The HASHEMITE KINGDOM OF JORDAN

Ministry of Water and Irrigation
Water Authority of Jordan

Feasibility Study, Environmental and Social Impact Assessment and Detailed Designs and Bidding Documents for Zarqa Governorate Wastewater System Reinforcement and Expansion Project

PRELIMINARY ENVIRONMENTAL & SOCIAL ASSESSMENT Final REPORT

March 2010

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ABBREVIATIONS

ARAP	Abbreviated Resettlement Action Plan
asl	Above sea level
ACOR	American Center for Oriental Research
AGTP	Ain Ghazal Preliminary Treatment Plant
ALARP	As Low As Reasonably Practicable
ARI	Acute Respiratory Infections
BAT	Best Available Technology
BSL	Below Sea Level
CBO	Community Based Organization
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CR	Cultural Resources
CRIS	Cultural Resources Impact Study
CRM	Cultural Resources Management
CV's	Curriculum Vitas
DAJ	Department of Antiquities of Jordan
DoA	Department of Antiquities
EMMP	Environmental Management and Monitoring Plan
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EZPA	East Zarqa Pumping Station
GCEP	General Corporation of Environment Protection
GoJ	Government of Jordan
GPS	Global positioning system
HCPS	Hitteen Camp Pumping Station
HSE	Health and Safety Executive

HSEM	Health, Safety and Environmental Management System
IBA	Important Bird Area
ICAH	International Council of Arts and Heritage
ICCROM	International Center for the Study of Preservation and Restoration of Cultural Property
ICOMOS	International Council of Monuments and Sites
IUCN	The World Conservation Union (often known as International Union for the Conservation of Nature and Natural Resources)
JADIS	Jordan Antiquities Database and Information System
JISM	Jordan Institute for Standards and Meteorology
JS	Jordanian Standard
JSC	Joint Services Councils
JVA	Jordan Valley Authority
km	kilometers
KTD	King Talal Dam
KTR	King Talal Reservoir
LAL	Land Acquisition Law
lcd	Liters per Capita per Day
mbgl	Meter below ground level
MCC	Millennium Challenge Corporation
MDHS	Methods for Determining Hazardous Substances
ME	Ministry of Energy
MEL	Maximum Exposure Limits
MEMR	Ministry of Energy and Mineral Resources
MoE	Ministry of Environment
MoH	Ministry of Health
MOTA	Ministry of Tourism and Antiquities
MoU	Memorandum of Understanding

MP	Master Plan
MWH	Montgomery Watson Harza
MWI	Ministry of Water and Irrigation
NGO	None Governmental Organization
NRA	Natural Resources Authority
OECD	Organization for Economic Cooperation and Development
PAP	Project Affected Persons
PCRIA	Preliminary Cultural Resources Impact Assessment
PESIA	Preliminary Environmental and Social Impact Assessment
PM	Particulate Matter
PMU	Program Management Unit
PNA	Pottery Neolithic A.
PPNB	Pre-Pottery Neolithic B.
RAP	Resettlement Action Plan
RFP	Request for Proposal
RPF	Resettlement Policy Framework
RSCN	Royal Society for the Conservation of Nature
TOR	Terms of Reference
TSP	Total Suspended Solids (TSP)
TWA	Time Weighted Average
UNESCO	United Nations Educational, Scientific and Cultural Organization
USAID	United States Agency for International Development
VC	Valuation Committee
VECs	Valued Ecological Components
VOC	Volatile Organic Compounds
WAJ	Water Authority of Jordan

WwTP Wastewater Treatment Plant

WZPS West Zarqa Pumping Station

1. EXECUTIVE SUMMARY

1.1. Introduction

MWH was retained by the Ministry of Water & Irrigation / Water Authority of Jordan (MWI/WAJ) to perform consulting services for the preparation of the feasibility study, environmental and social impact assessment and detailed designs and bidding documents for Zarqa Governorate wastewater system reinforcement and expansion. This report presents the Draft Report of the Preliminary Environmental and Social Impact Assessment for the mentioned project.

The project proponents consist of two parties:

- Millennium Challenge Corporation (MCC) which is the project funding party.
- Water Authority of Jordan (WAJ) which is the Ministry's of Water and Irrigation entity in charge of water and wastewater systems.

The PESIA main objectives are:

- To ensure environmental and social factors are considered in the decision-making process.
- To ensure that possible adverse environmental and social impacts are identified and avoided or minimized.
- To ensure that environmental and social aspects are enhanced.
- To improve project design.

1.2. Project Overview

1.2.1. Project Need, Objectives and Scope

The project of reinforcing and expanding Zarqa Governorate wastewater system is perceived to be an important step towards protection of both public health and water resources as well as a step towards improving service levels and consequently living standards for the population of that governorate. Also, since the national water policies consider treated wastewater as a resource for irrigation, this project would enhance the volumes of wastewater collected for treatment and reuse.

This project aims at achieving the following for Zarqa Governorate:

- Decrease or eliminate sewage overflows and the resulting health risks and costs; and
- Extend the piped sewerage system to that part of the population who are presently served only by water and not by sewer.

The project's scope of services includes:

- **Stage I:** Preliminary Design, ESIA, Feasibility Study and Economic analysis
- **Stage II:** EIA and Detailed Design and Preparation of Contract Documents (optional)

The current study covers Stage I which will then form the basis to identify the investment project to be potentially funded by MCC, under a compact that is currently being prepared.

1.2.2. Project Study Area

The project study area includes all the communities in the Zarqa River basin within the Zarqa Governorate in addition to some of Amman catchment areas that flow downstream of Ain Ghazal pre-treatment facility via the existing West Zarqa wastewater pumping station. After discussions with WAJ, it was understood that a feasibility study and final design and preparation of bidding documents project for the wastewater collection, treatment and reuse for Azraq, in the eastern parts of the governorate, is currently underway. Therefore, the area of Azraq will be excluded from this study. The major communities within the study area include Zarqa, Russeifa, Hashmiyah, Dhuleil and Sukhneh.

1.2.3. Existing Wastewater Network within Study Area

The first piped sewerage system was constructed in 1985 serving the central areas of Zarqa and Russeifa cities. Today the total length of the gravity sewer network is about 851 km of diameter 200 – 1000 mm, serving most of Zarqa, Russeifa and al-Hashmiyah areas.

The existing collection systems are supported by three existing pumping stations (West Zarqa, East Zarqa and Hitteen). West Zarqa pumping station serves west Zarqa area that drains towards Zarqa River and Russeifa in addition to flows coming from parts of Amman that drain downstream of Ain Ghazal preliminary treatment plant. East Zarqa pumping station located in Al-Hashmiyah serves the eastern parts of Zarqa and Al-Hashmiyah. Hitteen pumping station is small lifting station serving a small section of Hitteen camp in Russeifa.

All collected wastewater at West Zarqa and East Zarqa pumping stations is delivered to As-Samra WwTP via 1200 mm diameter and two-500 mm diameter pumping mains, respectively.

The existing wastewater collection system is designed as a separate collection system, which is not sized for storm water collection. The sewer networks are operated by WAJ Zarqa Directorate.

1.2.4. Evaluation of Existing Wastewater Network

Presently, the deficiencies in the sewerage system in Zarqa Governorate are as follows:

1. Blocked sewers by sand, silt and grease, causing spills of raw sewage into the street.
2. Several segments of the collection system are overloaded during rain events, causing backup into streets, wadis, and, in some rare cases, into residences.
3. Inadequate pumping (storage) capacity at the pumping stations to cater for rain events.
4. Odor problems at the pumping stations.

The other major problem with the existing sewer system in Zarqa Governorate is its extent where the system coverage is around 72%.

1.2.5. Determination of New Service Areas

The new service areas within the catchments of the existing networks consist mainly of the newly developed neighborhoods of Zarqa and Russeifa west of the Zarqa River and some parts of Hai Batrawi

in north Zarqa. The towns and villages in Birein, Dhuleil and Al-Hashmiyah districts that do not drain to the existing pumping stations will be included in the study.

The new service areas can be classified into two main categories:

- New Service Areas within Zarqa, Russeifa and Hashmiyah Municipalities.
- Remote and Isolated Communities which include:
  - West communities.
  - East communities.
  - Abu Sayyah community south of Russeifa.

1.2.6. Description of Proposed Wastewater System Reinforcement and Expansion

Wastewater Collection Zones

Based on the topography of the study area, and based on the main system elements of the Zarqa wastewater system, the study area is divided into four main wastewater collection zones:

1. West Zarqa Pumping Station Zone.
2. East Zarqa Pumping Station Zone.
3. Sukhneh Pumping Station Zone.
4. Wadi Zarqa Zone.

New Pumping Stations

It is anticipated to have the following new pumping stations to serve remote and isolated communities:

- Sukhneh Pumping Station.
- Wadi Dhuleil Pumping Station.
- Al-Alouk Pumping Station.
- Wadi Zarqa Pumping Station.

Main Wastewater Options

Based on the derived main wastewater catchment areas, and based on the location of the existing and new service areas, five main options are identified:

- Option 1: Convey flows from the study area to the location of the proposed Wadi Zarqa Treatment Plant.
- Option 2: Continue to convey flows from the study area to as-Samra WwTP with flows from the Sukhneh and Wadi Zarqa pump stations pumping their flow to WZPs.
- Option 3: Continue to convey flows from the study area to as-Samra WwTP with flows from the Sukhneh and Wadi Zarqa pump stations pumping their flow to WEZPs.
- Option 4: Continue to convey flows from the study area to as-Samra WwTP, but provide the communities of Birein Districts with package wastewater treatment units.

- Option 5: Continue to convey flows from the study area to as-Samra WwTP, but provide the communities of Birein Districts with package wastewater treatment units. Also eliminate WZPS and replace it with a new pumping station within Sukhneh area that pumps to as-Samra WwTP with a booster lifting station on the conveyance route between Sukhneh PS and as-Samra WwTP.

Planning Criteria

The following criteria and projections have been established and used in the formation of the Master Plan:

- Planning Period: Through year 2035. Therefore, key planning parameters, such as population, water consumption and wastewater production projections, have been defined in five-year increments, with the first being 2010.
- Service Area: All villages and towns in the Governorate of Zarqa shall be included in the study except area of Azraq which is included in a different project.
- Level of Service: The initial focus of the reinforcement and expansion program will be on bringing sewers to areas that are currently only served by water and to areas that have inadequate wastewater collection systems.
- Sewer Design and Installation Considerations
- House Connections Considerations
- Manholes Considerations
- Pumping Station Design Criteria: Sewage pumping station discharge flow rates shall, at minimum, accommodate the 25-year planning horizon.

Figure 1.1 below illustrates the existing wastewater networks within the study area as well as the proposed network extensions.

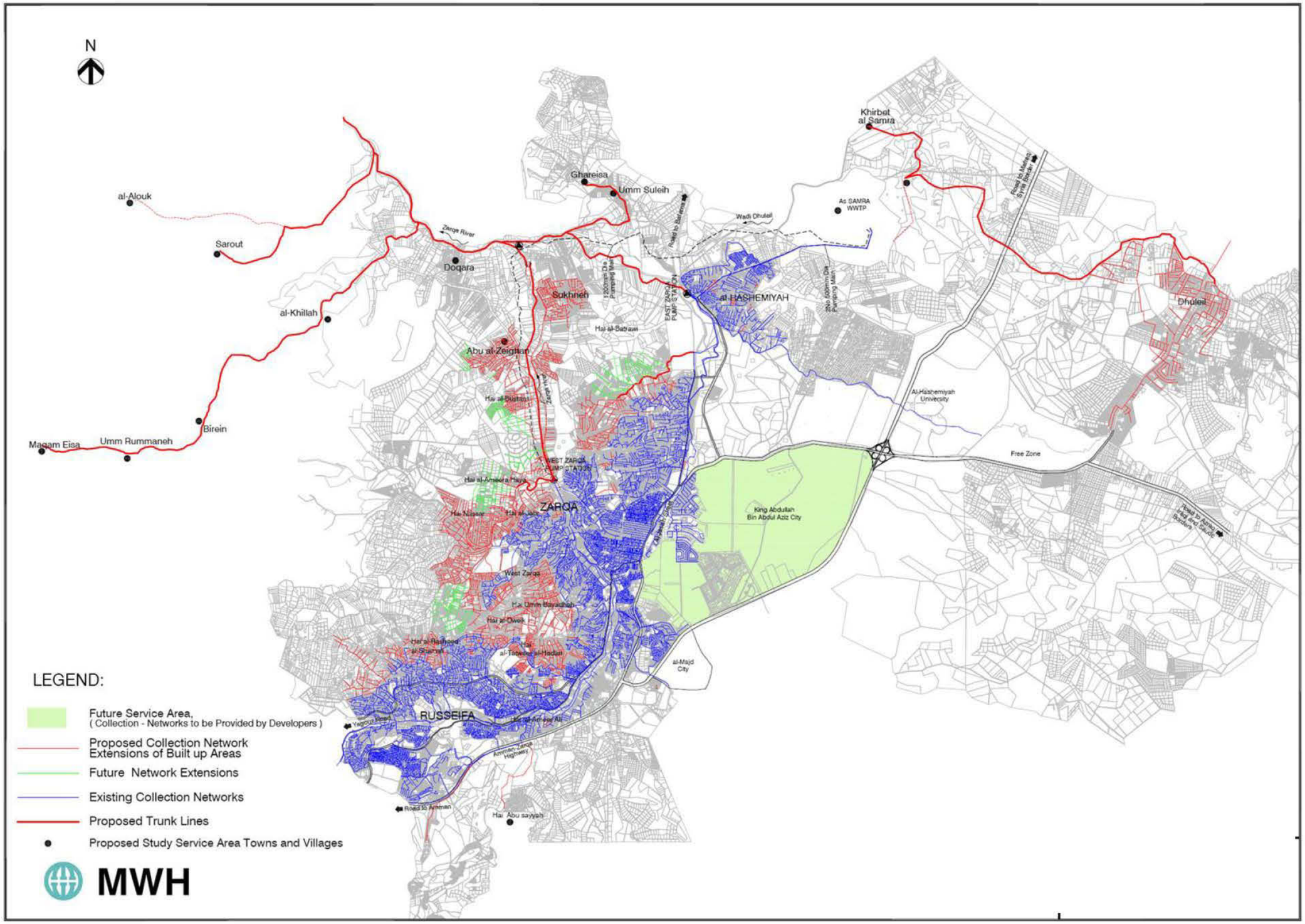

Figure 1.1: Proposed Collection System Extensions

1.3. Policy, Legal and Institutional Framework

The principal relevant national and international policies, laws, regulations, agreements and standards governing the implementation of this project are addressed in **Section 4** of this report. The relevant institutions and guidelines governing the required permits and approvals in the contents of this project, specifically Jordanian EIA Regulation No. (37) for year 2005 and MCC Environmental and Social Guidelines, were revised.

The Competent Environmental Authority for projects within the Kingdom of Jordan, the Ministry of Environment, is responsible for the evaluation of the environmental impacts of the project and the issue of associated approvals and permits. Also, as this project is funded by MCC, the MCC Environmental and Social Guidelines need to be addressed to get MCC clearance on the environmental and social impacts of the proposed project.

If the Impact assessment is approved, the project will get the letter of approval and commence the proposed activities while adhering to the preliminary environmental mitigation and management systems specified and approved in the study. Any deviation from those guidelines would render the project to violations. On the other hand, the related entities (i.e., MoE and MCC) might require a further detailed environmental and social assessment impact study.

1.4. Description of Environmental and Social Baseline Conditions

1.4.1. Data Sources, Field Investigations, and Literature Reviews

To have an overview of environmental and social baseline conditions in the study area, the following were carried out:

- Demographic, meteorological and water resources data were collected.
- Field visits conducted to study area by various study groups for this preliminary ESIA.
- Various studies and reports were reviewed and these are listed in Section 14 of this report.

1.4.2. Physical Environment

Meteorology and Climate

Jordan's climate varies from Mediterranean in the west to desert in the east and south, but the land is generally arid. The proximity of the Mediterranean Sea is the major influence on Jordan's climate, although continental air masses and elevation also modify it. The prevailing winds throughout the country are westerly to north-westerly, but spells of hot, dry, dusty winds blowing from the southeast off the Arabian Peninsula frequently occur and bring the country its most uncomfortable weather.

The project area belongs to the Arid Mediterranean and Saharan Mediterranean climatic zones and its meteorological characteristics can be obtained from Al Zarqa Al Jadeida and Wadi Dhuleil stations.

The mean maximum and minimum temperatures recorded at Al Zarqa Al Jadeida and Wadi Dhuleil stations indicate hot summers and cold winters. The relative humidity in Al Zarqa Al Jadeida and Wadi

Dhuleil are around 59% and 58%, respectively. Precipitation rates at Al Zarqa Al Jadeida station (105.5 mm) are slightly higher than at Wadi Dhuleil area (93.76 mm).

Air Quality

High air pollution is one of the main environmental risks at Zarqa Governorate due to the surrounding industrial areas including the thermal power plants, oil refinery, and industrial plants stack emissions. Hence, these industrial enterprises can be considered the major source of air pollution within the project area.

Topography and Geology

The project area elevation ranges from 498 m in the northern part to about 807 m in southern part of the project area.

The geology of the project area is part of the geology of Amman-Zarqa Basin. The outcropping of Amman-Zarqa Basin extends from Lower Cretaceous (except for the wadi fill deposits which are of Quaternary) to recent age, which is belonging to the Ajloun and Belqa Groups according to Jordanian classification. However, the Kurnub Group (Lower Cretaceous) is usually found at certain depths except outcrops at the western parts of the study area (Baq'a Valley) along the axis of Sweileh anticline. In addition, the older Zarqa Group (Jurassic-Triassic age) occurs at considerable depth.

The outcropping rocks in the study area mainly consist of Ajloun group (A4, A5/6 and A7) and Belqa Group (B1 and B2). Soil cover is generally thin, although local topography has led to accumulation of wind-blow soils in numerous places. Valleys are generally filled with alluvial deposits of gravel, boulders, and pebbles. The Amman Formation B2 (Santonian – Campanian) consists of cyclic deposits of chalk, phosphate, silicified phosphate, limestone and chert. The limestone is occasionally silicified. In the Amman-Russeifa and Zarqa areas, two members of the formation are recognized:

- Upper chalk-marl and phosphate member (26-27m thick in Russeifa); and
- Lower chert-limestone member (about 90m east of Amman).

Tectonic Setting

Overall, the rate of seismic activity in Jordan, including the project area, is moderate with many of the strong seismic events located along the axis of Dead Sea Rift.

Water Resources

The water resources of the study area include the Zarqa surface water basin and the Amman-Zarqa groundwater basin.

Zarqa Surface Water Basin

This basin is one of the most significant surface water basins in Jordan and the Zarqa River is the third largest river in Jordan. It has approximately 65% of the country's population and more than 85% of its

industries located within its catchment area. The main populated centers are the cities of Amman, Zarqa, Jerash and Russeifa. The industrial activities in the basin have witnessed a sudden expansion in urban development. Agricultural areas (irrigated) are concentrated around groundwater wells and along the side beds of the river while rain fed agriculture can be found in high rainfall areas. The rest of the basin is scattered vegetative areas used for grazing, bare and rocky areas and forests.

The Zarqa River flows northeasterly as it leaves Amman toward Zarqa, and turns west at its confluence with Wadi Dhuleil, near Sukhneh. The river flows through the King Talal Reservoir (KTR) and into the Jordan Valley where it joins the Jordan River 20 km north of the Dead Sea.

Amman-Zarqa Groundwater Basin

Amman-Zarqa groundwater basin is on the country's basins suffering from overexploitation. It has a safe yield of 88 MCM per annum and is considered to be the critical renewable groundwater basin in Jordan. The intensive urbanization and agricultural expansion in the area of Dhuleil and Hallabat included within this basin have resulted in over-pumping reaching to 157% of the safe yield. Sewage infiltration from septic tanks and broken sewer networks in addition to over-pumping resulted in a fast depletion of water quality and quantity in the aquifer which contributed to desertification.

According to the potentiality of water bearing, three aquifer systems are available in Amman-Zarqa Basin:

- Upper aquifer system, which includes Basalt and underlying Amman-Wadi As Sir (B2/A7) formation;
- Middle aquifer system, consisting of Hummer (A4) and Naur (A1/2) formations; and
- Lower aquifer system (Kurnub Group).

The two main aquifers in the Amman-Zarqa basin are the Amman/Wadi Sir formation (B2/A7) and the Hummer (A4) formation. Both of them are exposed to the high rainfall region which reaches 400 mm/year to the west of Amman, while in the area, the rainfall does not exceed 150 mm/year.

Main Sources of Water Pollution Discharges

The main sources of degradation of the Zarqa River Basin water quality and quantity are as follows:

- Domestic and industrial effluents.
- Domestic and industrial solid waste.
- Over abstraction of groundwater and the competition in water usage between municipal, agricultural, and industrial sectors.
- Overgrazing and deforestation.
- Agricultural activities as well as construction activities that have increased the sediment load of surface water.
- Wide fluctuations in annual rainfall due to climate change and associated desertification.

1.4.3. Biological Environment

The study area is located in Zarqa and it extends from Zarqa Free Zone in the east to Alouk in the west and from Greesa in the north to Mukhiam Hitteen in the south. It falls under two biogeographic regions, namely the Mediterranean and the Irano-Turanian. In the Eastern side of the study area, Saharo-Arabian (Desert) affinities intersect with the Irano-Turanian zone.

The Mediterranean region covers the western part of the study area. The area can be further subdivided into the Batha Steppe and the forested Mediterranean sub-groups based on the dominant representative vegetation in this area. The majority of the western part is a series of barren slopes with Batha steppe vegetation that changes to grass land steppe as we move to the east. Farm lands are predominantly confined around both sides of the wadi system and mostly near Khirbet As-Samra area. Very limited planted pine forests occur only on the extreme mid-western borders of the study area. Forested areas are limited to the stretch between Birein and north of Sarrout, and it extends after to the west-north up to Al Alouk.

The Irano-Turanian covers the central and eastern parts of the study area, and it represents Zarqa city Russeifa and its outskirts, reaching Al-Hashmiyah and Al-Sukhneh. The dominant representative vegetation is Grassland Steppe. It is interrupted by Zarqa River tributaries flowing from the south and south-east to north and north-west, and then turns to the west. This riverine joins wadi system arising from Khirbet As-Samra and Wadi Al Dhuleil to the east. Elevation ranges from 750 to 450 m asl. It should be noted that the man-made lagoons of Samra WWTP have been designated as an IBA.

The central section of this area is heavily populated, most significantly in Mukhiam Hitteen. It is considered the most densely populated area in Jordan. However, the side banks of Zarqa River in the area between El Nuzha and El Jabal El Abied, between Hai Eth Thawra El Arbiya El Kubra and Awajan, and the stretch in Russeifa are being cultivated. The same applies for the side banks of Wadi Ed Dhuleil and other wadis and tributaries in Khirbet As-Samra, Al Hashmiyah, Um EsSulieh and Al Sukhneh.

The eastern side is an arid land of the Irano-Turanian with Eastern Badia affinities. The vegetation cover is grassland but with much less density compared to the north-western grassland basically due to rainfall volumes. This area, in particular along the Zarqa to Mafraq highway, is under growing urbanization and development in the form of residential and commercial uses.

Within this section, and on the area between the Zarqa Free Zone and the Refinery, land uses include industrial, residential and agricultural. Two universities exist within this zone: Zarqa Private University and Al-Hashmiyah University.

In general, the populated urban centre is of no ecological significance since population density in these areas is very high and different environmental challenges contributed to deteriorating the ecological character of the area.

1.4.4. Socio-cultural Conditions

The approaches utilized to prepare a description of the socio-economic baseline included:

- A comprehensive literature review of secondary data available through reports and other publications; and
- A quantitative socio-economic profiling of the target study area through collected secondary data from official records, mainly the Population Census 2004 of the Department of Statistics.

Social Baseline Conditions within Study Area

The resident population of Zarqa Governorate the year 2004 was approximately 799,000, which is about 15% of the national population. This indicated a growth rate for the governorate of 2.2% per annum between the 1994 and 2004 inter-censal period.

It is important to note that the projections, as well as the Governorate's general projected growth rate, do not take into consideration the effects of the two major urban development projects of King Abdullah Bin Abdul Aziz City and al-Majd City in East Zarqa.

Areas selected for the preliminary assessment fell in three municipalities in Al-Zarqa Governorate which are Al-Zarqa Municipality, Russeifa Municipality, and Al-Hashmiyah Municipality. The main results of the demographic characteristics of the target neighborhoods are as follows:

- The average family size in the target neighborhoods is higher than the national average of 5.4, being the highest in the target neighborhoods within Zarqa Municipality at 5.68.
- The marital status of the target neighborhoods shows that more than 55% of the people are married.
- The majority of the residents in the target neighborhoods live in apartments, while others own their houses.
- The educational levels at those areas are more or less consistent with the national numbers.
- Zarqa Governorate has an unemployment rate of 12.3% which is very close to the national unemployment rate for the same period (12.2%).
- The female economic activity rate in Zarqa Governorate at 11.4% is lower than the corresponding national number of 14.3%.
- The overwhelming majority of males in the workforce in Zarqa and Russeifa municipalities' target neighborhoods work in the private sector, and the majority of working females in Zarqa and Hashmiyah municipality work in the public sector.

Existing Public Health within Study Area of Zarqa Governorate

Health indicators reflect that Zarqa Governorate is deprived of equal share of health care. Epidemic hepatitis, typhoid and paratyphoid diseases are higher than expected.

Communicable diseases profile in Zarqa Governorate is changing but infectious diseases remain on the list of major causes of morbidity.

With respect to non-communicable diseases, Zarqa is witnessing an epidemiological transition characterized by an increase of non-communicable diseases. Among the factors contributing to this high prevalence are the increasing elderly in the population as well as the lifestyle changes.

Health Issues Associated with the Existing Wastewater System within Study Area

The main potential health and safety impacts associated with the existing wastewater system within study area include:

- Potential health and safety impacts of existing wastewater networks due to possible transmission of typhoid, salmonellosis, shigellosis, and infectious hepatitis to residents, wastewater workers and agriculture workers
- Potential health and safety impacts of continued use of cesspools and septic tanks. These are dangerous because the wastewater would seep into the soil and gradually extend the zone of pollution and endanger the safety of wells at a considerable distance way. Besides the disposal of wastewater by cesspool may contaminate the ground with parasites that would in turn contaminate community drinking water and food especially vegetables eaten raw.
- The main potential health and safety impacts of existing pumping stations include:
  - Odor problem associated with the existing pump stations.
  - Insect problem associated with open wastewater reservoirs.

1.4.5. Cultural Heritage Resources

The following major archaeological sites have been identified in Zarqa Governorate:

- Qasr Shabib
- Khirbat Masarah
- Qasr al- Hallabat
- Hammam as-Sarah
- Khirbet Russeifa
- Qasr Azraq
- Quseir Amra
- Tall Al-Sukhneh
- Tall al-Birah
- Hashmiyah Mill stones
- Gharesa
- Khirbet As-Samra
- Batrawi

1.5. Analysis of Proposed Project Alternatives

Four alternatives were assessed to determine whether a more environmentally and socially sound alternative to the proposed project can be adopted. These alternatives were the No Action alternative and the four options introduced in the project description.

The “No Action” alternative was compared to the proposed project and the five proposed options were compared against each other. The analysis results were as follows:

- “No Action” Alternative versus the Proposed Project: Although going through with the proposed project could lead to certain impacts on the environment and the social aspects within the study area due to project construction activities, those impacts can be mitigated and their significance eliminated or minimized. On the other hand, not going ahead with the

proposed project would deprive the local communities within the study area of a high value project once in its operational phase.

- Comparison of Options 1 through 5: Although all options will eventually enhance water resources quality and consequently public health and ecological resources as they all lead to proper management of wastewater, Option 1 can be considered as the preferred option environmentally. But since this option is associated with major land acquisition issues and rejection from land owners and since it has not been budgeted for within the Zarqa greater development, this option is not anticipated to be adopted at this stage. As for the remaining options, and since the environmental impacts associated with each are almost similar in nature, it can be concluded that the most preferred option, from an engineering and economical perspective (most economical capital, operation and maintenance costs) although it is perceived to be faced with social rejection by land owners near local packages WwTP, is Option 4.

However, the above is the result of the preliminary assessment of the project alternatives and it is recommended to have more detailed assessment of for the most favorable alternative in order to recommend the most environmentally, socially and cost effective option.

1.6. Preliminary Identification of Potential Environmental and Social Impacts

In order to enable the determination of the overall significance of the impact, each identified aspect - receptor interaction was ranked in terms of consequence and likelihood. Impact significance is expressed as the product of the consequence and likelihood of occurrence of the activity.

- **Likelihood**: the likelihood that an activity will occur.
- **Consequence**: the resultant effect (positive or negative) of an activity's interaction with the legal, natural and/or socio-economic environments.
- **Significance = Consequence x Likelihood**.

Based on its consequence-likelihood score, each environmental aspect was ranked into five categories or orders of significance. These are: critical, high, medium, low and negligible. Any impact that remains after mitigation measures have been applied is labeled as a residual impact.

The study findings on potential preliminary impacts on resettlement and land acquisition reflect that although the project will result in a significant general benefit to the entire population of Zarqa Governorate, its implementation will entail some negative impacts on some of the land users. This is due to the need to expropriate areas to serve the pumping stations downstream and the trunk sewers and pipe networks in many other locations within the governorate. The proposed expropriation locations and their respective areas are presented in **Table 1.1**.

Table 1.1: Proposed Expropriation Areas for Main Lines, Sub-lines and Pumping Stations

Location	Proposed Expropriation Area (m²)
Areas expropriated for main lines passing through private plots and downstream as well as for sub-lines passing through private plots	
Dogara	695
Dogara	4,025
Al Alouk	4,320
Sarout	6,055
Dogara	11,195
Al Khililah	4,905
Um Rummaneh	2,500
Birein	4,470
Sukhneh	8,475
Sukhneh	7,785
Hai Ma'amel al Toub	19,555
Hai Bustan, Hai al Hashemi	42,260
Hai Batrawi, Zarqa Jadeida	11,628
Hai Nasser (Zawahra)	18,320
Hai al Jraiba	320
Hai Makah Al Mukarrama	12,295
Hai al Falah	4,770
Hai Jafar al Tayyar	1,360
Khirbat al Samra	15,500
Khirbat al Samra	8,680
Hashmiyah	21,220
Dhuleil	3,365
Dhuleil	2,350
Dhuleil	3,355
TOTAL	**219,403**
Proposed Expropriation areas for Pumping Stations	
Sukhneh PS	3,000
Wadi Zarqa PS	3,000
Al Alouk PS	3,000
Dhuleil PS	3,000
TOTAL	**12,000**

According to Table 1.1 above, the total area to be expropriated is approximately 23 hectares including the pumping stations land.

Table 1.2 below provides a summary of the preliminary ESIA results relating to the other potential socio-economic impacts as well as the potential environmental impacts due to the project planned and unplanned activities.

Table 1.2: Summary of Preliminary Impact Assessment of Planned and Unplanned Activities

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[1]
Construction Phase							
1	Trenching and Excavation Works	Planned	Degraded air quality due to dust and emissions	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Degraded topography, geomorphology and soils	Certain (5)	Critical (3)	High (15)	ALARP/BAT
			Visual intrusion and aesthetic interference	Certain (5)	Negligible (1)	Low (5)	HSEMS
			Pollution of surface water resources	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Pollution of groundwater	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Likely (3)	Sever (4)	High (12)	ALARP/BAT
			Disruption to existing businesses	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Damage to Infrastructure – Transport system and potential traffic impacts	Very Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Damage to water and wastewater lines	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to power and communication lines	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Employment opportunities	Certain (5)	Positive (+)	Positive (+)	None
			Damage to archaeological/cultural heritage sites	Very Unlikely (1)	Catastrophic (5)	Low (5)	MSEMS
2	Solid Waste (Spoil) Generation/Disposal	Planned	Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Visual intrusion and aesthetic interference	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Impact to surface water	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS

1 Unacceptable or Managed to ALARP, BAT, or with HSEMS
ALARP: As Low As Reasonably Practicable
BAT: Best Available Technology
HSEMS: Health, Safety and Environment Management System

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[1]
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to public health and safety	Vey Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Unlikely (2)	Catastrophic (5)	High (10)	ALARP/BAT
3	Material and Chemical / oil storage	Planned	Degraded air quality due to emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Visual intrusion and aesthetic interference	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to surface water	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Impact to shallow groundwater	Unlikely (3)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
4	Vehicle operation	Planned	Degraded air quality due to emissions	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Noise pollution	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Impact to soil	Likely (3)	Marginal (2)	Medium (6`)	ALARP/BAT
			Impact to surface water	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Damage to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Risk to utilities due to accidents	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
5	Equipment operation	Planned	Degraded air quality due to emissions	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Impact to soil	Likely (3)	Severe (4)	High (12)	ALARP/BAT

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[1]
			Visual intrusion and aesthetic interference	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to surface water	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to land use	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Risk to public health and safety	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to utilities due to accidents	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
6	Access Roads (if needed)	Planned	Degraded air quality due to dust emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Disturbance to top soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
7	Vehicle Collisions	Unplanned	Degraded air quality due to exhaust emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Disturbance to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Unlikely (2)	Catastrophic (5)	High (10)	ALARP/BAT

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[1]
8	Spill of chemical and liquid fuels	Unplanned	Degraded air quality due to emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to shallow groundwater	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Very Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Impact on land use	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Impact to existing infrastructure / utilities	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
9	Ignitions of flammable materials / accidental fires	Unplanned	Degraded air quality due to emissions	Very likely (4)	Critical (3)	High (12)	ALARP/BAT
			Noise pollution	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Very likely (4)	Severe (4)	High (16)	ALARP/BAT
			Impact on land use	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to transport and other infrastructure/utilities	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
Operation Phase							
1	Pump Stations Operation	Planned	Odor generation	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Noise pollution	Very unlikely (1)	Marginal (2)	Low (2)	HSEMS
			Visual intrusion	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Impact to surface and ground water resources	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Employment opportunities	Certain (5)	Positive (+)	Positive (+)	
			Energy need	Certain (5)	Critical (3)	High (15)	ALARP/BAT
2	Flow of wastewater in sewer networks	Planned	Impact to soil	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Visual intrusion (Only above ground trunk lines)	unlikely (2)	Marginal (2)	Low (4)	HSEMS

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[1]
			Impact to groundwater	Certain (5)	Positive (+)	Positive (+)	
			Land value	Certain (5)	Positive (+)	Positive (+)	
			Public health and living standards	Certain (5)	Positive (+)	Positive (+)	
3	Pump station power failure / malfunction problems	Unplanned	Odor generation	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Marginal (3)	Medium (9)	ALARP/BAT
			Risk to public health	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
4	Rupture/breakage of utility lines	Unplanned	Impact to shallow groundwater	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to infrastructure (road subsidence)	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Risk to public health	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT

1.7. Preliminary Mitigation Measures

Mitigation measures recommended by this study are summarized in **Table 1.3** below.

Table 1.3: Proposed Preliminary Mitigation Measures

Impact	Mitigation Measure
Impacts to flora / habitats	• Minimize width of access tracks. • Limit driving to marked tracks and lines except in an emergency. • Prevent the removal of plants by workers on site.
Impacts to Fauna	• Deviate work away from faunal communities' concentration areas. • Avoid human and vehicular contact with fauna, including their burrows / nests and feeding grounds. • Prevent illegal hunting by workers on site. • Avoid working in times of bird migration.
Impact to water resources	• All fuel storage (if applicable) must be appropriately bonded and refueling must be undertaken in designated areas following set procedures. • Develop a spill response plan, to control any inadvertent leakage or spillage of hydrocarbons. Spill response measures should be instigated (as necessary) to contain and clean up any contaminated soil present. • Adopt appropriate soil conservation measures, reducing the disturbed area and scheduling work, where practical, to avoid periods of high rainfall. • The slopes and slope lengths of steeper sections of the pipeline route and any areas of cut and fill will be minimized and drains installed to intercept and divert run-off water. • Road crossings and other traffic areas will be located and constructed to minimize the concentration or diversion of water into the wadi bed and drainage lines. Where practical, surface cover will be maintained in these areas. • Third party environmental specialists will be appointed to periodically review implementation of the management plan. • Proper design of the pumping stations to accommodate potential overflows • Develop and redesign the storm water collection system to minimize the flow of storm water through the sewer system.
Impacts to Population	• Use noise attenuation devices on plant. Ensure that noise levels at receptors do not exceed standards. • avoiding work on weekend (Friday) and ceasing work activities during the weekdays between 8:00 pm and 6:00 am • Give advance warning to the area's residents as to the project activities and possible disturbances (noise, dust etc). • Compensate any loss to livelihood. • Provision for the additional traffic may need to be made, potentially with additional turn-off lanes and traffic signaling installed to prevent congestion and minimize the risk of vehicular accidents at road crossing points. • A formal traffic management plan to be developed in consultation with the main project contractor. • If pumping stations are a must, ensure that those will be properly designed to handle the wastewater flow, where the need for exposed overflow emergency ponds is illuminated or significantly minimized. • Where it would not increase dust and erosion levels, break up compacted soil, especially in cultivated areas.

1.8. Preliminary Environmental Management and Monitoring Plan

This section presents a summary of the EMMP activities in **Table 1.4** followed by a summary of the Resettlement Policy Framework.

Table 1.4: Summary of Proposed Preliminary Mitigation and Monitoring Measures

Potential Impact	Mitigation	Monitoring
Dust & Noise		
• Construction of the pipeline network and pumping stations will result in increased levels of dust and noise generation.	• Dust – During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an "as needs" basis. • Noise – Activities that are likely to generate elevated noise levels (for example, blasting) must be avoided during weekends (Friday) and ceased during weekdays between 8:00 pm and 6:00 am in compliance with Standards for the Prevention and Elimination of Noise (2003). • Give advance warning to area residents within 100m from the construction site, at the beginning of the campaign, alerting them of the project activities and potential disturbances (noise, dust, light, etc). • Maintain a safe distance of 100m between the construction equipment and nearest human receptor (whenever possible). • Establish a simple complaints procedure to enable community feedback on issues of concern. • Maintain open dialogue with the residents of the area within or surrounding the construction site, if and when complaints are received. • Minimize transportation of project personnel to and from the project area to the extent possible. • Maintain open dialogue with stakeholders through the development of a Stakeholder Engagement Program. • Appropriate occupational health and safety measures to be employed for on-site personnel.	• Dust and noise monitoring should be undertaken on site and, where required, in surrounding areas. Noise shall be monitored by use of portable noise dose meters/sound level meters and dust monitoring will largely be completed by visual assessment of nuisance.
Solid & Liquid Waste		
• Wastes will be generated as a result of construction activities	• All inert and domestic waste generated during construction must be removed from site and disposed of in accordance with the regulatory requirements and within landfills approved by	• Quarterly monitoring during construction.

Potential Impact	Mitigation	Monitoring
on site. • Minimum solid waste will be generated once the pipeline network and pumping stations are operational	the local municipality. • Hazardous wastes and liquid wastes generated should either be recycled or disposed off-site to an approved waste facility. • Elimination or minimization of sewage overflow from pumping stations during operation through proper engineering design to enable the station (i.e. West Zarqa Pumping Station) to handle wastewater flows, especially upstream discharges (Amman).	
• Possible significant risk to groundwater quality being affected due to construction activities • Potential significant risk to groundwater during operation of pumping stations due to overflow discharges during normal and emergency operations.	• All fuel storage areas (if applicable) must be appropriately bonded and refueling activities undertaken in designated areas following specified procedures. • Specific procedures shall be developed for the removal of waste or spilled fuel, oil and contaminated soil at approved recycling / disposal facilities. • Provide spill cleanup kits on site. • Provide proper training for construction personnel on the containment and clean up of spills of they occur. • Ensure proper operation of the pumping stations, where overflows can be avoided whenever possible.	• Daily monitoring of construction activities to ensure that available means for the control and clean up of spills are adequately placed and properly utilized when needed. • Daily monitoring of pumping station performance including quality and volumes of overflow into the River.
Terrestrial Flora and Fauna		
• Potential impact to flora.	• Clearing of vegetation should be avoided • Access tracks should be aligned such that a minimal loss of vegetation will occur. • Vegetation should be cut to ground level to keep rootstock in place (if clearing of vegetation cannot be avoided. • Disturbance/destruction of sensitive environmental units, identified in Section 5 of this report	• Pre construction survey, Initial monitoring after installation of pipeline networks and construction of the newly proposed

Potential Impact	Mitigation	Monitoring
	must be avoided. • Management strategies will be implemented to restrict the spread of weeds and to minimize the impact of erosion/sedimentation. These measures to minimize the potential for adverse impact on vegetation communities in the area. • Re-vegetation of disturbed areas to be undertaken on an "as required" basis. Where practical, regeneration of native flora will be assisted by exclusion of grazing animals.	pumping stations, then annually.
• Potential loss of some habitat for terrestrial fauna through the clearing of vegetation whenever applicable. • Restricted impact to reptile, mammal and bird species during construction period.	• During the construction and operational phases of the project, the habitats supporting the highest species diversity in the study area will be protected where practical from on-going disturbance. Impact on the habitat value and condition will be minimized by preventing indirect impacts associated with erosion, drainage, waste contamination and the spread of weeds. • Damage to important environmental features to fauna such as water sources, Zarqa River Basin and Wadi and mature nesting trees should avoided. • Where possible, animals that fall into the trench during construction will be removed and ladders or branches placed in open excavations to assist fauna to escape.	• Pre construction survey. Initial monitoring after completion of construction activities. Annual survey of fauna during operation.
Archaeology		
• Potential impact to archaeological sites.	• Required site specific protective measures are identified during design phase and a general plan of works necessary to minimize project related damage to the Cultural Resources. • Definition of tender requirements as they relate to the implementation of the specified design measures.	• A construction and post-project monitoring program.
Health and Safety		
Potential health and safety risks and measures to minimize or eliminate them are detailed in Table 10.1 of the preliminary ESIA report.		

1.8.1. Resettlement Policy Framework

Consistent with the Bank's OP4.12, this Preliminary Resettlement Framework sets out three underlying policy principles:

- Involuntary resettlement is avoided wherever feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid involuntary resettlement, activities are conceived and executed as sustainable development programs, providing sufficient investment resources to enable people adversely affected by the project to share project benefits.
- Displaced persons are assisted in their efforts to improve their livelihoods and standards of living, or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

This RPF provides the flexible structure whereby during the course of the project, and particularly by mid-term review, additional RAPs could be prepared and submitted for Bank approval.

More details on affected landlords will be provided in RPF and individual RAPs in the next stage. Moreover, the RPF will include more details on the following issues:

- Eligibility Criteria for defining Project affected persons
- Estimated numbers and categories of affected population
- Residential and other properties
- Vulnerable Groups
- Multiple ownership
- Government property

Although it is difficult at this stage to identify the number of affected people, large-scale works are envisaged and this will apply on agricultural livelihoods and on other uses.

All persons affected by the project shall be entitled to compensation. Only those persons who have been enumerated in the census, or who are able to demonstrate that they should have been included, or that they have been left out in error, shall be assessed for losses and compensation.

Entitlement to compensation shall be to all families, business enterprises or adults affected in respect of property or rights legally held as of the cut-off date. No distinction shall be made in respect of citizenship.

Persons establishing residence or business after the date of the census shall not be entitled to compensation under the project. The purpose of the cut-off date is to prevent persons establishing claims after the intention to expropriate is known, so as to profit from compensation.

However, it should be noted here that no compensation is required for the temporary disruption of businesses either by the Land Acquisition Law of GoJ or World Bank OP 4.12. However, the project

will apply practical mitigation measures to reduce any potentially adverse impacts on businesses during trenching and excavation stage, through the development of a stakeholder and public communication plan.

Where property is expropriated, the minimum standard below which compensation or restitution may not fall in a World Bank-financed project is the condition of the affected persons prior to the project.

Although, this project is large scale and the nature of most expropriations are not simple, it does not require a complex special institutional arrangements. The project will rely on mechanisms and institutions already in place.

Resettlement Estimate Costs

A summary of the costs of implementing the RPF and RAPs for the Zarqa Governorate Wastewater System Reinforcement and Expansion Project has been developed. The costs presented are the costs to the project for compensation for expropriation. At this stage, these costs are notional and purely for indicative purposes. The individual RAPs shall contain more precise cost estimates.

Table 1.6 provides an itemized list of project RAP costs. The details of compensation entitlement packages can be addressed in the detailed stage.

Table 1.5: Overall Project RAP Compensations

Compensation Parameter	**Cost JD**
Land acquisition for sewer lines	6,095,252
Land acquisition for pumping stations	102,000
Sub-total	*6,197,252*
Compensation for physical elements[2]	325,560
Compensation for trees and crops	30,195
Sub-Total	***6,444,487***
Other un-foreseen compensation[3] 10%	644,449
TOTAL	**7,208,307**

The 10% added over the total cost of resettlement in Table 10.3 above is assumed to cover the loss of livelihood which was not possible to define and estimate at this stage of the study due to the fast track nature of this task and the time allowed for the assessment. More realistic cost estimates can be provided in the detailed stage of the ESIA if to be commissioned by WAJ/MCC.

2 Physical element include any (built up area, gates, fences walls, courtyards, water reservoirs ...etc)
3 Any unexpected compensation comes up during detailed design stage.

1.9. Recommended Project Categorization

1.9.1. Project Categorization According to GoJ Requirements

The Environmental Regulation No. 37/2005, the MoE requires a project description consistent with Annex 1 of the regulation in order to determine the project category for an EIA process.

However, according to Annex 3 of the Regulation, infrastructure projects are classified as Category 2 projects requiring preliminary environmental impact assessment. Based on the findings of this preliminary assessment, the MoE will provide its recommendation on whether there is a need to proceed to a comprehensive ESIA study or not.

1.9.2. Project Categorization According to MCC Environmental and Social Guidelines

The preliminary ESIA of the proposed project revealed that the project under study has potential environmental and social impacts that are of moderate significance. These impacts are site-specific with few if any of them being irreversible. Mitigation measures for the identified impacts are available. Hence, according to MCC screening guidelines, this project may be classified as Category B.

1.10. Preliminary Public Consultation

Public consultation activities carried out and expected to be carried out at later stages are as follows:

- Identification of project stakeholders and all parties affected or related to this project.
- Preliminary consultations carried by the social team with people at Zarqa Governorate.
- Conducting a public scoping session and documenting its results in a scoping statement.

1.10.1. Project Stakeholders

All stakeholders with a specific interest in the project activities have been identified. These included stakeholders from the following groups:

- Municipalities of the study area (Zarqa, Al-Russeifa, and Hashmiyah)
- Ministry of Agriculture – Al-Zarqa Agriculture Directorate
- NGOs within study area
- Ministry of Environment – Al-Zarqa Directorate
- Al-Hashmiyah University
- Water Authority of Jordan - Wastewater Directorate
- Local Community members of target neighborhoods
- Households and business owners around the pumping stations

1.10.2. Preliminary Public Consultations

Table 1.6 through **Table 1.8** summarize the comments and feedbacks received from the identified stakeholders during the conducted preliminary public consultation exercise. It should be noted that in general, most of the stakeholders stressed on the fact that short term nuisances due to construction activities would be accepted/tolerated for the long term benefit of expanding the wastewater network.

Table 1.6: Summary of Public Consultations Feedback on Construction Activities

Type of Impact	Positive Impacts	Negative Impacts
Economic Impacts	• Increase in sales especially for grocery stores and popular restaurants were expected to take place on a temporary and low impact basis as a surge of laborers work in the neighborhoods.	• Noise and vibrations from site works are anticipated to significantly and directly impact the poultry farms in the areas where these activities shall take place. • If roads leading to agricultural lands and poultry farms are closed, or if partial closures do not allow large vehicles passage to the agricultural lands, the cattle and poultry farms could suffer financial loss. • Dust resulting from construction activities can cause significant damage to fruit and vegetable farms. • Possible accidental power outages and/or water service disruptions will have a highly negative impact on farms, especially poultry farms. • As long as road closures were done properly and promptly, people of the local communities agreed that it is not a major issue. • Possible accidental outages in the electricity service can burden families due to possible damages to household appliances.
Health/ Environmental Impacts	-	• Participants asserted throughout their interviews that any effects resulting from construction work are temporary, expected, and well known to the community.
Social Impacts	• Al-Sukhneh community contains a large number of skilled and trained young people who will welcome an employment opportunity in construction	• Mobility: construction activities will affect mobility in general and the impact would somewhat increase towards some groups in the community, namely females and children. • Noise impact on students: Some past construction projects had schedules that coincided with exam periods for students, which caused stress for students and impeded their abilities to concentrate.
Infrastructural Impacts	-	• Utilities outages during road work projects were expected. Outages in the electricity could damage household appliances and outages in the water service could force residents to buy water for household use. • Need for proper reinstatement of roads as past construction works left the streets in a bad condition.

Table 1.7: Summary of Public Consultations Feedback on Operation of Wastewater Network

Type	Positive Impact	Negative Impact
Economic Impacts	• **Operational Cost**: connecting to the network is more economically beneficial to the residents of the target areas than the operational costs of cesspools. Eliminating the cost of pumping the seepage pit is identified as a significant and tangible benefit to the residents of the target communities. • **Real Estate Value:** expanding the wastewater network to cover the target areas will raise the land values and housing values. This will also result in improving the socioeconomic mage of the neighborhoods in general.	• **House Connection Fees:** a large portion of the population will be heavily burdened by the connection fee.
Impacts to Local Residents	• **Improved Social Interaction:** issues of hygiene, humidity in houses, odor, annoyances of pumping tankers, etc. frequently cause tensions between neighbors. Those tensions would be eliminated with the introduction of a wastewater network. • **Improved Social Image:** The mere presence of a wastewater network should improve the social status of the community. It is anticipated that the population of the targeted neighborhoods could increase as the areas become more attractive.	-
Health/Environmental Impacts	• **Eliminating the need for seepage pits:** the elimination of seepage pits will have a tangible positive health impact on their communities.	• **Network Overflow Issues:** the overflow of the wastewater network is predominant in Zarqa. Hence, it is needed to take technical and maintenance aspects into consideration so that those issues would not be repeated in the new extended network.
Impacts to Infrastructure	• **Added Value of Wastewater Network Service:** positive impact on the lives of people in the studied communities. Women are expected to benefit the most from the extension of the network as they are the most likely to feel the difference as they will not need to ration their water usage to prevent pits from overflowing. • The project is expected to improve the current situation and stop the constant flooding of the current network and consequently will improve the overall infrastructure of the city as the floods are causing damages to houses (humidity), roads, cars, and walls.	• **Utility Outages during Construction:** past experiences reflect that utilities' outages during road work projects were expected. However, if responded to promptly, it should not be a big problem for the community.

Table 1.8: Stakeholders Feedback on Existing and Proposed Pumping Stations

Pumping Station	Stakeholders Feedback
West Zarqa Pumping Station	• Having an exposed overflow emergency pond irritates the surrounding community with all the hygiene and odor problems it poses. Both residents and business owners complained about the odor the pond produces, especially at nighttime and during the weekends. • Many participants from the local community as well as the Zarqa Governorate mentioned that sometimes, the pumping station redirects its untreated overflow into the Zarqa River. This causes environmental damage to the already polluted river. It also increases the odor problems as it reaches populated areas down the stream. • According to the Ministry of Environment (MoE), the overflow from the West Zarqa pumping station of untreated sewage, arriving from Amman, into the river is considered the major source of surface and groundwater contamination within the project area due to its frequent occurrence. The overflow contributes to the already contaminated river basin, as well as the aquifer through infiltration. Accordingly the MoE recommend the construction of a new Waste Water Treatment Plant, where treated effluents can be discharged into the river provided its quality meets the standards, to eliminate the need for the pumping stations forming a major part of the existing issues.
Pumping Station at Al-Hashmiyah	• Pumps in the Al-Hashmiyah station are new and thus have a larger pumping capacity. This eliminates the need for an emergency pond and as a consequence eliminates most of the odor and hygiene problems. • Unless there was something wrong with the station, odor was not a big issue.
Pumping Station at Hitteen Refugee Camp	• Due to the presence of another establishment near this pumping station (Birket al-Pepsi – Pepsi Pond), the residents were not sure whether it was residential wastewater or the factory's refuse that caused the odor issue. Either way, the odor was unbearable around the pumping station. • There are also safety hazards posed by the pool as well as the repulsive scene of the pond.
Proposed Pumping Station near Al-Sukhneh	• No social acceptance of the proposed pumping station near Al-Sukhneh due to: ▪ Establishing a pumping station or a purification station would have air quality impacts to the village. ▪ Placing the pumping station there will decrease land values and obstruct agricultural activities in the region. ▪ The land where the pumping station is planned to be built is the only public space/outing for both residents and visitors from outside Al-Sukhneh. • It should be noted though that their perception of how a nearby station could affect them is influenced by their exposure to the existing pumping station.

1.10.3. Public Scoping

Upon submission of the application and categorization of the Project, the ESIA Scoping Process is initiated for the purpose of providing the identified stakeholders approved by WAJ and MCC with information pertaining to the proposed investments, outline the ESIA preparation and review process, and obtain their views on the key environmental and social issues that should be considered during the design and implementation of the Project. The MoE will review and provide comment on the Scoping Statement, which when approved will provide the agreed scope of the subsequent ESIA.

2. INTRODUCTION

MWH was retained by the Ministry of Water & Irrigation / Water Authority of Jordan (MWI/WAJ) on November 19th, 2009 to perform consulting services for the preparation of the feasibility study, environmental and social impact assessment and detailed designs and bidding documents for Zarqa Governorate wastewater system reinforcement and expansion. This report presents the Draft Report of the Preliminary Environmental and Social Impact Assessment for the mentioned project.

A preliminary screening of potential environmental and social issues is carried by MWH in conjunction with initial site investigations and development of the Investment Master Plan as required by Section 6 of the TOR and in compliance with the standards and procedures detailed in Jordan's Ministry of Environment Regulations for Environmental Impact Assessment (No.37/2005).

The sub-sections below describe the consultant's understanding of the project, the proponents, the environmental team working to fulfill project requirements, and the structure of this Preliminary ESIA report.

2.1. Project Appreciation and Understanding

Jordan is a semi-desert country and considered to be one of the 10 poorest countries worldwide in water resources. The highly variable seasonal rainfall of 8.3 billion cubic meters is its main source of water.

The per capita annual water share from available renewable water resources dropped from 3,600 m^3 in year 1946 to less than 160 m^3 in year 2007. This water scarcity is the single most important natural constraint to Jordan's economic growth and development. Hence, the country's water sector strategy stresses the need for improved water resource management. Special care is advocated for protection against pollution, quality degradation, and depletion of water resources.

Zarqa Governorate is the third largest governorate in population within the Hashemite Kingdom of Jordan. It has present deficiencies in the wastewater system that present a potential hazard to public health. In particular blocked sewers and resulting spills of raw sewage into the streets is not acceptable. The other major problem with Zarqa Governorate existing wastewater system is its extent where only 72% of the governorate's total subscribers were connected to the sewerage system in 2007.

Hence, this project of reinforcing and expanding Zarqa Governorate wastewater system is perceived to be an important step towards protection of both public health and water resources as well as a step towards improving service levels and consequently living standards for the population of that governorate.

Also, since the national water policies consider treated wastewater as a resource for irrigation, this project would enhance the volumes of wastewater collected for treatment and reuse.

2.2. The Proponents

The project proponents consist of two parties:

- Millennium Challenge Corporation (MCC) which is the project funding party.
- Water Authority of Jordan (WAJ) which is the Ministry's of Water and Irrigation entity in charge of water and wastewater systems.

The Millennium Challenge Corporation (MCC) is an innovative and independent U.S. foreign aid agency helping lead the fight against global poverty. It provides eligible countries with large-scale grants to fund country-led solutions for reducing poverty through sustainable economic growth. MCC grants complement other U.S. and international development programs. There are two primary types of MCC grants:

- **Compacts** which are large, five-year grants for countries that pass MCC's eligibility criteria.
- **Threshold programs** which are smaller grants awarded to countries that come close to passing these criteria and are firmly committed to improving their policy performance.

The Hashemite Kingdom of Jordan has been declared eligible for a five-year multimillion dollar poverty reduction grant from MCC and an agreement have been signed between MCC and the Government.

The Government authority following up on this MCC funded project is the Water Authority of Jordan, Ministry of Water and Irrigation.

Ministry of Water and Irrigation (MWI) is the official body responsible for the overall monitoring of the water sector, water supply and wastewater systems and related projects, planning and management, the formulation of national water strategies and policies, research and development, information systems and procurement of financial resources. Its role also includes the provision of centralized water-related data, standardization and consolidation of data.

The Ministry of Water and Irrigation embraces the two most important entities dealing with water in Jordan. These are the Water Authority of Jordan (WAJ) and the Jordan Valley Authority (JVA). WAJ is the entity in charge of water and sewage systems.

2.3. The Environmental and Social Impact Assessment Team

The MWHAJ project team consisting of engineers and specialists is presented in **Table 2.1**. The primary contact for MWHAJ is:

Imad Ghanayem
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MWH Arabtech Jardaneh
PO Box 9532 - Amman 11191, Jordan
Telephone: +9626 586 1074
Fax: +9626 586 1075
E-mail: imad.s.ghanayem@uk.mwhglobal.com

Table 2.1: MWH Proposed Environmental and Social Assessment Team Assigned for the Project

Name of Staff	Organization	Experts	Task Assigned
Ian Hutchinson	MWH	Home Office Project Director	• Responsible for the overall implementation of the study in quality and timely manner
Imad Ghanayem	MWH	Senior Environmental Specialist (ESIA Project Lead)	• Management of the ESIA Study deliverables; • Complete impact assessment process; • Development of recommendations; • Communicating findings of Environmental and Social Assessments with the Client; and • ESIA QA/QC management.
Widad Adas	Mahara	Social expert (including gender experience)	• Comprehensive Literature Review; • Disaggregation of Collected Data; • Verification of Data; • Preparation of Public Statement; and • Review and Support during Identification of a Priority Investment Program.
Jamal Al Dali	UNRWA	Resettlement and land acquisition	• Assessment of adverse socio-economic impacts; • Assess impact of property acquisition on livelihoods and economic activities; • Preparation of the Resettlement Action Plan RAP; and • Preparation of the operational documents under the RAP.
Dr. Mohammed Waheeb	Lecturer at multiple universities/ consultant	Cultural resources	• Cultural heritage /Archaeology and paleontology baseline assessment; and • Cultural heritage/Archaeology and paleontology impact assessment.
Dr. Zuhair Amr	Jordan University of Science and Technology (JUST)	Flora and Fauna	• Ecological site survey; and • Impact Assessment (Biological Environment).
Atallah Rabi	Jordan University of Science and Technology (JUST)	Public/environmental health;	• Environmental Health Assessment; and • Public Health Assessment.
Ammar Jarrar	VFF Water Council	Water resource management	• Water Resource Management and sustainable water resources.
Samar Haj Hasan	Mahara	Public consultation	• Identification of Stakeholders; • Development of Stakeholder Engagement Plan; • Provide interested parties with information about the development; • Discuss the more significant environmental and socio-economic aspects of the development; and • Organize and manage Public Consultation programs including EIA Scoping Sessions.

Name of Staff	Organization	Experts	Task Assigned
John Hobson	MWH	Air Quality Specialist	• Assessment of air quality impacts including odor control and associated issues; and • Development of preliminary air impacts mitigation and control measures.
Shada El Sharif	MWH	Environmental Engineer	• Assist in conducting the Environmental and Social Impact Assessment Study and development of preliminary impact mitigation measures for the Project.
Ashraf Ma'ani	MWH	Environmental Engineer	• Assist in conducting the Environmental and Social Impact Assessment Study and development of preliminary impact mitigation measures for the Project.
Rasha Tomaira	MWH	Environmental Scientist	• Assist in conducting the Environmental and Social Impact Assessment Study and development of preliminary impact mitigation measures for the Project.

2.4. Objectives of Preliminary Environmental and Social Assessment

The objectives of this preliminary environmental and social impact assessment (PESIA) study are:

- to describe the proposed project and associated works together with the requirements for carrying out the proposed project;
- to provide an overview of the legal and institutional framework related to environmental and social aspects of the project;
- to provide initial description of elements of community and environment likely to be affected by the proposed project and/or likely to cause adverse impacts to the proposed project, including natural and man-made environment;
- to identify emission sources and determine preliminary impacts on sensitive receivers and potential affected uses;
- to identify any potential losses or damage to flora, fauna and natural habitats;
- to identify any negative impacts on sites of cultural heritage and to propose preliminary measures to mitigate these impacts;
- to identify the negative impacts and propose the provision of infrastructure or preliminary mitigation measures so as to minimize pollution, environmental disturbance and nuisance during construction and operation phases of the project;
- to identify, predict and evaluate the residual environmental impacts and the cumulative effects expected to arise during the construction and operation phases of the proposed project in relation to the area's sensitive receptors and potential affected uses;
- to identify, assesses and specify methods, measures and standards, to be included in the detailed design, construction and operation of the proposed project which are necessary to mitigate these environmental impacts and reduce them to acceptable levels;

- to identify any potential land acquisitions and consequent resettlement issues; and
- To design and specify preliminary environmental monitoring and management requirements, if necessary, to ensure the implementation and the effectiveness of the environmental protection and control measures adopted.

The above study objectives will allow the PESIA to achieve the following:

- Ensure environmental and social factors are considered in the decision-making process.
- Ensure that possible adverse environmental and social impacts are identified and avoided or minimized.
- Ensure that social aspects are enhanced.
- Identify key potential impacts and initial measures for mitigating them.
- Facilitate the design of a monitoring program.
- Improve project design.
- Inform the public about the project.
- More effective projects in terms of meeting their socio-economic objectives.
- A positive contribution toward achieving sustainability.

2.5. Report Structure

This draft Preliminary ESIA report has been prepared to provide MoE and WAJ/MCC with a feedback of the likely environmental, social and health impacts due to project execution. This will enable any impact identified to be incorporated into the project design and planning process and hence avoid or minimize potential impacts early in the project. It also will also enable identification of positive environmental and social impacts and instances where these impacts may be amplified. This report consists of the following sections:

Executive Summary	Non technical summary of the preliminary environmental and social impacts assessment report.
Introduction	Overview of the project, its proponent, the PESIA study team and report structure.
Project Description	A clear and concise description of the project from mobilization, construction, operation through to decommissioning. The description is sufficient to allow the preliminary risks and impacts to be identified, described and evaluated.
Policy, Legal and Institutional Framework	Overview of regulatory framework with potential implications to the project.
Environmental and Socio-Cultural Baseline	Assessment of the baseline conditions against which the impacts of the project can be assessed along with a summary of the preliminary

	consultation process which will identify the affected parties and describe how the project will communicate, inform and discuss the substantive issues with identified stakeholders.
Identification of Environmental and Social Receptors	A listing of the indentified environmental and socio-cultural receptors within the project area.
Analysis of Project Alternatives	A comparison of the project alternatives considered and their potential impacts.
Preliminary Assessment of Environmental and Social Impacts	Assessment of the impacts of the project (and methodology used), which includes a listing, description, assessment (including quantification of impact), and discussion of the possible negative and positive impacts of the project on the environment and social fabric, including socio-economic context and public health and safety issues at the preliminary level.
Recommended Project Categorization	A description of the likely significant effects of the Project resulting during the construction and operation phases along with measures to minimize or, if possible, eliminate potential environmental adverse effects. This information is as required by Annex 1 of the EIA Regulation No. 37 and based on the results obtained from the preliminary impact assessment process.
Preliminary Recommendations on Mitigation Measures	Recommendations for measures to eliminate/minimize negative impacts and/or to enhance positive ones.
Preliminary Public Consultation	Summary of the preliminary consultation process which will identify the affected parties and describe how the project scoping will communicate, inform and discuss the substantive issues with identified stakeholders.
Conclusions and Recommendations	Presents the main outcomes and recommendations of the Preliminary ESIA study.
References	A listing of all the references used in the ESIA study.

3. PROJECT DESCRIPTION

The feasibility study, environmental and social impact assessment and detailed designs and bidding documents for Zarqa Governorate wastewater system reinforcement and expansion is divided into two stages: Stage I, which is the base contract, and Stage II, which is optional and will start only upon authorization after a compact is signed with the Millennium Challenge Corporation (MCC). Stage I of the study includes preparatory studies that are required to define an investment program; preliminary environmental and social assessment; preliminary designs; and the assessment of feasibility of the investment program, including economic analysis. Stage II is the preparation of EIA and detailed design and contract documents, and is dependent upon the successful completion of Stage I.

The sections below present a more detailed description of the project objectives, area, components, phases and other aspects that would lead into an understanding of the project and consequently a more comprehensive appreciation of its environmental and social impacts.

3.1. Purpose and Need for Project

Jordan is considered to be one of the 10 poorest countries worldwide in water resources. The available renewable water resources are dropping drastically to an annual per capita share of less than 160 m^3 in recent years, compared to 3600 m^3 per capita in 1946. Thus, the water sector strategy stresses the need for improved resource management, with particular emphasis being placed on the sustainability of the present and future uses. Special care is advocated for protection against pollution, quality degradation and depletion of water resources.

Accordingly, this project aims to plan and prepare urban sanitation improvements in Zarqa Governorate for a project proposal for MCC funding, with the intended purpose to provide collected wastewater, to be later processed and treated, and then used as a substitute for non-domestic purposes (irrigation, industrial, etc), in order to reduce demand on the limited domestic quality water resources.

Fulfilling the objectives of this project will result in a significant general benefit to the entire population of Zarqa due to the decrease or elimination of sewage overflows and the resulting health risks and costs. Also, there will be specific benefit to that part of the population who are presently served only by water and not by sewer when the piped sewerage system is extended.

In addition, the project should be a benefit to people living downstream from Zarqa, near the wadis, due to reduced pollution resulting from the extension of the piped sewerage coverage and the increase in treatment capacity.

Therefore, the objectives of this project are to:

- achieve an overall understanding of the present sanitation conditions and future requirements;

- determine satisfactory service levels and standards commensurate with affordability and environmental concerns;
- project the long-term needs of physical works and how they should be phased in view of investment requirements and availability of funds and criteria to be set on priorities;
- provide justifications for investments in view of expected impacts;
- ensure that the facilities to be provided are least cost solutions, financially and environmentally sustainable and appropriate to the circumstances;
- arrive at the most feasible alternatives for expansion and upgrading of the wastewater collection systems;
- Prepare a feasibility study and detail designs and tender documents for the expansion and upgrading of the sanitation systems in Zarqa Governorate.

3.2. Project Scope of Work

In order to achieve the above mentioned objectives, the following scope of services has been developed:

- **Stage I:** Preliminary Design, ESIA, Feasibility Study and Economic analysis
  - Task 1: Collection of data and preparatory works
  - Task 2: Hydraulic model, analysis of options and Master Plan
  - Task 3: Preliminary environmental and social assessment
  - Task 4: Feasibility study, preliminary design and work plan
- **Stage II:** EIA and Detailed Design and Preparation of Contract Documents (optional)
  - Option A: Environmental impact assessment
  - Option B: Preparation of detailed designs and contract documents

The current study covers Stage I which includes developing and detailing an investment program to reinforce and expand the wastewater system of Zarqa Governorate, conducting a feasibility study and undertaking environmental and social assessments, developing reliable and realistic cost estimates for the proposed investments and developing detailed engineering design and bidding documents for construction.

