪ Provide drainage pattern with the present drainage.	Contractors
	Earthworks	▪ Excavation will be undertaken expeditiously, with surplus spoil removed as it is produced. ▪ Deep excavations should be properly guarded with reflective barriers and warning tapes and illuminated at night. Shallow excavation must be also covered at night.	Contractors
	Archaeology	▪ Any finding that is suspected to be archaeologically important will be reported by the Contractor to Al Reehan representatives whom in their turn will report it to the Department of Antiquities.	
	Wastewater Disposal	▪ Generated Wastewater will be collected and sent to Ramallah and Al Bireh Collection system. Proper final disposal will take place.	Contractors
	Dust emissions	▪ Sprinkling water over dusty ground surfaces ▪ Work zone and truck moving area shall be protected by a series of water sprays to prevent the escape of air blown dust ▪ Maintaining stockpiles at minimum heights and forming long-term stockpiles into the optimum shape to reduce wind erosion ▪ Protect stockpile from wind using retaining walls, windbreak fences or an upwind mound ▪ Maintaining handling areas in a dust free state as far as practicable ▪ Establishing and enforcing appropriate speed limits over all unpaved surfaces ▪ Traveling on existing and paved tracks wherever possible	Contractors

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
Construction	Solid Waste Disposal	▪ The loads of all waste streams will be recorded and reported monthly by the subcontractor on an environmental sheet as per the subcontractor environmental policy. ▪ The subcontractor shall supervise the transportation of waste from site to disposal facility. ▪ Dump trucks will not be fully filled to avoid waste loss during transportation. ▪ Quantity of waste is reduced at the source by applying waste reduction measures such as purchasing restrictions to ensure the selection of supplies that generate less waste. ▪ Ensure waste reuse to the maximum extent ▪ Avoid waste mixing and adopt waste segregation to facilitate recycling, reuse and disposal ▪ All personnel shall be responsible for ensuring that standards of "good housekeeping" are maintained. This will include clearance of all rubbish and work associated debris ▪ Hazardous waste such as waste oil, solvents, used batteries and medical waste will be sent for recycling or disposal at a licensed facility wherever possible. Licensed service providers shall be hired. In case there is no immediate disposal solution for hazardous waste streams, Al Reehan will ensure appropriate and safe storage while studying and sourcing appropriate disposal routes. ▪ All extra earth material from excavations and land leveling should be transported and dumped in the designated areas as per the Palestine's guidelines	Contractors
	Reduction/Loss of Fauna and Flora	▪ Relocation of native fauna, if applicable	Contractors
	Loss of the natural view and flora	▪ The project includes an ecosystem rehabilitation plan through landscaping a large area which will improve vegetative cover and add to airshed purification functions. Different and divert kinds of plant species have been chosen in the landscaping design of Al Reehan for their ecological compatibility	Contractors
	Noise	▪ Enforcement of Preventive maintenance for all machinery & equipments ▪ Timely check /maintenance of all moving machinery parts ▪ Construction of effective barriers like masonry walls.	Contractor

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
	Construction and raw material	▪ The contractor shall use environmental friendly products and raw material whenever applicable this includes, but not restricted to: o Water-based paints free from heavy metals. o Avoid use of PVC (Polyvinylchlorides) o Install double glaze windows for better heat insulation o Use environment friendly heat isolation material	Contractor
	Traffic movement	▪ Enforcement of safe driving practices & regularizing the heavy vehicles / truck timings	Contractor
Construction	Public Health and Safety	▪ Adequate provision will be made for preventing unauthorized access to all parts of the site. Adequate watching and lighting will be provided during the hours of darkness. Internal traffic will be managed carefully to avoid any accidents.	Contractor
	Workmen's' Health and Safety	▪ Al Reehan will take all necessary measures to protect his workmen from injury. Adequate First Aid and domestic facilities will be provided.	Contractor
	Spills & Leakage	▪ Leakage of hydrocarbons, chemicals and similar polluting substances shall be considered an emergency and dealt with accordingly. Should the Supervision Engineer consider that substantial quantities of construction chemicals or other substances may have reached the groundwater; the Contractor shall immediately inform the relevant authorities and implement appropriate methods of cleaning and recovery. ▪ Keep appropriate firefighting equipments / extinguishers to arrest oil / fuel spills that lead to fires or explosions ▪ Hazardous chemicals & construction coating chemicals shall be handled under ventilated conditions and with appropriate personal protective equipments (PPE) (e.g. an air-purifying respirator with acid gas cartridges and butyl rubber gloves). ▪ An eye wash/chemical spill shower should be located in proximity to the chemical handling / mixing areas	Contractor
	Fire hazards	▪ Implement appropriate operational controls & restrict the use inflammable materials ▪ Providing training for safer usage of wood based material for all employees ▪ Provide fire fighting / control equipments	Contractor
Gardening & landscaping	Landscaping & Introducing Exotic flora & fauna	▪ Introduction of Cultivated & Ornamental flora and invasion of fauna are expected to compensate such impact	Contractor

