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Al Ghabawi Septic Tank Facility Project

Environmental and Social Impact Assessment Report

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Table of Contents

Annexes

List of Tables

List of Figures

Abbreviations

AEI	Average Exposure Indicator
AGTP	Ain Ghazal Treatment Plant
AL	Aerated Lagoons
amsl	above mean sea level
ASL	Amman Silicified Limestone
BOOT	Build–Own–Operate–Transfer
BOT	Build–Operate–Transfer
BUR	Biennial Updated Report
CBD	Convention on Biological Diversity
CDA	Civil Defence Authority
CESMP	Construction Environmental and Social Management Plan
CIA	Cumulative Impact Assessment
CLO	Community Liaison Officer
CSO	Civil Society Organisation
CSR	Corporate Social Responsibility
DLS	Department of Lands and Survey
DoA	Department of Antiquities
EBRD	European Bank for Reconstruction and Development
EEC	European Economic Community
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMARCU	Environment Monitoring and Research Central Unit
ERC	Environmental Research Centre
ESHS	Environmental and Social Health and Safety
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ET0	Crop Evapotranspiration
EZPS	East Zarqa Pumping Station
FS	Feasibility Study
GHG	greenhouse gases

GoJ	Government of Jordan
H_2S	Hydrogen Sulphide
HCM	Highway Capacity Manual
HR	Human Resources
IBA	Important Bird Area
IHE	Intestinal Helminths Eggs
INDC	Intended Nationally Determined Contribution
JISM	Jordanian Institute for Standardization and Metrology
JS	Jordanian Standard
JVA	Jordan Valley Authority
LOS	Level Of Service
LRP	Livelihood Restoration Plan
MBBR	Mixed Bed Bio-Reactor
MCC	Manual Classified Count
MEMR	Ministry of Energy and Mineral Resources
MoA	Ministry of Agriculture
MoEnv	Ministry of Environment
MoH	Ministry of Health
MoL	Ministry of Labour
MoT	Ministry of Transport
MoTA	Ministry of Tourism and Antiquities
MSDS	Material Safety Data Sheets
MWI	Ministry of Water and Irrigation
NGO	Non-Governmental Organisation
NH_3	Ammonia
NMHC	Non-Methane Hydrocarbons
NRA	Natural Resources Authority
O&M	Operation and Maintenance
OHS	Occupational Health and Safety
PE	Population Equivalent
PIU	Project Implementation Unit
PM	Project Manager
$PM_{2.5}$	Particulate Matter

PMU	Performance/Project Monitoring Unit
POPs	Persistent Organic Pollutants
PPE	Personal Protective Equipment
PR	Performance Requirement
RSCN	Royal Society for the Conservation of Nature
RSS	Royal Scientific Society
RTMS	Real-Time Monitoring System
SPC	Samra Plant Company
THMs	TriHaloMethanes
TIA	Traffic Impact Assessment
ToR	Terms of Reference
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
URC	Um Rijam Chert-Limestone
VOCs	Volatile Organic Carbons
WAJ	Water Authority of Jordan
WWTP	Waste Water Treatment Plant

Executive Summary

Background

The Ministry of Water and Irrigation (MWI) and the Water Authority Jordan (WAJ) have approached the European Bank for Reconstruction and Development (EBRD) to support the preparation and financing of the construction of a new septic tank facility to replace and relocate the existing facility at Ain Ghazal Treatment Plant (AGTP). The Tanker Discharge Facility at AGTP has been causing odour, local noise pollution and increased traffic problems especially for the surrounding communities. This necessitated the need to find an appropriate solution to resolve its issues; and be able to cater for growing demand. Moreover, the septage from the tanker discharge facility at AGTP is conveyed along with collected wastewater via a conveyor line to As Samra wastewater treatment plant where the high biological loading coming from septage has been affecting the design capacity of As-Samra WWTP creating problems for its operator. Accordingly, a new septic tanker discharge facility has been proposed to be located at Al Ghabawi ("the Project") and the tanker discharge facility at AGTP will be decommissioned.

An Environmental and Social Impact Assessment (ESIA) study has been prepared for the Project in line with EBRD's Environmental and Social Policy (ESP) and Performance Requirements (PRs) of 2014 as well as Jordan's local regulations including Environmental Impact Assessment Regulation No. 37 for year 2005. This executive summary of the ESIA presents a brief overview of the Project, its stakeholders, benefits, environmental and social risks and impacts along with their management measures.

Project Overview

This project involves the development of a completely new septage receiving facility and wastewater treatment plant (WWTP) on the land plot No. 63, basin No.1 at Al Ghabawi/ Al Madouneh Area. This project area is 300 dunums and is located approximately 20 km to the east of Amman in Al Ghabawi area next to Al Ghabawi solid waste landfill site. The Project's location between Amman and Zarqa governorates and the proximity to most districts facilitates the transportation of septage tankers from most localities. Moreover, the roads leading to the plant are considered to be easily accessible for tankers. There are no residential areas within at least 5 km radius of the proposed site. The topography of the site is featured by gentle to moderate ground slopes with storm-water natural wadi running from the north-west to the south-east corner of the site. The surrounding facilities within a close proximity to the proposed Project site include Al Ghabawi solid waste landfill site, Amman Strategic Reserve Terminal for Petroleum Products, a cow farm, and Amman Asia Electric Power.

The influent wastewater into the WWTP will be from tankers transferring septage from the unsewered areas of Amman and Zarqa Governorates, in addition to sludge transported from the treatment plants of Salt, Fuheis, and Baqa'a. The WWTP will be designed to treat a future inflow of approximately 22,500 m^3/day up to the year 2045.

The proposed wastewater treatment process for Al Ghabawi WWTP is a Conventional Activated Sludge process followed by sludge treatment using aerobic digestion. The process will involve the following treatment steps:

- Preliminary Treatment to protect equipment at the plant and improve wastewater treatment.

- Primary Treatment to remove the majority of suspended solids in the wastewater.
- Secondary Treatment, which is a biological treatment system that oxidizes both suspended and soluble organic materials providing greatest improvement in the effluent quality.
- Tertiary Treatment which involves processes to provide high quality effluent.
- Sludge Treatment to treat the sludge to become well stabilized so as to prevent odour emission and to reduce pathogens and volume.

In line with Jordan's water strategy all wastewater needs to be treated and used as a replacement of fresh water and utilized by the agricultural sector. The effluent wastewater will be treated to comply with JS 893/2006 on the reuse of treated wastewater, the EU Directive (91/271/EEC) on urban wastewater treatment, and the 2006 WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater. The options for the reuse of the treated effluent include discharge into nearby wadi, reuse for irrigation at the agricultural investment areas and the green belt area indicated by GAM's land use master plan for East Amman, and reuse by the local community for restricted irrigation purposes. At this stage of the Project development, the treated effluent reuse option is discharge into the nearby wadi.

The Project construction phase is expected to last for around 24 months and the Project lifetime is 50 years. The anticipated workforce during the construction phase will be a peak of 300 persons (for a 4-months peak period). However, the required workforce for the WWTP operation phase is around 30 employees.

The Ghabawi WWTP's operational activities as well as physical facilities will be owned by the Government of Jordan through MWI. It is expected that the project components will be operated by WAJ, either directly or through an agreement with a third party like Miyahuna.

Existing Environmental and Social Conditions

The existing environmental baseline conditions for the within the Project site and its surrounding are as follows:

- Climate: The project area has an average minimum temperature of 3.5°C recorded during January and maximum temperature of 34.3°C during August. Annual average precipitation is around 84 mm and the majority of the rain (more than 80%) occurs during December to March. Westerly winds prevail within the Project area.
- Air Quality: Air quality data show that H_2S exceeds the allowable limits as per Jordanian ambient air quality standards (JS 1140/2006). This elevated level of H_2S is attributed to operations at the neighbouring Al Ghabawi solid waste landfill.
- Noise Levels: Noise levels at the Project site are below the limits indicated by the Jordanian Guidelines for Prevention of Noise (2003) for residential areas.
- Topography, Geology and Geomorphology: The Project site is semi-flat with a gentle slope towards the north-east with elevations ranging between 775 to 795 m above mean sea level. The surface is a soft, thick bedded chalky marl and chalky limestone, which acts as an impermeable barrier to water flow. The site lies in a chalk marl unit called Muwaqqar formation consisting of soft, thick-bedded chalky marl, marl and chalky limestone with bedded nodules of microcrystalline limestone and chert.
- Surface Water: the site does not contain and is not close to any surface water resource. In

terms of surface water runoff, the catchment area contributing storm water runoff towards Al Ghabawi WWTP site is limited to the project site itself and is found to be relatively small and can be discharged without flooding the receiving adjacent water courses (i.e., wadis), which are dry most of the year and prone to high evaporation rates (reaching around 2,222 mm/year).

- Groundwater: The project site is considered to be located within the Zarqa groundwater basin. However, there is no shallow groundwater present in the project area rendering the chances for groundwater pollutions as very low.
- Landscape and Aesthetics: The area and its surroundings are characterized as barren land with no vegetative cover. Due to its proximity to the existing solid waste landfill site and the prevalent wind direction in the area, trash bags can be found scattered within the site and mostly to the southern side.
- Climate Change: the potential climate change implications foreseen for Al Ghabawi WWTP Project include impacts from the rising temperature on the anaerobic ponds in the primary and secondary treatment stages and the sludge treatment process as well as on the per capita water demand during heat waves and implications of this seasonal increase on the WWTP capacity. Moreover, the likelihood of future intensification of energy price shocks on international energy markets will have implications on the operating cost of the WWTP.
- Biodiversity:
  - The vegetation cover within and around the site is already degraded and high disturbance have been found due to proximity to AlGhabawi landfill. The recorded flora species at the proposed site and its surrounding areas are common species found in similar habitats in other parts of the country.
  - No herpetofaunal, mammal, or significant bird species were recorded within the site. Absence of herpetofaunal species can be explained by the degraded vegetation cover and the cold weather during the site survey carried during the month of November which limits herpetofaunal activities. Despite the timing of the site survey, the degraded nature of the site and its proximity to an existing landfill operation does not present an ideal habitat for fauna species.
  - The site is not located within or close to sensitive habitats (i.e., protected areas, IBAs, and rangeland reserves).
  - No priority biodiversity features or critical habitat, as per EBRD PR6, has been identified on site or in the immediate surrounding area.

With respect to social conditions, the closest community is Qa'four, which is located at a distance of around 8 km from the Project site. At 11 to 13 km from the Project site, there are the villages of Al Madouneh, Al Manakher, Mghayer Muhanna, Khashafieh South, Khashafieh North, and Al Baidah. These are the closest communities to the Project site and they fall mostly within Uhud area under Sahab district, except for Mghayer Muhanna village which falls under Muwaqqar district. The total population of these villages is 30,662 individuals. The main sectors of employment for the population of those villages are the public sector and the armed forces, and a large portion of individuals who own a business or are self-employed. One in 10 households reported owning and breeding livestock as a livelihood. The unemployment rate in those areas is 20% according to the household survey.

The Project area is considered to be barren land that is unsuitable for agriculture. GAM classifies the Project location under the "strategic services" area. The project site is located directly to the east, and adjacent to, the Al Ghabawi solid waste land fill site operated by Greater Amman Municipality (GAM). The surrounding facilities found within a close proximity to the proposed Project site include:

- Al Ghabawi solid waste landfill site located directly next to the project site.
- Amman Strategic Reserve Terminal for Petroleum Products located 1.5 Km to the south of the site.
- A cow farm around 3 km south from the Project site.
- Amman Asia Electric Power, which is around 12 km south-west of the Project site.

Existing power lines (medium voltage) are also available on the main road. In addition, the project site already has communication/mobile network coverage.

The Project site can be reached by existing access roads from Zarqa and Amman (12 Km from Amman Development Corridor Road).

With respect to archaeology and cultural heritage, no potential archaeological sites were found in close proximity or within the 1.5 km buffer zone for the Project area.

PROJECT STAKEHOLDERS

The Project's stakeholder groups, were identified to include the following:

Internal Stakeholders

- Project Owner: Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ).
- Direct Workers/ employees: This includes WAJ male and female employees involved in this project. This includes temporary and part-time workers.
- Contractors/ Sub-contractor workers: Contracted Workers and those employed by third parties such as the Contractor and/or sub-contractor. This includes temporary and part-time workers.
- Operator's O&M Team: Personnel responsible for the operation and maintenance of the septic tank facility during the operation phase of the project.
- Tanker operators/ owners: Tanker operators will be responsible to collect and transfer the septage from the unsewered areas of Amman and Zarqa Governorates, in addition to sludge from the treatment plants of Salt, Fuheis, and Baqa'a and will transport them to the septic tank facility at Al Ghabawi.

External Stakeholders

- Local Authorities: including Ministry of Environment (MoEnv), Ministry of Labor (MoL), Ministry of Transport (MoT), Ministry of Health (MoH), Ministry of Energy and Mineral Resources (MEMR). Ministry of Tourism and Antiquities (MoTA), Greater Amman Municipality (GAM) and relevant municipalities, Civil Defence Authority, and Miyahuna.
- Members of the local community and villages living within the project surroundings.
- Vulnerable Groups including women, youth, and Syrian refugees.
- Local communities within the areas to be served which are households residing in areas that are un-sewered within Amman and Zarqa Governorates. These households are currently

served by the existing septic tank facility at Ain Ghazal Treatment Plant, and will eventually be served by the proposed Project, although the activity of septage removal and transport by tankers will not change.

- Non-Governmental Organizations (NGOs)/ Civil Society Organisations (CSOs) within the project area and its surroundings such as East Amman Society for Environmental protection, Roboua Al Manakher Society, Al-Bayida' Society (charity), Maghayer Muhanna Society, and Khashafiyeh Dabaybeh Society.
- Neighbouring facilities: The closest facilities surrounding Al Ghabawi septic tank facility project which are Al Ghabawi landfill, Electricity generating company Amman East, Reserve terminal for petroleum products, Cattle farm, and other facilities under construction.
- International Financing Agencies/ Donors and International NGOs working in the infrastructure sector in Jordan.

Public Consultation and Stakeholders Meetings

A public consultation session was held as part of the ESIA study to identify the issues of concern raised by stakeholders throughout different phases of the project. The identified E&S issues identified to be of significant concern include:

- Significant E&S issues during construction:
  - Occupational health and safety concerns.
  - Air quality concern due to dust and emissions from vehicles and equipment.
  - Impact of high noise levels and vibrations on occupational health.
  - Soil pollution due to accidental leakage of oil and fuel.
  - Traffic accidents.
  - Impact on land value for surrounding areas.
  - Work conditions for the labour force in terms of number of work hours and salary pay.
  - Positive impact of creating job opportunities to youth from surrounding communities.
- Significant E&S issues during operation:
  - Odour generation.
  - Occupational health and safety concerns.
  - Impact on groundwater.
  - Impact on air quality and their implication on health for the surrounding community.
  - Sludge handling after the 7 years period.
  - Increase in traffic accidents and potential impacts on traffic due to movement of septage tankers from Amman and Zarqa towards Ghabawi.
  - Potential change in the fees paid for transporting the septage to the new Ghabawi WWTP.
  - Monitoring of the septic tankers so they do not empty the septage illegally.
  - Concern for potential of odour generation from the stored dried sludge.
  - Cumulative impacts on air quality, odours and traffic.
  - Potential effect on land prices within the surrounding area.
  - Work conditions for the labour force.
  - Contribution of the Ghabawi WWTP to greenhouse gas emissions.

- Cumulative impacts due to Al Ghabawi WWTP in relation to odour generation, air quality, soil and water quality.
- Potential to use the Ghabawi WWTP to treat the leachate coming from the Ghabawi landfill.

Additional stakeholder consultation meetings and a household survey were carried out with local community stakeholders to engage them early on and understand their concerns together with managing their expectations. The meetings outcomes are documented in the Project's Stakeholder Engagement Plan (SEP) and the household survey findings are discussed throughout the ESIA report.

Environmental and Social Benefits

In addition to resolving the problem of odour nuisance and traffic around AGTP current location, a list of additional E&S benefits associated with the project implementation are presented in Table S1.

Table S1. Potential E&S benefits identified in relation to Project implementation

Parameter	Potential Benefits
Construction Phase	
Employment Opportunities	- Generation of employment opportunities to local community during construction phase.
Operation Phase	
Air quality	- The Project operation will lead to a significant reduction in the odour nuisance for the surrounding communities at the old project site of the septic tankers receiving facility at Ain Ghazal.
Water Resources	- Positive impact of securing additional irrigation water supply for areas surrounding the Project.
Employment Opportunities	- Potential positive impact of employment opportunities for local community.
Infrastructure	- The septage from the septic tank receiving facility at AGTP has been creating a high biological loading affecting the design capacity of As-Samra WWTP. Accordingly, the new septic tank receiving facility at Al Ghabawi ("the Project") will solve the problem of biological overloading at As-Samra WWTP, thereby improving wastewater treatment capacity.
Transfer of Skills	- The Project will contribute to transfer of skills in wastewater treatment technologies to operator staff as well as project owner.

Environmental and Social Risks and Management Measures

Table S2 presents the E&S potential impacts considered to be of concern and their management measures.

Table S2. E&S potential risks and management measures required for Project implementation

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Construction / Decommissioning Phase				
Air Quality	- Odour and dust due to activities carried at the neighbouring Ghabawi landfill. - Air pollution due to exhaust gas from construction machinery and vehicles. - Dust due to excavation works and machinery movement over unpaved roads.	Minor	The Contractor is required to: - Conduct 24-hour air quality monitoring for $PM_{2.5}$, H_2S, and NH_3 each month. - Carry out proper management of vehicles and equipment. They should be switched off when not in use and kept in good technical condition. - Suppress dust scattering by sprinkling of water on a as needed basis. - Properly stockpile (friable materials) and cover truck loads to minimize dust generation.	WAJ supported by Supervision Engineer to: - Observe and carry out site inspection for dust. - Review the results of the one day of air quality monitoring for $PM_{2.5}$, H_2S, NH_3 and report instances of exceeding the limits set by JS 1140/2006 and by EU Directive 96/62/EC - Air quality framework directive. - Review complaints records for number of complaints recorded.
Soil	- Soil Pollution resulting from potential leakage of small amounts of oil from construction machinery and vehicles. - Improper handling of small amounts of solid and/or liquid waste.	Minor	The Contractor is required to: - Maintain the machinery and vehicles. - Have a spill response plan to control any leakage or spill. - Maintain proper housekeeping site. - Properly collect and dispose of solid and liquid wastes in line with legal requirements and maintain records as proof of the safe disposal of wastewater, solid waste in approved landfills, and hazardous waste in Swaqa landfill. - In case of having temporary fuel tanks onsite, use secondary containment tanks to control accidental leakages.	WAJ supported by Supervision Engineer to carry out site inspection and observations such as checking for oil leakage from construction machinery and vehicles, review waste manifests and the permit of approved disposal sites, etc.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Biodiversity	- Birds exposed to potential risk of being hunted by Project workers, especially during the migration season.	Major	The Contractor is required to: - Prohibit workers from hunting.	WAJ supported by Supervision Engineer to carry out site inspection and observations.
Community Health and Safety	- Disturbance to local community caused by project construction activities.	Minor	WAJ through the Contractor to: - Appoint two Community Liaison Officers (CLOs) to manage community related matters for the project and the community grievance mechanism.	WAJ with the assistance of CLOs to: - Monitor grievance log and ensure all complaints are addressed. - Ensure project area is secure and access is well monitored.
Labour & Working Conditions	- Potential employment of child labour or forced labour.	Minor	The Contractor to: - Ensure that labour, health and safety, and recruitment are all in line with Jordanian laws and the requirements of EBRD PR 2 are in place. - A Grievance Mechanism is available for all workers and employees. - Employing workers under the minimum age of 18 for employment is not allowed nor is the use of force or compulsory labour.	Contractor, Supervising Engineer and WAJ to: - Ensure that systems are in place to monitor compliance with labour and health and safety standards. - Appoint a manager on site to be responsible for ensuring that labour and health and safety legislation is complied with. - Review the employee's grievance log sheets.
Occupational Health and Safety Risks	- Occupational Health and Safety risks to labour working in the project site including potential exposure of construction personnel and site workers to injuries and safety events.	Severe	The Contractor to: - Develop an Occupational Health and Safety (OHS) Plan that complies with Jordanian and EBRD OHS related policies and procedures that is based on emergency plans prepared prior to commencement of work.	Contractor, Supervising Engineer and WAJ to: - Daily site inspection and auditing to check for compliance with OHS procedures. - Monthly review of inspection records, records on reported injuries or accidents, trainings conducted, and records of mock up drills on site.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Transportation	- Temporary increase in traffic load due to light and heavy vehicles and construction equipment travelling to and between the site and both Amman and Zarqa.	Minor	The Contractor to ensure that: - All trucks and vehicles accessing the facility are operated by licensed operators and comply with speed limits and signs. - Vehicles are adequately maintained and inspected. - Entry and exit points at the Project site are controlled.	Contractor to: - Maintain open dialogue with Al Ghabawi landfill personnel as it is located adjacent to the project area. - Monitor vehicle movement to and from the Project area.
Cultural Heritage	- Potential for accidental encounter of archaeological remains or relics during excavation.	Negligible	The Contractor to: - In case of coming across any artefacts during excavation works, follow chance procedure including stopping the work and informing Department of Antiquities (DoA).	Contractor, Supervising Engineer and WAJ to: - Carry our observations on existence of any artefacts at construction site. - Review records of coordination with MoTA/DoA.
Operation Phase				
Air Quality/ Odour	- Odour nuisance due to WWTP operations	Minor	The Operator to: - Ensure availability of an odour control system. - Once per month, carry 24 hours of air quality measurements for $PM_{2.5}$, H_2S, and NH_3. - Reduce the work hours for workers in exposed areas. - Develop an Odour Committee to check on odour within the WWTP. - Have a green barrier around the Project to assist in reducing odours and emissions.	WAJ to: - Review results of air quality monitoring measurements within the WWTP site. - Ensure that the Odour Committee meet and document the odour at the WWTP. - Review the records on odour complaints.
Greenhouse Gas Emissions	- GHG emissions mainly contributed by electricity consumption from the national network grid.	Minor	Design team to: - Consider energy efficiency in Project design to reduce energy demand (already considered but to be refined).	Operator to: - Prepare an annual estimation of GHG emissions by the WWTP.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Water Resources	- There is no negative impact on water resources within the study area. Still, it is required to implement a water quality monitoring program from the water well nearest to the Project site in order to ensure protection of groundwater sources.	-	-	Operator to: - Maintain records proving the safe disposal of solid waste at approved landfills and hazardous waste at Swaqa hazardous waste landfill. - Implement a groundwater monitoring program.
Sludge Handling	- Potential for odour and/or insect nuisance from onsite sludge stockpiling.	Minor	The Operator to: - Ensure proper stabilization of the treated sludge. - Review records of odour and/or insect complaints. - WAJ and Operator to develop a long-term strategy for handling the treated sludge.	WAJ to: - Check that the long-term plan for sludge handling has been prepared.
Biodiversity	- Potential attraction of birds and/or mammals to open wastewater tanks.	Minor	The Operator to: - Ensure the site is fenced and proper means are used to prevent birds and/or mammals from landing on open influent wastewater. - Prohibit workers from hunting.	WAJ to: - Observe availability of fencing and control measures.
Local Community Perceptions	- Potential community concerns from environmental impacts and public health impacts from the project	Severe	The Operator to: - Appoint one CLO to manage the grievance mechanism. - Have an odour control system and an odour monitoring committee. - Implement WAJ's existing Grievance Mechanism. - Implement initiatives related to maintaining social responsibility with the local community in line with WAJ's "Social Responsibility Strategy".	Project Operator and WAJ to ensure the implementation of the SEP throughout the project operation phase including maintaining of stakeholder consultation records and records of grievance logging and reporting.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
			- Allow only septage tankers that are tracked electronically by the Ministry of Environment. - Adopt strict monitoring system to ensure the quality and type of the septage received.	
Community Health and Safety	- Potential safety hazards to local community and tanker drivers entering and exiting the site.	Minor	The Operator to control the entrance and exit into the facility as a safety procedure.	Project Operator and WAJ to ensure Project area is secure and access is well monitored.
Occupational Health and Safety	- Potential occupational health and safety impacts on workers associated with working at the WWTP.	Major	The Operator to: - Develop an Occupational Health and Safety (OHS) Plan that complies with OHS related policies and procedures complying to local Jordanian requirements, as well as EBRD requirements where applicable. - Enforce the use of PPEs, use of inspected equipment, proper handling of hazardous material, use of warning signs, availability of first aid kits, etc. - Allocate specific personnel to be responsible for health and safety management on site. - Ensure adequate and appropriate training of all workers on the contractor's OHS policies and procedures. - Prepare emergency plans for the operation areas. - All workers should undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies and provide worker immunization (e.g. for Hepatitis B and tetanus).	Project Operator and WAJ to: - Regularly inspect and test all safety features and hazard control measures. - Regularly audit for the compliance with OHS procedures. - Carry out surveillance of workers' health through periodic clinical and/or physiological assessment of individual workers. - Review records on reported injuries or accidents and the corrective action taken, records of trainings conducted, and evidence and records of mock-up drills and emergency exercises on site.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Transportation	- Potential increase in illegal dumping of transported septage due to the increase in transportation cost.	Moderate	MoEnv to monitor the tankers using the WWTP by MoEnv Online Tracking System for Wastewater Tankers.	WAJ and the operator to coordinate with MoEnv to add the location and route information of the tanker owners and drivers involved in the Project operation phase to the MoEnv's database to be tracked and undergo review for any violations done by the wastewater tankers using the WWTP.
	- Increase in traffic load within the surrounding road network during operation.	Moderate	The Operator to: - Ensure availability of warning signs for truck drivers and others using the road. - Use speed bumps or rumble strips. - Control entry and exit points at the WWTP. - Raise the driver's awareness.	Project Operator and WAJ to: - Monitor access roads around the site. - Review the records on documented incident reports.
Treated effluent not meeting the standards	- Treated effluent not meeting Jordanian and EU standards for discharge into wadi/ irrigation due to a process malfunction.	Moderate	Operator to: - Have WWTP Design controls. - Prevent discharge (operating procedures) unless quality standards achieved.	WAJ to: - Have a monitoring program for the treated effluent to ensure that it is in line with Jordanian Standard JS 893/2006 for reuse of treated wastewater and the EU Urban Waste Water Directive.
Risk of untreated wastewater overflow under emergency operation conditions at the WWTP	- As the wastewater is transported by tankers to the WWTP and the WWTP has large capacity equalization tanks, no incidences of untreated wastewater overflow are anticipated.	Negligible	The Operator to: - Maintain a record of occurrence of such emergency situations.	WAJ to: - Review the records on documented such incidences and evaluate the extent of exceedance of the equalization tanks capacity.

Component	Potential Impact	Impact Significance	Mitigation Measure(s) and Responsibility	Monitoring Measure(s) and Responsibility
Risk of chlorine gas release at the chlorination unit	- Accidental chlorine release from the chlorination unit poses occupational health risk to workers at the facility.	Moderate	The Operator to: - Have leak detection sensor for chlorine gas at the chlorine gas storage room along with a system that treats the released gas. - Material Safety Data Sheet (MSDS) information on chlorine gas. - Place warning signs and develop safety protocols, including staff training.	WAJ to: - Check for availability of safety protocols and warning signs.
Risk of industrial wastewater at the WWTP	- Receipt of industrial wastewater by the septic tankers transporting the wastewater.	Major	Operator to: - Receive wastewater from licensed municipal wastewater septic tankers. - Have a separate tank to empty tankers suspected of carrying industrial wastewater. - Adopt an influent wastewater quality monitoring program.	WAJ to: - Monitor the WWTP records for influent quality monitoring and to check that wastewater tankers are licensed as municipal wastewater septic tankers.
Risk of Fire incidents as unplanned events	- Risk to individuals available within the Project site in case of fire accidents.	Moderate	The Operator to: - Have a firefighting plan and system for the facility including planned fire drills with evacuation procedures. - Have regular inspections and maintenance for the firefighting system.	Project Operator and WAJ to: - Review available firefighting plan and a representative to attend the firefighting drills at least once annually.