This study will then form the basis to identify the investment project to be potentially funded by MCC, under a compact that is currently being prepared.

3.3. Project Area

The project covers Zarqa Governorate which extends from Zarqa River in the west to the Saudi border in the east with year 2004 population of 799,000. However, ninety percent of the governorate population is concentrated in the Zarqa, Russeifa and Al-Hashmiyah metropolitan area. This urban area is the second largest metropolitan area in Jordan after Amman with year 2004 population of 687,000 and because of its proximity to Amman is a fast developing area with many urban

development projects planned such as the King Abdullah Bin Abdul Aziz City, with an intended population of 400,300.

The project study area includes all the communities in the Zarqa River basin within the Zarqa Governorate in addition to some of Amman catchment areas that flow downstream of Ain Ghazal pre-treatment facility via the existing West Zarqa wastewater pumping station. After discussions with WAJ, it was understood that a feasibility study and final design and preparation of bidding documents project for the wastewater collection, treatment and reuse for Azraq, in the eastern parts of the governorate, is currently underway. Therefore, the area of Azraq will be excluded from this study. The major communities within the study area include Zarqa, Russeifa, Hashmiyah, Dhuleil and Sukhneh.

The Zarqa Governorate neighborhoods along with 2004 population are presented in **Table 3.1** and the project area is depicted in **Figure 3.1**. Amman neighborhoods were not included as only the wastewater flow downstream of Ain Ghazal Pump Station will be considered.

Table 3.1: Year 2004 Population of Zarqa Governorate

Area	Neighborhood	Neighborhood	2004 Population
Qasabat Al Zarqa			
Al Zarqa			
al-Tafeh	al-Tafeh	الطافح	**693**
al-Rukban	al-Rukban	الركبان	**177**
Khaw	Khaw	خو	**369**
al-Farwaniyeh	al-Farwaniyeh	الفروانية	**110**
Al Wassat AlTejari	Hai al-Hadiqa	الحديقه	3,678
	Hai al-Nuzha	النزهه	5,707
	Hai al-Hussein	الحسين	19,234
	Hai al-Wassat al-Tijary	الوسط التجاري	15,189
	Hai al-Nasr	النصر	12,701
	Hai Ramzi	رمزي	28,155
	Hai Shaker	شاكر	11,225
	Hai al-Basateen	البساتين	1,492
	Hai Ma'soum	معصوم	22,067
	Hai al-Hashemi	الهاشمي	1,438
	Hai al-Ghweireyeh	الغويريه	28,413
	Hai al-Ameer Mohammad	الامير محمد	14,179
	Hai al-Shyoukh	الشيوخ	8,197

Area	Neighborhood	Neighborhood	2004 Population
	Hai Barakh	برخ	6,931
	Hai Ibn Sina	ابن سينا	6,032
	Hai al-Iskan	الاسكان	3,653
		Sub Total	**188,291**
Al Thawrah Al Arabiya Al Kubrah	Hai al-Dhubbat	الضباط	3,966
	Hai al-Janna'a	جناعه	19,146
	Hai al-Thawra al-Arabiya al-Kubrah	الثوره العربيه الكبرى	19,891
	Hai al-Jundi	الجندي	5,058
	Hai al-Masane'e	المصانع	2,099
	Hai Tariq Bin Zeyad	طارق بن زياد	5,902
	Hai Tariq Bin Zeyad	اسكان التطوير الحضري	6,164
		Sub Total	**62,226**
Awajan	Hai al-Ameer Hamzah	الامير حمزه	11,311
	Hai al-Jabal al-Abyad	الجبل الابيض	14,595
	Hai al-Ameera Rahmah	الاميره رحمه	9,157
	Hai al-Ameera Hasan	الامير الحسن	10,423
	Hai al-Malek Talal	الملك طلال	12,734
	Hai Awajan	عوجان	1,463
	Hai al-Falah	الفلاح	7,922
	Hai Umm Bayadhah	ام بياضه	3,444
	Hai al-Dweik	الدويك	1,493
	Hai al-Madina al-Munawara	المدينة المنوره	1,030
	Hai Makah al-Mukarramah	مكه المكرمه	195
	Hai al-Ahmad	الاحمد	1,159
	Hai Nasser	نصار	2,057
		Sub Total	**76,983**
al-Zawahra	Hai al-Zawahra	الزواهره	16,520
	Hai al-Qamar	القمر	3,139
	Hai Qurtuba	قرطبه	3,291
	Hai al-Jneineh	الجنينه	1,056
	Hai al-Jabr	الجبر	1,663

Area	Neighborhood	Neighborhood	2004 Population
	Hai al-Ameera Haya	الاميره هيا	4,168
	Hai Shomar	شومر	313
	Hai al-Bustan	البستان	246
		Sub Total	**30,369**
Al-Zarqa Al-Jadeida	Hai al-Zarqa al-Jadeida	الزرقاء الجديده	23,244
	Hai al-Batrawi	البتراوي	9,235
	Hai al-Hirafyeen	الحرفيين	29
	Hai al-Hashmiyah al-Janoubiyah	الهاشميه الجنوبيه	4,608
	Hai al-Bustan Ma'amel al-Toub	معامل الطوب	215
		Sub Total	**37,331**
Birein			
Birein	Birein	بيرين	**1,174**
Umm Rummaneh	Umm Rummaneh	ام رمانه	**1,070**
al-Kamsha	al-Kamsha	الكمشة	**1,239**
al-Alouk	al-Alouk	العالوك	**630**
Hai Sarout	Hai Sarout	صروت	**1,178**
Marhab	Marhab	مرحب	**646**
Rujm al-Shook	Rujm al-Shook	رجم الشوك	**690**
al-Naseriyah	al-Naseriyah	الناصرية	**508**
al-Mikman	al-Mikman	المكمان	**488**
al-Masarrah al-Sharqiyah	al-Masarrah al-Sharqiyah	المسرة الشرقية	**359**
al-Masarrah al-Gharbiya	al-Masarrah al-Gharbiya	المسرة الغربية	**431**
al-Makhdat	al-Makhdat	الماخذات	**24**
al-Khillah	al-Khillah	الخلة	**236**
Maqam Eisa	Maqam Eisa	مقام عيسى	**521**
Ein Saber	Ein Saber	عين صابر	**584**
al-Birah	al-Birah	البيرة	**333**
al-Riyadh	al-Riyadh	الرياض	**437**
al-Sahhara	al-Sahhara	السحارة	**55**

Area	Neighborhood	Neighborhood	2004 Population
al-Ouweillieh	al-Ouweillieh	العويلية	**139**
Wadi Suwwan	Wadi Suwwan	وادي الصوان	**208**
Umm Fatyer	Umm Fatyer	ام الفطاير	**101**
Ein al-Hawaya	Ein al-Hawaya	عين الحوايا	**82**
Umm Khasheibah	Umm Khasheibah	ام خشيبة	**353**
Umm al-Biyar	Umm al-Biyar	ام البيار	**413**
Al-Dhuleil			
al-Dhuleil	al-Dhuleil	الضليل	**27,643**
Qasr al-Hallabat al-Sharqi	Qasr al-Hallabat al-Sharqi	قصر الحلابات الشرقي	**1,823**
Qasr al-Hallabat al-Gharbi	Qasr al-Hallabat al-Gharbi	قصر الحلابات الغربي	**2,461**
al-Deheitem	al-Deheitem	الدهيثم	**257**
Sayeh Diyab	Sayeh Diyab	سايح ذياب	**273**
Mazare'e Hallabat	Mazare'e Hallabat	مزارع الحلابات	**149**
Russeifa			
AlAameria	Hai Awajan al-Shamali	عوجان الشمالي	260
	Hai Umm Jarada	ام جراده	205
	Hai al-Jundi	الجندي	4,076
	Hai al-Ameer Ali	الامير علي	4,386
	Hai Kharrouba al-Sharqi	خروبة الشرقية	301
	Hai Kharrouba al-Gharbi	خروبة الغربي	84
	Hai al-Arateqa	العراتفه	8,550
	Hai al-Arab	العرب	5,034
	Hai al-Hussein	الحسين	9,655
		Sub Total	**32,551**
al-Qadessiyah	Hai al-Jabal al-Shamali	الجبل الشمالي	30,630
	Hai al-Khalediyah	الخالدية	3,748
	Hai al-Qadessiyah	القادسية	23,326
		Sub Total	**57,704**
al-Yarmouk	Hai Awajan al-Gharbi	عوجان الغربي	14,025
	Hai Umm Jarada al-Shamali	ام جرادة الشمالي	6,275

Area	Neighborhood	Neighborhood	2004 Population
	Hai Umm Jarada al-Gharbi	ام جرادة الغربي	4,143
	Hai al-Daheriyah	الظاهرية	5,155
	Hai Iskan al-Ameer Talal	اسكان الامير طلال	4,064
	Hai al-Razi	الرازي	1,982
	Hai al-Tatweer al-Hadari	التطوير	18,139
	al-Mustashfa	المستشفى	57
		Sub Total	**53,840**
al-Rasheed	Hai al-Rasheed al-Janoubi	الرشيد الجنوبي	7,869
	Hai al-Hurriyah	الحرية	2,439
	Hai Ja'far al-Tayar al-Janoubi	جعفر الطيار الجنوبي	1,161
	Hai Ja'far al-Tayar	جعفر الطيار	7,465
	Hai al-Rasheed al-Shamali	الرشيد الشمالي	11,682
	Hai Jraiba	جريبا	2,218
		Sub Total	**32,834**
Hitteen	Hai al-Ghaidaniyah	الغيضانية	152
	Hai Ein Shabwa	عين شبوا	81
	Hai al-Msheirfah	المشيرفة	11,731
	Hai al-Msheirfah al-Gharbi	المشيرفة الغربي	2,870
	Hai al-Msheirfah al-Janoubi	المشيرفة الجنوبي	3,212
	Hai al-Iskanat	الاسكانات	8,542
	Hai Abu Ghalyoon	ابو غليون	2,740
	Hai Jabal al-Ameer Faisal	الامير فيصل	18,405
	Hai al-Wananat	الونانات	636
	Theodor Shneller	ثيودور شلنر	76
	Hai al-Fakhourah	الفاخورة	2,361
		Sub Total	**50,804**
Hai Abu Sayyah	Hai Abu Sayyah	ابو صياح	**2,001**
Hai Hitteen Camp	Hai Hitteen Camp	مخيم حطين	**38,501**
Al-Hashmiyah			
Al-Hashmiyah	Hai al-Hashmiyah	الهاشمية	**18,396**
	Hai Iskan al-Hashmiyah	اسكان الهاشمية	**5,979**

Area	Neighborhood	Neighborhood	2004 Population
	Hai al-Fayha'a	الفيحاء	**1,100**
al-Sukhneh	al-Sukhneh	السخنة	**12,687**
Abu al-Zeighan	Abu al-Zeighan	ابو الزيغان	**2,127**
Dogara	Dogara	دوقره	**1,868**
Ein al-Nimra	Ein al-Nimra	عين النمره	**131**
Ghareisa	Ghareisa	غريسه	**667**
Umm Suleih	Umm Suleih	ام الصليح	**2,140**
al-Ghuneiyah	al-Ghuneiyah	القنية	**550**
Daba'an	Daba'an	ضبعان	**243**
Tawaheen al-Adwan	Tawaheen al - Adwan	طواحين العدوان	**47**
al-Hasab	al-Hasab	الحصب	**47**
Al-Azraq			
	Al-Azraq District		**9,021**
Grand Total			**764,650**

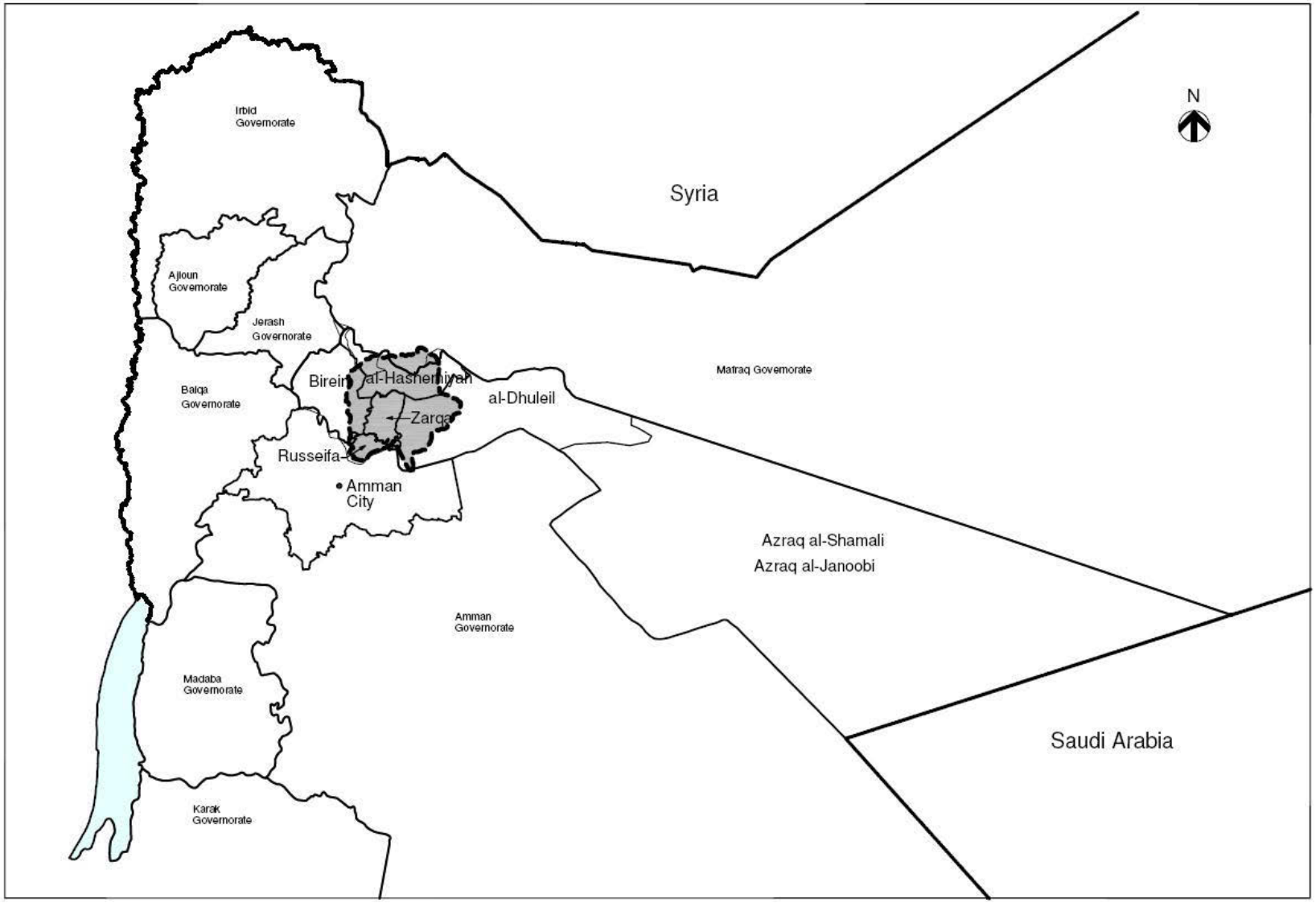

Figure 3.1: Location Map of Project Area

3.4. Existing Wastewater System

The first piped sewerage system was constructed in 1985 serving the central areas of Zarqa and Russeifa cities. Today the total length of the gravity sewer network is about 851 km of diameter 200 – 1000 mm, serving most of Zarqa, Russeifa and al-Hashmiyah areas.

The existing collection systems are supported by three existing pumping stations (West Zarqa, East Zarqa and Hitteen). West Zarqa pumping station serves west Zarqa area that drains towards Zarqa River and Russeifa in addition to flows coming from parts of Amman that drain downstream of Ain Ghazal preliminary treatment plant. East Zarqa pumping station located in Al-Hashmiyah serves the eastern parts of Zarqa and Al-Hashmiyah. Hitteen pumping station is small lifting station serving a small section of Hitteen camp in Russeifa.

All collected wastewater at West Zarqa and East Zarqa pumping stations is delivered to As-Samra WwTP via 1200 mm diameter and two-500 mm diameter pumping mains, respectively.

The existing wastewater collection system is designed as a separate collection system, which is not sized for storm water collection.

3.4.1. Existing Wastewater Collection System

The existing collection system in the Amman-Zarqa Study Area includes the main sewer trunk lines (generally 300 to 1200 mm in diameter) and collector sewers (generally 200 mm in diameter) in three adjacent but distinct areas, as follows:

- Russeifa – West Zarqa Sewer System: The communities of Russeifa and Zarqa form a continuous sewered area with Amman in the Zarqa River Basin. The Northeast Amman areas of Tariq, Marka and part of Shafa Badran, Jubaiha and Naser are also tributary to the Russeifa/West Zarqa sewer system, resulting in a sub-system that accounts for about 70% of the collection system in the Study Area. Flow collected by the Russeifa/West Zarqa system drains by gravity to the West Zarqa Pumping Station. At the West Zarqa Station, wastewater flows are pumped into the 1200 mm siphon under pressure of approximately 110 meters to al-Samra WSP. Trunk sewers in the Russeifa/West Zarqa system are predominantly 300 to 1000 mm diameter pipes.
- East Zarqa – Hashmiyah Sewer System: A separate gravity sewer network serves developed areas in East Zarqa and Hashmiyah, resulting in a sub-system that accounts for about 30% of the collection system in the study area. Flows collected from the area are conveyed by gravity to the Hashmiyah Pumping Station and pumped directly to al-Samra through two 500 mm, 7.2 km force mains under a pressure head of approximately 90 meters. Trunk sewers in the sub-system are predominantly 300 to 1000 mm diameter pipes.

The total length of the main sewers with diameters equal to or above 300 mm is about 117 km. The secondary network is a network of 200 mm diameter sewers covering most of the populated areas of Zarqa, Russeifa and al-Hashmiyah with a total length of about 734 km and about 91,045 house

connections. Most of the sewers are made of concrete, and a few are made of ductile iron and vitrified clay.

The sewer networks are operated by WAJ Zarqa directorate through two wastewater operation offices: one for the Zarqa and al-Hashmiyah networks and one for the Russeifa networks.

Investigations have shown that:

- Most of the flat sewers are blocked by sand, silt and grease; and
- Several segments of the collection system are overloaded during rain events, causing backup into streets, wadis, and in some rare cases into residences.

In 2008, WAJ started a program for cleaning the sewers using specialized bucket machines. WAJ operators have carried out the cleaning of 22 km during the last two years, and the cleaning of another 20 km was contracted to a local firm. Results of the sewer cleaning operations are very promising as sewers blocked to more than half full have been fully cleared of the sediments. It is thought that such cleaning operations should be continued, as they will increase the expected life of the sewers considerably, and will eliminate the need for upgrading or replacement of many of the sewers.

The basic layout of the sewer system was obtained from the GTZ/OMS team who are currently working on the preparation of the GIS systems for the Zarqa water and wastewater systems.

The MWH Team conducted an extended verification of the wastewater GIS maps of the sewer system, by comparing the drawings to the record drawings of the 60 collected wastewater construction contracts and through site visits and meeting with the Zarqa Water Directorate operators. Sewer networks for areas such as Hai Ja'far al-Tayyar in Russeifa and scattered sewers in al-Hashmiyah and Hai al-Batrawi in Zarqa were added to the OMS maps, but there are still some areas for which no information is available for the existing sewers.

The extent of the existing wastewater collection networks is shown in **Figure 3.2** and the lengths of the sewers are summarized in **Table 3.2**.

Table 3.2: Summary of Lengths of Existing Gravity Sewers[4]

Sewer Diameter	Length (meter)
200	726,378
300	53,412
400	15,665
500	19,535
700	8,678
800	27,170
1000	2,366

4 Note: Does not include sewer networks in Hai al-Jundi and Hai al-Ameer Ali in Russeifa which no as-built drawings were made available.

Sewer Diameter	Length (meter)
Total	**853,204**

The last records obtained from WAJ show that the total number of water house connections in 2009 is 130,948, while the number of wastewater house connections is 94,265, which indicates 72% coverage.

Although storm water inflow is recognized as a significant source of excess flow into the collection system during rainfall events, the relative infrequency of significant rainfall events does not justify major upsizing of the system to accommodate storm flows. Rather, it is assumed that WAJ will continue efforts to promote compliance with current storm water regulations that require that roof and area drains not be connected to the wastewater system.

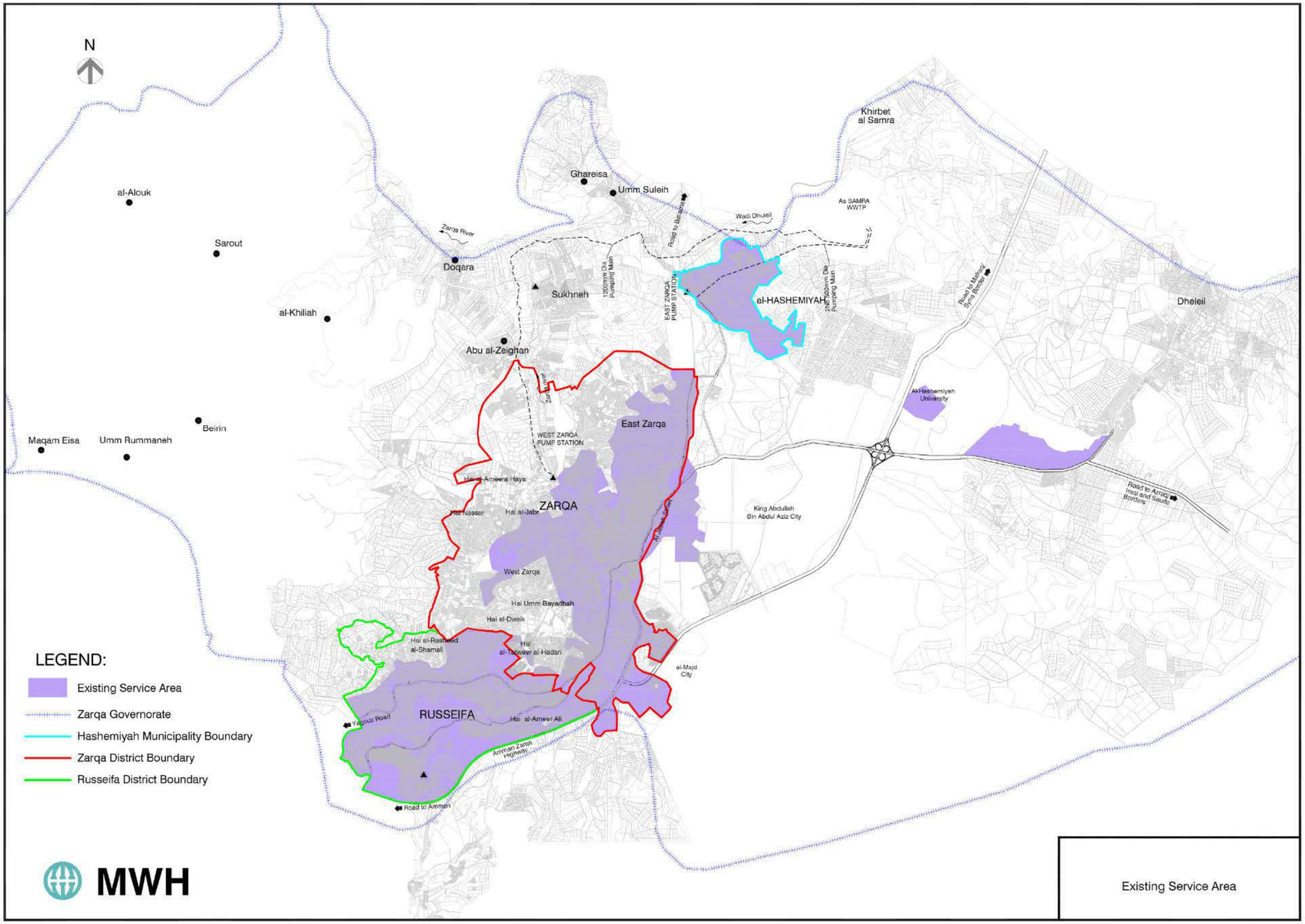

Figure 3.2: Extent of the Existing Service Area

3.4.2. Existing Pump Stations

Zarqa sewerage system includes two main pump stations: West Zarqa Pumping Station (WZPS), and East Zarqa Pumping Station (EZPS) that deliver to As-Samra WwTP. A lifting station, Hitteen Camp Pumping Station (HCPS), serves a small section of the camp and delivers to the Russeifa collection network. West Zarqa and East Zarqa Pumping Stations are currently operated and maintained by the As-Samra Plant Operation & Maintenance Co. Ltd., and Hitteen Camp Pumping Station is operated by WAJ / Russeifa operations. **Table 3.3** presents the observations and findings concerning these pumping stations.

The odor problem at West Zarqa Pump Station could be contributed to one or a combination of the following problems:

- Odor at the inlet work indicates prolong storage of screening and grit at the facility.
- Because of the relatively small size wet wells, the emergency pond (10,000 m^3) is used frequently to store excessive flows. The overflow during the day passes from the wet wells to the emergency pond and is returned back during the night. Odor is believed to be generated at the emergency pond because it is not being regularly cleaned.
- The aeration system in the emergency pond is not operational due to the fact that the pond is located at a low level which causes the accumulation of rocks, solids...etc to at the bottom of the pond. This causes clogging the aeration system by the accumulated solids.
- At summer time, the pond will be a good environment and food source for flies and insects which cause a severe health and environmental problems.

Table 3.3: Overview of the Operating Pump Stations

Pump Station	Catchment Area	Discharge Location	Approximate Daily Average Discharge	Facilities at Pump Station	Observations & Comments
West Zarqa Wastewater Pumping Station - WZPA	Russeifa, west Zarqa and the northern parts of Amman	Downstream of Ain Ghazal Treatment Plant (AGTP)	57,000 m^3/day at a pressure of 65 m	• Inlet Structure • Grit Removal System • Wet Wells • Pumps • One discharge flow meter • Emergency pond • Emergency power generator	• The pump station is working close to its full capacity; any additional inflow will require pump station upgrade or replacement. • The manual coarse screen at the inlet work needs periodic and continuous cleaning due to high continuous flow load; being manual consumes a lot of time and effort in cleaning. • A fairly noticed amount of oil and grease are collected at the top level in the Grit Removal and is removed by flushing (which is technically unaccepted and inefficient). • Rotten egg odor is an indication of hydrogen sulfide formation. This can be read as well from the H_2S indicator in the control room.
East Zarqa Wastewater Pumping Station - EZPS	East Zarqa and Al-Hashmiyah	As-Samra WwTP	12,000 m^3/day	• Inlet Structure • Wet Wells • Pumps • Outlet force main • Power generator	• The screening produced from the fine screens are removed manually (the conveyor does not work). At high load, this will be an operational problem and manual removal will not be applicable, furthermore, odor problems will be clearly noticed. • This station can receive more flow in the future, however the need for expansion will depend on the future flows estimated and the final alternative considered.
Hitteen Camp Pumping Station	The lower elevations in Hitteen Camp and nearby areas	-	-	• Inlet chamber with a screening basket including lifting crane • Wet Well • 3 submersible pumps including lifting crane	• The station is in a bad operational condition and up to now details of flows and capacities are not available.

3.5. Evaluation of Existing Wastewater Network

Presently, the deficiencies in the sewerage system in Zarqa Governorate are such that they represent a danger to public health. The deficiencies can be outlined as follows:

1. Blocked sewers by sand, silt and grease, causing spills of raw sewage into the street. Some of the sewers have been found to be more than half full with sediments. This can be explained in various ways: undersized pipes; poor condition of some pipes and manholes; and poor maintenance of the sewerage system.
2. Several segments of the collection system are overloaded during rain events, causing backup into streets, wadis, and, in some rare cases, into residences. These wet weather problems are largely attributed to unauthorized storm drain connections from many buildings, as well as open manhole covers in flooded streets and wadis.
3. Inadequate pumping (storage) capacity at the pumping stations to cater for rain events. Storm water collected through the sewer system is allowed to overflow into Zarqa River.

The other major problem with the existing sewer system in Zarqa Governorate is its extent where the system coverage is around 72%.

Future wastewater generation rates are expected to increase by more than double the present level, to 192,000m^3/day by the year 2035. It is urgent to improve, renew and extend the wastewater collection, treatment and disposal systems. To address these issues, the following aspects will be studied:

- The extension of the coverage of piped sewerage within Zarqa Governorate to areas that are not presently connected.
- The expansion of the trunk sewer system to better cope with present and future demand.
- The reduction of the number of blockages and sewage overflows through the upgrading of trunk sewers.
- Increasing wastewater volumes being collected and treated.

Collection system improvements will require immediate implementation primarily of maintenance and management actions intended to reduce the impacts of storm water inflow, silt and debris, and industrial discharges on system performance. Specific recommended actions include:

1. Sewer Cleaning and Maintenance: Proceed with immediate implementation of a systematic program of sewer inspection, cleaning and repair to reduce the impacts of silt and debris accumulations, protruding taps and structural damage on system performance. Initial efforts should be prioritized based on the results of the field investigations performed for the master plan.
2. Control of Storm water Inflow: Initiate immediate action for preventing future connection of storm water drains to sanitary sewers and encourage the re-direction of exiting storm water connections. Actions required may include improved enforcement of building codes,

development of typical details for elimination of private storm water connections and implementation of public education programs aimed at encouraging the redirection of storm water connections. Progress in this area should be monitored through annual monitoring of wet weather sewer flows at select locations.

3. Control of Discharges to Sewer System: Develop and implement programs to more aggressively control potentially toxic industrial discharges of oils, heavy metals and/or toxics to the sewer system. Actions required may include the identification and registration of industrial dischargers and the enforcement of industrial pre-treatment regulations. Public education efforts should also promote the use of low “suds” detergents to reduce foaming in the treated wastewater effluent.

3.6. Determination of New Service Areas

The new service areas within the catchments of the existing networks consist mainly of the newly developed neighborhoods of Zarqa and Russeifa west of the Zarqa River and some parts of Hai Batrawi in north Zarqa.

The towns and villages in Birein, Dhuleil and Al-Hashmiyah districts that do not drain to the existing pumping stations will be included in the study. Topographic maps for the whole study area were used to define the main and sub-main flow catchment areas for both served and proposed to be served areas.

Most areas of Birein district drain to Zarqa River downstream of Sukhneh. The town of Dhuleil and nearby villages drain to Wadi Dhuleil which passes near As-Samra WwTP. Flows from eastern parts of al-Hashmiyah district could be collected at the town of Sukhneh which lies at the confluence of Zarqa River and Wadi Dhuleil and flows from the western parts of this district could be collected at point downstream of Zarqa River along with flows from al-Birein district.

3.7. Description of Proposed Wastewater System Reinforcement and Expansion

To meet the needs of the Zarqa wastewater systems over the proposed service area through the year 2035, improvements to the existing systems will be required. In this section, alternatives to improve and extend these utility systems are identified. The objective is to select a recommended long-range plan for the improvement to the wastewater systems over the planning horizon.

3.7.1. Main Catchment Zones

Based on the topography of the study area, and based on the main system elements of the Zarqa wastewater system, the study area is divided into four main wastewater collection zones as illustrated in **Figure 3.3**. The boundary of each zone includes all existing sewer networks as well as any future sewer networks that will be implemented within the zone. This gives a clear idea about future service areas that will affect any existing or new sewers. The four zones are:

1. West Zarqa Pumping Station Zone: This zone includes the areas that drain by gravity towards the existing West Zarqa Pumping Station. This zone includes mainly the old developed parts of west Zarqa, Russeifa and the northeast parts of Amman (Marka, Tareq, part of Shafa Badran, parts of Jubaiha and parts of Nasser).
2. East Zarqa Pumping Station Zone: This zone includes the areas that drain towards the existing East Zarqa Pumping Station. This zone includes mainly east Zarqa, al-Hashmiyah and the new development area of King Abdullah Bin Abdul Aziz City.
3. Sukhneh Pumping Station Zone: This zone includes the areas that drain towards the proposed Sukhneh Pumping Station. This zone includes mainly the Sukhneh town, new developed neighborhoods west of Zarqa (such as Hai al-Ameera Haya, Hai al-Hashemi, Hay al-Bustan, Hai Shomer, Hai al-Jabr, Hai Nassar, Hai al-Ahmad, Hai Makka al-Mukarrama and parts of Hai al-Madinah al-Munawwara). It also includes communities along Wadi Zarqa and upstream of Sukhneh such as Abu Zeighan and Salheyah.
4. Wadi Zarqa Zone: This zone includes the areas that are located downstream of the proposed Sukhneh Pumping Station and drain their sewers directly toward the proposed Wadi Zarqa Treatment Plant. This zone includes mainly the staggered communities located in the northwestern part of Zarqa Governorate, such as Birein, Um Rummanah, Maqam Eisa, Dogara, al-Khilah, Sarout, al-Alouk, Ghareisa and Um Sulaih.

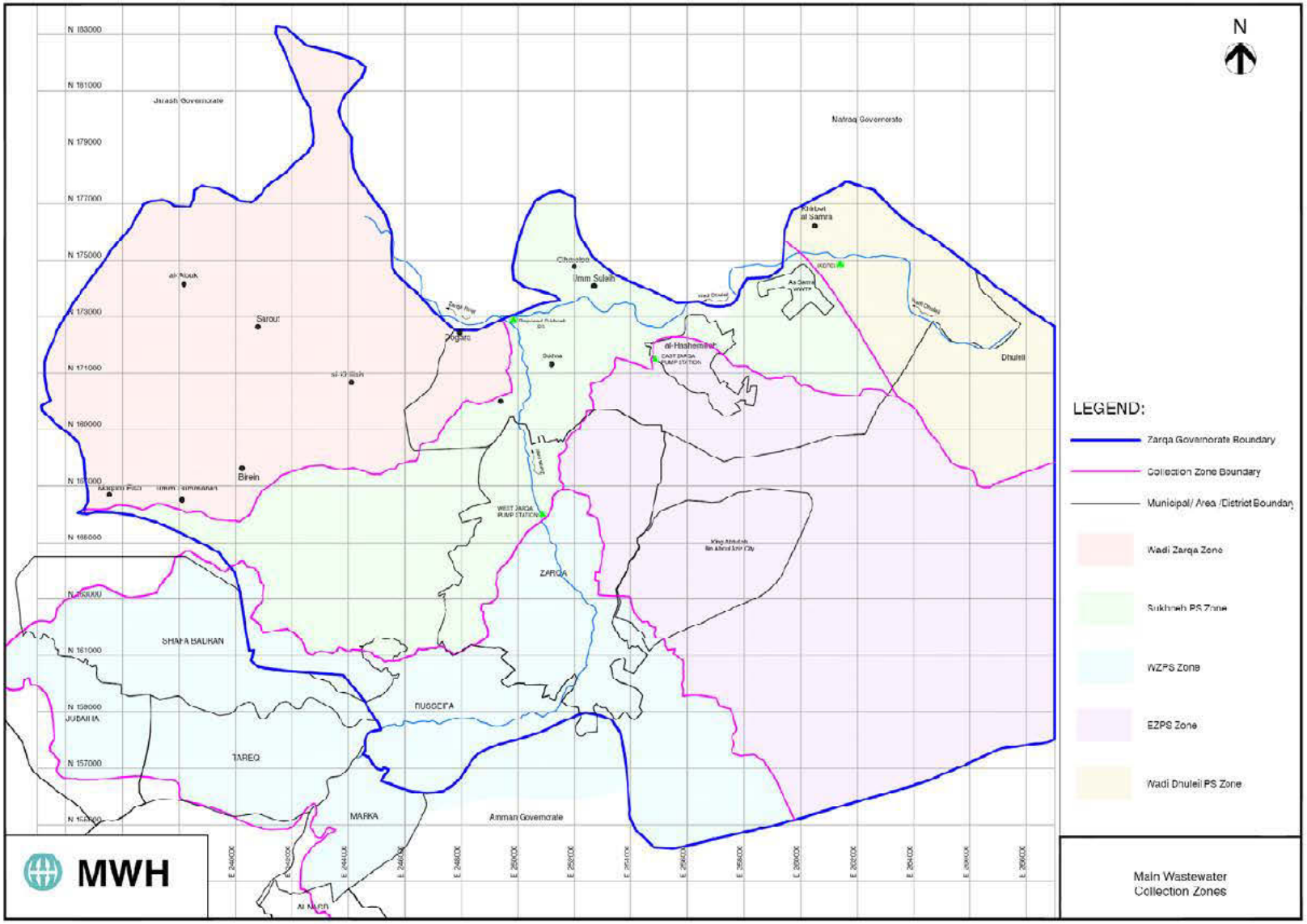

Figure 3.3: Four main Wastewater Collection Zones

3.7.2. New Service Areas

The ToR has asked for the following areas to be served by new wastewater networks:

- Russeifa North (120 ha).
- Otl al-Zarqa and al-Russeifa (170 ha).
- Batrawi (220 ha).
- Sukhneh (290 ha).
- Hashmiyah (200 ha).
- Other unserved parts within served areas (filling gaps).

Accordingly, and based on the findings regarding the extent of the existing wastewater network, a layout of the proposed wastewater networks was prepared that covers the unserved areas within the main Zarqa zones described above, as shown on **Figure 3.4**.

The new service areas can be classified into two main categories:

- New Service Areas within Zarqa, Russeifa and Hashmiyah Municipalities: The main new served areas within this category are:
    1. Hai Batrawi (partially)
    2. Sukhneh town
    3. Salheyah
    4. Abu al-Zeigan
    5. Hai al-Bustan
    6. Hai Shomer
    7. Hai al-Hashemi
    8. Hai al-Jneneh
    9. Hai al-Ameera Haya
    10. Hai Nassar
    11. Hai al-Jabr
    12. Hai al-Ahmad
    13. Hai al-Madinah al-Munawwarah (partially)
    14. Hai Makka al-Mukarramah
    15. Hai Umm Bayadhah
    16. Hai al-Duwaik
    17. Hai al-Falah (partially)
    18. Hai al-Rasheed al-Shamali (partially)
    19. Hai al-Tatweer al-Hadari
    20. Hai al-Jraiba (partially)
    21. Networks to fill gaps (scattered in various areas)
- Remote and Isolated Communities: The proposed systems can be classified as follows:
    - West communities that could be served either by gravity to the proposed Wadi Zarqa Treatment Plant, or by sewer force main back to the proposed Sukhneh Pumping Station. These communities include:
        - Maqam Eisa;
        - Umm Rummanh;
        - Birein;
        - al-Khillah;
        - al-Alouk;
        - Sarout;
        - Ghareisa;
        - Umm Suleih; and

    - Dogara.
- East communities that could be served by sewer trunk line along Wadi Dhuleil and force main up to the existing As-Samra Wastewater Treatment Plant. A pre-treatment facility will be provided at the proposed pumping station at Wadi Dhuleil. The communities are:
    - Dhuleil; and
    - Khirbet As-Samra.
- Abu Sayyah community south of Russeifa that could be served by a sewer trunk line and connected to the main existing sewer line along Amman-Zarqa Highway.

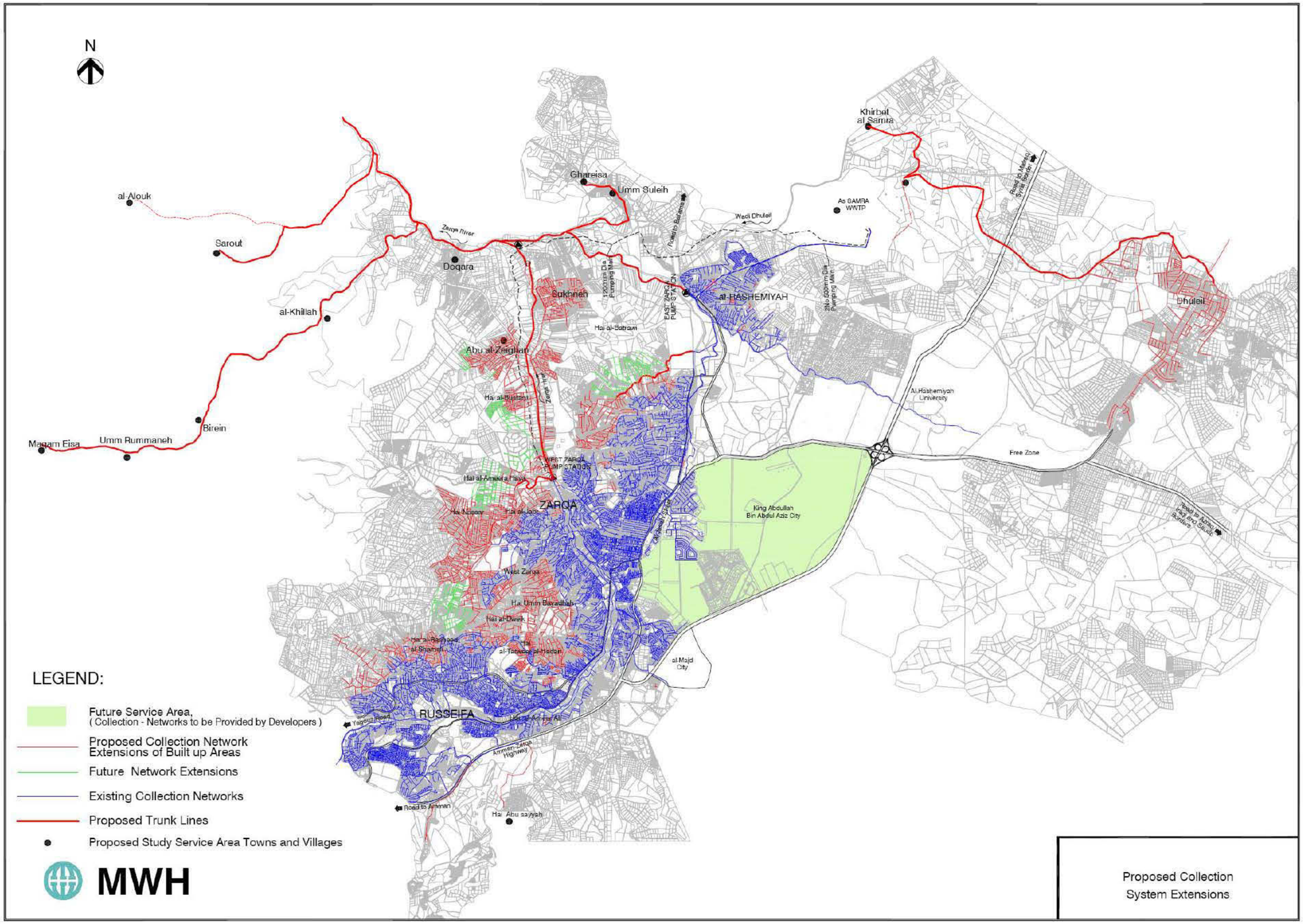

Figure 3.4: Proposed Collection System Extensions

3.7.3. New Pumping Stations

It is anticipated to have the following new pumping stations to serve remote and isolated communities:

- Sukhneh Pumping Station: As mentioned above, if the option selected for treating wastewater will be in As Samra WwTP, this pump station will be required. In such case, the option of pumping the wastewater to WZPS as proposed by the previous design have to be re-evaluated against having multiple pumping stations to pump directly to As Samra WwTP due to the high difference in head. However, if the option to transfer wastewater to the new proposed Wadi Zarqa Treatment Plant this pump station will not be required.
- Wadi Dhuleil Pumping Station: This pumping station would be required to serve east communities, and it will pump to As Samra WwTP.
- Al-Alouk Pumping Station: To serve the small community in Al-Alouk it will require a pump station to convey the wastewater to Wadi Zarqa.
- Wadi Zarqa Pumping Station: This pump station would be required if the option selected is to treat wastewater at As Samra WwTP. In this case Wadi Zarqa Pumping Station would pump its inflows to Sukhneh Pumping Station.

3.7.4. Main Wastewater Options

Based on the derived main wastewater catchment areas, and based on the location of the existing and new service areas, five main options are identified for evaluation at later stages of this study. These options are:

- Option 1: Convey flows from the study area to the location of the proposed Wadi Zarqa Treatment Plant. This option involves constructing a new pump station at Al-Alouk and a new wastewater treatment plant at Wadi Zarqa. The East and West Zarqa pump stations will be eliminated. Khirbet AS-Samra pump station will be built to pump wastewater from Khirbet As-Samra and Dhuleil areas to As-Samra Wastewater treatment plant. The proposed wastewater trunk lines are depicted in **Figure 3.5**.
- Option 2: Continue to convey flows from the study area to as-Samra WwTP. This option involves expansion of the EZPS and WZPZ and the construction of new pump stations which are Wadi Zarqa, Sukhneh, and Khirbet As-Samra pump stations. The Sukhneh and Wadi Zarqa pump stations will pump their flow to WZPs. The proposed wastewater trunk lines are depicted in **Figure 3.6**.
- Option 3: Continue to convey flows from the study area to as-Samra WwTP. This option involves expansion of the EZPS and WZPZ and the construction of new pump stations which are Wadi Zarqa, Sukhneh, and Khirbet As-Samra pump stations. The Sukhneh and Wadi Zarqa pump stations will pump their flow to EZPs. The proposed wastewater trunk lines are depicted in **Figure 3.7**.
- Option 4: Continue to convey flows from the study area to as-Samra WwTP. But provide the communities of Birein Districts with package wastewater treatment units where Maqam Eisa, Umm Rummaneh and Birein will be served by one local WwTP and Al-Alouk and Sarout will

be served by another local WwTP. This option involves constructing a new pump station at Al-Alouk and two new local wastewater treatment packages for Wadi Zarqa. Al-Alouk pump station will be constructed to convey the flow to one of the local wastewater treatment packages. The East and West Zarqa pump stations will be expanded. Sukhneh pump station will pump to EZPS. Khirbet AS-Samra pump station will be built to pump wastewater from Khirbet As-Samra and Dhuleil areas to As-Samra Wastewater treatment plant. The proposed wastewater trunk lines are depicted in **Figure 3.8**.

- Option 5: Continue to convey flows from the study area to as-Samra WwTP. But provide the communities of Birein Districts with package wastewater treatment units where Maqam Eisa, Umm Rummaneh and Birein will be served by one local WwTP and Al-Alouk and Sarout will be served by another local WwTP. This option involves constructing a new pump station at Al-Alouk and two new local wastewater treatment packages for Wadi Zarqa. Al-Alouk pump station will be constructed to convey the flow to one of the local wastewater treatment packages. The East Zarqa pump station will be expanded, whereas the West Zarqa Pump station will be eliminated. A new pump station will be built near Sukhneh and a new booster pumping station will be added along the conveyance route between Sukhneh and Samra WwTP. Khirbet AS-Samra pump station will be established to pump wastewater from Khirbet As-Samra and Dhuleil areas to As-Samra Wastewater treatment plant. The proposed wastewater trunk lines are depicted in **Figure 3.9**.

These five options are illustrated in **Figure 3.5** through **Figure 3.9**. These are further discussed in terms of environmental implications in **Section 7 – Preliminary Analysis of Project Alternatives**.

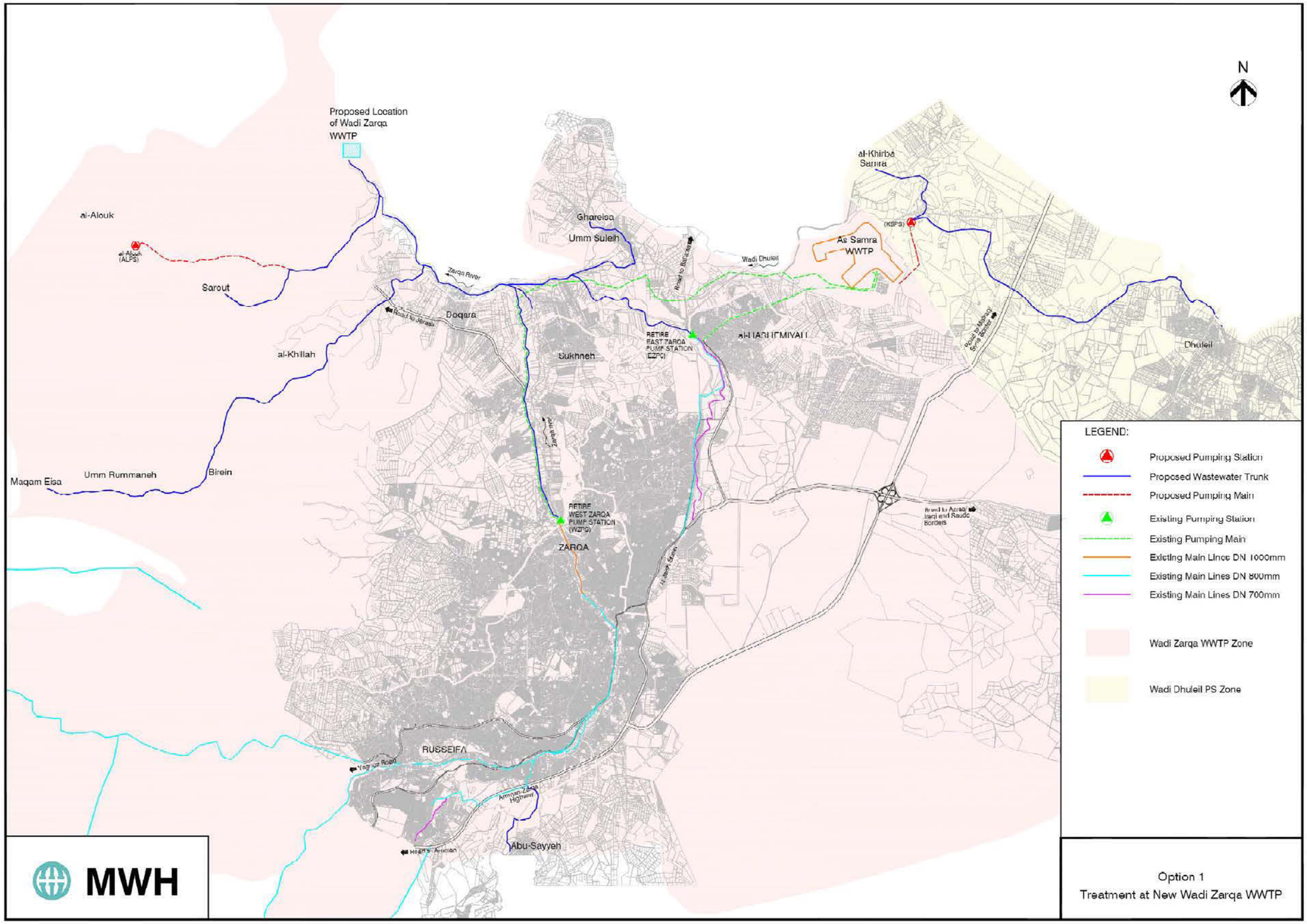

Figure 3.5: Option 1

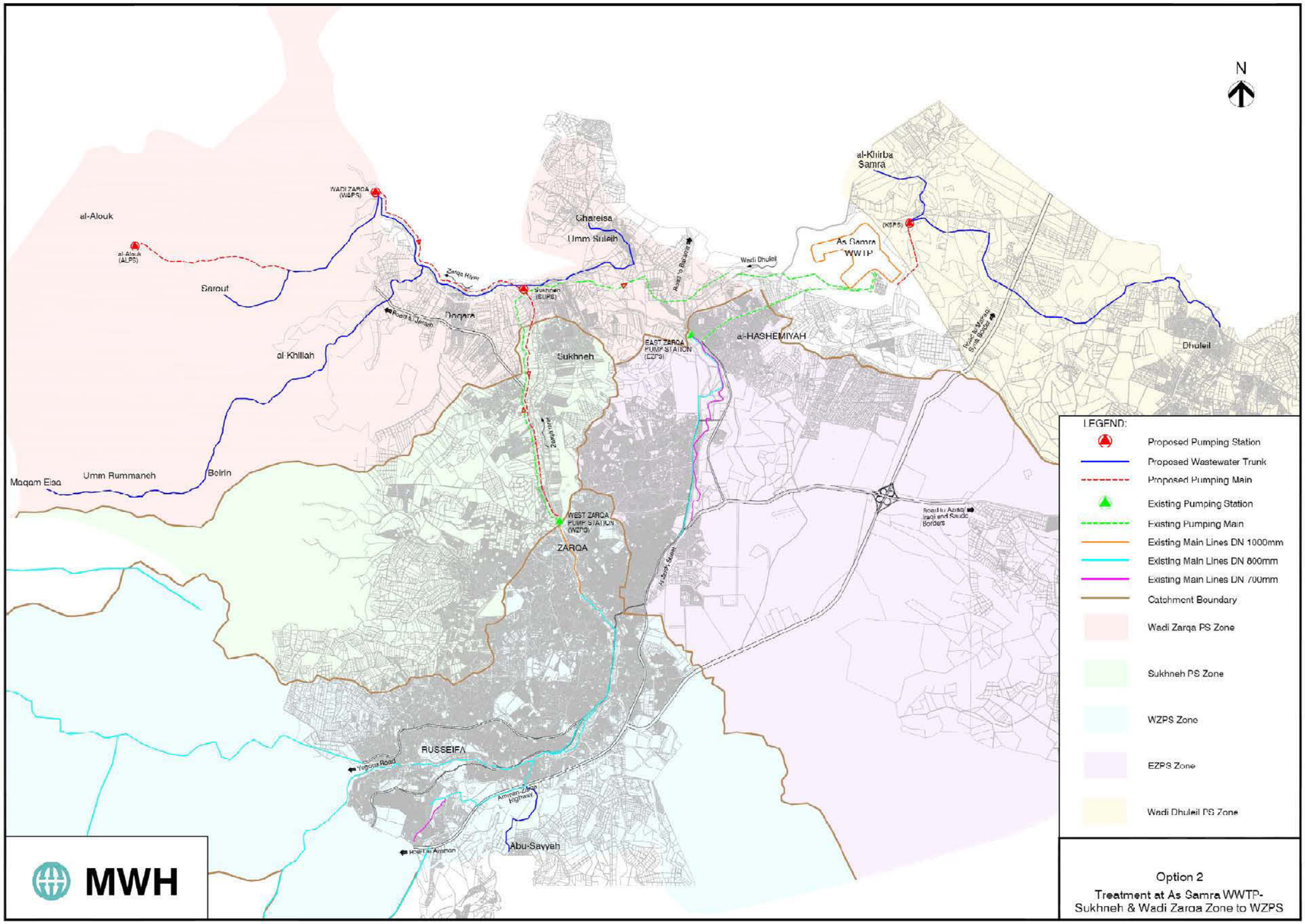

Figure 3.6: Option 2

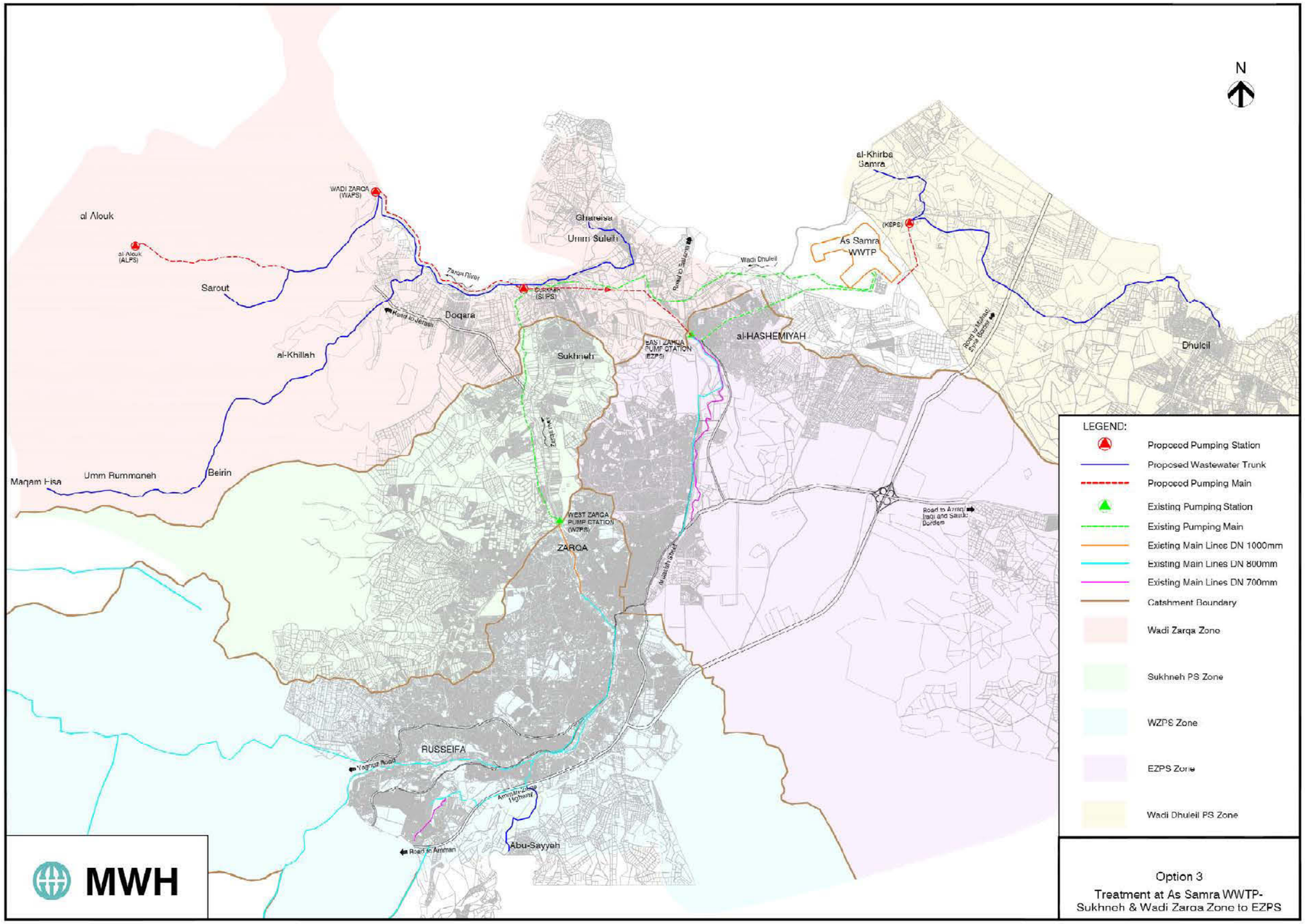

Figure 3.7: Option 3

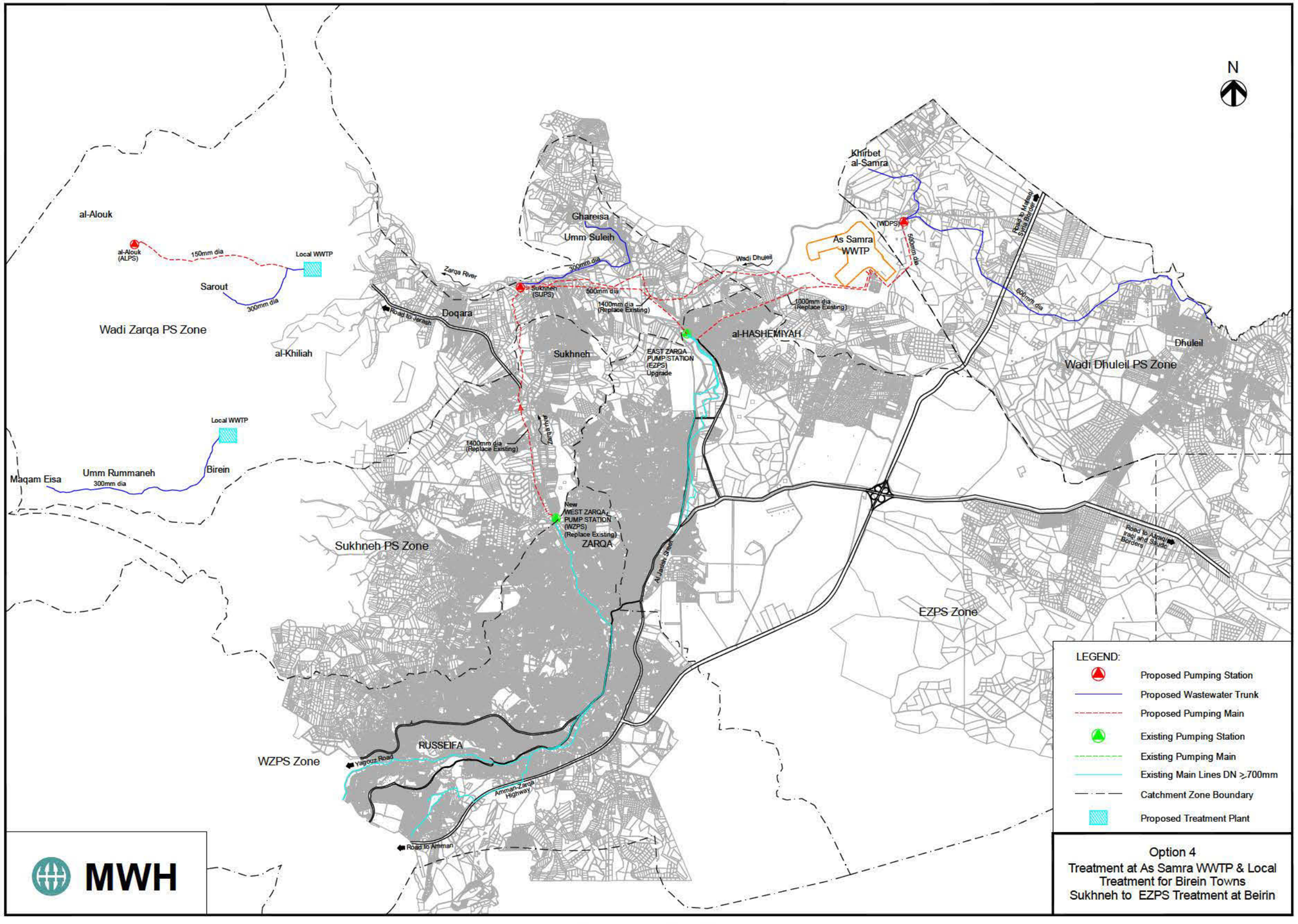

Figure 3.8: Option 4

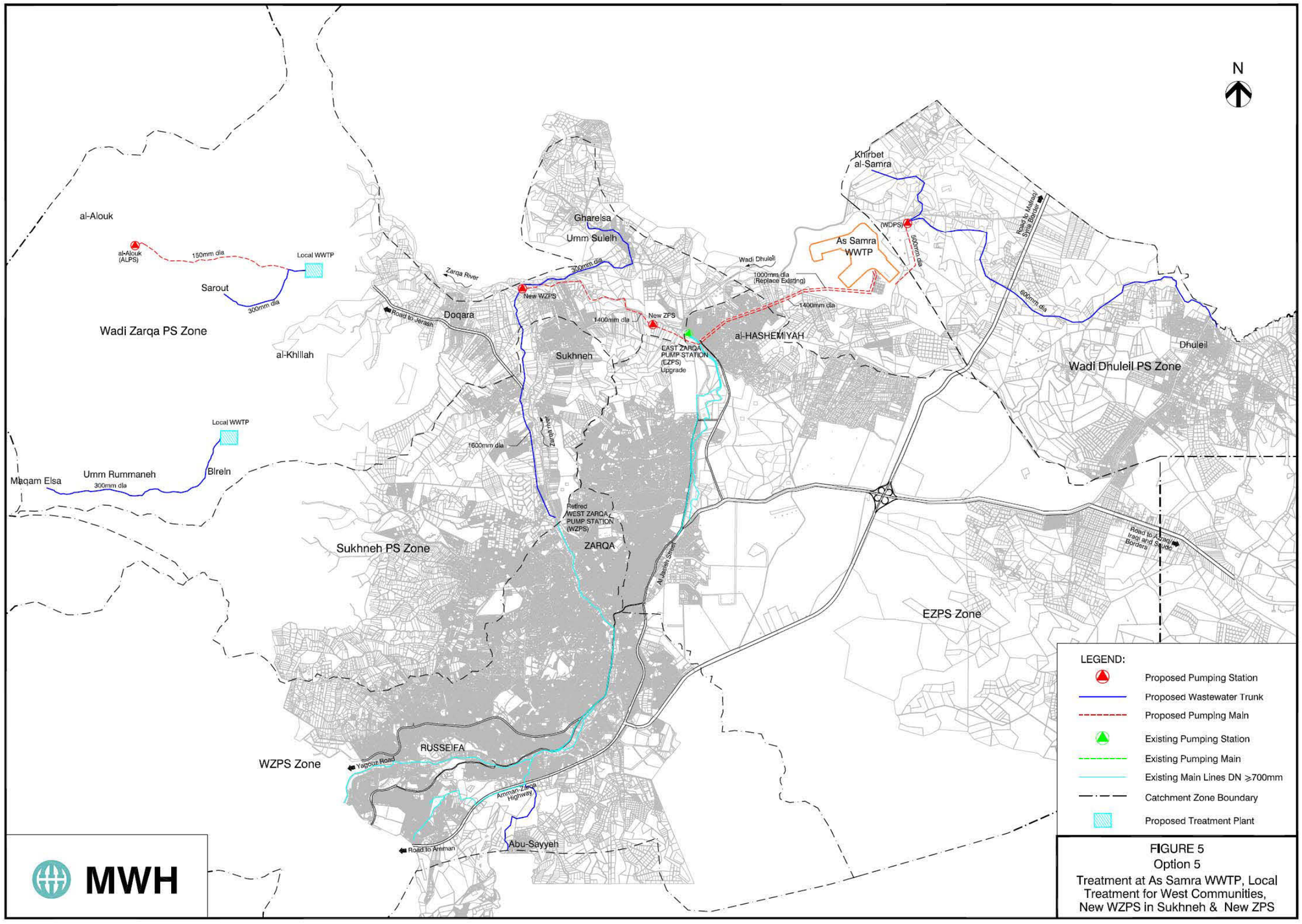

Figure 3.9: Option 5

3.7.5. Planning Criteria

The establishment of basic planning criteria and the subsequent projection of wastewater services requirements using these criteria are crucial to the formation of a proper Wastewater Development Plan for Zarqa. The following criteria and projections have been established and used by the Project Team in its formation of the Master Plan. For the most part, the criteria and projections summarized herein are based on the experiences of WAJ and on the past studies conducted within the planning area supplemented with additional data and information collected by the Team under this current study. These planning and design criteria are discussed below.

Planning Period

The planning period for this project was established to be the period through year 2035. Therefore, key planning parameters, such as population, water consumption and wastewater production projections, have been defined in five-year increments, with the first being 2010.

Service Area

In accordance with the Terms of Reference all villages and towns in the Governorate of Zarqa shall be included in the study. After discussions with WAJ it was understood that a feasibility study and final design and preparation of bidding documents project for the wastewater collection, treatment and reuse for Azraq, in the eastern parts of the governorate, is currently underway. Therefore this area will be excluded from this Study.