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
	Traffic movement increase	▪ The Project sites internal road network has to be designed to efficiently distribute the entire traffic to all zones as quickly as possible ▪ Support to develop public transportation infrastructure which ultimately will reduce dependency on private vehicles and increase the public transport mode share ▪ All material distributors and delivery contractors shall be instructed to deliver materials during non-peak hours only.	Operator
Post-Construction and Operation	**STP**-Air and Odor emissions	▪ Adopting a sound hydraulic design to control daily flow ▪ Improving operation and maintenance design procedures ▪ Provision of covers ▪ Landscaping a proper natural windbreaker around the facility ▪ Precipitating odor-causing compounds through the use of chemicals such as, potassium permanganate, mineral salts, … ▪ Collecting and treating gaseous byproducts by using activated carbon filters	STP Operator
		▪ Maintaining proper cleanliness and housekeeping ▪ Transportation of odorous byproducts in enclosed container trucks ▪ Diluting, masking or treatment of odorous emissions	STP Operation Staff
	STP-Noise generation	▪ Incorporating low-noise equipment ▪ Locating mechanical equipment in proper acoustically-insulated enclosures ▪ Tree planting around the STP	Design engineers
Post-Construction and Operation	**STP**-Visual amenity	▪ Maintaining cleanliness around and within the plant ▪ Proper fencing and landscaping an area equivalent to 10 % of the site's area	STP administration and operation staff/ Design engineers

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
	STP- public and occupational hazard	▪ Restricting unattended public access ▪ Supplying personnel with personal protective equipment (gloves, eye and noise protection, and respirators when necessary ▪ Providing adequate safety measures and monitoring equipment ▪ Emphasizing safety education and training for system staff ▪ Implementing health and safety standards ▪ Ensure that the room doors of the influent lifting station, headworks, and sludge dewatering remain closed with a notice warning from high levels of hydrogen sulphide. Workers shall as well wear gas masks prior to entering the room.	STP administration and operation staff
	STP-Contamination of plants and trees irrigated with treated effluent	▪ Continuously monitoring the suitability of effluent for plant irrigation ▪ Training irrigation team for the proper handling of treated effluent	Ramallah Municipality
	STP- Soil and groundwater pollution at sludge storage, disposal, or reuse sites	▪ Proper design and operation of sludge handling and treatment units ▪ Provision of adequate storage areas and capacities on-site ▪ Proper sludge transport by top-covered trucks ▪ Monitoring of sludge quality prior to disposal or reuse	Design engineers/ STP administration and operation staff
	Solid Waste Disposal	▪ Domestic wastes & hazardous should be stored separately in appropriate containers / waste skips as per the skip clearance and heavy vehicles standards ▪ Collect all waste and segregate as organic and non-organic for possible recycling it either as on /off –site treatment and reutilization. ▪ All non-recyclables has to be transported to Ramallah Municipality approved treatment and disposal sites ▪ Medical waste should be segregated as per the recommended color codes and sent for further treatment and disposal to a licensed facility. ▪ hospital authorities must hold a contract with an approved transport company to the place of disposal. ▪ Appropriate Personal Protective Equipment PPE shall be worn by waste handlers & cleaners	Sub-contractor

PHASE	IMPACT	MITIGATION	RESPONSIBILITY
	Landscape irrigation	▪ The developer shall plant trees with low water consumption demand. ▪ Use of drip irrigation system since it is a very efficient water saving technique when used it can also reduces the risk of erosion, soil compaction and insect and fungal problems in plants. It's great for all garden areas. Hardly any water is wasted through wind, evaporation, run-off or overspray. ▪ Irrigation shall be conducted only during early morning/night.	Sub-contractor
	Water saving measures	▪ Install flow restrictors in showers, taps and automatic valves in public lavatories. ▪ Install leak detection equipment. ▪ Reduce cistern volume to cut on flush volume. ▪ Use small flushing capacity toilets and plumbing fixture.	Contractor
	Light saving measures	The operator shall: ▪ Locate stickers on windows that instruct the employees to switch off appliances and lighting when not in use. ▪ Adjust lighting levels to ensure minimum energy use for given comfort levels. ▪ Install low energy lights. ▪ Make use of natural light as much as possible. ▪ Paint walls with light colors preferably white because it reflects light. ▪ Install key switches in guest bedrooms that will cut-off the electricity from the room once the guest leaves it. ▪ Use florescent lights. ▪ In the parking lot have censors on lights so as they switch off automatically if it is not in use.	Contractor