1 INTRODUCTION

1.1 Background

The Ministry of Water and Irrigation (MWI) and the Water Authority Jordan (WAJ) have approached the European Bank for Reconstruction and Development (EBRD) to support the preparation and financing of the construction of a new septic tank facility to replace and relocate the existing facility at Ain Ghazal Treatment Plant (AGTP). The proposed new septic tank facility will be located at Al Ghabawi and will serve Amman and the surrounding area.

As such, the EBRD has engaged the services of the consultants to prepare a feasibility study (FS) that the Bank can use to appraise the Project and take a decision on the prospective financing including the preparation of a comprehensive Environmental and Social Impact Assessment (ESIA) study for the Project.

This Environmental and Social Impact Assessment (ESIA) report has been prepared for the Project in line with EBRD's Environmental and Social Policy (ESP) and Performance Requirements (PRs) of 2014 as well as Jordan's local regulations including Environmental Impact Assessment Regulation No. 37 for year 2005.

1.2 Need for the Project

The Tanker Discharge Facility at AGTP has been causing odour, local noise pollution and increased traffic problems especially for the surrounding communities. This necessitated the need to find an appropriate solution to resolve its issues; and be able to cater for growing demand, especially with an influx of Syrian refugees to Jordan and the impact of climate change on scarce water resources applying additional demand on municipal infrastructure. Moreover, the septage from the tanker discharge facility at AGTP is conveyed along with collected wastewater via a conveyor line to As-Samra wastewater treatment plant (WWTP) where the high biological loading coming from septage has been affecting the design capacity of As-Samra WWTP creating problems for its operator. Accordingly, GoJ engaged Engicon in 2009 and Fichtner in 2017 to investigate different alternatives to solve these issues. Both Engicon and Fichtner studies recommended the relocation of the Tanker Discharge Facility at AGTP. This Project involves the relocation of the Tanker Discharge Facility at Ain Ghazal and the development of a new septic tank receiving facility and wastewater treatment to be located at Al Ghabawi to serve Amman and the surrounding area.

1.3 Project Proponent and Funding

The Ministry of Water and Irrigation / Water Authority of Jordan (MWI/WAJ) is the owner and implementer of the project. The project is financed by the European Bank for Reconstruction and Development (EBRD).

1.4 ESIA Objectives and Report Structure

The aim of the ESIA is to identify and assess any potentially significant adverse environmental and social impacts associated with the Project, determine the measures needed to prevent, minimise, mitigate and compensate adverse impacts, and identify potential environmental and social

opportunities, including those that would improve the environmental and social sustainability of the Project. The ESIA is used for environmental permitting by Jordan's Ministry of Environment (MoEnv) and to inform EBRD's project appraisal and decision-making process. However, an update may be required at a later stage in the Project development in order to reflect the detailed design.

The report structure for this ESIA is presented in Table 1.1.

Table 1.1. ESIA Report Structure

Section	Contents
Executive Summary	Presents a summary of the ESIA background, outcomes and recommendations.
1. Introduction	Presents the Project's background, need, and ESIA objectives.
2. Project Description	Presents a brief description of the Project and associated facilities and/or activities as well as alternatives considered.
3. Analysis of Alternatives	Examines the possible alternatives related to the Project and compares them terms of potential environmental and social impacts.
4. Regulatory Framework	Identifies the pertinent regulations and standards governing the environmental and social performance of the Project.
5. ESIA Approach	Describes the approaches adopted in conducting the ESIA study.
6. Environmental and Social Baseline Conditions	Describes the current environmental and social status (baseline) of the planned Project area and its surroundings.
7. Project Stakeholders and Consultation	Identifies potentially affected stakeholders and interested parties with including identifying vulnerable people or groups who could be disproportionately affected by the project. It also presents the results of the consultation with the identified stakeholders.
8. Assessment of Environmental and Social Impacts	Identifies the potential environmental and social impacts associated with the Project implementation.
9. Mitigation Measures	Presents the mitigation measures needed to avoid, minimize, mitigate or compensate for the potentially identified adverse future impacts, issues and/or risks.
10. Monitoring Measures	Presents the monitoring measures to follow on impacts and their mitigation measures.
11. Environmental and Social Management Plan	Describes the environmental and social avoidance, minimisation, mitigation, compensation and monitoring measures identified for the Project stages in an Environmental and Social Management Plan (ESMP).
12. Conclusion	Lists the main findings of the ESIA study and the needed next steps.
13. References	Lists the references used in the preparation of the ESIA report.
Annexes	Annex 1 to Annex 12

2 PROJECT DESCRIPTION

This project involves the development of a completely new septage receiving facility and wastewater treatment plant (WWTP) in Al Ghabawi area to be located on a land plot designated by MWI in order to treat the flow of septage from Amman and Zarqa Governorates. The Project description is presented below.

2.1 Project Location

The project location is about 25 to 30 Km to the east-south-east direction from the AGTP depending on the route taken to reach the site. The Project is assigned an area of 300 dunums on the land plot No. 63, basin No.1 at Al Ghabawi/ Al Madouneh Area. This plot is owned by the Government of Jordan and assigned to WAJ. The land coordinates are shown in Table 2.1 and its area is shown in Figure 2.1.

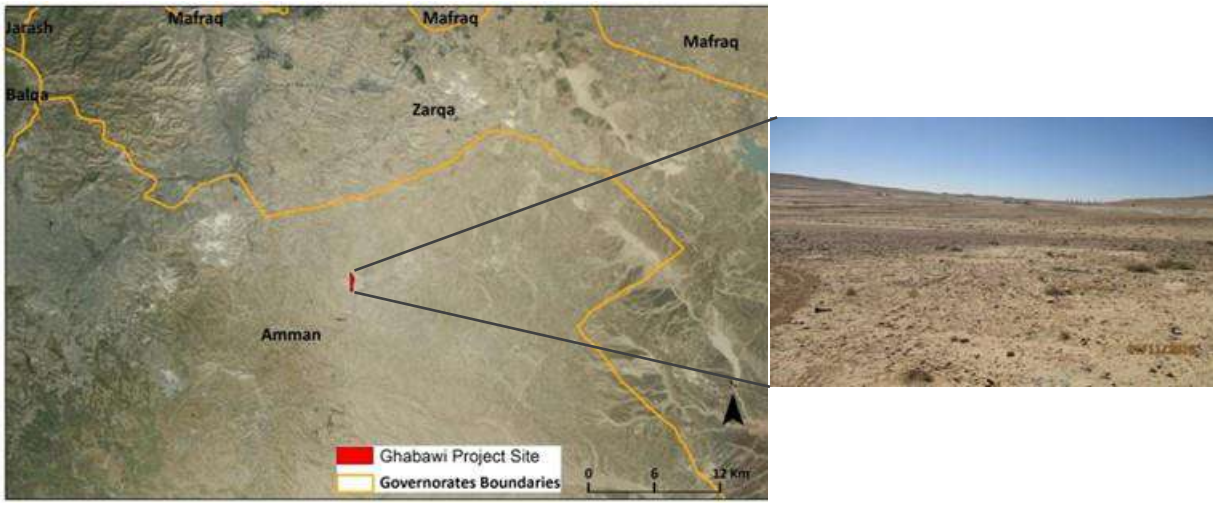
Table 2.1. Coordinates of the Project land plot at Ghabawi

Coordinate Point No.	PAL_X	PAL_Y	LONG	LAT
Point 1	263216.8636	1148504.4673	36.19589568	31.92568306
Point 2	262996.7217	1148507.4026	36.19356826	31.92572767
Point 3	262996.7217	1149616.1999	36.19367528	31.93572549
Point 4	263093.3715	1149616.4399	36.19469736	31.9357197
Point 5	263351.7639	1149154.9799	36.19738509	31.93153747
Point 6	263364.4226	1149029.9699	36.19750683	31.93040923

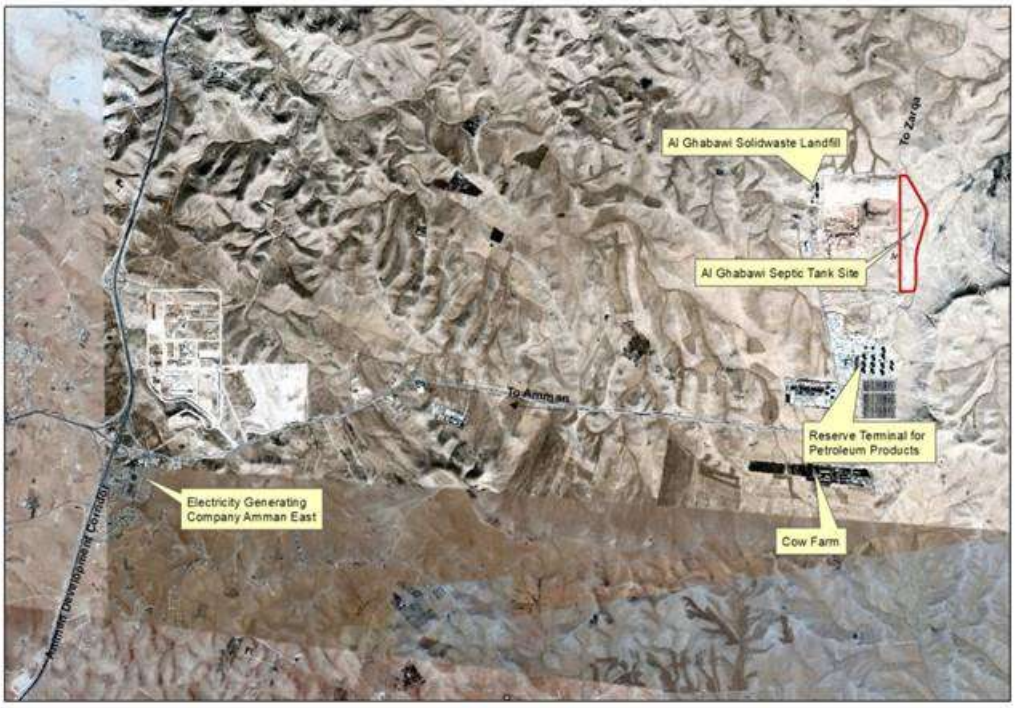
Figure 2.1. Project location and coordinate points

The project location can be reached by existing tar roads from Zarqa and Amman (12 Km from the Amman Development Corridor Road - Al Ghabawi Interchange). The Project area is located approximately 20 km to the east of Amman in Al Ghabawi area next to Al Ghabawi solid waste landfill site. The Project's location between Amman and Zarqa governorates and the proximity to most districts facilitates the transportation of septage tankers from most localities. Moreover, the roads leading to the plant are considered to be easily accessible for tankers and do not require further extension. There are no residential areas within at least 5 km radius of the proposed site. The topography of the site is featured by gentle to moderate ground slopes with storm-water minor drainage line running from the north-west to the south-east corner of the site. The Project location is illustrated in Figure 2.2(a). Figure 2.2(b) shows the surrounding facilities found to be in proximity to the proposed Project site and which include:

- Al Ghabawi solid waste landfill site owned and operated by GAM is located directly next to the project site.
- Amman Strategic Reserve Terminal for Petroleum Products that belongs to the Ministry of Energy and Minerals, is located 1.5 Km to the south of the site.
- There is a cow farm around 3 km south from the Project site.
- Amman Asia Electric Power which is around 12 km south-west of the Project site.



(a) Location of the Project land area



(b) Facilities surrounding Al Ghabawi

Figure 2.2. (a) Location of Al Ghabawi Site and (b) the facilities surrounding the site

2.2 Influent Wastewater

2.2.1 Source

The influent wastewater into the WWTP will be from tankers transferring residential septage from the unsewered areas of Amman and Zarqa Governorates, in addition to sludge transported from the treatment plants of Salt, Fuheis, and Baqa'a.

2.2.2 Quantity

The current amount of septage received at Ain Ghazal is estimated at 11,180 m^3/day (2018), delivered by more than 600 tankers. This amount is projected to reach around 16,500 m^3/day by year 2035 serving Amman and the surrounding areas, with a future projected inflow of approximately 22,500 m^3/day, serving the catchment area up to the year 2045. The future inflow is expected to be delivered by around 1,250 tankers.

In addition to the septage quantities generated from Amman and Zarqa Governorates, sludge will be transported from the treatment plants of Salt, Fuheis, and Baqa'a and its expected quantities are presented in Table 2.2.

Table 2.2. Sludge Quantities to be received from Existing WWTPs

Source of Liquid Sludge	Annual Flow Rates of Liquid Sludge (m^3)	Average of Liquid Sludge (m^3/day)
Salt WWTP	28,057	78
Baqa'a WWTP	86,629	240
Mahes and Fuheis WWTP	14,400	40
Total	**129,086**	**358**

2.2.3 Quality

The quality of the septage inflow to the proposed Al Ghabawi Septic Tank Treatment Facility was established for design purposes based on records obtained from Ain Ghazal for the period from January 2016 to September 2018. The received data that included water quality tests for Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Volatile Suspended Solids (VSS), Ammonia-N (NH_3-N), Total Kjeldahl Nitrogen (TKN), Sulphate (SO_4) and pH. Based on statistical analyses, the influent concentrations presented in Table 2.3 were adopted for the design parameters.

Table 2.3. Design loads and concentrations for Al Ghabawi Septic Tank Facility

Parameter	Unit	Influent Concentration
COD	mg/L	5,950
BOD5	mg/L	2,700
TSS	mg/L	3,300
TN	mg/L	220
Design Temperature	°C	15

2.3 Wastewater Treatment System

The proposed wastewater treatment process for Al Ghabawi WWTP is a Conventional Activated Sludge process followed by sludge treatment using aerobic digestion. This treatment process is summarized in Table 2.4 and the process and layout are illustrated in Figure 2.3 and Figure 2.4, respectively.

Table 2.4. Summary of the proposed wastewater treatment process at Al Ghabawi

Treatment Level	Objective	Processes	Comments
Preliminary Treatment	–To protect equipment at the plant and improve wastewater treatability	–Sand and rock traps to protect equipment and ensure a continuous flow to downstream treatment units. –Screening. –Aerated grit and fats, oil, and grease (FOG) removal to prevent accumulation in treatment units downstream. –Odour Control Units involving installation of biological filters and collecting the gases from the head works, the sludge	–

Treatment Level	Objective	Processes	Comments
		digesters/thickeners and the dewatering building.	
Primary Treatment	–To remove the majority of suspended solids in the wastewater	–Online equalization tank to absorb fluctuations in the incoming wastewater loads and flows and allows the downstream treatment units to operate under the preferable steady conditions. –Primary settling tanks to achieve ~60% removal of suspended solids and 30% removal of BOD via settling.	–Stored flow in the equalization tank will be continuously mixed via coarse bubble diffusers which will elevate the dissolved oxygen level. –Primary settling tanks will reduce the size and energy requirements in the secondary treatment.
Secondary Treatment	–A biological treatment system that oxidizes both suspended and soluble organic materials providing greatest improvement in the effluent quality.	–Conventional activated sludge process consisting of an aeration tank that achieves organic material oxidation as well as ammonia nitrification, an anoxic tank that achieves denitrification for nitrogen removal, and a secondary settling tank to separate the treated effluent from the activated sludge.	–
Tertiary Treatment	–processes after secondary treatment to provide high quality effluent.	–Slow Sand Filters as rectangular sand beds for removal of suspended solids, turbidity as well as viruses and bacteria removal. – Chlorination to reduce pathogen by use of the bactericide hypochlorite. To achieve disinfection, a contact time of 30 minutes must be provided at a residual chlorine concentration of 0.5 mg/l. this chlorine disinfection will provide at least 10 mg/L dose and will have a standby chlorinator. The system will have chlorine gas cylinders for 1-month use. –Effluent Reuse Tank with an effluent storage capacity of one-day.	–Rectangular sand beds are robust and require low maintenance. –For chlorination, high ammonia and suspended solids concentrations hinder the effect of chlorine on bacteria die off.
Sludge Treatment	–To become well stabilized so as to prevent odour emission and to reduce pathogens and volume	–Gravity thickened aerobic digester to provide both, aerobic sludge digestion of the primary and secondary sludge as well as gravity thickening. –Sludge Dewatering using centrifuges to reduce the sludge volume and increase its dryness to ~22% dry matter content.	–Owing to land constrains, greenhouse drying technology reduces the required area for drying, by maximizing solar energy utilization as well as providing a cover that

Treatment Level	Objective	Processes	Comments
		– Greenhouse Sludge Drying Beds will be utilised to dry the dewatered sludge up to 50% dry matter content. – Onsite stockpiling where dried sludge will be collected and stored in the stockpiling area with a capacity to stockpile up to 7 years.	protects from precipitation.

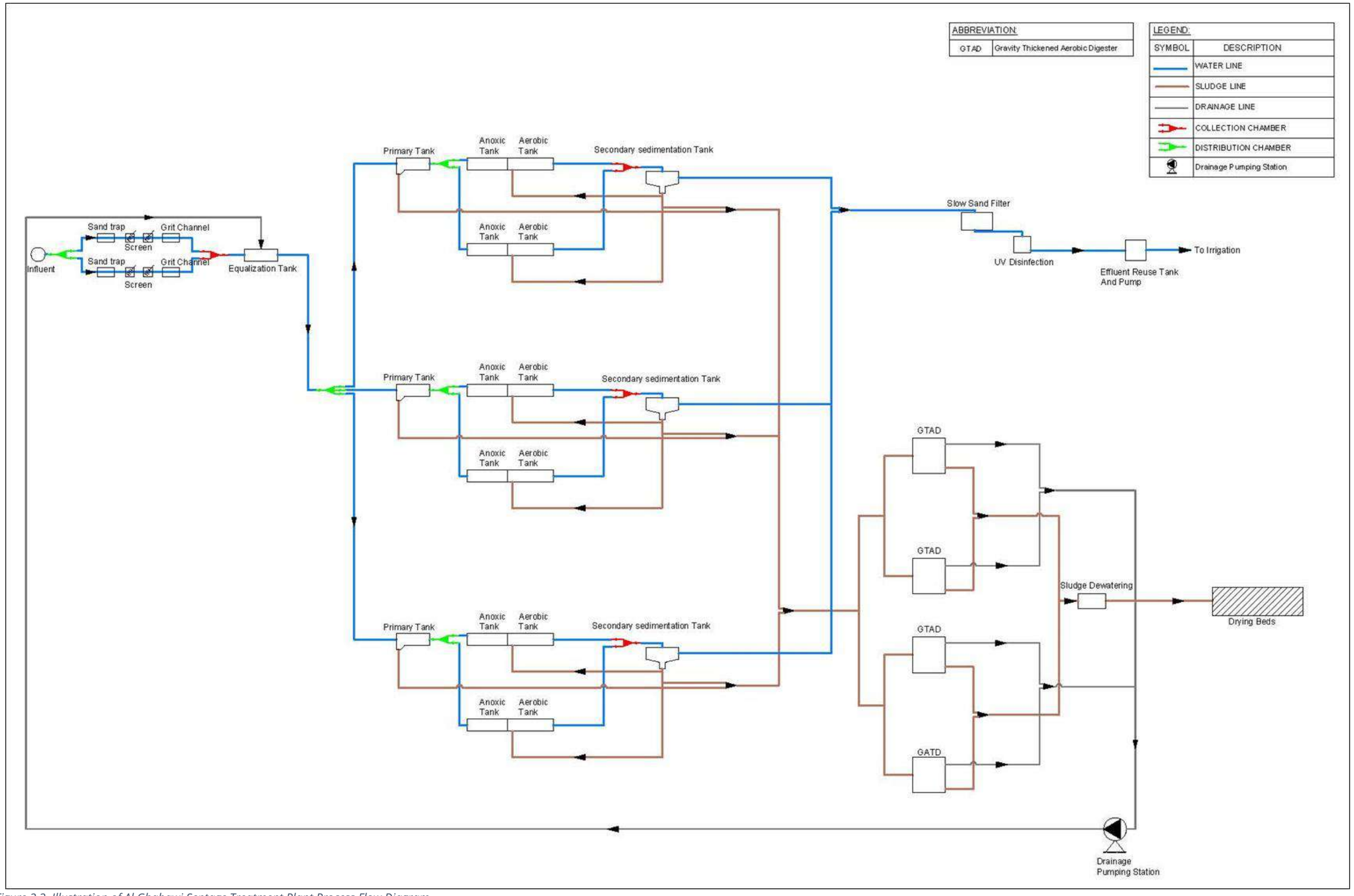
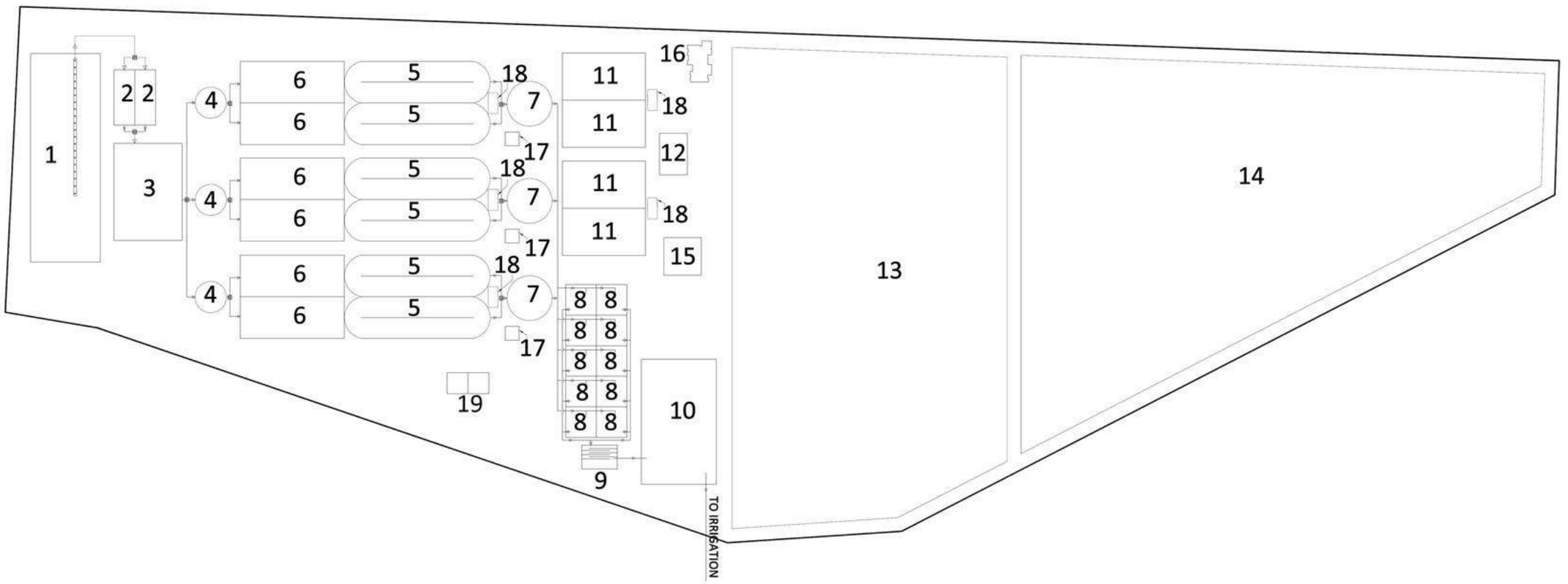


Figure 2.3. Illustration of Al Ghabawi Septage Treatment Plant Process Flow Diagram



NO	Unit Description	NO	Unit Description	NO	Unit Description	NO	Unit Description
1	Tanker discharge area	5	Aeration tank - Aerobic	10	Effluent reuse tank	15	Drainage pumping station
2	Headworks	6	Aeration tank - Anoxic	11	Aerobic digester (GTAD)	16	Admin building
3	Equalization tank	7	Secondary settling tank	12	Sludge dewatering building	17	RAS/WAS Building
4	Primary settling tank	8	Slow Sand filter	13	Drying beds	18	Blower Room (If aeration is by air diffusion)
		9	Chlorination System	14	Stockpiling area	19	Standby Generator And Electrical Room

AL-GHABAWI SEPTAGE TREATMENT PLANT
PROCESS UNITS LAYOUT

0 30 60 90 120 150
Scale 1:3000

Figure 2.4. Wastewater treatment process units' layout

2.4 Odour Control System at the WWTP

The WWTP will have an odour control system to achieve air suction and treatment from the headworks building, sludge dewatering building, sludge handling facilities, sludge tanks, and any additional structures that might emit offensive smells and harmful gases. This odour control system will be sized to achieve a minimum air change of 6 air changes per hour. The odour control system is to be a biological one.

The odour control systems will consist of the following:

- **At the septage channel:** The septage channel used by the septic tankers for emptying the transported wastewater will be covered with provision for air suction for adequate odour control.
- **At the headworks building:** it will be enclosed and equipped with adequate odour control system.
- **At the equalization tank:** it will be equipped with enough air mixing to prevent solids settling and odour generation.
- **At the sludge dewatering building, sludge tanks and sludge handling facilities:** The sludge thickeners will be covered and provided with air suction for at least 6 air changes per hour, while the dewatering building air suction will be 12 air changes per hour.

2.5 Effluent Wastewater Quality and Reuse

In line with Jordan's water strategy all wastewater needs to be treated and used as a replacement of fresh water and utilized by the agricultural sector. The Jordanian Standard (JS) 893/2006 addresses the reuse of treated wastewater and the standards for the control of the disposal of treated domestic wastewater. According to JS 893/2006, it is mandatory for all new WWTP projects to include a fully designed and feasible wastewater reuse aspect. Accordingly, the effluent characteristics shall comply with the relevant Jordanian and EU standards as discussed later on under section 4.8 on Project standards. Table 2.5 presents the characteristics of the influent wastewater as well as the effluent characteristics as per JS 893/2006 for Class A Irrigation and the EU Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment shown in Table 2.5.

Table 2.5. Design loads and concentrations for Al Ghabawi Wastewater Treatment Facility

Parameter	Unit	Influent Concentration	Target Effluent Concentration	Jordanian Standard (JS 893 / 2006)	EU Directive (91/271/EEC)	Actual Percentage Design Reduction
				Irrigation Class A	Minimum Percentage of Reduction (%)	Percentage (%)
BOD5	mg/L	2,700	30	30	70-90	98.9
COD	mg/L	5,950	100	100	75	98.3
DO	mg/L	-	<2			
TSS	mg/L	3,300	50	50	90	98.5
pH	-	6-9	6-9	6-9	-	-

Parameter	Unit	Influent Concentration	Target Effluent Concentration	Jordanian Standard (JS 893 / 2006)	EU Directive (91/271/EEC)	Actual Percentage Design Reduction
				Irrigation Class A	Minimum Percentage of Reduction (%)	Percentage (%)
Turbidity	NTU	-	10	10	-	-
NO_3	mg/L	-	30	30	-	-
TN	mg/L	220	45	45	-	79.5
P (as PO_4)	mg/L			30*	-	
E. Coli	CFU/100 ml	-	100	100	-	-
Intestinal Helminthes Eggs (IHE)	1/L		≤ 1	≤ 1	-	-
FOG (Fats, Oil, and Grease)	mg/L	-	8	8	-	-
Design Temperature	°C	15	-	-	-	-

* For discharge into wadis, the JS 893:2006 indicates the limit for P (as PO_4) to be 15 mg/L.