The proposed area consists of the existing wastewater service area plus approximately 10,300 hectares within the current municipality boundaries encircling the existing service from west and north directions in addition to the proposed development areas in the King Abdullah Bin Abdul Aziz City and al-Majd City and the towns and villages in Birein, al-Hashmiyah and al-Dhuleil districts. This area has been developed in conjunction with WAJ and is also consistent with the planning boundaries of the municipalities of Zarqa, Russeifa and al-Hashmiyah.

Level of Service

The initial focus of the reinforcement and expansion program will be on bringing sewers to areas that are currently only served by water and to areas that have inadequate wastewater collection systems. These areas will be given high priority under the evaluation of areas to be included in the MCC funded Investment Program. As future areas develop, the plan will be formulated on the basis that both water and sewerage services will be provided to each new development at the same time.

Relative to the specific targeted levels of service to be provided, the following principals have been used for this Master Plan:

- 100 percent coverage by reticulated sewer system for all developed urban areas within the Zarqa, Russeifa and al-Hashmiyah municipality boundaries;

- 100 percent coverage by reticulated sewer system for all towns and villages that could be connected to the existing systems by gravity or are within close proximity to the existing systems;
- If found feasible, reticulated sewer system will be provided to towns and villages in Birein, al-Hashmiyah and Dhuleil districts; and
- Outlying small villages such as Tafeh, Mazare'e Halabat and Ruheil will remain on on-site wastewater disposal systems.

Population

The results of the 2004 Census revealed that the resident population of Zarqa Governorate for that year was approximately 799,000, about 15% of the national population. This indicated a growth rate for the governorate of 2.2% per annum between the 1994 and 2004 inter-censal period. The national and Amman Governorate growth rates were 2.6% and 2.8% respectively for the same period. It is considered that migration to Amman skews the population growth rates below the average for Amman Governorate.

The population projections are based on the Department of Statistics (DOS) projections and the planning considerations of the major urban development areas. The DOS projected population of the Zarqa Governorate is presented in **Table 3.4**.

Table 3.4: Department of Statistics Zarqa Governorate Projected Population

Year	Population	Growth rate
2004	799,000	
2010	921,451	2.40%
2015	1,033,404	2.32%
2020	1,133,368	1.86%
2025	1,231,580	1.68%
2030	1,329,048	1.53%
2035	1,426,229	1.42%

Source: Department of Statistics

In discussions with DOS officials it was understood that the above projections do not consider the effects of the two major urban development projects of King Abdullah Bin Abdul Aziz City and al-Majd City in east Zarqa. The planned population of these two areas at year 2035, shown in **Table 3.5**, as collected from the developers is about 33% of the DOS projected population.

Table 3.5: Populations Projections of Major Development Areas

Year	King Abdullah Bin Abdul Aziz City	Al-Majd City	Total
2010		-	
2015	67,945	31,800	99,745
2020	121,824	42,400	164,224
2025	260,429	42,400	302,829
2030	339,071	42,400	381,471
2035	430,400	42,400	472,800

Therefore, to arrive at a reasonable population projection for the project area it is considered that half of the population of the new major development areas would come from outside the Zarqa Governorate. The adopted growth rates and population projection at five year intervals up to year 2035 based on the above criterion is shown in **Table 3.6**.

Table 3.6: Proposed Zarqa Governorate Population Projection

Year	Migration from other governorates	DOS Zarqa population projection	Proposed projected population	Overall growth rate
2010		921,451	921,451	
2015	49,873	1,033,404	1,083,277	3.29%
2020	82,112	1,133,368	1,215,480	2.33%
2025	151,415	1,231,580	1,382,995	2.62%
2030	190,736	1,329,048	1,519,784	1.90%
2035	236,400	1,426,229	1,662,629	1.81%

The projected population distribution in the districts and municipalities of Zarqa is based on the projected growth of the existing population of the existing built up areas and on the projected population densities in the planned new residential expansion areas in each of the districts.

The population distribution projection in the towns and villages outside the municipality planning boundaries of Zarqa, Russeifa and al-Hashmiyah is primarily based on the forecasts made by DOS.

The population distribution projection in the existing built up areas within the above mentioned municipality boundaries is primarily based on the forecasts made by judgment of the present saturation levels determined from examination of the satellite images and observations made by the Team during reconnaissance trips. For areas judged to be currently built up more than 60% of saturation levels an annual growth rate of 1% was adopted for the period from 2004 to 2010 and a constant growth rate of 0.5% thereafter until 2035 or until the area reached saturation levels.

For areas judged to be to currently saturated (40% to 60% saturation level) an annual growth rate of 1.5% was adopted for the period from 2004 to 2010 and a constant growth rate of 1% thereafter until 2035 or until the area reaches its saturation levels.

The population distribution projections in the new expansion within the planned municipality boundaries of Zarqa and Russeifa have been made by distributing the total projected population in the new expansion areas for each phase by assuming a constant population density for all districts and for each phase.

Detailed population projection calculations in the districts are summarized in **Table 3.7** and **Table 3.8**.

Table 3.7: Population Growth Rates in Project Areas

Period	Towns and villages outside Zarqa, Russeifa and al-Hashmiyah	Zarqa, Russeifa and al-Hashmiyah areas		
		Current saturation level less than 40%	Current saturation level between 40-60%	Current saturation level more than 60%
2004-2010	2.40%	22.90%	1.50%	1.00%
2010-2015	2.32%	6.76%	1.00%	0.50%
2015-2020	1.86%	5.45%	1.00%	0.50%
2020-2025	1.68%	2.39%	1.00%	0.50%
2025-2030	1.53%	1.03%	1.00%	0.50%
2030-2035	1.42%	2.19%	1.00%	0.50%

Table 3.8: Projected Zarqa Governorate Population

District / Community	Year						
	2004	2010	2015	2020	2025	2030	2035
Zarqa District [5]	1,410	1,626	1,823	1,999	2,173	2,345	2,516
Zarqa Municipality	412,982	497,032	539,433	585,503	614,876	634,111	665,392
Birein District	12,434	14,339	16,081	17,637	19,165	20,682	22,194
Dhuleil District	34,071	39,292	44,066	48,329	52,517	56,673	60,817
Russeifa District	280,287	304,925	312,807	323,832	333,108	341,387	351,211
al-Hashmiyah Municipality	26,619	28,257	28,971	29,702	30,452	31,221	32,009
al-Hashmiyah District *	21,772	25,109	28,159	30,883	33,559	36,215	38,863
Azraq District	9,426	10,871	12,192	13,371	14,530	15,680	16,826
King Abdullah Bin Abdul Aziz City			67,945	121,824	220,000	339,071	430,400
al-Majd City			31,800	42,400	42,400	42,400	42,400
Total	**799,000**	**921,451**	**1,083,277**	**1,215,480**	**1,362,780**	**1,519,784**	**1,662,629**

5 Population of towns and villages outside planned municipality boundaries.

Wastewater Flow

Based on review of the billing data for the period 2006-2009 the water consumption during this period was about 100 L/c.d assuming an unaccounted for water of 54% and administrative losses of 80% of the physical losses during that period.

The recommendations of the year 2004 National Water Master Plan (NWMP) for municipal water use are adopted to estimate the water consumption for the project area. The NWMP municipal water consumptions are presented in **Table 3.9**. These consumption figures include all municipal uses such as residential, commercial, institutional and light industrial.

Table 3.9: NWMP per Capita Water Consumption Projections (L/c.d)

Socio-economic unit	2015	2020	2025	2030	2035
Governorates	128	132	132	132	132
Urban areas (Amman and Irbid)	145	150	150	150	150

The jump in the 2015 water consumption rate NWMP projection is very steep from the current consumption rates. As this rise cannot be foreseen to happen prior to the implementation of the major water supply projects such as the Disi project the water consumption rate for years 2010 and 2015 are assumed to be 101 and 106 L/c.d as recommend by the year 1997 Harza Master Plan report.

In 1997 Master Plan, wastewater flows were calculated to be about 87% of water consumption based on wastewater flows measured at AGTP and the WZPS and EZPS. This same proportion was used as the basis of projecting wastewater flow in the master plan. The 2006 update of the master plan also recommended the use of this percentage, so for the purpose of this study it is also assumed that 87% of the water consumed results in wastewater generation.

Future wastewater generation rates estimated based on population forecasts, water consumption rates and the wastewater return value are presented in **Table 3.10**.

Table 3.10: Wastewater Generation Projections of Zarqa Governorate (m^3/d)

	2010	2015	2020	2025	2030	2035
Zarqa District	143	168	230	250	269	289
Zarqa Municipality	43,674	49,747	67,239	70,612	72,821	76,414
Birein District	1,260	1,483	2,025	2,201	2,375	2,549
Dhuleil District	3,453	4,064	5,550	6,031	6,508	6,984
Russeifa District	26,794	28,847	37,189	38,254	39,205	40,333
al-Hashmiyah Municipality	2,483	2,672	3,411	3,497	3,585	3,676
al-Hashmiyah District *	2,206	2,597	3,547	3,854	4,159	4,463
Azraq District	955	1,124	1,536	1,669	1,801	1,932

	2010	2015	2020	2025	2030	2035
King Abdullah Bin Abdul Aziz City		6,266	15,898	28,710	44,249	56,167
al-Majd City		2,933	5,533	5,533	5,533	5,533
Total	**80,968**	**99,900**	**142,157**	**160,611**	**180,506**	**198,340**

Detailed future wastewater flow projections from the study that could be drained into the existing systems are summarized in **Table 3.11**.

Table 3.11: Wastewater Flow Projections of Study Area (m^3/d)

	2010	2015	2020	2025	2030	2035
Zarqa District	-	-	-	-	-	-
Zarqa Municipality	43,606	49,648	67,078	70,431	72,631	76,201
Birein District	-	-	-	-	-	-
Dhuleil District	2,927	3,445	4,705	5,113	5,518	5,921
Russeifa District	26,794	28,847	37,189	38,254	39,205	40,333
al-Hashmiyah Municipality	2,483	2,672	3,411	3,497	3,585	3,676
al-Hashmiyah District *	2,078	2,445	3,340	3,629	3,916	4,203
Azraq District	-	-	-	-	-	-
King Abdullah Bin Abdul Aziz City	-	6,266	15,898	28,710	44,249	56,167
al-Majd City	-	2,933	5,533	5,533	5,533	5,533
Total	**77,888**	**96,255**	**137,154**	**155,168**	**174,637**	**192,035**

It is assumed that 100 % of the population within the planning boundaries of the municipalities of Zarqa, Russeifa and al-Hashmiyah will be connected to the sewers in the future in addition to major towns and villages in al-Hashmiyah and Dhuleil districts.

Sewer Design and Installation Considerations

The minimum size of sewer pipe, to prevent clogging shall be:

- Minimum service connection diameter: 150 mm
- Minimum sewer diameter: 200 mm

The minimum depth of sewers shall be 1.50 m to allow house connections to be made and to reduce the crossing probabilities with other utilities such as water, electricity and telephone.

The minimum cover of the sewer pipe shall be 1.0 m to protect the pipe from traffic loads. If this protection is not achieved then the sewers shall be encased in concrete.

The maximum depth depends on the slope, topography, ground conditions and other factors, but typically should be limited to 6 m.

The horizontal separation distance between sewers and water mains shall not be less than 3.0 m. The vertical separation distance at crossings between inverts of water lines and crown of sewers shall not be less than 0.5 m. Where this vertical separation distance in not secured, both lines shall be concrete encased for at least 3.0 m from both sides of the crossings.

Width of trenches shall be limited to outside pipe diameter plus 600 mm. Minimum working space around the sides of the pipe shall be 200 mm.

House Connections

House connections, usually 150 mm in diameter, shall be connected to the main sewers at manholes. These shall be installed at a minimum gradient of 2 percent and at 90 degrees to the centerline of the sewer. House connections shall end at an inspection manhole one meter outside the property wall to permit cleaning out the connection and to locate blockages.

All house connections inside the properties shall be provided with ventilation pipes.

Wherever possible a single connection to a manhole shall be used to serve two or three houses. This will be accomplished by running a 150 mm parallel sewer along the sidewalk.

Manholes

Manholes are provided on sewers as a means of access for inspection, testing and clearance of obstructions. Except for very shallow sewers of less than one meter depth to invert; all manholes should be of adequate dimensions to facilitate entry and for the operation of cleaning apparatus while wearing full safety equipment.

Manholes shall be provided at the head of a sewer, at every junction of two or more sewers and wherever there is a change in its alignment, gradient, diameter or material. Otherwise maximum spacing should be as listed in **Table 3.12**.

Table 3.12: Maximum Spacing between Manholes

Sewer diameter	Maximum spacing
200 mm	50 m
300 & 400 mm	70 m
500 mm and larger	100 m

Recommended Pipe Materials

It is recommended that the technical specifications for the construction of gravity sewers in Zarqa permit only the pipe materials shown in **Table 3.13**.

Table 3.13: Recommended Pipe Material

Pipe diameter	Pipe material
Up to 200 mm	Concrete, uPVC
300 mm to 1000 mm	Reinforced concrete, GRP
Over 1000 mm	GRP

3.7.6. Pumping Station Design Criteria

Pumping stations are provided in a sewerage system generally to either avoid the construction of uneconomically deep gravity sewers or to transfer sewage flows from isolated communities which cannot be connected to the treatment works or point of disposal by a gravity pipeline.

The pumping station must be located so that neither noise nor odors are potential causes of nuisance. The location of all pumping stations should be such as to permit reasonable vehicular access for the purposes of repair and maintenance.

Planning Period

The design flow for the sewage pumping stations shall consider the current and projected peak flow rates. Sewage pumping station discharge flow rates shall, at minimum, accommodate the 25-year planning horizon taking into consideration the lifecycle of the pump station components as the follows:

- Site works, civil and structural components: 50 years
- Electrical works: 25 years
- Instrumentation: 10 years
- Mechanical equipment: 15 years

In circumstances where the pumping station is planned for interim use the planning period for establishing flow rate can be shorter. For all pumping stations, consideration shall be given to future upgrading flexibility necessary to accommodate flows beyond the planning horizon. This is especially important for the larger sewage pumping stations.

Pumping Station

Submersible wastewater non-clog pumps shall be used for wastewater pump stations. Pumping stations shall be designed to pump the flow utilizing a minimum of three pumps (2 operational + 1 standby) with consideration for future expansion.

Ductile Iron pipe work will be used in the pump station and for inter-connecting pipe work.

All main pumping station sumps should be constructed in reinforced concrete of rectangular design. The wet wells will be lined with GRP or PE, which perform satisfactorily provided that they are installed with care, allowing no possibility for attack of the concrete beneath it.

A single manhole outside the station sump shall be provided at all pumping stations into which all incoming sewers are collected so that there is only one inlet to the sump itself. This simplifies the problem of over pumping of sewage in the event of a major failure of the pumping station.

Sluice valves and non-return valves are fitted to each pump outlet, and further valves are often not necessary unless it is intended to be able to isolate the rising main for washing out purposes or for the addition of further pumping units in the station at some future date.

If twin rising mains are installed, an emergency by-pass should be provided between the two pipelines, and sufficient sluice valves must then be fitted immediately outside the station, so that either main can operate as the duty main or both pipelines can operate either separately or together.

Although the sumps are entirely closed there is the possibility of odor problem at most main pumping stations. De-odorisation equipment may therefore need to be provided.

Flow metering is to be provided as standard in all pumping stations.

Sewage composition can vary widely, adequate consideration and necessary provisions shall be taken to ensure that sewage pumping station equipment and materials are suitable for the anticipated composition of sewage. Mechanical screens and in some cases grit removal systems should be provided to protect pumps and prevent the pumps being clogged by large objects.

Also, consideration should be given to providing main pumping stations with emergency storage facilities, should space permit.

Sewerage systems normally incorporate two types of pumping stations:

- Submersible stations: These could be used to serve average wastewater flows up to 100 L/s, the submersible station basically comprises a wet well with two or more submersible pump sets.
- Wet well / dry well stations: These are designed essentially to be able to isolate the pumping equipment from the sewage without moving the equipment, for ease of maintenance. These main pumping stations normally operate on trunk sewers.

4. POLICY, LEGAL AND INSTITUTIONAL FRAMEWORK

This section starts by presenting the national international guidelines that this PESIA follows. It then describes national institutions related to this project and outlines regulations relevant to the natural environment of the Hashemite Kingdom of Jordan and describes relevant international conventions and treaties signed and ratified by Jordan and incorporated into the national law.

Specifically, the legislative framework presented in this section is relevant to the wastewater system reinforcement and expansion works and the assessment associated with this type of project.

4.1. National and International Environmental Policies and Agreements

4.1.1. Policies

In this section reference is made to MWI water policies on irrigation, water, groundwater, and wastewater management.

The Wastewater management policy key considerations are:

- Provision of adequate wastewater collection and treatment facilities for all the major cities and towns in Jordan.
- Protection of the environment and public health in the areas affected by the proposed systems, especially, surface and ground waters.
- Consideration of treated effluents as a source for irrigation reuse.
- Improvement of the socioeconomic conditions in the areas to be served by the proposed systems.

The aspects of the wastewater management policy related to this project are as follows:

- On Resource Development:
  - Wastewater is a perennial water source and shall form an integral part of renewable water resources and the national water budget.
  - Collection and treatment of wastewater is a necessity to circumvent hazards to the public health and the environment. It becomes imperative when contamination of freshwater resources with wastewater is eminent.
  - Collection and treatment of wastewater becomes mandatory to protect public health against water borne diseases, and where epidemics become a threat otherwise.
  - Existing levels of wastewater services shall be maintained and upgraded where necessary to enhance public health and the environment.
- On Wastewater Collection and Treatment:
  - The existing level of services shall be sustained and promoted. Where it is necessary to meet public health and environmental objectives, treatment shall be improved. Wastewater shall be collected and treated in accordance with WHO and FAO Guidelines as the basis for effluent quality requirements for reuse in irrigation.

However, final reuse options, type of crops to be irrigated, location of the reuse and the treatment plant location shall govern the level of treatment (effluent parameters), and the treatment technology to be adopted.

- Priority shall be given to protecting public health and water resources from chemical and microbiological pollutants.
- Where possible, gravity flow shall command the collection and conveyance lines.

- On Pricing:
  - In view of increasing marginal cost of wastewater collection and treatment, wastewater charges, connection fees, sewerage taxes and treatment fees shall be set to cover the operation and maintenance costs at a minimum. It is also highly desirable that part of the capital cost of the services is recovered. The ultimate aim is for a full cost recovery.
  - Appropriate criteria in order to apply the "polluter pays" principle shall be established.
  - Different charges for different areas may be applied. This shall be assessed for each geographical area as a function of end use and effluent quality and will be subject to economic and social considerations.
- On Selected Priority Issues:
  - Priority shall be accorded to situations and locations where waste-water disposal practices threaten the environmental integrity of freshwater resources, and where performance of cesspools and percolation pits pollute underground water aquifers.
- On Standards, Regulations and Quality Assurance:
  - Jordanian Standards JS893/95, JS202/91, JS 1145/96, WAJ's regulations for the quality of industrial wastewater to be connected to the collection system and WAJ's specifications for sewerage works, have been, thus far, the benchmarks against which plans and specifications of treatment plants and wastewater reuse were evaluated. They were established to bring about relative uniformity throughout the country. Periodically, these standards and regulations should be reviewed and modified to reflect special ambient conditions or end uses. Other aspects shall also be considered, e.g. economic socio-cultural, environmental and regional aspects.
  - Roof and storm water connections to public sewers shall be prohibited. Collection of storm water shall be done separately and will be the subject of water harvesting.
- On Financing and Investment:
  - Because of the limited financial resources available to Jordan, setting investment priorities in wastewater will be compatible with government investment plans.
  - Criteria for prioritizing investments in the wastewater sector shall take into account the current and future needs of the country, needs to expand wastewater systems in urban areas and to provide wastewater systems to smaller towns and villages that are not yet served.
  - Priorities of wastewater projects shall not be disconnected from water supply projects and urbanization in general. Decisions will be made concerning them to attain

optimum solutions to the need for services, availability of finance and availability of trained manpower.

- On Public Awareness:
  - The public shall be educated through various means about the risks associated with the exposure to untreated wastewater and the value of treated effluents for the different end uses.
  - Public awareness campaigns shall also be waged to educate the public on the importance of domestic hygiene, wastewater collection, treatment and disposal.

4.1.2. Regional and International Agreements and Protocols

The Kingdom of Jordan has signed and ratified (that is, placed into national law) the following international protocols and agreements relevant to this Project (dates of entry into force noted in parentheses):

- International Plant Protection Convention (24/4/1970).
- Convention Concerning the Protection of the World Cultural and Natural Heritage (17/12/1975).
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (10/5/1077).
- Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES) (14/3/1979).
- Protocol to amend the Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR Convention) (1/10/1986).
- Amendment to the Convention of International Trade in Endangered Species of Wild Fauna and Flora (art. XI) (13/4/1987).
- Protocol on Substances that Deplete the Ozone Layer (30/8/1989).
- Convention for the Protection of the Ozone Layer (31/8/1989).
- Convention on Biological Diversity (10/2/1994).
- Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer (10/2/1994).
- Framework Convention on Climate Change (21/3/1994).
- Amendments to the Montreal Protocol on Substances that Deplete the Ozone Layer (28/9/1995).
- International Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (26/12/1996).
- Constitution of the Food and Agriculture Organization of the United Nations (23/1/1951).

4.2. Relevant Environmental-Related Institutions

MWH have identified the main ministries, institutions and authorities that are directly involved with the environmental control, protection and regulation within the Project's study areas. These different entities are described in the following sections.

4.2.1. Ministry of Environment

The Jordanian Ministry of Environment (MoE) is the principal environmental institution in Jordan and is responsible for the evaluation of the environmental impacts of the project and the issue of associated project licenses and clearance.

The MoE was established in 2003, with the mission to maintain and improve Jordan's environmental quality through sustaining and conserving the environmental resources; thus contributing to sustainable development. The MoE develops environmental policies that are implemented and enforced throughout the Kingdom. Moreover, it is dedicated to ensuring that legislation is enforced through raising public awareness, implementation of inspection and monitoring programs, and encouraging cooperation with national, regional and international bodies.

The MoE is legally reinforced by the environmental law which provides the Ministry with the tools necessary to perform their duties. The Environmental Protection Law was one of the temporary laws issued in 2003, and was officially endorsed by the Jordanian Parliament in 2006 and issued as the Law No. 52 for the Year 2006.

The law considers the Ministry of Environment to be the competent authority for the protection of environment in the Kingdom, and the official and national authorities shall be bound to implement the instructions and resolutions issued under the provisions of this law which gave the Ministry all the judicial powers it requires for implementing it.

Law No. 52 provides the Ministry with the legal power to inspect any facility, and according to the findings of the audit, gives the Ministry the right to order a facility shutdown until the proper mitigation and control measures are implemented and the environmental violation eliminated. This inspection system was further strengthened with the establishment of the Environmental Police in 2007. The police now act as an implementation tool and a fully fledged partner in the implementation of the environmental law.

The Environmental Protection Law has also introduced a system of an environmental "pre-emptive" assessment of all economic and developmental projects to be established in Jordan. This process is known as the Environmental Impact Assessment (EIA) where any developmental or economic project should carry out a detailed assessment of the expected environmental impacts potentially arising from the implementation of the project, and how these impacts can be mitigated through remedial action at the technical, legislative and public levels.

According to the Environmental Protection Law, the EIA study should be done before the project is initiated and sent to the Ministry of Environment where it will be reviewed. A reference to the EIA Regulation No. (37) / year 2005 should be made as it sets out the process for conducting an EIA study and the required documentation for obtaining an environmental clearance. In addition, it lists the projects that require a full EIA or a Preliminary Environmental Impact Assessment.

This wastewater system project is classified as infrastructure. According to the Jordanian EIA Regulation No. (37) for year 2005, infrastructure projects are listed under Category 2 projects i.e. it requires a preliminary EIA.

However, the results of the preliminary EIA will indicate whether the project will remain as a Category 2 project or would be classified as a Category 1 requiring a full EIA. If the project is to be categorized as a Category 1, and in accordance with Article (9) of Jordanian EIA Regulation, the Project Owner (i.e. WAJ) need to submit a preliminary draft of the Terms of Reference (ToR) for the EIA Study followed by the subsequent Draft Scoping Statement, Final Scoping Statement and TOR, Draft EIA Report with Environmental Management Plan and then a Final EIA report incorporating all received comments and feedback.

If the Impact assessment is approved, the project will get the license and start its implementation program while adhering to the environmental mitigation and management systems specified and approved in the study. Any deviation from those guidelines would render the project in violation of laws and regulations.

4.2.2. Ministry of Energy and Mineral Resources

Ministry of Energy and Mineral Resources (MEMR) shares the responsibility with the Ministry of Environment and Ministry of Health for the protection of the environment within Jordan.

4.2.3. Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)

As mentioned earlier, Ministry of Water and Irrigation (MWI) is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system and the related projects, planning and management, the formulation of national water strategies and policies, research and development, information systems and procurement of financial resources. Its role also includes the provision of centralized water-related data, standardization and consolidation of data.

Units for public relations, internal monitoring and water security and protection are directly subordinate to the Minister of Water and Irrigation with responsibilities overarching MWI, WAJ and JVA (Ministry By-Law No.52 of 1992).

The Ministry of Water and Irrigation embraces the two most important entities dealing with water in Jordan:

- The Water Authority of Jordan (WAJ): in charge of water & sewage systems.

- The Jordan Valley Authority (JVA): responsible for the socio-economic development of the Jordan Rift Valley, including water development and distribution of irrigation.

According to Article 3 of the permanent Water Authority Law No.18 of 1988, WAJ was established as an autonomous corporate body that carries full responsibility for the public water supply, wastewater services and related projects as well as for the overall water resources planning and monitoring, construction, operations and maintenance. The responsibilities of WAJ are defined in the said law and are briefly described hereafter:

- Survey the different water resources, conserve them, and determine ways, means and priorities for their implementation and use.
- Develop potential water resources in the Kingdom and put forth programs and plans to meet future water needs by providing additional water resources from inside or outside the Kingdom.
- Regulate and advise on the construction of public and private wells, investigate groundwater resources, drill exploratory, reconnaissance, and production wells, and license well-drilling rigs and drillers.
- Study, design, construct, operate, maintain, and administer water and wastewater projects including collecting, purifying, treating, disposing and using any other methods of dealing with water.
- Draw terms, specifications and special requirements in relation to the preservation of water and water basins.
- Carry out theoretical and applied research and studies regarding water and wastewater to achieve the Authority's objectives.
- Issue permits to engineers and licensed professionals to perform public water and wastewater works and participate in organizing special training courses to enhance their qualifications and consequently reduce water loss and pollution.
- Regulate the use of water, prevent its waste, and limit its consumption.
- Plan, allocate, permit monitoring and regulate wastewater reuse activities.
- WAJ Program Management Unit (PMU) regulates water supply and wastewater utilities under private management.

4.2.4. Other Relevant Institutions

Ministry of Health

The Ministry of Health (MoH) undertakes all health affairs in the Kingdom and its tasks and duties include:

- Maintaining public health by offering preventive, treatment and health control services.
- Organizing and supervising health services offered by the public and private sectors.
- Providing health insurance for the public within available means.

- Establishing and controlling the management of health, educational and training institutes and centers according to relevant provisions of the legislations enacted.
- The Ministry also works in coordination with concerned parties, to raise public health standards by fighting diseases resulting from malnutrition.

Ministry of Municipalities and Municipal Affairs

The Ministry is taking up the supervisory role over the activities of the municipalities and the Joint Services Councils (JSC) operating all over the Kingdom with a total of (93) municipalities and (22) JSCs. The main duties are:

- Providing the various facilities to the municipalities to enable them to perform their functions and support them in improving the services efficiency.
- Oversee, coach and monitor the financial, administrative and organizational performance of the municipalities.
- Enhance the institutional capabilities of the sector.
- Manage the financial transactions and arrange with the relevant parties to provide the necessary funding for the programs and projects.
- Set, develop and implement the legislative, administrative, financial and institutional frameworks that are effective for the municipal operations.
- Prepare the regional, organizational and detailed construction plans for the municipalities.
- Monitor and control the implementation of the regulations, policies and instructions of the municipalities and joint services councils. Draw up the regulatory bills of the municipal affairs sector. Review and supervise the infrastructure projects of the municipal councils and develop the designs, technical specifications and tender documents in addition to sustaining and developing the inhabited clusters that have no municipal councils.

Ministry of Public Works and Housing

The Ministry of Public Works and Housing aims to develop a network of public roads in the kingdom, linking towns, villages and communities, sites of industrial production, agricultural and tourist areas and archaeological sites. The Ministry of Public Works and Housing also aims to link the Kingdom and neighboring countries and sustain this network. The Ministry is also working on upgrading the quality of roads and the promotion of safety requirements in addition to keeping abreast of the latest updates and techniques of modern roads and lighting.

Department of Land and Survey

The Department of Land and Survey is responsible for maintaining, documenting, preserving and facilitating the use of the land property rights, and providing the data base necessary to build the national geographic information system. This department will be consulted for issues relating to land acquisition and resettlement, if needed.

Ministry of Transport

- The Ministry of Transport assumes the following responsibilities under the Transport Law No. (89) / year 2003 and authorizations needed in order to carry out its mission:
- Devising the general policy for transport and overseeing its implementation in coordination and cooperation with all related parties.
- Regulating and monitoring the road freight transport sector and its services, as well as issuance of necessary permits for individuals and companies operating in the sector.
- Regulating and monitoring the freight transport by rail sector and its services, as well as issuance of necessary permits for operating in the sector and many other responsibilities.

Public Security Directorate / Traffic Department

The Traffic Department of the Public Security Directorate is needed to coordinate any changes in road traffic due to construction works. The department's duties include:

- Participate in the general policy of traffic control and transport in the Kingdom in cooperation with other involved entities.
- Enforce the traffic control law and all regulations and instructions issued based on that law.
- Monitor and organize traffic movement within cities.
- Monitor road conditions within and outside cities and determine technical problems in cooperation with related entities in order to reach suitable solutions.
- Put plans and procedures to monitor and control roads used by official envoys.
- Issue tickets and collecting fines for issued tickets.
- Participate in implementation of public transport policy in coordination with Public Transport Regulatory Commissions.
- Monitor the work of traffic safety volunteers and activate the role of social police.
- Prepare public awareness campaigns to increase traffic awareness across all social groups.
- Track and find stolen and wanted vehicles.
- Conduct traffic studies and research to determine traffic problems, their reasons and suitable solutions.

Ministry of Awqaf and Islamic Affairs and Holy Sites

This Ministry is responsible for the development of religious tourism and economic investment, identifying investment priorities and laying the foundations for investment projects to cover all the governorates of the Kingdom. The Ministry also looks after and manages all Awqaf, Islamic affairs and Holy sites in the Kingdom of Jordan.

Ministry of Agriculture

The Ministry of Agriculture (MoA) is responsible for managing public rangelands and forests; protecting soil; pasture-land and flora; provision of agricultural loans; supporting farmers, and granting permits for the import and export of agricultural products of plant, animal and veterinary medicines

and vaccines, and live birds. MoA is also responsible for the establishment and renewal of licenses for companies, factories, shops, galleries, nurseries and agricultural farms and olive presses, provide training for farmers, protecting and managing wildlife, and issuing fishing and hunting licenses and regulations.

Some wildlife protection and permitting tasks are the responsibility of the Royal Society for the Conservation of Nature (RSCN).

Ministry of Tourism and Antiquities / Department of Antiquities

The Ministry will work towards developing tourism in a comprehensive and integrated approach to express the nation's legacy, culture, history, heritage, inheritance, successive civilizations and economic prosperity. It aims to develop an advanced tourism industry capable of utilizing its comparative and competitive advantages through highly developed infrastructure facilities and superstructure services.

The Department of Antiquities of Jordan (DoA) is the official institutional authority mandated by law to be responsible for the protection, conservation and presentation of antiquities.

The first unit that took the role of a Department of Antiquities of Jordan was founded in 1924. Its main job was to supervise fieldwork, in cooperation with foreign expeditions and archaeological missions, and to implement salvage excavations and limited consolidation and preservation works. The official Department of Antiquities of Jordan was established in 1928.

The main institutional policy of the DoA:

- The principal policy of the Department of Antiquities is the protection of antiquities, preferring conservation measures that do not require physical intervention to the remains as the first choice where possible.
- The second policy is for the presentation of antiquities, including research, survey, excavation and site management.

One of the important issues the DoA would be involved in such a wastewater project is the possibility of coming across some artifacts during construction work due to excavation activities. The Law of Antiquities (No. 21, 1988) calls for immediate reporting of any found remains where Article (21) of this law indicates that all antiquities discovered during excavations carried out by any party shall be considered the property of the State. The Department then has the right to assess the significance of any discovered remains/antiquities and puts its recommendations accordingly.

Ministry of Labor

Since its emergence, the Ministry of Labor has undertaken the responsibility of accomplishing the general objectives of labor and laborers affairs and issues in the Kingdom. To keep pace with social

and economic development, the Labor Law No. (8) for the year 1996 was issued and the administrative regulation No. (38) of the year 1994 was established, along with its amendments.

The tasks of the Ministry include:

- Organizing the labor sector, as well as updating labor legislations so as to meet the needs of the labor market in light of the social and economic developments within a framework that maintains the production parties rights, and contributes in encouraging the foreign investments.
- Contribution in the development of workforces through the Vocational and Technical Training and Educational Council.
- Collaboration in human resources and workforces development projects.
- Applying the Law of Vocational Work Organization.
- Organizing the foreign labor in the Jordanian Labor Market.
- Maintain available job opportunities to employ Jordanian Labor.
- Restructuring and re-organizing the Ministry of Labor so as to enable it to achieve its objectives with full efficiency.
- Building up labor market databases.
- Consolidating cooperation and partnership with the private sector.
- Consolidating regional and international cooperation and partnership.
- Consolidating partnership and cooperation with corporations concerned with preparing and developing Human Resources.

Jordan Institute for Standards and Meteorology (JISM)

Jordan Institution for Standards and Metrology (JISM) plays a proactive role in protecting the interests, health and safety of citizens and environment and enhancing the competitiveness of Jordanian products in the national, regional and international markets in keeping with the national goals and contributing to achieving them within the defined priorities.

JISM prepares, approves, revises, amends and monitors the implementation of standards and technical regulations with regard to all services and products (with the exception of pharmaceutical products, medicines, veterinary medicines, serums and vaccines).

JISM fulfils its mandate to build, implement and update systems compatible with international practices, in the fields of standardization, metrology, conformity assessment, market surveillance, accreditation, information and related areas through providing an internal supporting working environment and developing all needed human, knowledge, material, technological and financial resources.

4.3. Principal National Legislation

4.3.1. Laws

- The Environment Protection Law No. 52 for the year 2006.
- Water Authority Law No. 18 of the year 1988 and its amendments.
- Underground Water Control By-Law No. 85 of 2002.
- General Health Law (No.47, 2008).
- Public Health Law No. 54 of 2002.
- Decree (12) of 1987 or Land Acquisition Law (LAL) and its amendments.
- The Development Zones Law No. (2) for the year 2008.
- Traffic Law (No. 49, 2008).
- Transportation Law (No. 89, 2003).
- Agricultural Law of 2002.
- Temporary Law (No.64, 2002) – General Electricity Law.
- Labor Law No. 8 for the year 1996 and its amendments.
- Law of Awqaf and Islamic Affairs and Holy Sites (No. 32, 2001).
- The Antiquities Law and its amendments year 2004, simultaneously read with The Antiquities Law No. 21 / year 1988.
- Civil Defense Law (No. 18, 1999).
- Forestry and Soil Protection Law No. 23, year 1972, issued in accordance with Article 31 of the Jordanian Constitution.
- The Organization of the Natural Resources Affairs Law no. (12) / year 1968.
- Law of Handicrafts and Industries (No.16, 1953)
- Municipality Law (No. 55, 1954).
- Administration of Public Property Law (No. 17, 1974).

4.3.2. Regulations

- The Environmental Impact Assessment Regulation No. (37) For the year 2005.
- Land use planning Regulation No. 6 for the year 2007.
- Regulation for the licensing and permitting of excavation and infrastructure network projects (No. 112/2007).
- Natural Reserves and National Parks Regulation No. (29) / Year 2005.
- The Protection of the Environment from Pollution in Emergency Situations Regulation No. 26 for the year 2005.
- Regulation of Harmful and Hazardous Waste Management, Transfer & Handling No. 24, 2005.
- Soil Protection Regulation No. 25 for the year 2005.
- Regulation of Solid Waste Management No. 27 for the year 2005.
- Air Protection Regulation No. 28 for the year 2005.

- Regulation of Controlling the Use of Substances that Deplete the Ozone Layer for the year 2003, issued in accordance with Law No. (1) 2003 Articles 9-15; 'Law for the Protection of the Environment'.
- Regulation (No.43, 1998) of Protection and Safety from Industrial Tools and Machines and Worksites – Issued by the virtue of the provisions of Paragraph (c) of Article (85) of the Labor Law No. (8) of 1996.
- Regulation for the establishment of Occupational Health and Safety Committees no.(7) / year 1998, issued in accordance to Article (85) of the Jordanian Labor Law no.(8) / year 1996 and its amendments.
- Groundwater Control Regulation No. 85 of 2002, Issued pursuant to Articles 6 and 32 of Water Authority Law No. 18 or 1988.
- Regulations for Protection of Birds and Wildlife and rules covering their hunting (No. 113, 1973).
- Regulation of Awqaf and Islamic Affairs and Holy Sites (No.142, 1966) and its amendments till 16th of December, 1991.

4.3.3. Instructions

- Instructions for the Limitation and Control of Noise for the year 2003.
- Instructions for Disposal of Industrial and Commercial wastewater into the sewage network, issued in accordance with Water Authority Law No. 18 for year 1998 and Article No. 23 of the Sewage System Law No. 66 for the 1994.
- Instructions No. (1) for year 2006 or the prevention of occupational hazards related to health hazards resulting from labor housing units onsite, issued in accordance to article (51) of the temporary general health law No. (54) for the year 2002.
- Instructions for disposal of industrial wastewater to public sewer of the year 1998 / Water Authority of Jordan.

4.3.4. Standards

- Standards for industrial reclaimed domestic wastewater (No. 202/2007) (JS893).
- Standards for reclaimed domestic wastewater (No. 893/2006).
- Ambient Air Quality (Standard No. 1140/2006).
- Standards for the prevention and elimination of noise (2003).
- Standard 1189/1998 Maximum Allowable Limits of Air Pollutants Emitted from Stationary Sources.
- Standard JS 525: 1987 Heat – Heat Levels allowed to be exposed to in work environment.
- Standard JS 524: 1987 Lighting Levels in work environment.
- Jordanian Standard JS 286 / 2001 Requirements for Drinking Water and its amendments.
- Jordanian Standard JS 893/ 2007 Requirements for Reclaimed Domestic Wastewater.
- Jordanian Standard JS 202 / 2006 Requirements for Discharges of Industrial Effluents.

4.4. National Water Strategy

Jordan Water Strategy 2008-2022 states that the vision for a water strategy is one whereby 2022, Jordan has:

- Adequate, safe and secure drinking water supply.
- Greater understanding and more effective management of groundwater and surface water.
- Healthy aquatic ecosystems.
- A sustainable use of water resources, and implemented fair, affordable and cost -reflective water charges.
- Adaptation to increased population growth and economic development across the water sector and water users.

Despite the huge improvements in infrastructure to supply water, Jordan is still facing a critical and serious supply-demand imbalance. A sustainable water supply and demand balance must be secured which means that there is a need to limit and even reduce water consumption, while not ruling out new supply infrastructure.

More pressure will be put on our water resources from changes in population, household formation and development, and lifestyles. The increase in demand is witnessed in areas where there is already a lot of pressure on the country's water resources.

The economic development of the past two decades has created enormous pressures on the quality of ground and surface water resources. The process of deteriorating water quality must be halted. This requires that water sources are actively protected from pollution through actions of the Ministry of Water and Irrigation and other involved Ministries/Agencies (i.e. Ministry of Environment), such as setting up and implementing groundwater and surface water protection zones as well as through appropriate land use planning which takes the need for water resources protection into account.

This water strategy outlines a strategic and integrated approach to the sustainable management of the country's water resources, for the public water supply as well as for the provision of healthy ecosystems and the services they provide. Achieving the vision will have social, environmental and economic implications, which need to be addressed.

This water strategy sets out Jordan's vision and key priorities for water.

In order to achieve the visions of this Water Strategy, the implementation are set under the following main themes:

- An efficient and effective institutional reform.
- A drastic reduction in the exploitation of the groundwater.
- Efficient use of water resources.
- Implementation of the Disi water conveyance and the Red Dead conveyance projects.

- Irrigated agriculture in the highlands will need to be capped and regulated and the by-laws will need to be reinforced.
- Appropriate water tariffs and incentives will be introduced in order to promote water efficiency in irrigation and higher economic returns for irrigated agricultural products

The National Water Strategy consists of the following chapters:

1. A Summary of Jordan's Water Vision
2. Water Demand
3. Water Supply
4. Institutional Reform
5. Water for Irrigation
6. Wastewater
7. Alternative Water Resources
8. Summary of Goals, and Actions

These chapters contain statements that are articulated as goals and approaches for strategic management of the Kingdom's water resources. Each of these approaches needs to be elaborated in one or more action plans that will specify how the approach will be achieved. This includes more details on the specific approach, identification of the responsible party for implementation, a timeline, and, as appropriate, geographic focus area.

4.5. Specific Relevant Government of Jordan Standards and Guidelines

All projects undertaken in Jordan are governed by the specific project design requirements and applicable agreements with environmental permitting authorities. Specific requirements relating to the following are provided below:

- Ambient air quality.
- Air emission limits from stationary sources.
- Ambient noise.
- Waste Management (aqueous, solid and radio-active).

4.5.1. Ambient Air Quality

Ambient air quality limits recommended by the Ambient Air Quality Standards (No. 1140/2206) are enforced in Jordan. A summary of these recommended standards is presented in **Table 4.1**.

Table 4.1: Relevant Ambient Air Quality Standards

Air Pollutant	Average Time	Maximum Allowable Concentration in the Ambient Air	Number of Allowed Exceedances
Sulfur Dioxide (SO_2)	1 Hour	0.30 mg/kg	3 times within a given month in one year
	24 Hour	0.14 mg/kg	Once a year
	1 Year	0.04 mg/kg	--

Air Pollutant	Average Time	Maximum Allowable Concentration in the Ambient Air	Number of Allowed Exceedances
Carbon Monoxide (CO)	1 Hour	26 mg/kg	3 times within a given month in one year
	8 Hour	9 mg/kg	3 times within a given month in one year
Nitrogen Dioxide (NO_2)	1 Hour	0.21 mg/kg	3 times within a given month in one year
	24 Hour	0.08 mg/kg	3 times within a given month in one year
	1 Year	0.05 mg/kg	--
Hydrogen Sulfide (H_2S)	1 Hour	0.03 mg/kg	3 times within a given month in one year
	24 Hour	0.01 mg/kg	3 times within a given month in one year
Ozone (O_3)	1 Hour	0.08 mg/kg	--
	8 Hour	0.12 mg/kg	--
Ammonia (NH_3)	24 Hour	270 µg/m^3	3 times within a given month in one year
	1 Year	8 µg/m^3	--
Total Suspended Particles (TSP)	24 Hour	260 µg/m^3	3 times within a given month in one year
	1 Year	75 µg/m^3	--
PM_{10}	24 Hour	120 µg/m^3	3 times within a given month in one year
PM_{10}	1 Year	70 µg/m^3	--
$PM_{2.5}$	24 Hour	65 µg/m^3	3 times within a given month in one year
	1 Year	15 µg/m^3	--
Lead (Pb)	Seasonal	1 µg/m^3	--
	1 Year	0.5 µg/m^3	--
Phosphate (P_2O_5)	24 Hour	100 µg/m^3	3 times within a given month in one year
	1 Year	40 µg/m^3	--
Cadmium (Cd)	1 Year	0.005 µg/m^3	--

4.5.2. Air Emissions from Stationary Sources

Regulation for the Maximum Allowable Limits of Air Pollutants Emitted from Stationary Sources (No. 1189/2006) sets standards and limits for air emissions from various stationary sources and applicable to this Project (**Table 4.2**)).

Table 4.2: Air Emission Standards for Stationary Sources Relative to the Project

Air Pollutant	Maximum Allowable Concentration (mg/m^3)
Sulfur Dioxide (**SO_2**) from combustion of petroleum products	6500[6]
Nitrogen Dioxide (**NO_2**) from: Combustion sources with temperature less than 1200 ^oC Combustion sources with temperature more than 1200 ^oC	 200 1500
Volatile Organic Compounds (**VOC**)	20
Lead (Pb)	0.5
Lead compounds	20

4.5.3. Ambient Noise Limits

Article (4) of the Standards for the Prevention and Elimination of Noise (2003) indicated that all projects and noise producing facilities should comply with International Noise Standards (No. 2204) and related amendments for issues related to measurement of noise and other associated technical issues.

Article (5) of the same standards established a list of activities which are prohibited by law. Those activities relative to the proposed Project are:

- All construction activities utilizing noise producing plants and equipments (e.g. mixers and vibrators) must cease between 8:00 pm and 6:00 am, unless a permit is granted by the Minister of Environment.
- Work activities within light industrial areas with residential dwellings are prohibited to continue between 9:00 pm and 7:00 am (summer) and between 8:00 pm and 6:00 am (winter).
- The Project area encompasses residential, commercial and industrial uses.
- Article (6) of the Noise Standard specifies the maximum allowable noise level (in dBA) for specific times and areas. The maximum allowable noise levels applicable to this project are detailed in **Table 4.3**.

6 Until another petroleum source with lower sulfur content is made available or after five years, whichever comes first.

Table 4.3: Maximum Allowable Noise Limits

Area	Allowable Limits for Noise Levels (dBA)	
	Day	Night
Residential areas within the City	60	50
Commercial areas	65	55
Industrial areas (Heavy Industry)	75	65

4.5.4. Soil and Groundwater Quality

Soil

The Soil Protection Regulation No. 25 for the year 2005 outlines the requirements of protecting the soil and preventing its contamination through proper management and monitoring. However, due to the absence of soil quality standards in Jordan, international standards such as the Dutch Ministry of Housing Soil Quality Standards presented in **Table 4.4** below are adopted for this project.

Table 4.4: Dutch Soil Quality Standards

Parameter	Soil (mg/kg dry matter)	
	Reference Value	Intervention Value
I. Metals		
Cadmium (Cd)	0.8	12
Chromium (Cr)	100.0	380
Copper (Cu)	36.0	190
Nickel (Ni)	35.0	210
Lead (Pb)	85.0	530
Zinc (Zn)	140	720
Mercury (Hg)	0.3	10.0
Arsenic (As)	29.0	55.0
Barium (Ba)	160	625
Cobalt (Co)	9.0	240
Beryllium (Be)	1.1	30
Silver (Ag)	-	15
Selenium (Se)	0.7	100
Tin (Sn)	-	900
Antimony (Sb)	3.0	15
II. Inorganic Compounds		
Bromide	20	-
Chloride	-	-
Fluoride	500	-
III. (Volatile) Aromatic Compounds		
Benzene	0.01	1
Toluene	0.01	130
Ethyl benzene	0.03	50
Xylene	0.1	25
Phenol	0.05	40
Styrene (vinylbenzene)	0.3	100
IV. Polycyclic Aromatic Hydrocarbons		

Parameter	Soil (mg/kg dry matter)	
	Reference Value	Intervention Value
PAH (sum of 10)	1	40
V. Chlorinated Hydrocarbons		
Polychlorobiphenyl (sum)	0.02	1

Groundwater

The general rules of the Groundwater Control Regulation No. (85) of 2002, issued pursuant to Articles 6 and 32 of Water Authority Law No. 18 of 1988, is that:

"The groundwater is state-owned and subject to its control. It is not permissible to pump out or utilize underground water without obtaining a license issued according to the provisions of the law. The purpose usage and the quantities of pumped-out water and any other conditions should be identified in the license".

Owning land does not include ownership of water stored underground. A license is required for drilling wells. In addition, supervision from the authority is required, plus a pumping test before utilization.

"Anyone who is granted a license to extract groundwater shall be committed not to cause water pollution or depletion and to strictly comply with the conditions of the license".

The regulation also covers licensing rules and fees as well as water prices, pollution control, and requirements from private well owners.

4.5.5. Waste Management

Solid Waste Management

Solid waste management must comply with the Regulation of Solid Waste Management No. 27 for the year 2005.

The objective of the Regulation is to ensure the management of solid waste in a way that maintains environmental protection and public health.

It lists details, responsibilities and tasks to be undertaken including observing and collecting operations, transportation of wastes, permitting, supervising, scheduling and archiving and outlining the responsibilities and tasks for the Ministry of Municipalities, Rural Affairs and Environment. In addition, it sets the duties to be fulfilled by the Ministry in cooperation with the related bodies. These duties include picking up the waste, defining stipulations of storage, collection, sorting, recycling, and treatment and awareness and training programs, in addition to dealing with compliance, offences, punishments and fines.

Handling of Hazardous Waste

Regulation of Harmful and Hazardous Waste Management, Transfer & Handling No. 24, 2005 focuses mainly on setting the general procedures for hazardous waste producers in terms of storing, handling and collection and disposal procedures for hazardous waste and empty hazardous waste containers, including emergency plans, precautions and setting general procedures before transferring to those who are responsible for transporting this type of waste.

The regulation also deals with special conditions for owners or managers of the specified site for storing, treating and disposing of hazardous waste in terms of receiving and registering the waste, ensuring the implementation of safe procedures in order to prevent fire and other accidents, since there are special restrictions for safety and health of the employees in the site.

Handling of Spent Oils

The handling of spent oils must follow the Instructions for Recycling and Handling of Consumed Oils of the year 2003. These instructions provide definitions of consumed oils as oils refined from raw petrol or industrial oils that have been used, and which, as a result, are transferred into polluted waste together with chemicals or physical pollutants that should be disposed of, treated or recycled. Examples are machine oils, engines oils, hydraulic oils, energy transfer and movement oils, heat exchange or any other oils that are used for lubrication. Other definitions are given for underground tanks used as storage tanks to store and treat oil, oil containers and oil collecting licensed stations. They describe how these instructions should be implemented by oil producers, parties that transport oil, collecting stations, treatment units, oil combustors, and all directly or indirectly related parties in the stages of oil use and recycling.

Definitions of general requirements are also included such as:

- Prohibition of discharge of oil into sewage networks or septic tanks or surface and ground water resources or the environment.
- All parties mentioned in Article 3 must obtain a license from the Public Institution for Environmental Protection.
- Oil mixing with solid residential waste and disposal into the municipal dump for residential waste is prohibited.
- Oil use for energy production is prohibited in food producing institutions.
- Use of raw oil for energy production is prohibited in institutions, factories or houses unless an approval is given.
- Mixing of oils with hazardous waste and chemicals is prohibited.

In addition, general conditions for oil producers, oil collection stations and oil carriers are set and the general conditions for oil carriers include having an identification number (license), submitting of full information about the company with the license request, transferring the oil into a licensed collection station only. Other articles list the conditions for oil recycling and treatment units.

4.5.6. Expropriation And Resettlement

Jordan has an established system for expropriation of land and property in the public interest. This section outlines Jordan's existing legal and policy framework relating to the expropriation of any private land.

Legal Provisions for Expropriation and Compensation of Private Land and Property

Legal instrument

Land acquisition is done under a single piece of legislation, Decree (12) of 1987, commonly referred to as the Land Acquisition Law (LAL). The LAL applies in all cases and to all concerned institutions. The key articles of the LAL are discussed in this section in the context of World Bank guidelines for land acquisition and resettlement respectively, noting where appropriate provisions that would not apply in the present Zarqa Governorate Wastewater System Reinforcement and Expansion Project.

Land Owners

The LAL specifies (Article 7) that the owner of the property is the person in whose name the property is registered at the Land Registry. If the property is not registered, the person seizing (i.e. in de facto possession of) the land on the day of issuance of the Council of Ministers' Resolution to acquire shall, for the purposes of compensation, be considered the owner. This stipulation does not preclude anyone else from claiming ownership through the courts. The entitlements of legally-established renters and renters are also confirmed.

In the case of multiple ownerships, it is the general practice of the government to deal with the owners as a body and to ask them to select a representative to act and negotiate on their behalf. Nonetheless, all owners (shareholders) will be entitled to property compensation according to their shares.

Compensation for Improvements and Water Rights

Compensation for farmlands may include separately itemized compensations for features such as walls, greenhouses, wells, water rights, etc.

The LAL in Article 10 stated clearly that compensation should be fair to all PAPs both owners and renters. Owners should be compensated for their properties including (land, buildings, improvements, trees, .etc.) at full replacement cost. Judgments on the LAL in 1996 confirm this position: "*The property appropriated is the land and the buildings, trees and other fixtures on it including the water tank built in the land. Claiming for equitable compensation includes all that is in the property*".

The loss of water rights also attracts compensation: "*That the appropriation of the land which includes water spring by the Water Authority does not include the waters of that spring. The owners if the land was irrigated from the spring shall have the right to claim for compensation due to harm accrued to their land as a result of depriving it from the right of irrigation*."

Crops and Trees

Under the LAL, tree and annual crops are subject to compensation but no guidelines are defined expect that the expropriation shall be in consideration of an equitable compensation.

Under past practice Tree Crops have been compensated in the basis of a flat rate single payment defined according to a schedule developed for this purpose based on the type and age of tree. This schedule is dated, and is widely believed to lead to the underestimation of asset values. The courts have often increased compensation substantially after receipt of independent valuation reports. However, Zarqa Governorate Wastewater System Reinforcement and Expansion Project for this purpose will use the table guide of Department of Land and Survey (DLS), which originally prepared and adopted by the Ministry of Agriculture.

Amount of Compensation Payable to Renters

The LAL caps the awards to renters proportionately as a percentage of the compensation for the plot. The maxima are:

- 15% if the compensation is for occupation for industrial or commercial purposes.
- 5% if the property is occupied for any other purpose.

The LAL does not preclude private agreements between renters and owners. In conjunction with other laws, a settlement without the agreement of the renter extremely unlikely.

Source of funds

More accurate estimation of compensation will be provided in the next stage. Therefore, the necessary fund for compensation should be secured and allocated in a separate budget line item in the DLS, a Department of the Ministry of Finance.

Procedures and Mechanism for Expropriation

The LAL lays down the following procedure for the acquisition of land illustrated in **Table 4.5**.

Table 4.5: Land Expropriation under Decree 12, 1987

Ministry of Water & Irrigation/WAJ	Other concerned authorities	Project Affected Persons
Step 1: WAJ provide detailed information on the land and properties to be expropriated.	PMU assist the WAJ to identify and finalize information on the land and properties to be expropriated	
Step 2: Concerned WAJ announces in 2 daily newspapers the WAJ intent to expropriate specified land, providing full details.	PMU will help WAJ to estimates the budget for the proposed expropriation and support WAJ to ensure budget allocations.	

Ministry of Water & Irrigation/WAJ	Other concerned authorities	Project Affected Persons
Step 3: Establish valuation committee VC to estimate compensation[7], (valuations are based on current land values and prices).	PMU will monitor the valuation process and make sure total cost within the allocated budget.	
Step 4: Announce the details of land acquisition profile including compensation cost and publish them in the official magazine.		**Step 5**: Affected persons then have 30 days to discuss compensation with Concerned municipalities and VC. Owners have the right to object, and appeal against the Compensation estimate.
Step 6: Negotiation and establish final offer in full coordination with VC.		**Step 7**: If no agreement is reached, owners have recourse to the Courts.[8]
Step 8: Minister of Water & Irrigation approval.	**Step 9**: The cost of compensation is finalized on ratification by the Minister of Water & Irrigation.	
Step 10: Disburse fund to PAPs.	PMU will follow-up and ensure that PAPs receive their compensation without any delay.	
	Step 11: Judicial involvement when no agreement is reached.	

4.6. MCC Environmental and Social Guidelines

MCC recognizes the following:

- The pursuit of sustainable economic growth and a healthy environment are necessarily related.
- Gender inequality can be a significant constraint to economic growth and poverty reduction.
- Development projects can have unintended negative impacts on people when not well designed.

To address these issues more fully, MCC has two specific guidance documents:

- The Environmental Guidelines: These establish a process for the review of environmental and social impacts to ensure that the projects undertaken in a Compact are environmentally sound, are designed to operate in compliance with applicable regulatory requirements, and, as required by the legislation establishing MCC, are not likely to cause a significant environmental, health, or safety hazard.
- Gender Policy: Gender is defined as the social roles, behaviors, and responsibilities assigned to women and men in any society. Unlike biology, gender is mutable, and women's and men's roles, behaviors, and responsibilities change over time and are different in different societies.

7 The committee include representatives from WAJ, DLS and Ministry of Finance.
8 If PAPs are continue to object the acquisition plan then WAJ could proceed with compulsory expropriation.

MCC's Gender Policy provides overall guidance to country partners with their responsibilities for the integration of gender in all stages of Compact development and implementation. Countries should review the Gender Policy as they plan their consultative process and review the Environmental Guidelines as they start to identify potential priorities and should integrate relevant organizations and government ministries or agencies in the Compact development process.

The environmental guidelines cover environmental review, environmental screening, public consultation and disclosure, monitoring and reporting.

The completion of the requisite environmental and social impact analysis is the responsibility of the eligible country. However, the MCC's ESA experts will advise and consult on these requirements and work closely with the country Core Team.

The MCC will work to ensure that the preparation of Environmental Impact Assessments will include consultation with affected parties and public disclosure of the associated documents. Finally, MCC is committed to the principle of host-country ownership of a Compact, and consequently a Compact project is expected to comply with host-country laws, regulations and standards, as well as requirements by which the host country is bound under international agreements.

4.7. World Bank Operational Policy 4.12 on Involuntary Resettlement

The World Bank experience indicates that involuntary resettlement under development projects, if unmitigated, often gives rise to severe economic, social, and environmental risks: production systems are dismantled; people face impoverishment when their productive assets or income sources are lost; people are relocated to environments where their productive skills may be less applicable and the competition for resources greater; community institutions and social networks are weakened; kin groups are dispersed; and cultural identity, traditional authority, and the potential for mutual help are diminished or lost. This policy includes safeguards to address and mitigate these impoverishment risks.

Involuntary resettlement may cause severe long-term hardship, impoverishment, and environmental damage unless appropriate measures are carefully planned and carried out. For these reasons, the overall objectives of the Bank's policy on involuntary resettlement are the following:

- Involuntary resettlement should be avoided where feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid resettlement, resettlement activities should be conceived and executed as sustainable development programs, providing sufficient investment resources to enable the persons displaced by the project to share in project benefits. Displaced persons should be meaningfully consulted and should have opportunities to participate in planning and implementing resettlement programs.

- Displaced persons should be assisted in their efforts to improve their livelihoods and standards of living or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher Impacts Covered

This policy covers direct economic and social impacts that both result from Bank-assisted investment projects, and are caused by:

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

The policy indicates that requests for guidance on the application and scope of this policy could be addressed to the Resettlement Committee. It also provides details on the following aspects for policy application:

- Required Measures
- Eligibility for Benefits
- Resettlement Planning, Implementation, and Monitoring
- Resettlement Instruments
- Assistance to the Borrower

5. DESCRIPTION OF ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

Following is an overview of the findings of the data collection, field investigations and review work. A listing of the data obtained, field investigations and reports reviewed is presented in the section below, and the overview of the physical, biological and socio-economic conditions is described in the subsequent sections.

5.1. Data Sources, Field Investigations, and Literature Reviews

To address the project's scope of work, data were collected, field visits conducted and reports reviewed.

The collected data included:

- General physical characteristics of the service area:
    a) Meteorological: Detailed climate data (monthly averages of the last 5 years: 2004-2008) concerning the project area has been obtained from the Jordanian Department of Meteorology. Data was obtained from a total of two meteorological stations falling within the Zarqa governorate. These data, presented in **Annex 1**, included minimum and maximum temperatures, relative humidity, monthly rainfall averages, and wind speed.
    b) Surface, Sub-surface and Ground water Information within the project area.
    c) Air Quality: Air quality data is only available for al Hashmiyah area and can only be obtained from the MoE.
- Population and demographic data. Lists the different districts within the Zarqa governorates within the Project area by the Project activities. It also includes some primary indicators on each of the districts, including:
    a) Year 2004 census results
    b) Current and projected population
    c) Spatial distribution of current population
    d) Local population trends and historic growth rates
    e) Proposed development plans
    f) Total population for each district
    g) Population by gender within each district
    h) Employment rates
    i) Unemployment rates
    j) Economic activity of labor by gender
    k) Civil Defense Centers

The environmental study reports reviewed for information are referenced in **Section 13** of this report and they include a number of studies and reports covering a number of governorates within the Kingdom including the Zarqa Governorate.

Also, several field visits were carried by the various environmental team members including the social and public health and safety study team, archaeological and cultural heritage expert, and ecology expert. Pictures of the project area were taken during those field visits.

5.2. Physical Environment

5.2.1. Meteorology and Climate

Jordan's climate varies from Mediterranean in the west to desert in the east and south, but the land is generally arid. The proximity of the Mediterranean Sea is the major influence on Jordan's climate, although continental air masses and elevation also modify it. The prevailing winds throughout the country are westerly to north-westerly, but spells of hot, dry, dusty winds blowing from the southeast off the Arabian Peninsula frequently occur and bring the country its most uncomfortable weather.

The country's climate is a result of both its geographical location in the Eastern Mediterranean region and its relief, which ranges from 416 m at the Dead Sea shoreline to 1800 m in the Southern Highlands (GTZ, Water Resources in Jordan-2004).

In the highlands, the climate is relatively temperate; cold and wet in the winter with temperatures reaching a few degrees below zero during night, to hot and dry in summer with temperatures reaching 35 ºC at noon and dropping at night to less than 20 ºC. In the desert, temperatures reach more than 40 ºC during summer and drop in winter to a few degrees above zero. Temperatures in Aqaba region can rise to 45 ºC in summer, while in winter the temperature in those areas falls to a few degrees above zero.

Over 95 percent of the land area in Jordan has an annual rainfall of less than 200 mm, while only about 2% has more than 350 mm/year rainfall. Snowfall occurs occasionally in all parts of Jordan with the exception of Jordan Valley rift, and most frequently occurs on the higher hills. The potential evaporation rates range from about 1,600 mm/year in the extreme north-western edges of Jordan to more than 4,000 mm/year in the Aqaba and Azraq area. The high evaporation potential all over the country makes precipitation especially in the eastern and southern parts of the country ineffective because the precipitated water readily evaporates, leaving soil deprived of their moisture content and hence, not allowing the development of plants.

The Climate of Jordan can be categorized into three climatic zones:

- The Jordan Rift Valley with its sub-tropical climate, featuring mild winters and very hot summers. The northern part of the valley witnesses relatively good rainfall during the months October to May. Average rainfall ranges from 350 mm/a in the north, to 200 mm/a around the Dead Sea and less than 50 mm/a in the South towards the Red Sea.
- The Northern and Southern Highlands have rather cool, rainy winters and warm summers. Ajloun receives the most rainfall (more than 600mm/yr on average), while the rest of the highlands receive between 300 and 200 mm/yr. In winter, snowfall is not uncommon.

- The Eastern (Badia) and Southern Desert have cool winters and very hot summers. Average total rainfall is below 50 mm/yr, and maximum temperatures may exceed 50 ºC in the summer. 80% of the land area of Jordan belongs to this climatic zone.

A map showing the bioclimatic zones of project area is presented in **Figure 5.1** below. It indicates that the project area belongs to the Arid Mediterranean and Saharan Mediterranean climatic zones. The project area meteorological characteristics can be obtained from Al Zarqa Al Jadeida and Wadi Dhuleil stations.

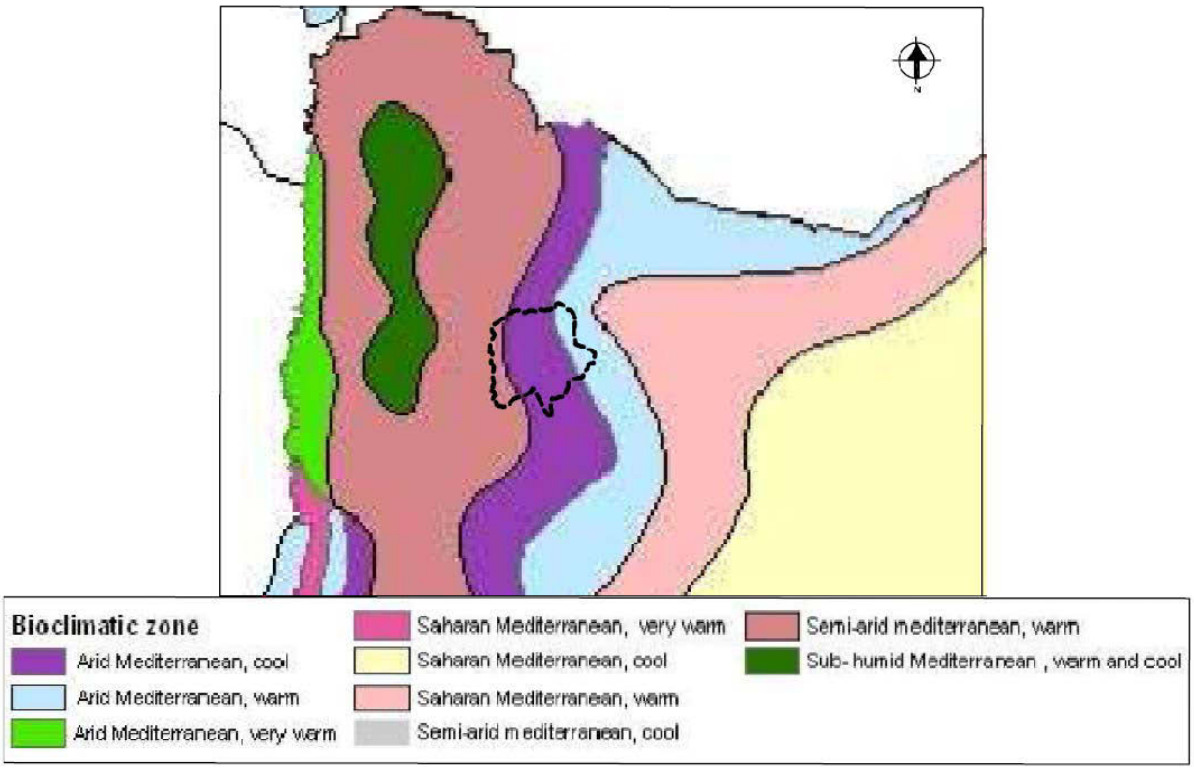

Figure 5.1: Bioclimatic Zones of Project Area

Table 5.1 below summarizes the average annual temperature, rainfall, humidity and wind speed readings over a period of five years.