7.4 ENVIRONMENTAL MONITORING PLAN

Monitoring component is very important for identifying successfulness of mitigation measures formulated for the significant impacts identified. The monitoring works will identify impacts that have not been foreseen and give enough time to analyze the situation and formulate measures to minimise impact. Survey records and results have to be maintained for these monitoring and inspections, highlighting any problems and the measures taken to address it.

7.4.1 Construction and Operational Phase Monitoring

Monitoring works during the construction and operational phase will be carried out according to the Environmental Management Plan to ensure that the recommended environmental control and mitigation measures are being undertaken. **Table 7-3** summarizes the recommended Environmental monitoring requirements that should be regularly carried out on a periodical basis.

Table 7-3 Summary of Environmental Monitoring Program

ITEM	PARAMETERS	FREQUENCY	LOCATION
DURING PROJECT CONSTRUCTION PHASE			
Raw water	pH, Hardness, Alkalinity TSS, TDS, Fecal coliform & Residual chlorine	Every month	Labour rest room & Site office drinking water storage facilities
Effluent	pH, BOD, COD, TSS, TDS	Once in 3 months	Labour rest room & Site office toilets septic tanks
Noise	Ambient Noise levels for Leq, Lmin & Lmax	Once in 3 months	At major construction site area (minimum of 5 stations)
DURING PROJECT OPERATION PHASE			
Treated & untreated waste water from STP	pH, BOD, COD, TSS, TDS, faecal coliform and other relevant parameters to meet the irrigational water quality requirements as per adopted Guidelines	Once in every month	From wastewater collection tanks - before and after treatment process of STP - Implement odor complaint system; keep a record of odor complaints and identify needed corrective measures
Odors	H_2S and NH_3	Daily	- At odor control units - At buffer zone limits

7.4.2 Occupational Health and Safety Monitoring Program

(Reference: **IFC, EHS guidelines**)

The occupational health and safety monitoring program should include:

- Surveillance of the working environment:

Employers should document compliance using an appropriate combination of portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

- Surveillance of workers health*:*

When extraordinary protective measures are required, workers should be provided appropriate and relevant health surveillance prior to first exposure and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.

- Training*:*

Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

- Accidents and diseases monitoring:

The employer should establish procedures and systems for reporting and recording:

- Occupational accidents and diseases
- Dangerous occurrences and incidents.

These systems should enable workers to report immediately to their immediate supervisor any situation they believe presents a serious danger to life or health. The systems and the employer should further enable and encourage workers to report to management all:

- Occupational injuries and near misses
- Suspected cases of occupational disease
- Dangerous occurrences and incidents

All reported occupational accidents, occupational diseases, dangerous occurrences, and incidents together with near misses should be investigated with the assistance of a person knowledgeable/competent in occupational safety. The investigation should:

- Establish what happened
- Determine the cause of what happened

- Identify measures necessary to prevent a recurrence

7.5 CONTINGENCY PLAN

An emergency is an unplanned event when a project operation loses control, or could lose control, of a situation that may result in risks to human health, property, or the environment, either within the facility or in the local community. Emergencies do not normally include safe work practices for frequent upsets or events that are covered by occupational health and safety.

The Emergency Preparedness and Response Plan should include the following basic elements:

- Administration (policy, purpose, distribution, definitions, etc)
- Organization of emergency areas (command centers, medical stations, etc)
- Roles and responsibilities
- Communication systems
- Emergency response procedures
- Emergency resources
- Training and updating
- Checklists (role and action list and equipment checklist)
- Business Continuity and Contingency

Additional information is provided for key components of the emergency plan, as follows below.