Three options were considered for the reuse of the treated effluent:

- Discharge into the nearby wadi;
- Reuse for irrigation at the agricultural investment areas and the green belt area indicated by GAM's land use master plan for East Amman (see Figure 3.2 under section 3.20 on analysis of alternatives); and
- Provision of the treated effluent to water users from the local community for restricted irrigation purposes.

At this stage of the Project development, the treated effluent reuse option is discharge into the nearby wadi. This wadi discharge stream is part of Al-Zarqa River basin which flows into King Talal Dam. Water from this dam is used for irrigation purposes and also receives treated wastewater from other WWTPs, including As-Samra WWTP. The other options for treated effluent reuse are discussed under section 3.2 on analysis of treated effluent reuse alternatives. However, for the purpose of the Project planning and this ESIA, the default management of treated effluent is discharge to the wadi as illustrated in Figure 2.5. The option for reuse locally for irrigation will be agreed at a later stage. It may require some infrastructure, such as a pipeline and pump station to direct treated wastewater to irrigation areas.

Figure 2.5. Wadi for discharge of treated effluent

2.6 Treated Sludge Disposal

The WWTP is expected to generate 285 m^3/day of dried sludge with a Moisture Content being >50% and Dry Matter of 62-tonnes per day. Considering the limitations provided by JS 1145/2016 (see Annex 2) and that the dried sludge from the WWTP will meet Class #2 in terms of the moisture content (> 40%), the sludge disposal/reuse options included:

- Use of treated sludge as soil conditioner in rangelands within the project area taking into consideration the conditions and limitations provided by JS 1145/2016 and availability of land;
- Disposal into Al Ghabawi landfill operated by GAM whether with or without expansion of the landfill;
- Onsite stockpiling of the dried sludge; and
- Reuse of sludge as incineration/clinker fuel.

Based on the analysis of the various management options presented in section 3 on analysis of alternatives, stockpiling on site was the recommended temporary (short-term) solution until a sludge management national strategy is created. The onsite stockpiling will involve mechanical dewatering to reduce the sludge volume and increase its dryness to around 22% dry matter content. This will be followed by greenhouse drying technology to further dry the dewatered sludge up to 50% dry matter content. This will allow WAJ to stockpile onsite with a capacity of 5-7 years while also maintaining flexibility to move to a long-term solution once a national strategy is in place.

The reuse of treated sludge for land application as soil conditioner is not currently practiced due to social considerations. Therefore, this reuse option is considered as long-term reuse option which requires further investigation in terms of its technical viability, financial feasibility, and social acceptance.

2.7 Project's Resource Efficiency

2.7.1 Energy Efficiency

Several energy efficiency measures were taken into consideration during the design the WWTP. These measures are summarized in Table 2.6.

Table 2.6. Al Ghabawi WWTP Energy Efficiency Measures

No.	Energy Efficiency Measure	Description
1	Gravity Treatment Process	The WWTP process is gravity based thus eliminating any pumping requirements except for the recirculation and sludge pumps.
2	Slow Sand Filter	Slow sand filters are gravity based. Slow sand filters require little or no mechanical power to operate compared to fast/pressurized sand filters.
3	Aeration System	Using surface aerators will consume at least a minimum of 10% of energy compared to fine bubbles submersible aerators.
4	Sludge Drying using Green Houses	Greenhouse drying technology is the least energy consuming option for **sludge drying above 50% per m^3 of sludge** compared to other mechanical and thermal drying technologies.
5	Sludge Stock piling in-site	Stock piling is the least energy consuming option for sludge disposal compared to other options/technologies.

2.7.2 Waste Minimization

Both liquid and solid waste minimization measures are taken into consideration in the design of the WWTP as follows:

- Liquid Waste: The treated effluent will be treated up to the standards required for irrigation and may be used for irrigation purposes as discussed later under section 3.2 on treated effluent reuse options. Moreover, the liquid sludge generated from the WWTP will be dried to minimize the liquid content up to 50%.
- Solid Waste: The generated sludge of 285 m^3/day from the WWTP will be dried and stockpiled as a short-term disposal option (for 7 years). However, in the long term, it is envisioned that the dried sludge could be disposed of in a landfill or utilized as soil conditioner in the surrounding rangelands to improve the soil properties as discussed under section 3 on analysis of alternatives.

2.8 Project Implementation Schedule, Workforce and Cost Estimate

The Project construction phase is expected to last for around 24 months. Moreover, a one-year operation and maintenance (O&M) support period will be added to the contractor's scope of work in order to ensure a suitable capacity building and proper O&M of the WWTP. This one-year assignment shall commence after the project handing over by the contractor to WAJ. During this period, one manager and two engineers, all specialized in the operation and maintenance of WWTPs, shall be made available permanently onsite.

The workforce during the construction phase will have a peak of 300 persons (for a 4-month peak period) and will involve the use of around 25 heavy construction equipment and 25 light vehicles.

The Project lifetime is 50 years and during operation phase, the WWTP will operate for 24-hours with 12 hours for tankers discharge. The anticipated workforce required during the WWTP operation phase are around 30 employees as summarized in Table 2.7.

Table 2.7. WWTP estimated workforce during operation phase

Facility Operators	Number
Manager	1
Electrical engineer	1
Mechanical engineer	1
Operators	4
Mech. Technicians	1
Elect. Technicians	1
Lab. Technicians	1
Administration (Clerk, Store Keeper, Office-boy)	4
Drivers	1
Laborers	15
Total	**30**

The Project is estimated to have a construction cost of around 46 million JOD and a preliminary estimated operation and maintenance (O&M) cost of around 4.5 million JOD.

3 ANALYSIS OF ALTERNATIVES

This section provides an analysis of certain alternatives to the Project development in relation to: (i) the selected wastewater treatment technology, (ii) treated effluent reuse options, (iii) the sludge disposal and management, and (iv) the "No Project" alternative which assumes that the Project development does not take place.

3.1 Wastewater Treatment Technology

In order to identify viable solutions for the Project, several treatment alternatives that would be appropriate solutions for the treatment of septage wastewater were investigated. The treatment systems discussed fulfil several requirements regarding the cost of construction, cost of operation, complexity of operation and treatment efficiency. Treatment systems that do not fulfil the criteria such as Membrane Bio-Reactor (MBR), and oxidation ponds as well as other recent technologies, which are not widely used and doesn't have previous experience in the region, are not considered further. As a result, the following three treatment alternatives were evaluated for a range of flows between 16,000 m^3/day and 22,500 m^3/day:

- Alternative 1: Conventional Activated Sludge Process (CAS);
- Alternative 2: Aerated lagoons system followed by constructed wetland or slow sand filters; and
- Alternative 3: Mixed Bed Bio-reactor Process.

An overview of these three alternatives is presented in Table 3.1. This overview gives ranges of land requirements, according to the types of treatment technology and expected flow rates. Hence, it served to assess the viability of the alternatives under consideration given the constraint on land availability.

- If Conventional Activated Sludge (CAS) Treatment is to be used, the only viable option will be to use Slow Sand Filter for the Tertiary Treatment and Mechanical Dewatering with Emergency Drying Beds for the Sludge Treatment.
- The Aerated Lagoons (AL) do not seem to be a viable alternative due to land constraint.
- Similar to the Conventional Activated Sludge, if MBBR Treatment Technology is to be used, the only viable option will be to use Slow Sand Filter for the Tertiary Treatment and Mechanical Dewatering with Emergency Drying Beds for the Sludge Treatment.

Table 3.1. Overview of the considered wastewater treatment technologies and their land requirements

Alternative	Overview	The project works may consist of (but not limited to)	Land Requirements (Estimated Area in Dunums)			Conclusion
			Process Description	22,500 m^3/d	16,500 m^3/d	
Alternative 1: Conventional Activated Sludge Process (CAS)	- One of the most efficient systems in removing organics from wastewater. - Produces considerable amounts of activated sludge, which shall be wasted to keep the reactants in balance. - The produced sludge has good settling property but needs further stabilization to reduce organics and odour. - The effluent from the aeration tanks is conveyed to the settling tanks where the sludge is separated and recycled to the aeration tanks and the surplus sludge is pumped to the thickeners and digesters, then to the drying beds or dewatering machines.	- Head works (receiving collector, screens, oil and grit removal chambers) - Equalization tank - Primary settling tanks - Aeration tanks - Secondary settling tanks - RAS and WAS pumping station - Chlorination system - Constructed wetland for nitrogen removal OR slow sand filters - Irrigation storage tank and network - Aerobic sludge digesters - Sludge thickeners - Drying beds with or without dewatering machines	CAS with Slow Sand Filter and Drying Beds (CAS 1)	360	279	If Activated Sludge Treatment is to be used, the land constraint limits the selection of processes to Slow Sand Filter for the Tertiary Treatment and Mechanical Dewatering for the Sludge Treatment.
			CAS with Slow Sand Filter and Mechanical Dewatering (CAS 2)	152	119	
			CAS with Constructed Wetland and Drying Beds (CAS 3)	585	455	
			CAS with Constructed Wetland and Mechanical Dewatering (CAS 4)	377	295	
Alternative 2: Aerated lagoons system	- Has high efficiency in removal of organics and pathogens	- Head works (receiving collector, screens, oil removal chambers)	AL with Slow Sand Filter and Drying Beds (AL 1)	669	510	It was concluded that the land constraint excludes the use of the Aerated

Alternative	Overview	The project works may consist of (but not limited to)	Land Requirements (Estimated Area in Dunums)			Conclusion
			Process Description	22,500 m^3/d	16,500 m^3/d	
followed by constructed wetland or slow sand filters	and relatively lower cost and simplicity of operation. - Usually used as an alternative to waste stabilization ponds in order to reduce the land area required for treatment. - It consists of anaerobic ponds, aerated lagoons, maturation ponds with rock filter and finally constructed wetland to achieve nitrogen, phosphorous, pathogens and BOD reduction.	- Aerated lagoons with anaerobic solids digestion pond within the flat bottom of the aerated lagoon - Maturation ponds with rock filters - Constructed wetland or slow sand filters - Irrigation storage pond - Drying beds and/ or dewatering machines	AL with Slow Sand Filter and Mechanical Dewatering (AL 2)	449	345	Lagoons Treatment Option.
			AL with Constructed Wetland and Drying Beds (AL 3)	719	546	
			AL with Constructed Wetland and Mechanical Dewatering (AL 4)	499	381	
Alternative 3: Mixed Bed Bio-reactor Process	- Highly efficient in removing organics and nitrogen from wastewater. - At the bio-reactor tanks, the biodegradable organic materials are oxidized by oxygen supplied to the process. The resulted products are new microbiological cells attached to the plastic media and carbon dioxide that is released to the atmosphere.	- Head works (receiving collector, screens, oil and grit removal chambers) - Equalization tank - Primary settling tanks - Mixed bed bio reactor with anoxic and oxic zones - Recycling pumping station	MBBR with Slow Sand Filter and Drying Beds (MBBR 1)	355	274	- It was concluded that if MBBR Treatment is used, the land constraint limits the selection of processes to Slow Sand Filter for the Tertiary Treatment and Mechanical Dewatering for the Sludge Treatment.
			MBBR with Slow Sand Filter and Mechanical Dewatering (MBBR 2)	147	114	

Alternative	Overview	The project works may consist of (but not limited to)	Land Requirements (Estimated Area in Dunums)			Conclusion
			Process Description	22,500 m^3/d	16,500 m^3/d	
	- The aeration system consists of air blowers and air diffusers to supply oxygen for the aerobic treatment. - The effluent from the reactor is conveyed to the settling tanks where the sludge is pumped to the thickeners and digesters, then to the drying beds or dewatering machines.	- Secondary settling tanks - Chlorination system - Slow sand filters or CWL - WAS pumping station - Aerobic sludge digesters - Sludge thickeners - Drying beds and/or dewatering machines - Irrigation storage tank and network	MBBR with Constructed Wetland and Drying Beds (MBBR 3)	580	450	
			MBBR with Constructed Wetland and Mechanical Dewatering (MBBR 4)	372	290	

Based on Table 3.1, only two viable solutions are CAS and MBBR; both utilising Slow Sand Filter for the Tertiary Treatment and Mechanical Dewatering with Emergency Drying Beds for the Sludge Treatment. To finally select the optimum treatment alternative, a qualitative assessment based on the technical team's extensive experience was conducted that considered technical, construction, operational, and environmental factors.

Each one of these groups was given a weight to be able to carry out the qualitative assessment. Technical weighted at 30%; the Construction at 30%, the O&M Group at 20% and the Environmental at 20%. These weights consider the relative importance of the group. Within each group, the qualitative criteria are assigned a relative importance with a value between 25 to 100%:

- Critical – 100%
- Very Important – 75%
- Important – 50%
- Not Important – 25%

This fraction, multiplied by the Group Weight, gives the overall weight for each criterion as presented in Table 3.2.

Table 3.2. Corresponding Criterion Weight

Group	Weight of Group	Criterion	Importance Rating	Total Weighting
Technical	30%	Experience	50	0.038
		Process Reliability	100	0.075
		Process Flexibility	50	0.038
		Process Control	25	0.019
		Odour Generation Potential	100	0.075
		Land Area	75	0.056
Construction	20%	Process Construction Cost	100	0.133
		Process Simplicity of Construction	50	0.067
Operational	30%	Process Electrical Power	100	0.086
		Process Costs Other Than Electricity	50	0.043
		Operator Technical Knowledge	50	0.043
		Maintenance Staff Knowledge	50	0.043
		Bio - Solids Generated	100	0.086
Environmental	20%	Socio - Economic Issues (i.e., employment, public acceptance and awareness)	75	0.086
		Public Health Issues (i.e., air pollution, vector breading, occupational health and safety)	50	0.057
		Natural Resources & Environment (i.e., natural flora and fauna, sludge disposal, contamination of ground water resources)	50	0.057

The three alternatives (i.e., CAS, MBBR, and AL) were evaluated against each one of the criteria mentioned above. The ranking of each option was based on the weights described in Table 3.2 and

the qualitative scores given based on previous experience in similar projects. Each viable alternative was scored out of 10 (10 being the highest) against the criteria mentioned above and then multiplied by the weights established above to come up with a weighted average score.

Table 3.3 is a comparison between the most relevant technologies. Although the Advanced Integrated Aerated Lagoons scored highest, this process was not selected because it requires a larger land area than that available for the project.

Table 3.3. Weighted Average Score of each criterion

Criterion	Total Weighting	CAS		MBBR		Advanced Integrated Aerated Lagoons		Comments
		Rel. Score	Score	Rel. Score	Score	Rel. Score	Score	
Experience	0.038	9	0.34	6	0.23	10	0.38	More municipal WWTPs in Jordan utilize AL followed by CAS then MBBR.
Process Reliability	0.075	8	0.60	9	0.68	10	0.75	High HRT of AL guarantees more dilution and stable effluent quality. MBBR better that CAS in producing stable effluent quality.
Process Flexibility	0.038	9	0.34	10	0.38	8	0.30	More media can readily be added in MBBR to increase treatment capacity. AL and CAS require expansion works to increase treatment capacity.
Process Control	0.019	10	0.19	9	0.17	8	0.15	CAS has the advantage that MLSS can be controlled by regulating sludge wasting.
Odour Generation Potential	0.075	9	0.68	9	0.68	10	0.75	Daily sludge handling/wasting in CAS and MBBR is required.
Land Area	0.056	8	0.45	10	0.56	6	0.34	MBBR reduces the size of the aeration tanks. AL require more land than CAS or MBBR.
Process Construction Cost	0.133	8	1.07	7	0.93	10	1.33	MBBR media is costly. AL utilize minimal mechanical equipment and structures.
Process Simplicity of Construction	0.067	8	0.53	7	0.47	10	0.67	Special requirements for utilizing the MBBR media.
Process Electrical Power	0.086	7	0.60	6	0.51	10	0.86	AL consume minimal energy. MBBR requires more energy for mixing and aeration than CAS.
Process Costs Other Than Electricity	0.043	7	0.30	6	0.26	10	0.43	AL requires no chemicals, minimal maintenance and manpower.

Criterion	Total Weighting	CAS		MBBR		Advanced Integrated Aerated Lagoons		Comments
		Rel. Score	Score	Rel. Score	Score	Rel. Score	Score	
Operator Technical Knowledge	0.043	9	0.39	9	0.39	10	0.43	MBBR and CAS require higher operator level of knowledge than AL.
Maintenance Staff Knowledge	0.043	8	0.34	8	0.34	10	0.43	MBBR and CAS require higher maintenance staff level of knowledge than AL.
Bio - Solids Generated	0.086	6	0.51	7	0.60	10	0.86	AL produces much less sludge that does not require daily attention. MBBR produces less secondary sludge than CAS.
Socio - Economic Issues	0.086	10	0.86	10	0.86	6	0.51	Less employment opportunities in AL plants compared to CAS and MBBR.
Public Health Issues	0.057	10	0.57	8	0.46	7	0.40	More aerosols produced in AL followed by CAS (rotor aerators) then MBBR (diffusers).
Natural Resources & Environment	0.057	10	0.57	10	0.57	9	0.51	More evaporation from AL compared to MBBR and CAS.
Total Score	**1.000**	**----**	**8.3**	**------**	**8.1**		**9.1**	

As such, based on the above analysis (Table 3.3) and the land area requirement (Table 3.1), the optimum recommended solution was the Conventional Activated Sludge Treatment with Slow Sand Filters for the Tertiary Treatment and Mechanical Dewatering with Emergency Drying Beds for the Sludge Treatment. This option was recommended since:

- It has the lowest capital and operation cost;
- It has the highest process reliability and flexibility;
- It includes unit processes that meet the required treatment criteria; and
- It includes low technical equipment that can be easily operated and maintained.

3.2 Treated Effluent Reuse Options

The treated wastewater effluent from AlGhabawi WWTP will meet the JS 893/2006 for Class A Irrigation and the EU Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment. Accordingly, the treated effluent will be suitable for discharge into wadis and for reuse in irrigation. Though the effluent will meet the standard for class A irrigation, its reuse will be restricted to fodder crops due to the potential for the formation of trihalomethanes (THMs) in treated wastewater under certain conditions as a result of the chlorination used for final disinfection. Based on this, the following three options were identified for the treated effluent reuse:

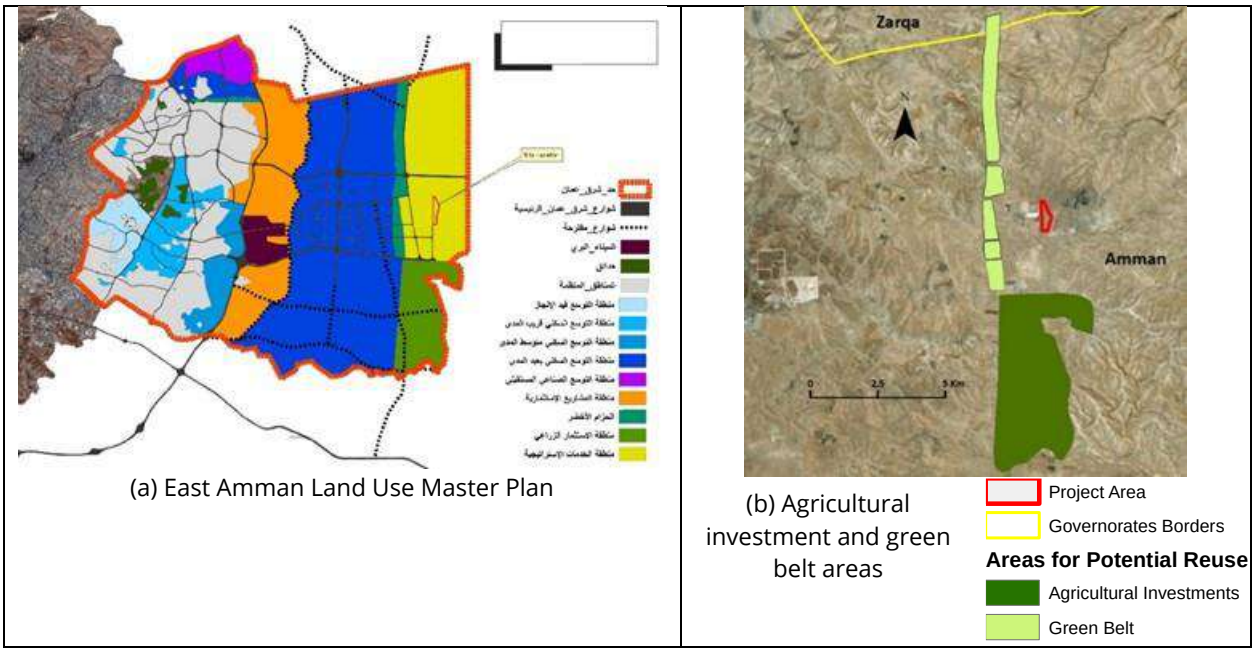
- Discharge to nearby wadi which eventually leads to Zarqa River or infiltration into groundwater resources (see Figure 2.5);

- Provide the treated effluent to local water users for restricted irrigation; and
- Provide the treated effluent to GAM for irrigation of the green belt areas and agricultural investment areas designated in East Amman land use master plan. For this purpose, a pipeline can be installed along the road corridor to the agricultural area and another pipeline can be installed adjacent to Al Ghabawi landfill sidewall as presented in Figure 3.1. Restricting the pipeline routes to existing road corridors and reserves would limit land requirements and reduce impacts or crossing other areas.

Figure 3.1. Pipeline paths (in red color) for the transfer of treated effluent to the green belt and agricultural investment areas

In fact, irrigation is one of the most common practices in water reuse in Jordan where it is used mainly in the production of forage crops "without blending with fresh water". This practice helps in reducing the use of fresh groundwater in agriculture. According to the land use master plan of East Amman, around 22 km^2 of green belt areas and agricultural investment areas are available for reuse of the treated effluent in irrigation as follows (see Figure 3.2):

- Green Belt area: Located 1.5 km to the western side of the WWTP with total area of ~5.4 km^2 to improve the environmental conditions.
- Agricultural Investment area: Located 2 km to the southern side of the WWTP with area of ~16.6 km^2 to promote agricultural activities and promote economic growth.



(a) East Amman Land Use Master Plan

(b) Agricultural investment and green belt areas

Figure 3.2. (a) Land use master plan for East Amman (source: Greater Amman Municipality), and (b) Agricultural investment and green belt areas close to the Project site

Calculations of the irrigation water requirements for these two areas were carried using Penman-Monteith equation and based on the collected metrological data for Zarqa Weather Station. The data shows that the dry season extends from May to October with the peak Evapotranspiration Rate (ET0) during the month of July reaching as high as 7.6 mm/day. The irrigation will be required during all the months of the years even in the wet season (November to April). For the green belt area, generally water conservative crop types such as native trees and shrubs "*Acacia saligna* or *Acacia cyanophylla*, *Moringa Peregrina*, and *Ziziphusspina-christi*" are used in green development areas in Jordan. For the purpose of this assessment, the Kc factor for these crops was assumed to be 0.5. As a result, the peak crop water requirements for the green belt was 3.8 l/m^2 during the month of July (see Annex 3). For areas of agricultural investments, in general Alfalfa and barely are the most grown crops using reclaimed water for foraging in Jordan. For the purpose of this assessment and to optimize the use of the generated effluent during the year "winter & summer", it is planned to grow Barely as winter crop and alfalfa as perennial. This cropping pattern ensures utilizing the most available effluent quantity during the year. The tables included in Annex 3 show the annual crop water requirements for Barely and Alfalfa. It indicates a peak water requirement of 5.59/day for alfalfa and 1.91 mm/day for barely. Based on the crop water requirements as peak water demand per day, the land required to utilize the effluent water is shown Table 3.4.

Table 3.4. Area of land to be irrigated by the treated effluent

Year	Cropping Pattern	Irrigated Area	CWR Peak/day	Available Effluent	Required Effluent	Available Balance
		dunum	m^3/dunum	m^3/day	m^3/day	m^3/day
Green Belt Area	Native Trees	500	3.8	22,500	1,900	20,600
Agricultural Development Area	Alfalfa	3,000	5.59	20,600	16,770	3,830
	Barely	2,000	1.91	3,830	3,820	10

Based on Table 3.4, the effluent water of 22,500 m^3/day can irrigate an area of 500 dunums of the green belt plus 3000 dunums of alfalfa during the year and 200 dunum of barely during the winter season. These calculations are based on the peak crop water requirements per day for each crop. Having the above as the backbone of this high-level assessment, it can be concluded that the available green belt and agricultural areas are enough to accumulate the effluent water generated from the WWTP up to year 2045.

However, based on discussions with WAJ, WAJ's first priority for treated effluent reuse is to provide it to local water users for use in restricted irrigation. This requires developing agreements with those local water users and this is what WAJ aims to achieve in the future. WAJ's second priority, is to provide the treated effluent to GAM for irrigation in the green belt and agricultural investment areas. For this option, infrastructure is needed to deliver the treated wastewater to those areas and GAM should contribute to the required infrastructure. Further funding at that stage might be sought from other donors, if needed, but this will be part of a different project.

With respect to the E&S impact evaluation of the three options, this is illustrated in Table 3.5.

Table 3.5. Environmental and social evaluation of treated effluent reuse options

Environmental & Social Components	Treated effluent discharged to wadi	Treated effluent to local water users for restricted irrigation	Treated effluent to GAM for irrigation of green belt and agricultural investment areas
Air Quality	0	0	0
Noise Generation	**0**	**0**	**0/X**
Topography, Geology and Soils	0	0	0
Water Resources	**0/+**	**0**	**+**
Visual Impacts	0	0	+
Ecological Resources	0	0	0
Socio-economic Impacts	**0**	**+**	**0**
Land Value	**0**	**+**	**+**
Community Health & Safety	**0**	**0/X**	**0/X**
Traffic Disturbance	0	0	0
Other Utilities/Infrastructure	0	0	X
Archaeology / Cultural Property	0	0	0
Symbols indicating the overall evaluation of the specified environmental component and social aspects: S- : Denotes potential significant adverse impact X : Denotes potential for impact, which is not considered significant 0 : Denotes No Potential Impact / No change to existing conditions + : Denotes potential significant beneficial impact			

Table 3.5 reveals that the E&S parameters of relevance with respect to the options of treated effluent reuse include potential impacts to water resources, socio-economy, land value, noise generation, and community health. Providing the treated effluent to the local community will result in positive impacts on socio-economic conditions as it will secure irrigation water for cultivation which will in turn secure income to the local community. Also, when water is available for land cultivation, the land value is expected to increase. Based on the household survey conducted as part of this Project (see section 5.8), 48% of the respondents indicated that they would use the treated effluent if provided to them, 46% said they would not, and 7% were not sure. The respondents' perception of potential uses of the treated effluent are illustrated in Figure 3.3. These responses, along with the concerns raised by members of the local community during focus groups on potentially unsafe use of treated effluent, highlight the importance of raising awareness on the safe use of treated effluent in case the Septic Tank Facility were to provide it to the local community. Main issue of concern is to agree with the local community that the treated effluent will be used for restricted irrigation (mainly fodder crops) in order to avoid health implications associated with THMs that may be present under certain conditions in the treated effluent due to disinfection by chlorination.