Table 5.1: Averages of Monthly Climate Data for Years 2004 – 2008

Station / Element	Al Zarqa Al Jadeida	Wadi Dhuleil
Ave. Mean Max Temp(ºC)	25.35	26.30
Ave. Mean Min Temp (ºC)	13.20	10.30
Ave. Total Rainfall Amount (mm)	105.50	93.76
Ave. Mean Relative Humidity (%)	59.19	58.06
Ave. Mean Wind speed 'Knot'	4.54	3.40

The mean maximum and minimum temperatures recorded at Al Zarqa Al Jadeida and Wadi Dhuleil stations indicate hot summers and cold winters. The relative humidity in Al Zarqa Al Jadeida and Wadi Dhuleil are around 59% and 58%, respectively. Precipitation rates at Al Zarqa Al Jadeida station (105.5 mm) are slightly higher than at Wadi Dhuleil area (93.76 mm). **Figure 5.2** and **Figure 5.3** present the mean rainfall for Zarqa and Dhuleil, respectively.

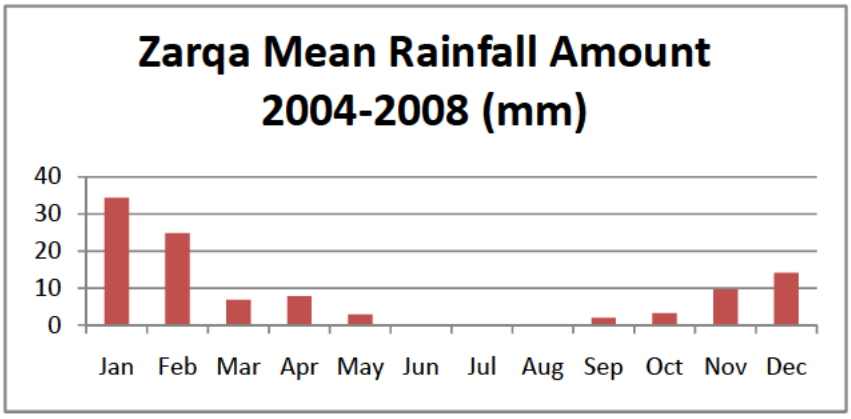

Figure 5.2: Zarqa Mean Monthly Rainfall Amount for Year 2004-2008

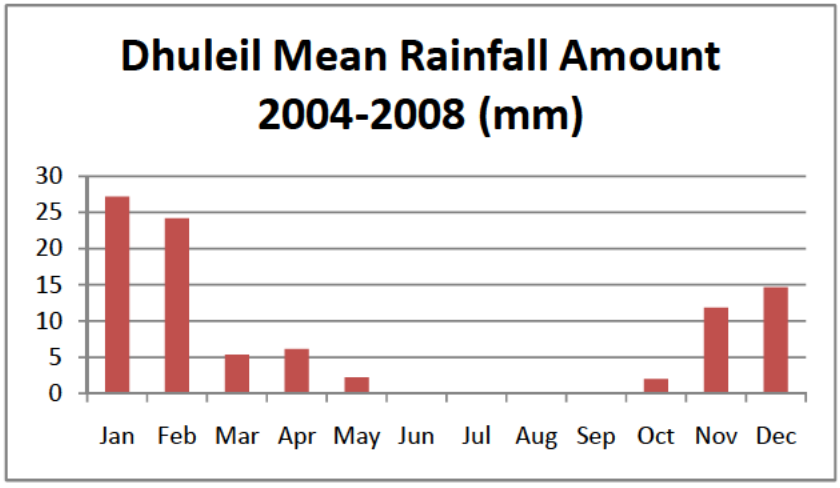

Figure 5.3: Wadi Dhuleil Mean Monthly Rainfall Amount for Year 2004-2008

The wind roses below provide wind direction and speed data as recorded by Jordan's Meteorological Stations for the two stations, Zarqa and Wadi Dhuleil. During most of the year, winds blow from the north-west direction, and they are generally of light to moderate speed.

The Al Zarqa Al Jadeida Station region witnesses minimal wind during the year. When wind does blow, it is almost of moderate to strong speed and blows from the north-west direction. The prevailing wind direction at Zarqa is north-westerly. The average wind speed ranges from 7-11 knots at times, and sometimes from 11-17. Very occasionally, wind speed may fall between 17-21 knots depending on the season (see **Figure 5.4**).

At Wadi Dhuleil, the prevailing wind direction is north-westerly where the average wind speed ranges from 4-7 knots and occasionally from 7-11 knots (sees **Figure 5.5**). More often, wind speed may be recorded at 17-21 knots, depending on the season.

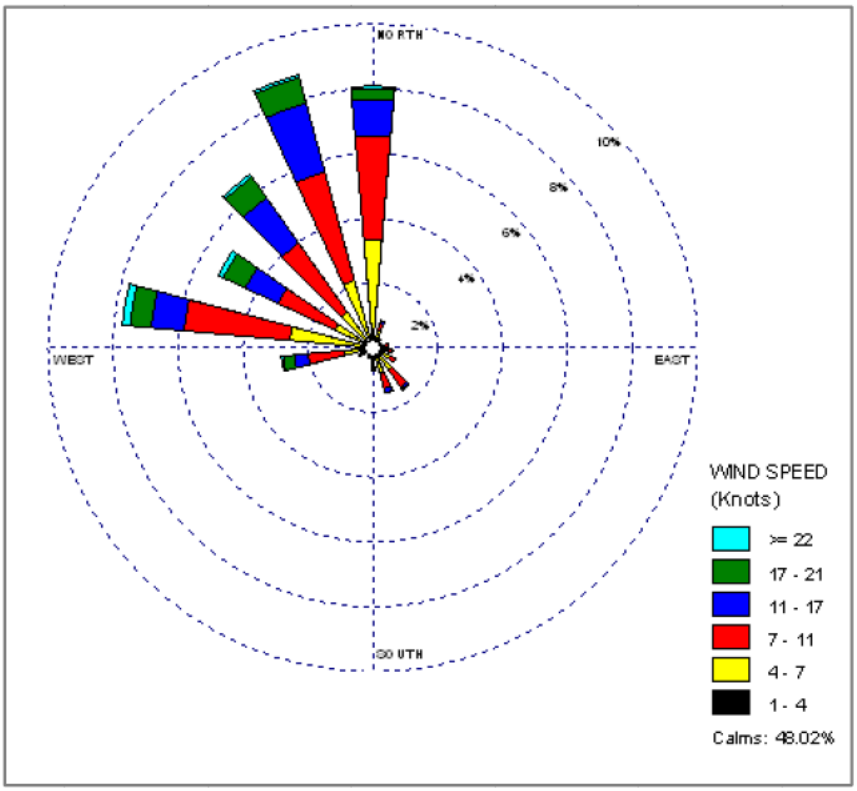

Figure 5.4: Wind Rose for Al Azraq South Station (2004 – 2008)

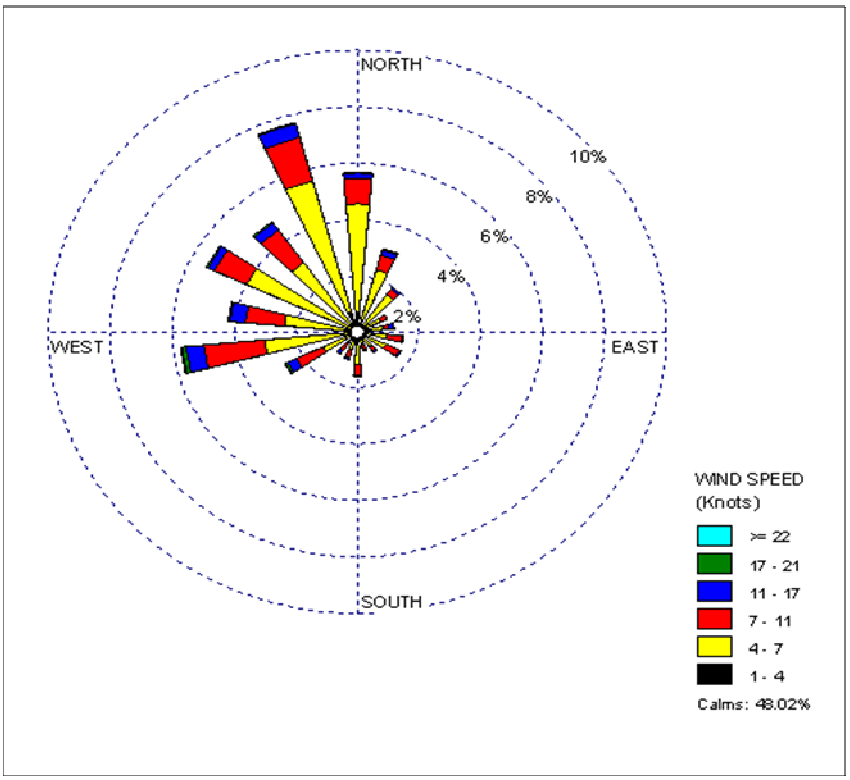

Figure 5.5: Wind Rose for Wadi Dhuleil Station (2004 – 2008)

5.2.2. Air Quality

Zarqa Governorate is considered the largest industrial zone within which half of Jordanian industrial establishments lie. High air pollution is one of the main environmental risks at Zarqa Governorate due to the surrounding industrial areas including the thermal power plants, oil refinery, and industrial plants stack emissions. Hence, these industrial enterprises can be considered the major source of air pollution within the project area. Particulate emissions or fugitive dusts are also a main environmental concerns associated with other types of industries such as marble manufacture.

5.2.3. Topography and Geology

The project area elevation ranges from 498 m in the northern part to about 807 m in southern part of the project area. Wadi Zarqa flows north as it leaves the urban area, but at its confluence with Wadi Dhuleil near Sukhneh it turns west to flow, via King Talal Reservoir (KTR). into the Jordan Valley where it joins the Jordan River at elevation -350 m about 20 km north of the Dead Sea.

Geology in Jordan includes basalt, sandstone, limestone, chalk, marl and chert and various Pleistocene and Holocene deposits of alluvial and Aeolian origin. Alluvium and Wadi sediments are encountered in the Wadi floors or depressions. Also, quaternary deposits containing travertine or fluviatile and lacustrine gravels from the Pleistocene period are present (Synergy & Worley-Parsons Komex, 2008).

The geology of the project area is part of the geology of Amman-Zarqa Basin. The outcropping of Amman-Zarqa Basin extends from Lower Cretaceous (except for the wadi fill deposits which are of Quaternary) to recent age, which is belonging to the Ajloun and Belqa Groups according to Jordanian classification. However, the Kurnub Group (Lower Cretaceous) is usually found at certain depths except outcrops at the western parts of the study area (Baq'a Valley) along the axis of Sweileh anticline. In addition, the older Zarqa Group (Jurassic-Triassic age) occurs at considerable depth (Howard Humphreys 1983).

Lithologically, Amman-Zarqa Basin includes the following (from old to young):

- Zarqa Group: this group consists of sandstone, shale, dolomite and dolomitic limestone, marl, gypsum and intercalation of volcanic ash. Its thickness reached up to 1000 meters as encountered at Wadi Rimam (south of Amman).
- Kurnub Group: this group is exposed in the western parts of Amman-Zarqa Basin at Baq'a Valley. It mainly consists of white, gray and multicolored sandstone (weakly cemented fine-medium and coarse grained) with red silts, shales and dolomite streaks. The top of this group is known as the Subeihi Formation, which mainly consists of red-brown varicolored sandstone with a large portion of marl, clay and siltstone. On the other hand, the lower part of this group is known as Aarda Formation which consists of yellow-white sandstone with shale partings and dolomite streaks. The thickness of Kurnub Group has been encountered between 200-300 meters (USAID and WAJ 1989). The age of this formation is Lower Cretaceous.
- The Ajloun Group overlays the Kurnub Group and consist of five formations, namely: the Naur (A1-2); the Fuheis (A3); the Hummer (A4); the Shuayb (A5-6) and the Wadi as Sir (A7).
- The Belqa Group overlays the Ajloun Group and consists of five formations, namely: Wadi Umm Ghudran (B1); Amman-Al Hisa (B2); Muwaqqar (B3); Umm Rijam (B4) and Wadi Shallala (B5). However, Wadi Shallala formation is not represented in the geological of Amman-Zarqa Basin.

The outcropping rocks in the study area mainly consist of Ajloun group (A4, A5/6 and A7) and Balqa Group (B1 and B2). Soil cover is generally thin, although local topography has led to accumulation of wind-blow soils in numerous places. Valleys are generally filled with alluvial deposits of gravel, boulders, and pebbles. The Amman Formation B2 (Santonian – Campanian) consists of cyclic deposits of chalk, phosphate, silicified phosphate, limestone and chert. The limestone is occasionally silicified. In the Amman-Russeifa and Zarqa areas, two members of the formation are recognized:

- Upper chalk-marl and phosphate member (26-27m thick in Russeifa); and
- Lower chert-limestone member (about 90m east of Amman).

The study area possesses various structural features indicating that Jordan Dead Sea Transform represents the structural control of the region.

The major element, which determines the configuration of the whole study area, is the Amman-Zarqa syncline structure represented by a syncline and adjoining folded layers. The syncline extends

through the area southwest of Amman to northeast of Zarqa. It swings gradually to the north, widens behind Awajan, and plunges towards the east.

A fault zone exists within the Zarqa River Valley as a result of the relative 20° rotation of the block on both sides of the Zarqa River, which has a relationship with the structural history and tectonic factors of the region. The movement of this structure is thought to have taken place in the Quaternary Era.

The geological structures affecting groundwater movement can be summarized as follows:

- Sweileh Anticline: The axis of this anticline strikes NE-SW. In its care, erosion has exposed the Kurnub Sandstone Aquifer in Ain el Basha and Baqa north of Sweileh. Modern recharge in this relatively high rainfall area directly and indirectly reaches the Kurnub and the underlying Zarqa aquifers.
- Amman- Zarqa Syncline: The axis of this syncline strikes NE-SW. It extends from the southwestern side of Greater Amman to a point about 6.60 km southeast of Zarqa. The syncline is about 30 km long by 10-15 km wide. This synclinal zone is the highest potential area in the Hummer aquifer.
- The Amman- Zarqa Monoclinal Flexure: The axis of this structure is parallel to the Amman-Zarqa syncline. It is to the southeast of the synclinal axis. They are 6.5-19 km apart. This monoclinal flexure and associated faulting form a hydraulic barrier to the eastward movement of water within the Hummer (A4) aquifer.

5.2.4. Tectonic Setting

The geological structure of Jordan shows the effect of several phases of deformation since the Cambrian period. The crustal movement that affected the country has resulted in gentle, regional tilting, uplift and subsidence and a combination of faulting and folding (Geology, Geography & History in Brief, Eng. Kamal Jreisat)

Due to different kinds of structural deformations and patterns, the country has been divided into three major structural provinces (Geology, Geography & History in Brief, Eng. Kamal Jreisat):

1. The Nubo-Arabian Shield of South Jordan
2. The Block-Faulted Platform of Jordan east of the Rift
3. The Wadi Araba-Jordan Rift

Extensional, rift-related tectonics dominated the area during late Precambrian-early Cambrian periods. The North-west / South-east Najd fault system which originated in this period has resulted in the formation of large depressions that were subsequently filled with Paleozoic clastics.

Passive margin conditions with periods of transgressions and regression dominated Jordan during early Paleozoic period, whereas an active tectonic movement of deep erosion has dominated the late Paleozoic period. The most important sediments that were deposited during that period were upper Ordovician glacial clastics and lower Silurian organic-rich shales.

Most of Paleozoic basins in Jordan are compartmentalized by Cretaceous-Tertiary wrench faults related to the late Cretaceous fragmentation of Arabian Plate.

During the Permo-Triassic period, extensional tectonics has rifted Arabia from Turkish-Iranian Gondwana fragments. Although extensional tectonics were a prominent characteristic of Jordan during the late Cretaceous period, the western margin of the Levant was characterized by East-West to West North-West and East South-East compressional feature known as Syrian Arc.

Mesozoic-Cenozoic basins in Jordan are dominantly rift-related (Azraq, Safawi and Northern Highlands).

A mid-Tertiary tectonic phase has resulted in opening of Red Sea and has led to the development of Dead Sea-Wadi Araba plate boundary that separated the Arabian plate from the African plate, and has sutured the Arabian plate to Eurasia. Consequently, this phase resulted in pull-apart basins of thick sedimentary piles.

Overall, the rate of seismic activity in Jordan, including the project area, is moderate with many of the strong seismic events located along the axis of Dead Sea Rift.

5.2.5. Water Resources

Jordan is classified as a country with scarce water resources. The available water resources per capita are falling due to population growth and are anticipated to fall from less than 160 m^3/capita/year at present to about 90 m^3/cap/year by 2025, putting Jordan in the category of absolute water shortage. Due to the limited water resources in Jordan, the demands and uses of water are exceeding renewable water supply, as a result of major contributing factors, such as the unsustainable use of groundwater through overdrawing of highland aquifers which leads to the gradual depletion of groundwater resources (MoE, 2006).

In terms of renewable water resources; groundwater, base flow and flood flow are considered conventional resources while treated wastewater, brackish and desalinated water are considered non-conventional resources. Highly variable seasonal rainfall is the main source of water in the Country. Significant amounts of rainfall (i.e. above 200 mm/a) are limited to the highlands in the north-western part presenting the long-term average of annual precipitation. Around 5% of rainwater infiltrates into the ground, thereby replenishing groundwater aquifers. The amount transformed into direct flow is slightly smaller. The largest share of over 90% of annual rainfall is lost to evapotranspiration.

Besides the indigenous water resources the country's renewable water resources are replenished through regional watercourses and trans-boundary groundwater flow. (GTZ, NWMP, Plan-Water Resources in Jordan, 2004). Water desalination, on the other hand, could be considered a future source of water supply.

Below is a description of surface and groundwater hydrology, existing water pollution discharges, and receiving water quality for water resources related to Zarqa Governorate.

Surface Water

Surface water basins in Jordan are depicted in **Figure 5.6**. According to this figure, the surface water basins in the project area include only the Zarqa surface water basin.

The Zarqa River Basin is one of the most significant surface water basins in Jordan. The river basin drains an area of 4120 square kilometers where about 95% of its area is within Jordan and only 5% is in Syria. The basin is bordered by the Yarmouk Basin to the North, the Azraq Basin to the East and South, the Dead Sea Basin to the South-West, and by the Reft Sidis Basin to the West.

The Zarqa River is the third largest river in Jordan. It has approximately 65% of the country's population and more than 85% of its industries located within its catchment area. The river is polluted by untreated and partially treated domestic and industrial wastewaters and domestic and industrial solid wastes. The main populated centers are the cities of Amman, Zarqa, Jerash and Russeifa. The industrial activities in the basin has witnessed a sudden expansion in urban development such as building, roads, new universities, scattered urban centers and other infrastructure. Agricultural areas (irrigated) are concentrated around groundwater wells and along the side beds of the river while rain fed agriculture can be found in high rainfall areas. The rest of the basin is scattered vegetative areas used for grazing, bare and rocky areas and forests.

It flows northeasterly as it leaves Amman toward Zarqa, and turns west at its confluence with Wadi Dhuleil, near Sukhneh. The river flows through the King Talal Reservoir (KTR) and into the Jordan Valley where it joins the Jordan River at an elevation of -350 m, approximately 20 km north of the Dead Sea.

The basin represents a transitional area between the semi arid highlands in the west to the arid desert in the east. The annual rainfall depth ranges from more than 500 mm in the north western part to less than 100 mm in the eastern part with an average precipitation of 280 mm/year. The rain occurs mainly from November till March with occasional thunder storms on October and April. The stream flow of the Zarqa River is impounded by King Talal Dam (KTD) at an elevation of 120 m and a capacity of 75 MCM. The area behind the river is about 3100 km^2 producing an average runoff of about 60 MCM. In addition to natural flows, flow from the Zarqa River into the KTR includes large wastewater return flows from As-Samra plus smaller flows from Jerash, Abu Nuseir and Baqa'a. KTR is an impoundment in Zarqa River formed by the KTD. The dam is located on the Zarqa River about 40 km upstream its confluence with the Jordan River. The KTR is about 6 km long, 0.2 km wide, with a full (reservoir surface elevation 180 m MSL) surface area of about 2.8 sq km. The reservoir has a flushing time of about one year, depending on the Zarqa River flows and reservoir levels. Since the primary objective of the KTR is to support irrigated agriculture in the Jordan Valley, its storage volume fluctuates according to irrigation demand and annual fluctuations in runoff.

As a result of the unplanned and uncontrolled activities, the basin now is facing many environmental problems such as land degradation and desertification, mining and salination of ground water,

reduced base flow and deforestation processes. A large wastewater treatment plant, As-Samra, with an effluent volume of 65 MCM is situated at the upper part of the basin serving the two major cities of Amman and Zarqa and the surroundings. The effluent of this plant discharges to the main river contributing to about 50% of its annual yield.

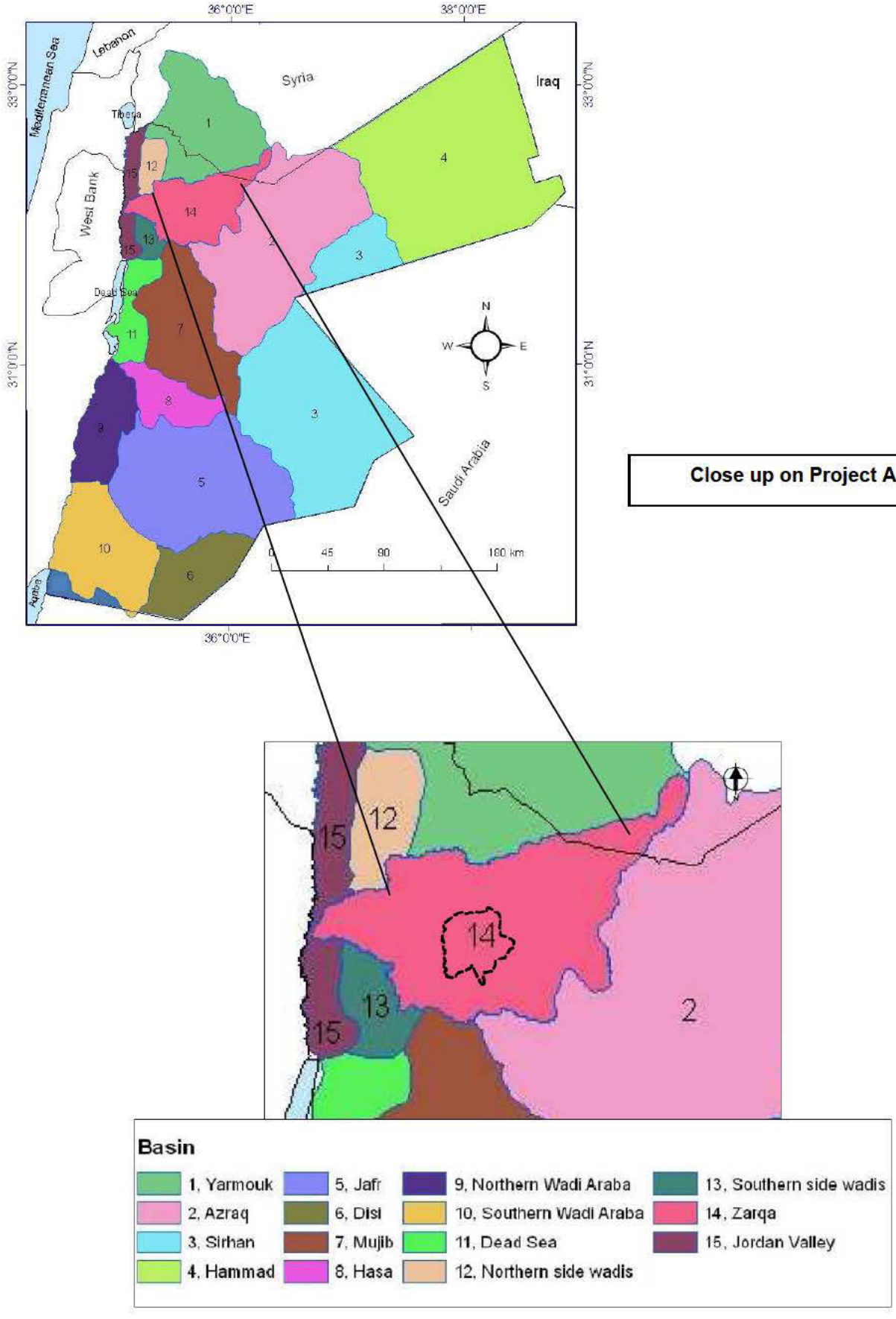

Figure 5.6: Project Area Surface Water Basins

Groundwater

Groundwater is water that is stored underground in spaces of soil or rock. The water-bearing porous soil or rock strata yielding significant amounts of water to wells or springs are called 'aquifers'. The ground water aquifers in Jordan are classified into three main complexes:

- The Deep Aquifer Complex: This is formed from sandstone and is found as one unit in the south and two units in the north separated by thick limestone and marl layers.
- The Middle Aquifer Complex (the upper and middle cretaceous complex): This consists of limestone, dolomite, marl stone and chert beds.
- The Shallow Aquifer Complex: This is the mostly exploited and consists of two main systems; the basalt aquifer system and the sedimentary rocks and alluvial deposits of Tertiary and Quaternary ages system.

Groundwater recharge is extremely important. In Jordan, groundwater is recharged either by the seepage of a small percentage of total rainfall into the ground, or through groundwater inflow from Syria (referred to as "transboundary flow", in which water resources are shared with another country). Other inflows are the result of return flows from irrigation, leaks from pipes, reservoirs, and wastewater treatment plants. Groundwater outflows are from abstraction by pumping wells, spring and base flow discharge (GTZ, NWMP-Water Resources in Jordan, 2004).

Twelve groundwater basins are identified having a total renewable annual supply "safe yield" of about 280 MCM. The spatial distribution of these groundwater basins is shown in **Figure 5.7**. Groundwater development was rapid in the 1980s and early 1990s, as successive Governments freely awarded licenses for tube-wells. As a result, by the mid-1980s, a pattern of systematic overdrawing of groundwater had been established. Over-abstraction is evident in six of the basins where the safe yields have been exceeded by more than 100 percent in some cases space. The total groundwater abstraction from eleven basins in 2003 was about 506 MCM representing an over-draft of about 226 MCM. Water levels in the main aquifers are declining due to this over-exploitation with some aquifers showing considerable deterioration of their water quality due to salinity.

The groundwater basins of project area are presented in **Figure 5.7**. The project area is included within the-Zarqa groundwater basin which is on the country's basins suffering from overexploitation.

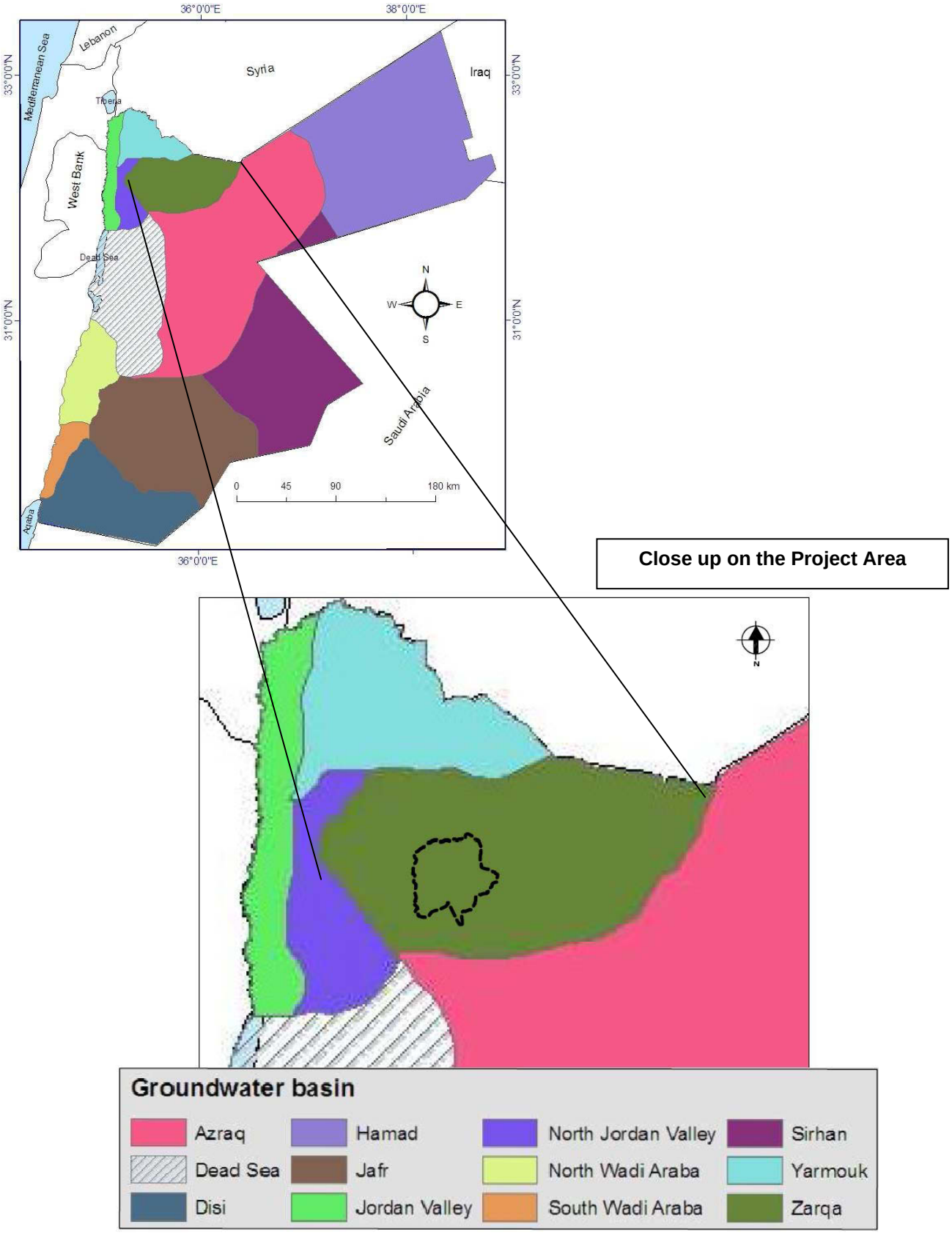

Figure 5.7: Groundwater Basins in project area

Below the basin, Amman-Zarqa aquifer system is located and is considered one of the most important basins with respect to its role in development. This basin is situated where Amman and Zarqa cities are located, hosting 54% of the total population of the country and hosting around 70% of its small- to medium-size industries. It has a safe yield of 88 MCM per annum and is considered to be the critical renewable groundwater basin in Jordan.

The intensive urbanization and agricultural expansion in the area of Dhuleil and Hallabat included within this basin have resulted in over-pumping reaching to 157% of the safe yield. In this part of the country, sewage infiltration from septic tanks and broken sewer networks in addition to over-pumping resulted in a fast depletion of water quality and quantity in the aquifer which contributed to desertification (MoE, 2006).

The two main aquifers in the Amman-Zarqa basin (the Amman/Wadi Sir formation (B2/A7) and the Hummer (A4) formation) are both exposed in the high rainfall region which reaches 400 mm/year to the west of Amman, while in the area; the rainfall does not exceed 150 mm/year. The major aquifer system in the area is (B2/A7), which is known as the Upper Aquifer. These aquifers are well jointed and fissured and on a local scale exhibit solution channels and karstic features. It is believed that the two aquifers are hydraulically connected and in some locations they are separated by an aquiclude (i.e. Ghudran Formation B1), which consists of chalk, marl and marl limestone. The Amman formation (B2), which acts as an aquifer, consists mainly of chert and limestone with phosphate beds. The Wadi Sir Aquifer lies below the Amman Formation and consists mainly of highly-fractured limestone, dolomitic limestone and some chert concretions. Most of the groundwater wells extract water from these aquifers.

According to the potentiality of water bearing, three aquifer systems are available in Amman-Zarqa Basin:

- Upper aquifer system, which includes Basalt and underlying Amman-Wadi As Sir (B2/A7) formation;
- Middle aquifer system, consisting of Hummer (A4) and Naur (A1/2) formations; and
- Lower aquifer system (Kurnub Group).

Upper Aquifer System

Basalt Aquifer

Basalts are outcropping in various parts of Jordan, specifically along the eastern margin of the Dead Sea (Wadi Zarqa Ma'in, Wadi Heidan, north of Wadi Mukheiris, Wadi Dardur and the plateau area north and south of Wadi Mujib). Also, they outcrop at the rims and on the plateaus facing of the Yarmouk Valley and in the lower Wadi Al Arab as well as at the subsurface of the Jordan Valley and in the vast Harrat-Ash Shaam basaltic province north and east of Azraq. Those kinds of basalts are associated with the formation of the Red Sea- Dead Sea-Jordan Rift and the relative northward movement of the eastern plate that governed the area from Oligocene to recent times. However, the most frequently encountered age of basalt extrusions on the eastern margin (Red Sea-Dead Sea-

Jordan Rift) is Pleistocene (Bender 1974). The basalts extend from Azraq and Wadi Dhuleil region in Jordan (11,000 km^2) to Jabal Al Arab in Syria.

This aquifer represents the main aquifer in Wadi Dhuleil area and even to the north and north-east of the study area. It was concluded that the basalt as a whole is a potential aquifer to the east of Wadi Ez'atri where the water bearing zone comprises a highly porous and scoriaceous reservoir. Therefore, there is a hydraulic connection between the Basalt and the underlying of Wadi As Sir formation (B2/A7) and they are considered as one hydraulic unit. The Basalt with the B2/A7 aquifer is the main aquifer in Amman-Zarqa Basin.

The estimated recharge to the whole Basalt aquifer in Jordan is about 45 MCM/y of fresh water, suitable for all types of usages. Of that amount, only 28 MCM/y are available within the Amman-Zarqa Basin in Jordan, while the rest discharges into the Azraq basin. The transmissivity varies from 2-113,000 m^2/d and the storage coefficient varies between 0.0001-0.003.

The Amman-Wadi Sir Aquifer System (B2/A7)

This is the most important aquifer in the Basin. It has a large and continuous extent, and a relatively high permeability. It receives the highest amount of modern recharge and is considered to be the principal source of fresh water for domestic as well as for irrigated agriculture in the Plateau. The delineation of the Amman-Zarqa Groundwater basin is based on the configuration and properties of this aquifer in the basin area.

Groundwater from the Amman recharge mound flows in four directions. A flow component is directed north-eastwards down the Amman-Zarqa Syncline to discharge into the upper Wadi Zarqa Valley. The second component is directed westwards and gives rise to Wadi Sir springs. The third component is directed southwards to contribute to the base flow of Wadi Mujib and Wadi Zarqa Ma'in. The fourth component is directed eastwards into the Azraq Basin. In the Qihati fault, the maximum displacement is about 300 meters, which places the impermeable Muwaqqar aquitard against the B2/A7 aquifer. This forms a groundwater barrier, which separates water discharging to the upper Wadi Zarqa Valley from groundwater flowing to the Azraq Basin.

Recharge occurs in the western highlands. In particular, a recharge mound is developed on the high outcrop area of the western highlands. The crest of the mound is a few kilometers to the west of Amman. Most of the direct recharge enters the aquifer in this high rainfall zone. Estimated total recharge within the basin is about 40-45 MCM/y. Prior to aquifer depletion, an additional amount of about 23 MCM/y used to be transferred to the B2/A7 from the basalt aquifer in the upper Zarqa valley area. The transmissivity of the B2/A7 ranges from 9.0 to 900 m^2/d and the storage coefficient varies between 0.01-0.3.

Middle Aquifer System

The Hummer Aquifer (A4)

This is a productive local aquifer in the Amman-Zarqa and Sukhneh areas. It is an important source of water supply in the Amman-Zarqa syncline. Elsewhere, its productivity is limited. The aquifer is artesian in two synclinal areas, and the hydraulic pressure is high enough to sustain flows from wells. However, water levels have been declining in recent years, suggesting that the aquifer may be overexploited.

The flow is controlled by a divide, which extends between Amman and Wadi Sir northwards to Sweileh. West of the divide, the flow direction is south-westwards to Wadi Sir. East of the divide, the flow is to the south-east towards Amman and then to the east and north-east. The flexure of south Amman, which strikes NE-SW, forms the south-eastern limit of the flow.

The estimated direct recharge is limited to an outcrop of about 20 km^2 extending from the southwestern edges of the Amman-Zarqa syncline (Bayadir Wadi Sir to Sweileh through Sukhneh). Estimated recharge is approximately 5 MCM/y. In the northern part of the basin, the permeability is low and receives little recharge. The transmissivity of the B2/A7 ranges from 230-2800 m^2/d and the storage coefficient varies between 0.01-0.10.

The Nau'r Aquifer (A1/2)

The A1/2 Formation overlies the Kurnub Group directly and comprises a Late Cretaceous (Cenomanian) sequence dominated by limestone, dolomite and marl. The A1/2 Formation can be found separately in some parts of the area south of Zarqa River. The outcrops of A1/2 are limited in extent and receives small amount of direct recharge in northwest. The thickness of the A1/2 varies between 30 and 40 meters. It appears to be hydraulically connected to the Amman-Wadi As Sir (B2/A7, the overlying aquifer) and slightly connected to the lower Kurnub aquifer which means downward leakage from the B2/A7 into the A1/2 and from the A1/2 into the Kurnub aquifer. The number of productive drilled wells in A1/2 is very limited so that the information for the thickness and groundwater movement in Amman-Zarqa Basin are still unknown. The limestone layers of Hummer (A4) and Naur Formations (A1/2) form potential aquifers of significant local importance where the B2/A7 aquifer is missing. Direct recharge of these aquifers is limited due to small outcrop areas and they are almost under artesian conditions with piezometric level at or close to the ground surface in some localities. Thus, in many cases and on regional scale studies, the formations from A1 to A6 are considered as one formation called the A1/A6 aquitard.

The base of the Nau‘r Aquifer consists of marl which confines the underlying Kurnub. Recharge occurs in the areas outcropping west and southwest of Amman. The estimated amount of recharge within the basin area is about 4.5 MCM/y, much of which emerges as spring flow. The transmissivity of Nau'r aquifer ranges from 4 to 10 m^2/d and the storage coefficient varies is 0.0006.

Deep Aquifer System

Kurnub Aquifer

The Kurnub Formation extends almost over whole Jordan. It mainly crops out in the lower Zarqa River (Baq'a Valley) and along the eastern flanking escarpment of the Jordan Valley, Dead Sea and Wadi Araba Graben. Also, it crops out in the deeply eroded cores of anticlines in the areas of Wadi Sir, Naur and Wadi Hisban. The Kurnub Formation is of Lower Cretaceous age and consists mainly of sandstone (white, multicolored and gray with medium to coarse grained size) and shale. However, in the northern and central parts of Jordan the Kurnub Formation is characterized by very fine-to coarse grained, partly carbonaceous sandstones with intercalations of sandy dolomite. Dolomitic limestone, siltstone and shale are common. In Amman-Zarqa Basin, the Kurnub aquifer represents the lower aquifer system and outcrops only in Baq'a valley along the Sweileh anticline. It consists of sandstone, white or varicolored with layers of reddish silt and shale. Because of the presence of clay layers in Kurnub aquifer, there are variations in horizontal and vertical permeability. The depth to the Kurnub aquifer is approximately 480 m south of Amman and 530 m near to the Zarqa area (Howard Humphreys 1983). Most of wells drilled in Jordan reaching the Kurnub aquifer have neither good yielding nor quality except in the Baq'a Valley (part of Amman-Zarqa basin).

The Kurnub sandstone is a regional aquifer in Jordan. Recharge is limited to small outcrop areas in Baqa, Jerash and the Zarqa River. The aquifer is also recharged by leakage from the overlying carbonate aquifers. The estimated total recharge to both the Kurnub and the underlying Zarqa aquifer within the basin is about 8 MCM/year. The aquifer is separated from the underlying Zarqa aquifer by bluish-green shale and marls of the upper Zarqa formation, and is confined by the overlying Nau‘r marls. The transmissivity of Kurnub aquifer varies between 3.0 and 1700 m2/d and the storage coefficient ranges from 0.001 to 0.10.

Main Sources of Water Pollution Discharges

Zarqa River basin is capable of supporting forests and agricultural activities. Natural forests occurring in the mountainous part are composed of oak, pine, juniper, wild olive and cypress. Agricultural activities and their associated weeds have supplanted the indigenous flora communities. Agriculture is scattered with the basin from rain-fed orchards, olive and field crops to irrigated agriculture on the river banks and the Jordan valley. Private Irrigated area using groundwater as a source of irrigation water can be found in scattered places in the middle and the eastern part of the basin.

During the last 20 years, the basin has undergone considerable land use changes. The expansion of Amman and other towns has been enormous, where before large areas of grazing land and fertile agricultural land could be found between Amman and other towns, it has now developed into one large urban conglomerate.

The main industrial activities in the basin are: al-Hussein thermal power plant, the oil refinery, textile industries, paper processing, leather production, food Industries, distilleries, drugs and chemical

industries, intermediate petrochemicals, engineering industries, paper and carton products and mining industries (Phosphate).

These activities are considered the main source of pollution to the surface and groundwater where some industries in the Zarqa River Basin produce high strength organic wastewater effluents and others produce high salinity wastewater. Some industries are permitted to discharge their wastewater to the municipal sewer systems, either untreated or after pre-treatment; others recycle their effluent for on-site irrigation purposes. However, it is understood that some industries fail to comply with these standards, and discharge non-compliant wastewater into the municipal sewer network. It is also reported that some industries dispose of their wastewater by tanker truck, which should convey the wastewater to treatment facilities, but may sometimes discharge it in nearby wadis.

In addition to that, the basin includes four municipal wastewater treatment plants whose effluent has reached 70 MCM/year and is discharged into the river. This volume is expected to reach 180 MCM by the year 2025.

Thus, the main sources of degradation of the Zarqa River Basin water quality and quantity are as follows:

- Domestic and industrial effluents.
- Domestic and industrial solid waste.
- Over abstraction of groundwater and the competition in water usage between municipal, agricultural, and industrial sectors.
- Overgrazing and deforestation.
- Agricultural activities as well as construction activities that have increased the sediment load of surface water.
- Wide fluctuations in annual rainfall due to climate change and associated desertification.

5.3. Biological Environment

This report provides assessment of the ecological character of the study area based on a desk-top study. The study included review of available literature, review of Google Earth satellite images, and review of available topographical maps.

The objectives of this desk-top preliminary ecological baseline description are:

- To examine national ecological data bases and published literature, including the IUCN Red List and Birdlife International Register of IBAs, for the project area; and
- To prepare a list of recorded sites and species that include name, reference, location by description, brief details of the prime ecological interest and the main species recorded, current conservation status, value, and threats.

5.3.1. Study Area

The study area is located in Zarqa and it extends from Zarqa Free Zone in the east to Alouk in the west and from Greesa in the north to Mukhiam Hitteen (Theodor Shneler Palestinian Refugees Camp) in the south (**Figure 5.8**).

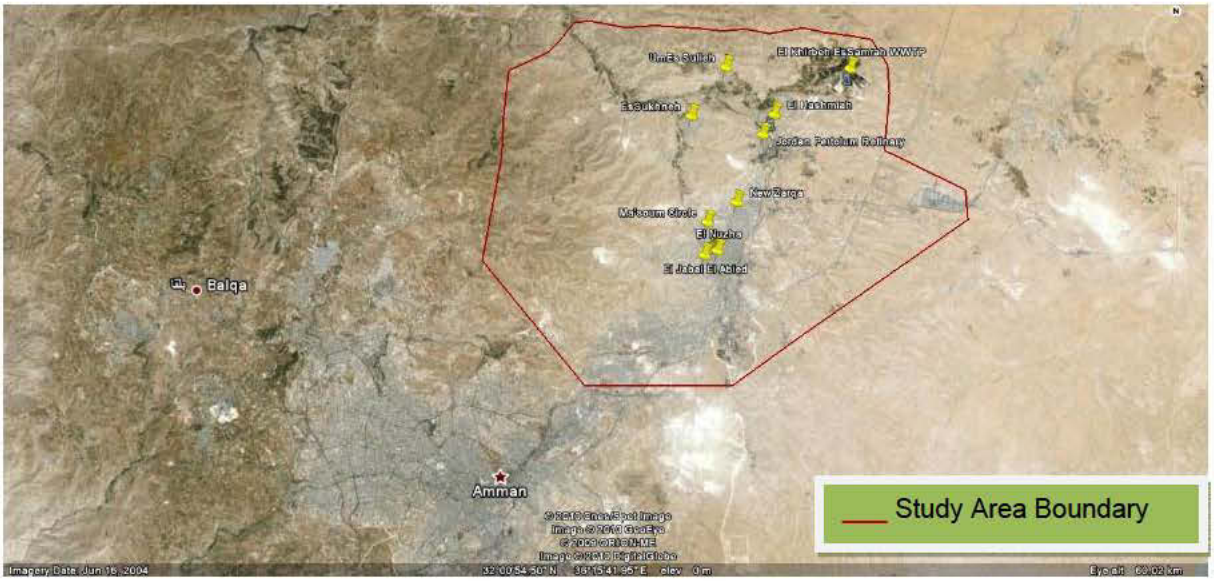

Figure 5.8: Boundary of the Study area

5.3.2. Biogeography and Climatic Zones in Jordan

Jordan is located within the eastern margins of the eastern Mediterranean. Much of Jordan can be classified as semi-desert, with only the western high lands enjoying a Mediterranean climate.

Despite the relatively small area, a number of diverse and distinct biotopes exist in Jordan, allowing diversity, heterogeneity and range expansion of the different faunal elements (see **Figure 5.9**). Based on phytogeography, annual rainfall and soil types (Feinburn & Zohary 1955, Long 1957, Poore & Robertson 1964, Al-Eisawi 1985, Albert et al. 2003), Jordan is divided into the following four main biogeographical regions:

- **The Mediterranean:** This region extends from the northern mountains to the south near Petra. It is characterized by its distinctive terra rosa and rendzina soil types. Annual rainfall ranges 400-600 mm and the altitude ranges 900-1,700 m. Oak (*Quercus* sp.), juniper (*Juniperus phoenica*) and pine forests (*Pinus halepensis*) are found along these relatively narrow mountain strips.
- **The Irano-Turanian region:** surrounds the Mediterranean one. It extends over about the lower half of the Jordan valley and reaches Ras An Naqab in the south. The annual rainfall varies through 150-250 mm at altitudes ranging 400-700 m. The soil is loess and/or calcareous and supports poor scattered vegetation (e.g. *Artemesia herba-alba, Anabasis sp.*

and *Retama raetam*). The vegetation type under this biogeographical zone is commonly referred to as the steppe vegetation.

- **The Saharo-Arabian region:** occupies the largest portion of the area of Jordan. The soil is extremely poor and comprises hammada, saline, sandy loam or mud flats. The surface is covered by sand-dunes, gravel or pebbles and black Laval rocks. The annual rainfall is 50-100 mm. *Artemesia herba-alba, Achillea fragrantissma* and *Trigonella sp.* are among the most common plant species.
- **The Sudanian penetration region:** covers Wadi Arabah, the eastern borders of the southern end of the Dead Sea and southern Jordan. In Wadi 'Arabah altitudes range from 400 m below sea level to sea level near Aqaba and 200 m above sea level at Ar-Rishah. Soil is predominantly alluvial, saline sand with scattered sand-dunes, lisan marls and others. The annual rainfall ranges 50-100 mm. Vegetation is exemplified by *Haloxylon persicum, Acasia sp., Calotropis procera* and *Nitraria retusa*.

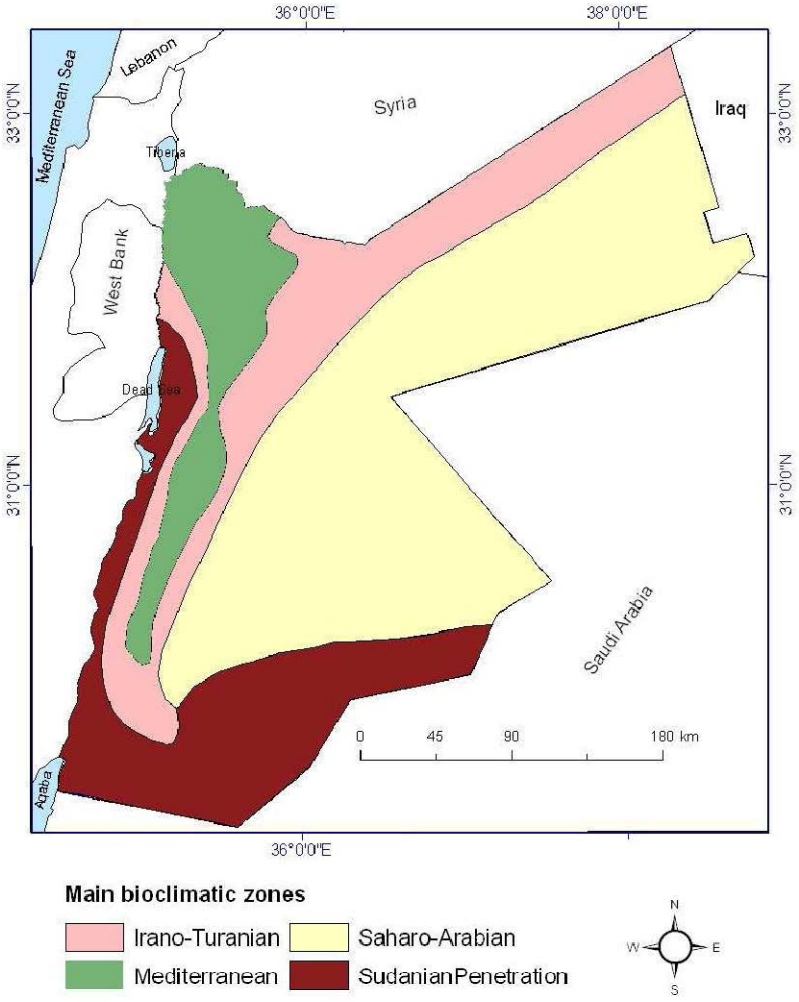

Figure 5.9: Map of Jordan Showing the Biogeographical Regions

5.3.3. Biogeography and Ecosystems in the Study Area

Biogeography and Land Use in Study Area

The study area falls under two biogeographic regions, namely the Mediterranean and the Irano-Turanian. In the Eastern side of the study area, Saharo-Arabian (Desert) affinities intersect with the Irano-Turanian zone.

The Mediterranean region covers the western part of the study area. The area can be further subdivided into the Batha Steppe and the forested Mediterranean sub-groups based on the dominant representative vegetation in this area (**Figure 5.10**).

Figure 5.10: The Barren Slopes with Batha steppe

The majority of the western part is a series of barren slopes with Batha steppe vegetation that changes to grass land steppe as we move to the east. Farm lands are predominantly confined around both sides of the wadi system and mostly near Khirbet As-Samra area. Very limited planted pine forests occur only on the extreme mid-western borders of the study area.

Forested areas in this section are limited to the stretch between Birein and north of Sarrout, and it extends after to the west-north up to Al Alouk (**Figure 5.11**).

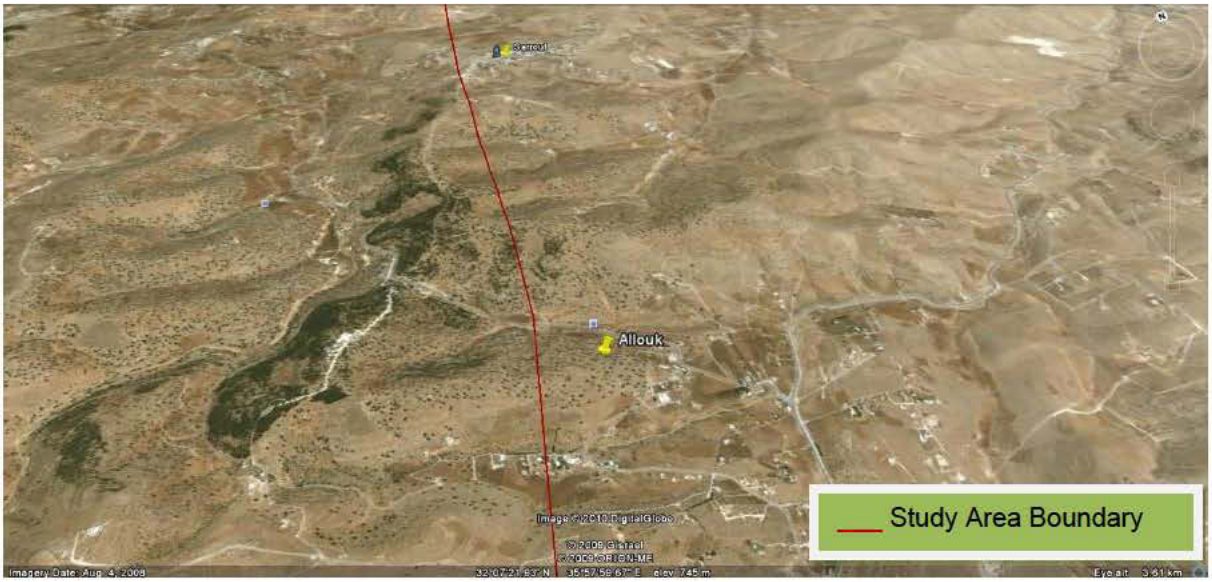

Figure 5.11: Forest-Mediterranean Region within the Study Area

The Irano-Turanian covers the central and eastern parts of the study area, and it represents Zarqa city Russeifa and its outskirts, reaching Al-Hashmiyah and Al-Sukhneh (see **Figure 5.12**). The dominant representative vegetation is Grassland Steppe. It is interrupted by Zarqa River tributaries flowing from the south and south-east to north and north-west, and then turns to the west. This riverine joins wadi system arising from Khirbet As-Samra and Wadi Al Dhuleil to the east. Elevation ranges from 750 to 450 m asl.

Figure 5.12: The North-East Side of the Study Area

Figure 5.13: The Area between Zarqa City and Zarqa Free Zone

The central section of this area is heavily populated, most significantly in Mukhiam Hitteen. It is considered the most densely populated area in Jordan. However, the side banks of Zarqa River in the area between El Nuzha and El Jabal El Abied, between Hai Eth Thawra El Arbiya El Kubra and Awajan, and the stretch in Russeifa are being cultivated (**Figure 5.14**). The same applies for the side banks of Wadi Ed Dhuleil and other wadis and tributaries in Khirbet As-Samra, Al Hashmiyah, Um EsSulieh and Al Sukhneh (**Figure 5.15**).

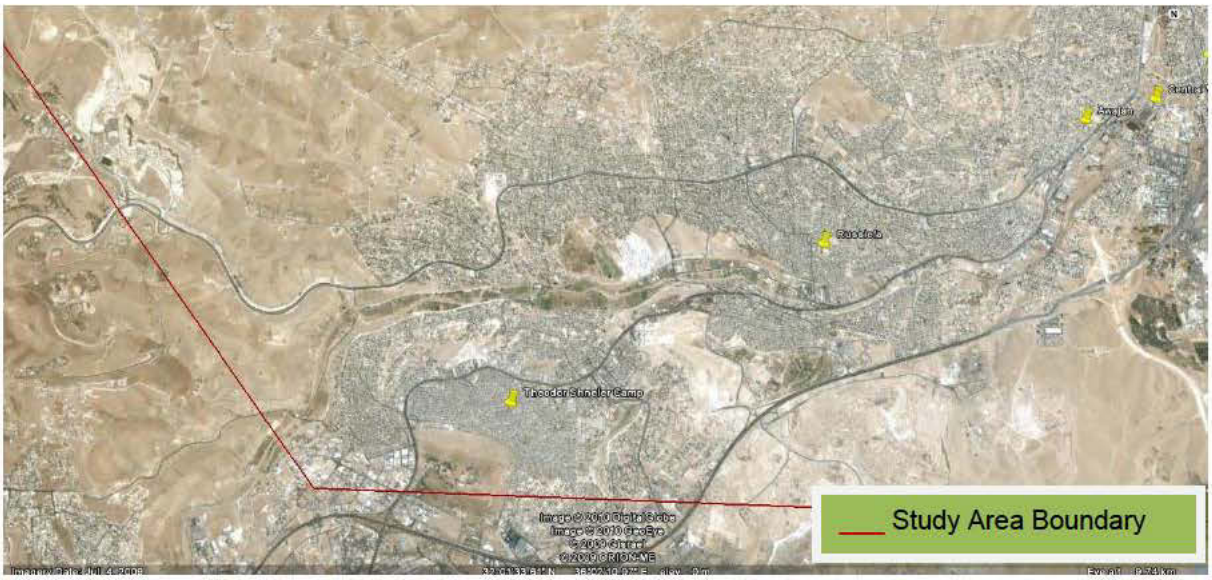

Figure 5.14: Cultivated Area in Russeifa

Figure 5.15: Cultivated Area between Al-Hashmiyah and Al-Sukhneh

The eastern side is an arid land of the Irano-Turanian with Eastern Badia affinities. The vegetation cover is grassland but with much less density compared to the north-western grassland basically due to rainfall volumes. This area, in particular along the Zarqa to Mafraq highway, is under growing urbanization and development in the form of residential and commercial uses (**Figure 5.16**).

Figure 5.16: Land Use in the Eastern Section along Zarqa-Mafraq Highway

Within this section, and on the area between the Zarqa Free Zone and the Refinery, land uses include industrial, residential and agricultural. Two universities exist within this zone: Zarqa Private University and Al-Hashmiyah University.

Figure 5.17: Land Use between the Zarqa Free Zone and the Refinery

Ecosystems and Habitat in the Study Area

The study area subject to assessment was found to cross two ecosystems, namely: Mediterranean, and Grassland Steppe. Different habitat types can exist within the same ecosystem based on the site-specific bio-physical characteristics such as rainfall, soil type and geomorphology (see **Figure 5.18**).

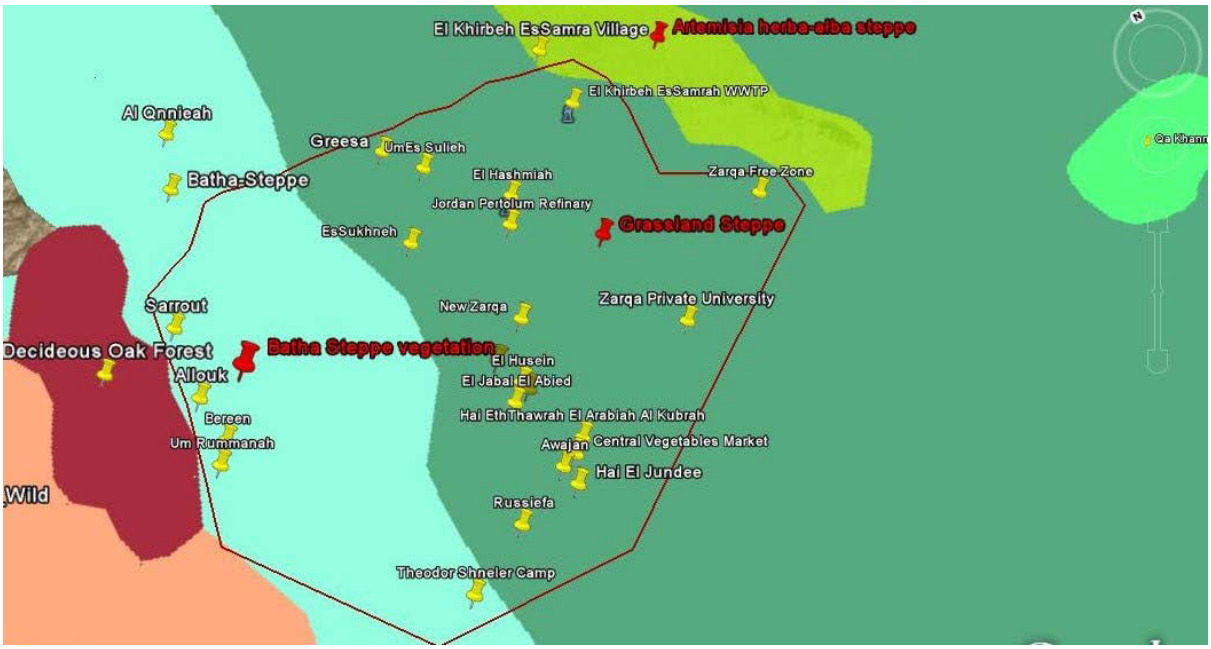

Figure 5.18: Habitats and Dominant Vegetation in the Study Area

About The Grassland Ecosystem (Steppes)

This is an ecosystem that is characterized by a wide range of mean annual precipitation and can be divided into the following:

- The transitional grasslands that border the desert ecosystem, this area receive (200 - 350 mm), and estimated to constitute about 6% of the total surface area of Jordan. This area is cultivated by winter barley and is heavily grazed. The type of agriculture is highly dependent on the probability of having a good year in terms of rainfall; otherwise the land will be left abandoned for one year and cultivated the year after. The part of this zone that receives more than 250 mm is cultivated by winter crops such as wheat, lentils, chickpeas and summer crops such as tomatoes, watermelons, and other members of the *Cucurbitaceae* family.
- The plains grassland, this area is the major dry farming area in Jordan. This area receives (350-500 mm) MAP. It is the extended area of Sahal Horan which has a great agricultural importance in Lebanon, Syria, Jordan and Natural Palestine. This area is heavily cultivated by winter and summer crops. Most of this area is located in North and Central part of the country. Much of the natural vegetation in this area is weedy species that grows with the crops. Many members of the important Mediterranean families are present in this ecosystem. Including grass families, as well as Thistle-like members of the Daisy family. Some steppes are predominantly grassy with many kinds of annual grasses as well as herbaceous legumes and plantain species. Others have a mixture of perennial plants including Anemones, Irises, Poppies, and members of the Daisy and Borage families. Many bulbous plants grow in this ecosystem.

About the Mediterranean Forest Ecosystem

This ecosystem comprises the smallest of all in area (736,000 dunum 0.8% of Jordan total area). It also includes both natural and artificial (Manmade) forests. About 400,000 dunum is natural forest and 336,000 dunum is artificial forest. It is also the most heterogeneous. The vegetation types dominating the areas of the Mediterranean that lack forest cover are called Non-Forest Mediterranean. It comprises vast areas and dominated by dwarf bush plant communities. Leading species of this vegetation in the northern parts are *Rhamnus spp. Calycotome villosa, Sarcopoterium spinosum, cistus villosus*. The forest areas on the other hand can be classified into the following categories.

- **Broad-leaved evergreen forest:** This type is dominated by two species of Oak (*Quercus coccifera* and *Quercus aegilops*) mixed with Wild Pistacia and Olives (*Pistacia atlantica* and *Olea europeae*) and with a (Kharoub) *Ceratonia siliqu* and tall Shrubs such as *Arbutus andrachne*. This type covers 250,000 dunum of all forested area in Jordan.
- **Broad-leaved deciduous forest:** This type is dominated by Quercus infectoria and *Quercus aegilops* and *Pistacia atlantica*, *Pistacia palestina* and *Ceratonia siliqua* mixed with tall shrubs of *Styrax officinalis*. This type covers 42,000 dunum of all forested area in Jordan.

- **Narrow-leafed coniferous forest:** This type is dominated by two species of trees Aleppo Pine in the Northern part of the country (*Pinus halepensis*) and the Phoenician Juniper (*Juniperus phoenicea*) in the Southern part of the country. This type covers an area of 77,000 dunum of all the forested area of Jordan.
- **Mixed forest:** This type is made of a mixture of several species of trees and occurs only in the Northern part of the country. Aleppo pine, Oak, Pistacia, *Pyrus* and *Arbutus* dominate this type of forest. This type covers 30,000 dunum of all forested area in Jordan.
- **Artificial forest:** This type is manmade forest and was planted using seedlings of Aleppo Pine (*Pinus halepensis*) and Blue-leafed Wattle (*Acacia cyanophylla*) which is an exotic species native to Australia. This type of forest occurs in hilly areas and along the main roads in Jordan. It covers more than 336,000 dunum.

The Ecological Character of the Study Area

Discussion of the ecological character of the study area is provided below and includes dominant vegetation cover, flora diversity, fauna diversity, avifauna diversity, and delineation and conservation areas. The study area is sub-divided into two main sub-divisions based on their biogeographic regions: namely, the Mediterranean and the Irano-Turanian groups.

Sub-Division Mediterranean Zone

This sub-division covers the western part of the study area within Zarqa governorate, specifically within the area between Al-Sukhneh, Sarrout and Birein, up to Quniah and Greesa in the north.

Vegetation types and Flora Diversity

This area fall within the Mediterranean vegetation type known as the Batha Steppe. It is considered a transitional zone between the Mediterranean and the Irano-Turanean realm. It exhibits steppe vegetation as well as Mediterranean. The soil condition has prompted massive agriculture at these areas, predominantly by olive trees.

Within this area forestation exist on undulating terrains of high altitudes, being forested mostly with pine trees. The forested area extends between north of Birein village and up to the north west of Sarrout village. Other forestation can be also seen along the running wadis with some native and other introduced species.

Several plant associations within this type including *Ballota undulat*a, *Ononis natrix* association, *Echinops polyceras* and *Ballota undulata, Phlomis* sp. and *Euphorbia heirosolymitana.* Several species has been recorded at this type such as: *Phlomis brachyodon, Astragalus bethlehemiticus, Verbascum eremobium, Chrdinia orientalis, Minuartia picta, Ancusa strigosa, Scrophularia* sp. *Crupina crupinastrum, Eryngium glomeratum, Carlina hispanica, Convolvulus dorycnium, Rhagadioulus stellatus, Bromus* sp. *Poa bulbosa, Aegilops kotschy, Boissiera squarrosa, Taenistherum crinitum.* Other species with steppe affinities recorded include *Atriplex halimus, Anabasis Syriaca, A. articulata, Nonea mucronata, Salsola vermiculata, Notobasis syriaca,*

Hyocyamus reticulata, Alcea acaule, Retama raetam and *Gymnarrhena micrantha.* Many bulbous species from the lily and the Iris families were recorded including, *Gynandriris sisyrinnchium, Gladiolus* sp., *Tulipa polychroma, Glaucium grandiflorum, Allium stamineum* and *Gagea reticulata.*

Faunal Diversity within the Mediterranean Section

As it is mentioned above, the study area in the western section is situated in either residential or agricultural areas, except for the forestation areas. These habitats are severely affected by man-made changes that influenced the general integrity of their original nature.

Mammalian fauna of this habitat includes the subterranean mole rats (*Spalax leucodon*) and Tristram's Jird (*Meriones tristrami*) as the most common rodents. The Red Fox (*Vulpus vulpus*) is common in such habitats, since it frequent inhabited areas looking for scraps. The Eastern European Hedgehog *(Erinaceus concolor*) is also found in such habitats. Other carnivores may include the Stone Marten (*Martes foina*) and the Eurasian Badger (*Meles meles*). There are past records of the striped Heynea from the vicinity of this area.

Reptiles and amphibians known to occur in the area include: the Green Toad, *Bufo viridis*, the Rurkish Gecko, *Hemidactylus turcicus,* the Levant Fan-footed Gecko, *Ptyodactylus puiseuxi*, the Mediterranian Thin-toad Gecko, *Cyrtopodion kotschyi*, the Starred Agama, *Laudakia stellio*, the European Chameleon, *Chamaeleo chamaeleon*, the Snake-eyed Lizard, *Ophisops elegans,* the Strpied Legless Skink, *Ophiomorus latastii*. Several species of snakes are known from this area such as *Coluber jugularis, Coluber rubriceps, Eirenis decemlineata*, *Eirenis rothi*, *Malpolon monspesulanus, Telescopus nigriceps* and possibly *Vipera palaestinae*.