7.5.1 Types of Emergencies

Considering the Al Reehan project nature, various possible emergencies may arise:

- Natural disasters: Earthquake, fire, storm water floods, intense sunlight and heat
- Technological accidents: hazardous material spill, energy shortage, explosions
- Terrorist activity, war

7.5.2 Communication Systems

Workers notification and communication

Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Related measures include:

- Testing warning systems at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations
- Installing a back-up system for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency

Community Notification

If a local community may be at risk from a potential emergency arising at the STP facility or at the attraction area, the company should implement communication measures to alert the community, such as:

- Audible alarms, such as fire bells or sirens
- Fan out telephone call lists
- Vehicle mounted speakers
- Communicating details of the nature of the emergency
- Communicating protection options (evacuation, quarantine)
- Providing advise on selecting an appropriate protection option

Media and Agency Relations

Emergency information should be communicated to the media through:

- A trained, local spokesperson able to interact with relevant stakeholders, and offer guidance to the company for speaking to the media, government, and other agencies
- Written press releases with accurate information, appropriate level of detail for the emergency, and for which accuracy can be guaranteed

7.5.3 Emergency Resources

Fire services

The Ramallah city Fire Department is the primary responder to emergencies. The nearest Fire Station to be located in Al Reehan shall be responsible for firefighting and providing fire engine and relief services.

Medical Services

The company should provide first aid attendants for the project facilities as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital.

Availability of Resources

Appropriate measures for managing the availability of resources in case of an emergency include:

- Maintaining a list of external equipment, personnel, facilities, funding, expert knowledge, and materials that may be required to respond to emergencies. The list should include personnel with specialized expertise for spill clean-up, flood control, engineering, water treatment, environmental science, etc., or any of the functions required to adequately respond to the identified emergency
- Providing personnel who can readily call up resources, as required
- Tracking and managing the costs associated with emergency resources
- Considering the quantity, response time, capability, limitations, and cost of these resources, for both site-specific emergencies, and community or regional emergencies

- Considering if external resources are unable to provide sufficient capacity during a regional emergency and whether additional resources may need to be maintained on-site

Contact List

The company should develop a list of contact information for all internal and external resources and personnel. The list should include the name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.

7.5.4 Training and Updating

The emergency preparedness facilities and emergency response plans require maintenance, review, and updating to account for changes in equipment, personnel, and facilities. Training programs and practice exercises provide for testing systems to ensure an adequate level of emergency preparedness. Programs should:

- Identify training needs based on the roles and responsibilities, capabilities and requirements of personnel in an emergency
- Develop a training plan to address needs, particularly for fire fighting, spill response, and evacuation
- Conduct annual training, at least, and perhaps more frequent training when the response includes specialized equipment, procedures, or hazards, or when otherwise mandated

7.5.5 Business Continuity and Contingency

Measures to address business continuity and contingency include:

- Identifying replacement supplies or facilities to allow business continuity following an emergency. For example, alternate sources of water, electricity, and fuel are commonly sought.
- Using redundant or duplicate supply systems as part of facility operations to increase the likelihood of business continuity.
- Maintaining back-ups of critical information in a secure location to expedite the return to normal operations following an emergency.

8 COMMUNITY MEETING

In compliance with the TOR requirement, a community meeting was held, at the Grand Park Hotel on Tuesday, March 16th 2010, for the purpose of informing attendants about Al- Reehan EIA study and its objectives, hence obtaining feedback on the project.

The meeting was attended by representatives from Al Reehan Real Estate Company, Al- Bireh Municipality, Ramallah Municipality, Joint Service Council for Solid Waste Management/ Al-Bireh and Ramallah governorate, Home Engineering, Arab Consultants, Amaar Group, Sakakini and Partners, Environmental Quality Authority, Jerusalem Water Undertaking, Jerusalem Electricity District Company, Palestinian Water Training Institute, CHF International, MOH, PWA, and CEP.

A list of the participants and minutes of the meeting are presented in Appendix 3.

Furthermore, in light of the meeting, the following issues were raised for further consideration:

- Environmental approval of the project vs. license acquirement.
- The EIA study, is it a national requirement or a request from the donor?
- The responsibility of national institutions concerning water supply and the capability of existing roads to serve Al- Reehan project.
- Wastewater:
    - Estimated amount generated
    - The method of collection and disposal.
    - The recycling possibility (financial feasibility concerns).
    - The developer's final decision concerning the treatment plant.
- Solid Waste Management:
    - The method of collection and disposal
    - The recycling possibility
- Environmental Compensation due to use of large areas for construction.
- The impact of the project on existing utilities.
- The Socio-economic impact of the project.
- Identifying the authority responsible for monitoring the mitigating measures.
- Visual pollution:
    - Diverse designs were performed by four consultants.
- The adjustment possibility in the TOR.

- Air Quality:
    - Eliminating the measurement of the project's impact on the air quality from the study's requirements.