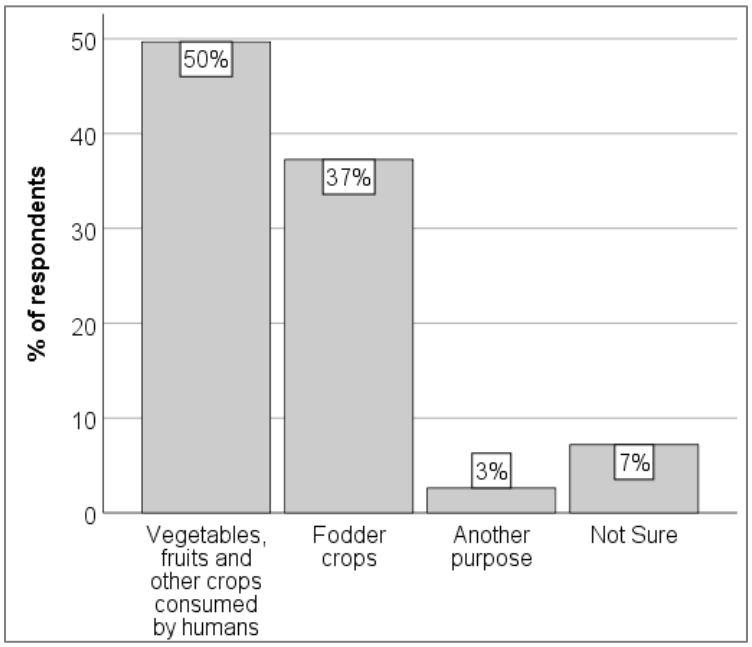


Figure 3.3. Surveyed local community perception of potential uses of the treated effluent (Source: Household Survey, 2020)

Providing the treated effluent to GAM for irrigation of the green belt areas and agricultural investment areas will enhance land value in the agricultural investment area due to availability of irrigation water. It will also enhance general aesthetics due to availability of water resources to cultivate those areas. However, if the pipeline and related infrastructure needed to deliver the treated effluent to those areas involved pumping stations, then noise generation may be a source of nuisance though so far no sensitive receptors have been identified along the route depicted in Figure 3.1. Similar to above, it should be note that at the agricultural investment area, the treated effluent should be designated for restricted irrigation

It is noted that no E&S impacts have been identified with the release of the treated effluent into the nearby wadis. This is mainly because the treated effluent will meet the required standards for discharge into wadis and most of the water is expected to evaporate before eventually reaching the Zarqa river or infiltrating into groundwater resources.

At this stage of the Project, and based on the above discussion, it was agreed that the default management option for the treated effluent will be the discharge to wadi. The preference, however, is to reuse the treated wastewater but these options will be investigated in more detail at a later stage in discussion with various stakeholders.

3.3 Sludge Disposal and Reuse Options

The planning for sludge disposal/reuse is regulatory driven and is more stringent than treated effluent reuse in Jordan. Jordanian Standards JS 1145/2016 on the Uses of Treated Sludge and Sludge Disposal regulates the entire cycle of sludge production, transport, and eventually its reuse and disposal. JS 1145/2016 (presented in Annex 2) clearly prohibits the reuse of untreated sludge and defines three classes for the treated sludge "reuse and disposal":

- Class 1 & 2: allows treated sludge to be used as soil conditioner to improve the quality of the soil in the rangelands "as per Ministry of Agriculture classification" or to be disposed to landfills.
- Class 3: allows treated sludge to be disposed to landfills only.

In addition to the above, the regulation also regulates the application process as per the below conditions:

- Technical Conditions: The treated sludge is only allowed to be used as soil conditioner in lands classified as rangelands as per the MoA laws. However, treated sludge is not allowed to be used in irrigated lands even if it is located within rangelands classification. Furthermore, the maximum application rate of treated sludge is not allowed to exceed 6 tonnes/hectare/year.
- Health and Environmental Conditions: Sludge must not be reused near to the wadis, flood areas, irrigation cannels, surface water and places that negatively affect ground water and surface water.

Table 3.6 provides an analysis of all the possible sludge disposal methods with respect to environmental and social impacts and associated risk, and Table 3.7 provides an analysis of the reuse options for the treated sludge.

Table 3.6. Sludge Disposal Options

Sludge Disposal		
Methods	**Environmental and Social Considerations**	**Risk Evaluation**
Stockpile on site	- Health risk concerns due to the pathogen content within the sludge, such as Escherichia coli, as well as the potential for existence of harmful levels of toxic metals and environmentally persistent chemicals such as polychlorinated biphenyls and dioxins. - Potential for nuisance and odour attributed to the storage and spreading of sludge.	Medium

Sludge Disposal		
Methods	**Environmental and Social Considerations**	**Risk Evaluation**
	- Contribution to climate change impacts due to emission of greenhouse gases.	
Stockpile off site	- Health risk concerns due to the pathogen content within the sludge, such as Escherichia coli, as well as the potential for existence of harmful levels of toxic metals and environmentally persistent chemicals such as polychlorinated biphenyls and dioxins. - Potential for nuisance and odour attributed to the storage and spreading of sludge. - Contribution to climate change impacts due to emission of greenhouse gases.	Medium
Send to GAM landfill without expansion	Though mixing sludge with municipal solid waste can enhance the rate of biological stabilization of the waste, it can also lead to the following environmental concerns: - Enhanced leachate generation with increased concentrations of ammoniacal nitrogen and total phosphorus levels in the leachate. - Increased contribute to the generation of greenhouse gas emissions. - Potential of land subsidence of the landfill.	Low given that leachate and gas management systems are in place
Send to GAM landfill with expansion		

Table 3.7. Sludge Reuse Options

Reuse Options	
Methods	**Environmental and Social Considerations**
Reuse of treated sludge as agricultural Fertilizer	- Not allowed in Jordan - Needs to be treated to comply with the Jordanian Standard on "Water – Sludge – Uses of treated sludge and sludge disposal" (JS 1145/2006). - A source of greenhouse gas emissions that contributes to climate change. - Health risk concerns due to the pathogen content within the sludge, such as Escherichia coli, as well as the potential for existence of harmful levels of toxic metals and environmentally persistent chemicals such as polychlorinated biphenyls and dioxins. - Potential for nuisance and odour attributed to the storage and spreading of sludge.
Sludge reuse as incineration/clinker fuel	- Sludge needs to be dewatered. - Using the sludge in cement kilns can reduce industry's reliance on fossil fuels and decrease greenhouse gas emissions.

However, the sludge disposal and reuse options face the following constraints:

- There is no strategic sludge waste management policy at the national level.
- In response to contacting GAM to clarify and confirm possible arrangements for sending all

waste sludge to the neighbouring GAM landfill facility for a set fee, GAM have stated that there is no available capacity that could be made available to accept sludge stating that it will reduce cell life. Though GAM has plans for expansion, it only intends to meet municipal waste demand.

- The reuse of treated sludge as agricultural fertilizer is prohibited by the Ministry of Agriculture.
- The reuse of sludge as incineration/clinker fuel is also not a viable option since it requires drying to a greater solid content; which could be more of a long-term strategy.

Therefore, it was necessary that any option or process for managing sludge would provide WAJ with an immediate short-term solution without hindering WAJ's ability in the medium to long term to align with a future sludge management strategy or policy direction. Table 3.8 presents and analyses all the viable options given the constraints currently faced.

Table 3.8. Qualitative Analysis of Viable Sludge Disposal Options

Sludge Disposal					
Methods	Capacity	Capex	Opex	Rank	Comments
Stockpile on site	Medium	Low	Very Low	1	- Temporary measure. - Only small quantity can be stock piled onsite at the current design philosophy.
Stockpile off site	High	Medium	Low	2	- Temporary measure. - Offsite facility would need to be identified. - Additional drying may still be needed for transport purposes.
Construct new landfill	Medium	Very High	Medium	3	- There are existing plans to further develop Al Ghabawi Landfill but to meet municipal waste demands only. - Pressures and complication exist around funding and the surrounding land (which is owned by the Army).
Incinerate on site	High	V. High	High	4	- Al Ghabawi is the only landfill site in Amman. The only other dump site exists at a significant distance of 40-60km away. - Engineered waste solutions are limited. - This option should be considered as a national strategy.
Incinerate off site	High	Very High	Very High	5	- Not environmentally aligned with stakeholders. High water content means very energy intensive, which increases total expenses.

** At the current design, the available land serves about 7 years.

Based on Table 3.8, and given the constraints around GAM landfill, land allocation as well as budget, stockpiling on site is a recommended temporary solution until a sludge management national strategy is created. This will involve mechanical dewatering to reduce the sludge volume and increase its

dryness to around 22% dry matter content. This will be followed by greenhouse drying technology to further dry the dewatered sludge up to 50% dry matter content. This will allow WAJ to stockpile onsite with a capacity of 5-7 years while also maintaining flexibility to move to a long-term solution once a national strategy is in place.

Since the dried sludge from the WWTP is expected to meet Class #2 in terms of the moisture content (> 40%), the dried sludge theoretically speaking, treated sludge can be used as soil conditioner in rangelands within the project area taking into consideration the conditions and limitations of JS 1145/2016 (see Annex 2) and availability of land. Given a maximum application rate of 6-ton dry matter/hectare/year, around 3,770 ha of land will be covered. However, the reuse of treated sludge in land application, including the use as soil conditioner, is not currently practiced due to social considerations. Therefore, this reuse option is considered as long-term reuse option, which requires further investigation in terms of its technical viability, financial feasibility, and social acceptance.

3.4 "Project" versus "No Project" Alternative

This discusses the "Project" versus "No Project" alternatives. The "No Project" alternative considers the option of not implementing the project at all. It is normally evaluated to assess the impacts if the project does not go ahead.

As discussed before, the AGTP Septage Receiving Facility has been causing odour, local noise pollution and increased traffic problems especially for the surrounding communities at Ain Ghazal. This necessitated the need for relocating the facility at Ain Ghazal and the development of a new septic tank receiving facility and wastewater treatment at Al Ghabawi.

Accordingly, the "No Project" alternative is evaluated for two locations: the proposed Project site and the Ain Ghazal Septage Receiving Facility. 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, community health and safety, social acceptance, infrastructure impacts, land use and value, and cultural heritage aspects. Results of this evaluation are presented in Table 3.9.

Table 3.9. Environmental and social evaluation of "Project" versus "No Project" alternatives

Environmental & Social Components	"Project" implementation at Project site		"No Project"	
	"Project" Construction Phase	"Project" Operation Phase	No Project at the selected Site	Continued Operation at Ain Ghazal Receiving Facility
Air Quality	S-	X	0	S-
Noise Generation	X	0	0	X
Topography, Geology and Soils	X	0	0	0
Water Resources	X	0/+	0	S-
Visual Impacts	0/X	0/X	0	S-
Ecological Resources	0	0/X	0	0
Socio-economic Impacts	X/+	S-/+	0	S-
Land Value	0	+	0	S-
Community Health & Safety	X/S-	0/X	0	S-
Traffic Disturbance	X	X	0	S-
Other Utilities/Infrastructure	X	0	0	0

Environmental & Social Components	"Project" implementation at Project site		"No Project"	
	"Project" Construction Phase	"Project" Operation Phase	No Project at the selected Site	Continued Operation at Ain Ghazal Receiving Facility
Archaeology / Cultural Property	0	0	0	0
Symbols indicating the overall evaluation of the specified environmental component and social aspects: S- : Denotes potential significant adverse impact X : Denotes potential for impact, which is not considered significant 0 : Denotes No Potential Impact / No change to existing conditions + : Denotes potential significant beneficial impact				

At Ain Ghazal Septage Receiving Facility, the "No Project" means the continued operation of the facility and consequently the continuation of odour, local noise pollution and increased traffic problems especially for the surrounding communities.

At the proposed Project site, the "No Project" alternative implies that the environmental and social aspects will not vary from prevailing conditions. However, not going ahead with the Project is also associated with the loss of opportunity of having treated wastewater that may be reused for irrigation purposes within the green belt areas and agricultural investment areas indicated by East Amman land use master plan (see Figure 3.2).

With respect to the "Project" alternative, the construction phase of the proposed project will include disruptions to air quality, noise levels, health and safety within the proposed Project site. However, these impacts are manageable, temporary and limited to the construction phase of the project.

The operation of the proposed project is associated with concerns related to potential odour problems in case of improper odour control measures, increased traffic to and from the Project site, and occupational and community health concerns. Despite some of the social concern expressed by representatives of some of the local community, these issues are considered to be manageable. Moreover, the closest community is at around 7.5 km away from the Project site, and hence the odour and community health concerns are not anticipated due to the Project operation. On the contrary, there is potential for some socio-economic benefits in terms of potential for job opportunities, availability of treated wastewater for irrigation. It is also possible for the operator to adopt a social responsibility strategy during Project implementation that achieves maximum communication and involvement of the Project stakeholders in line with WAJ's "Social Responsibility Strategy" and to provide some measures that have a positive impact on nearby local communities. However, this will be later determined between WAJ and the operator. In addition, the operation of the Project will eliminate the odour, social and traffic nuisance at the Ain Ghazal location.

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 and due to odour and health and safety concerns in case of improper operation, those impacts can be mitigated and their significance minimized. Moreover, the proposed project will provide positive impacts related to elimination of odour and other nuisances at Ain Gahzal area, job opportunities for local communities close to the proposed Project site at Al Ghabawi, and availability of additional water supply within the Project's area through the reuse of the treated effluent.

4 REGULATORY FRAMEWORK

The legal and regulatory framework relevant to the environmental and social considerations of the Project is presented in this section.

4.1 Relevant National Policies, Legislation and Regulations

This section presents in Table 4.1 the national legislative register applicable during both the construction and operational phases of the wastewater treatment plant at Ghabawi. This is followed by a brief description of the national legislation that are most relevant to this Project. Where applicable and relevant, specific stipulations are addressed and described within the different sub-sections.

Table 4.1. Legislative Register relevant to the Project

Legislation	Responsible Authority
Cross-Sectoral Legislation	
Law of Organization of Cities, Villages and Buildings No. 79 of 1966	Ministry of Municipal and Rural Affairs
Environmental Protection Law No. 6 of 2017	Ministry of Environment
Environmental Impact Assessment Regulation No. 37 of 2005	Ministry of Environment
Agriculture Law No. 13 of 2015	Ministry of Agriculture
Public Health Law No. 47 of 2008	Ministry of Health
Management and Administration of Government Properties Law No. 17 of 1974	Ministry of Finance
Land Acquisition Law (LAL) No. 12 of 1987	Cabinet/Ministry of Finance
Water Resources Legislation	
Sanitary Wastewater System Code, and the Water Supply Code of 1988	Ministry of Public Works and Housing
Water Authority Law No. 18 of 1988	Water Authority of Jordan
Drinking Water Instructions of 1981	Water Authority of Jordan
Wastewater Management Legislation	
Solid Waste Management Regulation No. 27 of 2005	Ministry of Environment
Sanitary Wastewater System Code, and the Water Supply Code of 1988	Ministry of Public Works and Housing
Jordanian Standards for Industrial Wastewater - JS 202/1991	Water Authority
Jordanian Standard for Reclaimed Domestic Wastewater - JS 893/2006	Water Authority
Jordanian Standard for Reclaimed Industrial Wastewater - JS 202/2007	Water Authority
The Regulations of the Sewage System No. 66 of 1994	Water Authority
Prevention of Repulsive Waste and Fees for Solid Waste Collection within Municipality's Boundaries No. 1.	Municipalities

Legislation	Responsible Authority
Jordanian Standard on General Precautionary Requirements for Storage of Hazardous Materials – JS 432/1985	Ministry of Health
Air Quality, Noise, Soil Protection, Traffic Legislation	
Soil Protection Regulation No. 25 of 2005	Ministry of Environment
Environmental Law No 6 of 2017	Ministry of Environment
Traffic Law No. 49 of 2008	General Security Department
Regulation for the Protection of Air No. 28 of 2005	Ministry of Environment
Ambient Air Quality Standards (JS 1140/2006)	Jordanian Institute for Standardization and Metrology (JISM)
Maximum Allowable Limits of Air Pollutants Emitted from Stationary (JS 1189/2006)	Jordanian Institute for Standardization and Metrology (JISM)
Instruction for Reduction and Prevention of Noise for 2003	Ministry of Environment
Water – Sludge – Uses of Treated Sludge and Sludge Disposal (JS 1145:2006)	Jordanian Institute for Standardization and Metrology (JISM)
Solid Waste Handling	
Regulation on the Management of Solid Waste No. 27 of 2005	Ministry of Environment
Management, Transportation and Handling of Harmful and Hazardous Substances Regulation No. 24 of 2005	Ministry of Environment
Instructions on Solid Waste Management of 2019	Ministry of Environment
Instructions on Hazardous Waste Management and Handling for 2019	Ministry of Environment
Nature Conservation Legislation	
Civil Defense Order No. 1: The Protection of Forestry in Jordan of1993	Civil Defense Department
Protection of Birds and Wildlife Bylaw No. 113 of 1973	RSCN
Natural Reserves and National Parks Bylaw of 2005	Ministry of Environment
Environmental Law No. 6 of 2017	Ministry of Environment
Regulation of Management of Environmental Protection No. 37 of 2018	Ministry of Environment
Cultural and Archaeological Heritage Legislation	
Law of Antiquities No. 20 of 2004	Ministry of Tourism and Antiquities
Quarries Bylaw No. 8 of 1971	Natural Resources Authority
Labour Conditions, Health and Safety	
Regulation of Forming Committees and Supervisors of Occupational Safety and Health No. 7 of 1998	Ministry of Labour
Labour Law No. 8 of 1996 and its amendments	Ministry of Labour
Labour Law Amendment No. 26 of 2010 related to rights and protection of non-Jordanian workers	Ministry of Labour
Social Security Law No. 1 of 2014.	Social Security Corporation/Ministry of Labour

Legislation	Responsible Authority
Social Security Corporation (SSC) Law – Work Injuries Instructions	Social Security Corporation/Ministry of Labour
Civil Service Regulation No. 82 of 2013	Civil Service Bureau
GAM Human Resources Regulation No. 71 of 2012	Greater Amman Municipality
Regulation No. 42 of 1998 on Preventive Medical Care and Treatment for Institutional Workers	Ministry of Labour
Regulation No. 43 of 1988 on Protection and Safety from Industrial Machinery and Equipment on Worksites	Ministry of Labour
Instruction for Initial Medical Examination of Workers in Institutions of 1999	Ministry of labour
Instruction for the Protection of Workers against the Risks of the Work Environment No. 8 of 1996	Ministry of labour
Jordanian Standard on Heat Levels in the Work Environment - JS 525/1987	Jordanian Institute for Standardization and Metrology (JISM)
Jordanian Standard on Lighting Levels in the Work Environment - JS 524/1987	Jordanian Institute for Standardization and Metrology (JISM)

4.2 Institutional and Management Setup

4.2.1 Water and Wastewater Sector Planning and Management

There are three institutions that take responsibility for water administration in Jordan; Ministry of Water and Irrigation (MWI), Water Authority of Jordan (WAJ), and Jordan Valley Authority (JVA).

The **Ministry of Water and Irrigation (MWI)** is responsible for the overall national leadership on policy, strategic direction and planning, in coordination with WAJ and JVA. Under Bylaw No. 14 of 2014, MWI assumes full responsibility for water and public sewage and all related projects in the Kingdom. MWI aims to upgrade, develop and regulate the water sector and enhance the quality of water services. It has a mandate to: develop sectorial policies and strategies; endorse plans and programs related to water resources protection; implement international agreements; develop laws, bylaws, regulations and normative and technical standards; develop private sector partnerships; supervise the implementation of strategic plans and programs; and follow up on the performance of the water companies and utilities. The proposed Ghabawi septic tank receiving facility and wastewater treatment plant will be owned by the Government of Jordan as represented by MWI.

The **Water Authority of Jordan (WAJ)** is responsible for the operational management of the water sector, which includes bulk water supply and retail distribution where commercialization of distribution services has not occurred. WAJ is mandated for all operational functions of the water sector including management of water and wastewater services; regulation of construction and quality of service provision projects, operations and maintenance; monitoring of all levels of sector services; and supervision of the water utilities and water companies through the Performance Management Unit (PMU). WAJ manages all contracts with the water companies through (PMU). WAJ and JVA recommend water service cost changes and capital projects, but the Government of Jordan

through the Council of Ministers (Cabinet) has the ultimate regulatory authority, especially for setting tariffs. WAJ will be the entity responsible for the operation of Al Ghabawi WWTP, either directly or through an agreement with a third party.

The **Jordan Valley Authority (JVA)** is a governmental organization responsible for the social and economic development of the Jordan Rift Valley, including the development, utilization, protection and conservation of water resources. The King Abdullah Canal represents the backbone of the JVA water distribution system north of the Dead Sea and is used to irrigate farm units.

The **Performance/Project Monitoring Unit (PMU)** is another institution directly subordinate to the MWI (previously called Program Management Unit). It is in charge of projects with private sector participation. It has also carried out major investment projects such as the water loss reduction program in Amman and has regulated the private operator in Amman from 1999 to 2006. The PMU was initially set up to be a core unit for a future semi-autonomous water regulatory agency for the entire country, to be established by law outside of the Ministry of Water and Irrigation. As a step in that direction, a Water Sector Audit Unit (WSAU) was established in the PMU in May 2008. The unit has set up a benchmarking system using performance indicators that have initially been applied to the Aqaba Water Company and Miyahuna. Due to the absence of a regulatory agency, tariff setting is the responsibility of the Cabinet, after proposal from the MWI. The PMU is directly responsible for all As-Samra Wastewater Treatment Plant and related facilities (Ain Ghazal Treatment Plant (AGTP), West Zarqa Pumping Station (WZPS) and East Zarqa Pumping Station (EZPS), and pipelines). This includes the Septic Tanks Receiving and Unloading Facility at Ain Ghazal.

It is not clear at this stage if a Project Implementation Unit (PIU) will be set up within WAJ (or the PMU) to undertake the Ghabawi Project implementation, however, it is also possible that the PMU will implement this project through its existing institutional structure. In any case, EBRD will hire a PIU/PMU support consultant for this Project.

Miyahuna is a government-owned (WAJ) utility company that operates through commercial entities to provide retail distribution and other functions such as water and wastewater treatment in Greater Amman as well as Balqa, Zarqa and Madaba with several hundred thousand of customers. Miyahuna is responsible for the operation of the Septic Tanks Receiving and Unloading Facility at Ain Ghazal in which they ensure that the septic tank discharge operation follow Jordanian regulatory requirements. The Septic Tanks Receiving and Unloading Facility had earlier been proposed to be relocated and to be managed by the Samra Plant Company (SPC).

The **Ministry of Environment** (MoEnv) has a mission to maintain and improve the quality of Jordan's environment, conserve natural resources and contribute to sustainable development through effective policies, legislations strategies, monitoring and by mainstreaming environmental concepts into all national development plans. The MoEnv includes many technical divisions among which are the land use, environmental impact assessment, water quality and air quality monitoring divisions. The environmental monitoring department of the MoEnv is responsible for water resources quality monitoring but does not have a Laboratory. Water quality analysis is subcontracted to the Environment Monitoring and Research Central Unit (EMARCU) of the Royal Scientific Society (RSS). The responsibility of EMARCU is to collect data and make available water quality data from a Real-Time Monitoring System (RTMS) and from national water testing Laboratories located at WAJ, JVA, and the Environmental Research Centre (ERC). The MoEnv has implemented a monitoring program to monitor

and assess the quality of water in different water resources in the Kingdom and in cooperation with the RSS through "The National Project for Monitoring Water Quality in Jordan". The project will monitor the quality of water at over a hundred different locations across the Kingdom.

4.3 Relevant National Policies, Legislation and Regulations

This section presents a description of the national legislations that are most relevant to this Project. Where applicable and relevant, specific stipulations are addressed and described within the different sub-sections.

4.3.1 National Wastewater Related Policies

This policy outlines a brief history of the wastewater management in Jordan and highlights the main aspects of the policy such as resource development, resource management, wastewater collection and treatment, reuse of treated effluent and sludge, pricing, finance and investment, public awareness and the role of the private sector. The policy specifies that collection of wastewater is a necessity to circumvent hazards to the public health and the environment. The policy also indicates that wastewater from industries with significant pollution should be treated separately to standards allowing its reuse for purposes other than irrigation or to allow its safe disposal.

Sewerage Regulation/Bylaw No. 66, 1994

According to the Regulation, no person is allowed to dispose of waste and liquids other than the Refuse (defined in the Regulation as being the wastewater, liquid waste and unbound waste which results from the different usages of water and the sewage) into the public wastewater system. Otherwise, WAJ may respond appropriately such as blocking the source of this violation and charging the violator extra fees.

No person is allowed to dispose, into water sources, any natural course or any open place, of liquid waste, polluted water or ordinary water until after treating it and acquiring a written approval in that respect from the Water Authority.

If it was impractical to connect the private wastewater discharge points to the public wastewater network for any reason, the owner should, at his/her own expense and within the boundaries of his/her estate, dig a suction pit and/or a dissolving pit in accordance with the instructions and standards set by the local council. If it is decided, thereafter, to connect the estate to the public wastewater network, the owner should fill up the pits at his/her own expense with suitable material that would not cause detriment to public health. Otherwise the owner could use the pits for any other purpose, except for drinking water, after cleaning same.

The Regulation also deals with the Authority's right to extend and maintain the public and private wastewater networks.

No person is allowed to commit any act that will obstruct or disable the public wastewater systems, or cause damage to the purification works and the wastewater project. According to the water authority law anyone who committed any violation under the provisions any regulations issued pursuant to the law shall be liable to a fine of not less than JD (100) and not exceeding JD (1000) or to imprisonment for a period of not less than one month and not exceeding six months.

Instructions for the Commercial and Industrial Wastewater into Sewerage / Disposal through the Sewerage Project Network were issued as per Article 23 of this Regulation. These instructions prohibit

the disposal of industrial and commercial wastewater whether polluted or non-polluted through the sewerage network before getting a written approval from WAJ.

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 Year 1994.

The *Instructions for Commercial and Industrial Wastewater* provides the legal foundation for prohibiting the disposal of industrial wastewater (water used in some or all stages or manufacture, cleaning, cooling or others) and commercial wastewater (hospitals, labs, fuel stations, slaughterhouses, cattle and poultry farms, etc.) through the sewerage network before getting a written approval from the authority. Moreover, the act provided specific concentration levels on heavy or toxic chemicals that are prohibited.

In addition, commercial and industrial institutions should present engineering drawings showing the method and specifications of the pipe construction and inspection points prior to the written approval. The Water Authority shall charge the commercial and industrial institutions fees for connecting their systems with the sewerage network according to a set tariff. The Authority also charges these institutions when disposing with a COD concentration higher than the maximum allowable limit.

Reclaimed domestic wastewater Jordanian Standard JS 893/2006

This standard presents the general conditions that should be met regarding reclaimed wastewater. The JS divides reclaimed wastewater into two categories: reclaimed wastewater for discharge in streams, wadis or surface water, and reclaimed wastewater for re-use purposes.

The Standard highlights the required qualities of reclaimed wastewater that should be achieved based on the two categories mentioned above.

This standard will apply to the proposed receiving station and wastewater treatment plant in Ghabawi.

Reclaimed industrial wastewater Jordanian Standard JS 202/2007

This standard determines the conditions, requirements and restrictions for the discharge of industrial WW into streams, wadis, surface water, or re-use of such water for irrigation or other purposes. It provides the standards for the industrial wastewater discharged into wadis, water courses and water bodies. It also states the frequency of sampling according to its reuse purpose.

In compliance with Jordanian Standard 202/2007, industrial waste water haulers should use a grey color for their vehicles, such color is supposed to differentiate industrial waste tankers from others. Each vehicle's license is expected to be categorized as Registered Industrial Waste Transporting Vehicle.

Water Authority of Jordan (WAJ) Law No. 18/1988 and its amendments No. 22 for the Year 2014

This law allows WAJ to act as an autonomous corporate body, with financial and administrative independence. The law describes the mandate of WAJ, in which WAJ is fully responsible for providing municipal water and wastewater services, in addition to the development and management of groundwater resources. It also clarifies WAJ's relationship with the Ministry of Water and Irrigation.