Avifaunal Diversity

In terms of avifaunal diversity, the western part varies to great extent depending on altitude and the characteristics of the vegetation cover. Segmentation of this section based on the avifaunal regions could be divided into the two segments: first, the Wadi systems with perennial streams, and second the rocky slopes. The Wadi systems with perennial streams might possibly have the following breeders, Smyrna Kingfisher, Yellow-vented Bulbul, Rufous Bush Robin, Cetti's Warbler, Graceful Warbler, Palestine Sunbird, and Spanish Sparrow. Rocky slopes, especially the forested area, provides diverse habitats for typical Mediterranean bird communities breeding including Kestrel, Chukar, Little Owl, Crested Lark, Long-billed Pipit, Black-eared Wheatear, Blue Rock Thrush, Black-eared Wheatear, Sardinian Warbler, Rock Sparrow, and Linnet.

Sub-Division Irano-Turanean Zone

This sub-division includes the central part of the study area within Zarqa governorate, specifically within Russeifa, Awajan, El Jabal El Abied, Al Zarqa El Jadeedeh, Zarqa-Mafraq Highway, and Al-Hashemiyah.

In general, the populated urban centre is of no ecological significance since population density in these areas is very high and different environmental challenges contributed to deteriorating the ecological character of the area.

Biodiversity and ecological characteristics in less populated rural areas, and in unpopulated areas varies in their ecological setting and biological diversity based on geographical variances including altitude, surface water systems, soil type, etc.

Vegetation Types and Flora Diversity

This is mainly dominated by the grassland steppe types with islands of Artemisia herba-alba steppe. Irano-Turanean realm is evident with pure grasslands, grass hills and grasslands with coarse and fine wadis, dominating the majority of this steppe vegetation. Islands of islands of *A. Herba alba* brush also occur within this vegetation type. The grassland steppe is represented by pure grasslands, grassy undulating hills, and grasslands with coarse and fine wadis. Soil is calcareous and leading species are *Anabasis articulata, Achillea fragrantissima, Seidlitzia rosemarinus, Filago desertorum, Gymnarrhena micrantha, Mesebryanthemum nodiflorum, Bromus* spp. *Stipa capensis, Trigonella stellata Aaronsohnia factorovskyi, Spergularia diandra* and *Asteriscus pygmaeus.*

This part of the Irano-Turanian Realm is mostly a gently undulating terrain. The dominant habitat is heavily disturbed and eroded grassland steppe due to urbanization and development. Most vegetation is related to weedy growth that grows next to roads or within agricultural fields. Some forestation activities have been taking place especially using *Pinus halepensis* and *Cupressus semipreverense* and *Eucalyptus* trees.

Main plan associations include Centaurea damascene and Lactuca orientalis, A. herba-alba, Poa bulbosa and Stipa capensis. Association of Salsola vermiculata and Anabasis articulata. Other species that exist include Atriplex halimus, Anabasis Syriaca, A. articulata, Ancusa stigosa, Nonea mucronata, Salsola vermiculata, Notobasis syriaca, Hyocyamus reticulata, Alcea acaule, Retama raetam and Gymnarrhena micrantha. Many bulbous species from the lily and the Iris families were recorded including, Gynandriris sisyrinnchium, Gladiolus sp., Tulipa polychroma, Glaucium grandiflorum, Allium stamineum and Gagea reticulata.

In areas closer to the desert region like the area between Zarqa Free Zone and Zarqa City, mixed vegetation between the dominant steppe grass vegetation, and desert species. The area is mostly flat intersected by small wadis. This is a flat arid region with deteriorate vegetation cover. Main species recorded are *Acillea fraarantissima, Artemisia herba-alba, Anabasis syriaca, A. articulata, Poa bulbosa, Schismus arabicus, Filago desrtorum, Gynandriris sisyrinchium, Ballota undulate, Phlomis syriaca, Ferula communis,* and *Sinapis arvensis*.

Faunal Diversity

Faunal diversity within this biogeographic region varies based on the characteristics of the vegetation cover of each well location. The discussion below provides details on faunal diversity for sub-groups within the Irano-Turanian region in the study area. The details below exclude the heavily populated areas where only feral species are found in this area including *Mus musculus* and *Rattus rattus*.

Sub-Group 1: (Estern Side Beteen Al Jabal El Abied and Birein)

This is an arid Mediterranean / Irano-Turanian area void of dense vegetation or natural forests. As seen from the map, the area is populated with limited framed areas (**Figure 5.19**).

Mammals include small rodents such as *Gerbillus dasyurus*, *Gerbillus tristrami* and *Spalax leucodon* in low density. Reptiles are confined to small lizards (*Ophisops elegans*, *Laudakia stellio* and *Trapelus ruderatus*. Snakes such as *Eirenis coronella* and *Coluber jugularis* were recorded from this area.

Figure 5.19: Land use within Sub-group 1 of the Irano-Turanian Region

Sub-Group 2: (South-Centre Section along Zarqa River in Russeifa)

This section is located in agricultural blots along the Zaraq River waterbed, being surrounded of very densely populated areas. The area is void of animals of significance, and only pests such as the House Mouse, *Mus musculus*, and the Black Rat, *Rattus rattus* are common (**Figure 5.20**).

Figure 5.20: Land Use within Sub-group 2 of the Irano-Turanian Region in Russeifa

Sub-Group 3: (Eastern Section)

Despite the presence of various installations in this area (**Figure 5.21**), it is still relatively rich in animals. This section includes a wide variety of mammals ranging from small to medium sized animals. The small mammals are represented by several rodent species (i.e. *Gerbillus dasyurus, Jaculus jaculus*, *Meriones libycus* and *Psammomys obesus*) that are common across the Jordanian desert. Insectivores are exemplified by two species (*Paraechinus aethiopicus* and *Hemiechinus auritus*). The Arabian Hare, *Lepus capensis,* is known in this area but at low densities. Order Carnivora is represented by one species; the Red Fox, *Vulpes vulpes.*

Reptiles are represented by several species, most of which are a mix of both the Irano-Turaean and Saharo-Arabian species (**Gekkonidae**: *Bunopus tuberculatus, Hemodactylus turcicus, Stenodactylus grandiceps,* **Lacertidae**: *Acanthodactylus boskianus, Acanthodactylus grandis, Mesalina brevirostris, Mesalina guttulata,* **Agamidae***: Trapelus pallidus* and **Varanidae**: *Varanus griseus*). Snakes are diversified and include at least seven species (*Eirenis coronella, Eirenis rothi, Malpolon moilensis, Psammophis schokari* and *Spalerosophis diadema*.

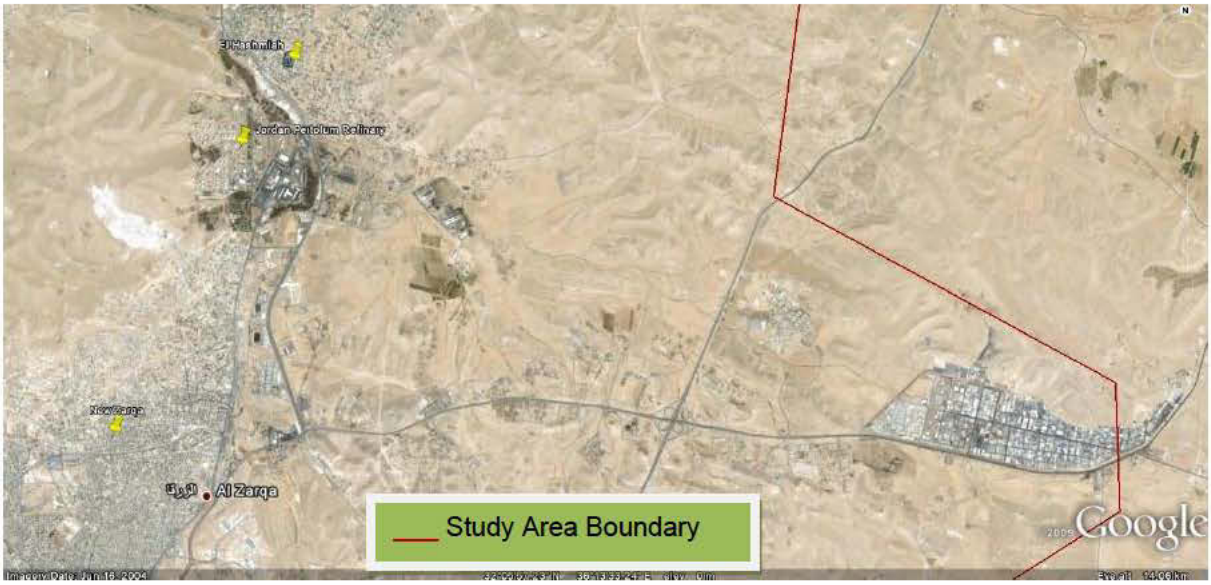

Figure 5.21: Land Use within the Sub-group 3 of the Iran-Turanian Region –Eastern Section

Sub-Group 4: (North Section)

This area includes Khirbet As-Samra, Al-Hashemiyah, Greesa, Al-Sukhneh, the area between Al-Sukheh and Al Qniah (**Figure 5.22**). Most vegetation is related to weedy growth that grows next to roads or within agricultural fields. Some forestation activities have been taking place especially using *Pinus halepensis* and *Cupressus semipreverense* and *Eucalyptus* trees. Main species recorded are *Sinapis arvensis, Picnomon acarna, Erucaria boveana, Eruca sativa, Erodium spp. Lamarckia aureus, Hordeum bulbosum, Senecia galucus, Centaurea sp. Cardus australis, Anagalis arvensis, Malva sylvestris, Urginea maritime, Cardaria draba*.

Noteworthy plant species are these that are used for forestation activities (P. *halepensis, Eucalyptus sp.,* and *C. semipreverense*) that could be subject to removal.

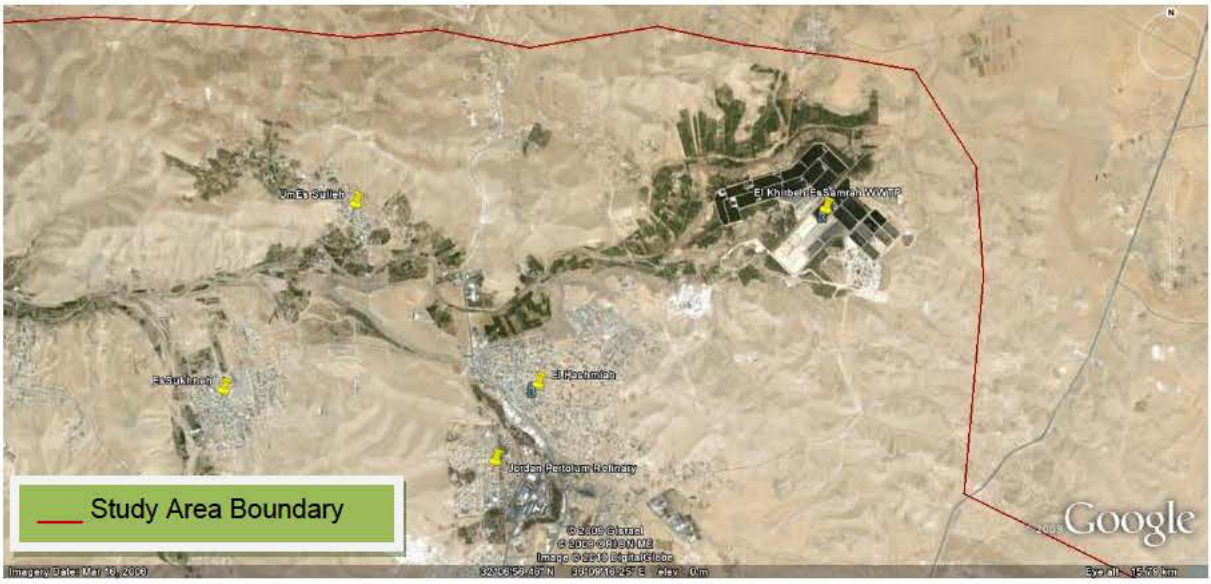

Figure 5.22: Land Use within the Sub-group 4 of the Iran-Turanian Region –North Section

Of the species recorded in the hilly areas include Anabasis syriaca, Urginea maritime, Asphodelus microcarpus, Sianpis arvensis, Papver syriaca, Calendula tripterocarpa, Trifolium sp. Plantago sp. Iflago spicata, Gynandiris Sisyrhinchium, Carlina hispanis, Poa bulbosa, Romulea hybrida, Picnomon acarna, Hordeum bulbosum, Plantago spp. and Erodium spp.

Mammals that are known to occur in this section, especially in the wadi systems, are mostly wild rodents including *Meriones crassus* and *Gerbillus dasyurus*. In addition, the Levant Vole, *Spalax leucodon* seems to be present at the margins of agricultural fields. The red fox, *Vulpes vulpes*, was also recorded from that area.

Several species of reptiles are known in this section such as *Laudakia stellio, Trapelus ruderatus and Acanthodactylus boskianus, Acanthodactylus grandis, Mesalina brevirostris, Mesalina guttulata, Ophisops elegans, Varanus griseus*. Snakes are diversified and include at least seven species: *Coluber rogersi, Eirenis coronella, Eirenis rothi, Malpolon moilensis, Psammophis schokari* and *Spalerosophis diadema*.

Avifaunal Diversity

The area of this segment is characterized by monotonic poor habitat coverage and deterioration alongside being highly populated area. This segment leaves little chance for wild birds to inhabit or depend on this type of habitat for feeding. Small areas of scarcely scrubby and bushy areas exist outside populated areas. These spots are often productive for migrant warblers and shrikes. They also represent relatively good spots for Roller, Red-rumped Swallow, Graceful warbler and Great Grey Shrike. Migrating raptors and storks can also pass over this site in low numbers.

The Important Bird Area (IBA), Khirbet As-Samra, was first declared in 1994 (IBAs of the Middle East by M.Evans). Later in 2000, the National IBA inventory (RSCN 2000) recognized the area as an IBA comprised mainly of open, man-made pools – sewage pools. This IBA was identified mainly by the migrating birds passing through during spring and autumn migration, where large numbers of White Storks pass. Several other water birds occur in the sewage plant during winter time including Ferruginous Duck. Confirmed breeders within the borders of the sewage plant include Spur-winged Plover and Black-winged Stilt.

A complete list of mammalian and reptilian species available in the study area is provided in **ANNEX 2**.

5.4. Socio-cultural Conditions

5.4.1. Socio-Economic Baseline Description Approach

The approaches utilized to prepare a description of the socio-economic baseline for this preliminary ESIA are described below.

Comprehensive Literature Review

A comprehensive literature review of secondary data available through reports and other publications was conducted. The main purpose of this review was to provide the consultant with the overall picture on the social issues and characteristics related to the assignment based on the available data and studies. The literature review included existing reports of the target areas, the institutional regulatory framework, relevant laws, regulations and standards and relevant international guidelines on gender policies, resettlement policies and procedures. The literature review included listing and identification of stakeholders in the Zarqa Governorate relevant to this project (government and non-government organizations, community leaders, local residents in the project areas).

The following documents were reviewed as part of the comprehensive literature Review:

a) Al-Hashmiyah Municipality Development Plan Report. Developed by Al- Hashmiyah Municipality Development Unit; 2007.
b) Socioeconomic Reality of Zarqa Governorate- Developed by Zarqa Governorate Development Unit; 2005.
c) Social Assessment Report by Dr. Amer S. Jabarin; 2009.
d) Zarqa River Rehabilitation Launch Report; 2009.
e) Antiquities in Zarqa Governorate – Zarqa Tourism & Antiquities Department; 2009.
f) MCC Guidelines:
    i. Compact Guidelines: Best Practices in Compact Development
    ii. Guidelines for Accountable Entities and Implementation Structures
    iii. Characteristics of a Good Team
    iv. Guidelines for Conducting a Consultative Process
    v. Gender Policy
    vi. Guidelines for Environment and Social Assessment
    vii. Guidelines for Economic and Beneficiary Analysis of a Compact Proposal
    viii. Guidelines for Monitoring and Evaluation Plans
g) Water Authority Law (Law No.18 of the Year 1988)
h) Sewage System Act for the Year 1994/ issued under Article -32 - of the Water Authority Law Number 18 for Year 1988.
i) Environmental Protection Act (Law No. 52 for the Year 2006).
j) Establishment of Sewage Systems in the Municipality of Zarqa / According to Article (41) of the Municipalities Act No. (29) for 1955.
k) Construction Contractors Law No. 2 of the Year 2002.

Quantitative Socioeconomic Profiling

This approach was used to put together a demographic and socio economic profile of the target communities at the neighborhood level, revealing the features of the population in each target community.

The profile collected secondary data from official records (mainly the Population Census 2004/ Department of Statistics). The collected data was processed and statistical projections of the populations for 2009 were calculated. The raw data from DOS is presented in **Annex 3**.

5.4.2. Social Baseline Conditions within Study Area

Due to time constraints, the areas included in the preliminary assessment are a sample of the whole area targeted by the project. The areas selected were the neighborhoods that were largely un-serviced and mainly tackled the expansion of the wastewater network, in addition to the three pumping stations: West Zarqa, Al-Hashmiyah, and Hitteen.

Areas selected for the preliminary assessment fell in three municipalities in Al-Zarqa Governorate. Those municipalities were Al-Zarqa Municipality, Russeifa Municipality, and Al-Hashmiyah Municipality. The neighborhoods selected from within each of those municipalities where the wastewater network is not available are listed in **Table 5.2** and illustrated in **Figure 5.23**.

Table 5.2: Selected Study Areas

Municipality	Neighborhoods
Al-Zarqa Municipality	Al-Hashimi
	Al-Falah
	Al-Dweik
	Al-Madina Al-Munawara
	Makka Al-Mukarrama
	Hai Ahmad
	Hai Nassar
	Al-Jneineh
	Hai Al-Jaber
	Hai Al-Amira Haya
	Al-Bustan
	Al-Batrawi
	Hai Ma'amel Al-Toub
Russeifa Municipality	Hai Ja'far Al-Tayyar
	Al-Rasheed Al-Shamali
	Jreiba
Al-Hashmiyah Municipality	Al-Sukhneh

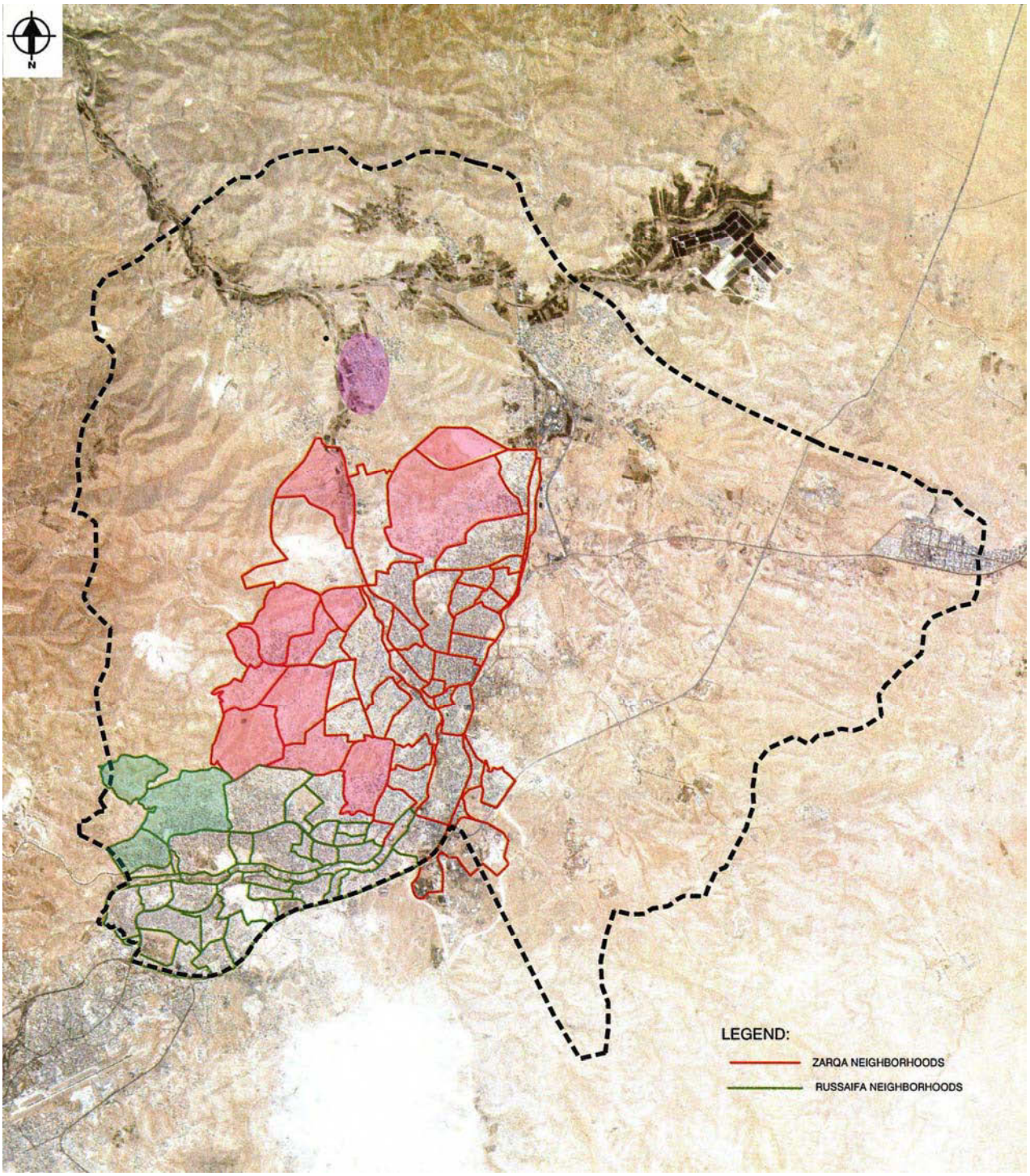

Figure 5.23: Neighborhoods Highlighted Selected for the Social Study

Figure 5.23 above shows the areas selected for the preliminary assessment (Al-Sukhneh highlighted in purple, Al-Zarqa in red, and Al-Russeifa in green.) Areas that are bordered but not highlighted are ones that are included in the project's scope but not in the preliminary assessment. These "un-highlighted" neighborhoods are either partially serviced and need network expansion or need network rehabilitation.

Socio-Economic Profile

The results of the 2004 Census revealed that the resident population of Zarqa Governorate for that year was approximately 799,000, about 15% of the national population. This indicated a growth rate for the governorate of 2.2% per annum between the 1994 and 2004 inter-censal period. The national and Amman Governorate growth rates were 2.6% and 2.8% respectively for the same period. It is considered that migration to Amman skews the population growth rates below the average for Amman Governorate.

The population of Zarqa for the year 2009 was calculated using the official national growth rates for each year after 2004 (DoS 2010) shown in **Table 5.3** below.

Table 5.3: 1999-2009 National Population Projections

Year	Population (/1000)	Average Growth Rates
1999	4738.0	2.5
2000	4857.0	2.5
2001	4978.0	2.5
2002	5098.0	2.4
2003	5230.0	2.6
2004	5350.0	2.3
2005	5473.0	2.3
2006	5600.0	2.3
2007	5723.0	2.2
2008	5850.0	2.2
2009	5979.0	2.2

Population Projection

The demographic profile below describes the population of the neighborhoods targeted by the expansion of the wastewater network (currently unserved areas). The neighborhoods were clustered according to the municipality they fall in as listed in Table 5.2.

The year 2009 projected population of the target neighborhoods in Zarqa Governorate based on 2004 census data is presented in **Table 5.4** below.

Table 5.4: Population by Age and Gender[9]

Municipality	Neighborhood		0-9	10-19	20-29	30-39	40-49	50-59	60+	Total
Zarqa Municipality	Al-Hashimi	M	235	202	136	116	64	38	29	820
		F	233	182	139	114	50	34	35	786
	Al-Falah	M	1,257	1,104	868	614	321	182	177	4,522
		F	1,296	1,061	772	554	314	179	150	4,326
	Al-Dweik	M	269	226	136	113	83	20	26	872
		F	245	216	120	108	59	26	20	793
	Al-Madina Al-Munawara	M	145	131	116	78	63	27	21	581
		F	152	155	87	83	50	20	22	570
	Makka Al-Mukarrama	M	37	28	23	12	11	2	6	120
		F	30	27	17	10	9	2	3	98
	Hai Ahmad	M	217	168	112	89	45	25	23	678
		F	185	143	112	79	47	26	25	617
	Hai Nassar	M	317	342	221	135	93	51	49	1209
		F	292	296	194	133	87	53	35	1089
	Al-Jneineh	M	178	127	116	69	56	32	23	602
		F	153	134	105	80	56	27	22	578
	Hai Al-Jaber	M	270	220	170	144	94	46	39	983
		F	213	235	146	140	74	41	26	875
	Hai Al-Amira Haya	M	617	579	466	286	199	145	124	2415
		F	574	519	399	296	221	131	101	2241
	Al-Bustan	M	44	39	25	13	16	7	2	145
		F	32	32	26	18	15	2	4	130
	Al-Batrawi	M	1,346	1,374	887	649	515	268	216	5255
		F	1,315	1,262	868	710	492	230	178	5055
	Hai Ma'amel Al-Toub	M	2	11	112	65	26	1	1	218
		F	4	4	6	3	1	2	1	22
	Total		**9,659**	**8,818**	**6,378**	**4,714**	**3,058**	**1,616**	**1,357**	**35,600**
Russeifa Municipality	Hai Ja'far Al-Tayyar	M	1,147	1,110	799	560	345	184	189	4,334
		F	1,148	1,008	651	534	328	187	149	4,005
	Al-Rasheed Al-Shamali	M	1,879	1,584	1,194	928	474	286	318	6,664
		F	1,879	1,447	1,155	840	476	317	273	6,387
	Jreiba	M	390	323	240	164	85	45	67	1,314
		F	335	286	209	155	80	47	51	1,164
	Total		**6,779**	**5,758**	**4,248**	**3,182**	**1,789**	**1,066**	**1,047**	**23,867**
Hashmiyah Municipality	Al-Sukhneh	M	1,937	1,616	1,390	985	532	333	387	7,180
		F	1,822	1,564	1,326	973	588	327	392	6,992
	Total		**3,759**	**3,180**	**2,716**	**1,958**	**1,119**	**660**	**779**	**14,172**

Household Data

It is important to note that the above projections, as well as the Governorate's general projected growth rate, do not take into consideration the effects of the two major urban development projects of King Abdullah Bin Abdul Aziz City and al-Majd City in East Zarqa.

9 Source: DoS/Population Census 2004. Numbers represent only areas included in preliminary assessment. 2009 projections based on 2004 census data.

It is worthy to note that the average family size in the target neighborhoods is higher than the national average, being the highest in the target neighborhoods within Zarqa Municipality at 5.68 (**Figure 5.24**).

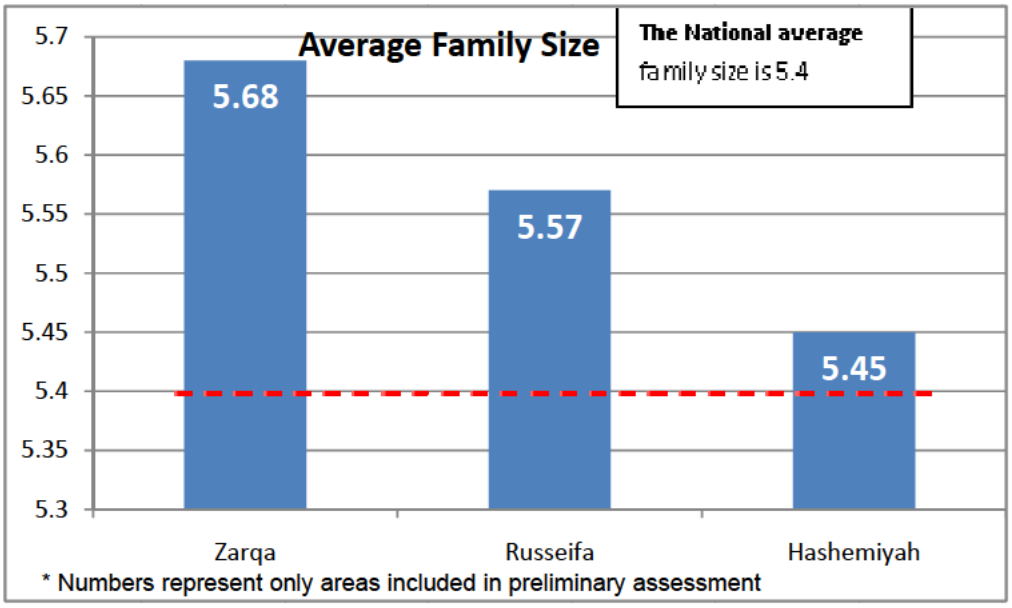

Figure 5.24: Average Family Size (Source: DOS/Population Census 2004)

Figure 5.25 reflects the marital status, broken down by sex, in the target neighborhoods within each municipality.

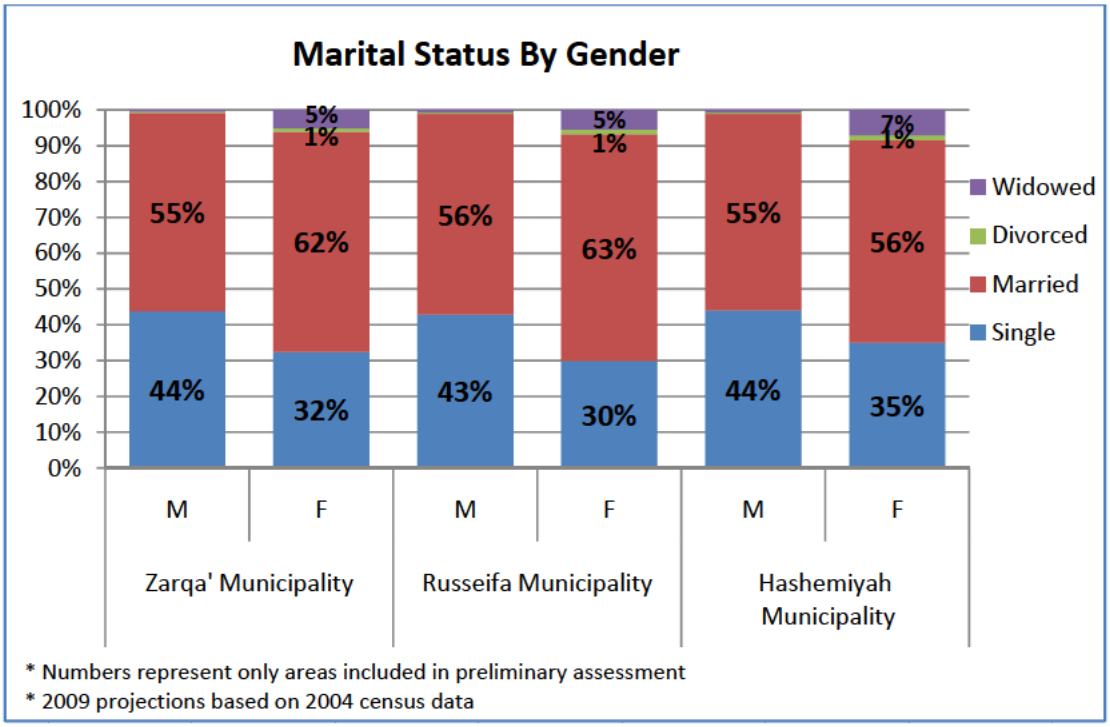

Figure 5.25: Marital Status by Sex (Source: DOS/Population Census 2004)

Figure 5.26 and **Figure 5.27** below show the housing type and home ownership type of families in the target neighborhoods in each of the three municipalities. It is worthy to note that the majority of the

residents in the target neighborhoods live in apartments (67.3%); followed by standalone houses (26.7%) and the overwhelming majority of residents are homeowners (80.4%).

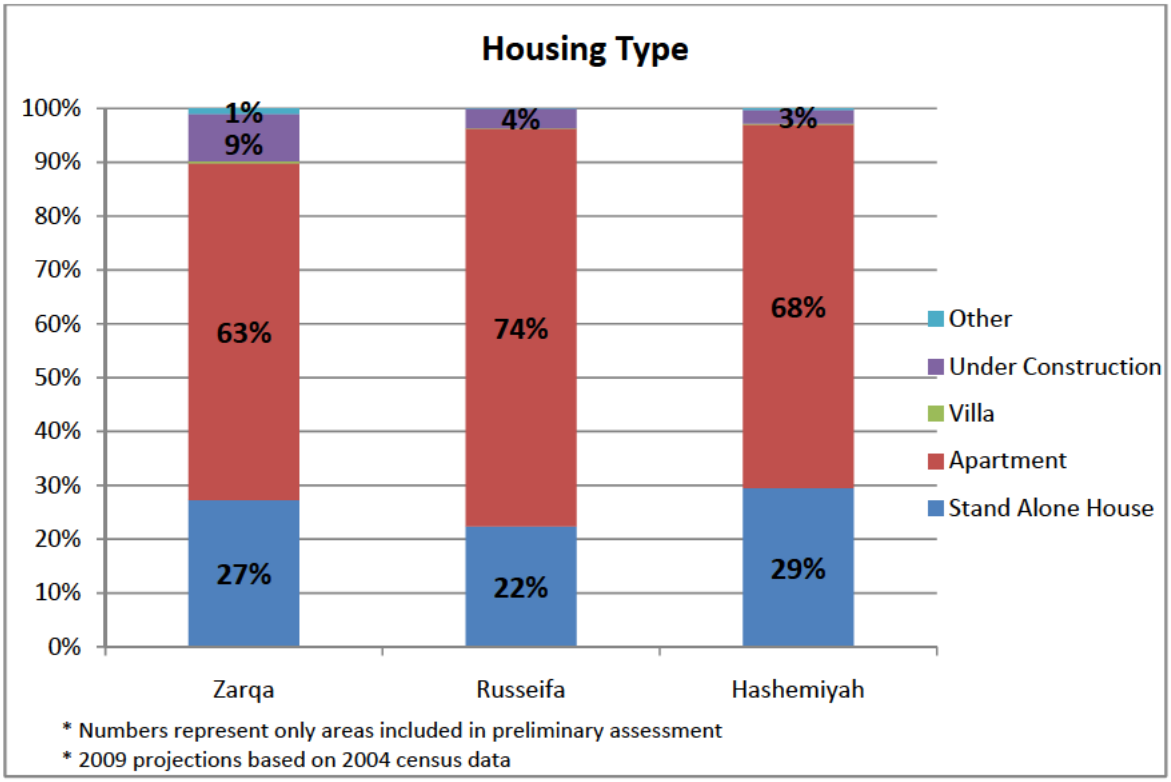

Figure 5.26: Housing Type

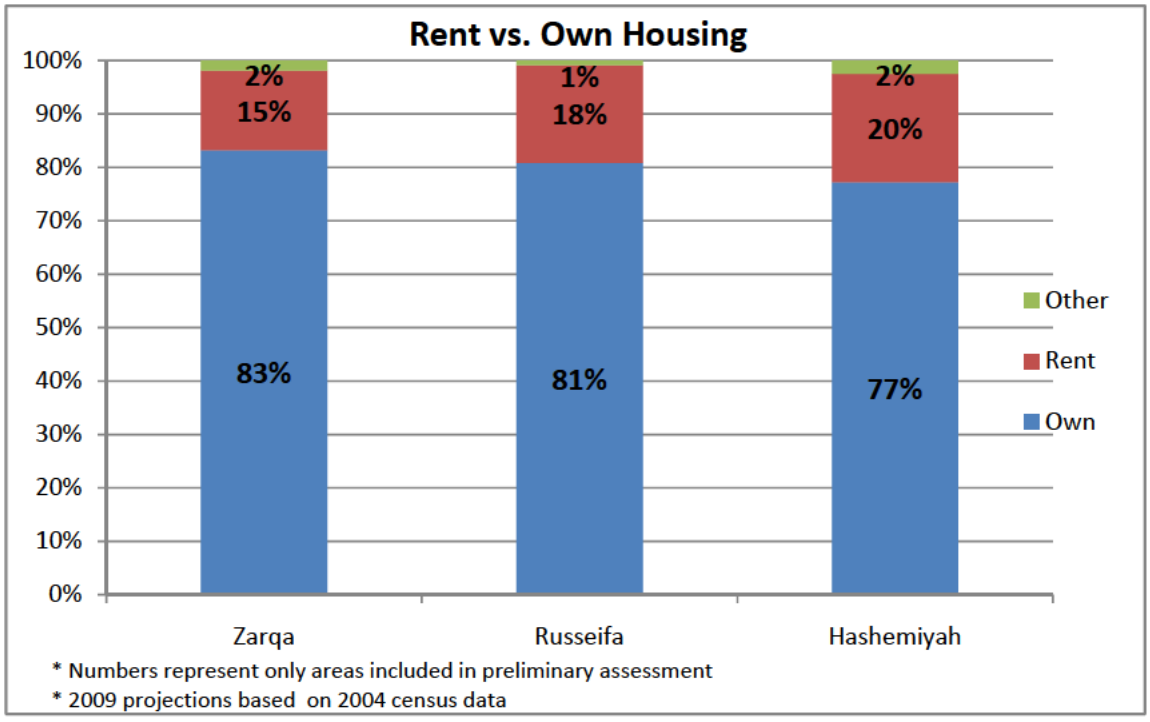

Figure 5.27: Home Ownership (Source: DOS/Population Census 2004)

Educational Level

Figure 5.28 shows the educational levels of males and females in the target neighborhoods. The educational levels are more or less consistent with the national numbers with women in Al-Hashmiyah target neighborhoods (Al-Sukhneh) having a somewhat below national average educational level.

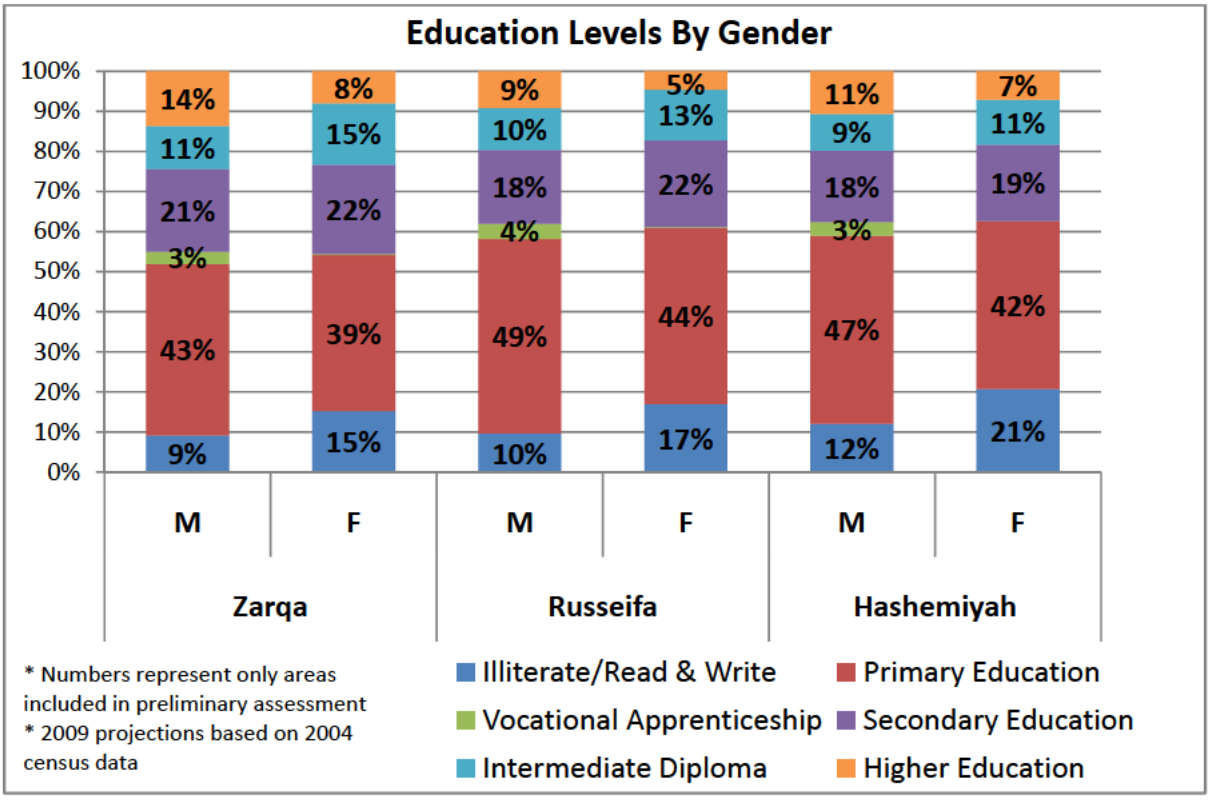

Figure 5.28: Educational Level by Sex (for those 15 years of age and above (Source: DOS/Population Census 2004)

Economic Activity

Table 5.5 displays the Economic Activity Status of Jordanians residing in the Zarqa governorate as of the last quarter of 2009 (DoS/Employment & Unemployment Survey - November 2009). The data provide that Zarqa has an unemployment rate of 12.3% which is very close to the national unemployment rate for the same period (12.2%). It is worthy to note that female economic activity rate in Zarqa at 11.4% is lower than the corresponding national number of 14.3%.

Table 5.5: Zarqa Population Age 15+ Economic Activity Status by Sex (%)[10]

Sex	Unemployment Rate (%)	Not Economically Active (%)	Economically Active (%)			Total%
			%Unemployed	%Employed	%Total	
Male	11.4	31.0	7.8	61.2	69.0	100.0
Female	17.9	88.6	2.0	9.4	11.4	100.0
Total	12.3	59.2	5.0	35.8	40.8	100.0

10 Source: DoS/Employment and Unemployment Survey – Nov. 2009.

Figure 5.29 shows the sectors of employment of residents of the target neighborhoods. The number reflect that the overwhelming majority of males in the workforce in Zarqa and Russeifa municipalities' target neighborhoods work in the private sector, and the majority of working females in Zarqa and Hashmiyah municipality work in the public sector.

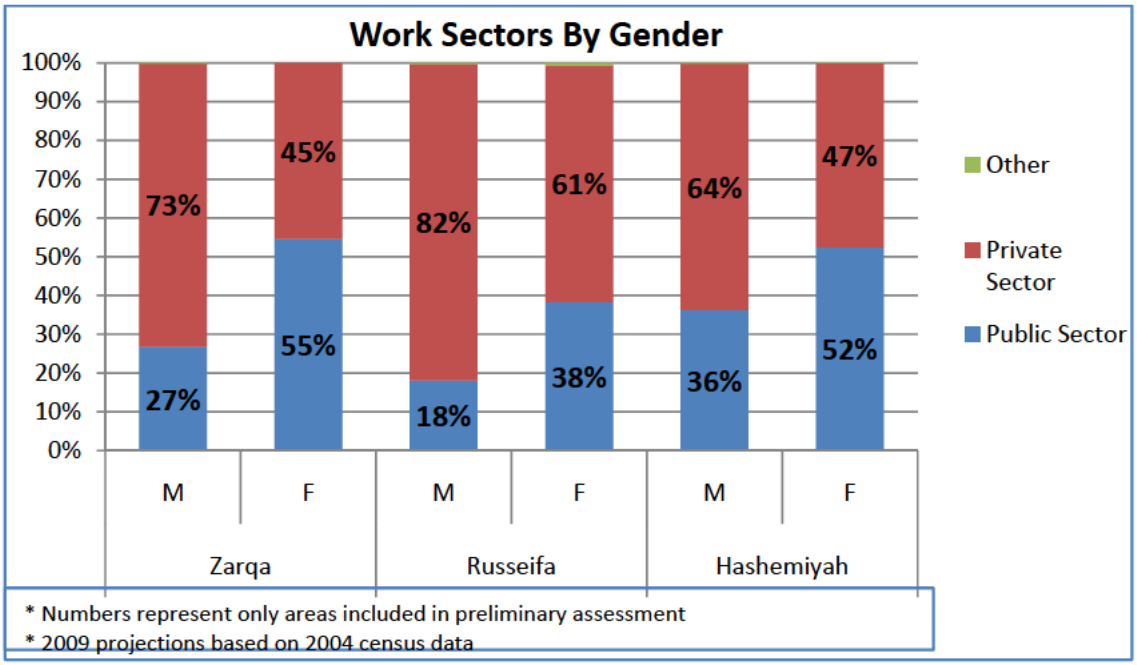

Figure 5.29: Work Sectors by Sex for those 15 years of age and above (Source: DOS/Population Census 2004)

5.4.3. Existing Public Health within Study Area (Zarqa Governorate)

This sub-section addresses existing public health and safety conditions within study area in terms Zarqa Governorate health indicators, prevalence of communicable and non-communicable diseases, and the assessed public health and safety concerns with respect to existing wastewater networks, cesspools and septic tanks, and pumping stations within the study area.

Health Indicators of Population in Zarqa Governorate

The general Jordanian demographic indicators are presented in **Table 5.6** and the major health indicators for Jordan and for Zarqa Governorate are presented and compared in **Table 5.7** below.

Table 5.6: General Jordanian Demographic Indicators for Year 2008[11]

Jordan Demographic Data	Jordan
Crude Birth Rate for 1000	28
% Population Growth Rate	2.2

11 Source: Ministry of Health Annual Report, 2008.

Jordan Demographic Data	Jordan
Average Persons per Family	5.4
% of Population Ages 15-64	60.8
% of Total Adult Literacy Rate	92
Life Expectancy at Birth (Yrs) Male	71.6
Life Expectancy at Birth (Yrs)Female	74.4
Average Life Expectancy at Birth (Yrs)	73.0
Total Fertility Rate	3.6
% Immunization coverage	95
Crude Death Rate (per 1000 .pop.)	7
Infant Mortality Rate (per 1000 live births)	22
Access to Safe Drinking Water %	96.3
% of Underweight Children under Five Years	4.4
% of Population using Sanitation Facilities, Total	85
% of Population using Sanitation Facilities, Urban	88
% of Population using Sanitation Facilities, Rural	71

Table 5.7: Health Indicators for Jordan and Zarqa for Year 2008[12]

Health Indicators	Jordan	Zarqa Governorate	% Cases in Zarqa of total Cases in Jordan
Population	5,850,000	871,600	14.9
Total Number of Physician Visits	8,992,772	934,760	10.4
Average Annual Number of Physician Visits/Person	1.5	1.1	7.3
Total Annual Number of Pediatric Health Care	182,840	9,406	5.1
Total Number of Food Poisoning	282	18	6.4
Total Visits of People with Pulmonary Diseases	254,352	59,012	23.2
Number of Hospital bed/10,000	18	11	61.1
% of Occupancy Rate in Hospitals	84.7	95.0	112.2
Total Number of Hepatitis B	464	101	21.8
Total Number of Diarrhea Cases	135,645	16,535	12.2
Total Number of Tuberculosis Cases	172	13	7.6

12 Source: Ministry of Health Annual Report, 2008.

Health Indicators	Jordan	Zarqa Governorate	% Cases in Zarqa of total Cases in Jordan
Total Number of Typhoid and Paratyphoid Cases	9	2	22.2
Total Number of Lab Tests	15,578,671	964,548	6.2

From the health indicators, Zarqa Governorate population constitutes about 15 % of the Kingdom's population. The data above shows that Zarqa is deprived of equal share of health care. The average number of hospital beds for each 10,000 persons is 61.1% of the Kingdom average. Epidemic hepatitis, typhoid and paratyphoid diseases (diseases transmitted by water and food) are higher than expected. This indicates the significant need for proper and sanitary wastewater network and treatment system.

Prevalence of Communicable and Non-communicable Diseases

Prevalence of Communicable Diseases in Zarqa Governorate

Although disease profile in Zarqa Governorate as well as in Jordan is changing, infectious diseases remain on the list of major causes of morbidity. According to reports of the Disease Control Directorate in the Ministry of Health (MoH), the most commonly reported communicable diseases in Zarqa Governorate in 2008 are:

- Diarrhea diseases
- Acute respiratory infections (ARI)
- Influenza
- Hepatitis
- Pulmonary Tuberculosis
- Typhoid
- Food borne diseases
- Water borne diseases
- AIDs (Jordan is among low prevalence rate where the estimated prevalence is less than 0.02% 2008).

Prevalence of Non-Communicable Diseases in Zarqa Governorate

Zarqa, as the rest of Jordan, is witnessing an epidemiological transition, which is characterized by an increase of non-communicable diseases, particularly:

- Cardiovascular diseases:
  - Hypertension (prevalence rate of hypertension of 32% among those aged 25 years and above)
  - Coronary heart disease
  - Stroke
- Cancer.

- Diabetes.
- Chronic respiratory diseases conditions.
- Chronic and acute renal failure and acute renal failure.
- Accidents and Injuries.
    - Home accidents.
    - Occupational.
    - Road traffic accidents.
- Endocrine, Nutritional & Metabolic Diseases.
- Hereditary Diseases (Genetic).

Among the factors contributing to the high prevalence of non-communicable diseases are the increasing elderly in the population as well as the lifestyle changes including unhealthy food consumption pattern, smoking and residential life lacking manual work and physical exercise.

Health Issues Associated with the Existing Wastewater Network within Study Area

The fresh water supplies of Jordan are scarce and strategically critical. With an average per capita annual share of less than 160 cubic meters, Jordan ranks as one of the World's 10 most water stressed countries. Acute water scarcity compounded by relatively high population growth rate is considered an important constraint to sustainable development. Water availability per capita declined and continues to decline due to population growth. The economic constraints of the country hinder the development of additional non conventional water resources (desalinated or imported). The water scarcity is exacerbated by pollution, which constitutes a serious threat to health. The main sources of pollution include: insufficient and inefficient management of domestic wastewater, uncontrolled disposal of industrial waste, leaching from unsanitary solid waste landfills, seepage from agro-chemical sources (excessive use of fertilizers and pesticides).

Public piped water supplies are available to 95% of the Jordanian population. Water is provided intermittently with supply frequency of once or twice a week, each of 12-24 hour's duration. The quality of supplies suffers from water supply interruptions and from inadequate state of the distribution systems. The intermittent water distribution forced the Zarqa Governorate residents to have underground, above ground and roof water reservoirs to collect water for use during the period of interruptions. These private household reservoirs are not always protected from pollutants. Most of these reservoirs are not tightly closed, accessible for insects and rodents and organic matter from soil and air. Moreover, they are not subject for quality control.

About 60% of the urban population and 50% of the total population have access to wastewater collection and treatment systems, thus raising the sanitation level and strengthening control of surface and ground water pollution in the areas.

In areas where there is no wastewater public system, the underground water reservoirs are in close proximity of the cesspool of the same household or the neighbor household with high possibility of

contamination of water. This explains the relatively high prevalence rate of waterborne diseases such as salmonellosis, diarrhea and typhoid.

The current conditions make the upgrading, maintenance and expansion of the wastewater system a must.

Potential Health and Safety Impacts of Existing Wastewater Networks

The existing conditions of the wastewater network in Al Zarqa Governorate along with water scarcity and rationing may lead to the possible transmission of typhoid, salmonellosis, shigellosis, and infectious hepatitis to residents, wastewater workers and agriculture workers. Wastewater irrigation workers (the most highly exposed group), may be protected by their high levels of immunity to a broad spectrum of common entero-viruses. Susceptible infants and children would be the most likely to show ill effects, During the irrigation season, wastewater irrigation workers and young children in neighboring residential areas will be exposed to wastewater aerosols and may suffer high enteric disease rates.

The most common enteric diseases likely to be transmitted by existing wastewater network in Zarqa Governorate are:

- Salmonellosis
- Amebiasis
- Campylobacterosis
- Diarrhea
- Shigellosis
- Giadiasis
- Viral hepatitis

Potential Health and Safety Impacts of Continued Use of Cesspools and Septic Tanks

In areas where there is no wastewater public system, residents will use private or individual wastewater disposal systems. Due to financial constrains, these private systems depend mainly on the simple manner of cesspools, rather than using the more satisfactory method of septic tanks.

A cesspool is a covered pit with open-joined lining which raw sewage is discharged, the liquid portion of which is disposed of by seepage or leaching into the surrounding porous soil, the solids or sludge being retained in the pit. A cesspool is not recommended as a substitute for a septic tank since the raw sewage discharged into the cesspool tends to seal the openings in the lining and the surrounding porous formation, thereby reducing the leaching area and often causing the cesspool to overflow. Such conditions are dangerous because the pollution enters the soil at a depth below the upper layers of the soil where are found the aerobic nitrifying bacteria which carry on the work of purification of waste organic matter. Thus the sewage, instead of being oxidized or purified, seeps into the soil and gradually extends the zone of pollution, and may endanger the safety of wells a considerable distance way. The second danger is that the disease germs maybe discharged onto the surface of the ground

or into shallow ditches. Since the effluent of the tank is putrescible, it frequently causes a nuisance by collecting in stagnant pools and giving rise to very objectionable odor. For small families in localities where the soil is sufficiently porous, these unsanitary and dangerous cesspool may be remodeled by making them water-tight and by allowing the over flow to filter through the soil by means of various filtering devices. Cesspools present definite health hazards when excavated to excessive depth into water bearing formations.

The existing cesspools are built with insufficient knowledge of the rationale and the technical procedure for their construction and operation. Besides the possible contamination of the ground or underground household water reservoir by pathogenic organisms that are causative agents for typhoid fever, paratyphoid fever, dysentery, infectious hepatitis, etc. The disposal of wastewater by cesspool may contaminate the ground with worms such hookworms, ascaris, tape worm, pin worm, etc. These worms will contaminate community drinking water and food especially vegetables eaten raw such as lettuce.

Potential Health and Safety Impacts of Existing Pumping Stations

The main potential health and safety impacts of existing pumping stations include:

- Odor problem associated with the existing pump stations:

  All domestic wastewater (water plus organic and inorganic materials from showers, sinks, toilets and washing machines) and industrial wastewater (water plus organic and inorganic material from commercial buildings and processes) is collected and transported in a network of underground pipes These pipes include gravity mains (that allow wastewater to travel downhill) and rising mains (that allow wastewater to flow under pressure by pumping stations). The existing pumping stations are used to lift wastewater to higher levels within networks or pump wastewater under pressure to As-Samra wastewater treatment plants.

  When air inside the wastewater network comes into contact with wastewater, gases can be released. These gases can sometimes escape from the network and cause unpleasant smells in the environment. The gases contain traces of hydrogen sulfide (the main source of odor) as well as methane and ammonia. People living nearby or immediate vicinity of pumping stations complain from unpleasant odors.

  The volume of gases released from the wastewater network (at any location) is very low. There is no adverse health effects associated with the gases unless they are inhaled in large volumes in confined spaces.

- Insect Problem associated with open wastewater reservoirs:

  The wastewater reservoirs in the existing pumping stations are open forming breeding sites for insects such as mosquitoes. The insects may transmit certain diseases such as malaria. They also will be a source of nuisance especially in summer where people need to open their windows through which insects will enter into houses and interfere with people sleep and make living uncomfortable especially for infants. Skin irritations may be caused as a result of insects' bites.

5.4.4. Cultural Heritage Resources

An archaeological study and investigation was conducted in the project area. This study aimed at:

- Locating archaeological sites within the limits of the construction project.
- Identifying those sites that may be threatened by the project.
- Defining the works necessary to minimize the threat to the regional cultural resources base from the project (Mitigation Plan).
- Detailing a suitable implementation structure for the cultural resources management project, especially coordination between the different related parties.

Methodology

The survey was conducted in accordance with the antiquities Law No.21 for the year 1988 and its regulations such as Article No. 31 which states that no permit should be granted for any construction project, including buildings and fences, unless a distance of 5-25 meters is left between them and any antiquity, according to Director's decision.

The implemented procedure for studying the project area included recording and mapping all the sites located within Zarqa Governorate. The available maps used in the survey were the 1-25,000 or 1-50, 5000 scale series k737.

The study was conducted on foot, with study members walking at a distance between 20-30 meters from each other.

The sites were registered, mapped, and properly dated and evaluated. The following tasks were carried:

- Review of Jordan antiquities database and information system (JADIS) Searching / Department of Antiquities of Jordan.
- Library Searching at Department of Antiquities of Jordan (DAJ), American Center of Oriental Research (ACOR), and British Council for Research in Levant (BCRL).
- Field visits.
- Filed study.
- Field Documentation.
- Data Analysis /Computer ...etc.
- Report preparation.
- Final Report with Recommendations.

Survey Results and Major Archaeological Sites Description

The survey record describing the essential data from each identified site includes:

- I.D. number assigned in the field
- UTM coordinates

- Modern Arabic name of site (if known)
- Brief description of the remains
- Recommended actions

Major archaeological sites identified in Zarqa Governorate are described below and **Annex 4** provides a list of all archaeological sites within the Governorate that should be avoided as much as possible.

Site No.	1
Site Name:	Qasr Shabib
Site location:	Zarqa
Site Coordinates	N 35314 E 2247

Site Description:

Located in the centre of Zarqa City, it is a square building (13.75 × 13.75 m) with a double entrance is located in the centre of the northern side. It was built of trimmed limestone and consists of square hole, roofed by vault and has three divorces arrows of more than two meters high. In the northeast corner staircase ascends to the roof of the first floor.

Site No:	2
Site Name:	Khirbat Masarah
Site Location:	East of Zarqa
Site Coordinates	N 35625 E 7767

Site Description:

Located in the west of Zarqa, it is dated to the Roman-Byzantine periods. Remains of church walls still appear on the surface in addition to many walls and buildings foundations.

Site No:	3
Site Name:	Qaser al- Hallabat
Site Location:	East of Amman
Site Coordinates	N 35540 E 2479

Site Description:

Locate about 65 kilometers east of Amman, it is one of the most extensive and elaborate of the Umayyad desert complexes in Jordan. The main building is a 44-metre square, with four large rectangular corner towers.

Site No:	4
Site Name:	Hammam as-Sarah
Site Location:	South East Qasr Al-Halabat
Site Coordinates	

Site Description:

Locate about 2kilometer south east Qasr Al-Halabat. The bathhouse was decorated in fine marble, mosaics and painted plaster. It is a small version of the baths of Qasr Amra.

Site No:	5
Site Name:	Khirbet Russeifa
Site Location:	North West of Amman
Site Coordinates	N 35467 E 2183

Site Description:

Khirbet Russeifa is located (15Km) north west of Amman. On the main Yajuz road and it lies on the left bank of the river. Studies and analysis of this excavation results proved that Khirbet Russeifa is a wide riche site of ruins passed through different historical periods, monuments and findings that represent each period, starting from the Chalcolithic , Bronze and iron ages, and continues up to the age of the Roman Empire, to the Byzantine and ending with Islamic ages.

Site No:	6
Site name:	Qaser Azraq
Site location:	Azraq
Site Coordinates:	N 35295 E 2945

Site Description:

Qaser Azraq was probably first built in the late Roman period, around 292- 306 AD. The 80 x 72 meter fort was one of a string of Roman defensive installations which protected this area.

An inscription confirms the fort was rebuilt in 1237 under the Ayyubids, and it must have been used by the Byzantine, and the Umayyad, Abbasid and succeeding Arab/Islamic inhabitants of the land.

Site No:	**7**
Site name:	Quseir Amra
Site location:	East of Amman
Site Coordinates:	N 35212 E 2715

Site Description:

Quseir Amra is an Islamic castle in Jordan, about 50 miles east of Amman. It was said to have been built by the Umayyad Caliph al-Walid between 712-715 AD, for use as a vacation residence or rest stop. Quseir Amra is best known for its amazing mosaics and murals which decorate the central hall and connected rooms.

Site No:	8
Site Name:	Tall Al-Sukhneh
Site Location:	Near Al-Sukhneh Village
Site Coordinates	N 171.41 E 250.45

Site Description:

Located near to Al-Sukhneh village. It is dated to the Middle Bronze ages.

Site No:	9
Site name:	Tall al-Birah
Site location:	North of Zarqa
Site Coordinates	N 175.06 E 245.50

Site Description:

Located north of Zarqa, it has archaeological remains and artifacts dated to the Early Bronze age, Iron, Byzantine and Islamic periods.

Site No:	10
Site Name:	Hashmiyah Mill stones
Site Location:	
Site Coordinates	N 3558889 E 228991

Site Description:

Located in Al-Hashmiyah town, it is an important site dated to the Roman period. It was built near to the old Roman road and contains number of Roman mile stones.

Site No:	11
Site Name:	Gharesa
Site Location:	
Site Coordinates	N 3561836 E 224546

Site Description:

Located on the top of a hill west of Khirbet As-Samra. It was dated to many periods started from prehistoric till to Islamic periods.

Site No:	12
Site Name:	Khirbet As-Samra
Site Location:	
Site Coordinates	N 3559784 E 252.2

Site Description:

A major site located between Zarqa and Mafraq Cities .The site represent a village of several occupational phases especially the Byzantine periods.

Site No:	13
Site name:	Batrawi
Site location:	North-East of Al-Hashmiyah town
Site Coordinates:	N 35554 E 2243

Site Description:

It is Middle Bronze age site, located north-east of Al-Hashmiyah town. It has many fortification walls and considered as one of the major sites of Zarqa City.

6. IDENTIFICATION OF ENVIRONMENTAL AND SOCIO-ECONOMIC RECEPTORS

6.1. Identification of Environmental and Socio-Economic Receptors

Table 6.1 below provides a summary of the identified environmental and socio-economic receptors within and in the vicinity of the project area.

Table 6.1: Identified Environmental and Socio-economic Receptors

RECEPTOR	COMMENT
Physical Environment	
Atmosphere	The atmosphere at and around the project area.
Soil	The soils of areas in which project activities are to occur.
Hydrogeology	The hydrogeology (i.e., groundwater) in the area in and around where the project activities would occur.
Hydrology	Possible surface water within the project area.
Landscape / Visual Impact /Topography	The geomorphologic land forms and terrain at the Project sites.
Biological Environment	
Flora	Plant species that could potentially occur in the areas in which the construction and operational activities will occur.
Fauna	
Birds	*Birds that rely on the area as a habitat and/or food source.*
Reptiles	*Reptiles that could potentially be present within or in the vicinity of project area which might be affected by to construction and operation activities of the project.*
Mammals	*Mammals that occur in the environments in which construction activities are proposed to occur.*
Health & Safety	
Workers	Staff on the project site who will be subjected to occupational hazards / public health effects such as noise, dust, etc.
Population in the Vicinity of Activity /Land users	Residents and/or workers/land-users within or at the vicinity of the project sites that can be exposed to potential Project operational hazards such as noise, dust, etc.
Socio-economic Environment	
Population in the Vicinity of Activity	The population (people) that utilize the areas during construction activities.
Land Use & Land Ownership/Acquisition	Existing uses of the land areas in which the construction activities are to occur. Traditional boundaries, access issues, permit requirements and distribution of any private and/or government-owned lands. Possibility for need of Land Acquisition for network expansion or building of new pump stations.
Utilities and infrastructure	The utilities (e.g. power supply, water services) and infrastructure (e.g. commercial and industrial and leisure facilities) of areas in which the construction activities are proposed to occur.
Workforce	Impacts of new workforce on the Project area.

RECEPTOR	COMMENT
Transport	Road transport systems of the area in which the construction activities are to occur.
Archaeology / Cultural Property	Archaeological sites and artifacts that have cultural significance (if found in within or in the vicinity of the Project area).

6.2. Summary of Environmental and Socio-Economic Aspects

Based on the review of environmental and social aspects, project activities, potential environmental impacts and the project's environmental receptors, the **Table 6.2** below presents the possible interaction between the environmental aspects and receptors relevant to this project.

Table 6.2: Summary of Environmental and Socio-economic Aspects

Project Activity	Environmental Receptor / Potential Environmental Impact
Planned Project Activities	
Construction Phase	
Land Use & Land Acquisition	• Potential to occupy land preventing its use for economic purposes by locals (e.g. grazing of animals). • Potential disruption of existing businesses. • Potential for public health and safety concerns.
Trenching and Excavation Works	• Potential for dust emissions and noise emissions. • Potential for spillage of fuel, oil or waste with consequent risk to water resources and for aquifer contamination. • Landscape modification. • Potential for top soil disturbance and erosion processes. • Visual/Aesthetic impacts. • Potential impact to flora, fauna, terrestrial habitats, and/or Important Bird Areas (potentially present) within the project area. • Potential public health and safety impacts. • Potential disruption to businesses. • Potential traffic disruption. • Potential impact to existing utilities/infrastructure during construction work. • Potential employment opportunities in construction and operation works. • Potential impact to archaeological and cultural heritage sites (if present).
Solid waste (Spoil) Generation / Disposal	• Potential for soil disruption and impacts of surface water resources, if present. • Potential impact to land use. • Potential of visual impact. • Potential risk to flora and fauna if using unplanned disposal methods. • Potential risk of traffic accidents during transport. • Potential public health risk to project area residents. • Potential impact to archaeological and cultural heritage sites (if present).
Material and Chemical / oil storage	• Potential for air emissions. • Potential impact to surface water resources, if present. • Potential for disturbance of shallow groundwater due to risk of fuel/oil spill. • Potential for soil quality degradation. • Potential of visual impact. • Potential for flora and fauna disturbance. • Potential impact to public health and safety. • Potential impact to land use.

Project Activity	Environmental Receptor / Potential Environmental Impact
Vehicle operation	• Potential increases in exhaust emissions from vehicles. • Noise and vibrations when in the proximity of environmental and social receptors. • Potential for spillage of fuel, oil or waste with risk to water resources. • Potential for top soil disturbance and erosion processes. • Potential impact to flora, fauna, terrestrial habitats, and/or Important Bird Areas (potentially present) within the project area. • Potential of impact on existing traffic within the project area. • Potential impact to archaeological and cultural heritage sites (if present). • Potential impact to infrastructure / utilities in case of accidents.
Equipment operation	• Potential increases in exhaust emissions from equipment. • Noise and vibrations when in the proximity of environmental and social receptors. • Potential for spillage of fuel, oil or waste and consequent risk to soil and groundwater. • Potential for top soil disturbance and erosion processes. • Landscape modification. • Potential of visual impact. • Potential impact to flora, fauna, terrestrial habitats, and/or Important Bird Areas (potentially present) within the project area. • Potential to occupy land preventing its use for economic purposes by locals (e.g. grazing of animals). • Potential of impact on existing traffic within the project area. • Potential impact to archaeological and cultural heritage sites (if present). • Potential impact to infrastructure / utilities in case of accidents.
Access Roads (if needed)	• Potential for dust emissions and noise during excavation. • Potential for top soil disturbance. • Potential increase in impacts to ground transport to newly accessed areas for construction activities. • Potential impact to flora, fauna, terrestrial habitats, and/or Important Bird Areas (potentially present) within the project area. • Potential for public health and safety implications. • Potential impact to archaeological and cultural heritage sites (if present).
Operation Phase	
Pump Stations	• Potential for odor generation. • Potential for noise. • Potential positive impact to water resources quality by protecting them from sewage overflows. • Potential for visual intrusion. • Potential for employment opportunities.
New trunk lines and sewer lines	• Potential positive impact to groundwater resources by preventing sewage infiltration. • Potential impact on land value. • Positive impact to public health and living standards.
Potential Accidental Events (Unplanned)	
Construction Phase	
Vehicle collisions and accidents with other infrastructure	• Potential for spillage of fuel, oil or waste and consequent impact on soil and water resources. • Potential disturbance to flora and fauna. • Health and Safety risk for project area residents and workers. • Potential impact to infrastructure and transport system. • Potential impact to archaeological and cultural heritage sites (if present).