Moreover, the consultant clarified that most of the issues raised in the community meeting were addressed in the Final report, this is shown as follows:

- In reference to section 2.3 of the Final Report (The Palestinian Environmental Law), the issue of environmental approval and licensing is tackled in accordance with article (47) of Part 4 of the Palestinian Environmental Law.
- In reference to Section 2.4 in the Final Report (Environmental Policy), it is shown that the goals, objectives and procedures related to Environmental Assessment Studies in Palestine are all outlined in the Palestinian Environmental Policy, including the Parties' responsible for the implementation of such policy.
- In reference to section 2.6 (Institutional Framework), the institutions' responsibilities concerning services is discussed; for instance the municipality, and in cooperation with the Ministry of Transportation, MOP, MOLG, Ministry of Finance (petroleum cooperation, is responsible for transportation which includes road opening. Furthermore, as for the water supply, it is beyond municipal control and is provided by JWU.
- Section 3.4.13 (Utility Connections) includes sub-sections that discuss wastewater when it comes to quantity generated, its collection and treatment
    - Sub-section 3.4.13.3 states that the construction of sewer mains is being planned by relevant authorities. Additionally, it is stated in table 7-2 (Project Environment Mitigation Plan) that wastewater will be collected and sent to Ramallah and Al-Bireh Collection system.
    - Several sub-sections discuss the proposed wastewater Treatment Plant and the reuse of treated wastewater.
- Section 3.4.14 (Solid Waste Management), 5.8 (Waste Generation) and table 7-2 (Project Environment Mitigation Plan) discuss solid waste -both domestic and medical and how it is to be handled.
- Section 4.3 (Biological Environment) discusses possible plans to be follow in order to maintain the natural character of the project area, also further mitigation suggestions are present in table 7-2 (Project Environment Mitigation Plan) concerning this issue.
- Section 4.4 discusses the existing Infrastructure; however, further research will be conducted to examine the impact of the project on the existing utilities.
- Section 5.9 discusses the Socio-Economic Impact.
- Section 7 (Environmental Management Plan and Mitigation) in the Final Report discusses in detail the Environmental Management Plan and Mitigation showing both roles and responsibilities of each party.

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Appendix 1 Palestinian Environmental Law No. 7

Appendix 2 Palestinian Environmental Assessment Policy

Appendix 3 list of the participants of the public meeting

Al Reehan EIA

Community Meeting

Tuesday, 16th of March 2010

No	Name	Organization	Position	Telephone
1	Musa Jwayyed	AlBireh Municipality	City Engineer	0599202190
2	Reem Khalil	Joint Service Council for SWM	Acting Ex. Manager	059- 568866
3	Sonia Alzubidi		Ministry of Ecology	0599595764
4	Ziad Jaraem	Ramallah Municipality	Wastewater Advisor	0599595932
5	Ahed Bseiso	Home Engineering	G.M	0599306821
6	Salam Abu-Khouzam	ARCH-Consultants	G.M.	0599 251095
7	Khaled S. Alamleh	CHF International	Senior Engineer	0597 500 249
8				
9	Falah Demery	سلطة الطاقة	سلطة الطاقة	0545733559
10	USAMA SAKAKINI	SAKAKINI & Partners	ARCHITECT	0599209654
11				0599-264230
12	Marwan Yacoub	EQA	Environmental Protect	02 2403495
13		EQA		2403495
14				
15	Mahmoud Abu-Shanab	EQA	Deputy D.G	2403495
16	Yahya Hajali	JWU	operation Department Acting Manager	2969164
17	Ali Ijjas	JWU	Labmanager	2969164
18	Saleh Rabi	Poles. Water Training		
19	Saed Nasser Ed	Institute (PWTI)	Director	29663718
20	Saed Nassar Eddin	W.B.W.D. (PWA)	South Manager	0598803496
21	Ibrahim Atiya	M.O.H	Env. Health Dept.	0598818913
22	Feda AbedAlrahman	JDECO	Electrical Engineer	0598949618.
23	Odeh Awwad	Amaar Group	Marking Dept	0599257711
24	Wali d Amer	"	Development Director	0597270070

Al Reehan EIA

Community Meeting

Tuesday, 16th of March 2010

25	Firas Abdelrahmeen	Al-Reehan	Marketing of	2413355
26				
27				
28	Roula El-Khoury	AMAAK GROUP	Marketing/Sales	2983560
29	Badawi Qawasmi	Al Reehan	Project Mng. Design & Planning	02-2413361(2)
30	Wijdan Alsharif			
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