The Water Authority has the right to enter private lands and real estates to carry out its works. The Authority has the right to receive assistance for this purpose from the governors or the police whenever needed. Moreover, if the owner suffered any losses, the Water Authority assesses the amount of compensation to be paid to the owner.

WAJ are responsible for all drinking water and wastewater flowing through their systems and network. WAJ is not responsible for drinking water and wastewater not flowing through their network. WAJ is not responsible for the management and control of Industrial wastewater. However, they must undertake necessary measures for the protection of their wastewater systems and water and wastewater treatment plants (WWTP) including ensuring that illegal discharge or industrial wastewater into the municipal system does not take place unless authorized by WAJ. WAJ draws terms, standards and special requirements in relation to the preservation of water and water basins, protect them from pollution, and ascertain the safety of water and wastewater structures, public and private distribution and disposal networks, and take the necessary action to ensure technical control and supervision, including, all necessary tests.

Water Authority of Jordan (WAJ) Law No. 18 of 1988, Article 24 B, for the construction of water and WW pipelines in privately owned lands

According to Article 24, governmental land included within a strip of 1000 meters in width on each side of the centerline of the water mains and the main irrigation canals is designated for the development of the governmental irrigation projects, socially and economically. This prohibited land shall not be disposed of, dispossessed, or used in any way except with the approval of the Council of Ministers upon the recommendation of the Minister. Article 24 stipulates that the Water Authority has the right to install private or public pipelines, or maintain them, through public roads. In case this is not possible for technical reasons, according to its sole evaluations, the Authority has (as added by Law No. 62 of 2001) the right to install these pipes within private lands and real estates. The Water Authority shall take precautions to avoid causing loss during installation of the sewerage pipelines within private property. The Water Authority or its agents shall restore in all cases the conditions as they were before implementing the installations. The water Authority shall assess the amounts of compensation to be paid to the owner if he suffered any loss. The Water Authority has the right to enter private lands and real estates to carry out its above-mentioned works stated in this Article. The Authority has the right to receive assistance for this purpose from the governors or the police whenever needed.

4.3.2 Other Relevant National Policies (Laws, Regulations and Instructions)

Environmental Protection Law 6 of 2017

This law is the cornerstone for environmental protection in Jordan and although it repeals its predecessor, Environmental Protection Law 52 of 2006, all regulations and standards issued pursuant to Law No. 52 of 2006 remain valid under Law No. 6 of 2017. This Law consists of 33 articles that aim at protecting the environment and provides that the Ministry of Environment is the authority responsible for environmental protection. It also provides that the Ministry together with the related parties shall develop the policies and prepare the plans and programs, work on forecasting climate change, follow the implementation of international environmental agreements, protect the biodiversity, and identify areas that need special attention, MoEnv's responsibilities according to the Law include, but are not limited to, the following: Setting necessary policies and plans for environmental protection; and issuing specifications to fulfill environmental quality objectives. This is applied in the process of licensing and license renewal of facilities.

The regulations issued by MoEnv include handling of hazardous substances and their final disposal. The entry of hazardous substances and waste into the Kingdom is prohibited through the provisions of the Law. The Law introduces the need to carry out Environmental Impact Assessments (EIAs) for certain projects prior to their commencement. MoEnv grants approval for environmental studies and

projects submitted on behalf of any official entity to a donor agency. Penalties and consequences associated with environmental violations are further described in the Law.
The Law stipulates that MoEnv is responsible for ensuring ambient quality, environmental protection, and water resources protection against pollution and for securing the quality of irrigation water supplies. MoEnv is responsible for preventing the discharge of industrial wastewater into wadis and for ensuring that tankers do not discharge municipal wastewater or industrial wastewater illegally into manholes, wadis, or at undesignated WWTPs.

EIA Regulation No. 37 of 2005
This regulation sets out the EIA process in Jordan. Its annexes provide screening criteria, listing the types of projects which require a comprehensive EIA or a preliminary EIA study, and those for which neither is needed. For Category 1 projects (like this Project), a public scoping hearing is required to prepare the EIA Terms of Reference (ToR). The Regulation requires that the EIA describe the project and environmental baseline conditions, and cover impacts to be assessed, and mitigation measures to be developed. Article 4 of the Regulation requires Environmental Approval of industrial, agricultural, commercial, and housing or tourism projects or construction development, or project types listed in Annexes 2 and 3 of the Regulation.

Air Quality (regulating air emissions): Regulation for the Protection of Air No. 28 of 2005
This regulation describes the requirements of several entities including the Ministry of Environment in relation to protecting the environment against air pollution. This regulation is supported by Jordanian Standard – Ambient Air Quality (JS1140/2006). This standard outlines the technical requirements and allowable limits for air pollutants in regards to ambient air quality. Several pollutants are considered including CO, SO_2, NO_2, and TSP. Depending on the treatment process selected for the proposed plant at Ghabawi and the presence of stationery air emission sources, Jordanian standard 1189 of 2006 - Maximum Allowable Limits of Air Pollutants Emitted from Stationary (JS 1189/2006) may be applicable.

Noise prevention - Instruction for Reduction and Prevention of Noise for 2003
This instruction describes the requirements of several entities including the Ministry of Environment for protecting the environment against noise pollution, in relation to the noise levels outside the work environment (i.e. the fence of the facility). Noise levels within the work environment are listed under the Ministry of Labour's (MoL) "Instruction for the Protection of Employees and institutions against risk of work Environment". This instruction outlines the noise limits within the work place and the number of acceptable exposure hours.

Regulation for the Prevention of Health Nuisances within Municipal Areas No. 1 of 1978 and its amendments
This Regulation operates under the Law of Municipalities and states the necessity to prevent health nuisances (which are presented in Article (4) in order to avoid adverse impacts on the environment and public health. This is applicable to the proposed project at Ghabawi.

Public Health Regulations
Public Health Law No. 47 of 2008 is a framework law that establishes the responsibilities of the Ministry of Health over public health issues, including monitoring and surveillance for diseases. Protecting the Environment in Emergency Situations (Regulation No. 26 of 2005 governs government planning in case of emergencies).

Protection of Ecosystems and Biodiversity

Agriculture Law No. 13 of 2015, developed by the Ministry of Agriculture (MoA), prohibits the disposal of any type of solid or liquid waste or other harmful substances in the environment. Owners of any project or establishment must ensure that no borders of forests or agricultural areas are to be violated. There are several legislations that relate to the protection of ecosystems and biodiversity in Jordan, including the legal mandates of the Royal Society for the Conservation of Nature (RSCN), the Environmental Protection Law No. 6 of 2017, and Regulation No. 43 of 2008 for the Classification of Birds and Wild Animals Species Forbidden from Hunting.

Antiquities Law No. 20 of 2004

This law, developed by Ministry of Tourism and Department of Antiquities, outlines the responsibilities and necessary actions to ensure the protection and conservation of the country's cultural heritage including archaeology. The Law outlines the required actions to be undertaken for the appraisal of archaeological objects and sites and their importance. In addition to penalties associated to the violation of any provisions of this law.

Labour Laws and Regulations

- Labour Law No. 8 of 1996 and its amendments: This applies to private sector labour and includes occupational health and safety requirements.
- Labour Law Amendment No. 26 of 2010: Related to rights and protection of non-Jordanian workers.
- The Social Security Law No. 1 of 2014.
- Social Security Corporation (SSC) Law – Work Injuries Instructions.
- Regulation on Preventive Medical Care and Treatment for Institutional Workers (No. 42, 1998).
- Regulation on Protection and Safety from Industrial Machinery and Equipment on Worksites (No. 43, 1998).
- Instructions - Initial Medical Examination of Workers in Institutions of 1999 which requires periodic medical examination of workers in certain risky environments, including working in waste management.
- Instructions for the Protection of Workers against the Risks of the Work Environment No. 8 of 1996. These instructions include the requirements to reduce the risk to health and safety of workers in certain environments and protective measures (such as PPE), welfare facilities (e.g. changing rooms), noise and lighting levels.
- Jordanian Standard JS 525:1987 - Heat Levels in the Work Environment.
- Jordanian Standard JS 524:1987 - Lighting Levels in the Work Environment.
- Jordan is a member of the International Labour Organization (ILO) and has ratified seven of the core conventions in addition to 13 other conventions.

Land Acquisition Law (LAL) No. 12 of 1987

Although no land acquisition is foreseen as part of this project, the need may arise during project implementation to temporarily acquire, lease or otherwise infringe on properties. This law governs the transfer of ownership of land or property owned by private groups or individuals to any governmental, legal and juristic persons, and corporate bodies for the development of a project for the public benefit while compensating the owner for the loss of land or property. This law will be

applicable to the project if any form of land acquisition becomes necessary at Ghabawi. The procedures, conditions and requirements for land acquisition based on this law are outlined below.

1. The project should be for the public benefit and meet with fair compensation principle.
2. An advertisement should be placed in at least two daily local newspapers to declare its intention to proceed to the Cabinet for land acquisition purpose.
3. To submit a request to the Cabinet to outline the acquisition required and reveal the total compensation and thus proving the financial ability to pay within three months from the date of the advertisement.
4. If the Cabinet accepts that the project is for the public benefit and that the acquirer has the ability to pay the compensation, the Cabinet will decide for either permanent land acquisition or temporary use for a limited period. This Decision of Expropriation should be issued within six months from the date of the declaration and published in the official newspaper.
5. If the acquirer is one of the ministries or departments or institutions of the official public government or municipalities, the Cabinet may decide to approve the use of the property for any other form of public benefit.
6. After the Decision of Expropriation of the Cabinet, the acquirer must do the following:

- Submit a copy of the Decision and planned acquisition to the Director of Land Registration, including the decision of ownership, and refrain from conducting any transaction on the property. If the property is not registered, the names of the acquirers and their addresses, in addition to the decision of acquisition, should be submitted.
- The real estate must be examined by a Committee formed by the acquirer to establish the situation before the Decision of Expropriation was made. The Committee's report is considered as evidence of a preliminary situation for the purposes of assessing compensation estimation of the property. Upon the request of the acquirer, the Committee can include in its report the amount of compensation estimated for the property.

7. If there are people having the use or leasing right of the property, the owner must write their names and their rights during 30 days from the date of publication of the Decision. Also, the right-holder should do the same within the 30-day period.
8. The acquirer must publish an advertisement in at least two daily newspapers, including a summary of the acquisition decision, a description of the property, and the names of owners, administrators, and owners of any property rights. Within thirty days from the date of publication of the advertisement, the acquirer shall engage with the owner and negotiate the amount of compensation to be paid to him.
9. If the owners do not agree on the compensation amount, they can appeal to the court to have fair compensation.
10. The following principles should be taken into account in assessing compensation for any real estate taken under this law:

- Fair compensation for the property or its use is considered to be the price that could be obtained if sold publicly in the market, or the value of rental which would be paid, on the day of publication of the Declaration.
- Fair compensation for the damage caused by the creation of any restriction on the ownership of the property is considered to be the reduction in the market price of the property due to the damage or restriction.

- Fair compensation for a renter or user of property other than the owner is considered to be a maximum of 15% of the owner's compensation where the property occupied for commercial or industrial purposes, and not more than 5% if the property is occupied for other purposes.
- If the owner wants to take all or some of the materials and assets on the property, like trees and the ruins of buildings, then the exact value of these extractions will be deducted from the total value of the compensation, and he must remove the extractions from the property at his own expense. The transfer of the extractions should be within the period specified by the acquirer. If it is not removed by the owner, then the acquirer will transfer it with appropriate methods, and deduct the transportation costs from the compensation.
- One or more of the following assessment methods of compensation should be considered:

  Cost: this means the comparison to the cost of the establishment of new real estate similar to the acquired one in specifications, and based on construction costs at the time of acquisition, as approved and published by the Department of Lands and Survey, and also taking into account the age of the structures, and their condition and suitability for use.

  Comparison: This means to estimate the value from the market prices of similar properties of the property and real value.

  Income: This means the expected return or capitalization of net income from the property and the safe interest rate over the remaining useful life of the property.
- A report is prepared using the compensation rates from the Department of Lands and Survey. The report should include the method for determining the amount of compensation.

4.3.3 Jordan's Climate Change Policy

Jordan submitted its commitment to the United Nations Framework Convention on Climate Change (UNFCCC) in September 2015 in the form of Intended Nationally Determined Contribution (INDC). The Kingdom put forward a dual target: an "unconditional" target of 1.5% reduction of greenhouse gases (GHG's) by 2030 compared to business as usual scenario, and a "conditional" target of 12.5% reduction by 2030 if financial assistance by the international community is made available.

The INDC refers to 70 projects that have been identified to reach the 14% target and indicates that the energy sector (inclusive of generation and transport) represent 73% of total GHG emissions. This is why Jordan's emissions reduction efforts must tackle the energy sector in order to reach the target.

The Sector Strategic Guidance Framework of the National Climate Change Policy of the Hashemite Kingdom of Jordan (2013-2020) calls for building the adaptive capacity of communities and institutions in Jordan in order to increase the resilience of natural ecosystems and water resources, as well as agricultural resources, to climate change.

4.4 Relevant International and Regional Conventions and Treaties

Jordan is a signatory to the number of international conventions, treaties, and protocols aiming at protecting the environment. The most relevant to the proposed project are the following:

- Kyoto Protocol on Climate Change, 2003
- Ramsar Convention of Wetlands of International Importance, 1971
- Vienna Convention and the Montreal Protocol for the Protection of the Ozone Layer
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal -1992
- UN Convention to Combat Desertification (UNCCD) - 1996
- Cartagena Protocol on Bio-safety
- Convention on the Protection of African-Eurasian Migratory Waterfowls
- Convention on the Conservation of Migratory Species of Wild Animals, 1979
- Stockholm Protocol on Persistent Organic Pollutants (POPs), 2004
- Convention on Biological Diversity (CBD) - 1994

4.5 EBRD's ESP and PRs

4.5.1 Project Categorization as per EBRD's Environmental and Social Policy (2014)

According to its ESP, EBRD is committed to promoting "environmentally sound and sustainable development" in the full range of its investment and technical cooperation activities. This is achieved through an E&S appraisal of the financed project. The EBRD categorises each project to determine the nature and level of environmental and social investigations, information disclosure and stakeholder engagement required. This will be commensurate with the nature, location, sensitivity and scale of the project, and the significance of its potential adverse future environmental and social impacts. A project may be categorized into one of three categories (EBRD 2014; EBRD, 2015):

- **Category A:** when it could result in potentially significant adverse future environmental and/or social impacts which, at the time of categorisation, cannot readily be identified or assessed, and which, therefore, require a formalised and participatory environmental and social impact assessment process. According to the list of indicative Category A projects presented in the ESP, municipal wastewater treatment plants with a capacity exceeding 150,000 population equivalent (PE) are categorized as "A".
- **Category B:** A project is categorised B when its potential adverse future environmental and/or social impacts are typically site-specific, and/or readily identified and addressed through mitigation measures.
- **Category C:** A project is likely to have minimal or no potential adverse future environmental and/or social impacts, and can readily be addressed through limited environmental and social appraisal.

Overall, the Project will be located in a barren area with no human habitation around; biodiversity at the site is minimal; no sensitive receivers exist in the Project's area; the WWTP design capacity (amount of septage) is relatively small (15,500 m^3/day); and the WWTP's spatial extent is confined. All these factors favour a Category B classification. The proposed WWTP at Al Ghabawi will serve a population

estimated in 2017 to be around 1,314,843 capita with an estimated septage inflow of 12,430 m^3/day. Since the Project would be significantly above the 150,000 PE threshold defined by EBRD's E&S policy and the EU EIA Directive for Category A/Annex1 projects, adhering to this requirement have resulted in categorising the Project as "A" and thus triggered this full ESIA study.

4.5.2 EBRD Performance Requirements (PRs)

Performance Requirement 1 - Assessment and Management of Environmental and Social Impact Issues

This PR establishes the importance of developing and implementing an integrated assessment that aims to identify the environmental and social impacts and issues resulting from a project's activities. An Environmental and Social Management System (ESMS) is one of the important pillars of this PR that combines all plans and management systems into one cohesive framework to enhance the quality of the project in addition to providing a guideline for implementing good international practices. The main objectives of this PR are:

- Identifying and evaluating the environmental and social impacts and aspects of the project.
- Adopting a mitigation hierarchy approach to address adverse environmental and social impacts.
- Promoting the improvement of the project's environmental and social performance by the use of effective management systems.
- Developing an ESMS specifically for the project.

Performance Requirement 2 - Labour and Working Conditions

This PR recognizes the importance of the workforce and good human resource management that establishes a sound worker-management relationship based on respecting workers' rights and providing a safe working environment for them. The main objectives of this PR are:

- Respecting and protecting the fundamental principles and rights of workers.
- Promoting the decent work agenda that includes fair treatment, non-discrimination and equal opportunities of workers.
- Establishing, maintaining and improving a sound worker-management relationship.
- Promoting compliance with any collective agreement such as national labour and employment laws.
- Protecting and promoting safety and health of workers, by promoting safe and healthy working conditions.
- Preventing the use of forced labour and child labour as defined by the ILO as it relates to the project activities.

Performance Requirement 3 - Resource Efficiency and Pollution Prevention and Control

This PR recognizes that the increase of economic activities and urbanization can lead to the generation of increased levels of air, water and land pollution, in addition to the consumption of natural finite resources that might threaten the lives of the people and the environment at the local, regional and global levels. It recognizes the importance of implementing resource efficient activities and pollution prevention and control to ensure environmental and social sustainability. PR 3 aims to:

- Identify project related opportunities for energy, water and resource efficiency improvements

and waste minimization.

- Adopt the mitigation hierarchy approach to address the adverse impacts on human health and the environment arising from the use of resources and the pollution resulting from project activities.
- Promote the reduction of project-related greenhouse gas emissions.

Performance Requirement 4 - Health and Safety

This Performance Requirement addresses the health and safety impacts on the workforce and project-affected communities and consumers. It recognizes the importance of avoiding or mitigating the adverse health and safety impacts and issues resulting from project activities.

The objectives echoed throughout the requirements of this PR are:

- Protecting and promoting the safety and health of workers by ensuring safe and healthy working conditions and implementing a health and safety management system.
- Anticipating, assessing and preventing or minimizing adverse impacts on the health and safety of project-affected communities and consumers during the life cycle of the project.

Performance Requirement 5 - Land Acquisition, Involuntary Resettlement and Economic Displacement

Involuntary resettlement may result in long-term hardship and impoverishment for affected persons and communities, as well as environmental damage, and adverse socio-economic impacts if not properly managed. Under some circumstances, poorly executed involuntary resettlement may leave the client exposed to legal action. For these reasons, involuntary resettlement should be avoided. However, where it is unavoidable, resettlement should be minimised and appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented. The objectives of this PR are:

- Avoid or, when unavoidable, minimize involuntary resettlement by exploring and studying alternative project designs.
- Mitigate adverse social and economic impacts from land acquisition or restrictions on affected persons, by providing compensation for loss of assets at replacement costs, ensuring that resettlement activities are implemented with suitable information disclosure and consultation with the affected communities.
- Restore or, where possible, improve the livelihoods and standards of living of the displaced communities to their living conditions prior to displacement.
- Improve the living conditions among the physically displaced persons by providing adequate housing.

Performance Requirement 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources

Performance Requirement 6 recognizes that the conservation of biodiversity and sustainable management of living natural resources are fundamental to environmental and social sustainability. This PR aims to:

- Protect and conserve biodiversity using a precautionary approach.
- Adopt the mitigation hierarchy approach that results in no net loss of biodiversity, and where appropriate, a net gain of biodiversity.
- Promote Good International Practice (GIP) through sustainable management and use of

existing living natural resources.

Performance Requirement 7 – Indigenous Peoples

This Performance Requirement recognizes that projects can create opportunities for Indigenous Peoples to participate in and benefit from project-related activities that may help them fulfill their aspiration for economic and social development. Following a screening exercise, it has been determined that Indigenous Peoples as per the definition in PR7 are not present in the project area and therefore PR7 does not apply.

Performance Requirement 8 - Cultural Heritage

This PR recognizes the importance of cultural heritage for present and future generations. The aim is to protect cultural heritage and to guide clients in avoiding or mitigating adverse impacts on cultural heritage in the course of their business operations. The clients are expected to be precautionary in their approach to the management and sustainable use of cultural heritage. The aim of this PR is to:

- Support the protection and conservation of cultural heritage.
- Adopt the mitigation hierarchy approach to protecting cultural heritage from adverse impacts arising from the project
- Promote the equitable sharing of benefits from the use of cultural heritage in business activities.
- Promote the awareness and appreciation of cultural heritage where possible.

Performance Requirement 9 – Financial Intermediaries

This Performance Requirement recognizes that Financial Intermediaries (FIs) are a key instrument for promoting sustainable financial markets and provide a vehicle to channel funding to the micro, small and medium-sized enterprise (SME) sector. This PR will not be applicable to the project as the financing structure does not include financial intermediaries.

Performance Requirement 10 - Information Disclosure and Stakeholder Engagement

This PR recognizes the importance of an open and transparent engagement between the client, its workers, local communities directly affected by the project and, where appropriate, other stakeholders as an essential element of good international practice and corporate citizenship. To be effective, stakeholder engagement should be initiated at an early stage of the project cycle. The objectives of this PR are:

- Outline a systematic approach to stakeholder engagement that will help clients build and maintain a constructive relationship with their stakeholders, in particular the directly affected communities.
- Promote improved environmental and social performance of clients through effective engagement with the project's stakeholders.
- Promote and provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that meaningful environmental and social information is disclosed to the project's stakeholders.
- Ensure that grievances from affected communities and other stakeholders are responded to and managed appropriately.

Out of the Bank's ten performance requirements above, it is clear that PR1, 2, 3, 4, 6, 8 and 10 are triggered by the Ghabawi Project. PR5 is not triggered as no physical or economic resettlement is foreseen, the land is state-owned, and no livelihoods will be affected by the project.

4.6 Related EU Directives

This section provides a brief description of the relevant EU Directives that are referred to within EBRD's ESP and are considered as applicable to this Project. It is noted that EBRD's ESP of 2014 states that the Bank is committed to promoting European Union (EU) environmental standards as well as the European Principles for the Environment.

Directive 85/337/EEC - Directive on EIA

This directive was in force since 1985 and has been amended recently in 2014. It is applied to various public and private projects. The amended EIA Directive 2014 came into force on May 15th 2015, amending 2011/92/EU, stating that it will "simplify the rules for assessing the potential effects of projects on the environment." Member States must implement it by May 16th 2017. The EIA Directive 2014 makes a number of changes, including a new definition of EIA and standardization of the EIA screening process across Member States with information that developers must provide for the screening process to be prescribed. There is also clarification that the cumulative impact of a project and other existing or approved projects should be considered as part of the screening process; and a requirement for the main reasons behind the screening decision or screening opinion to be published at the same time, as well as a new time frame for the screening process (to be carried out within 90 days).

It should be noted that the Jordanian EIA legislation (No. 37 of 2005) is broadly in line with the process required by the EU Directives, although it is limited on social assessment, consultation, information disclosure, and implementation and follow up especially in relation on the ESMP.

Directives related to Labour and Working Conditions

- Directive 2006/54/EC – Equal opportunities
- Directive 2002/14/EC – Informing and consulting employees
- Directive 2000/78/EC – Equal treatment
- Directive 89/391/EEC – OHS- Framework & Directive
- Directive 2009/104/EC – Use of work equipment
- Directive 92/58/EEC – Safety and/or health signs
- Directive 89/656/EEC – Use of personal protective equipment
- Directive 89/654/EEC – Workplace requirements
- Directive 2009/161/EU – Occupational exposure limit values
- Directive2012/18/EU – Major-accident hazards
- Directive 90/269/EC – Manual handling of loads

Directive 96/62/EC - Air quality framework directive

This directive describes the basic principles for assessing and managing air quality in Member States. The directive lists the pollutants for which air quality standards and objectives will be developed and specified in legislation.

Directive 2002/49/EC - Assessment and Management of Environmental Noise
This Directive relates to the assessment and management of environmental noise. It is the main EU instrument to identify noise pollution levels and to identify the necessary action both at Member States and at EU level. Since this EU Directive does not specify noise limits, the IFC "**Environmental, Health, and Safety (EHS) Guidelines: Environmental – 1.7 Noise Management**" are referred to for noise limits specifications.

Directive 2008/98/EC - Waste Framework
This directive sets the general framework of waste management requirements and the basic waste management definitions for the EU. It determines the basic concepts and definitions related to waste management and lays down waste management principles such as the "polluter pays principle" or the "waste hierarchy".

EU Council Directive 91/271/EEC - Directive on Urban Wastewater Treatment
This directive adopted in 1991, requires that urban wastewater be treated to minimum levels before its discharge into surface waters. This directive depends on the population equivalent of the relevant catchment area and the nature of the receiving waters. The main issues outlined in this directive are planning, regulating, monitoring and information and reporting. The requirements to be fulfilled based on this directive are the following:

- Collection and treatment of wastewater in areas of more than 2000 population equivalent (PE)
- Secondary treatment processes of all discharges should be implemented from areas of more than 2000 PE, and more advanced treatment processes for areas of more than 10,000 PE
- Pre-authorization is required for all discharges of urban wastewater
- Performance monitoring of treatment plants and receiving waters
- Sewage sludge disposal control and re-use, in addition to re-use of treated wastewater

Directives relating to Public Participation

- Directive 2003/04/EC – Access to Environmental Information
- Directive 2003/35/EC – Providing for Public Participation

Council Directive 86/278/EEC of 12 June 1986 on the Protection of the Environment, and in particular of the Soil, when Sewage Sludge is used in Agriculture
The sewage sludge directive aims to regulate the use of sewage sludge in agriculture in such a way as to prevent harmful effects on soil, vegetation, animals and man, while encouraging its correct use. Among its requirements is that sludge must be treated before being used in agriculture and sludge should be used under conditions which ensure that the soil and the surface and ground water are protected.

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the Conservation of Wild Birds
This directive provides a legal framework for the protection of all wild birds in the EU, including their eggs, nests and habitats. It also prohibits the sale, transport for sale, keeping for sale and the offering for sale of live or dead birds and of any readily recognisable parts or derivatives of such birds.

Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora

This directive addresses the conservation of natural habitats and of wild fauna and flora and aims to promote the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements.

4.7 Analysis of Legal Requirements and Identification of Gaps

Table 4.2 outlines the gaps that exist between the local requirements and those of EBRD particularly as they relate to the following aspects: environmental permitting, environmental management, land acquisition, public consultation and disclosure, and wastewater treatment efficiency.

It should be noted that while the Project needs to meet the Bank's PRs of 2014 and relevant EU standards as well as Jordanian requirements, however, where differences in requirements exist, the most stringent of requirements would apply.