Project Activity	Environmental Receptor / Potential Environmental Impact
Spill of chemicals or liquid fuels	• Potential air emissions. • Potential for disturbance of surface water and shallow groundwater. • Potential for soil quality degradation preventing its use for economic purposes by locals. • Potential risk to public health. • Potential for flora and fauna disturbance. • Potential impact to land use and existing infrastructure.
Ignitions of flammable materials / accidental fires	• Potential for hazardous emissions. • Potential for noise generation and disturbance of environmental and human receptors. • Potential disturbance to flora and fauna. • Potential risk to workers and project area residents. • Potential damage to existing land uses and may force people to move out of their residences or land area • Potential of damage to transport, machinery and general equipment. • Potential impact to archaeological and cultural heritage sites (if present).
Operation Phase	
Pump Station power failure / malfunction problems / Emergency Overflow	• Potential for odor. • Potential for surface water pollution. • Potential for soil pollution. • Potential risk to public health and station employee safety.
Sewer trunk/pipeline rupture and leakage	• Potential infiltration of leaking wastewater into surrounding groundwater resources and/or other receiving water bodies. • Potential pollution of soil. • Potential damage to adjacent structures. • Potential subsidence of roads. • Potential risk to public health.

6.3. Environmental and Socio-Economic Aspect Matrix

Identified project activities and legal, environmental and socio-economic receptors have been integrated into matrices with the activities on the y-axis and receptors on the x-axis. Each matrix was subsequently assessed to identify every possible case of potential activity-receptor interaction. A summary list of project activities and their potential environmental and socio-economic impacts are presented in **Table 6.3** below.

Table 6.3: Environmental and Socio-economic Aspects and Receptor Matrix

Receptor / Activity		Physical					Biological			Health & Safety	Socio-Economics						Other
		Atmosphere	Noise	Soil & Groundwater	Hydrology (Surface Water)	Visual Amenity and Landscape / Topography	Flora / Habitats	Birds	Reptiles & Mammals	Workers/Area's Residents and Land users	Population / Resettlement	Workforce & employment	Land Use / Ownership	Utilities / Infrastructure	Transport	Archaeology / Cultural Property	Liability / Reputation
Planned Project Activities																	
Construction	Land Use & Land Acquisition									●	●		●				●
	Trenching and Excavation Works	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
	Solid Waste (Spoil) Generation/Disposal			●	●	●	●	●	●	●		●	●		●	●	●
	Material & Chemical / oil storage	●		●	●		●	●	●	●			●				●
	Vehicle operation	●	●	●		●	●	●	●	●		●		●	●	●	●
	Equipment operation	●	●	●		●	●	●	●	●		●	●	●	●	●	●
	Access roads (if needed)	●	●	●		●	●	●	●	●		●			●	●	●
	Project Offices/Workers Accommodations (if required)	●	●	●	●		●	●	●	●		●	●	●	●		●
Operation	Pump Station	●	●		●	●		●				●					●
	New Trunk & Sewer Lines			●		●				●			●	●			●

Receptor / Activity		Physical					Biological			Health & Safety	Socio-Economics						Other
		Atmosphere	Noise	Soil & Groundwater	Hydrology (Surface Water)	Visual Amenity and Landscape / Topography	Flora / Habitats	Birds	Reptiles & Mammals	Workers/Area's Residents and Land users	Population / Resettlement	Workforce & employment	Land Use / Ownership	Utilities / Infrastructure	Transport	Archaeology / Cultural Property	Liability / Reputation
Unplanned Project Activities																	
Potential Accidental Events (unplanned) during Construction Phase	Vehicle collisions	●	●	●	●		●	●	●	●				●	●	●	●
	Spill of chemicals or liquid fuels	●		●	●	●	●	●	●	●			●	●	●	●	●
	Ignitions of flammable materials / accidental fires	●	●			●	●	●	●	●	●		●	●	●	●	●
Potential Accidental Events (unplanned) during Operation Phase	Pump Station Power Failure / Malfunction	●		●	●	●				●							●
	Trunk / Sewer Pipeline Rupture and Leakage			●	●					●				●	●		●

7. ANALYSIS OF PROPOSED PROJECT ALTERNATIVES

The analysis of project alternatives is one of the requirements of environmental impact policy and procedures world-wide. The assessment of alternatives from an environmental and social standpoint is one aspect of the preliminary ESIA that can contribute to the improvement of decision making. By considering various alternatives prior to the commencement of Project activities, environmental and social project benefits can be maximized and potential challenges can be identified and addressed.

This part of the preliminary ESIA deals with the analysis of alternatives considered to meet the ultimate project objectives. The analysis covers five major alternatives proposed for the project including the 'no project' alternative.

7.1. Proposed Alternatives

The following alternatives are assessed in this section to determine whether a more environmentally and socially sound alternative to the proposed project can be adopted. These alternatives are listed in **Table 7.1** below.

Table 7.1: Proposed Alternatives

Alternative 1	No-Project Option: Is there a need for the proposed project?
Alternative 2	Option 1: Convey flows from the study area to the location of the proposed Wadi Zarqa Treatment Plant.
Alternative 3	Options 2 & 3: Continue to convey flows from the study area to as-Samra WwTP.
Alternative 4	Option 4: Continue to convey flows from the study area to as-Samra WwTP, but provide towns of Birein with package wastewater treatment units.
Alternative 5	Option 5: Same as option 4 but eliminate WZPS and build a new pumping station at Sukhneh and a booster station along the route from Sukhneh to Samra WwTP.

These five options are illustrated in Figure 3.5 through **Error! Reference source not found.**. This section on analysis of the proposed options has grouped options 2 and 3 into one alternative as the only difference between them is the direction of flow from the Sukhneh and Wadi Zarqa pump stations: in Otpion2, the direction of their flow will be towards WZPS and in Option 3 the flow direction will be towards EZPS. This difference does not affect the environmental and social evaluation of these two options.

This preliminary ESIA attempts to examine the several major environmental components and social aspects as a basis for comparison between the proposed project and each of the alternative options listed above. **Table 7.2** below presents the symbols that denote the various levels of environmental impact to aid in comparison of the alternatives. Each symbol indicates an overall evaluation of the specified environmental component and social aspect.

Table 7.2: Evaluation symbols for levels of environmental impact

Symbol	Description
X	Denotes potential for impact, which is not considered significant
S-	Denotes potential significant adverse impact
S+	Denotes potential significant beneficial impact
*	Denotes no change to the existing situation

7.2. "No Action" Alternative versus the Proposed Project

The 'No-Action' option considers the alternative of not conducting the project at all. It is normally evaluated to assess the impacts if the project does not go ahead. This alternative is evaluated against the overall project of enhancing and reinforcing the wastewater system in Zarqa Governorate. Results of this evaluation are presented in **Table 7.3** below.

Table 7.3: Comparison of Overall Environmental and Social Impacts as a Result of the Proposed Project against the 'No-Action' Alternative

Environmental & Social Components	Project vs. No Project	
	Proposed Project	No-Action Alternative
Air Quality	X	S-
Noise Generation	X	*
Wastewater Generation	S+	S-
Waste Generation / Disposal	X	S-
Topography, Geology and Soils	S+	S-
Water Resources	S+	S-
Visual Impacts	X	S-
Ecological Resources	X	S-
Socio-economic Impacts	S-	S-
Land Use / Land Value	S-	S-
Public Health & Safety	S+	S-
Traffic Disturbance	X	*
Other Utilities/Infrastructure	X	*
Archaeology / Cultural Property	X	*
X : Denotes potential for impact, which is not considered significant S- : Denotes potential significant adverse impact S+ : Denotes potential significant beneficial impact * : Denotes no change to the existing situation		

The main adverse impacts introduced as a result of the project activities are mostly related to the land value as perceived by the local communities. This is based on previous experience with As-Samra WwTP.

Other temporary impacts include disruptions to air quality, noise levels, and traffic within the study area caused by the construction activities. However, these are limited to the construction phase of the project and would be eliminated once the proposed project is in its operation phase.

However, the 'No-Action' alternative will deprive the people within the study area from a project that has the potential to improve public health conditions and protect Zarqa Basin from the impacts caused by the discharge domestic wastewater. As shown in Table 7.3, the negative significant impacts on water resources, ecological resources and public health will persist.

Therefore, although going through with the proposed project could lead to certain impacts on the environment and the social aspects within the study area due to project construction activities, those impacts can be mitigated and their significance eliminated or minimized. In addition, the proposed project is regarded to be of high value to communities within the study area when operational.

7.3. Comparison of Various Project Options

In this sub-section, options 1 through 5 are evaluated against each other in order to compare the best environmentally and socially sound option. This evaluation is presented in **Table 7.4** below.

The environmental and social parameters used in comparing the options included physical parameters (air, noise, water resources, topography and soil), ecological resources, socio-economic impacts, public health and safety, social acceptance, infrastructure impacts, land use and value, and cultural heritage aspects. Social acceptance is compared to take into consideration the social rejection of locating new wastewater treatment plants or packages by local communities due to perceptions of decreasing land value where the WwTP is to be constructed.

Table 7.4: Comparison of Various Project Options in terms of Overall Environmental and Social Impacts

Environmental & Social Components	Various Project Options			
	Option 1	Options 2 & 3	Option 4	Option 5
Air Quality	X	X	X	X
Noise Generation	X	X	X	X
Wastewater Generation	S+	X	X	X
Waste Generation / Disposal	X	X	X	X
Topography, Geology and Soils	S-	S-	S-	S-
Water Resources	S+	S+	S+	S+
Visual Impacts	X	X	X	X
Ecological Resources	X	X	X	X
Public Health & Safety	S+	S+	S+	S+
Social Acceptance of WwTP	S-	S-	S-	S-
Land Use / Land Value	S-	S-	S-	S-
Traffic Disturbance	X	X	X	X
Other Utilities/Infrastructure	S-	S-	S-	S-
Archaeology / Cultural Property	*	X	X	X

X : Denotes potential for impact, which is not considered significant
S- : Denotes potential significant adverse impact
S+ : Denotes potential significant beneficial impact

Environmental & Social Components	Various Project Options			
	Option 1	Options 2 & 3	Option 4	Option 5
* : Denotes no change to the existing situation				

As reflected from Table 7.4 above, all the analyzed options will eventually enhance water resources quality and consequently ecological resources as they all lead to proper management of wastewater.

Options 1 and 5 have a significant beneficial impact to air quality and noise mainly due to elimination of EZPS and WZPS which are located within the vicinity of the communities. The elimination of pumping stations within populated areas is expected to enhance the overall environmental, social and health conditions within the governorate. This is of a positive impact in Options 1 and 5 that eliminate WZPS from within the crowded communities of Zaqra City. However, Option 1 is perceived to be faced with social rejection by land owners near wadi Zarqa proposed WwTP. As for Option 5, it involves the transfer of the WZPS to Sukhneh area. Though this is considered to have a positive impact on Zarqa community, it would entail a negative impact of higher significance on power resources than the remaining options (options 2, 3 and 4).

Although all options will eventually enhance water resources quality and consequently public health and ecological resources as they all lead to proper management of wastewater, Option 1 can be considered as the preferred option environmentally. But since this option is associated with major land acquisition issues and rejection from land owners, and since it has not been budgeted for within the Zarqa greater development, this option is not anticipated to be adopted at this stage. As for the remaining options, and since the environmental impacts associated with each are almost similar in nature, it can be concluded that the most preferred option, from an engineering and economical perspective (most economical capital, operation and maintenance costs) although it is perceived to be faced with social rejection by land owners near local packages WwTP, is Option 4.

It should be noted here that the above only reflects the results of the preliminary assessment of the project alternatives. Detailed assessment of the most favorable alternative will have to be completed in order to recommend the most environmentally, socially and cost effective option.

8. PRELIMINARY IDENTIFICATION OF POTENTIAL ENVIRONMENTAL AND SOCIAL IMPACTS/ISSUES

The primary objectives of the impact assessment are to:

- Establish the significance of identified potential impacts that may occur as a result of the project activities being undertaken.
- Differentiate between those impacts that are insignificant (can be sustained by natural or socio-economic systems) and those that are significant (cannot be sustained by natural or socio-economic systems).

This section provides an overview of the preliminary assessment approach and identifies the primary biophysical and socio-economic impacts expected to result from the proposed project's activities. Compliance with environmental and socio-economic legislation, regulations, standards and policies is considered within this impact assessment.

8.1. Environmental Assessment Approach

The scope of the assessment covered all Project areas and was undertaken in accordance with relevant MoE regulations and applicable local, national and international standards and guidelines (especially MCC guidelines and World Bank Operational Policy 4.12).

The initial step in the ESIA process was the identification of the project environmental, social and economic and health aspects for all proposed activities. The activities were considered in terms of their potential to:

- Interact with the environment (physical, biological, socio-economic).
- Breach the conditions of relevant national and international standards and guidelines or company policy.

The environmental, socio-economic and engineering information and data gathered, collated and reviewed during the baseline and aspect identification tasks were systematically developed to prepare matrices of key project activities and environmental, social, health and economic receptors. This allowed for a preliminary assessment of the key environmental and socio-economic issues. When assessing the impacts, MWH considered the following:

- Positive or negative impacts.
- Direct or indirect impacts from Project activities.
- Magnitude of impact.
- Public health and safety risks
- Geographical extent of the effect.
- Duration and frequency of the impact.
- Sensitivities of the receiving environment over the entire concession areas.
- Potential significance.

- Residual impacts.

Following the completion of aspect and receptor identification, a process of impact assessment was completed taking into consideration direct, indirect, planned and unplanned (accidental) impacts. In order to enable the determination of the overall significance of the impact, each identified aspect - receptor interaction was ranked in terms of consequence and likelihood. Impact significance is expressed as the product of the consequence and likelihood of occurrence of the activity.

- **Likelihood**: the likelihood that an activity will occur (see **Table 8.1**).
- **Consequence**: the resultant effect (positive or negative) of an activity's interaction with the legal, natural and/or socio-economic environments (see **Table 8.2**).
- **Significance = Consequence x Likelihood** (see **Figure 8.1**).

Table 8.1: Likelihood categories and rankings for environmental and socio-economic impacts

Category	Ranking	Definition
Certain	5	The activity will occur under normal operating conditions.
Very Likely	4	The activity is very likely to occur under normal operational conditions.
Likely	3	The activity is likely to occur at some time under normal operating conditions.
Unlikely	2	The activity is unlikely to but may occur at some time under normal conditions.
Very Unlikely	1	The activity is very unlikely to occur under normal operating conditions but may occur in exceptional circumstances.

Table 8.2: Consequence categories and rankings

Consequence	Ranking	Description
Catastrophic	5	Massive effect - Persistent severe environmental damage or severe nuisance extending over a large area. Constant, high Exceedances of statutory or prescribed limits.
Severe	4	Major effect - Severe environmental damage. Extensive measures are needed to restore polluted or damaged environment to its original state. Extended breaches of statutory or prescribed limits.
Critical	3	Localized effect - Limited discharges of known toxicity or nuisance. Repeated breaches of statuary or prescribed limits. Affecting neighborhood. Spontaneous recovery of limited damage.
Marginal	2	Minor effect – Contamination. Damage sufficiently large to attack the environment. Single Exceedances of statutory or prescribed criterion. Single complaint. No permanent effect on the environment.
Negligible	1	Slight effect – Local environmental and/or socio-economic damage. Negligible financial severity.
None	0	No impact.
Positive	+	Beneficial impact – enhances the environment and/or socio-economic conditions.

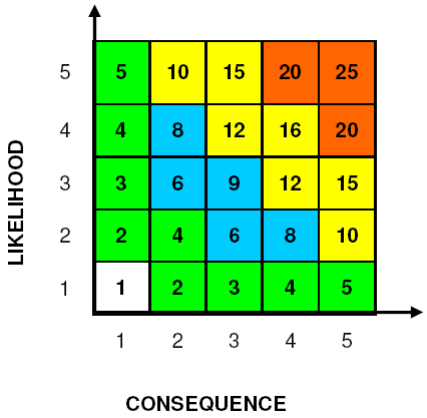

Figure 8.1: Consequence – Likelihood Ranking

Based on its consequence-likelihood score, each environmental aspect was ranked into five categories or orders of significance as illustrated in **Table 8.3** below.

Table 8.3: Consequence-likelihood ranking

Ranking (Consequence X Likelihood)	Significance
>16	Critical
10-16	High
6-9	Medium
2-5	Low
<2	Negligible

Residual impacts are impacts that remain after mitigation measures have been applied. The residual impacts assessment identified the project activities that are likely to result in a semi-permanent to permanent change in the natural (i.e. physical, biological) and/or socio-economic environments.

8.2. Impact Assessment

Following the completion of aspect and receptor identification, a process of impact assessment was completed. Every identified aspect was assessed in terms of its potential to cause an impact on natural and/or socio-economic receptors and was subsequently ranked in terms of consequence and likelihood, thus enabling the determination of the overall significance of the impact.

8.3. Analysis of the Preliminary Environmental Impacts

This section identifies and, where appropriate, quantifies the primary biophysical effects expected to result from construction/rehabilitation and operation of the sewage pipes network and pumping stations facilities. The section identifies project activities requiring environmental management and provides an outline of associated control measures. This section is structured according to the main issues and effects resulting from both construction and operational activities associated with the proposed project. They are also presented as a summary table at the end this section where the ranking system, as described in Section 8.1, is applied for each activity considered an aspect (Section 6).

8.3.1. Potential Impacts to Physical Environment

Air Quality

Construction

Significant emissions of SO_2, NO_x, CO, CO_2, CH_4 and PM_{10} will result from the operation of plant and road vehicles during construction of the pipeline network, either within areas where existing pipeline are to be replaced due to their deteriorated conditions or inadequacy to handle the projected flow and/or within unserved areas where a new network of pipes is to be installed. The same would also apply to the construction activities associated with the rehabilitation of the existing pumping stations or the construction of new ones (if required). However, emissions will arise over a large geographical area and over the entire construction period. Hence any worsening in air quality at any one location is unlikely to be significant, and is expected to be transient.

Operation under Normal Conditions

As pumping stations, under normal operation conditions, will operate on public electrical system, emissions associated with the operational phase are limited to a small number of vehicle trips, and therefore impacts are not anticipated. Emissions from the pipeline network including trunk lines are not anticipated.

Emergency Operation

Pumping stations comprise of emergency collection ponds to contain sewage overflow during loss of power or receiving of flows over the station's design capacity. Depending on the sewage retention time within those ponds, emissions relating to H_2S will be observed through odor detection, as recorded during the field visits to the three existing pumping station within the project area, particularly at the West Zarqa Pumping Station. Release of odor could lead to olfactory impacts and creates potential health risks and nuisance to the inhabitants within the vicinity of the station area.

Dust

Construction

Dust to be generated during construction will result from clearing and earthworks, including trenching, leveling, site construction and reinstatement operations. The major dust sources will be from the movement of vehicles over the cleared work area within proposed pumping stations sites, along the pipeline network easements and from vehicles transporting material and equipment to the work areas. Under normal meteorological conditions, dust impacts would be limited to within several hundred meters of the project site. However, under strong wind conditions, these effects could extend further.

Dust generation can affect the ability of nearby vegetation to survive and maintain effective evapotranspiration. It may also pose health risks and irritation to humans, but typically where working in uncontaminated soils, wind-blown dust is normally only considered a nuisance to those exposed.

It is not anticipated that dust levels will impact greatly the existing settlements within the area given short duration of the construction activities at a given location rendering the potential impact to be of medium significance.

Operation

Minimal dust will be generated as a result of the pipelines and pumping stations operation. Therefore, the significance of impacts associated with dust generation during this phase of the project is considered low.

Noise

Construction

Since the activity will occur under normal operating conditions (likelihood ranking of 5 – certain), and is expected to have a localized effect with repeated breaches of statutory or prescribed limits causing an impact within neighborhoods where the activities are planned to take place (consequence ranking of 3 – critical), the impact significance can be considered high.

Operation

Slightly elevated noise levels may be perceived at the boundaries of the pumping stations if and when emergency back-up generators (if applicable) are used during a mains power failure causing an impact of low significance.

The pipeline network itself is inherently quiet under normal operation and is unlikely (likelihood ranking of 2) to generate noise levels that would have more than a single Exceedances of statutory or prescribed criterion (consequence ranking of 2 – marginal); therefore, impact significance associated with noise emissions during the operation phase of the pipeline network can be considered low.

Topography, Geomorphology and Soils

Construction

Due to limited rainfall in the region, the potential for erosion resulting from surface water runoff will largely be confined to episodic intense rainfall events. The potential for impact from wind erosion during construction will be of concern and will result in the generation of dust (see above). Specifically the outcropping rocks within the study area, areas where soil cover is generally thin, and within areas consisting of accumulated wind-blown soils caused by local topography, will be the most prone to potential erosion. Removal of soil in the direct alignment of the proposed pipelines and pumping stations, construction sites and construction activities in some erosion prone areas is unavoidable. But since excavation of mobile sand for emplacement of the pipelines or construction of pumping stations will only have a temporary impact, potential impact on topography and soil within the project area during the construction phase can be considered of medium significance.

Operation

Potential impacts to soil during normal operation of the pipelines and pumping stations is considered very minimal. During emergencies where overflow from pumping stations is discharged directly to the environment, potential impacts to soil within or in the vicinity of the discharge area be considered significant especially if the overflow contains elevated concentrations of raw sewage.

Soil contamination due to pipeline emergencies can be related to pipeline leakage or complete rupture of the pipelines which is unlikely to occur.

Water Resources

Construction

Groundwater within the project area occurs at depths of more than a 100 mbgl and mostly supplied from al Azraq basin approximately 70km east of Zarqa. Since, no de-watering will be required to lower the groundwater table during pipelines or pumping stations construction or operation activities and therefore the potential for impact on groundwater availability from the construction of the pipelines and pumping stations, under planned activities, is considered minimal.

Water requirements during the construction phase is not expected to be obtained from water wells located within the boundaries of the Zarqa Governorate. Water, where required, will be transported in by road tanker.

The main impact on the surface water hydrology of the project area (i.e. Zarqa River) will be as a result of some modification to natural drainage lines through differential settlement in the area of the backfilled pipeline trench and the potential hardening of surface soil within the unserved areas. Access tracks, trenches or pipeline networks to be established in areas of erodible soils and areas of significant gradient, could lead to an increase in the competency of surface water runoff leading to erosion and sedimentation during and after significant rainfall events.

Operation

Normal operation of the pipeline network and pumping stations will not pose a risk to the groundwater resources within the project area. It is anticipated that the operation of the sewage network, when operational, will enhance the groundwater quality, by inhibiting the infiltration of contaminants into the aquifer (positive impact). As described in Section 5 above, the Zarqa surface water basin is the only surface water basin within the project area and considered the third largest river in Jordan.

According to the report[13] prepared by B & E Engineers on behalf of the Ministry of Environment in 2009, the Zarqa River basin, including groundwater resources (groundwater wells) are currently facing number of environmental issues some of which are directly related to exposure to various sources of pollutions leading to degradation of the surface and groundwater (through infiltration of overflows) basin's water quality and quantity. One of the major sources of pollution is directly related to the discharged sewage

13 Zarqa River Basin Wastewater and Solid Waste Treatment Project, Final Report.

(untreated wastewater) overflow from the exiting West Zarqa pumping station, as the volumes of wastewater received by the station far exceed its current capacity, which would force the pumping station to directly discharge this excess waste water into the river. According to the project design team, either project design alternative (i.e. replacement of West Zarqa pumping station, and the rehabilitation the remaining stations, or the removal of pumping stations and construction of a new WWTP) would solve this issue, making it unlikely for similar overflows to take place (Likelihood ranking of 2). But if the event occur, the consequence is expected to severe (Consequence ranking: 4); therefore, the potential impact associated with this activity is expected to be of 'Medium' significance,

Aesthetics

Construction

Much of the project sites are through areas that are sparsely vegetated or have no vegetation covers, and hence no trees will need to be removed as part of the stripping operation. For the majority, the pipeline will be located within or adjacent to existing road easements. In these areas, the visual effects of the construction will not be significant or long term.

Operation

When established the pipeline network will represent only a minor visual impact, mainly associated with the installation of trunk lines. Based on the outcomes of the public consultation program, many residents within close proximity to the existing pumping stations neither have noticed their presence, nor have an idea about their actual function. Hence, visual amenity impacts associated with the proposed pumping stations is anticipated to be of 'Low' significance.

8.3.2. Potential Impacts to Biological Environment

Construction and Operation

The project activities anticipated to cause an impact to ecological resources (flora, fauna, and sensitive habitats) during construction phase include:

- Trenching and excavation works
- Solid Waste (Spoil) generation and disposal
- Wastewater discharge
- Materials, chemicals and oil storage including accidental spill of chemical and liquid fuels, ignition of flammable materials and/or accidental fires
- Vehicle and Equipment operation
- Opening new access roads, if needed

The pipelines corridors (e.g. trunk lines) and locations of the newly proposed pumping stations will be stripped during the construction phase of the project and as such some habitat loss may occur. In addition, human activity, such as earthmoving procedures and other vehicular traffic movement during the construction phase may cause fatality to some fauna and/or to, at least temporarily, move away from

the affected areas. Alterations to the flow regime of surface water runoff resulting from the construction activities may also affect some species, particularly amphibians utilizing Zarqa River basin that are sensitive to such disturbance. Some reptiles and small mammals may fall into the open trenches or be buried during trenching and backfilling activities. Birds are likely to be least affected, except where nesting or food source trees are removed. After construction of the pipelines and pumping stations and the rehabilitation of affected areas, there will be minimal disturbance to the area and wildlife is expected to return.

As for faunal communities, physical disturbance to the land surface during construction and increased vehicular movement through the project area during construction and operation will provide an opportunity for ruderal species to germinate and seed. These are opportunistic species relying on lack of competition, which rapidly colonize bare ground, many being annuals and, moreover, many being introduced weed species.

In general, the overall magnitude of impacts to biological environment was evaluated to be of low significance for the following reasons:

- The populated urban centre is of no ecological significance since population density in these areas is very high and different environmental challenges contributed to deteriorating its ecological characteristics.
- Only 10% of the project area is designated as natural vegetation, forests and agricultural land. There are no natural reserves within the project boundaries.
- The only Important Bird Area (IBA) identified is Khirbet As-Samra which is comprised of open, man-made pools – sewage pools. This IBA is identified mainly by the migrating birds passing through during spring and autumn migration.

Other Impacts on Terrestrial Flora and Fauna

Flora and fauna may be indirectly impacted by a range of activities other than those resulting from habitat loss and potential direct mortality during project activities. Such activities include:

- Vehicle, equipment and plant operation that creates noise emissions, especially from the vibration sources.
- Earthworks that create dust.
- A general increase in anthropogenic activity in the survey and camp areas.
- Disturbance of fauna during mating seasons.
- Potential of attracting some species such as wolves in the case of leaving the waste behind of site.

Specific potential interactions are discussed below.

Noise

Noise-sensitive species would be expected to avoid the Project areas but would be expected to return when noise-generating operations are discontinued. Similarly, species intolerant of surface disturbance

and human activities would also be expected to avoid disturbing Project activities until the emissions cease. Therefore, impacts associated with noise and general disturbances are considered to be minimal.

Dust

Dust can accumulate on the leaves and stems of plants thus reducing their ability to photosynthesize and grow. In arid areas, plants are typically well adjusted to hot and dusty conditions (e.g. have thin or small leaves thus reducing potential for moisture loss). Being endemic to arid conditions, the flora species found within most of the Project area are, to a level, dust and heat tolerant. Increased levels of dust may however cause additional stress to areas containing plant species that can be sensitive to high levels of dust, if dust suppression was not implemented within dusty areas, although this is hard to quantify.

Anthropogenic Activity

Collective disturbance would increase stress levels for all fauna species within the range of effect, noting that this is different for noise and luminance. High stress levels can have a number of behavioral effects on animal species, with the most serious being those that decrease the chance for survival and reproductive success. Since the density and importance of those faunal communities within the northern western part of Project area is considered high, the significance of impact as a result of these activities, if proper mitigation measures were not adopted, can be considered ‘Major’.

8.3.3. Analysis of Impact Assessment Results from Unplanned Project Activities

Degradation to Soil, Surface and Groundwater Quality

Degradation to soil, surface and groundwater quality could result from accidental rupture of fuel storage tanks on site (if stored on site), resulting in a release to the surrounding environment.

Highest risk of contamination to groundwater and surface will be the potential infiltration of the occasional overflow discharges from the pumping stations during emergency operations into wadi Zarqa, therefore extra diligence is required. This event is unlikely to take place as it would require complete station failure and/or power shut down including failure of emergency backup generator.

Based on the above, a complete discharges of wastewater from pumping stations into the basin are unlikely to occur (likelihood rank of 2 – Unlikely) and it is anticipated take place over a limited period of time forming an addition to the existing overall sources of pollution within the project area, the impact is anticipated to be of a limited nature caused by limited discharges of known toxicities, the consequence of this event can be given a rank of 3 – Critical; therefore, and unless the proper mitigation measure are adopted and implemented, the potential environmental impact associated with an accidental event of this type is considered to be ‘Medium’.

8.4. Analysis of the Social and Health Impacts

8.4.1. Introduction

The purpose of the social and health impact assessment is to identify the potential socioeconomic issues to be taken into account during the design, construction, and and operation of the reinforcement and rehabilitation of the wastewater system in the Zarqa Governorate. In addition, this preliminary social assessment aimed at ensuring the engagement of all key stakeholders and incorporating their views and opinions in the study.

As described earlier, the preliminary social assessment made sure to capture any issues that could affect special groups in the community throughout the research. It is important to note, and it was made clear throughout the preliminary assessment, that the subject-matter is a community and household issue and any activities relevant to this subject-matter affects households and communities as a whole. Nevertheless, the gender lens was applied throughout the research to pinpoint any impacts or issues that could be special to females or could impact them differently. All such findings were noted and represented under their corresponding subsections.

Stakeholders including representatives from the local communities within and adjacent to the Project sites boundaries were contacted to assess their attitude toward the project. Focus groups were conducted to assess the local communities' opinions about the existing wastewater management system (mostly seepage pits) and the proposed network extension. These focus groups were conducted for the targeted study areas in Al-Russeifa and Al-Sukhneh. The focus groups were arranged in co-ordination with local NGOs (Al-Muammar Society in Al-Russeifa and Al-Sukhneh Women's Society in Al-Sukhneh).

Al-Zarqa residents participated in the research through one-on-one interviews as opposed to a focus group. Separate discussions were made for the expansion issue and the issue of the existing pumping stations. One-on-one interviews were also used to assess opinions of local authorities in the Governorate, the targeted municipalities, as well as concerned non-governmental parties.

Results of the focus group meetings were based on reaching consensus on the positive and negative potential impacts associated with the existing condition and the proposed project. In this case, consensus was reached with the majority of the stakeholders in agreement that their input was accordingly considered. Results of the public consultation program are discussed in Section 12.

Impacts as foreseen by the consulted stakeholders were further analyzed based on MWH understanding of the actual nature of the Project activities. The results of the further assessments are included in the following sections.

8.4.2. Impact on Population and Project Personnel

The potential impacts on the population within the construction and operation areas:

- Social and cultural interaction issues.
- Health impacts associated with noise, dust and ground-borne vibrations.

- Impacts to land use and land value.
- Utilities and transportation impacts.
- Impacts to archaeological and cultural heritage resources.
- Economic impacts.
- Generation of employment opportunities.
- Improvement of living standards.

The activities that may result in these potential impacts include:

- Utilization of existing access tracks, and clearing for new access tracks (if applicable).
- Construction activities.
- Construction Camp operations (if applicable).
- Pipelines and Pumping Stations operation activities.

Social and Cultural Interaction Issues

In general, the main impacts associated with social and cultural interaction issues will result from undertaking the works throughout the populated areas, including the site preparation, trenching, excavation, pipeline lay down activities and pumping stations construction and rehabilitation activities.

Construction work will be undertaken through highly populated areas as well as areas of lower population densities. The estimated periods for competing the construction works vary based on the level of construction required (i.e. replacement of existing network or the installation of a new network within unserved areas). It is anticipated that the "pipeline spread" will progress at an average rate of 100 m per day. Since the total length of the pipeline network has not been calculated yet, it would be difficult to estimate the actual construction period required within each of the neighborhoods within the project boundaries, although it is anticipated to be of a short term nature (less than 1 year).

The outcomes of the public consultations revealed that residents of the area have raised concerns over the mobility of females -whether for running errands or for social activities- due to the presence of laborers within the neighborhood.

During pipeline and pumping stations operations, very minimal interaction between laborers and the general public is anticipated, as it would be limited to pipeline maintenance activities and the operation of the proposed pumping stations.

Based on the above, impacts associated with social and cultural interactions from undertaking the construction and operation works throughout the area, is considered ‘Low’.

Noise, Dust and Ground-borne Vibrations

Noise

Noise will be generated by plant and equipment associated with the pipelines network and pumping stations construction activities. These sources would include clearing, ditch digging, pipe handling,

vehicle movements and reinstatement. Likely noise levels would be similar to those associated with typical construction sites.

Construction noise levels associated with typical machinery based on "BS 5228: 1997 Noise and Vibration Control on Construction and Open Sites" are included in **Table 8.4** below. The estimated variability of the composite levels is ± 3dB and for comparison, spot measurements for on-site equipment, for a similar project, are included.

Table 8.4: Sound Pressure (Noise) Levels of Construction Machinery and Vehicles

		Noise Level (dBA)	
Type of Construction	**Type of Machines**	**BS 5228: 1997 at 10 m**	**Typical Site Value at 1m (2003)**
Earth Moving	Compactors	78	80
	Front loaders/bull dozers	88	92
	Back hoes	76	
	Tractors	71	
	Scrapers	82	
	Caterpillar grader (300 HP)	84	
	Pavers	74	
	Dump Trucks	74	86
	Universal Excavators	78	91
Materials Handling	Small concrete mixers with electric drive	76	
	Concrete pumps	81	
	Building crane	81	
Stationary	Pumps	82	
	Generator	82	
	Air compressors	85	83
Others	Vibrators	74	80
	Vibratory screen	82	
	Vibratory roller	78	
	Plate vibrator	80	
	Internal electric vibrator	78	
	Saws	82	

With the exception of the areas of al Sukhneh and Khirbet As-Samra which can be considered areas of low population density, the project area is highly populated. Construction works are expected to take place within very close proximity to residential dwellings, causing nuisance to the human receptors within the area, as noise levels will exceed limits for allowable noise levels established for the residential areas (Table 4.3).

Dust

Dust to be generated during the Project can be considered as a major source of health impacts leading to potential respiratory problems.

The occurrence and significance of dust generated by the construction activities is difficult to estimate and depends upon meteorological and ground conditions at the time and location of site preparation and earth works.

Certain areas within the Project sites comprise fine material and hence any Project activity which disturbs surface soil could increase atmospheric dust levels. Dust levels already tend to be high in some areas due to high wind conditions and low moisture and vegetation covers, which cause the mobilization of sands to become a common occurrence.

Activities which could increase dust levels include the utilization of unpaved access tracks, excavation, trenching, leveling, grading, and site reinstatement activities especially during windy conditions.

Airborne dust can be associated with a human health impact if generated in sufficient amount. The UK Health and Safety Executive (HSE) have developed new technical guidance in the Methods for Determining Hazardous Substances (MDHS). This guidance gives Time Weighted Average (TWA) Maximum Exposure Limits (MEL) for hazardous substances. The TWA for dusts (respirable) are 4mg/m^3 and for dusts (inhalable) are 10 mg/m^3.

Airborne dust may at times represent a nuisance to construction workers and third party human receptors (i.e. residents in the localized project area). For the most part, however, it is likely that dust particles would settle as soon as the construction activities would cease, thereby minimizing health risk. Since the construction activities are anticipated to be of short term and temporary nature, the significance of windblown dust impacts can be considered ‘Medium’.

Proper management of the project related activities will help in the reduction of noise, dust and vibration impacts.

Vibration

There is no data on existing ground-borne vibrations sources or levels within the Project area.

Vibration impacts associated with Project activities such as trucks and construction equipment and associated plants movement on the access roads are likely to generate relatively small levels of ground borne vibration and are not anticipated to result in a significant impact to humans.

Since the pipelines and pumping stations are inherently quite during operation, the impact of noise, vibration and dust on the population within the project area is limited to the construction phase and can be considered 'Medium' of significance.

Impact on Land Use and Land Value

Construction

Project activities have the potential to impact land use within the Project area. This could result from the utilization of access tracks, as well as general construction activities. Those are, but not limited to, the commercial, industrial and/or retail facilities as temporary obstruction of access especially when activities pass directly by them or through them will occur.

Construction machineries and associated plants and trucks are large in size and could cause traffic congestion within populated areas. In addition, the operation of this equipment could cause the soil to become compacted which in turn would impact areas under cultivation.

Most of the construction sites will be planned within major dwellings and legal land uses within the project area, but since these activities are considered temporary and of a short term nature, their impact significance can be conceded 'Medium'.

Operation

Impact to land use during operation of the project components are minimal and can be considered 'Low'.

However, the operation of the wastewater networks and pumping stations will imply an extended service to new areas. This has a positive impact of increasing the land and property value due to availability of the new utility service, which is the wastewater network. This positive impact will result in a subsequent improvement of the socioeconomic image of the neighborhoods in general.

Impact to Utilities

Construction

Utilities include the supply of electricity, gas, phone lines and water (to pumping stations). There are no planned interruptions to any of these utilities.

During constriction, the project will not put a strain on existing public utilities or water resources as the quantities of water utilized during the construction program is anticipated to be minimal. Most probably, water will be supplied to the pipelines spread and pumping stations construction sites by tankers.

Although various utility service lines and pipelines might be crossed by the project, it is not envisaged that these crossings will cause any disruption to services. An accidental event, such as those resulting from the construction works through underground utility lines and/or vehicle collision with a public utility, would cause the temporary disruption of their function; however, this is considered unlikely and therefore of a 'Moderate' impact.

Operation

During operation, the proposed pumping stations, similar to those existing, would be supported and powered by substations, likely to cause potential significant strains on the exiting power supply within the Zarqa Governorate. Impact on utilities as a result of increasing the number of pumping stations within the project area can be considered of 'Medium" significance.

Impact to Transport

Construction

There are number of activities that have the potential to disrupt the existing transport infrastructure, including the crossing of main roads and utilization of public roads within the area's neighborhoods during the replacement of existing pipelines, installation of new networks, rehabilitation of exiting pumping stations and/or the construction of the newly proposed pumping stations as one of the project's options works causing general congestion on the those roads.

It is anticipated that vehicles normally using the main roads for transport routes would utilize newly constructed access tracks. The impact is 'Likely' to take place and would yield a 'Critical' consequence. The impact to transport is therefore considered to be 'Medium'.

Operation

It is not expected that much disruption to the road structure or transportation activities will occur due to the limited number of vehicles and plants in use during the operation. The impact to transport during operation is therefore considered to be 'Minor'.

Impact to Archaeology and Cultural Heritage

As discussed in Section 5, the project area contains number with archaeological features, some of which have been identified as being culturally and historically significant.

Transportation of project equipment and utilization of access tracks for the construction work will pose the greatest risks to potential subsurface archaeological features. Negative impacts could result from activities that stand to potentially alter, directly or indirectly, any of the characteristics of an archaeological feature, or diminish its physical integrity.

Construction personnel in the field area should be instructed to look out for archaeological and paleontological artifacts and items during their day-to-day work, and to report these, preferably with a GPS reading, to the Department of Antiquities. As major archaeological sites have already been identified and delineated within the boundaries of the Project area, and they are clearly visible to the construction crew on the ground, it is considered very unlikely that the impact would take place. If it happens, though, the consequence would be severe. The assessment process for this receptor has yielded the 'Minor' impact significance ranking.

Economics

Construction

During construction of the proposed pipeline networks, pumping stations and associated infrastructures, it is expected that the local and national economies will be beneficially impacted. The regional economy will benefit primarily by increased employment opportunities and diversification of skill base within the existing workforce.

As well as enhanced employment opportunities, the project will create considerable potential for local enterprises to secure contracts for the provision of goods and services. During the construction phase, local firms will be considered for contracts to provide pipe materials, food, building materials, earthmoving, etc.

During construction there may be a strain on the local socio-economic environment with a sudden increase in local population, but over time as local business and industry expand supply, demand is expected to stabilize. The local economy will benefit with more local business and services being patronized. The overall outcome is anticipated to be economic and social growth within the kingdom, particularly in Zarqa.

Operation

Overall, the provision of a wastewater network and associated structures will positively impact areas that are currently facing sanitation.

During the operational phase, local firms will have the opportunity to be awarded contracts for a wide variety of services such as, building materials for maintenance, maintenance work on the pumping stations, pipelines and vehicles. The additional income earned by these local workers is expected to directly benefit the local communities.

The long-term operation of the pipeline network, pumping stations and associated infrastructure will provide specialized employment and training for a small local workforce.

Employment Generation

Among the positive benefits of the project that may arise during construction and operation activities is the generation of employment opportunities.

During construction phase, the employment opportunities generated would be short-term extending only over the construction period. This impact can be further amplified if preference to the governorate population is given and if the logistics and project-required supplies are targeted to the local people within Zarqa where feasible.

The employment opportunities generated during operation phase would be of long-term nature. However, these opportunities are limited in number and require people with certain technical

qualifications. Therefore, if preference would be made to Zarqa Governorate residents, then training might be needed in case the available candidates do not meet technical requirements of the project.

Living Standards

One of the positive benefits of the project that may arise during operation activities is the improved living standards of people in the project area. This improvement is due to the extension of wastewater services to the new areas and the elimination of cesspools and septic tanks that constitute a public health hazard.

Also, it will be an improvement in living standards of women within project area, as they are the individuals who have to take care of house chores and regulate the quantities of generated wastewater in order to avoid the overflow of the septic tanks.

8.4.3. Waste

Construction & Operation

Waste oil from the servicing of vehicles and miscellaneous building debris, including spent welding rods, packaging waste, used drums, wood, scrap metal and building rubble will be generated during the construction phase of the project.

During the operation of the pipeline and pumping stations, little waste will be generated and there will be a low potential risk for significant environmental impact. Domestic rubbish will be transported off-site for general landfill disposal.

8.4.4. Preliminary Public Health and Safety Impacts

Potential Health and Safety Impacts of Rehabilitation and Expansion of Wastewater Network

Potential Health and Safety Impacts of Rehabilitating Existing Wastewater Networks

Sanitary sewer system rehabilitation is an important activity in every community served by a public wastewater collection system. Efficient, upgraded maintenance practices can help to reduce stoppages, backups, and sanitary sewer overflows and the resulting health risks, property damage, inconvenience, repair and cleaning costs, and liability.

As part of its mission to protect public health and the environment, Zarqa Governorate is responsible for conveying, pumping and treating wastewater collected from currently served households.

Rehabilitation and expansion of network to increase capacity of the sewers that lead in and out of the pump station in Zarqa Governorate will increase capacity and insure safe and reliable operations.

In summary, rehabilitating the existing wastewater network will have positive safety and health impacts such as:

- Increasing the network capacity will eliminate the need for wastewater storage will remove the odor, insects and nuisance problems

- Reduce the prevalence of insect borne diseases
- Protection of public health and the environment
- Improve land quality and quality of life

During rehabilitation process some negative impacts will occur. Examples of the negative impacts are:

- Air pollution caused mainly by releasing suspended particulates exacerbating respiratory.
- Noise pollution as a result of work of heavy equipments interfering with communication and sleep especially for sick people and children.
- Road blocks and traffic problems, which may result road and traffic accidents.
- Soil disturbance.
- Disruption.

These impacts are limited in place (construction areas) and in time (just for the duration of the rehabilitation and expansion). Therefore, positive impacts are considered higher than anticipated negative impacts.

Potential Health and Safety impacts of extending wastewater network into unserved areas

Extending and upgrading wastewater transport system will ensure that future growth in Zarqa Governorate can be accommodated for at least the next 25 years. The wastewater transport system includes the pipe work, pumping stations and other structures necessary for collecting and transporting sewage. The wastewater system collects wastewater from the community and delivers it through a network of mains and pumping stations to As-Samra facilities for treatment. The aim of extension and upgrading existing network is to achieve best liquid waste disposal with minimal impact on the environment and customers caused by overflows. The upgraded wastewater system in Zarqa will increase the capacity of the system so it is expected to generally perform very well, without affecting localized areas, customers and the environment during heavy rainfall or during summer where the water use is at maximum.

In summary, extending existing wastewater network will have positive safety and health impacts such as:

- Covering unserved households and areas in Zarqa Governorate thus eliminating the need for primitive methods of wastewater disposal such as the use of cesspools.
- Eliminating sources and causes of household water contamination thus significantly decreasing water and food borne diseases.
- Eliminating sources and causes of soil contamination thus elimination contamination of eaten raw food with parasites.
- Protection of public health and the environment.
- Improve land quality and quality of life.

During extending process some negative impacts will occur. Examples of the negative impacts are:

- Air pollution caused mainly by releasing suspended particulates exacerbating respiratory.

- Noise pollution as a result of work of heavy equipments interfering with communication and sleep especially for sick people and children.
- Road blocks and traffic problems, which may result road and traffic accidents.
- Soil disturbance.
- Disruption.

These impacts are limited in place (construction areas) and in time (just for the duration of rehabilitation).

Potential Health and Safety Impacts of upgrading existing pump stations

Upgrading the existing pump stations involve the installation `of new pumps and electrical equipment and a new main that will result in an increase in `the pump station's capacity`. The work will reduce sewer overflow` problems that were previously `occurring during winter as a result of storm water and during summer when the use of water is the peak.

Upgrading existing pump stations will result in the following positive health and safety impacts:

- Replacement of aging pump station equipment and sewer lines to ensure safe and reliable operations.
- Increasing pumping capacity to accommodate future growth in served areas population growth rate and household increase rate.
- Eliminating odor source and insect breeding places.
- Meeting current design standards, including odor and noise control.
- Protection of public health and the environment.
- Improving of land quality and quality of life.

During upgrading process of the existing pump stations, some negative impacts will occur. Examples of the negative impacts are:

- Air pollution caused mainly by releasing suspended particulates exacerbating respiratory.
- Noise pollution as a result of work of heavy equipments interfering with communication and sleep especially for sick people and children.
- Road blocks and traffic problems, which may result road and traffic accidents.
- Soil disturbance.
- Disruption.

8.4.5. Potential Impacts on Land Acquisition

Although this project will result in a significant general benefit to the entire population of Zarqa Governorate due to the decrease or elimination of sewage overflows and the resulting health risks and costs as well as due to the specific benefit to that part of the population who are presently served only by water and not by sewer when the piped sewerage system is extended, the implementation of this project entails some negative impacts on some of the landlords. More than 300,000 m² will be expropriated to

serve the four pumping stations downstream and the new trunk sewers in many other locations in Zarqa Governorate. **Table 8.5** and **Table 8.6** provide a brief profile of the land which will be affected by the proposed expropriations.

Table 8.5: Project Affected Locations and Proposed Expropriation Areas for Sewer Lines

Location	Sheet No. (map reference)	Length of Main lines pass through private plots	Proposed Expropriation Area m²	Length of Main lines down stream	Proposed Expropriation Area m²	Length of Sub-lines pass through private plots	Proposed Expropriation Area m²
Dogara	1	0	0	695	695	0	0
Dogara	2	0	0	4,025	4,025	0	0
Al Alouk	3	0	0	4,320	4,320	0	0
Sarout	4	0	0	6,055	6,055	0	0
Dogara	5	665	2,660	8,535	8,535	0	0
Al Khililah	7	0	0	4,905	4,905	0	0
Um Rummaneh	9	0	0	2,500	2,500	0	0
Beirin	10	0	0	4,470	4,470	0	0
Sukhna	11	0	0	8,475	8,475	0	0
Sukhna	13	0	0	2,575	2,575	2,605	5,210
Hai Ma'amel al Toub	14	2,650	10,600	1,885	1,885	3,535	7,070
Hia Bustan, Hai al Hashemi	15	6,410	25,640	5,730	5,730	5,445	10,890
Hai Batrawi, Zarqa Jadida	16	1,150	4,600	3,010	3,010	2,009	4,018
Hia Nassar (Zawahra)	17	2,935	11,740	3,590	3,590	1,495	2,990
Hia al Jraiba	20	80	320	0	0	0	0
Hia Makka Al Mukarrama	21	1,255	5,020	3,045	3,045	2,115	4,230
Hia al Falah	22	0	0	0	0	2,385	4,770
Hia Jafar al Tayyar	24	0	0	0	0	680	1,360
Kurba al Samra	28	3,875	15,500	0	0	0	0
Kurba al Samra	29	2,170	8,680	0	0	0	0
Hashmiyah	30	5,305	21,220	0	0	0	0
Dhuleil	31	0	0	3,365	3,365	0	0
Dhuleil	33	0	0	0	0	1,175	2,350
Dhuleil	34	0	0	2,835	2,835	260	520
TOTAL		**26,495**	**105,980**	**70,015**	**[14]70,015**	**21,704**	**43,408**

14 Although the total land area will be affected by the project approximately (280,060) m², only 25% is anticipated to be private ownership and required to be expropriated.

Table 8.6: Project Affected Locations and Proposed Expropriation Areas for Pumping Stations

Location	Proposed Expropriation Area m²
Sukhneh PS	3,000
Wadi Zarqa PS	3,000
Al Alouk PS	3,000
Dhuleil PS	3,000
TOTAL	**12,000**

Table 8.7 below, provides a summary of the preliminary ESIA for the project's planned and unplanned activities.

Table 8.7: Summary of Preliminary Impact Assessment of Planned and Unplanned Activities

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[15]
Construction Phase							
1	Trenching and Excavation Works	Planned	Degraded air quality due to dust and emissions	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Degraded topography, geomorphology and soils	Certain (5)	Critical (3)	High (15)	ALARP/BAT
			Visual intrusion and aesthetic interference	Certain (5)	Negligible (1)	Low (5)	HSEMS
			Pollution of surface water resources	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Pollution of groundwater	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Likely (3)	Sever (4)	High (12)	ALARP/BAT
			Disruption to existing businesses	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Damage to Infrastructure – Transport system and potential traffic impacts	Very Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Damage to water and wastewater lines	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to power and communication lines	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Employment opportunities	Certain (5)	Positive (+)	Positive (+)	None
			Damage to archaeological/cultural heritage sites	Very Unlikely (1)	Catastrophic (5)	Low (5)	MSEMS
2	Solid Waste (Spoil) Generation/Disposal	Planned	Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Visual intrusion and aesthetic interference	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Impact to surface water	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS

15 Unacceptable or Managed to ALARP, BAT, or with HSEMS
ALARP: As Low As Reasonably Practicable
BAT: Best Available Technology
HSEMS: Health, Safety and Environment Management System

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[15]
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to public health and safety	Vey Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Unlikely (2)	Catastrophic (5)	High (10)	ALARP/BAT
3	Material and Chemical / oil storage	Planned	Degraded air quality due to emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Visual intrusion and aesthetic interference	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to surface water	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Impact to shallow groundwater	Unlikely (3)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
4	Vehicle operation	Planned	Degraded air quality due to emissions	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Noise pollution	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Impact to soil	Likely (3)	Marginal (2)	Medium (6`)	ALARP/BAT
			Impact to surface water	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Damage to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Risk to utilities due to accidents	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
5	Equipment operation	Planned	Degraded air quality due to emissions	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Impact to soil	Likely (3)	Severe (4)	High (12)	ALARP/BAT

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[15]
			Visual intrusion and aesthetic interference	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to surface water	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Impact to land use	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Risk to public health and safety	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Risk to utilities due to accidents	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
6	Access Roads (if needed)	Planned	Degraded air quality due to dust emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Disturbance to top soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to floral and faunal habitats	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Workforce employment	Certain (5)	Positive (+)	Positive (+)	
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
7	Vehicle Collisions	Unplanned	Degraded air quality due to exhaust emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Noise pollution	Very Likely (4)	Marginal (2)	Medium (8)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Disturbance to flora and fauna	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Risk to public health and safety	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Risk to transport system and potential traffic impacts	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Unlikely (2)	Catastrophic (5)	High (10)	ALARP/BAT

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[15]
8	Spill of chemical and liquid fuels	Unplanned	Degraded air quality due to emissions	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to shallow groundwater	Unlikely (2)	Marginal (2)	Low (4)	HSEMS
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Very Likely (4)	Severe (4)	High (16)	ALARP/BAT
			Impact on land use	Likely (3)	Severe (4)	High (12)	ALARP/BAT
			Impact to existing infrastructure / utilities	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
9	Ignitions of flammable materials / accidental fires	Unplanned	Degraded air quality due to emissions	Very likely (4)	Critical (3)	High (12)	ALARP/BAT
			Noise pollution	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Damage to floral and faunal habitats	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Risk to public health and safety	Very likely (4)	Severe (4)	High (16)	ALARP/BAT
			Impact on land use	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to transport and other infrastructure/utilities	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Damage to archaeological/cultural heritage sites	Very unlikely (1)	Severe (4)	Low (4)	HSEMS
Operation Phase							
1	Pump Stations Operation	Planned	Odor generation	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Noise pollution	Very unlikely (1)	Marginal (2)	Low (2)	HSEMS
			Visual intrusion	Likely (3)	Marginal (2)	Medium (6)	ALARP/BAT
			Impact to surface and ground water resources	Unlikely (2)	Severe (4)	Medium (8)	ALARP/BAT
			Employment opportunities	Certain (5)	Positive (+)	Positive (+)	
			Energy need	Certain (5)	Critical (3)	High (15)	ALARP/BAT
2	Flow of wastewater in sewer networks	Planned	Impact to soil	Unlikely (2)	Critical (3)	Medium (6)	ALARP/BAT
			Visual intrusion (Only above ground trunk lines)	Unlikely (2)	Marginal (2)	Low (4)	HSEMS

No.	Project Activity	Planned or Unplanned	Potential Environmental and Social Impacts	Likelihood	Consequence	Impact Significance	Impact Management[15]
			Impact to groundwater	Certain (5)	Positive (+)	Positive (+)	
			Land value	Certain (5)	Positive (+)	Positive (+)	
			Public health and living standards	Certain (5)	Positive (+)	Positive (+)	
3	Pump station power failure / malfunction problems	Unplanned	Odor generation	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to surface water	Likely (3)	Marginal (3)	Medium (9)	ALARP/BAT
			Risk to public health	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
4	Rupture/breakage of utility lines	Unplanned	Impact to shallow groundwater	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to soil	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT
			Impact to infrastructure (road subsidence)	Very Likely (4)	Critical (3)	High (12)	ALARP/BAT
			Risk to public health	Likely (3)	Critical (3)	Medium (9)	ALARP/BAT

9. PRELIMINARY MITIGATION MEASURES

This Section considers all impacts that were identified in Section 8 as being significant and presents recommended mitigation measures eliminate or minimize these impacts.

Mitigation measures, recommended by this study, aim to offset any significant negative impacts that result from the project, and provided below in discussion format, with a tabular summary provided in **Table 9.1** below. Although this section focuses on those impacts deemed 'Major', measures have also been suggested to further reduce those impacts considered to be 'Minor' or 'Moderate'.

Table 9.1: Proposed Preliminary Mitigation Measures

Impact	Mitigation Measure
Impacts to flora / habitats	• Minimize width of access tracks. • Limit driving to marked tracks and lines except in an emergency. • Prevent the removal of plants by workers on site.
Impacts to Fauna	• Deviate work away from faunal communities' concentration areas. • Avoid human and vehicular contact with fauna, including their burrows / nests and feeding grounds. • Prevent illegal hunting by workers on site. • Avoid working in times of bird migration.
Impact to water resources	• All fuel storage (if applicable) must be appropriately bunded and refueling must be undertaken in designated areas following set procedures. • Develop a spill response plan, to control any inadvertent leakage or spillage of hydrocarbons. Spill response measures should be instigated (as necessary) to contain and clean up any contaminated soil present. • Adopt appropriate soil conservation measures, reducing the disturbed area and scheduling work, where practical, to avoid periods of high rainfall. • The slopes and slope lengths of steeper sections of the pipeline route and any areas of cut and fill will be minimized and drains installed to intercept and divert run-off water. • Road crossings and other traffic areas will be located and constructed to minimize the concentration or diversion of water into the wadi bed and drainage lines. Where practical, surface cover will be maintained in these areas. • Third party environmental specialists will be appointed to periodically review implementation of the management plan. • Proper design of the pumping stations to accommodate potential overflows. • Develop, redesign and upgrade the capacity of the existing pumping stations to handle all sewage flow into them and avoid overflow of untreated sewage into the surface and groundwater resources within the project area.
Impacts to Population	• Use noise attenuation devices on plant. Ensure that noise levels at receptors do not exceed standards. • Avoiding work on weekend (Friday) and ceasing work activities during the weekdays between 8:00 pm and 6:00 am. • Give advance warning to the area's residents as to the project activities and possible disturbances (noise, dust etc). • Compensate any loss to livelihood. • Provision for the additional traffic may need to be made, potentially with additional turn-off lanes and traffic signaling installed to prevent congestion and minimize the risk of vehicular accidents at road crossing points. • A formal traffic management plan to be developed in consultation with the main

Impact	Mitigation Measure
	project contractor. • If pumping stations are a must, ensure that those will be properly designed to handle the wastewater flow, where the need for exposed overflow emergency ponds is eliminated or significantly minimized. • Where it would not increase dust and erosion levels, break up compacted soil, especially in cultivated areas.

9.1. Flora / Habitats

Decreasing the number and width of access tracks, pipeline trenches and corridors (whenever possible) would require no/less vegetation removal and would therefore impact fewer (or possibly no) habitats. Access tracks should utilize the minimal size of area required to undertake the activities.

If new access tracks are to be constructed to enable the project to access inaccessible sites, especially within unserved areas, the new access tracks should be made inaccessible to the general public. This will prevent the use of the tracks as common transport routes which would exacerbate habitat degradation, dust, and landscape erosion impacts. This would also assist in the natural restoration of any removed vegetation (if required).

Access tracks should also deviate around sensitive habitats identified in Section 5 of this report.

To limit the impact to vegetation, vehicles and plant equipment should be limited to driving upon marked lines and tracks except in an emergency. Newly constructed access to the tracks should be limited to project personnel only. This may entail blocking or guarding the tracks in those areas likely to be utilized by non-project personnel.

9.2. Fauna

The deviation of pipes (whenever possible) around those habitats supporting faunal populations (e.g. forest, farms and Wadi Zarqa) will ensure a greater level of protection of these species and their habitats. Burrows and nest sites should not be disturbed, and working on site during bird migration seasons within the identified IBA (if required) must be avoided.

Project activities should not be undertaken in faunal populated areas during sensitive times of the year, i.e. during breeding / hatching. This will minimize stress to faunal populations as well as avoid direct mortality of the young. For most species, it is thought that breeding and hatching occur between April and early June.

Human and vehicular contact with fauna, including their burrows / nests and feeding grounds should also be avoided.

Workers on site must also avoid the removal of trees within the project area. The project must obtain an approval from the Ministry of Agriculture prior to the removal of any trees if this action is deemed

necessary and unavoidable. In addition new trees ought to be planted on site to compensate for the removed trees (if applicable).

9.3. Population

To mitigate noise impacts to the human population within the project area, communication with the residents regarding the nature and timing of the project should be undertaken. It is suggested that advance scouts approach populated areas a few days prior to the construction scheduled through that area.

Dust suppression methods (i.e., watering down) around populated areas or during windy conditions or following the breaking up of ground would limit the impacts from dust on project personnel and surrounding residents.

In order to ensure that area residents, land users, government agencies and NGOs are aware of the Project activities and provided with all information and measures necessary to prevent or minimize any potential impacts that could arise from the project within their area of concern, and also to ensure full compliance with the laws and standards governing those activities, the project will have to engage those stakeholders through the development of a Stakeholder Engagement Plan.

9.4. Health and Safety

To mitigate potential health and safety impacts to the workers and human population in the Project area, the project will have to completely adhere with the requirements of the Jordanian Labor Law No. 8 for the year 1996 and its amendments pertaining to employee carrying one of the occupational diseases, disabilities or death due to working practices.

As mentioned earlier in this report, and by identifying dust as a potential source for health impacts, dust suppression methods (i.e., watering down) around camp sites and populated areas or during windy conditions or following the breaking up of ground and the use of protective clothing would limit the impacts from dust for Project workers and surrounding residents.

In addition to the above and in order to mitigate any potential health and safety impacts arising from the project activities on workers and human receptors within or surrounding the project area, the following measures should be adopted:

- First aid kits should be available at the construction sites and easily accessible by all workers.
- Vehicles are to be inspected daily by the driver and maintained and inspected every six weeks by a competent person.
- Hazardous chemical assessments are required for any hazardous substances if required for use by the project.
- Generators (where required) to be located away from working and residential areas.
- All electrical equipment is to be checked by a competent person prior to commencement of work.

- An adequate emergency plan is to be produced and drills carried out to confirm its effectiveness.
- A fire safety plan is to be developed identifying potentially hazardous areas.
- Construction workers, and during hot weather, are to drink plenty of fluids, and replace salt and minerals, use of appropriate clothing and sunscreen.
- Open trenches are to be clearly marked, guarded and made inaccessible to none project personnel.
- Schedule trenching activities carefully, use a buddy system, monitor people at high risk.
- Noisy activities are to be located away from sensitive receptors (whenever possible).
- Equipment and vibrating activities are to be located away from sensitive receptors (whenever possible).
- Provision of adequate Personal Protection Equipment (PPE) for workers on site.
- Secured visitors access to the construction sites and operation.
- Site tidiness is to be monitored daily and maintained at all times.
- The transport of the waste needs to be adequate to ensure that it is contained during transit.
- Adequate accommodation to be available at all times, cleaning regime to be implemented.
- Machines to be guarded at all times.
- Isolation of personnel with contagious illnesses from workers and the general public within or around the project area, and provide immediate medical attention and treatment through contacting the nearest Civil Defense Station to the construction site.

9.5. Archaeological and Cultural Heritage Sites

It is recommended that Chance Find Procedures be followed. It shall be the responsibility of the Contractor to obtain all information available from the Supervisor of the Cultural Resources Management Office of the Department of Antiquities regarding the location of any know archaeological site in the construction area, and he shall make this information available to the Engineer's Representative as soon as he obtains it. If any know sites will be threatened by construction agreement must be reached with the Department of Antiquities in order to minimize damages to the sites. It shall also be the Contractor's responsibility to notify the supervisor of the Cultural resources Management Office of the Department of Antiquities of antiquities are encountered in any era during construction, and Clause" V of the General Conditions of contract must be closely observed and also specifications set in articles 15 of the antiquities Law No. 21. of 1988.

If any site found during construction and will be damaged by construction activities, the Department of Antiquities will assess the discovered remains and may carry out an emergency salvage excavation salvage excavation means archaeological excavation conducted during construction phase it should be conducted only when an archaeological site is found by accident (chance find) during construction.

Given the short time available for a salvage excavation, this type of work should be avoided. The available short time for salvage excavations cannot be considered an authorization to destroy the discovered remains or site.

Since each site must be given proper consideration and analysis before its destruction can be authorized.

The Contractor shall seek the written approval of the Department of Antiquities before the removal of any chance find building, foundation structure, fence and other obstruction, any portion of which is in the right of way. All designated salvageable material shall be removed, without causing unnecessary damage, and in sections or pieces which may be readily transported, and shall be started by the contractor at approved locations, for later use or possession of the Department of Antiquities.

10. PRELIMINARY ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

10.1. Environmental, Social and Health Commitment

This Preliminary Environmental Management and Monitoring Plan (EMMP) are structured to address potential environmental impacts identified in the ESIA as a result of the construction and operation of sewage pipeline network and pumping stations.

This EMMP addresses environmental issues pertinent to the project, these being:

- Flora and habitats
- Fauna
- Groundwater
- Surface water
- Dust and noise
- Waste management
- Land Acquisition
- Archaeology and cultural heritage

In compliance with MCC requirements, a resettlement policy framework is developed as part of the EMMP.

The preliminary EMMP also reflects the content of various environmental, health and safety issues associated with the project including:

- Environmental issues related to construction management plan
- Traffic management plan
- Waste management plan
- Emergency response procedure
- Spill contingency management
- Archaeology management plan.
- Health and Safety Management

10.2. Summary of Overall Environmental, Social and Health Management Objectives

Key environmental management objectives for implementing the project are summarized below:

- Minimizing any adverse environmental, social and health impacts resulting from the project activities (construction and operation).
- Conducting all project activities in accordance with relevant MoE, Jordan legislation and guidelines and applicable international standards.
- Implementation of on-going environmental and social monitoring programs.

- Periodic review of the Environmental Management Programs to allow for iterative improvement.
- Working with the government and communities to ensure relevant concerns (where present) are addressed (development of Stakeholders' Engagement Plan).

10.3. Action Plan

10.3.1. Flora

Management Commitment	
Through the design of the project and management strategies to be adopted during construction and operation, Construction Contractor and facilities Operator will, where possible, conserve flora habitats within the project area and minimize the loss of vegetation in other areas.	
Management Strategies	• Clearing of vegetation should be avoided • Access tracks should be aligned such that a minimal loss of vegetation will occur. • Vegetation should be cut to ground level to keep rootstock in place (if clearing of vegetation cannot be avoided. • Disturbance/destruction of sensitive environmental units, identified in Section 5 of this report must be avoided. • Management strategies will be implemented to restrict the spread of weeds and to minimize the impact of erosion/sedimentation. These measures to minimize the potential for adverse impact on vegetation communities in the area. • Re-vegetation of disturbed areas to be undertaken on an "as required" basis. Where practical, regeneration of native flora will be assisted by exclusion of grazing animals.
Monitoring	• Pre construction survey, Initial monitoring after installation of pipeline networks and construction of the newly proposed pumping stations, then annually.
Reporting	• Initial and annually, as part of EMMP.

10.3.2. Fauna

Establishment of the pipelines network and pumping stations will result in the loss of some habitat for terrestrial fauna through the clearing of vegetation 9whenevr applicable). Impact to reptile, mammal and bird species identified is considered to be restricted to the period of construction with little potential for ongoing effect.

Management Commitment	
Where possible, construction activities will be undertaken such that adverse effects on fauna and faunal habitats are minimized.	
Management Strategies	• During the construction and operational phases of the project, the habitats supporting the highest species diversity in the study area will be protected where practical from on-going disturbance. Impact on the habitat value and condition will be minimized by preventing indirect impacts associated with erosion, drainage, waste contamination and the spread of weeds. • Damage to important environmental features to fauna such as water sources, Zarqa River Basin and Wadi and mature nesting trees should avoided. • Where possible, animals that fall into the trench during construction will be removed and ladders or branches placed in open excavations to assist fauna to escape.
Monitoring	• Pre construction survey. Initial monitoring after completion of construction activities. Annual survey of fauna during operation.
Reporting	• Initial and annually, as part of EMMP.

10.3.3. Groundwater

No de-watering is anticipated to be required to lower the groundwater table during construction. The most significant risk to groundwater is the possibility of groundwater quality being affected as a result of construction activities, and the operation of the pumping stations where overflows, during emergency operations, might be discharged to the Zarqa basin, leading to the infiltration of waste water to the area's aquifer system.

Management Commitment	
Management Strategies	• All fuel storage areas (if applicable) must be appropriately bunded and refueling activities undertaken in designated areas following specified procedures. • Specific procedures shall be developed for the removal of waste or spilled fuel, oil and contaminated soil at approved recycling / disposal facilities. • Ensure proper operation of the pumping stations, where overflows can be avoided whenever possible.
Monitoring	• Daily wastewater monitoring program must be developed to monitor the quality of overflows from pumping stations to eliminate the discharge of untreated sewage into the Zarqa River Basin.
Reporting	• Monthly to the MoE as part of EMMP.

10.3.4. Surface Water

The main impact on the surface water hydrology of the project area as a result of the development will be the modification to natural drainage lines during construction and the potential discharge of the pumping stations overflow into the Zarqa River basin.

Management Commitment	
Management Strategies	• Mitigation measures will be employed to ensure sediment and any contaminants present do not come into contact with, or are transported off-site in, surface water run-off. • Any contaminated soil will be removed and disposed in accordance with Municipality guidelines. • The slopes and slope lengths of steeper sections of the pipeline network and any areas of cut and fill should be minimized, and drains installed to intercept and divert run-off water. • Road crossings and other traffic areas will be situated and constructed to minimize the concentration or diversion of water in Wadi Zarqa and drainage lines. Where practical, surface cover shall be maintained in these areas.
Monitoring	• Daily wastewater monitoring program must be developed to monitor the quality of overflows from pumping stations, when operational, to eliminate the discharge of untreated sewage into the Zarqa River Basin.
Reporting	• Monthly to the MoE as part of EMMP.

10.3.5. Dust and Noise

Construction of the pipeline and pumping stations will result in increased levels of dust and noise generation.

Management Commitment	
Management Strategies	• Dust – During construction dust generated on unpaved roadways and work areas should be controlled by the application of water on an “as needs” basis. • Noise – Activities that are likely to generate elevated noise levels (for example, blasting) must be avoided during weekends (Friday) and ceased during weekdays between 8:00 pm and 6:00 am in compliance with Standards for the Prevention and Elimination of Noise (2003). • Give advance warning to area residents within 100m from the construction site, at the beginning of the campaign, alerting them of the project activities and potential disturbances (noise, dust, light, etc). • Maintain a safe distance of 100m between the construction equipment and nearest human receptor (whenever possible). • Establish a simple complaints procedure to enable community feedback on issues of concern.

Management Commitment	
	• Maintain open dialogue with the residents of the area within or surrounding the project area, if and when complaints are received. • Minimize transportation to and from the project area to the extent possible. • Maintain open dialogue with stakeholders through the development of a Stakeholder Engagement Program. • Appropriate occupational health and safety measures will be employed for on-site personnel.
Monitoring	• Dust and noise monitoring should be undertaken on site and, where required, in surrounding areas. Noise shall be monitored by use of portable noise dose meters/sound level meters and dust monitoring will largely be completed by visual assessment of nuisance.
Reporting	• Monthly during construction (as part of EMP).

10.3.6. Waste

Wastes will be generated as a result of construction activities on site. Little waste will be generated once the pipeline network and pumping stations are operational.

Management Commitment	
Management Strategies	• All inert and domestic waste generated during construction must be removed from site and disposed in accordance with the requirements of landfills approved by the local municipality. • Hazardous wastes and liquid wastes generated will either be recycled or disposed off-site to an approved waste facility. • During construction appropriate sewerage treatment systems will be installed at each construction campsite to treat effluent.
Monitoring	• Quarterly monitoring during construction.
Reporting	• Initial and Annual reporting, as part of EMMP.

10.3.7. Health and Safety

Project activities could form a source of potential risk to the health and safety of the project team and during construction activities and possibly environmental and human receptors within or in the vicinity of the construction sites.

Table 10.1 illustrates the sources for those potential risks and provides management measures to minimize or eliminate them.

Table 10.1: Potential Health and Safety Risks and Measures to Minimize or Eliminate Them

Activity, Material, Operation, Product or Service	Risks	Method of Control / Monitoring Document
Animals	Diseases from insects and reptiles	Use insect repellent, wear lightweight long-sleeved shirts, long pants, and a hat to wear outside, use pyrethroid insecticide to clear rooms of insects, shake clothing and shoes before putting them on, wear heavy, ankle high or higher boots, and long pants when walking outdoors at night in areas possibly inhabited by venomous snakes, if bitten seek medical attention immediately
Breaking ground	Underground services, Vibration, Contaminated land, Collapse of sides, Movement of plant, Dust.	Obtain utility drawings; mark out service on the ground, competent person to use a cable avoidance tool and signal generator, hand dig.
Driving	Inexperienced driver, poorly maintained vehicles, unsuitable vehicles, fatigue, excessive speed for conditions, desert conditions	Vehicles are to be inspected daily by the driver and maintained and inspected every six weeks by a competent person
Use of Excavation and hauling equipment	Collapse of rig, unstable ground, falls of persons, falls of materials, unguarded moving parts, services, defective equipment, noise, vibration, exposure to wet concrete	Construction equipment operatives should have a recognized qualification in the operation of machineries and are to be inspected daily before use by the operatives, an exclusion zone is to be set up around the cranes, moving parts of the excavators are to be guarded, vibration and noise levels are to be monitored with calibrated equipment by a competence person, hazardous materials assessments are to be produced for concrete and communicated to those who are affected by them
Dust – from stripped soil areas, vehicle movements, stockpiled aggregates etc.	Inhalation, Visibility, Nuisance	Dust suppression techniques are to be adopted, Respiratory Protective Equipment (RPE) and eye protection are to be worn in extreme dusts
Generator	Combustion fumes (e.g. CO, CO_2)	Generator to be located away from working and residential areas.
Earthmoving Plant - operating	Untrained operators, Poor maintenance, Site conditions, Reversing, Loading / unloading, Transporting, Overhead cables, Operatives working adjacent to the movement of plant, dust	Plant operators are to have a recognized qualification in the operation of the specific item of plant, plant is to be inspected daily before use by the operatives, pedestrians are to be segregated from plant and reversing risks eliminated though the use of one way systems or dedicated reversing areas
Electricity use	Electric shock, Fire, Trailing cables, Poor maintenance	All electrical equipment is to be checked by a competent person, all electrical works will only be carried out by a competent person

Activity, Material, Operation, Product or Service	Risks	Method of Control / Monitoring Document
Emergency preparedness	Inadequate: identification of potential emergency situations, understanding of individual emergency responsibilities, inadequate drills,	An adequate emergency plan is to be produced and drills carried out to confirm its effectiveness
Fire	Discarded cigarettes / matches, Arson, Misuse / faulty LPG equipment, Faulty electrical apparatus, Welding operations, Poor storage of materials	A fire safety plan is to be developed identifying potentially hazardous areas, the location of firefighting equipment and fire escape routes, waste is not to be allowed to accumulate, high levels of security is to be maintained to reduce the risk of arson
Use of Hazardous Substances	Asphyxiation, Poisoning, Dusts, Fumes, Spills, Skin Contact	Hazardous substances assessments are required for the hazardous substances; the assessments are to be communicated to those who are affected by them.
Heat – Working in heat	Heat stress, dehydration	Employees are to be selected based on age, obesity, fever, dehydration, heart disease, poor circulation, Stay cool indoors, drink plenty of fluids, replace salt and minerals, use of appropriate clothing and sunscreen, schedule outdoor activities carefully, use a buddy system, monitor people at high risk
Lifting Equipment - use of	Unsuitable foundations, Incorrect positioning, Method of erection or dismantling, Wrong equipment, Wrong lifting gear, Poor maintenance / examination / testing, Use of defective equipment, Unsafe slinging, Insecure loads, Incorrect signals, Overhead cables, Untrained operators / banks men / slingers	Lifting operations are to be planned by a competent person, plant operators are to have a recognized qualification in the operation of the specific item of plant, plant is to be inspected daily before use by the operatives, lifting appliances are to be examined annually, lifting equipment to be inspected six monthly, non essential people to be excluded from the lifting area, competent banks man, toolbox meeting & JSA.
Manual Handling	Excessive stress and strain, Cuts and abrasions, Falls of materials, Slips and trips	All employees to receive manual handling training, heavy equipment substituted for lighter equipment, materials are to be supplied in small easily handled quantities.
Noise	Occupational hearing loss, nuisance	Equipment and noisy activities are to be located away from sensitive receptors, noise monitoring to take place, PPE for employees. Noise map for the field operation will need to be issued if required.
Working near overhead Cables	Electric shock, Burns, Damage to plant and equipment	Obtain utility drawings, prevent plant from moving close to the cables with physical barriers

Activity, Material, Operation, Product or Service	Risks	Method of Control / Monitoring Document
Personal Protective Equipment - Provision and use of	Identify need for, Equipment provides adequate level of protection, Equipment fits properly, Different pieces of equipment worn together are compatible, Equipment causes additional hazards i.e. reduced sense of touch wearing gloves	PPE is to be selected for specific tasks and hazards
Use of Petrol / Fuel	Fire, Explosion, Spills	Small quantities of fuel are to be kept on site, specific refueling areas to be identified on the site plan (away from accommodation and working areas). Oil spill ER to be put in place.
Public Protection	Falls from height, falls into excavations, Falls of materials, Movement of plant, Electric shock	Secured visitors access to the construction site.
Reversing Vehicles	Poor visibility, Excavations, Physical obstructions, Proximity of other employees / members of the public, Untrained operators, Dirty PPE in use by banks man	Need for reversing to be eliminated by use of one way systems, dedicated reversing areas, segregation of pedestrians from plant and vehicles, competent banks man, reversing alarms on vehicles.
Site Access	Traffic, Visibility, Reversing Vehicles, Urban Areas	Specific off site traffic management plans to be developed considering local hazards (e.g. bridges, schools, overhead cables etc…).
Site Tidiness	Poor storage, Rubbish left to accumulate, Blocked or restricted access, Trailing cables, Protruding nails, Access routes left muddy / wet / slippery	Site tidiness is to be monitored daily and maintained at all times
Temporary Works	Collapse of structure, Falls of persons / materials / equipment, Loading, Dismantling	Temporary works are to be designed and coordinated by a competent person with recognized qualifications
Traffic	Reversing Vehicles, Movement of plant / materials, Interface with site pedestrians / members of the public	Traffic management to be produced and monitored
Vibration	Damage to blood circulation, Damage to property, Nuisance	Equipment and vibrating activities are to be located away from sensitive receptors, noise monitoring to take place, PPE for employees, employees are to have health surveillance for hand arm vibration, only low vibrating handheld work equipment to be used

Activity, Material, Operation, Product or Service	Risks	Method of Control / Monitoring Document
Waste	Fly tipping, Inadequate containment, Overloading, Fire, Pollution, Harm to health	Waste to identified, segregated, and stored appropriately on site prior to correct disposal. The transport of the waste needs to be adequate to ensure that it is contained during transit. Consult with local legislation to ensure compliance.
Welfare	Inadequate accommodation for: sleeping, preparing food, eating, washing / cleaning, resting, toilets, storage of personal belongings	Adequate accommodation to be available at all times, cleaning regime to be implemented
Use of Work Equipment	Untrained operator Poorly designed / constructed, Flying fragments, No safety system, Incorrect use, Poor maintenance, Fires and explosion, Unguarded moving parts, Poor lighting, Vibration.	Only fit for purpose work equipment is to be used, well maintained only operated by competent employees, moving parts to be guarded, appropriate PPE to be worn

10.3.8. Archaeological and Cultural Heritage

Management

This management plan has four main components, each related to a further project phase:

- Design phase: the definition of the required site specific protective measures and a general plan of works necessary to minimize project related damage to the Cultural Resources of the Region.
- Tendering phase: definition of tender requirements as they relate to the implementation of the specified measures.
- A construction monitoring program.
- Post project monitoring program.

Design Phase

The bulk of mitigation work for archaeological resources takes place during the detailed design phase of the project. This work includes:

1. Further archaeological assessment of threatened sites and design review of all threatened sites.
2. Design review and definition of mitigation options.
3. Documentation of non-threatened sites, if found.
4. Program review.
5. Development of site evaluation procedures.
6. Co-ordination with Ministry of Tourism and Antiquities (MOTA).
7. Consideration of indirect threats.

Further Assessment of the Discovered Sites

While there is no requirement for any site discovered during the survey to be removed, no destroy protection measures are recommended.

Design Review

A design review is proposed for each indirectly threatened site. It is intended that this be an interactive process between the design team and CRM archaeologist. The CRM archaeologist will provide the designers with a site brief:

- Location of the site and description.
- Initial estimate of area covered by the site.
- Linkages with other sites if any.
- Any other information that may be useful to the design team.

The design team will review this data and develop to a conceptual level the mitigation options that may be available for the site. These may include but need not be limited to:

- Realignment
- Localized design
- Both localized design and minor realignment.
- Cover site.
- Protection only (fences, guard, etc).
- None.

The design team would discuss their conclusions and findings with the CRM archaeologist and would agree a range (if available) of options.

It should be noted that these review teams are not the decision makers. They are therefore not obliged to reach a decision merely to present a range of appropriate options for mitigation to the decision makers.

The findings of each review should be contained in a site design review paper comprising:

- Site description and location.
- Site classification.
- Severity of threat.
- A mitigation options framework.
- Preliminary costs for each option.

Documentation of Non-Threatened Sites

Once the final areas have been fixed and the extent of any earthworks and borrow pits is known, sites that remain classified as non-threatened should be revisited and fully documented for record purposes.

Tendering

Pre Tender Conference

All prequalified contractors should be called to a pre-tender conference at which issues of special interest or concern will be outlined. With regard to Cultural Resources the Contractors will be briefed on:

- Chance finds procedures.
- Exclusion areas.
- Special procedures to be adopted in the vicinity of sites defined as requiring protection.
- Penalties for non compliance.
- Their coordination responsibilities with and to CRM monitoring groups.

Bid Documents

To support the stipulations of the tender conference, contract bid documents should include a set of final engineering drawings on which archaeological sites within or immediately adjacent to the construction area are defined.

Standard conditions, requiring special care in the vicinity of the defined sites so as not to disturb them, must be issued.

In addition, details of the site specific measures outlined in the previous section will be provided as Instructions to the contractor.

In general, for projects entering the construction stage, four points could be added to contract documents which would be beneficial for the protection of archaeological sites:

a) Borrow Areas

The location of borrow areas and quarry sites selected by the contractor should be approved by the Department of Antiquities, to prevent antiquities being damaged by quarrying or borrow excavation. Such inspection will not be unreasonably delayed.

b) Excavation and Observation of Construction

In areas where the Department of Antiquities knows or suspects the existence of remains under the surface, but where there is insufficient time for archaeological excavation (or the importance of the site does not warrant full scale investigation prior to construction), a representative of the Department should be present during the opening of any excavation or borrow pit to identify and record any archaeological remains found.

Additional Salvage Excavation

In areas where the Department has determined that further salvage excavation will be necessary, based on the information developed during the Final Design phase, this will be carried out at the beginning of the construction phase. Construction activities should be scheduled so as to leave any such area until late in the construction process, and construction activities will thus not be delayed by the archaeological excavation. The cost of the further salvage excavation will be included in the Bill of Quantities as a provisional sum.

Construction Monitoring

Site Access

Regular and frequent site inspections will be required to permit effective monitoring of the performance of the contractor with regard to compliance with applicable guidelines, regulations and statutes, and contract specifications. For the proposed Program monitoring to be effective therefore it will be necessary, during the course of construction and operation, for authorized agents from DAJ to have guaranteed access to all sites, related to any project component, at all times.

Accordingly, contract documents and operating agreements should incorporate a phrase with similar intent to that outlined below.

Monitoring Program

Two forms of inspection will be required:

(i) Event Specific

These will be pre Programmed events such as the opening and demarcation of a borrow area, and the opening of any site (area) deemed significant or at risk.

In addition CRM will carry out a walkover survey of all proposed access roads with a view to approving (non objection) that route. Subsequent, inspection will be required.

(ii) Random Inspections

Additional site inspections should be carried out on a regular basis but not necessarily to a structured pattern. A minimum of six visits per quarter to contract sites is required.

After each inspection during the construction phase, a report shall be compiled that is location and activity specific, and which identifies areas of contractor non compliance with the Mitigation Plan and which provides guiding remarks on the actions to be taken. The significance of the non compliance shall also be noted.

Every six visits the inspection reports shall be compiled into a review document that should highlight any areas of persistent non compliance or negligence by a contractor. This document should also contain records of any communications between DAJ, the supervising engineer, and contractors on matters relating to Cultural Heritage.

If it is considered appropriate, the executing agency may introduce a sliding scale of fines to be applied for repeated poor performance assessments of an individual contractor.

End of Project Report

An end of project report shall be prepared by the CRM archaeologist. It is envisaged that this report will have two principal sections.

a) Review of Project Works

This will be a typical end of project report. It will outline the background to the study and its objectives. Where possible, measurable criteria will be used to assess the relative success or failure of the project in meeting those objectives.

Specific sections will be required to review the effectiveness or otherwise of the project implementation procedures and processes and the potential lessons to be learned. This should be split into two sections: Pre-Construction and monitoring.

In general terms therefore the report should contain:

- Background to the project / Program / works
- Summary statements of methodologies adopted
- Summaries of findings
- A statement of lessons learned
- Recommendations for future works

The assessment should draw on the findings of the inspection reports prepared under the monitoring Program.

The findings of the archaeology Program should be the subject of a report prepared for publication in the Technical press and potentially non technical press. This will:

- Further extend knowledge of regional archaeology
- Reinforce the role of the DAJ in undertaking CRIS for major projects
- Demonstrate to the public the Non Governmental Organization (NGO) commitment to the preservation of National cultural heritage.

10.4. Resettlement Policy Framework

In compliance with the Bank's social safeguard policy on Involuntary Resettlement, this sub-section presents the preliminary resettlement policy framework as part of the Environmental and Social Impact Assessment (ESIA) for the proposed project.

It should be noted here that the acquisition and potential resettlement for similar projects are associated with the network itself, and location of the pumping stations. According to the design team, the network system for the proposed options will almost be the same. As for main conveyor lines, those would mainly run through the wadi where land acquisition and/or resettlements would not be required.

10.4.1. Definition, Scope and Applicability

The compulsory acquisition of land by legal authority in the public interest may be necessary to achieve project objectives. Even where those affected are the ultimate beneficiaries, there are always impacts and effects that require compensation and remediation because those who bear the costs are not always the same as those who enjoy the benefits. Due process has to be followed that establishes the rights of the persons affected by actions of expropriation.

Jordan has established laws and procedures covering the compulsory acquisition in the public interest of private land or the involuntary relocation of persons or economic activities. In every case, other than emergency refugee situations, where a project is financed by the World Bank or external donor, and that project requires the involuntary expropriation of private property or resettlement of persons or activities, the funding agency requires as a condition of project financing that the borrower/client

agree to comply with the provisions of the world bank policy on involuntary land acquisition and resettlement.

The purposes of the Jordanian Law and the Bank Policy are the same. However, the Bank's procedures are in some respects more specific and detailed and may require actions in the project context that will enable the GoJ to report and demonstrate to the Donor that due process has been followed and that the procedures used in this project are transparent, just and defensible.

Use of the terms "Involuntary" and "Resettlement" in this document: In a project financed by the Bank, wherever private property is compulsorily acquired in the public interest through the exercise of the legal power inherent in the state, the procedures of the Bank's policy termed "involuntary resettlement" apply. The reason for the policy is that, in the past, some projects in different parts of the world were financed by the Bank in which expropriation entailed resettlement with adverse social effects. In some cases, people might not have been sufficiently compensated or assisted to regain or improve their standards of living, resulting in social hardship and sometimes open discontent. The Bank's policy on Involuntary Resettlement evolved in response to this problem and its strict observance, where private property is expropriated, is a condition of Bank project financing.

10.4.2. Preliminary Resettlement Policy Framework Objectives and Principles

Consistent with the Bank's OP4.12, this Preliminary Resettlement Plan sets out three underlying policy principles:

- Involuntary resettlement is avoided wherever feasible, or minimized, exploring all viable alternative project designs.
- Where it is not feasible to avoid involuntary resettlement, activities are conceived and executed as sustainable development programs, providing sufficient investment resources to enable people adversely affected by the project to share project benefits.
- Displaced persons are assisted in their efforts to improve their livelihoods and standards of living, or at least to restore them, in real terms, to pre-displacement levels or to levels prevailing prior to the beginning of project implementation, whichever is higher.

10.4.3. Justification for Expropriation and Resettlement

The expansion of the existing wastewater collection system including construction of four additional pumping stations (Sukhneh PS, Wadi Zarqa PS, Al Alouk PS and Dhuleil PS) to support the wastewater collection system entail modest requirements for expropriation of land or some physical elements in the public interest, or resettlement of occupants, which will be described in greater detail in Resettlement Policy Framework (RPF) and in the individual Resettlement Action Plans (RAPs).

10.4.4. Why there is a Resettlement Policy Framework

Though the project involves all Zarqa Governorate, it involves four separate and independent expropriation actions in four different sites, and expropriation of required land for new trunk sewers in

different locations approximately. This clearly calls for five separate RAPs, with a single framework document comprising the common elements.

The RPF framework therefore provides the flexible structure whereby during the course of the project, and particularly by mid-term review, additional RAPs could be prepared and submitted for Bank approval.

10.4.5. Potential Impacts

A brief description of the proposed project potential impacts on land acquisition within study area have been presented in **Section 8.4.5- Potential Impacts on Land Acquisition**.

More details on affected landlords will be provided in RPF and individual Resettlement Action Plans RAPs in next stage. Moreover, the RPF will include more details on the following issues:

- Eligibility Criteria for defining Project affected persons
- Estimated numbers and categories of affected population
- Residential and other properties
- Vulnerable Groups
- Multiple ownership
- Government property

10.4.6. Compensation Entitlements

Policy Recommendations and Compensation Principles

Categories of Loss

Although it is difficult at this stage to identify the number of affected people, large-scale works are envisaged and this will apply on agricultural livelihoods and on other uses. Assessment of loss and compensation entitlements would take into account any tangible loss to existing occupation and uses. **Table 10.2** classifies the major impacts.

Table 10.2: Classification of Major Impacts on Lands within Study Area

Categories of Affected Persons	Major Impact
Residence	
Owner	Loss of residential property: land, buildings, improvements Loss of business location and facilities
Renter	Loss of residence
Business and Commercial Premises	
Owner	Loss of property Loss of business income Loss of rental income
Renter	Loss of business premises Loss of storage facility Loss of business income

Categories of Affected Persons	Major Impact
Farmers	
	Loss of Agriculture land Loss of crops and trees Loss of access to water rights

Principles Underlying Assessment of Impacts

Property ownership and uses are often complex and take many forms. The expected impacts of temporary or permanent expropriation of property on individuals and families vary widely, and each RAP will conduct a detailed local investigation of the situation. This will be a bit difficult if the number of affected people and businesses is too large.

Lessons learned from previous projects indicate that in the assessment of losses under the presently proposed project, it would be useful to address four related points:

- Jordanian law and practice does not limit consideration of the types of losses that may be assessed, but apparently envisages only cash compensation, whereas in certain situations other forms of compensation and supplementary assistance may be more appropriate. However, this approach does not prevent additional forms of assistance that could be provided in the context of the project.
- Not all losses can be translated directly into financial terms. This may particularly be in case of residential relocation, where there are qualitative considerations to be taken into account, such as location-specific ease of access to facilities such as schools, shops, transportation and medical facilities, or proximity to friends and relatives.
- Affected persons may not be sufficiently informed with regard to the kinds of losses they may put forward, or on the conduct of negotiations where court proceedings and appeals address only compensation, and may not be used to delay the process of expropriation.
- The assessment committees, constituted to assess losses and compensation, may call on any relevant expertise in reaching its assessment. In the case of this project, PMU in full coordination with WAJ has to monitor the performance of the Valuation Committee (VC) members to insure no conflict of interest and provide necessary support.

Eligibility Criteria

All persons affected by the project shall be entitled to compensation.

Each RAP shall establish a publicly-announced cut-off date, which shall be the effective date of the census of affected persons.

Only those persons who have been enumerated in the census, or who are able to demonstrate that they should have been included, or that they have been left out in error, shall be assessed for losses and compensation.

Entitlement to compensation shall be to all families, business enterprises or adults affected in respect of property or rights legally held as of the cut-off date. No distinction shall be made in respect of citizenship.

Persons establishing residence or business after the date of the census shall not be entitled to compensation under the project. The purpose of the cut-off date is to prevent persons establishing claims after the intention to expropriate is known, so as to profit from compensation.

Principles of Compensation Entitlement

Where property is expropriated, the minimum standard below which compensation or restitution may not fall in a World Bank-financed project is the condition of the affected persons prior to the project.

Hence, the World Bank policy expects full replacement costs of property, and fair compensation for other costs or losses incurred through expropriation.

Monetary compensation is intended to secure this standard. However, to achieve this result, the standard of compensating “current market value” in itself may be insufficient. It is also necessary to take into account the costs of relocation, which are not just physical but also institutional:

- Compensation values should be assessed at replacement cost, at market prices with a further additional cost included for the effect of compulsory acquisition.
- Equity considerations also dictate that all compensation due is treated equally. There can be no priority between equal competing claims.

10.4.7. Institutional Arrangements

General

The RPF is not itself primarily an operational or implementation document, but the framework for a series of operations to be described in individual plans of expropriation and compensation called Resettlement Action Plans (RAPs) or Abbreviated Resettlement Action Plans (ARAP). This Section describes the institutional arrangements for the implementation of RAPs.

Although, this project is large scale and the nature of most expropriations are not simple, it does not require a complex special institutional arrangements. The project will rely on mechanisms and institutions already in place. These are presented below.

Ministry of Water and Irrigation/PMU: Preparation of RAPs, Overall Implementation

MWI/PMU is responsible for preparing and submitting to the MCC RAPs for all expropriation activities. In doing so, MWI/PMU may draw as appropriate from in-country technical expertise to assist at any point.

MWI/PMU is also responsible for disclosing the RAPs in-country both in draft stage for comments from the public and affected persons, and the final stage.

MWI/PMU is also responsible for ensuring the overall implementation of the RAPs in a manner satisfactory to the Bank policy, including ensuring financial arrangements monitoring and reporting on this implementation.

MWI/PMU is responsible for liaising with the different institutions and persons who have roles in the implementation of the RAPs.

Department of Lands and Surveys

In this project MWI/WAJ is responsible for all expropriation activates. However, if WAJ failed to reach normal settlement with project affected persons (PAPs) and decided to proceed with the compulsory expropriation, in this case the Department of Lands and Survey (DLS) will be responsible for all legal matters in relation to expropriation, including gazetting, valuation and negotiated settlements.

Ministry of Finance

The Ministry of Finance approves valuations, negotiated settlements and makes budgetary allocations for payment of awards.

Valuation Committee (VC)

The VC will undertake the valuation and approve the initial offers of compensation made to entitled persons. The committee is comprised of the head of Acquisition Department/WAJ and a regional representative of the DLS and the Ministry of Finance. The VC has the power to seek advice from other specialist members on a case-by-case basis.

10.4.8. Resettlement Estimate Costs

General

This section summarizes the costs of implementing the RPF and RAPs for the Zarqa Governorate Wastewater System Reinforcement and Expansion Project. The costs presented are the costs to the project for compensation for expropriation. At this stage, these costs are notional and purely for indicative purposes. The individual RAPs shall contain more precise cost estimates.

Cost Estimate Principles

The following measures were applied during the course of preparing the cost of expropriations:

- 4m land width to be expropriated to serve the main lines passing through private land.
- 4m land width to be expropriated to serve the main and conveyor lines downstream.
- 2m land width to be expropriated to serve the sub-lines passing through private plots.
- 25% of the total area of wadi land could be private ownership.
- 3,000 m² land area required for each pumping station.
- All pumping station areas assumed to be private land and require expropriation.

- Unit cost per m² was determined for each geographical location based on DLS database verified versus field investigations done by experienced land acquisition specialist. Average of each category was used for the purpose of cost estimation.
- 25% price contingency was added to the estimate cost of land affected by main lines and 50% was applied for residential land affected by sub-sewer lines.
- 10% of total residential land area affected by sub-sewer lines has physical development. Therefore, 75 JD per m² was applied as a unit cost for Compensation.
- 10%-15% of total land area proposed for expropriation is agriculture land planted by fruit trees. Each 1,000 m² accommodate 40 trees and each tree valued at 20JD.

RAP Estimate Costs

Table 10.3 provides an itemized list of project RAP costs. These costs are notional in the present draft and will be revised at appraisal and finalized at detailed design stage.

Table 10.3: Overall Project RAP Compensations

Compensation Parameter	Cost (JD)
Land acquisition for sewer lines	6,095,252
Land acquisition for pumping stations	102,000
Sub-total	*6,197,252*
Compensation for physical elements[16]	325,560
Compensation for trees and crops	30,195
Sub-Total	***6,444,487***
Other un-foreseen compensation[1/] 10%	644,449
TOTAL	**7,208,307**

It should be noted that the cost of compensation estimates is based on a preliminary assessment, and hence, the loss of livelihood will not be easy to define and estimate at this stage. Therefore, the 10% added over the total cost of resettlement in Table 10.3 above is assumed to cover such elements. More realistic cost estimates can be provided in the detailed stage.

With respect to the disruption to existing businesses, though this was assessed to be a potentially significant impact during the construction stage, no compensation is required for such a temporary disruption of businesses either by the Land Acquisition Law of GoJ or World Bank OP 4.12. The project will apply practical mitigation measures to reduce any potentially adverse impacts on businesses during trenching and excavation stage through the development of a detailed stakeholder engagement and public communication program.

16 Physical element include any (built up area, gates, fences walls, courtyards, water reservoirs ...etc)
17 Any unexpected compensation comes up during detailed design stage.

Land Acquisition

Break down of land acquisition costs are listed in **Table 10.4**, **Table 10.5**, and **Table 10.6** below.

Table 10.4: Main sewer lines pass through private plots by Location

Location	Length of lines (m)	Area (m^2)	Unit Cost (JD)	Total Cost (JD)
Dogara	665	2,660	10	26,600
Hai Ma'amel al Toub	2,650	10,600	40	424,000
Hai Bustan, Hai al Hashemi	6,410	25,640	15	384,600
Hai Batrawi, Zarqa Jadida	1,150	4,600	40	184,000
Hai Nassar (Zawahra)	2,935	11,740	30	352,200
Hai al Jraiba	80	320	45	14,400
Hai Makka Al Mukarrama	1,255	5,020	30	150,600
Khirbet AsSamra	6,045	24,180	15	362,700
Hashmiyah	5,305	21,220	10	212,200
Total	**26,495**	**105,980**		**2,111,300**
Average m² cost JD				25
Total cost JD (based on the Average m² cost)				2,649,500
25% price contingency cost JD				662,375
Revised Total Cost JD				**3,311,875**

Table 10.5: Main sewer lines downstream by Location

Location	Length of lines (m)	Area (m^2)	Unit Cost (JD)	Total Cost (JD)
Dogara	13,255	53,020	5 - 8	367,520
Al Alouk	4,320	17,280	8	138,240
Sarout	6,055	24,220	8	193,760
Al Khililah	4,905	19,620	5	98,100
Um Rummaneh	2,500	10,000	20	200,000
Birein	4,470	17,880	15	268,200
Sukhneh	11,232	44,200	10	442,000
Hai Ma'amel al Toub	1,885	7,540	7	52,780
Hai Bustan, Hai al Hashemi	5,730	22,920	5	114,600
Hai Batrawi, Zarqa Jadida	3,010	12,040	7	84,280

Location	Length of lines (m)	Area (m^2)	Unit Cost (JD)	Total Cost (JD)
Hai Nassar (Zawahra)	3,590	14,360	15	215,400
Hai Makka Al Mukarrama	3,045	12,180	15	182,700
Dhuleil	6,200	24,800	5	124,000
TOTAL	**70,015**	**280,060**		**2,481,580**
25% of the proposed expropriation total area downstream assumed to be private ownership (m^2)	70,015			
Average m^2 cost JD				9
Total cost JD (based on Average m^2 cost)				630,135
25% price contingency cost				157,534
Revised Total Cost				**787,669**

Table 10.6: Sub-sewer lines pass through private plots by Location

Location	Length of sub-lines (m)	Area (m^2)	Unit Cost (JD)	Total Cost (JD)
Sukhneh	2,605	5,210	15	78,150
Hai Ma'amel al Toub	3,535	7,070	40	282,800
Hai Bustan, Hai al Hashemi	5,445	10,890	15	163,350
Hai Batrawi, Zarqa Jadida	2,009	4,018	40	160,720
Hai Nassar (Zawahra)	1,495	2,990	50	149,500
Hai Makka Al Mukarrama	2,115	4,230	50	211,500
Hai al Falah	2,385	4,770	35	166,950
Hai Jafar al Tayyar	680	1,360	40	54,400
Dhuleil	1,435	2,870	20	57,400
TOTAL	**21,704**	**43,408**		**1,324,770**
Summary Data				
Average m^2 cost JD				33
Total cost JD (based on Average m^2 cost)				1,410,760
25% price contingency cost JD				705,380
Revised Total Cost JD				**2,116,140**

10.5. Health, safety and Environmental Training Overview

Health, Safety and Environmental (HSE) training must be provided to MWI/WAJ project staff as well as construction and operation personnel to ensure that all project members are aware of the environmental as well as the public health and safety requirements in order to avoid or minimize potential direct and/or indirect impacts on the surrounding environment through the proper implementation of the recommended project specific environmental monitoring and auditing programs. The Project staff HSE training requirements are dictated by the work each employee performs (or are expected to perform) and the project geographical location within the project area where they would perform these activities. Appropriate method of delivery of training procedures will have to be selected and the content of the training material must include at a minimum:

- Review of the project's EMMS provided by this report
- The Construction and operation Management procedures
- The MWI/WAJ Organization
- Overview of Safety Management Standards and Hazard Assessment
- Process relevant to the proposed project
- Incident Reporting
- Office Ergonomics
- Emergency Procedures (emergency action plans, evacuation plans, fire alarms, gathering points, emergency communications).

Table 10.6 illustrates the HSE training and/skill knowledge matrix applicable to the proposed project personnel.

Table 10.7: HSE Training Skill/Knowledge Matrix

Job Classification	MWI/WAJ HSE Training							Contractor HSE Training																				
	HSE Induction	Behavioral Based HSE	Environmental Awareness	Confined Space Entry	Emergency Response	Incident/Near Miss Reporting	Environmental monitoring	HSE Induction	Behavioral Based HSE	Environmental Awareness	Confined Space Entry	Excavation	Health awareness	Working at height	Fire Prevention/Protection	Fire Watch	First Aid Training	Floor and Hole Openings	Food Handling	Guard Railing	Job Safety Analysis	Hazardous Substances	Hearing Protection	Hole Watch	Slinging/Rigging/Bank sman	Incident/Near Miss Reporting	Office HSE	Ladders	Environmental monitoring
MWI/WAJ Management	X	X	X		X	X		X																			X		
MWI/WAJ Site Management	X	X	X		X	X		X	X	X			X	X							X						X		
MWI/WAJ Site Supervisors	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X		X	X	X	X			X	X	X	X
MWI/WAJ Site Visitors	X																												
Construction Contractor Management	X					X		X	X	X			X		X						X						X		
Construction Contractor Supervisors	X		X	X		X		X	X	X	X	X	X	X	X			X		X	X	X	X			X	X	X	X
Construction Contactor Site Visitors	X							X																					
Banksman								X		X			X								X		X			X			
Bricklayers								X		X			X	X	X						X	X				X		X	
Carpenters								X		X		X	X	X	X			X		X	X		X			X		X	
Catering personnel								X		X			X		X				X		X	X				X			
Coating personnel								X		X			X		X						X	X	X	X		X			
Concrete workers								X		X		X	X	X	X			X		X	X	X	X			X		X	
Crane operators																													
Dump Truck Operation								X		X			X		X		X	X		X	X	X	X			X		X	
Electrical Personnel								X		X			X	X	X		X	X		X	X	X	X			X		X	
Emergency Response			X	X	X			X			X	X	X	X	X		X			X	X	X	X			X		X	

Job Classification	MWI/WAJ HSE Training							Contractor HSE Training																					
	HSE Induction	Behavioral Based HSE	Environmental Awareness	Confined Space Entry	Emergency Response	Incident/Near Miss Reporting	Environmental monitoring	HSE Induction	Behavioral Based HSE	Environmental Awareness	Confined Space Entry	Excavation	Health awareness	Working at height	Fire Prevention/Protection	Fire Watch	First Aid Training	Floor and Hole Openings	Food Handling	Guard Railing	Job Safety Analysis	Hazardous Substances	Hearing Protection	Hole Watch	Slinging/Rigging/Bank sman	Incident/Near Miss Reporting	Office HSE	Ladders	Environmental monitoring
Personnel																													
Excavator Operator								X		X		X	X		X					X	X		X			X			
Forklift Truck Operators								X		X			X		X						X		X			X			
Instrumentation Personnel								X		X			X	X	X			X		X	X	X	X			X		X	
Mechanical Installation Personnel								X		X	X		X	X	X	X		X		X	X	X	X			X		X	
Office Workers								X		X			X		X						X					X	X		
Painters								X		X			X	X	X			X		X	X	X	X			X		X	
Pipe fitters								X		X			X	X	X	X		X		X	X	X	X			X		X	
Plumbers								X		X			X	X	X	X		X		X	X	X	X			X		X	
HSE Personnel	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X
Scaffold Personnel								X		X			X	X	X			X		X	X		X			X		X	
Security personnel								X		X			X		X		X				X	X	X			X			
Vehicle maintenance personnel								X		X			X		X			X			X	X	X			X			
Warehouse personnel								X		X	X		X	X	X	X		X		X	X	X	X			X		X	
Welders								X		X	X		X	X	X	X		X		X	X	X	X			X		X	

10.6. Preliminary Cost Estimate of the EMMP

A preliminary cost estimate of the EMMP implementation is included to provide an overview of the required budget. This estimate is presented in **Table 10.8** below.

Table 10.8: EMMP Preliminary Cost Estimate

Task	Estimated Cost (JD)
Environmental Monitoring (Air, Water and soil)	1,200,000
Environmental Rehabilitation	480,000
Training and capacity Building	320,000
Total	**2,000,000**

11. PROJECT ENVIRONMENTAL CATEGORIZATION

11.1. Project Categorization According to GoJ Requirements

According to Annex 1 of the Environmental Regulation No. 37/2005, the MoE requires the description of the following items in order to determine the project category for an EIA process.

- Project Description which should cover:
  - Project type
  - Land use during preparation, construction, operation and decommissioning and reclamation.
  - Assessment of quality and quantity of emissions and wastes (pollution of air, water, soil, noise, vibrations, heat and radioactive)
  - Estimation of number of people, vehicles and equipment during project stages.
- List of project's most significant alternatives and rationale for choosing preferred alternative.
- Determination of potential environmental and social impacts / issues.

Table 11.1 below lists the section of the report that covered the required aspects.

Table 11.1: Sections relating to information for project categorization according to MoE Regulation No. 37/2005

Requested item for Project Categorization	Section Number & Title	Comments
Project Description	3. Project Description	-
-Project area, type and extent	3.3 Project Area 3.4 Existing Wastewater System	-
-Quality and quantity of emissions and wastes	-	Not possible to asses at this preliminary stage.
-Estimated of number of people, vehicles and equipment during project stages	-	Not possible to asses at this preliminary stage.
Most significant alternatives and rationale for choosing preferred alternative	7. Analysis of Proposed Project Alternatives	-
Determination of potential environmental and social impacts / issues	8. Preliminary Identification of Potential Environmental and Social Impacts/Issues	-

However, according to Annex 3 of the Regulation, infrastructure projects are classified as Category 2 projects requiring preliminary environmental impact assessment. Based on the findings of this preliminary assessment, the MoE will provide its recommendation on whether there is a need to proceed to a comprehensive ESIA study or not.

11.2. Project Categorization According to MCC Environmental Guidelines

MCC screens all Compact proposals to identify projects that require further review due to their potential adverse environmental and social impacts, and projects that are in sensitive sectors or in or

near sensitive locations. The result of this screening process will be an environmental classification following the recommendations contained in the Organization for Economic Cooperation and Development (OECD) *Common Approaches* and the practices of the World Bank, classifying in accordance with the potential environmental and social impact and the extent of the environmental review required. A summary of these classifications are presented in **Table 11.1** below.

Table 11.2: Environmental screening categories of MCC

Category	Type of Impact	Extent of Impact	Type of Projects	Environmental Screening Result
Category A	Has the potential to have significant adverse environmental and social impacts that are sensitive, diverse, or unprecedented	Affect an area broader than the sites or facilities subject to physical works	Includes projects in sensitive sectors or located in or near sensitive areas	MCC will require an Environmental Impact Assessment in accordance with OECD guidelines
Category B	Has potential environmental and social impacts that are less adverse than those of Category A projects	Site-specific, few if any of them are irreversible, and mitigation measures are more readily available	-	MCC will require specific environmental and social impact analyses, including Environmental Management Plans, as appropriate. Such analyses may be a condition for disbursement of some or all of the MCC funding for the project. Generally, the scope of such work will be narrower than for Category A projects.
Category C	Unlikely to have adverse environmental and social impacts	-	-	While MCC generally will not require environmental and social impact analysis for a Category C project, MCC reserves the right to require specific environmental and social impact studies, reporting, or training where relevant or where positive environmental and social impacts may be enhanced.
Category D	Sub-projects may potentially result in adverse environmental and social impacts	-	Involve an intermediate facility (such as a municipal public grant fund) that will use MCC funding to finance subprojects -	The host country must require that subprojects under a Category D project comply, at a minimum, with the environmental and social impact analysis standards, as well as relevant laws and regulations, of the host country. MCC reserves the right to set additional environmental performance standards and monitoring requirements for subprojects on a case-by-case basis, depending on the nature of the intermediate facility.

The preliminary ESIA of the Zarqa Governorate Wastewater System Reinforcement and Expansion revealed that the project under study has potential environmental and social impacts that are of moderate significance. These impacts are site-specific with few if any of them being irreversible. Mitigation measures for the identified impacts are available. Hence, according to MCC screening guidelines, this project may be classified as Category B. The scope and format of the analyses for a

Category B project must examine the potential negative and positive environmental and social impacts of the project and recommend any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and enhance positive impacts, including Environmental Management Plan (EMP), as appropriate. Generally, the scope of such work will be narrower than for Category A projects. Hence, the EMP will be on a preliminary basis.

12. PRELIMINARY PUBLIC CONSULTATION

Public Consultation is a requirement of Jordan's EIA regulation when conducting comprehensive EIA's. Also, the MCC's expect implementing entities to incorporate timely, participatory, and meaningful public consultation in the development of Compact-related Environmental Impact Assessments. They also expect that these documents be made publicly available and easily accessible.

The activities carried out and expected to be carried out at later stages of this ESIA are as follows:

- Identification of project stakeholders and all parties affected or related to this project.
- Preliminary consultations carried by the social team with people at Zarqa Governorate.
- Conducting a public scoping session and documenting its results in a public scoping statement.

12.1. Project Stakeholders

Stakeholders are identified as any individual and/or group that could be affected by the proposed project activities and has interest in their outcome. According to this definition, the stakeholders may include property owners, business owners, central government and local officials, special interest groups, and non-government organization.

In order to determine all stakeholders with a specific interest in the Project activities, the Zarqa Governorate and its districts within the Project's concession area have been identified and listed in **Table 12.1** below.

Table 12.1: List of Identified and Consulted Stakeholders

Stakeholder	Contact Person
Wastewater System Expansions Stakeholders	
Al-Russeifa Municipality – Neighborhood Committee	Mr. Yousef Salem Fadel
Al-Zarqa Municipality – Development Unit	Eng. Mohammad Al-Zawahreh
Al-Hashmiyah Municipality – Development Unit	Eng. Qasem Al-Sarayra
Ministry of Agriculture – Al-Zarqa Agriculture Directorate	Eng. Luciano Hibri
NGO in Russeifa target neighborhoods – Al-Muammar Society	Mr. Awwad Al-Khalayleh
NGO in Zarqa target neighborhoods – Qibya Society	Abu Fadi
NGO in target area in Al-Sukhneh – Al-Sukhneh Women's Society	Ms. Samiha Al-Shishani
Ministry of Environment – Al-Zarqa directorate	Mr. Abdel Majeed Khabour
Al-Hashmiyah University	DECLINED INTERVIEW
Water Authority of Jordan - Wastewater directorate	Eng. Nabeel Hijazin Mr. Odeh Al-Mashagbeh

Stakeholder	Contact Person
Wastewater System Expansions Stakeholders	
Local Community members in Al-Zarqa target neighborhoods	-
Local Community Members in Al-Russeifa target neighborhoods	-
Local Community Members in Al-Sukhneh	-
Pumping Stations Stakeholders	
Al-Russeifa Municipality – Neighborhood Committee	Mr. Yousef Salem Fadel
Al-Zarqa Municipality – Development Unit	Eng. Mohammad Al-Zawahreh
Al-Hashmiyah Municipality – Development Unit	Eng. Qasem Al-Sarayra
Business owners around Hai Ma'soum pumping station	-
Business owners around Al-Hashmiyah pumping station's area	-
Business owners around Hitteen pumping station	-
Households around the pumping station at Hai Ma'soum	-
Households around the pumping station at Al-Hashmiyah	-
Households around the pumping station at Al-Russeifa	-

12.2. Preliminary Public Consultations

The public consultation approach and its results are presented in the following sub-sections.

12.2.1. Consultation Approach: Qualitative and Participatory Assessment

The approach used for carrying out the preliminary public consultations was a qualitative and participatory assessment. This approach was used to provide the preliminary findings on the positive and negative impacts that might occur as a result of reinforcing and expanding the water system in Zarqa, during construction and operation phases. A semi-structured interview tool was designed and utilized to guide the discussions with stakeholders while keeping the gender-lens in check for any gender-specific issues.

Semi-structured individual and group interviews with local community members including women, civil society and community groups and other key stakeholders were conducted. The sessions were designed and conducted to ensure inclusiveness and engagement of stakeholders and were guided by the semi-structured interview tool to ensure consistency of collected data.

For the local community members' interviews in the three municipalities, open invitations to participate were communicated to the community members through Community Based Organizations (CBOs) and key members of the communities, and participation was stressed as being voluntary.

Discussions on the pumping stations were done mostly on a one-to-one basis with residents and business owners as well as the municipalities of the target areas.

MCC guidelines were taken into consideration especially regarding the issue of gender equality. The research tool was designed to capture any concerns or comments specific to a gender or expressed only by a specific gender. The research tool, in Arabic and English, is presented in **Annex 5** and **Annex 6**, respectively.

Table 12.2 below provides the points that guided the discussions during the preliminary public consultations.

Table 12.2: Discussion Points Considered during Preliminary Public Consultations

Aspect Considered	Impacts	Project Phases
Economic Aspects	• Effects on activities of local community with major concern to impact on transportation	Construction and Operation
Environmental and Health Aspects	• Noise pollution • Air pollution / dust • Added health benefit of a wastewater network vs. seepage pits or septic tanks	Construction Construction Changes after Operation
Social Aspects	• Hazards/security concerns during construction period • Added social benefit of a wastewater network vs. seepage pits or septic tanks • Aesthetics	Construction Changes after Operation
Infrastructure Aspects	• Outage of other services (water, electricity, etc…) • Added benefit of wastewater network as a useful utility • Any cost concerns	Construction Operation

12.2.2. Results of the Public Consultation Program

The following sections summarize the comments and feedbacks received from the identified stakeholders during the preliminary public consultation exercise conducted as part of the environmental and social impacts assessment study for the proposed project. The feedbacks were received by the public consultation focus groups in the field in a form of potential positive and negative impacts associated with the current wastewater network as well as the proposed project.

Impact Assessment of Construction Activities

Impacts resulting from project activities (during construction) were all identified as being temporary and of low impact with the exception of impacts to impacts of construction activities to agricultural establishments; this will be reflected in detail in the corresponding subsection under this section. Impacts were discussed with the stakeholders as described in the methodology section and special

attention was given to impacts on specific groups in the target neighborhoods, including females, children, and groups with special economic activities. Stakeholders asserted that construction activities for the project are not new to residents of Zarqa and construction activities do not have significant socioeconomic impacts on neighborhoods in which work is expected to be done.

Stakeholders stressed the importance of backfilling, reinstatement, and transportation of wastes to take place promptly without delays as to keep annoyances and negative impacts to a minimum.

Economic Impacts

Positive Impacts:

- Neighborhoods within the three target areas are mainly residential and businesses are mainly small and serve the community members residing in the neighborhoods. Increase in sales especially for grocery stores and popular restaurants were expected to take place on a temporary and low impact basis as a surge of laborers work in the neighborhoods during the construction period.

Negative Impacts:

- One group that will affected significantly by the construction activities are the farm owners in Al-Hashmiyah Municipality. According to Zarqa Agriculture Director, this group will be affected in a number of ways:
    - Noise and vibrations from clearing, grading, trenching, and other site works: these activities are anticipated to significantly and directly impact the poultry farms in the areas where these activities shall take place. The noise and vibrations startle the poultry in their barracks, causing them to cram in a corner of the barracks and cause suffocation to large numbers of poultry.
    - Road closures: If roads leading to agricultural lands and poultry farms are closed, of if partial closures do not allow large vehicles passage to the agricultural lands, farms and cattle and poultry farms can suffer great losses as some of the trucks - that are larger than regular and medium sized vehicles - need access to the farms on a daily basis (vehicles carrying feed or vehicles that transport produce). Therefore, closing roads could greatly affect these farms and cause financial loss.
    - Dust resulting from construction activities can cause significant damage to fruit and vegetable farms as the dust covers the plants and affects their growth and productivity. The damage from dust can be tremendous and is capable of running a whole agricultural project.
    - Possible accidental power outages and/or water service disruptions will have a highly negative impact on farms, especially poultry farms which rely on electric light to enhance the productivity of the poultry.
- Stakeholders did not anticipate any mentionable negative impacts to the businesses in the target neighborhoods mainly because they will remain accessible to the residents who

are their main target. As for the effects on public and personal transportation, the local communities seemed to be willing to tolerate short term road closures in return for the longer term benefit of connecting to the wastewater network. In general, the targeted areas did not express much concern about this issue as they anticipated it with any major construction project. As long as it was done properly and promptly, people agreed that it is not a major issue.

- Possible accidental outages in the electricity service can burden families as these outages can cause damages (short-circuits) to household appliances.

Health/Environmental Impacts

Negative Impacts

- Noise and pollution during construction: As with any other construction project, most of the people interviewed understood that there would be noise and pollution issues. However, the temporary nature of the construction work and, keeping the expected results in mind, the residents were actually looking forward to the construction work. As with all other negative impacts related to construction work, participants asserted throughout their interviews that any effects resulting from construction work are temporary, expected, and well known to the community. The Environment Directorate at Al-Zarqa Governorate said that alleviation measures (dictated by the Environment Law No. 52 for the year 2006) have to be utilized to alleviate possible disturbances and hazards.

Social Impacts

Negative Impacts

- Mobility: as previously mentioned, impacts anticipated as a result of construction activities were identified as temporary and of low impact. Stakeholder anticipated that that construction activities will affect mobility in general, and the impact would somewhat increase towards some groups in the community, namely females and children. Whether it was to avoid the laborers, the noise, or unsafe passages, people felt that they were going to be forced at some points to change their route due to the work being done. This issue concerned the whole community in general but was stressed upon more specifically for females. Once again the stakeholder stressed on the fact that such short term nuisances would be accepted for the long term benefit of expanding the network. Specifically:
- The mobility of females was anticipated to be impacted to a small extent by construction activities on the streets and around the houses in which they reside. Although these activities will not restrict the activities of females, it was anticipated that females who do not have commitments outside the house (namely females who are neither working nor studying) would be less active in social and other daily activities mostly due to noise and other annoyances. Again, these impacts were identified as small and temporary.

Moreover, with the presence of trenches and construction workers in the streets and in front of the houses, stakeholders anticipated that females may often change their routes as to avoid walking through a group of laborer or having to jump over a trench as "women are too shy to do so in public".

- Children mobility issues: Due to the absence of parks and other outlets in the communities where kids could spend their time, kids mostly resort to the streets as a pastime venue. Having construction work will limit children's ability from playing in the streets. Stakeholders again stressed the importance of working promptly and properly (especially in taking the necessary safety precautions) as to not place the communities' children at hazard.
- Noise impact on students: Some past construction projects had schedules that coincided with exam periods for students, which caused stress for students impeded their abilities to concentrate. Although the issue was just touched upon, it is worth looking into to see if a work schedule can work around exam schedules.

Positive Impacts

- Al-Sukhneh community is a smaller and more closed (rural) community than the other target neighborhoods. Stakeholders in Al-Sukhneh area believe that the social impacts, especially those affecting females, could be reduced if laborer were hired from Al-Sukhneh. According to Mr. Mohammad Abu Ghazaleh director of Al-Sukhneh Youth Club, Al-Sukhneh community contains a large number of skilled and trained young people who will welcome an employment opportunity in construction.

Infrastructural Impacts

Negative Impacts

- Utility outages during construction: Participants related from past experiences that utilities' outages during road work projects were expected; outages in the electricity could damage household appliances and outages in the water service could force residents to buying water for household use. Stakeholders agreed that if responded to promptly by the contractor and the responsible authorities, it should not be a big problem for the community. Again, many participants stressed on the idea that such short term disruptions to their daily lives will be tolerated in return for the construction of the long awaited wastewater network.
- Relating to bad past experiences with construction work, stakeholders stressed the importance of proper reinstatement. All stakeholders mentioned that past construction works left the streets in a bad condition where the contractors left sometimes without proper reinstatement of asphalt or without fully removing wastes after finishing work. Stakeholders stressed the importance of setting solid standards and closely monitoring contractors to eliminate such impacts on the infrastructure.

Impact Assessment of Operation of Wastewater Network

Economic Impacts

Positive Impacts

Operational Cost: Interviewed stakeholders indicated that connecting to the network is more economically beneficial to the residents of the target areas than the operational costs of cesspools especially to the residents of the target areas who have lived in their homes for over 10 years (after ten years, the capacities of the seepage pits greatly decrease). According to the interviewed stakeholders, residents of target neighborhoods have had the seepage pits in their homes for over a decade and thus need to pump them as often as once every two or three month. The cost of hiring pumping tankers to do that is already a burden to residents as it costs on average around 30 JOD to do so. The economic issue was magnified in Al-Sukhneh area for two reasons:

- Al-Hashmiyah District, in which Al-Sukhneh is part of, was identified as a poverty pocket with a poverty rate of 29% (MoPIC 2005).
- Being a rural area and further away from Zarqa in comparison to the other target neighborhoods, the cost of hiring pumping tankers is higher.

Eliminating the cost of pumping the seepage pit is identified as a significant and tangible benefit to the residents of the target communities. Compared to eliminating the operational costs of seepage pits, stakeholders agreed that the operational costs of a wastewater network would be a more economically viable choice on the short-term as well as the long term.

Real Estate Value: Stakeholders agreed that expanding the wastewater network to cover the target areas will raise the land values and housing values. For once they become serviced areas, the housing and land values will naturally increase. This will also result in improving the socioeconomic mage of the neighborhoods in general, especially those in West Zarqa which are considered popular neighborhoods in Zarqa. This benefit will not exclude Sukhneh Refugee Camp as stakeholders from the refugee camp relate to a similar experience in Al-Baqa'a Refugee Camp in Ain Al-Basha where, according to Mr. Mohammad Abu Ghazaleh Director of Al-Sukhneh Youth Club, land and housing values increased by 50% when the wastewater network covered the refugee camp.

Negative Impacts

House Connection Fees: Stakeholders agreed to the fact that the fee for connecting to the network was going to be a burden on many. The size of this issue brought in mixed feedback where some stakeholders advised that a large portion of the population will be heavily burdened by this cost, other stakeholder provided that it would be less of a burden compared to the economic and health burdens the current situation is causing. With some people pumping their seepage pits only once or twice a year, many of the residents will oversee the long term economic benefit and also the health and convenience benefits of a wastewater network and see that keeping their seepage pits will be a more viable option economically. According to WAJ-Wastewater Directorate, the expenses of connecting to the network is equivalent to three years of hiring pumping tankers and it is expected that around 20%

of the residents to resist connecting to the network because of the costs. Stakeholders suggested that if this fee was not covered by the donors, connecting fees should be added as installments on water bills. Otherwise, people might connect to the network illegally or keep using their pits even with the network available.

Again, keeping in mind the economic situation of the residents and the refugee camp, stakeholders added that making an exception for Al-Sukhneh should be considered, where income could be basis for the exemption of some families from these fees, a special installment program, or any other options that could alleviate the burden of this cost on the local community.

Impacts to Local Residents

Positive Impacts

Improved Social Interaction: Most of the participants agreed that the presence of seepage pits and all its resulting detriments are a cause of tension between neighbors. Issues of hygiene, humidity in houses, odor, annoyances of pumping tankers, etc. frequently cause tensions between neighbors and stakeholders agreed that those tensions would be eliminated with the introduction of a wastewater network.

Improved Social Image: The mere presence of a wastewater network should improve the social status of the community. In places where the service is currently unavailable, it is considered to be a "classy" service. The effect of this impact is maximized when issues of bad odors and flooding disappear. Stakeholders anticipate that the population of the targeted neighborhoods could increase as the areas become more attractive. This was emphasized in Al-Sukhneh, which is becoming more appealing to outsiders for its cleaner environment compared to Zarqa and Hashmiyah and close proximity to the both cities.

Health/Environmental Impacts

Positive Impacts

Eliminating the need for seepage pits: Almost all the people interviewed agreed that the elimination of seepage pits will have a tangible positive health impact on their communities. The current situation creates health problems that are magnified during the summer as well as rainy days. These problems comprise humidity in houses, bad odors, and the spreading of insects -mosquitoes and cockroaches in particular.

Negative Impacts

Network Overflow Issues: an issue that is predominant in Al-Zarqa is the overflow of the wastewater network. Stakeholders stressed on the fact that certain technical issues should be taken into consideration (i.e. piping materials, pipe widths, etc…) so that those issues would not be repeated in the new extended network. Also, residents stressed on the importance of good maintenance to the network which will also help in preventing overflow issues.

Members of Al-Sukhneh local community where especially concerned about this issue and are worried about Al-Sukhneh becoming "as bad as Zarqa City" in terms of bad odors and wastewater flooding which will be worse than the current situation of seepage pits. Members of Al-Sukhneh local community also stressed their concern for the other residents of Al-Sukhneh "misusing" the wastewater network (throwing waste that should not be thrown there, etc.) which would cause environmental and health problems throughout Al-Sukhneh

Spreading of rats and cockroaches through the network pipes was anticipated as currently seen in the Zarqa neighborhoods that are covered by the current network.

Filling up the seepage pits with earth after the installation of the wastewater network will be necessary to eliminate the environmental problems. This process will require heavy machinery vehicles to access the seepage pits, which can cause commotion especially in West Zarqa neighborhoods where the streets are narrow and the houses are close to each other.

Impacts to Infrastructure

Positive Impacts

Added Value of Wastewater Network Service: The added benefit of the new utility will have a positive impact on the lives of people in the studied communities. Women are expected to benefit the most from the extension of the network. According to the people interviewed, women are the most likely to feel the difference and will be more comfortable doing housework as they will not need to ration their water usage to prevent pits from overflowing.

The project is expected to improve the current situation and stop the constant flooding of the current network. This will improve the overall infrastructure of the city as the floods are causing damages to houses (humidity), roads, cars, and walls.

Negative Impacts

Utility Outages during Construction: Participants related from past experiences that utilities' outages during road work projects were expected. They agreed that if responded to promptly by the contractor and the responsible authorities, it should not be a big problem for the community. Again, many participants stressed on the idea that such short term disruptions to their daily lives will be tolerated in return for the construction of the long awaited wastewater network.

Impacts from Existing Pumping Stations

West Zarqa Pumping Station

The local community around the Hai Ma'soum station complained the most about the station's operations. In the targeted study areas, this station had an emergency overflow pond (see **Figure 12.1**). During the day, when the station's input exceeds its pumping capacity, the overflow is redirected to the emergency pond. Later on, when input levels decrease and pumps are not working

at full capacity, the overflow is withdrawn from the emergency pond and pumped into the treatment plant.

Figure 12.1: Pumping Station, Overflow Pond, and Nearby Houses

According to informants from the local community, three groups are affected by the pumping station:

- Residents of neighborhoods on the East of the pumping station (mainly Al-Bustan, Ma'soum, and Al-Hashemi neighborhoods): These neighborhoods are affected most by the odors as the air blows from the west carrying the odors from the overflow pool.
- Business owners at Ma'soum Circle: Similar to the neighborhoods on the east side of the pumping stations, these are affected most by the odors and pests.
- Residents of neighborhoods on the west of the pumping stations (mainly Hai al-Jneineh and part of Hai al-Zawahreh): These are less affected by the odors but their homes overlook the pumping station. According to engineers at the pumping stations, the residents of these neighborhoods complain the most because they see it and blame environmental problems in Zarqa river (which their houses overlook) to the pumping station.

Having an exposed overflow emergency pond irritates the surrounding community with all the hygiene and odor problems it poses. Both residents and business owners complained about the odor the pond produces, especially at nighttime and during the weekends (see **Figure 12.2**). Hasan, a local resident, said that odor problems have forced some people to move out of the area and leave their homes behind.

Said Ahmad, the owner of a bakery in a nearby commercial area complained about the odor as well as the increased presence of insects and rodents. He said that customers always complained about the odor coming from the pumping stations. As for the rodents and insects, Mr. Ahmad said that he

hired a pest-control company which comes and sprays insecticides three times a week. He said that this was a considerable financial burden on his business.

Figure 12.2: Businesses near West Zarqa Pumping Station (convenience store, restaurant, and pharmacy)

Abu Omar, owner of a nearby restaurant, said that the situation worsens during summer time. He said that the odor negatively affects his business as customers think the odor originates within the restaurant due to bad hygiene.

In addition, many participants from the local community as well as the Zarqa Governorate mentioned that sometimes, the pumping station redirects its untreated overflow into the Zarqa River. This causes environmental damage to the already polluted river. It also increases the odor problems as it reaches populated areas down the stream.

Pumping Station at Al-Hashmiyah

The pumping station in Al-Hashmiyah seemed to be less of an annoyance to its community. Pumps in the Al-Hashmiyah station are new and thus have a larger pumping capacity. This eliminates the need for an emergency pond and as a consequence eliminates most of the odor and hygiene problems.

When interviewed, owners of nearby stores did not even know that the establishment was actually a wastewater pumping station. Residents across the street from the station complained mostly about insects and rodents. They said that unless there was something wrong with the station, odor was not a big issue. It is worth noting that even the insects may be the result of the houses' proximity to Zarqa River.

Pumping Station at Hitteen Refugee Camp

Residents around this pumping station were confused as to the function of this station (see **Figure** 12.3). Due to the presence of another establishment near this pumping station (Birket al-Pepsi – Pepsi Pond), some people did not know that it was a wastewater pumping station. The "Pepsi pond,"

used by PepsiCo's nearby factory as a waste pond, produces strong odors and causes a lot of hygiene issues as well as public safety issues. Residents were not sure whether it was residential wastewater or the factory's refuse that caused the odor issue.

Either way, nearby residents complained about the odors or the researchers conducting the interview for this report reported that the odor was unbearable around the pumping station. The residents also complained about the safety hazards posed by the pool and recalled instances when lives were lost drowning in the pool, as well as the repulsive scene of the pond. Businesses interviewed in the vicinity did not complain about odors as they were relatively far from the pond.

Figure 12.3: Pumping Station, Sludge Pond, and Nearby Houses

Potential Impacts from Proposed Pumping Stations

Proposed Pumping Station near Al-Sukhneh

During the focus group discussion held at Al-Sukhneh, the mere mention of a wastewater network sparked a lot of debate on a proposed pumping station near Al-Sukhneh and asserted that they do not accept the placement of a pumping station in the proposed area.

A structure for a pumping station was built on the west side of Al-Sukhneh (by Zarqa River) in the 1990's and was since left there nonoperational. Several correspondence and petitions were submitted to the government beginning 1997 contesting the establishment of a pumping station in the proposed area[18] as well as a number of public speeches on the issue. The research team has been provided with copies of the correspondence regarding the pumping station and other water- and environment-related issues in Al-Sukhneh area.

18 Official correspondence on the issue of a pumping/purification station near Al-Sukhneh was submitted in Ministry of Interior, Ministry of Municipal Affairs, Ministry of Water and Irrigation, Ministry of Health (1997); Zarqa Governor (1998);MOPIC (1999); Ministry of Water and Irrigation (1999).

Members of Al-Sukhneh local community opposed placing the pumping station on the west side of Al-Sukhneh for the following reasons:

- Air blowing from the west side on Al-Sukhneh provides the only unpolluted air outlet in the area. Participants mentioned that both the petroleum refinery and the geothermal station in Al-Hashmiyah already pose odor problems. Establishing a pumping station or a purification station would “choke” the village.
- Placing the pumping station there will decrease land values and obstruct agricultural activities in the region.
- The land where the pumping station is planned to be built is the only public space/outing for both residents and visitors from outside Al-Sukhneh.

It should be noted though that when Al-Sukhneh residents think about pumping stations, they relate to the one in Hai Ma’soum which has an overflow emergency pond. Thus, their perception of how a nearby station could affect them is influenced by their exposure to that pumping station.

12.3. Public Scoping

Upon submission of the Application and categorization of the Project, the ESIA Scoping Process is initiated, for the purpose of providing the identified stakeholders approved by WAJ and MCC, with information pertaining to the proposed investments, outline the ESIA preparation and review process and obtain their views on the key environmental and social issues that should be considered during the design and implementation of the Project.

MWH will prepare a Scoping Session Handout to be submitted to and distributed with the scoping session invitation letters by the MoE to identified stakeholders. The purpose of this handout is to provide those stakeholders with information pertaining to the project prior to holding the scoping process workshop to be organized in collaboration with WAJ and MoE.

The scoping program will focus on the preliminary impacts identified in the preliminary ESIA and will assist in determining the significance of these impacts as well as identifying others that had not been included.

MWH will submit the final list of potential significant environmental and social issues to WAJ for review and approval, to later be considered as the basis of the environmental and social analysis that would follow.

Upon completion of the scoping session, MWH will prepare a Scoping Statement summarizing the deliberations of that session, the participating stakeholders and identification of significant impacts.

The Scoping Statement will identify key environmental impacts likely to be associated with the project as well as a methodology and execution plan for assessment, mitigation and monitoring of these impacts. This Scoping Statement, approved by MoE, provides the proposed scope of studies to be undertaken to complete a fully detailed ESIA.