Table 4.2. Gap analysis between national and EBRD requirements

Requirements	Gaps
Environmental Permitting	– The EIA is regarded as a permitting requirement to fulfill Jordanian legal requirements and should typically be commissioned before the project proponent has made key project decisions especially those related to project alternatives, site selection, project size, etc. According to the EIA regulation No. 37 of 2005, MoEnv is the sole authority responsible for requesting, screening, reviewing, and approving environmental impact assessment studies. – Larger projects in Jordan are often donor or international lender-financed (including by EBRD) and are appraised to donor requirements which are usually more stringent than national Jordanian requirements. Thus, areas related to social impacts, disclosure, public consultation and stakeholder engagement are expected to follow the requirements of EBRD for this project.
Environmental Management	– Jordanian legislation imposes limited post-permitting follow-up regarding the implementation of the provisions of Environmental Management Plans (EMPs) especially during the construction phase. – EIA remains a largely document-based process, with no real appreciation of the practical aspects of environmental controls and mitigation. However, it is a requirement by MoEnv. – There are inadequate provisions for institutionalizing controls and performance requirements and applying them on contractors and project operators. – Projects that have obligations to monitor and report on environmental performance (e.g. air emissions, discharges, etc.) often do so under different legislation.
Public Consultation and Disclosure	– Jordan's local legislation is not very elaborate on public consultation and disclosure requirements while EBRD's PR 10 recognizes the importance of an open and transparent engagement between the client, its workers, local communities directly affected by the project and, where appropriate, other stakeholders as an essential element of good international practice (GIP) and corporate citizenship. – EBRD requires that stakeholder engagement should be initiated at an early stage of the project cycle to outline a systematic approach to stakeholder engagement that will help clients build and maintain a constructive relationship with their

Requirements	Gaps
	stakeholders, in particular the directly affected communities; to promote improved environmental and social performance through effective engagement with the project's stakeholders; and to provide means for adequate engagement with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that meaningful environmental and social information is disclosed to the project's stakeholders. – EBRD requirements ensure that a grievance mechanism is established and grievances from affected communities and other stakeholders are responded to and managed appropriately. – The Jordanian legal requirements for consultation and engagement are mainly included within the "EIA Regulation No. (37) of 2005". The Regulation requires that for those projects which the MoEnv requires a comprehensive ESIA study "in-case this project required so", a scoping session must be held from the onset of the ESIA for all stakeholders who may be potentially affected by the Project. The objective of the session is to provide the stakeholder groups with all available information on the Project and the surrounding environment, in order to allow them to participate in investigating and identifying the potential impacts which may arise from the Project so that their concerns are taken into account throughout the ESIA study. To this extent, the MoEnv generally requires that the following stakeholder groups be invited to participate in the scoping session: (i) national governmental entities, (ii) local governmental agencies, (iii) Non-Governmental Organizations, (iv) academic and research institutions, and (v) local community representatives. In addition, the Regulation specifies that the outcomes of the ESIA study are to be announced to stakeholders and the public in a manner that the Ministry deems appropriate, and this is dealt with on a case by case basis – considering the type and nature of the project development. This is usually determined by the MoEnv once the ESIA study is reviewed and approved. Otherwise, no scoping session will be requested if this project requires a preliminary ESIA study.
Wastewater Treatment	Jordanian standards specify discharge limits for treated effluents from wastewater treatment plants depending on the end use and/or the receiving environment. EU requirements place greater emphasis on the following compared to the Jordanian national requirements: – Monitoring of wastewater effluent discharges to ensure they comply with the discharge limits. The monitoring protocol becomes more stringent if the potential impacts on the receiving environment are expected to be high. – Monitoring the amount and composition of sludge disposed of to surface waters. – Disclosing and publishing reports showing monitoring results.

4.8 Project Standards

The Project standards for wastewater effluent quality, sludge, air quality/odour and noise are discussed below.

4.8.1 Wastewater Effluent Quality

The Jordanian Standard JS # 893/2006 covers the reuse of treated wastewater in Jordan and provides the effluent limits for the reuse of treated domestic wastewater. According to JS 893/2006, all new WWTP projects in Jordan should include a fully designed and feasible wastewater reuse aspect. Furthermore, all wastewater quantities must be utilized for potential reuse within the vicinity of the WWTP and mainly for the cultivation of fodder crops and trees in areas surrounding the WWTP. For Al Ghabawi Project, the effluent quality will comply with JS 893/2006 for Class A (or Category A) for irrigation in terms of effluent quality while excluding irrigating edible crops.

WAJ allows WWTPs to discharge reclaimed wastewater to streams, wadis or water bodies, or reuse it if effluent quality complies with the properties and criteria in the Standard. Reclaimed wastewater may also be reused for artificial recharge of groundwater aquifers or used for irrigation purposes. When used for irrigation, it is prohibited to use reclaimed wastewater for irrigating vegetables that are eaten uncooked (raw). It is also prohibited to use sprinkler irrigation except for irrigating golf courses. When using reclaimed wastewater for irrigating fruit trees, irrigation must be stopped two weeks prior to fruits harvesting and any falling fruits in contact with the soil must be removed.

The effluent limits of Jordanian Standard (JS: 893/2006) for different effluent reuse options were shown in Table 4.3.

Table 4.3. Effluent Limits of Treated Wastewater according to JS893/2006

		Agricultural Irrigation			
Parameter	**Unit**	**Category (A) Cooked vegetables, parks, playgrounds and side roads inside cities**	**Category (B) Fruit trees, side roads inside cities outside of cities, green areas**	**Category (C) Field crops, industrial crops, and Forest trees**	**Flow into streams, wadis, water courses, etc.**
BOD_5	mg/l	**30**	200	300	60
COD	mg/l	**100**	500	500	150
DO	mg/l	**>2**	-	-	>1
TSS	mg/l	**50**	200	300	60
pH	mg/l	**6 -9**	6 -9	6 -9	6 -9
NO_3	mg/l	**30**	45	70	80
Total Nitrogen	mg/l	**45**	70	100	70
E. coli	MPN*/100 ml	**100**	1,000	-	1,000
Intestinal helminth eggs (IHE)	egg/litre	**≤ 1.0**	≤ 1.0	≤ 1.0	≤ 0.1

The effluent quality must also meet the limits prescribed in EU Council Directive 91/271/EEC of 21 May 1991 concerning Urban Wastewater Treatment. This is because the EBRD intends to finance the Project, and its Performance Requirements refer to EU standards where applicable at the Project level. The Directive prescribes concentration limits and percentage reduction targets for BOD, COD and TSS. The Directive allows application of concentration limits or a percentage reduction targets. For the Project, percentage reduction targets for these parameters are being adopted. Achieving Class A effluent quality as per JS893/2006 ensures that the percentage reduction target are easily achieved. 91/271/EEC also prescribes limits for nitrogen and phosphorus when wastewater is discharged to sensitive areas, which are subject to eutrophication. The discharge proposals for the Project do not trigger these limits. Table 2.5 under section 2.5 of this ESIA provided the design wastewater influent quality and the target effluent limits for Al Ghabawi WWTP. It also presented a comparison between the Jordanian Standard (JS 893 / 2006) and the EU Directive (91/271/EEC) Concerning Urban Wastewater Treatment. The Project will also apply the monitoring requirements required by 91/271/EEC and JS 893 / 2006.

In addition to EU Council Directive 91/271/EEC, the European Commission is considering a regulation on minimum requirements for water reuse (see Table 4.4). This regulation is still at the proposal stage. Although the parameters and restrictions on irrigation/crops are slightly different to JS 893 / 2006, a review indicates it is expected that the Jordanian limits for Class A wastewater effluent would achieve the EU's Class B quality requirements. Class A in the Jordanian Standard allows for irrigating vegetables that are eaten cooked, in addition to landscape, playgrounds and parks. The Project intention, and this subject to agreement with the various authorities and stakeholders, is to limit irrigation to fodder crops and landscape irrigation.

Table 4.4. Proposed reclaimed water quality requirements for agricultural irrigation as per EC regulation on minimum requirements for water reuse.

Reclaimed water quality class	Indicative technology target	Quality requirements				
		E. coli (cfu/100 ml)	BOD_5 (mg/l)	TSS (mg/l)	Turbidity (NTU)	Other
A	Secondary treatment, filtration, and disinfection	≤10 or below detection limit	≤10	≤10	≤5	*Legionella* spp.: <1,000 cfu/l where there is risk of aerosolization in greenhouses
B	Secondary treatment, and disinfection	≤100	According to Council Directive 91/271/EEC[1] ((Annex I, Table 1)	According to Directive 91/271/EEC ((Annex I, Table 1)	-	Intestinal nematodes (helminth eggs): ≤1 egg/l for irrigation of pastures or forage
C	Secondary treatment, and disinfection	≤1,000			-	
D	Secondary treatment, and disinfection	≤10,000			-	

The 2006 WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater (WHO, 2006) provide the array of pathogens and pollutants that can be found in wastewater in addition to the results of studies on human health risks posed by wastewater irrigation, especially from pathogen contamination. A review indicates that the limits prescribed in JS 893 / 2006 aligns with WHO Guidelines.

4.8.2 Sludge Quality

The Jordanian standard JS1145/2006 classifies sludge into three classes depending on sludge use. The three classes are identified as follows:

- Class I: Treated Sludge is allowed to be used as organic fertilizer for agricultural purposes, as well as for the purpose of improving the soil properties.
- Class II: Treated Sludge is allowed to be used for the purpose of improving the soil characteristics only.
- Class III: Treated sludge is allowed to be disposed in dumping waste.

Table 4.5 shows the maximum allowable concentrations for treated sludge for each class as per JS1145/2006.

Table 4.5. Maximum Allowable Concentration in the Treated Sludge (JS1145/2006)

Symbol	Particularity	Unit	JS1145/2006		
			Class I	Class II	Class III
As	Arsenic	Mg/kg-dry	41	75	75
Cd	Cadmium	Mg/kg-dry	40	40	85
Cr	Chromium	Mg/kg-dry	900	900	3000
Cu	Copper	Mg/kg-dry	1500	3000	4300
Hg	Mercury	Mg/kg-dry	17	57	57
Mo	Molybdenum	Mg/kg-dry	75	75	75
Ni	Nickel	Mg/kg-dry	300	400	420
Se	Selenium	Mg/kg-dry	100	100	100
Pb	Lead	Mg/kg-dry	300	840	850
Zn	Zinc	Mg/kg-dry	2800	4000	7500
Co	Cobalt	Mg/kg-dry	NA	NA	NA
-	Wet Level	%	10	50	-
TFCC	Colon faecal bacteria	Most potable no./gram or colonial/g	1000	200000	-
-	Salmonella	Spores/4 g dry	3	-	-
-	The living worms Eggs of Intestinal	Spores/4 g dry	1	-	-
-	Intestinal Virus	Unit/4 g dry	-	1	-

The EU Sewage Sludge Directive 86/278/EEC encourages the use of sewage sludge in agriculture. The Directive regulates sludge use in such a way as to prevent harmful effects on soil, vegetation, animals and human health and it provides specific rules for the sampling and analysis of sludge. Table 4.6 presents the limit values for heavy-metal concentrations in sludge for use in agriculture. The Directive also provides limit values for amounts of heavy metals which may be added annually to agricultural land.

Table 4.6. Limit values for heavy-metal concentrations in sludge for use in agriculture (mg/kg of dry matter)

Parameter	Limit values *(mg/kg of dry matter)*
Cadmium	20 to 40
Copper	1,000 to 1,750
Nickel	300 to 400
Lead	750 to 1,200
Zinc	2,500 to 4,000
Mercury	16 to 25
Chromium	N/A

A quick comparison shows that while the EEC limit values for Cadmium, Copper, Zinc, and Mercury are slightly more stringent than the Jordanian standard, Jordanian standards specify lower limits for lead. Considering that overall variations in maximum limits between the two standards are close and that the Jordanian standard stipulates specific sludge quality limits for each re-use category, the Project will apply the Jordanian limit values for sludge quality. If treated sludge is to be reused, "Class I" limit concentrations will be used.

4.8.3 Air Quality

The project must comply with the Jordanian ambient air quality standard as outlined in Jordanian Standard JS 1140/2006. The Standard includes guidelines and methods that have to be followed when sampling and monitoring for ambient air quality criteria pollutants. Table 4.7 presents the limits set by the JS 1140/2006.

Table 4.7. Jordanian Ambient Air Quality Standards (JS 1140/2006)

Pollutant	Averaging time	Units		No. of permissible exceedences/year
		ppm	µg/m^3	
Sulphur Dioxide (SO_2)	1-hour	0.30		3
	24 hour	0.14		1
	Annual	0.04		-----
Carbon Monoxide (CO)	1-hour	26.00		3
	8-hour	9.00		3
Nitrogen Dioxide (NO_2)	1 hour	0.21		3
	24 hour	0.08		3
	Annual	0.05		------
Hydrogen Sulphide (H_2S)	1 hour	0.03		3
	24 hour	0.01		3
Ozone (O_3)	1-hour	0.12		-------
	8-hour	0.08		-------
Ammonia (NH_3)	24 hour		270 µg/m^3	3
	Annual		8 µg/m^3	-------
Total Suspended Particulates (TSP)	24 hour		260 µg/m^3	3
	Annual		75 µg/m^3	-------
PM_{10}	24 hour		120 µg/m^3	3
	Annual		70 µg/m^3	--------
$PM_{2.5}$	24 hour		65 µg/m^3	3
	Annual		15 µg/m^3	---------
Lead (Pb)	Calendar Quarter		1.0 µg/m^3	----------
	Annual		0.5 µg/m^3	---------
Phosphate (P_2O_3)	24 hour		100 µg/m^3	3

Pollutant	Averaging time	Units		No. of permissible exceedences/year
		ppm	µg/m^3	
	Annual		40 µg/m^3	---------
Cadmium (Cd)	Annual	Annual	0.005 µg/m^3	----------

The European Union's legislation establishes health-based standards and objectives for a number of pollutants present in the air. These standards and objectives are summarized in the table below. These apply over differing periods of time because the observed health impacts associated with the various pollutants occur over different exposure times. Table 4.8 provides the ambient air quality standards according to the European Directive 2008/50/EU.

Table 4.8. Ambient air quality standards according to the European Directive 2008/50/EU

Pollutant	Concentration	Averaging period	Legal nature	Permitted exceedences each year
Fine particles (PM2.5)	25 µg/m3***	1 year	Target value to be met as of 1.1.2010 Limit value to be met as of 1.1.2015	n/a
Sulphur dioxide (SO2)	350 µg/m^3	1 hour	Limit value to be met as of 1.1.2005	24
	125 µg/m^3	24 hours	Limit value to be met as of 1.1.2005	3
Nitrogen dioxide (NO2)	200 µg/m^3	1 hour	Limit value to be met as of 1.1.2010	18
	40 µg/m^3	1 year	Limit value to be met as of 1.1.2010 *	n/a
PM10	50 µg/m^3	24 hours	Limit value to be met as of 1.1.2005 **	35
	40 µg/m^3	1 year	Limit value to be met as of 1.1.2005 **	n/a
Lead (Pb)	0.5 µg/m^3	1 year	Limit value to be met as of 1.1.2005 (or 1.1.2010 in the immediate vicinity of specific, notified industrial sources; and a 1.0 µg/m3 limit value applied from 1.1.2005 to 31.12.2009)	n/a
Carbon monoxide (CO)	10 mg/m^3	Maximum daily 8 hour mean	Limit value to be met as of 1.1.2005	n/a
Benzene	5 µg/m^3	1 year	Limit value to be met as of 1.1.2010**	n/a
Ozone	120 µg/m^3	Maximum daily 8 hour mean	Target value to be met as of 1.1.2010	25 days averaged over 3 years
Arsenic (As)	6 ng/m^3	1 year	Target value to be met as of 31.12.2012	n/a
Cadmium (Cd)	5 ng/m^3	1 year	Target value to be met as of 31.12.2012	n/a

Pollutant	Concentration	Averaging period	Legal nature	Permitted exceedences each year
Nickel (Ni)	20 ng/m^3	1 year	Target value to be met as of 31.12.2012	n/a
Polycyclic Aromatic Hydrocarbons	1 ng/m^3 (expressed as concentration of Benzo(a)pyrene)	1 year	Target value to be met as of 31.12.2012	n/a

* Under Directive 2008/50/EU, the Member State could apply for an extension of up to five years (i.e. maximum up to 2015) in a specific zone. The request is subject to an assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (48 µg/m^3 for annual NO_2 limit value).

** Under Directive 2008/50/EU, the Member State was able to apply for an extension until three years after the date of entry into force of the new Directive (i.e. May 2011) in a specific zone. The request was subject to assessment by the Commission. In such cases within the time extension period the limit value applies at the level of the limit value + maximum margin of tolerance (35 days at 75µg/m^3 for daily PM_{10} limit value, 48 µg/m3 for annual Pm10 limit value).

*** Standard introduced by Directive.

Under EU law a limit value is legally binding from the date it enters into force subject to any exceedances permitted by the legislation. For a target value the obligation is to take all necessary measures not entailing disproportionate costs to ensure that it is attained, and so it is less strict than a limit value.

Directive 2008/50/EC introduced additional $PM_{2.5}$ objectives targeting the exposure of the population to fine particles (see Table 4.9). These objectives are set at national level and are based on the average exposure indicator (AEI). This is determined as a 3-year running annual mean $PM_{2.5}$ concentration averaged over the selected monitoring stations in agglomerations and larger urban areas, set in urban background locations to best assess the $PM_{2.5}$ exposure of the general population.

Table 4.9. $PM_{2.5}$ target values as per Directive 2008/50/EC

Titleasa	Metric	Averaging period	Legal nature	Permitted exceedences each year
PM2.5 Exposure concentration obligation	20 µg/m^3 (AEI)	Based on 3-year average	Legally binding in 2015 (years 2013, 2014, 2015)	n/a
PM2.5 Exposure reduction target	Percentage reduction* + all measures to reach 18 µg/m^3 (AEI)	Based on 3-year average	Reduction to be attained where possible in 2020, determined on the basis of the value of exposure indicator in 2010	n/a

** Depending on the value of AEI in 2010, a percentage reduction requirement (0,10,15, or 20%) is set in the Directive. If AEI in 2010 is assessed to be over 22 µg/m3, all appropriate measures need to be taken to achieve 18 µg/m^3 by 2020.*

Table 4.10 compares the Jordanian ambient air quality limits with those stipulated by the EU Directive and assigns which limits will be applicable for the project for each parameter.

Table 4.10. Comparison of Jordanian ambient air quality limits with those stipulated by the EU Directive

Pollutant	Jordanian Standard (JS)			EU Directive	Project Standard
	Averaging time	Units		Limit Concentration and Averaging Period	
		ppm	µg/m³		
Sulphur Dioxide (SO_2)	1-hour	0.30		350 µg/m³ (1 hour) 125 µg/m³ (24 hours)	JS
	24 hour	0.14			
	Annual	0.04			
Carbon Monoxide (CO)	1-hour	26.00		10 mg/m³ (maximum daily 8 hour mean)	JS / EU
	8-hour	9.00			
Nitrogen Dioxide (NO_2)	1 hour	0.21		200 µg/m³ (1 hour) 40 µg/m³ (1 year)	JS / EU
	24 hour	0.08			
	Annual	0.05			
Hydrogen Sulphide (H_2S)	1 hour	0.03		-	
	24 hour	0.01			
Ozone (O_3)	1-hour	0.12		120 µg /m³ (maximum daily 8 hour mean)	JS / EU
	8-hour	0.08			
Ammonia (NH_3)	24 hour		270 µg/m³		
	Annual		8 µg/m³		
Total Suspended Particulates (TSP)	24 hour		260 µg/m³	300 µg/m³ (95 percentile of 24-hr values) 150 µg/m³ (24-hr mean) (EU Directive 80/779/EEC)	JS
	Annual		75 µg/m³		
PM_{10}	24 hour		120 µg/m³	50 µg/m³ (24 hours) 40 µg/m³ (1 year)	JS
	Annual		70 µg/m³		
$PM_{2.5}$	24 hour		65 µg/m³	25 µg/m³ (1 year)	JS
	Annual		15 µg/m³		
Lead (Pb)	Calendar Quarter		1.0 µg/m³	0.5 µg/m³ (1 year)	JS
	Annual		0.5 µg/m³		
Phosphate (P_2O_3)	24 hour		100 µg/m³	-	
	Annual		40 µg/m³		
Cadmium (Cd)	Annual	Annual	0.005 µg/m³	0.005 µg/m³ (1 year)	JS / EU

From the above table, a comparison between the Jordanian and EU ambient air quality standards reveals that air quality limits for carbon monoxide, nitrogen dioxide, ozone and cadmium are similar or very close while other air quality parameters show differences. However, it is advantageous to use

a single standard for the project in order to facilitate compliance and monitoring. For this purpose, the Jordanian air quality standard JS1140/2006 will be used for the project.

4.8.4 Noise Environment

The project will adhere to the Jordanian Guidelines for Prevention of Noise (2003) during construction and operation. The maximum allowable noise levels for various areas are listed in Table 4.11 for both day and night activities.

Table 4.11. Jordanian Maximum Allowable Noise Levels

Area	Allowable Limits for Noise Levels (dBA)	
	Day	Night
Residential areas within the city	60	50
Residential areas within the suburbs	55	45
Residential areas within villages	50	40
Commercial areas, city center, residential areas with workshops, vocational shops or businesses	65	55
Industrial areas (heavy industries)	75	65
Areas with educational institutions, hospitals, or houses of worship	45	35

Regarding occupational noise limits in Jordan, Regulation No. 43 of 1988 on Protection and Safety from Industrial Machinery and Equipment on Worksites will be applicable to the project. Furthermore, the provisions for noise limits in the "Instruction for the Protection of Workers against the Risks of the Work Environment No. 8 of 1996" issued by the Ministry of Labour will be applicable to the Ghabawi project. In regards to occupational noise limits, the EU Directive 2003/10/EC on minimum health and safety requirements regarding the exposure of workers to the risks arising from noise will be applicable to the Ghabawi Project.

According to the IFC Environmental, Health, and Safety (EHS) General EHS Guidelines on Environmental Noise Management, noise impacts should not exceed the levels presented in Table 4.12, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 4.12. IFC EHS Noise Level Guidelines

	One Hour LAeq (dBA)	
Receptor	Daytime (07:00 - 22:00)	Night-time (22:00 - 07:00)
Residential; institutional; educational	55	45
Industrial; commercial	70	70

It can be seen that the Jordanian standard for noise emissions in industrial areas (as per the designation of Ghabawi project area) during day time is 75dBA while the IFC EHS Guidelines require this level not to exceed 70dBA. The Jordanian standard is, however, more stringent for the night time noise level limit (65dBA) compared to the IFC Guidelines. Hence, a maximum day-time noise level of 70 dBA and a maximum night-time noise level of 65 dBA will be used for the project.

4.9 Project Ownership

The Water Authority of Jordan, operating under the MWI, is responsible for the operational management of water resources and the organization of water supply and wastewater treatment. The Ghabawi WWTP's operational activities as well as physical facilities will be owned by the Government of Jordan through MWI. It is expected that the project components will be operated by WAJ, either directly or through an agreement with a third party, including private sector contractors, or any other form that WAJ deems suitable.

4.10 Project Categorization

4.10.1 Based on EBRD Guidance

The proposed WWTP at Al Ghabawi will serve a population estimated in 2017 to be around 1,314,843 capita with an estimated septage inflow of 12,430 m^3/day. Since the Project would be significantly above the 150,000 PE threshold defined by EBRD's E&S Policy of 2014 and the EU EIA Directive for Category A/Annex1 projects, adhering to this requirement resulted in categorising the Project as "A" and thus require a full ESIA and public disclosure thereof.

4.10.2 Based on National Environmental Requirements

With respect to the Jordanian EIA Regulation (No. 37 of Year 2005) which regulates the environmental assessment process in the Kingdom, Article 4 stipulates that no project whether industrial, agricultural, commercial, housing, touristic, developmental, or any of the projects listed in Annexes 2 and 3 of the Regulation shall be permitted to commence operation until after obtaining the required environmental approval from MoEnv. Consequently, WAJ, as project proponent, filed an environmental permit application with MoEnv and MoEnv has responded requesting a full EIA study for the project which corresponds to EBRD's Category A classification. Accordingly, the EISA study was submitted and later on approved by MoEnv. A copy of MoEnv response letter and permit letter are included in Annex 4.

5 ESIA APPROACH

This ESIA study was carried out in accordance to the Jordanian Environmental Protection Law No. 6 for the year 2017 and the Environmental Impact Assessment Regulation No. 37 for the year 2005, as well as with EBRD's Environmental and Social Policy (ESP) and Performance Requirements (PRs) of 2014 and relevant European Union (EU) requirements.

This section describes the approach adopted in developing this ESIA study. The approach consisted of the following:

- Project Environmental and Social (E&S) screening and environmental application at MoEnv;
- Project description and analysis of alternatives;
- Identifying the regulatory framework applicable to the Project;
- Scoping phase and stakeholder engagement;
- Identifying the study area and data collection;
- Description of environmental and social baseline conditions;
- Evaluation approach of identified environmental and social impacts of the Project – including the approach to determining significance, development of mitigation measures, assessment of cumulative impacts, and assessment of residual impacts;
- Development of the Environmental and Social Management Plan (ESMP); and
- ESIA disclosure.

5.1 Project Screening and Environmental Application

A project environmental and social (E&S) screening was carried out based on the following:

- Review of Project documents and the field visits.
- The EBRD Environmental and Social Policy (ESP) of 2014.
- The Jordanian Environmental Impact Assessment (EIA) Regulation No. 37 of year 2005, which regulates the environmental assessment process in the Kingdom.
- Meeting with Jordanian Ministry of Environment (MoEnv) on November 21st, 2018 at the Licensing and Pollution Prevention Directorate with the Environmental Licensing Section as well as the EIA Section.

As mentioned in section 4.10, screening based on EBRD's ESP of 2014 resulted in categorising the Project as "A" and thus require a full ESIA. Following the Project's E&S screening, an environmental permit application was presented at MoEnv in accordance with the requirements of Regulation 37 for the purpose of:

- Obtaining an approval on the proposed location.
- Confirming the project categorization in accordance with the EIA Regulation No. 37 of 2005.

As presented in Annex 4, MoEnv has responded requesting a full EIA study for the project which corresponds to EBRD's Category A classification.

5.2 Project Description

A project description was developed to identify the relevant associated activities and operations including any project alternatives as required by EIA Regulation N. 37 for 2005 and in accordance to EBRD PR1. The Project description was defined by the feasibility study conducted for the Project, which considered the environmental and social requirements applied in this ESIA.

5.3 Analysis of Alternatives

Possible alternatives related to the Project were examined and compared with the respect to the following:

1. Analysis of wastewater treatment technology in order to identify the viable solutions for the Project;
2. Analysis of treated effluent reuse options;
3. Analysis of sludge disposal and management options based on national regulations and standards;
4. Analysis of the "No Project" option which assumes that the Project development does not take place. This analysis compares the environmental and social impacts of "Project" versus "No Project" in order to provide justification of Project implementation.

The alternatives analysis conducted as part of the feasibility study informed the definition of the Project.

5.4 Identifying the Regulatory Framework

The ESIA addressed the institutional and legislative aspects of the proposed project and a review of national and international guidelines relevant to this project was carried out. Moreover, a gap analysis was carried out to identify any existing gaps and deficiencies between the EBRD and national environmental and social requirements. The following specifically was used:

- Review local Jordanian environmental and social regulations and requirements including the relevant international conventions and treaties signed and ratified by Jordan.
- Description of the national institutions related to this project, their role and capacity.
- Outline of the regulations relevant to protecting the human and natural environment.
- Identification of the regulatory requirements of the jurisdictions in which the Project operates and outline national and municipal permitting requirements.
- Review of the environmental and social performance standards (ESPs) of EBRD.
- Limited consultations were carried as needed with key stakeholder to discuss roles and responsibilities and ensure that the required institutional capacity exists for the successful implementation and operation of the project.
- Preparation of a gap analysis of the EBRD and local/national environmental and social requirements in a tabular format.

5.5 Stakeholder Identification, Consultation and Engagement

The stakeholder identification involved determining the stakeholder groups affected and/or influencing the Project, their level of involvement and the extent of influence they may have on the Project. This was followed by stakeholder consultation and engagement carried in accordance to EBRD's PR 10 on "Information Disclosure and Stakeholder Engagement" and to the national EIA Regulation No. 37 of 2005.