The MoE will review and provide comment on the Scoping Statement, which when approved will provide the agreed scope of the subsequent ESIA. MWH will review and respond to any comments received from the MoE, for approval of the Scoping Statement.

MWH understands that preparing of the detailed ESIA will not commence until the methodology, format and content provided by the Scoping Statement is approved by MoE, WAJ, and MCC, and the contract option to proceed with Task 7 has been formally exercised.

13. CONCLUSIONS AND RECOMMENDATIONS

This section presents the main findings and recommendations of the preliminary ESIA carried for the reinforcement and expansion of Zarqa Governorate wastewater system. The main findings relate to the main environmental and social aspects of concern during the construction and operation phases of this project, the preliminary analysis of alternatives, and the potential impacts associated with identified environmental and social receptors.

The recommendations address the further studies and investigations needed to address the project preferred alternative and the measures needed to enhance the environmental and social performance of the proposed project.

13.1. Preliminary ESIA Conclusions

The major findings on existing environmental and social conditions are as follows:

- Air pollution is one of the main environmental risks at Zarqa Governorate due to the surrounding industrial areas.
- The water resources of the study area include the Amman-Zarqa surface and groundwater basin whose water quality and quantity are being degraded by:
  - Domestic and industrial effluents and solid waste.
  - Over abstraction of groundwater and the competition in water usage between municipal, agricultural, and industrial sectors.
  - Overgrazing and deforestation.
  - Agricultural activities as well as construction activities that have increased the sediment load of surface water.
  - Wide fluctuations in annual rainfall.
- The man-made lagoons surrounding area of Samra WWTP have been designated as an IBA.
- The populated urban centre of the study area is of no ecological significance since population density in these areas is very high and different environmental challenges contributed to deteriorating the ecological characteristics of the area.
- The existing wastewater system within study area is associated with several health issues:
  - Possible transmission of typhoid, salmonella, shigellosis, and infectious hepatitis to residents, wastewater workers and agriculture workers.
  - Cesspools and septic tanks are causing the wastewater to infiltrate the soil and gradually extend the zone of pollution and endanger the safety of wells. Besides the disposal of wastewater by existing cesspools may contaminate the ground with parasites that would in turn degrade the quality of community drinking water and food sources especially vegetables eaten raw.
  - The existing pumping stations are causing odor and insects problems.

On analysis of project alternatives, the preliminary ESIA study concluded the following:

- The “No Action” alternative of not going ahead with the proposed project would deprive the local communities within the study area of a high value project once in its operational phase.
- Although all of the four project options will eventually enhance water resources quality, the overall evaluation shows that the best environmentally and socially suitable option is Option 1.

On environmental and social impacts, the preliminary ESIA concluded that majority of the impacts are of medium to low significance during the project construction phase and operation phase. Identified potential impacts of medium to high significance during the construction phase were:

- Degraded topography, geomorphology and soils, risk to public health and safety, and disruption to existing businesses due to trenching and excavation works.
- Risk to public health and safety and damage to archaeological/cultural heritage sites due to solid waste (spoil) generation/disposal.
- Impact to soil due to material and chemical / oil storage and equipment operation.
- Noise pollution due to vehicle operation.
- Risk to public health and safety as well as damage to archaeological/cultural heritage sites due to accidental vehicle collisions.
- Risk to public health and safety and impact on land use due to possible risks of spill of chemical and liquid fuels.
- Degraded air quality due to emissions.
- Risk to public health and safety due to possible accidental ignitions of flammable materials / accidental fires.

Identified potential impacts of medium to high significance during the operation phase included:

- Energy need due to pump stations operation.
- Impact to water resources within the project area (Zarqa river and groundwater wells) due to emergency situations such as pump station power failure and/or malfunction problems.
- Impact to infrastructure (such as road subsidence) due to rupture/breakage of utility lines.

Positive impacts of the project were the employment opportunities to be generated by the construction activities. The operation of new pumping stations is expected to generate few employment opportunities. However, the major positive impacts during that phase would be the improved conditions to groundwater, land value, as well as to public health and living standards.

The public consultations reflect that project area population perceived a load of negative impacts affecting their daily lives during the construction phase. These impacts relate to noise, disruption of mobility, road closures and outage of utilities. Women and children were the most vulnerable groups regarding mobility. However, the people asserted that as long as proper reinstatement and mitigation

measures are taken, they are willing to bare those temporary, expected, and well known impacts for the sake of larger benefits to be achieved once project is in operation.

The public consultations have reflected that they are eager for the benefits achieved from project operation. The only concern was connection fees as a large portion of the population will be heavily burdened by this fee.

13.2. Preliminary ESIA Recommendations

Based on the study findings and consultation with key stakeholders (e.g. Ministry of Environment), the following are recommended:

- Conformity to the environmental regulations, requirements and standards identified within the project's legal framework, in addition to the recommended mitigation, management and monitoring programs provided by this report.
- Since the major source of contamination to the area's water resources can be associated with the overflow of untreated sewage from the West Zarqa pumping stations as it receives a flow of sewage from Amman that exceeds its current capacity, the Ministry of Environment recommend that pumping stations are to be decommissioned (where possible) and a new Waste WwTP shall be constructed.
- Further environmental and social analysis of the project alternative to be adopted for the project, where potential impacts specific to the aspects of the accepted alternative can be identified, and more refined and relevant mitigation and environmental and social control measures can be established.
- Continuous liaison with project stakeholders.
- Further development of the EMMP based on development of the preferred project alternative.
- Further social assessment of poverty zones within study area and methods of relieving the burden of wastewater system house connection fee for the identified poverty neighborhoods.

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ANNEX 1- LIST OF METEOROLOGICAL DATA OBTAINED FROM DEPARTMENT OF METEOROLOGY

Table 1: Zarqa Meteorological Data

Element: Mean Maximum Temperature (c)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	13.7	15.5	22.2	25.1	28.6	32.1	35.1	33.1	33.4	29.9	20.9	14.1
2005	14.2	14.2	20.6	25.2	28.4	31.4	34.3	34.2	31.7	27.2	20.5	18.5
2006	14.3	16.3	20.6	23.7	30.2	33.4	32.8	35	33.1	27.3	20.3	14.9
2007	14	15.9	18.8	23.6	31.3	33.4	34.7	34.2	32.4	30	22.2	16.2
2008	10.8	14.7	24	27.6	28.4	33.8	34.4	35	32.7	27.4	22.5	17.2
Mean	13.4	15.32	21.24	25.04	29.38	32.82	34.26	34.3	32.66	28.36	21.28	16.18
Element: Mean Minimum Temperature (c)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	5.5	5.8	9.8	12.1	14.9	18.1	20.9	19.4	18.4	16.9	10.7	4.4
2005	5.3	5.3	8.3	12.7	15.1	18	21	21.1	18.9	14.6	9.5	8
2006	5.6	6.7	8.5	11.9	15.4	19	20	20.8	19.3	15.8	8.9	3.9
2007	4.1	7.1	8	11.3	17.4	19.2	21.1	20.6	18.9	17.3	10	6.1
2008	1.8	4.6	10.7	13.3	14.8	19.4	20.8	21.6	19.7	15.6	11.1	6.8
Mean	4.46	5.9	9.06	12.26	15.52	18.74	20.76	20.7	19.04	16.04	10.04	5.84
Element: Total Rainfall Amount (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	29.7	22.6	0.8	1	2	0	0	0	0	0.3	22.9	14.4
2005	37.4	29.2	11.6	5.9	3	0	0	0	9	0	8.3	22
2006	18	32	3.1	29.5	0	0	0	0	0	5.3	0.1	18.6
2007	28.6	25	18.7	2.2	9.3	0	0	0	0	0.4	16.6	6.4
2008	57.9	15.3	0	0.6	0	0	0	0	0.7	9.9	0.2	9
Mean	34.32	24.82	6.84	7.84	2.86	0	0	0	1.94	3.18	9.62	14.08
Element: Mean Relative Humidity (%)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	75	75	61.5	49.4	48.4	53.8	53.6	54.4	52.6	55.3	66.8	71.5
2005	73.7	73.8	62.9	49.8	54.2	53.5	51.9	60	53.4	54.3	61.3	61.6
2006	73.2	66.8	58.7	65.2	47.4	47.4	59.4	58.2	54	60.9	56.4	60.9
2007	70.7	73.2	64.7	55.9	48.6	44.5	42.9	53.7	62.9	60.8	63.1	71.3
2008	69.5	70.4	50.1	46.5	47.1	42	46.3	48.7	57.3	64.1	65.6	69.7
Mean	77.52	71.84	59.58	53.36	49.14	48.24	50.82	55	56.04	59.08	62.64	67
Element: Mean Wind Speed 'knot'												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	4	4.9	2.9	4.6	6.2	4.3	4	4.6	2.8	1.9	3.3	1.1
2005	4.5	5.4	4.8	5.8	7.3	7.4	7.9	7.6	4.9	4	3.6	3.1
2006	4.3	5.4	6.4	7.2	5.4	5.8	7.8	5.3	4.6	4.3	2	2.9
2007	3.9	4.2	5.2	6.6	4.8	6.5	6.9	5.8	4.6	2.2	2.6	2.1
2008	3.6	3.5	3.8	4	4	4.4	4.1	4.4	4.7	3	2.3	3
Mean	4.06	4.68	4.62	5.64	5.54	5.68	6.14	5.54	4.32	3.08	2.76	2.44

Table 2: Wadi Dhuleil Meteorological Data

Element Mean Maximum Temperature (c)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	13.8	15.9	22.7	25.5	29.8	33.2	36.4	34.4	34.3	30.2	21.2	14.2
2005	14.6	14.6	21.3	25.8	29.6	33	36.1	35.9	32.9	27.7	20.7	19
2006	14.5	16.6	21.4	24.8	31.3	35.1	34.5	36.7	33.9	27.8	20.2	14.6
2007	13.9	16.1	19.5	24.3	32.4	35	36.5	36.2	34	30.7	22.7	16.6
2008	11.3	15.6	25.2	29	30.3	35.8	36.5	37.1	34.3	28.5	22.8	17.3
Mean	13.62	15.76	22.02	25.88	30.68	34.42	36	36.06	33.88	28.98	21.52	16.34
Element Mean Minimum Temperature (c)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	2.9	3.3	6.7	9.1	12.5	15.7	18.2	17	15.8	13.7	8.2	0.7
2005	2.7	3.5	5.8	9.7	12.1	15.6	18.5	18.9	15.8	10.9	5.1	4
2006	3.1	4.5	5.4	9.8	13.1	16.4	17.4	18.6	16.5	12.3	4	-0.9
2007	0.8	4.6	5.1	8.7	15.2	16.1	18.6	18.5	17.3	14.1	6.9	2.4
2008	-0.8	1.9	7.9	10.4	11.9	16.4	17.9	19.3	17.2	12.7	7.2	2.8
Mean	1.74	3.56	6.18	9.54	12.96	16.04	18.12	18.46	16.52	12.74	6.28	1.8
Element Total Rainfall Amount (mm)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	27.8	12	0	2.7	2.4	0	0	0	0	0	36.4	10.1
2005	22.3	28.3	8	9	3.6	0	0	0	0	0	4	21.5
2006	21.9	33.1	1.2	14.7	0	0	0	0	0	5.4	0.6	20.6
2007	19.5	28.5	14.3	4.3	5.2	0	0	0	0	0.6	14.7	8.5
2008	44.5	19	3.4	0	0	0	0	0	0.8	3.8	3.6	12.5
Mean	27.2	24.18	5.38	6.14	2.24	0	0	0	0.16	1.96	11.86	14.64
Element Mean Relative Humidity (%)												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	78.8	71	49.8	43.9	43.8	43.8	39.5	57.3	53.3	53.4	69.4	73.9
2005												
2006	75.7	68.4	61.3	61.6	46.6	44.9	55.6	53.3	57.8	71	62	62
2007	73.8	78.1	70.6	59.7	49.7	45.9	48.8	53.7	60.7	57.3	59.6	68.7
2008	72.6	68.5	49.4	43	45.1	45.2	49.6	52.7	58.8	60.2	57.1	60.2
Mean	75.225	71.5	57.775	52.05	46.3	44.95	48.375	54.25	57.65	60.475	62.025	66.2
Element Mean Wind Speed 'knot'												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
2004	1.7	2	2.4	3.2	3.6	2.7	2	2.1	1.3	2.6	5.5	4.4
2005	5.4	6	5.6	6.3	6.2	6.1	6.2	5.5	3.9	2.8	2.5	
2006	3	4	4.6	4.8	4.7	4.6	4.6	3.6	2.9	3.5	2.7	2
2007	2	2.7	3.3	4.5	3.5	3.3	3.2	3.5	2.9	2.2	1.2	1.1
2008	1.8	1.9	2.8	3.3	2.6	2.6	2.9	2.9	2.7	1.7	1.1	1.3
Mean	2.78	3.32	3.74	4.42	4.12	3.86	3.78	3.52	2.74	2.56	2.6	

ANNEX 2- STATUS OF FAUNAL SPECIES RCORDED IN THE STUDY AREA

Table 1: Status of mammalian species recorded in the study area

Species	IUCN status[19]	Local Status[20]
Order Insectivora		
Family Erinaceidae		
Paraechinus aethiopicus	LC	T
Hemiechinus auritus	LC	V
Family Soricidae		
Suncus etruscus	LC	R
Crocidura suaveolens	LC	R
Order Chiroptera		
Pipistrellus kuhli	LC	C
Tadarida teniotis	LC	R
Order Carnivora		
Family Canidae		
Canis lupus	LC	T
Canis aureus	LC	T
Vulpes rueppelli	LC	R
Vulpes vulpes	LC	C
Family Felidae		
Caracal caracal	NT	T
Felis silvestris	LC	T
Family Mustelidae		
Meles meles	LC	V
Martes foina	LC	V
Family Hyaenidae		
Hyaena hyaena	V	V
Order Lagomorpha		
Family Leporidae		
Lepus capensis	LC	T
Order Rodentia		
Family Dipodidae		
Jaculus jaculus	LC	C
Family Muridae		
Acomys russatus lewisi	LC	C
Mus musculus	LC	C
Rattus rattus	LC	C
Family Gerbillidae		
Gerbillus dasyurus	LC	C
Gerbillus cheesmani	LC	C
Gerbillus nanus	LC	C
Meriones libycus	LC	C
Meriones crassus	LC	C
Meriones tristrami	LC	C
Psammomys obesus	LC	C

19 IUCN status: LC: Least Concerned NT: Near Threatened V: Vulnerable
20 Local Status: C: Common T: Threatened V: Vulnerable R: Rare

Table 2: Status of reptilian species recorded in the study area

Species	IUCN[21]	Local[22]
Family Gekkonidae		
Bunopus tuberculatus	LC	C
Cyrtopodion kotschyi	LC	R
Hemidactylus turcicus	LC	C
Ptyodactylus puiseuxi	LC	C
Stenodactylus doriae	LC	C
Stenodactylus slevini	DD	R
Stenodactylus grandiceps	LC	C
Family Chamaeleonidae		
Chamaeleo chamaeleon	LC	R
Family Agamidae		
Laudakia stellio	LC	C
Laudakia stellio picea	LC	En
Phrynocephelus maculatus	LC	R
Trapelus ruderatus	LC	C
Trapelus pallidus haasi	LC	C
Uromastyx aegyptia	NT	T
Family Lacertidae		
Acanthodactylus boskianus	LC	C
Acanthodactylus opheodurus	LC	C
Acanthodactylus schmidti	LC	C
Acanthodactylus grandis	LC	R
Mesalina brevirostris	LC	C
Mesalina guttulata	LC	C
Mesalina olivieri	LC	C
Family Scincidae		
Ophiomorus latastii	DD	En, R
Chalcides ocellatus	LC	R
Mabuya vittata	LC	C
Scincus scincus	LC	R
Family Varanidae		
Varanus griseus	LC	T
Family Colubridae		
Coluber jugularis	LC	C
Coluber rhodorachis	LC	C
Coluber rubriceps	LC	C
Eirenis coronella	LC	C
Eirenis decemlineata	LC	C
Eirenis rothi	LC	C
Lytorhynchus diadema	LC	R
Malpolon moilensis	LC	C
Psammophis schokari	LC	C
Malpolon monspesulanus	LC	C
Natrix tessellata	LC	C
Spalerosophis diadema	LC	C

21 IUCN status: DD: Data Deficient LC: Least Concerned NT: Near Threatened
22 Local Status: C: Common T: Threatened V: Vulnerable R: Rare En: Endemic

Species	**IUCN**[21]	**Local**[22]
Telescopus dhara	DD	R
Telescopus nigriceps	DD	R
Family Viperidae		
Cerastes gasperettii	LC	C
Pseudocerastes fieldi	LC	C
Vipera palaestinae	LC	C
Family Elapidae		
Walterinnesia aegyptia	LC	C

ANNEX 3- DATA OBTAINED FROM DEPARTMENT OF STATISTICS

Tabe 1: Zarqa Govenorate Population by Gender

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	ذكر	انثى
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	734	704
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	4049	3873
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	782	711
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	520	510
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	107	88
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	607	552
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	1082	975
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	539	517
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	880	783
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	2162	2006
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	130	116
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	4708	4527
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	195	20
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	3880	3585
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	5965	5717
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	1176	1042
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	9527	8869
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	6428	6259

Table 2: Zarqa Govenorate Population by AgeGroups

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-97
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	205	214	186	158	125	121	103	103	58	44	38	26	22	35
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	1159	1126	1036	902	808	660	556	490	335	233	167	156	131	161
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	220	240	228	167	121	108	111	87	88	39	23	18	15	26
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	138	128	137	119	111	71	67	77	59	42	25	17	17	22
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	32	28	27	22	22	14	12	8	8	10	2	2	5	3
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	177	183	151	127	119	81	84	67	51	31	26	19	17	26
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	280	265	285	286	211	161	117	123	82	79	54	39	32	43
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	159	137	113	121	117	81	69	65	62	38	26	27	16	25
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	193	240	212	195	167	116	140	114	96	54	43	35	23	35
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	521	545	518	465	445	329	297	224	215	161	129	118	84	117
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	35	33	37	27	29	16	18	10	15	12	4	4	3	3
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	1163	1219	1246	1114	895	676	642	575	511	390	258	188	146	206
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	2	4	1	13	42	63	36	25	16	8	0	3	2	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	998	1057	1020	876	721	577	530	449	367	236	170	162	125	177
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	1748	1616	1448	1265	1158	945	872	711	491	359	263	277	225	304
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	330	319	295	250	223	179	169	117	95	53	34	48	59	47
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	2576	2408	2123	2056	1966	1747	1459	1153	717	542	419	367	357	494
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	1734	1631	1478	1369	1342	1089	967	786	561	441	303	288	251	446

Table 3: Marital Status at Zarqa Govenorate

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	عازب/عزباء	متزوج/متزوجه	مطلق/مطلقه	ارمل/ارمله	منفصل/منفصله
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	292	506	5	27	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	1666	2737	29	137	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	291	488	10	16	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	238	366	2	13	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	33	71	2	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	230	384	8	22	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	507	688	5	27	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	222	403	5	16	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	409	559	10	18	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	1005	1481	13	72	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	58	78	1	3	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	2195	3155	36	149	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	98	108	1	1	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	1615	2596	52	116	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	2501	4066	40	229	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	454	777	10	32	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	4286	6514	109	320	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	3075	4329	72	302	0

Table 4: Educational Level at Zarqa Govenorate

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	امي	ملم	ابتدائي	اعدادي	اساسي	تلمذه مهنيه	ثانوي	دبلوم متوسط	بكالوريوس	دبلوم عالي	ماجستير	دكتوراه
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	56	58	101	160	125	13	116	73	27	0	2	1
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	346	143	588	880	515	81	814	346	197	6	4	1
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	55	31	78	141	119	19	148	72	25	2	1	1
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	28	10	81	108	49	6	108	60	62	1	6	2
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	4	1	6	20	21	2	20	14	6	1	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	63	8	39	86	102	11	119	65	31	2	2	2
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	122	32	88	170	119	14	274	92	69	4	1	4
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	29	43	94	120	70	17	87	60	30	3	2	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	81	38	98	111	53	5	210	118	81	2	6	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	91	79	180	271	142	33	398	401	359	13	31	10
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	21	3	13	22	4	1	33	10	9	0	1	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	249	199	444	679	432	51	941	683	597	30	37	17
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	81	8	8	7	3	20	56	13	5	0	0	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	298	180	444	848	553	75	710	436	214	9	12	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	488	224	695	1041	783	121	1279	710	389	20	26	1
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	158	60	242	176	171	22	145	85	61	1	4	1
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	1038	380	980	1845	1340	124	1963	892	838	19	49	7
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	879	342	635	1189	1186	168	1015	754	471	15	35	3

Table 5: Family Size within Zarqa Govenorate

Q101	Q102	Q103	Q104	Q101A	Q102A	Q103A	Q104A	Q105A	Q106A	متوسط حجم الاسره
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	5.6
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	5.6
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	6.2
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	5.8
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	6.1
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	6.1
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	6
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	5.6
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	6.1
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	5.5
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	6.8
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	5.6
13	1	1	111	الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	2.8
13	2	1	11	الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	5.6
13	2	1	11	الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	5.5
13	2	1	11	الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	5.6
13	3	1	11	الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	5.4
13	3	1	12	الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	5.5

Table 6: Household Types at Zarqa Govenorate

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	دار	شقه	فيلا	براكيه	بيت شعر/خيمه	مؤسسه/مكان عمل	تحت التشييد	اخرى
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	96	221	1	1	0	0	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	446	1289	1	0	0	0	28	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	192	112	0	0	0	0	109	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	75	190	3	0	0	0	46	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	20	15	0	0	0	0	20	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	92	142	0	0	0	0	26	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	240	205	2	0	0	0	12	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	102	120	0	0	0	0	12	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	150	239	3	0	0	1	36	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	193	749	7	0	0	0	118	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	32	19	0	0	8	0	7	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	502	1618	11	0	1	1	274	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	4	4	0	0	0	70	4	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	352	1369	0	0	0	1	62	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	553	2304	3	0	0	0	53	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	293	277	0	0	0	0	83	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	1006	2837	7	7	2	3	91	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	989	1739	7	7	0	0	81	0

Table 7: Types of Household Ownership within Zarqa Govenorate

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	ملك للاسره او احد افرادها	مستأجر دون فرش	مستأجر مفروش	ملك لاحد الاقارب	مقابل عمل	دون مقابل	اخرى
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	176	36	0	39	5	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	839	217	1	351	2	0	1
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	218	11	0	10	3	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	164	13	0	0	0	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	31	1	0	0	0	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	155	23	5	0	5	3	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	286	19	0	38	1	1	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	128	24	0	36	0	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	192	39	0	38	2	1	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	409	164	0	187	1	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	36	0	0	0	0	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	1182	283	2	170	6	3	1
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	4	1	0	0	71	0	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	702	290	0	337	3	1	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	1161	400	0	548	7	4	1
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	270	12	0	93	16	2	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	1794	821	0	667	96	5	2
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	1296	336	0	646	30	8	1

Table 8: Work Sectors within Zarqa Govenorate

محافظه	لواء	قضاء	التجمع السكاني	المنطقة	الحي	قطاع عام	قطاع خاص	منظمات دوليه اخرى	غير مبين
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الوسط التجاري	الهاشمي	55	215	1	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الفلاح	354	1112	4	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الدويك	67	194	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	المدينة المنوره	43	175	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	مكه المكرمه	14	25	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	الاحمد	82	102	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	عوجان	نصار	169	183	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجنينه	35	172	2	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الجبر	106	208	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	الاميره هيا	276	604	2	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزواهره	البستان	21	15	0	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	البتراوي	642	1205	2	0
الزرقاء	لواء قصبة الزرقاء	قضاء قصبة الزرقاء	الزرقاء	الزرقاء الجديده	معامل الطوب	4	182	0	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جعفر الطيار	276	1192	5	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	الرشيد الشمالي	457	1916	5	0
الزرقاء	لواء الرصيفة	قضاء الرصيفة	الرصيفة	الرشيد	جريبا	108	280	1	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	الهاشمية	الهاشمية	الهاشمية	1575	2204	2	0
الزرقاء	لواء الهاشمية	قضاء الهاشمية	السخنة	السخنة	السخنة	866	1757	9	0

Table 9: Economic Activities within Zarqa Govenorate

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
20	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
22	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
27	الانشاءات	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
23	التعليم	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	الزراعة والصيد والحراجة	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الصحة والعمل الاجتماعي	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
63	الصناعة التحويلية	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
8	الفنادق والمطاعم	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	المنظمات والهيئات غير الاقليمية	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
28	النقل والتخزين والاتصالات	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	امدادات الكهرباء والغاز والمياه	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
57	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	غير مبين	الهاشمي	الوسط التجاري	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
95	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
29	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
163	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
168	الانشاءات	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
11	التعدين واستغلال المحاجر	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
127	التعليم	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الزراعة والصيد والحراجة	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
35	الصحة والعمل الاجتماعي	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
332	الصناعة التحويلية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
28	الفنادق والمطاعم	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	المنظمات والهيئات غير الاقليمية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
143	النقل والتخزين والاتصالات	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
14	الوساطة المالية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
15	امدادات الكهرباء والغاز والمياه	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
299	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	صيد الأسماك	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
8	غير مبين	الفلاح	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
21	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
40	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
25	الانشاءات	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	التعدين واستغلال المحاجر	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
17	التعليم	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الزراعة والصيد والحراجة	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الصحة والعمل الاجتماعي	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
48	الصناعة التحويلية	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الفنادق والمطاعم	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
33	النقل والتخزين والاتصالات	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الوساطة المالية	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	امدادات الكهرباء والغاز والمياه	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
55	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	غير مبين	الدويك	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
9	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
17	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
30	الانشاءات	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	التعدين واستغلال المحاجر	المدينة	عوجان	الزرقاء	قضاء قصبة	لواء قصبة	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
		المنوره			الزرقاء	الزرقاء	
38	التعليم	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	الصحة والعمل الاجتماعي	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
33	الصناعة التحويلية	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الفنادق والمطاعم	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
11	النقل والتخزين والاتصالات	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	الوساطة المالية	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
58	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	غير مبين	المدينة المنوره	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الانشاءات	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	التعليم	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	الصحة والعمل الاجتماعي	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الصناعة التحويلية	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	الفنادق والمطاعم	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	النقل والتخزين والاتصالات	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	امدادات الكهرباء والغاز والمياه	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	مكه المكرمه	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
21	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
49	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
17	الانشاءات	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
15	التعليم	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الصحة والعمل الاجتماعي	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
21	الصناعة التحويلية	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الفنادق والمطاعم	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
9	النقل والتخزين والاتصالات	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	الوساطة المالية	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	امدادات الكهرباء والغاز والمياه	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
28	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الاحمد	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
36	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
9	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
94	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
17	الانشاءات	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	التعدين واستغلال المحاجر	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
38	التعليم	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الزراعة والصيد والحراجة	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
14	الصحة والعمل الاجتماعي	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
48	الصناعة التحويلية	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	الفنادق والمطاعم	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
22	النقل والتخزين والاتصالات	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الوساطة المالية	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
13	امدادات الكهرباء والغاز والمياه	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
44	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	نصار	عوجان	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
9	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
13	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
26	الانشاءات	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	التعدين واستغلال المحاجر	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
20	التعليم	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	الصحة والعمل الاجتماعي	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
49	الصناعة التحويلية	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الفنادق والمطاعم	الجنينه	الزواهره	الزرقاء	قضاء قصبة	لواء قصبة	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
					الزرقاء	الزرقاء	
2	المنظمات والهيئات غير الاقليمية	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
36	النقل والتخزين والاتصالات	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الوساطة المالية	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	امدادات الكهرباء والغاز والمياه	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
33	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	غير مبين	الجنينه	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
13	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
59	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
19	الانشاءات	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	التعدين واستغلال المحاجر	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
33	التعليم	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الزراعة والصيد والحراجة	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
16	الصحة والعمل الاجتماعي	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
68	الصناعة التحويلية	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
4	الفنادق والمطاعم	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
32	النقل والتخزين والاتصالات	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الوساطة المالية	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
5	امدادات الكهرباء والغاز والمياه	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
52	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الجبر	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
39	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
30	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
88	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
53	الانشاءات	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	التعدين واستغلال المحاجر	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
179	التعليم	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
3	الزراعة والصيد والحراجة	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
49	الصحة والعمل الاجتماعي	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
121	الصناعة التحويلية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
11	الفنادق والمطاعم	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	المنظمات والهيئات غير الاقليمية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
75	النقل والتخزين والاتصالات	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
15	الوساطة المالية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
14	امدادات الكهرباء والغاز والمياه	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
188	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	صيد الأسماك	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	غير مبين	الاميره هيا	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
11	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	التعليم	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الزراعة والصيد والحراجة	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الصناعة التحويلية	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	النقل والتخزين والاتصالات	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	امدادات الكهرباء والغاز والمياه	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	البستان	الزواهره	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
78	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
20	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
67	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
302	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
114	الانشاءات	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
9	التعدين واستغلال المحاجر	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
252	التعليم	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
14	الزراعة والصيد والحراجة	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
91	الصحة والعمل الاجتماعي	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة	لواء قصبة	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
					الزرقاء	الزرقاء	
287	الصناعة التحويلية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
43	الفنادق والمطاعم	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	المنظمات والهيئات غير الاقليمية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
152	النقل والتخزين والاتصالات	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
37	الوساطة المالية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
36	امدادات الكهرباء والغاز والمياه	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
341	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
7	غير مبين	البتراوي	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
2	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
3	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
108	التعدين واستغلال المحاجر	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
6	الزراعة والصيد والحراجة	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
66	الصناعة التحويلية	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
1	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	معامل الطوب	الزرقاء الجديده	الزرقاء	قضاء قصبة الزرقاء	لواء قصبة الزرقاء	الزرقاء
92	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
1	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
35	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
90	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
220	الانشاءات	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
8	التعدين واستغلال المحاجر	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
117	التعليم	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
16	الزراعة والصيد والحراجة	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
44	الصحة والعمل الاجتماعي	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
325	الصناعة التحويلية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
28	الفنادق والمطاعم	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
5	المنظمات والهيئات غير الاقليمية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
200	النقل والتخزين والاتصالات	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
7	الوساطة المالية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
22	امدادات الكهرباء والغاز والمياه	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
263	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	جعفر الطيار	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
130	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
12	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
75	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
147	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
285	الانشاءات	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
20	التعدين واستغلال المحاجر	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
273	التعليم	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
24	الزراعة والصيد والحراجة	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
82	الصحة والعمل الاجتماعي	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
477	الصناعة التحويلية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
74	الفنادق والمطاعم	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
5	المنظمات والهيئات غير الاقليمية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
300	النقل والتخزين والاتصالات	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
31	الوساطة المالية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
34	امدادات الكهرباء والغاز والمياه	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
402	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
11	غير مبين	الرشيد الشمالي	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
41	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
1	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
11	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
43	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
29	الانشاءات	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
2	التعدين واستغلال المحاجر	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
28	التعليم	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
21	الزراعة والصيد والحراجة	جريبا	الرشيد	الرصيفة	قضاء	لواء الرصيفة	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
					الرصيفة		
9	الصحة والعمل الاجتماعي	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
80	الصناعة التحويلية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
10	الفنادق والمطاعم	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
1	المنظمات والهيئات غير الاقليمية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
39	النقل والتخزين والاتصالات	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
2	الوساطة المالية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
4	امدادات الكهرباء والغاز والمياه	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
66	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
3	غير مبين	جريبا	الرشيد	الرصيفة	قضاء الرصيفة	لواء الرصيفة	الزرقاء
232	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
11	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
51	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
977	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
210	الانشاءات	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
45	التعدين واستغلال المحاجر	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
352	التعليم	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
65	الزراعة والصيد والحراجة	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
108	الصحة والعمل الاجتماعي	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
849	الصناعة التحويلية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
57	الفنادق والمطاعم	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
2	المنظمات والهيئات غير الاقليمية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
247	النقل والتخزين والاتصالات	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
21	الوساطة المالية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
142	امدادات الكهرباء والغاز والمياه	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
400	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
19	غير مبين	الهاشمية	الهاشمية	الهاشمية	قضاء الهاشمية	لواء الهاشمية	الزرقاء
176	أنشطة الخدمة المجتمعية، والاجتماعية والشخصية الأخرى	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء

العدد	النشاط الاقتصادي	الحي	المنطقة	التجمع السكاني	قضاء	لواء	محافظه
7	الأسر الخاصة التي تعين أفراداً لأداء الأعمال المنزلية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
60	الأنشطة العقارية والايجارية وانشطة المشاريع التجارية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
340	الادارة العامة والدفاع، الضمان الاجتماعي الاجباري	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
281	الانشاءات	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
15	التعدين واستغلال المحاجر	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
293	التعليم	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
194	الزراعة والصيد والحراجة	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
68	الصحة والعمل الاجتماعي	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
542	الصناعة التحويلية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
45	الفنادق والمطاعم	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
9	المنظمات والهيئات غير الاقليمية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
209	النقل والتخزين والاتصالات	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
25	الوساطة المالية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
38	امدادات الكهرباء والغاز والمياه	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
325	تجارة الجملة والتجزئة، اصلاح المركبات ذات المحركات والدراجات النارية والسلع الشخصية والأسرية	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء
11	غير مبين	السخنة	السخنة	السخنة	قضاء الهاشمية	لواء الهاشمية	الزرقاء

ANNEX 4- LIST OF ALL ARCHAEOLOGICAL SITES LOCATED IN ZARQA DISTRICT

Table 1: Archaeological Sites within Zarqa District

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
1	No name *	249.41	164.06	UD (cairn)
2	No name *	249.66	164.31	UD (cairn)
3	No name *	249.88	164.65	UD (cairn)
4	No name *	249.16	164.72	UD (animal pen)
5	No name *	248.75	164.85	UD (cairns)
6	No name *	246.70	164.92	UD (cairns)
7	No name *	247.99	164.94	UD (animal pen)
8	No name *	250.90	165.02	UD (enclosure)
9	No name *	246.18	165.10	UD (cairn)
10	No name *	251.00	165.10	UD (structures)
11	No name *	248.34	165.18	UD (cairn)
12	No name *	248.97	165.22	UD (cave shelters, walls)
13	Heritage Site	250.88	165.25	IrII (settlement)
14	No name *	245.14	165.26	UD (enclosure)
15	No name *	249.00	165.33	UD (animal pen)
16	Huwaynit	250.80	165.42	IrII, Rom. Maml (building)
17	No name *	247.90	165.44	UD (cairn, enclosure)
18	No name *	249.49	165.49	UD (cairn)
19	No name *	247.32	165.65	UD (enclosure)
20	No name *	246.94	165.72	UD (structure)
21	No name *	245.90	165.76	UD (cairns)
22	Jabal Abu al-hulwah	250.75	165.87	Rom, Byz, Mod (farm)
23	No name *	247.00	165.88	UD (cairns)
24	No name *	249.33	165.97	UD (hut and animal pen)
25	No name *	246.92	166.02	UD (cairn)
26	No name *	248.27	166.03	UD (cairn)
27	No name *	247.45	166.11	UD (cairn)
28	No name *	248.52	166.14	UD (cairn)
29	No name *	249.50	166.18	UD (cairn)
30	No name *	249.35	166.20	UD (cairn)
31	No name *	249.26	166.24	UD (cairn)
32	Jabal ar-rahil	250.54	166.28	Epipal?, Mod (scatter)
33	Ain Qneyeh south	251.24	166.28	EBII, EBIII, EBIV (settlement)
34	No name *	249.00	166.35	UD (cairn)
35	No name *	245.67	166.40	UD (enclosure, structure)
36	No name *	246.46	166.45	UD (cairns)
37	Jabal Mutawaq	250.50	166.47	Rom/Byz, Maml (caves)
38	No name *	247.74	166.48	UD (cairns)
39	No name *	248.76	166.54	UD (enclosure)
40	No name *	248.90	166.55	UD (enclosure)
41	No name *	248.26	166.58	UD (cairn)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
42	No name *	252.30	166.70	UD (cairn)
43	No name *	246.52	166.74	UD(stone circle)
44	No name *	251.81	166.86	UD (cairn)
45	No name *	251.55	166.88	UD (cairn, structure)
46	No name *	247.99	166.89	UD (cairn)
47	No name *	247.59	166.91	UD (cairn)
48	No name *	247.73	166.93	UD (cairn)
49	Hashemiyah	250.44	166.93	Lpal, UD flints (scatter)
50	No name *	249.20	166.97	UD (cairn)
51	No name *	245.55	166.98	UD (structure)
52	No name *	246.33	166.98	UD (enclosure)
53	Karmah	250.23	166.98	Byz, Um, Maml, UD (hamlet)
54	Kh Hawaya	250.30	166.98	Mpal? (Scatter)
55	No name *	248.70	167.00	UD (circular structer,enclosure)
56	No name *	246.00	167.03	UD (enclosure)
57	No name *	251.81	167.05	UD (cairn)
58	No name *	248.52	167.06	UD (cairn)
59	Jrayyah	250.24	167.06	Byz,Um, Abb?, Maml (building)
60	No name *	245.38	167.07	UD (enclosure)
61	No name *	246.61	167.16	UD (circular structer,enclosure)
62	No name *	249.75	167.20	UD (cairns)
63	No name *	251.49	167.21	UD (cairn)
64	No name *	245.49	167.22	UD (cairn)
65	No name *	246.83	167.22	UD (cairn)
66	No name *	249.15	167.25	UD (cairns)
67	No name *	248.10	167.34	UD (cairn)
68	No name *	245.12	167.38	UD (cairn)
69	No name *	245.47	167.39	UD (encolosure)
70	No name *	248.66	167.40	UD (cairns)
71	No name *	248.51	167.44	UD (cairn)
72	No name *	245.89	167.49	UD (cairn)
73	Hashemiyah	250.30	167.50	UD (scatter)
74	No name *	245.64	167.58	UD (cairns)
75	No name *	246.19	167.58	UD (cairn)
76	No name *	249.23	167.58	UD (cairn)
77	No name *	248.54	167.60	UD (cairn)
78	No name *	247.06	167.61	UD (encolosure)
79	No name *	248.63	167.68	UD (circular structer,enclosure)
80	No name *	247.83	167.74	UD (cairn)
81	No name *	249.60	167.75	UD (animal pen)
82	No name *	247.68	167.76	UD (cairn)
83	No name *	253.75	167.83	UD (animal pen / stone circle)
84	No name *	247.33	167.90	UD (cairn,stone circle)
85	No name *	248.29	167.96	PPNB?, UD flints, Byz,Ay/Mam1, UD (enclosure)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
86	No name *	253.03	167.99	UD (cairn, animal pen)
87	Hashemiyah	250.20	168.00	UD (scatter)
88	No name *	247.51	168.04	UD (cairn)
89	No name *	250.15	168.05	UD (circular structure)
90	No name *	249.20	168.07	UD (structures)
91	No name *	250.02	168.08	UD (enclosure)
92	No name *	251.43	168.08	UD (cairns)
93	No name *	246.48	168.12	UD (cairn)
94	No name *	248.85	168.25	UD (cairns)
95	No name *	251.70	168.28	UD (cairn)
96	No name *	250.97	168.31	UD (cairn)
98	No name *	251.71	168.40	UD (cairn)
99	No name *	249.29	168.45	UD (cairn)
100	No name *	250.86	168.57	UD (cairns)
101	No name *	247.88	168.6	PPNB, UD flints, Ir, Rom/Byz, Ay/Mam1, UD (settlement?
102	No name *	249.28	168.63	UD (cairn)
103	No name *	251.77	168.64	UD (cairn)
104	No name *	254.07	168.64	UD (cairn)
105	No name *	249.03	168.67	UD (structure)
106	No name *	247.16	168.76	UD (cairn)
107	Kh. Metwi	251.88	168.86	Epipal? (cairn)
108	No name *	245.33	168.90	UD (cairn)
109	No name *	249.44	168.94	UD (cairn)
110	Kh. Khaw	252.08	168.96	UD flints (cairn)
111	No name *	246.86	169.06	UD (enclosure)
112	As-sukhneh east	250.25	169.12	Destroyed (settlement)
113	No name *	247.42	169.19	UD (cairns)
114	No name *	245.94	169.20	UD (cairns)
115	No name *	246.28	169.30	UD (enclosure)
116	Kh. Khan	252.00	169.30	UD flints, Byz, Maml, UD (stone circle)
117	Kh. Sakhra	252.26	169.38	UD flints, pottery (cairn)
118	No name *	247.64	169.40	UD (cairn)
119	No name *	248.48	169.42	UD (enclosure)
120	No name *	246.65	169.45	UD (cairns)
121	No name *	245.36	169.47	UD (cairns)
122	Kh Jreyyeh	251.78	169.47	(structures)
123	No name *	252.85	169.52	UD (cairns)
124	No name *	249.74	169.54	UD (caves, structure)
125	Hasya	251.38	169.55	Ir, Um, Maml, UD,UD flints (tower, scatter)
126	No name *	250.74	169.56	UD (animal pen / stone circle)
127	Ain Ghazal Caves	251.62	169.60	IR II,Um, Abb, Ay/Mam1,UD (settlement)
128	Khanna 2	252.43	169.64	Mpal? (cairn)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
129	Kh Monghareh	251,86	169.64	UD flints (stone circles, cairns)
130	No name *	245.82	169.65	UD (cairns)
131	Khanna 3	252.20	169.70	Maml, UD flints (stone circles)
132	No name *	246.84	169.72	UD (cairns)
133	No name *	245.12	169.74	UD (cairn)
134	No name *	247.42	169.76	UD (stone circles)
135	No name *	248.05	169.76	UD (cairn)
136	No name *	249.43	169.80	UD (animal pen)
137	No name *	245.30	169.84	UD (enclosure)
138	No name *	252.89	169.85	UD (enclosure)
139	No name *	248.50	169.90	UD (circular structure)
140	No name *	252.65	169.90	UD (structure, cemetery)
141	No name *	248.72	169.92	UD (cairn)
142	Khanna 6	252.28	169.92	UD flints (stone circles)
143	Khanna 7	251.98	169.98	Lpal, Mpal (scatter)
144	Khanna 7	251.45	170.01	UD flints (cairns)
145	No name *	245.31	170.04	UD (enclosure)
146	No name *	249.05	170.04	UD (cairn)
147	No name *	248.18	170.05	UD (structure)
148	No name *	248.54	170.05	UD (cairn)
149	No name *	247.88	170.15	UD (cairn)
150	No name *	246.84	170.20	UD (cairn)
151	No name *	248.26	170.23	UD (enclosure)
152	Khirbet Jamus	252.93	170.24	UD flints (cairns)
153	No name *	248.37	170.25	UD (cairn)
154	No name *	249.40	170.25	UD (stone circles)
155	No name *	252.30	170.28	UD (circle)
156	No name *	251.39	170.29	UD (cairn)
157	Khirbet as-Sil	253.46	170.40	UD flints (enclosure)
158	No name *	245.97	170.49	UD (rect. Structure)
159	No name *	252.20	170.50	UD (cairns)
160	Khirbet Bireen	253.30	170.50	UD flints (cairns)
161	No name *	247.69	170.55	UD (cairn)
162	No name *	245.60	170.56	UD (cairn)
163	Msherfeh	248.24	170.57	UD flints (cairn)
164	Hashemiyah	250.90	170.60	UD (scatter)
165	No name *	252.13	170.60	UD (cairn)
166	Khirbet Khaw	252.58	170.60	Upal, Epipal (Cairns)
167	No name *	250.72	170.65	UD (structures)
168	No name *	252.29	170.68	UD (structure)
169	Masarah	247.96	170.74	UD flints, EBII?, Rom/Byz, UD (stone circles)
170	Khirbet Russeifa	252.40	170.76	(cairns)
171	Khirbet Aluk	253.59	170.80	(cairn)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
172	Muamariyeh	248.20	170.90	UD flints (cairn)
173	Abu Ez-Zeighan	249.62	171.00	Upal?, UD flints, EB II, EB IV, Rom?, Byz, Ay/Mam1 (settl.)
174	Kharaysin	247.24	171.10	UD flints, EB I/II, UD (cairns, stone circles)
175	No name *	248.26	171.10	UD (cairn)
176	No name *	250.75	171.15	modern vellage (late ottoman ,modern)
177	Khirbet As-Samra	252.20	171.18	(cairns)
178	No name *	245.88	171.20	UD (cairn)
179	Kharaysin	247.74	171.20	EB II?, Rom, UD stone circles)
180	Ain Al-Asad	248.84	171.20	Ir II, LR?, Byz, Um, Ay/Mam1, UD (fort)
181	Khirbet Qneyeh south	253.10	171.20	(cairns)
182	No name *	249.35	171.28	UD (stone circle)
183	No name *	254.14	171.30	UD (cairn)
184	No name *	247.25	171.35	UD (cairns)
185	No name *	251.87	171.35	UD (terrace wall?)
186	Ain el Tel	250.45	171.41	MBA, Rom, Byz, UD (tell)
187	No name *	246.01	171.42	UD (cairns)
188	No name *	254.16	171.43	UD (enclosure)
189	No name *	249.50	171.45	UD (stone circle)
190	No name *	253.54	171.48	UD (cairn)
191	No name *	253.68	171.48	UD (enclosure)
192	Khanna1	247.29	171.53	Epipal?, UD flints (stone circles)
193	No name *	248.96	171.54	UD (animal pen)
194	No name *	247.48	171.60	UD (enclosure)
195	No name *	249.78	171.63	UD (hamlet, stone circles)
196	No name *	246.94	171.65	UD (stone circles, cairns)
197	No name *	249.53	171.65	UD (animal pen / stone circle)
198	No name *	253.23	171.66	UD (cairn)
199	No name *	249.22	171.70	UD (animal pen / stone circle)
200	Khirbit al-mak'hol	251.48	171.70	IrII, Mod (camp)
201	Gharesa	254.10	171.70	UD (scatter)
202	No name *	245.90	171.72	UD(encolosure)
203	No name *	246.29	171.73	UD (enclosure)
204	No name *	253.40	171.75	UD (enclosure)
205	No name *	245.45	171.82	UD (cairn?, stone circle)
206	No name *	247.38	171.84	UD (cairn)
207	AL Qnnayeh	250.33	171.86	EBII (settlement)
208	No name *	252.83	171.90	UD (cairn)
209	Gharesa	253.40	171.90	UD (scatter)
210	No name *	249.78	171.95	UD (enclsure)
211	No name *	254.24	171.95	Epipal (settelment?)
212	Gharesa	250.30	172.00	UD (scatter)
213	No name *	249.47	172.02	UD (animal pen / stone circle)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
214	No name (Ush)	254.40	172.11	Lpal (Acheulean, scatter)
215	No name *	250.98	172.22	UD (circles)
216	Marajem	245.27	172.27	PPNB, UD flints (stone circle)
217	No name *	250.58	172.38	UD (structure)
218	Dhuleil Cairn 3	249.10	172.40	Chalco, EB
219	No name *	248.83	172.46	UD (animal pen / stone circle)
220	El Nimrah	251.10	172.50	UD (scatter)
221	Dhuleil Cairn 2	249.10	172.60	Chalco, EB
222	Khirbet Shoumar	247.37	172.64	EB II, UD flints (settlement)
223	El Aluk	251.20	172.70	UD (scatter)
224	No name *	245.15	172.72	UD (structure)
225	Duqmusa	253.86	172.73	Upal?, UD flints (scatter)
226	No name *	247.10	172.75	UD (structures)
227	No name *	246.25	172.78	UD (stone circle)
228	Dhakhirah	249.00	172.80	UD (scatter)
229	Khirbet Zuqm al-ghurab	251.72	172.82	Chal (Dom), EBIV, Rom/Byz, Mod,UD (settlement)
230	An-Nimrah	249.90	172.88	Mpal, PPN?, UD flints, Rom, Byz?, Abb?, Mam1 (scatter)
231	Dhuleil Cairn 1	249.20	172.90	Chalco, EB
232	Hashemiyah	254.30	172.90	UD (scatter)
233	No name *	250.04	172.92	UD (MP scatter)
234	Al-hasiyya 2	249.74	172.94	Lpal, UD flints, Rom, Byz, Mam1,UD(fort?)
235	Argoub ibn Hadad	250.22	172.94	UD flints (scatter)
236	Anoqiyah	249.56	172.96	PPNB? (settlement)
237	Dolmen Field	251.20	173.00	UD (scatter)
238	Khrisan	244.94	173.04	Rom, UD flints (cairns)
239	Dolmens	253.74	173.05	Lpal (Late Acheulean; scatter)
240	Al-wad'ah	248.20	173.10	UD (settlement)
241	No name	253.35	173.10	UD flints, UD, pottery (cairns, circles)
242	Al-Birah south	249.16	173.14	Pneol (Dom), Byz, UD (settlement)
243	Cemetrey	247.90	173.20	UD (scatter)
244	As-sukhneh north	249.44	173.20	Maml, UD flints (scatter)
245	No name *	250.13	173.20	UD (settlement?)
246	Khirbet aj-jamos	245.28	173.21	Epipal (Natuf), Maml, UD (tower)
247	as-sukhneh modern village	249.66	173.23	Chal/eb 1, Byz, UD (settlement)
248	Dolmen Field	251.70	173.30	UD (scatter)
249	Betrawey	247.90	173.40	UD (scatter)
250	No name *	248.30	173.40	UD (cairn)
251	Al-hasiyya 1	248.96	173.56	Rom, Byz, Mam1, UD (settlement)
252	Azraq walls	247.10	173.60	UD (scatter)
253	Khirbet Abu Zeighan	246.39	173.62	MPAl?, UD flints (scatter)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
254	No name *	247.10	173.68	UD (cemetery)
255	Dolmen Field	253.20	173.70	UD (scatter)
256	No name *	246.96	173.72	UD (small tell)
257	No name *	245.68	173.77	UD (cairn)
258	No name *	250.26	173.78	UD (cairn)
259	No name *	248.74	173.79	UD (cairn)
260	No name *	250.41	173.81	UD (cairn)
261	No name *	246.95	173.87	UD (enclsure)
262	No name *	247.92	173.88	UD (cairns)
263	No name *	248.36	173.88	UD (cairns)
264	No name *	252.29	173.90	UD (cairns)
265	No name *	247.74	173.91	UD (cairn)
266	No name *	251.86	173.92	UD (cairn)
267	No name *	254.32	174.00	UD (animal pen, modern humlet)
268	No name *	248.99	174.01	UD (cairn)
269	No name *	250.98	174.05	UD (cairn)
270	No name *	249.33	174.06	UD (cairn)
271	No name *	249.80	174.11	UD (cairn)
272	No name *	250.99	174.18	UD (cairn)
273	No name *	250.67	174.23	UD (cairn)
274	No name *	252.26	174.26	UD (cairn)
275	No name *	249.80	174.28	UD (cairn)
276	No name *	250.20	174.29	UD (cairn, stone circle)
277	Azraq Druz	246.70	174.30	UD (scatter)
278	No name *	247.73	174.30	UD (cairns)
279	No name *	251.84	174.33	UD (cairn)
280	No name *	251.33	174.40	UD (cairn)
281	No name *	254.12	174.42	UD (cairn)
282	No name *	247.35	174.48	UD (stone circle)
283	No name *	250.02	174.50	UD (cairn)
284	No name *	251.34	174.53	UD (cairn)
285	No name *	247.92	174.54	UD (cairns)
286	No name *	253.95	174.71	UD (cairn, long wall)
287	No name *	254.21	174.72	UD (cairn)
288	Khirbat abu az-zayghan	245.46	174.75	UD flints, Ir?, Rom (Dom), Byz, Maml, UD (fort)
289	Khirbat al-wad'ah	245.35	174.78	Rom/Byz, Maml, UD (caves)
290	At-tuwayfiriyya	245.60	174.80	UD (scatter)
291	No name *	247.93	174.80	UD (cairns)
292	No name *	250.00	174.90	UD (cairn)
293	No name *	247.67	174.91	UD (cairns)
294	No name *	248.93	174.95	UD (cairn)
295	No name *	253.68	174.98	UD (cairn)
296	Hashemiyah	245.62	175.00	Ott (Water mills)

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
297	No name *	248.03	175.00	UD (cairns)
298	No name *	253.48	175.04	UD (cairn)
299	Ain Ghazal Caves	245.50	175.06	Chal?, EB?,EBII, IrII, Rom, Byz, Um, Ay/Mam1 (settlement)
300	No name *	252.18	175.13	UD (cairn, animal pen)
301	No name *	246.29	175.18	UD (enclosure)
302	No name *	250.02	175.19	UD (cairns)
303	No name *	253.32	175.19	UD (cairn)
304	No name *	254.25	175.21	UD (cairn)
305	No name *	253.89	175.23	UD (animal pens)
306	No name *	250.30	175.25	UD (cairn)
307	No name *	253.60	175.25	UD (cairn,long wall)
308	No name *	252.18	175.34	UD (cairn)
309	No name *	248.46	175.35	UD (cairns)
310	No name *	249.43	175.35	UD (cairn)
311	No name *	254.00	175.35	UD (animal pen / stone circle)
312	No name *	253.13	175.37	UD (cairn)
313	No name *	246.84	175.38	UD (cairn, enclosure)
314	No name *	250.07	175.38	UD (cairn)
315	No name *	253.39	175.41	UD (cairn)
316	Mugais	245.80	175.42	LP II? (settlement)
317	No name *	253.89	175.42	UD (modern humlet)
318	No name *	252.38	175.44	UD (animal pen / stone circle)
319	No name *	253.02	175.46	UD (modern house, animal pen, cairn)
320	No name *	249.91	175.48	UD (cairn)
321	Hashemiyah	245.70	175.50	UD (scatter)
322	No name *	248.55	175.55	UD (cairns)
323	No name *	249.26	175.66	UD (cairn)
324	No name *	248.23	175.71	UD (cairns)
325	No name *	251.40	175.84	UD (cairn)
326	No name *	252.65	175.90	UD (animal pen/stone circles/huts)
327	No name *	248.24	175.94	UD (cairns or structer)
328	No name *	253.26	175.99	UD (cairn)
329	No name *	250.80	176.00	UD (animal pen / stone circle)
330	Tawaheen	2715	35212	ottoman, Islamic
331	Telal Khaw	2916	35222	Bronze, Classic
332	Wadi As-Samra Site	3018	35225	Classic
333	Tell Meghanieh	2932	35242	UD
334	Um Bteiman	2948	35294	UD
335	Tell Meghanieh	2945	35295	UD
336	The Tower	2958	35305	Bronze
337	Qaser Hallabat	2695	35455	Roman, Byz, Islamic
338	Qneye	2695	35455	classic
339	Qneyeh South	2695	35455	clssic

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
340	Rosito Station	2177	35461	UD
341	Rujum at-taj	2205	35463	UD
342	Rujum As-Samra	2183	35467	Byz
343	Qneyeh South	2695	35495	clssic
344	Quseir Amra	2695	35495	Islamic
345	Zaqm et-That	2336	35532	UD
346	Rujum Sawwan	2216	35538	Bronze
347	Qaser el-Uweined	2479	35540	Roman Byz, Islamic
348	Yajooz Caves	2294	35543	Classic
349	Rujum Sakhara	7788	35549	Clssic
350	Qaser Ain Sil	2243	35554	Chalcol, Bronze
351	Rujum Nebi Hadad	2203	35564	Bronz, clssic
352	Sirat Arnab	7790	35606	UD
353	No name *	2822	35608	Neolithic, Roman
354	No name *	2207	35609	Byz, Roman
355	No name *	7798	35611	Bronze, Hellenestic
356	Wadi Ush (no name)	7756	35625	Bronze, Classic
357	Wadi Ush (no name)	7767	35625	Bronze, Classic
358	Wadi Ush (no name)	7755	35626	Bronze, Classic
359	No name *	7816	35634	Bronze; Byz.
360	No name *	2520	35635	Neolithic UD
361	No name *	7813	35637	Bronze Age
362	No name *	7789	35639	Bronze, Iron, Roman
363	No name *	7788	35640	Byzantine
364	No name *	7795	35648	Bronze
365	No name *	2173	35671	Bronze Age, Roman
366	Sahari	2173	35671	UD
367	Russeifa	2174	35676	Bronze, Classic, Islamic
368	No name *	7825	35683	Chalcu-Bronze
369	Tall al-Birah	7824	35690	Bronze, Classic, Islamic
370	Tall as-sukhneh	7823	35698	Bronze
371	No name *	7827	35699	Bronze
372	Sukhneh Tower	7827	35699	Bronze
373	No name *	7827	35705	Bronze Age
374	No name *	2205	35712	Chalco-Bronze
375	No name *	7823	35720	Bronze Age
376	No name *	2223	35727	Chalcolithic
377	No name *	2227	35744	Chalco-Bronze, modern
378	No name *	2723	35746	Neolithic
379	No name *	7876	35747	Byzantine
380	No name *	7792	35770	Chalcolithic - Roman
381	No name *	7783	35786	Bronze

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
382	No name *	2598	35789	Neolithic, Byz. Islamic
383	No name *	7816	35794	Bronze, Iron Age
384	No name *	7807	35799	Bronze Age
385	No name *	2690	35802	Neolithic, Byz. Roman
386	Zuqm at-That	26864	166624	UD
387	Zarqa Station	268023	166804	Ottoman
388	Zuqm ash-Sharql	268297	166831	Bronze
389	No name *	372854	351900	UD
390	Qaser Azraq	22354	355400	Bronze Age
391	Sarrut	22131	355901	Classic
392	No name *	3159661	355961	Neolithic
393	No name *	370230823	355983	Byzantine
394	No name *	22209	356074	Neolithic
395	No name *	22220	356101	Chalcolithic - Bronze Age
396	No name *	224261	3504871	
397	No name *	37022585	3539588	
398	No name *	370226075	3539965	tomb
399	No name *	370225386	3540454	Roman
400	No name *	370224999	3543436	Bronze+ Classical
401	No name *	360780845	3549491	Chalcolithic
402	No name *	37229405	3553880	UD
403	No name *	370223218	3556066	EB
404	No name *	234309	3558229	New Classical
405	No name *	231869	3558260	New Classical
406	No name *	228991	3558889	roman byzentan
407	No name *	232089	3558998	New Classical
408	No name *	3159820	3559079	Neolithic
409	No name *	230029	3559128	New Classical
410	No name *		3559337	roman byzentan
411	No name *	370230825	3559784	Byzantine
412	No name *	370230727	3559995	Chalcolithic
413	No name *	224546	3561836	B
414	No name *	223461	3563752	Bronze Age
415	No name *	221446	3564693	Heritage
416	No name *	224142	3564905	Classiced
417	No name *	219678	3565215	Bronze Age
418	No name *	219567	3565346	Bronze Age
419	No name *	218447	3566911	New Classical
420	No name *	782136	3569051	Classical
421	No name *	219429	3585388	Bronze Age
422	No name *	3201093	3600064	Neolithic
423	No name *	3201154	3601135	Modern
424	No name *	320130	3602186	Ottoman
425	No name *	3203746	3605752	Ottoman
426	No name *	782365	3659228	Bronze Age

Site No.	Site Name	E. Coordinate	N. Coordinate	Periods of Occupation
427	No name *	E2695	N35495	Neolithic
428	No name *	E2203	N35564	Bronze , Classical
429	No name *	E7824	N35673	Bronze , Classical
430	No name *	170599.00		roman Byz
431	Qasr Shabeeb	2247	35314	Ottoman

ANNEX 5- SOCICAL ASSESSMENT RESEARCH TOOL IN ARABIC

مقدمة

تقوم شركة *سلطة المياه* بالتعاون مع *ام دبليو اتش/اريتك جردانه* و بدعم من مؤسسة تحدي الألفية بمشروع لتحسين المستوى الحالي لخدمات الصرف الصحي لسكان مدينة الزرقاء من خلال توسيع نطاق التغطية لأنابيب الصرف الصحي في الزرقاء لتضم المناطق غير المخدومة في الوقت الحاضر بالشبكة الحالية و اعادة تأهيل نظام الصرف الصحي لزيادة قدرته على التعامل بشكل أفضل مع الطلب الحالي و المتوقع في المستقبل. وللبدء بـتنفيذ المشروع، يقوم فريق متعدد التخصصات بـاجراء تقييم اولي للاثر البيئي للمشروع بكافة مراحله (الإنشاء والتشغيل).

هذه المقابلة تأتي ضمن جزئيةالتقييم الأوّلي للأثر الإجتماعي-الإقتصادي حيث يقوم اعضاء الفريق المتخصصين في اجراء الدراسات الإجتماعية بـمقابلة المعنيين من مسؤولين وسكان المجتمع المحلي للتعرف على الآثار الاجتماعية والاقتصادية (الإيجابية والسلبية) التي قد تحدث نتيجة عمل المشروع ، مع إيلاء إهتمام خاص لاي قضايا متعلقة بالنوع الاجتماعي. التقييم الأوّلي للأثر الإجتماعي-الإقتصادي على المجتمعات المحلية في المواقع المستهدفة سيتطرق للنواحي الإقتصادية و الصحية و الإجتماعية و نواحي البنية التحتية للعمل بجميع مراحله (مرحلتي الإنشاء و التشغيل).

تفاصيل نشاطات المشروع (الإنشاءات)

1. **نقل المواد والمعدات اللازمة**
2. **ازالة هياكل** أو صخور أو اشجار وغيرها لضمان وصول المعدات إلى مواقع العمل.
3. **تسوية/تدريج الارض**: (تحضير موقع العمل لإنشاء سطح مستو يسمح بـتشغيل المركبات ومعدات البناء بأمان وتشمل هذه العملية إزالة الطبقة السطحية من التربة و/أو فائض).
4. **حفر خنادق للتمديدات** بإستخدام آليات للحفر و/أو تكسير الصخور.
5. **مد الأنابيب** : جميع العمليات اللازمة لمواءمة الأنابيب وثنيها لتتناسب مع التضاريس ; اللحام وفحص المفاصل ; وخفض الأنابيب في الخندق. هذه الأنشطة التي تتم بإستخدام المعدات الميكانيكية الثقيلة من قبل فرق العمل المتخصصة.
6. **ردم الخنادق**
7. **الإعادة إلى الوضع السابق**: تثبيت للمنحدرات ; إزالة طرق الانشاءات ; اعادة الطبقة السطحية للتربة ; التسميد ، وزرع البذور ، والري.
8. **تزويد الآليات بالوقود**
9. **إنتاج النفايات**: معظم الأنشطة المذكورة أعلاه سوف تنتج النفايات الصلبة أو السائلة. هذه النفايات سوف يتم تخزينها ونقلها إلى موقع للتخلص منها.

❖ النواحي الإقتصادية

❖ **كيف سيؤثر المشروع من النواحي الإقتصادية على المجتمع المحلي في مرحلتي الإنشاء و التشغيل؟**

نواحي أخرى؟	*سبل المعيشة*	*تكاليف الخدمات*	*العقارات*	*حركة المواصلات*	*حركة السوق*

- o التأثيرات الإيجابية
- o التأثيرات السلبية
- o هل هناك تأثيرات متعلقة بالنوع الإجتماعي بشكل خاص؟

❖ النواحي الصحية و البيئية

❖ **كيف سيؤثر المشروع على النواحي الصحية و البيئية للمجتمع المحلي في مرحلتي الإنشاء و التشغيل؟**

نواحي أخرى؟	*الهواء (تلوث/غبار)*	*النظافة العامة للشوارع و المساكن*	*الإزعاج*

- o التأثيرات الإيجابية
- o التأثيرات السلبية
- o هل هناك تأثيرات متعلقة بالنوع الإجتماعي بشكل خاص؟

❖ النواحي الإجتماعية

❖ **كيف سيؤثر المشروع على المجتمع المحلي من النواحي الإجتماعية في مرحلتي الإنشاء و التشغيل؟**

نواحي أخرى؟	*مخاطر إجتماعية*	*الصورة الإجتماعية للمنطقة*	*الحركة في المنطقة*	*النشاطات الإجتماعية*	*العلاقات الإجتماعية*

- o التأثيرات الإيجابية
- o التأثيرات السلبية
- o هل هناك تأثيرات متعلقة بالنوع الإجتماعي بشكل خاص؟

❖ البنية التحتية

❖ **كيف سيؤثر المشروع على المجتمع المحلي من نواحي البنية التحتية في مرحلتي الإنشاء و التشغيل؟**

نواحي أخرى؟	*الكهرباء*	*المياه*	*الشوارع*

- o التأثيرات الإيجابية
- o التأثيرات السلبية
- o هل هناك تأثيرات متعلقة بالنوع الإجتماعي بشكل خاص؟

ANNEX 6- SOCIAL ASSESSMENT RESEARCH TOOL IN ENGLISH

Introduction:

The Water Authority of Jordan, in coordination with MWH/Arabtech Jardaneh is developing a project funded by the Millennium Challenge Corporation to enhance the current situation of wastewater services in Al-Zarqa. This will be done through the expansion of the network to serve currently un-serviced areas as well as the rehabilitation of the existing wastewater network to better cope with the current use and the expected use in the future. A multi-disciplinary research team is conducting a preliminary socio-economic impact assessment to evaluate the project's impact both during construction and operation.

This interview/discussion is part of this preliminary assessment as the research team is interviewing key stakeholders (local authorities, residents, business owners, etc…) to point out social and economic impacts (both negative and positive) that may arise as a result of the proposed project. The focus of this research is to evaluate impacts of this project from a social perspective by addressing economic, environmental, social, and infrastructural issues that may be affected throughout the project's timeline.

Project's detailed activities
1. Transportation of required materials and machinery 2. removal of man-made structures, obstructions, trees or other tall plants from the construction area to ensure that it can be accessed by machinery equipment 3. Land grading to prepare work area for machinery to operate safely 4. Digging trenches for the pipes using mechanical excavators and rock crushers 5. Laying out the pipes: includes bending the pipes to match the topography, welding them and laying them in the trenches. 6. Backfilling the trenches 7. Reinstatement and restoration of the work area: includes removal of work road, restoring topsoil, fertilizing, seeding, and watering new plants in place of removed ones. 8. Fueling the machinery used during construction 9. Waste generation: most of the activities listed above will generate solid and liquid waste. This waste will require storage before being moved to its disposal location

- Economic Impacts

How will the project affect the economic dealings of the local community both during construction and afterwards (operation)?

Market activity	Transportation	Land values	Operational costs	Living standards	Other?

  - Positive impacts
  - Negative impacts
  - Are there any gender-specific impacts?

- Health/Environmental Impacts

How will the project affect health/environmental aspects within the local community both during construction and afterwards (operation)?

Noise	Public cleanliness	Air quality (pollution)	Other?

  - Positive impacts
  - Negative impacts
  - Are there any gender-specific impacts?

- Social Impacts

How will the project affect the social dealings of the local community both during construction and afterwards (operation)?

General social interaction	Social activities	Mobility issues	Social image of area	Social dangers	Other?

  - Positive impacts
  - Negative impacts
  - Are there any gender-specific impacts?

- Infrastructural Impacts

How will the project affect the infrastructure of the area/neighborhood?

Roads / Transportation	Water	Electricity	Other?

  - Positive impacts
  - Negative impacts
  - Are there any gender-specific impacts?