Accordingly, a public consultation session was held where the stakeholders were invited by MoEnv. The details on this session are further discussed under section 7.2. The overall aim of the session was to take into consideration issues of concern raised by stakeholders throughout different phases of the project.

Moreover, several stakeholder consultation meetings were carried out with local community stakeholders in order to engage them and understand their concerns together with managing their expectations. The details of these meetings are discussed in section 7.3.

In addition, as part of the stakeholder engagement, a project-specific Stakeholder Engagement Plan (SEP) has been prepared in order ensure that identified stakeholders are appropriately engaged on all issues that potentially affect them and to maintain an ongoing relationship with them throughout the Project.

5.6 Scoping of Valued Environmental and Social Components

Based on the outcomes of the public consultation session, the Project description, field visits, as well as the team's experience with similar project and knowledge of local conditions, scoping of Valued Environmental and Social Components (VESCs) was carried out. A draft register of identified interactions of project aspects (i.e., activities that interact with the environment and constitute the source of impact), potential impacts, and receptors (i.e., environmental and social receivers of the influence of the aspects) was prepared. This register allowed for specifying the potential environmental and social impacts during both the construction and operational phases of the Project that have either been scoped in for further detailed assessment or out and the relevant justification.

5.7 Study Area and Data Collection for Baseline Conditions

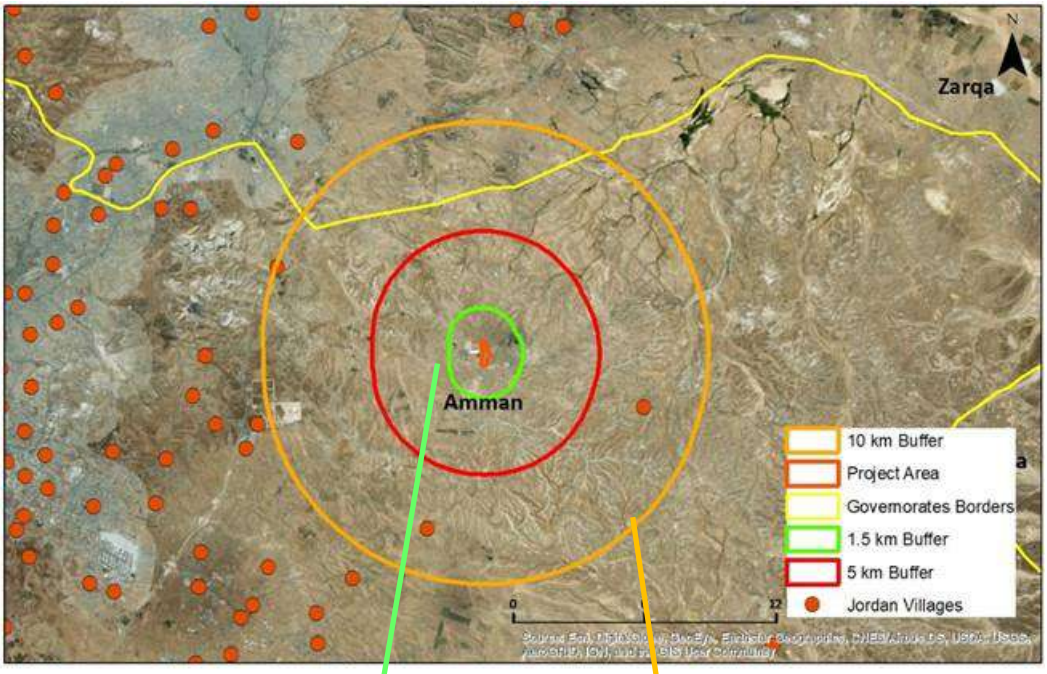
The aim of describing the baseline conditions is to assess the current environmental and social status (baseline) of the planned Project area and its surroundings, including environmental and social issues associated with any previous use of the areas planned to be occupied by the Project.

To characterize the baseline conditions, first the study area was delineated. Then, site visits and review of secondary resources (i.e. existing literature/documentation) were carried out to collect the data needed for baseline documentation.

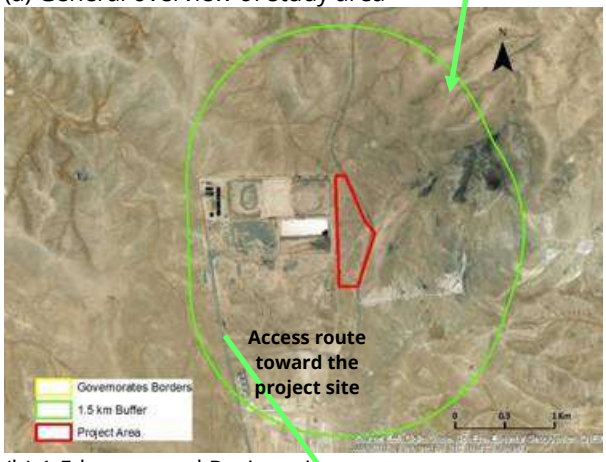
5.7.1 Study Area

The study area for this ESIA is the area affected by the Project implementation and which is beyond the Project's footprint. The following boundaries were used to delineate the study area (illustrated in Figure 5.1-a) for the purpose of evaluating the Project's potential impacts:

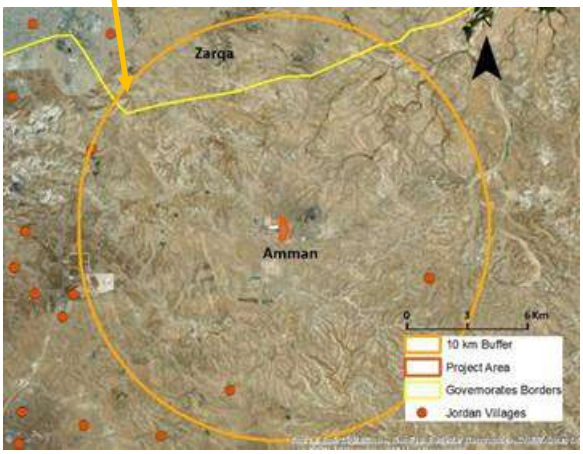
- A buffer of 1.5 km around the Project site was adopted as the area within which impact on physical, biological, archaeological and cultural heritage receptors are assessed (see Figure 5.1-b). This area is considered to cover the extent of potential impacts to be caused by the construction and operation of the Project on the parameters of physical and biological environments as well on cultural/archaeological resources.
- As the closest community was found to be at around 7.5 km from the Project site, an area with a radius of 10 km around the Project site boundary was adopted as the area of study for the socio-economic receptors (i.e., local community, economic activities, land use, etc.) (see Figure 5.1-c). Usually, the direct impact from the construction and operation of the WWTP is not expected to influence local communities available within 10 km or further distance. However, this ESIA study extended the description of baseline conditions and impacts to communities available within 7.5 to 13 km from the Project site boundary since no local communities are available at less than 7.5 km from the site.
- For transportation and wastewater reuse, a study area was not delineated. For transportation, tankers will be coming from within Amman and Zarqa governorates to the Project site. For treated wastewater, the reuse may extend to areas that are cultivated by members of local communities identified to be available at distances of greater than 12 km from the Project boundary. The same applies to discharge to the wadi.



(a) General overview of study area



(b) 1.5 km around Project site



(c) 10 km around Project site

(d) Access route to the Project site

Figure 5.1. Illustration of the Project's E&S study area as (a) general overview, (b) close up of the 1.5 km area, (c) close up of the 10 km area, and (d) access route towards the Project site

5.7.2 Data Collection

The characterisation of the baseline was achieved based on carrying out site visits and on a detailed review of secondary resources (i.e. existing literature/documentation) as well as field visits/investigations. The conducted works included:

- Hydrology assessment of the selected Project site.
- Local air and existing noise level measurements, whereby air quality parameters (Particulate Matter $PM_{2.5}$, Hydrogen Sulphide H_2S, Ammonia NH_3, and Volatile Organic Carbons VOCs) as well as noise levels were measured and previous data records obtained to establish baseline conditions within the vicinity of the Project site. The sources of the data were as follows:
  - 24 hours measurements for $PM_{2.5}$, H_2S, NH_3, VOCs, and noise levels were carried at the southern end of the project site over a period of 7 days. These parameters were selected for measurement as: 1) the construction activities will take place within an infrastructure services area of arid nature with the closest facilities to the Project site being industrial activities, and 2) these are the parameters requested by the MoEnv as being of concern during the Project operational stage.
  - Air quality and noise measurement results carried out for the Ghabawi solid waste landfill.
  - Air quality data for Ghabawi area obtained from the Directorate of Monitoring and Environmental Assessment at the MoEnv.
- Biodiversity survey of the proposed WWTP area at Ghabawi including surrounding areas and wadi ecosystems. The team reviewed all available information, biodiversity assessment or other surveys obtained previously for the study site and\or its adjacent areas. Collected information addressed flora and fauna species as well as habitat and typical species communities. Moreover, a rapid assessment of the site was carried out through a field visit that aimed to validate the secondary data collected through desktop review. Through walking along the site and adjacent areas within 500 m, the field observations were recorded for the presence of breeding and resident birds, animal signs and tracts, and plant species. All species observed were recorded and documented as part of the baseline conditions.
- Social information has been collected from Department of Statistics (DoS),on population numbers, level of education, family size, number of housing units, and number of Syrian refugees; supplemented with a Household Survey (see section 5.8).
- Traffic impact assessment (TIA) which assessed the impacts from the additional traffic generated by the septage tanker trucks and the measures to be introduced for traffic safety.
- The identification of archaeological and cultural heritage sites potentially available within the Project's area of influence depended on searching the MEGA Jordan online system (MEGA Jordan, 2010) and on contacting the Department of Antiquities (DoA) to inquire about availability of such sites.

5.8 Household Survey

A household survey was conducted to establish a baseline of the area's current socioeconomic conditions, and to assess from the local community's point of view the anticipated benefits and main issues of concern based on findings identified in the ESIA in relation to the Project.

A stratified random sample of 153 households in the communities 7.5 – 13 km from the project site were selected to participate in the household's survey. The design of the sample was based on the

population size of the population clusters identified as affected communities according to two main strata: neighbourhoods closer than 10-km to the Project Site and neighbourhoods between 10 and 13 km from the Project site. Table 5.1 shows the distribution of the sample per neighbourhood. It should be noted that the survey sample size has been devised to show general trends, but limits analysis through further breakdown of information to make generalisations about the conditions and experiences of smaller groups within the sample.

Table 5.1. Sampled households

Neighbourhood	Statistic
Qa'four & Madhouneh	13 (9%)
Mghayer Mhanna	35 (23%)
Manakher	18 (12%)
Al-Khashafieh	43 (28%)
Al-Beda	44 (29%)
Total #	**153 (100%)**

The questionnaire consisted of six main sections as follows:

- Information about the household: locality, home type and ownership, family size, income and characteristics of the household head.
- Households' agricultural and livestock activities: size and value of agriculture and livestock activities as livelihoods and the challenges they face in sustaining these activities.
- Household's health conditions: presence of selected chronic health conditions and the environmental nuisances in the vicinity of the house.
- Household's economic activity: the economic activity of all household members above age 15 years, sector of work and occupation for working individuals.
- Opinion about development of Al Ghabawi strategic services zone: perception of positive and negative impact of the development of Al Ghabawi as a Strategic Services Zone, and baseline conditions in terms of odours, noise, pollution and concerns over safety from traffic.
- Views, expectations and concerns about the planned Wastewater Treatment Facility: expected positive and negative impacts on infrastructure, health, the environment, local economy and livelihoods.

Six enumerators from the local community and two field supervisors collected the data during August 2020.

The survey results were generated using descriptive statistical analyses. Namely, distributions of responses, cross tabulations, in addition to mean values and standard deviations (SD). Median values are often presented particularly in small group sizes to reduce the influence of outliers when reaching conclusions about the central tendency.

The responses to six open-ended items in the questionnaire were analysed thematically and then coded to enable the production of visual information summaries.

Moreover, three main focus group discussions (FGDs) were conducted with the aim to explain the trends which emerged in the survey and fill gaps in information on different issues of concerns. The focus groups were:

- **Focus Group 1- Men:** The target was having an equal representation of youth < 30 years of age and household heads. This group helped in providing a well-rounded discussion on the anticipated positive and negative impacts.
- **Focus Group 2- Women:** Underrepresented in the survey sample (10%) due to the nature of the study and strong social norms which reinforce that participation in such matters is exclusive to men. This group helped in understanding gender dynamics, gendered impacts and reflect on the impact on families especially children.
- **Focus Group 3- Farmers and Livestock Owners:** Agricultural activities, including livestock breeding, is a main livelihood in the area. This group aimed at better understanding of the views of households owning livestock.

A maximum of 8 participants were invited to each focus group to ensure social distancing and safety from the spread of COVID-19. A summary of the FGD meeting details is provided in Table 5.2.

Table 5.2. Summary of the focus groups

No.	Group	Number of participants	Age range	Date	Duration
1	Livestock breeders and farmers From Beda, Khashfieh South, Madhouneh, and Al Manakher	8	48 – 65 years	6 September 2020	90 minutes
2	Men (18+) From Beda, Khashfieh South, and Khashfieh North	4	27 – 53 years	8 September 2020	80 minutes
3	Women (18+) from Beda, Khashfieh North, Mghayer Mhanna and Wadi El Esh	8	23 – 70 years	12 September 2020	90 minutes

5.9 Impact Assessment Evaluation Approach

The approach adopted towards assessment of the relevant environmental and social impacts involved steps. First, determining the consequence of the impact where for each impact consequence was determined based on receptor sensitivity / importance and the magnitude of the impact as follows:

Consequence = Receptor Sensitivity / Importance x Impact Magnitude

Where: "Consequence" is the effect (positive or negative) from an activity's interaction with the legal, natural and/or socio-economic environments (i.e., receptor). It is evaluated as the resultant of the receptor's sensitivity / importance and magnitude of impact affecting it (see Table 5.3 below).

Receptor Sensitivity / Importance refers to the adaptability and resilience of an environmental parameter to an identified impact.

Magnitude is the level of impact that may be caused compared to the baseline conditions.

The receiving parameter sensitivity was determined based as follows:

- *High*: The environmental/social parameter/receptor is fragile and an impact is likely to leave it in an altered state from which recovery would be difficult or impossible.
- *Medium*: The parameter/receptor has a degree of adaptability and resilience and is likely to cope with the changes caused by an impact, although there may be some residual modification as a result; and
- *Low*: The parameter/receptor is adaptable and is resilient to change.

The magnitude of the impact is the scale of change which the impact may cause compared to the baseline and how this change relates to accepted thresholds and standards. it may be a negative or a positive impact. The following categories were applied to the assessment:

- *High*: a negative impact which results in a large change compared to variations in the baseline. Potentially a clear breach of accepted limits;
- *Medium*: a negative impact which results in noticeable change and may breach accepted limits; and
- *Low*: a negative impact which when compared with the baseline may be noticeable but existing thresholds would not be exceeded.
- No impact.
- Positive impact.

Table 5.3. Consequence scores resulting from receptor sensitivity and impact magnitude

Magnitude	Receptor Sensitivity		
	Low (1)	Medium (2)	High (3)
High (3)	3	6	9
Medium (2)	2	4	6
Low (1)	1	2	3
No Impact (0)	0	0	0
Positive (+)	+	+	+

The consequence levels as resultant from the receptor sensitivity/importance and magnitude interactions are presented in Table 5.4.

Table 5.4. Explanation of consequence levels based on receptor sensitivity/importance and magnitude interactions

Consequence Score	Description of the consequence (positive or negative)
6-9 (Severe)	Severe environmental damage or severe nuisance extending over a large area and continuous emission or permanent change over more than 5 years. Likely major breach in compliance resulting in prosecution. Stakeholders concern is triggered on a national level.
4 (High)	Continuous emission or permanent change over less than 5 years resulting in negative medium to high impact to environmental, ecological, health, socio-economic, and/or cultural heritage receptors. Possible major regulatory noncompliance.

Consequence Score	Description of the consequence (positive or negative)
	Stakeholders concern is triggered on a national level.
3 (Medium)	Regular over short-term (less than 3 years) or intermittent over long-term (more than 3 years) leading to repeated breaches of statuary limit. Spontaneous recovery of limited damage within one year. Possible regulatory noncompliance. Stakeholders concern is triggered on a regional level.
2 (Low)	Minor magnitude effect on the environment but no permanent effect. Regulatory terms or corporate policy set defined conditions. Stakeholders concern is triggered on a local level.
1 (Negligible)	Local environmental damage within the fence and within systems with negligible severity. No regulatory noncompliance. Stakeholders concern is triggered on an individual level.
0 (None)	No impact.
+ (Positive)	Beneficial impact that enhances the environment. No public interest.

Then, the potential overall consequence was combined with the "Likelihood" to give the impact significance as follows and as illustrated in Table 5.6.

Significance = Consequence x Likelihood

Where: Likelihood" is the possibility that the planned/unplanned activity will occur. The scores for likelihood are presented and explained in Table 5.5.

Table 5.5. Likelihood of Occurrence

Likelihood Score	Likelihood an event will occur from planned or unplanned/accidental activities
5	**Certain** it will occur more than once on the facility.
4	**Possible** and could occur within the lifetime of the development.
3	**Likely** where an event could occur within the life of 10 similar facilities where it has occurred at similar facilities.
2	**Unlikely** or remote (similar event has occurred somewhere with similar projects but not likely to occur with current practices and procedures).
1	**Extremely Remote** (has never occurred within similar projects but theoretically possibly).
0	**Will Not Occur.**

Table 5.6. Significance Categories based on consequence-likelihood interaction

Significance = Consequence x Likelihood							
	Likelihood						
	5	4	3	2	1	0	
Consequence	Certain	Possible	Likely	Unlikely	Extremely Remote	Will Not Occur	Significance
6-9 (Severe)	30 - 54	24 - 36	Greater than 18 - 27	Greater than 12 - 18	6 - 9	0	Severe
4 (High)	20	16	12	8	4	0	Major
3 (Medium)	15	12	9	6	3	0	Moderate
2 (Low)	10	8	6	4	2	0	Minor
1 (Negligible)	5	4	3	2	1	0	Negligible
0 (None)	0	0	0	0	0	0	No Impact
+ (Positive)							Positive Impact

Mitigation measures for the evaluated environmental and social impacts are identified through proposing mitigation measures to avoid, minimize, mitigate or compensate for the potentially identified adverse future impact, issue and/or risk. It will also identify measures to enhance Project benefits.

Moreover, and as part of the impact analysis, the cumulative impacts arising during the project implementation were identified. The cumulative impacts analysis was based on known current and future planned activities within the project area, and based on available information on such existing/planned developments.

The impacts that remain after mitigation measures have been applied (including mitigations incorporated into the Project's base design and those developed in addition to the base design) are identified as "Residual Impacts" and their significance discussed.

5.10 Environmental and Social Management Plan (ESMP)

The Consultant described the avoidance, minimisation, mitigation, compensation and monitoring measures aimed at improving the Project and avoiding and reducing its E&S impacts in an Environmental and Social Management Plan (ESMP). The ESMP includes:

- A high-level description of the Environmental and Social Management System including operational policies, management plans, management systems, programmes, procedures, and practices;
- Mitigation measure(s) along with specific monitoring measures/parameters aimed at tracking actions specified in the ESMP as well as any regulatory monitoring and reporting requirements;
- Defined roles and responsibilities for the actions/mitigation measures; and
- Recommendation of the training or capacity-building required to ensure that personnel tasked with implementing the ESMP have the necessary awareness and skills to execute these functions effectively.

5.11 ESIA Disclosure

As part of the stakeholder engagement and consultations required by EBRD's PR10, the full ESIA documents will be disclosed to the public for 120 calendar days in line with the EBRD public information policy. The disclosed ESIA documents will include:

- Environmental and Social Impact assessment Report (ESIA);
- Non-Technical Summary (NTS);
- Stakeholder Engagement Plan (SEP); and
- Project Environmental and Social Action Plan (ESAP).

These documents will be available in English and Arabic through the following avenues:

- Electronically on MWI's website: (www.mwi.gov.jo)
- Electronically on EBRD's website: (www.ebrd.com)
- Hard copies of the ESIA, NTS, SEP, and ESAP documents with indication to procedures on accessing them given the Covid-19 restrictions to be made available at WAJ:

  Water Authority of Jordan, Building No. 6, Jaber Ben Hayyan Street, Shmeisani - Amman

  Telephone: +962 6-5652261
- Hard copy of the ESIA disclosed documents with indication to procedures on accessing them given the Covid-19 restrictions will be placed at Uhud District Municipal Directorate / GAM:

  Al-Khashafieh North District / opposite to Al- Khashafieh Health Center

  Tel: +962 6-4020410
- Hard copies of the NTS will be placed at the premises of local CSOs with indication to procedures on accessing them given the Covid-19 restrictions. Details on local CSO locations where the documents will be available will be communicated through the disclosure meeting.

Usually, disclosure meetings are carried out at a place that is closest to the communities of concern, as required by the EBRD. These meetings are conducted to present the outcomes of the ESIA and announce the availability of the disclosed documents to the stakeholders. However, given the prevalent COVID-19 pandemic and government restrictions regarding public meetings, the disclosure event will take the form of a virtual meeting; where an invite will be sent to the stakeholders. Before holding the disclosure virtual meeting, the disclosure presentation will be posted on WAJ's Facebook page and the link to the virtual meeting will be posted on MWI's website. The presentation will also be posted on the Facebook page of the local municipal committee head of Uhud District Municipal Directorate/GAM. The disclosure presentation will include slides informing people where the disclosure documents can be accessed and the link to the disclosure meeting. Moreover, the virtual meeting will be facilitated by the consultant and will be conducted in a manner that will ensure equal opportunity is provided to all participants to raise questions or express views. The virtual meeting (using Zoom) will include a presentation covering the project activities, ESIA findings (including impacts, grievance mechanism), and information on access to the ESIA documents. The meeting will also allow time for feedback and Q&A (Questions and Answers) at the end of the session. The meeting's presentation and Q&A will be recorded and documented in a summary report to EBRD and the link to the recorded meeting will also be posted on WAJ Facebook and the Facebook page of the local municipal committee head of Uhud District Municipal Directorate/GAM.

The disclosure approach will also involve preparing and distributing leaflet/brochure to be distributed to the local communities in coordination with local CSOs. The leaflet/ brochure will include the following information:

- the purpose, nature, scale and duration of the project activities.
- risks to, and potential impacts on, stakeholders and proposed mitigation measures.
- the envisaged stakeholder engagement process, opportunities and ways in which the local communities can participate during the project implementation including the details of the virtual meeting to be held.
- the process by which public grievances will be managed during the project implementation.
- access link to the Project ESIA Documents and locations where hard copies are disclosed.
- Contact details to receive feedback and comments on the ESIA documents during the disclosure duration.

Additional disclosure activities will include placing posters on notice boards at Uhud District Municipal Directorate and premises of local CSOs.

Finally, the stakeholders can raise their comments and concerns during the disclosure duration by communicating those to WAJ on the following contact address:

Water Authority of Jordan
Attention. Eng. Ahmad Al-Awamleh
Building No. 6, Jaber Ben Hayyan Street, Shmeisani
P.O. Box 5012, Amman-11181
Telephone: +961 6-5652261 – Extension (1050)
Fax: +961 6-5687760
Email address: ahmad_al-awamleh@mwi.gov.jo

The E&S consultant will review, discuss, and respond to comments/feedback received from the stakeholders through virtual meetings, phone calls or e-mail. Any amendments needed based on the stakeholder comments/feedback will be added to the ESIA documents.

6 ENVIRONMENTAL AND SOCIAL BASELINE CONDITIONS

This section describes the environmental and social baseline conditions based on the identified study area and data collection described under section 5.7.

6.1 Physical Environment

6.1.1 Climate

The project area belongs to the Arid Mediterranean cool climatic zone (Figure 6.1). The climate of the study area is dry with hot summers and north-westerly winds. Meteorological data for the study area was obtained from Ghabawi Meteorological Station. According to the data presented in Table 6.1 and illustrated in Figure 6.2, the average minimum temperature is 3.5°C recorded during January and maximum temperature was 34.3°C during August.

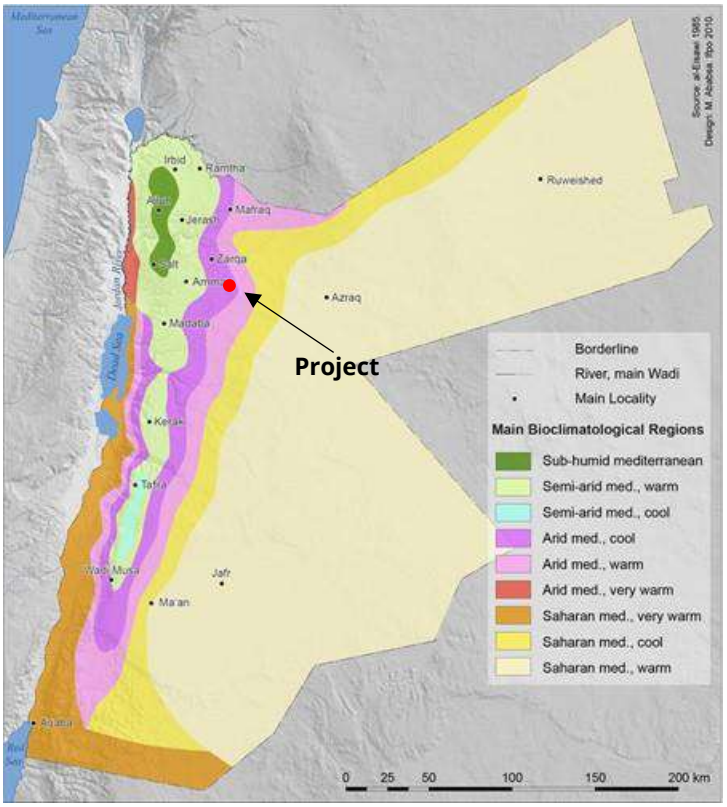


Figure 6.1. Jordan's main bioclimatic regions (source: Ababsa, 2013)

Table 6.1. Meteorological characteristics of the Project area for period of 2005 to 2017

Parameter	Yearly	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Average Temperature (°C)	**24.8**	13.3	15.5	19.7	24.8	28.9	32.4	34.1	34.3	31.7	27.5	20.6	15.4
Maximum Average Temperature (°C)	**11.9**	3.5	4.8	7.6	10.8	14.4	17.2	19.1	19.2	17.4	14.5	9.2	5.1

Parameter	Yearly	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean Average Temperature (°C)	**18.3**	8.4	10.15	13.65	17.8	21.65	24.8	26.6	26.75	24.55	21	14.9	10.3
Total Evaporation, Class A pan, (mm)	**2,222.6**	59.0	77.4	135.8	197.2	264.1	317.0	325.2	304.5	228.4	160.7	89.5	63.9

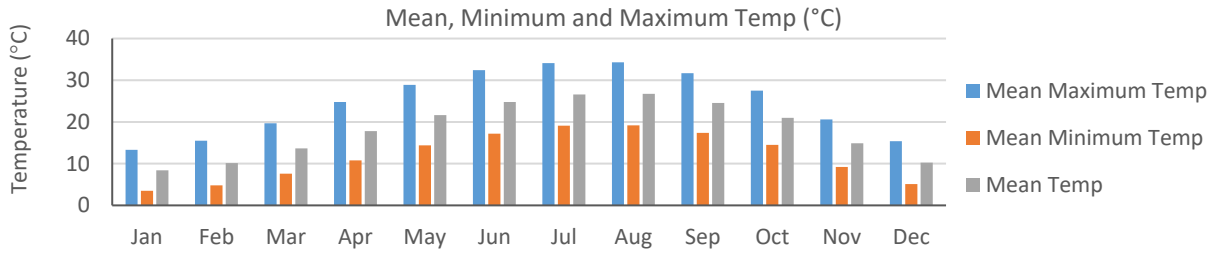


Figure 6.2. Minimum, maximum and mean temperature prevalent in the Project area based on data from Al Ghabawi Meteorological Station

For the area of study, annual average precipitation is around 84 mm. As illustrated in Figure 6.3, the majority of rain (more than 80% of the total average precipitation) occurs during the period from December to March.

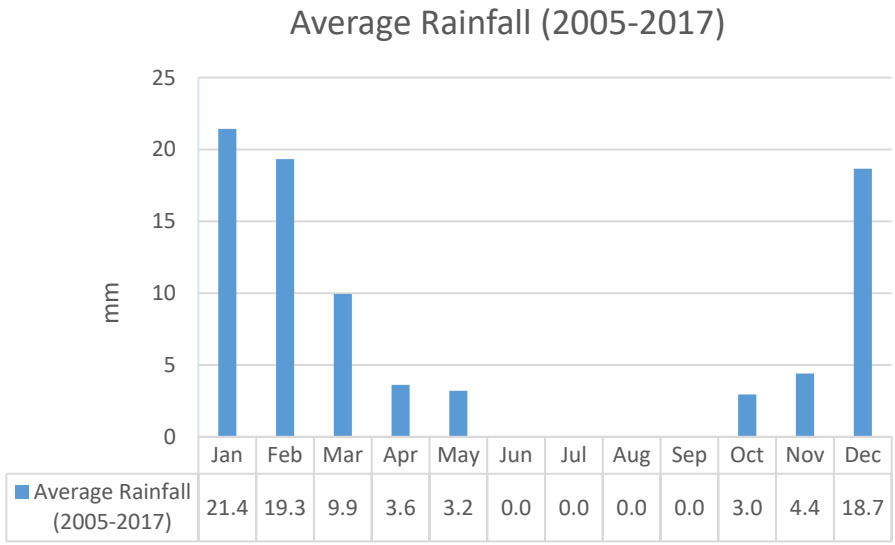


Figure 6.3. Average monthly rainfall within the study

The wind rose for the Project area is presented in Figure 6.4 and it shows the prevalence of westerly winds with an average wind speed of around 7.7 knots.

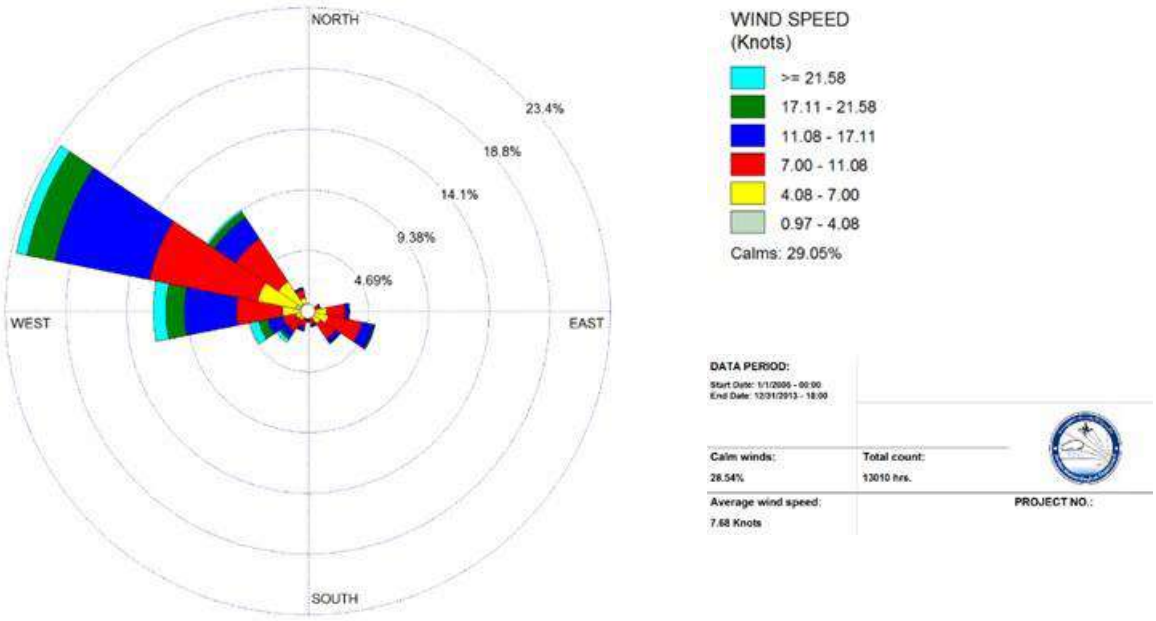


Figure 6.4. Wind Rose plot for project area

6.1.2 Air Quality

During the field visits that were conducted by the ESIA team, it was noticed that anthropogenic sources of air emissions within the Project area include Al Ghabawi municipal solid waste landfill and health care waste incinerator, Amman Strategic Reserve Terminal for Petroleum Products, and the associated movement of vehicles.

Air quality monitoring data were obtained from three sources:

1. Air quality measurements for H_2S, NH_3, VOCs, and $PM_{2.5}$ were carried out as part of this ESIA study at one location at the southern end of the Project site over a period of 7 days extending from 1st to 8th of December 2019. The results are presented in Annex 5. A summary of the results presented in Table 6.2 shows that NH_3 levels are below permissible level indicated the Jordanian and EU standards. For $PM_{2.5}$, the measured levels over 7 days were below the permissible 24-hour average limit indicated by the Jordanian standard but exceeded the limit indicated for the EU. However, given the arid nature of the Project area, the EU limits for particulate matter cannot be considered attainable for the Project area. Finally, the measured levels of H_2S showed exceedance of allowable limit as per the Jordanian standard over the 7 days of measurement. This elevated level of H_2S is attributed to operations at the neighbouring Al Ghabawi solid waste landfill. Though the H_2S 24-hour average is less than the EU limit indicated by the WHO guidelines for Europe, the hourly measurements presented in Annex 5 indicate that it exceeds the concentration does exceed the 7 µg/m^3 (i.e., around 0.005 ppm) limit which causes odour annoyance among the exposed population.

Table 6.2. Results of the air quality measurements at the Project site within December 2019

Time	Parameter	Results							JS 1140:2006	EU Standards*
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		
01 – 08/ 12/2019	$PM_{2.5}$ ($\mu g/m^3$)	**44.42**	13.91	17.90	**28.63**	**23.89**	7.45	10.47	65 $\mu g/m^3$	25 $\mu g/m^3$
	H_2S (ppm)	**0.02**	**0.03**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	0.01 ppm	0.005 ppm**
	NH_3 ($\mu g/m^3$)	253.21	254.60	240.74	235.77	246.21	250.90	256.95	270 $\mu g/m^3$	270 $\mu g/m^3$
	TVOCs ($\mu g/m^3$)	3.53	2.84	3.37	2.88	2.95	2.50	2.18	---	---

* The 24-hour limit EU ambient air quality standards refer to those provided by either DIRECTIVE 2008/50/ECEU on ambient air quality and cleaner air for Europe or the WHO Air Quality Standards for Europe (2000).
** This is a 24-hour average limit. In order to avoid substantial complaints about odour annoyance among the exposed population, hydrogen sulfide concentrations should not be allowed to exceed 7 $\mu g/m^3$ (i.e., around 0.005 ppm), with a 30-minute averaging period (WHO, 2000).

2. Air quality measurement results conducted for Al Ghabawi solid waste landfill (see Annex 6). The data represents hourly measurements with 24-hours averages for SO_2, NH_3, H_2S, VOC, NO_2, TSP, PM_{10} and $PM_{2.5}$ at five locations within Al Ghabawi landfill site for five days. The results indicated no exceedance in relation to SO_2, NH_3, H_2S, VOC, and NO_2. However, TSP, PM_{10} and $PM_{2.5}$ were found to exceed the 24-hour maximum allowable limit indicated by the Jordanian ambient air quality JS 1140/2006 and the EU air quality standards as illustrated in Figure 6.5. This exceedance in dust related parameters can be explained due to the arid nature of the Project area, scarce vegetative cover, and the operations carried out at Al Ghabawi solid waste landfill site.

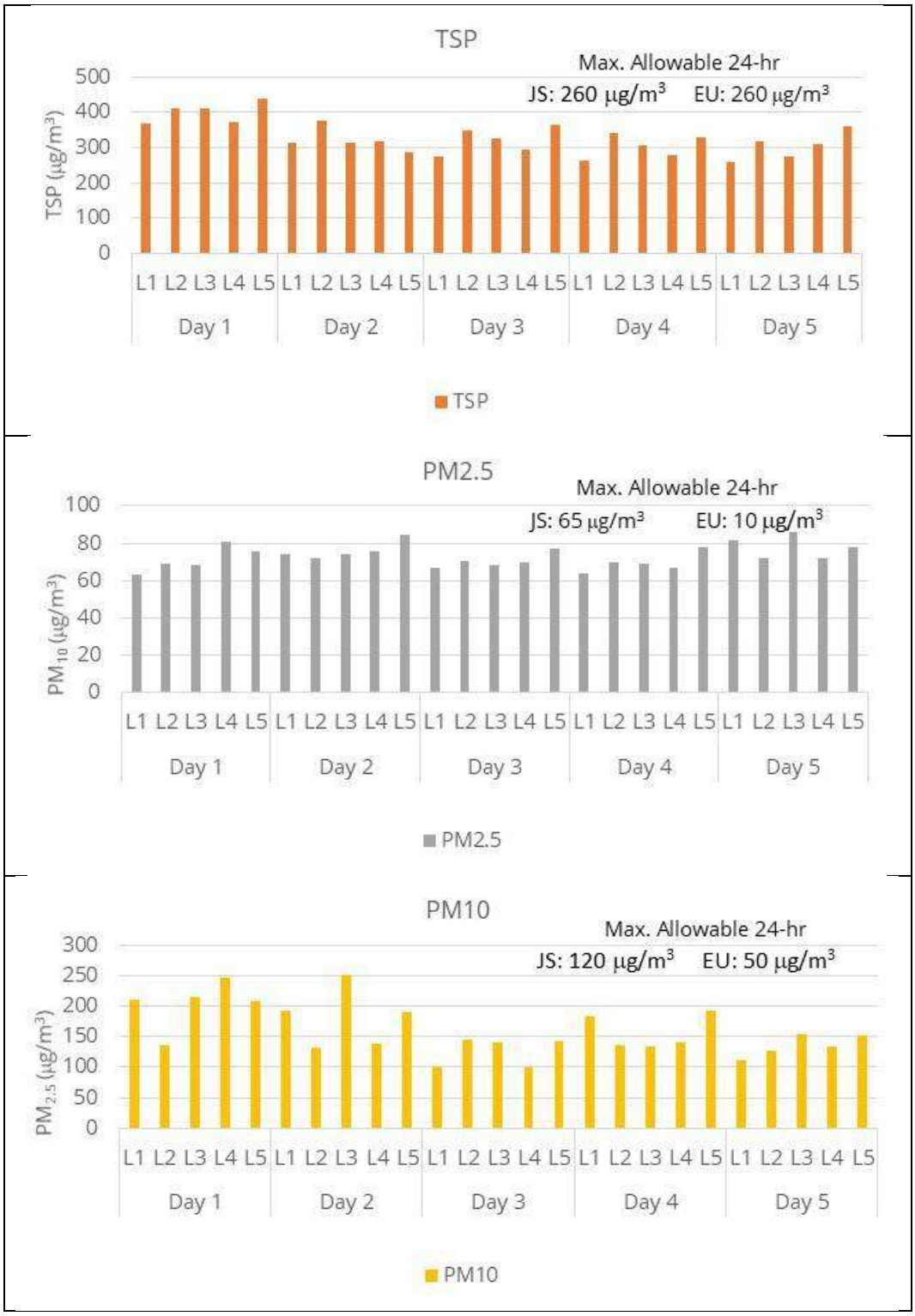


Figure 6.5. AlGhabawi landfill dust emission results for monitoring period 16-22 August, 2018 as measured by AlRawabi at five locations (source: AlRawabi, 2018)

3. Air quality data was obtained from MoEnv mobile air quality monitoring lab stationed west of the proposed Project site and next to Al Ghabawi landfill incinerator for health care waste between 16th to 22nd of October 2017. The measured parameters included: PM_{10}, $PM_{2.5}$, NO_2, NO, SO_2, CO, O_3, NH_3, H_2S, CH_4, and non-methane hydrocarbons (NMHC). The measurements were carried for three time periods: before operation of the incinerator, during operation of the incinerator, and after shutting down of the incinerator. A summary of the conclusions of the measurements is provided in Table 6.3 and the data are presented in Annex 6.

Table 6.3. Conclusions of air quality data from MoEnv mobile air quality monitoring lab stationed next to Al Ghabawi landfill incinerator for health care waste

Phase	Time Period	Measurements Conclusions
Before operation of the incinerator	16/10/2017 (3:00 pm) to 17/10/2017 (3:00 pm)	- No exceedance in any of the measured parameters in reference to the Ambient Air Quality Standard JS 1140/2006.
During operation of the incinerator	18/10/2017 (12:00 am) to 19/10/2017 (7:30 pm)	- Exceedance was noted for the hourly measurements and daily average of H_2S. Also, CH_4 levels were found to be higher. However, according to wind direction data, it was concluded that the landfill was responsible for these elevated levels and not the health care incinerator. - There were also 4 recorded exceedances in the measured levels of PM_{10}. However, this was explained to be due to the arid nature of the area.
After shutting down of the incinerator	19/10/2017 (7:30 pm) to 22/10/2017 (8:00 am)	- Three recorded exceedances for H_2S. The prevalent wind direction was south-east which implies that the source of these elevated levels of H_2S is Al Ghabawi.

6.1.3 Noise

Sources of noise within the study area were observed to be limited to vehicles movement and associated with traffic. No other sources of appreciable noise level were observed within the area. Data on noise levels were obtained from:

1. Noise level measurements carried out as part of this ESIA study at one location at the southern end of the Project site over 7 days extending from 1st to 8th of December 2019. The results are presented in Annex 5.
2. Noise level measurements results from the ESIA study of "GAM Solid Waste Landfill Project" (AlRawabi, 2018).

As shown in Figure 6.6, both studies did not show any exceedance of noise levels indicated by the Jordanian Guidelines for Prevention of Noise (2003) for residential areas nor by the noise levels provided by the IFC Environmental, Health, and Safety (EHS) Guidelines for Noise Management for industrial or commercial receptors.

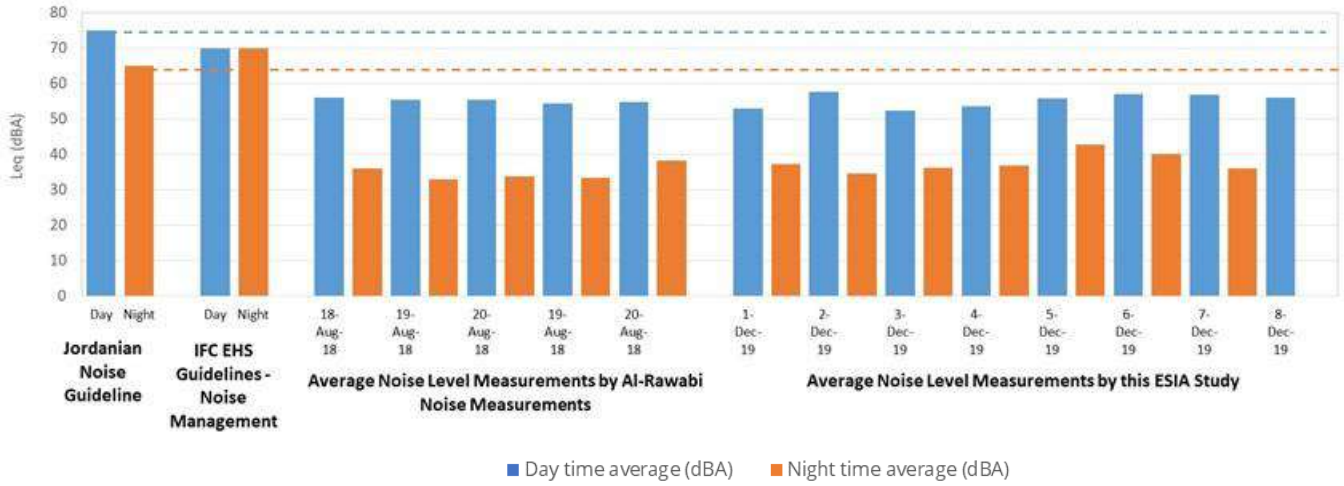


Figure 6.6. Comparison of average noise measurements by AlRawabi (2018) and by this ESIA study

6.1.4 Topography, Geology and Geomorphology

The Project site is semi-flat with a gentle slope towards the north-east. The site levels range from approximately 795 m above mean sea level (amsl), at the southern boundary of the site to approximately 775 m amsl at the downstream (eastern) end of a natural wadi dissecting the site. The northern part of the site is hilly, with a maximum elevation of approximately 795 m amsl.

The surface is a soft, thick bedded chalky marl and chalky limestone, which acts as an impermeable barrier to water flow. The site lies in a chalk marl unit called Muwaqqar formation consisting of soft, thick-bedded chalky marl, marl and chalky limestone with bedded nodules of microcrystalline limestone and chert. Some thick lenses (205 cm thick) of coarse grain granular phosphate are occasionally present (EcoConsult, 2008).

Based on the geological maps by Faddah (1988) and Smadi (1999), the stratigraphy of the Project area is characterized as rocks outcropping in the study area and surroundings range from Maastrichtian to Eocene age. Superficial deposits, however, are dated to Pleistocene and Recent Geologic Age. Geological formation of Belqa group outcrop at the project site and adjacent area. The bedrock is covered at several locations by Pleistocene gravel, alluvial and colluvial deposits. Three formations within Belqa group outcrop in the study area: Amman Silicified Limestone (ASL), Um Rijam Chert-Limestone (URC), and Muwaqqar Chalk-Marl. These are described as follows:

- Amman Silicified Limestone (ASL): This formation consists of chert, brecciated chert and phosphatic chert, interbeded with microcrystalline limestone, bituminous chalk and marl. The undulated nature in addition to fracturing and jointing of the chert beds is the distinguishing feature of this Formation. The formation is Campamnian in age. Thickness of this formation at the study area is about 80 to 90m. This formation (known also as B2) is part of the Wadi Sir-Amman Aquifer System (A7/B2) which is the most important aquifer system in Jordan.
- Um Rijam Chert-Limestone formation: The formation consists of massive hard chalky limestone and chert, thickness of the formation is 18 to 25m, the age is Paleocene to Eocene. This formation forms a shallow aquifer (known as B4/B5) in the area northwest of Irbid and Azraq, Sirhan, Jafr and the Hammad basins where the aquifer plays an important role for the

water supply.

- Muwaqqar Chalk-Marl: This formation underlies the Um Rijam Chert - Limestone Formation and consists of marl, thick bedded, chalky limestone with hard beds of microcrystalline limestone, chert and phosphorite. The thickness of this formation is about 70m to 200m (at the study area about 52m). The age of this formation is range from Maastrichtian – Paleocene. This formation considered as an aquitard (known also as B3) which overlies the A7/B2 aquifer. It has a low permeability and forms a confining layer to the A7/B2 aquifer and B4/5 aquifer and is therefore regarded as an aquitard.

Pleistocene fluvial gravel (Pleistocene sediments) consisting of uncemented poorly-sorted deposit of chert and limestone clasts cover the URC.

Based on the seismic map presented in Figure 6.7, a site is assigned one of the zones: 1, 2A, 2B and 3 with increasing hazard towards the Dead Sea Transform Fault which constitutes the major source of seismic hazard in Jordan. As illustrated in Figure 6.7, the area is within zone 2A which has a seismic zone factor of 0.15 as effective peak ground acceleration. This region is considered as the second active seismological zone of Jordan. Therefore, in case of earthquake, hazards are expected. However, according to historical records, there were no earthquakes in the surrounding area (EcoConsult, 2008).

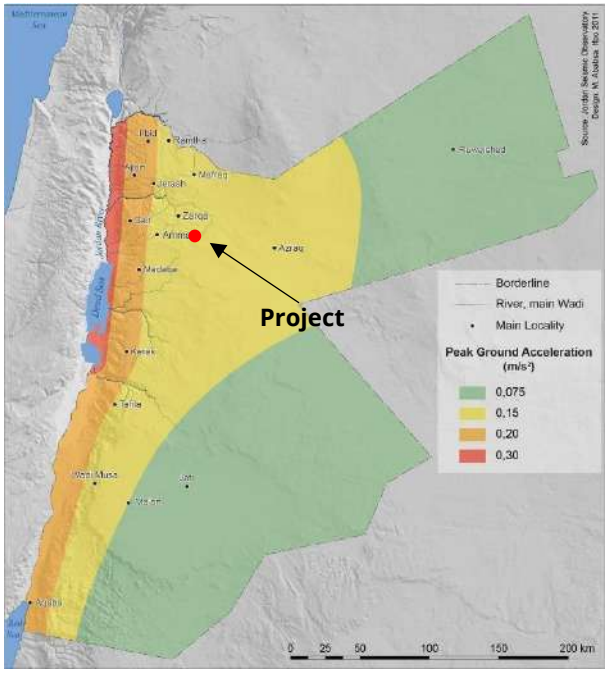
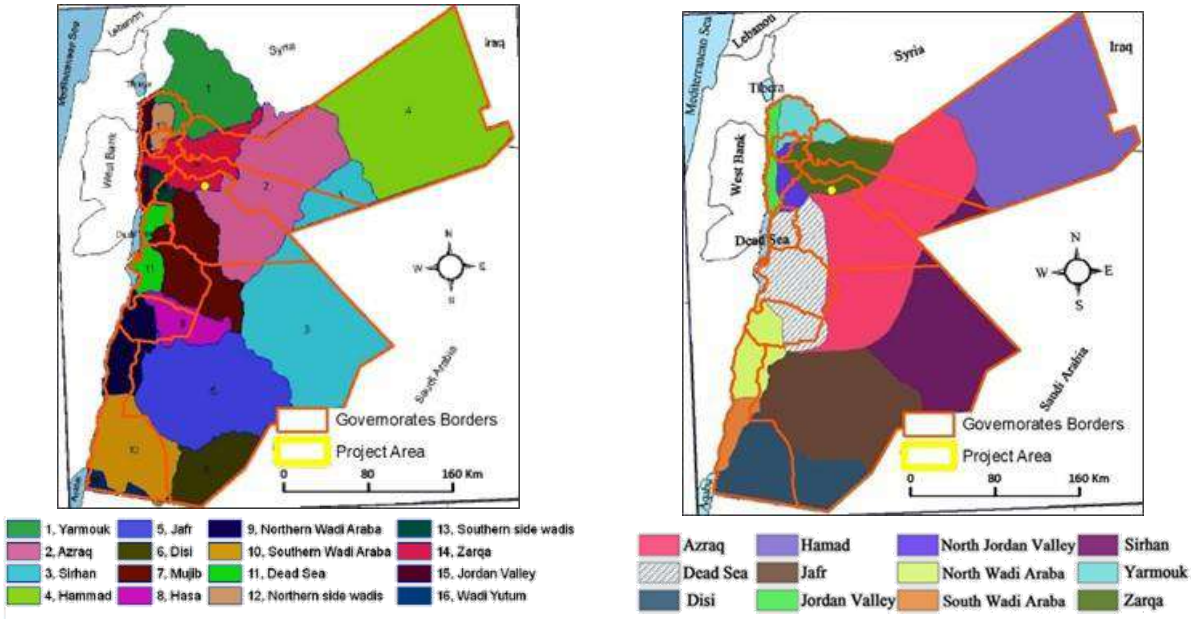


Figure 6.7. Seismic map of Jordan (source: Ababsa, 2013)

Seismic Zone	Peak Ground Acceleration (m/s^2)
1	0.075
2A	0.15
2B	0.20
3	0.30

6.1.5 Water Resources, Hydrology and Hydrogeology

The project area is located within Zarqa surface and ground water basins as illustrated in Figure 6.8.



(a) Surface water basins of Jordan

(b) Ground water basins of Jordan

Figure 6.8. Project location with respect to surface and ground water basins of Jordan

Surface Water and Hydrology

Though the project site is located within the Zarqa surface water basin, the site does not contain and is not close to any surface water resource. In terms of surface water runoff, the catchment area contributing storm water runoff towards Al Ghabawi WWTP site is limited to the project site itself, as there are no external catchment conveying runoff towards the site.

A run-off model using the Rational Method was used to determine the peak discharges of runoff for the Project site basin using an average annual rainfall of approximately 84 mm based on Al Ghabawi gage station and a 10-minute minimum time of concentration. The modelling used the Intensity-Duration-Frequency (IDF) curves from the Zarqa rainfall gage station, which is located about 17km away from Al Ghabawi WWTP site. These IDF relationships for Zarqa gage station are presented in Table 6.4.

Table 6.4. Rainfall Intensity-Duration-Frequency Relationship for Zarqa Gage Station (source: MWI)

Frequency	Duration (min.)								
(Years)	5	10	20	30	60	120	180	360	1440
2	15.8	12.3	9.6	8	5.5	3.4	2.6	1.6	0.6
5	25.3	20.1	15.6	13	8	4.9	3.8	2.6	1
10	31.3	24.9	19.6	16.3	10	6.2	4.8	3.3	1.2

Frequency	Duration (min.)								
(Years)	5	10	20	30	60	120	180	360	1440
25	39.4	30.8	24.7	20.5	12	7.7	6.1	4.1	1.5
50	45	35.8	28.4	23.6	14	8.8	7	4.7	1.8
100	53.3	40.9	32.2	26.7	16	9.9	8	5.3	2

The runoff from the Project site was estimated for the return periods of 2-year through 100-year return period. The catchment area contributing storm water runoff towards Al Ghabawi WWTP is limited to the project site itself, as there are no external catchment conveying runoff towards the site. After construction, the parts contributing to runoff within this catchment area will consist mainly of roads and paved surfaces and is estimated to be approximately 100,000 m^2.

Table 6.5 provides the computed runoff from Al Ghabawi WWTP for various storm return periods. It shows that the peak flow rates are relatively small, indicating that the runoff can be discharged without flooding the receiving adjacent water courses. This is the wadi that will also be used for the treated effluent discharge; its location and discharge flow path are illustrated in Figure 6.9.

Table 6.5. Computed runoff for Al Ghabawi WWTP project site

Return Period	Intensity	Peak Flow Rate
(Years)	(mm/hr)	(m^3/s)
2	12.3	0.3
5	20.1	0.4
10	24.9	0.6
25	30.8	0.7
50	35.8	0.8
100	40.9	0.9

(a) Overview of the wadi discharge flow path

(b) Starting location of the wadi discharge from within the Project site

Figure 6.9. Nearby wadi to which treated wastewater will be discharged

Groundwater and Hydrogeology

The project site is considered to be located within the Zarqa groundwater basin. It lies over the water saturation zone within B2/A7 aquifer system, which is one of the main water aquifers in Jordan. It has an average thickness of 108 m and a depth of water ranging from 182-248 m below ground surface. The overall groundwater flow direction is east and southeast with a hydraulic gradient of 0.007. This aquifer is bound from the top by the Muwaqqar-chalk marl (B3) aquitard with a thickness ranging from 80-132 m. Shallow top soil layer that ranges in thickness from 0.5 to 1 m also exists.

The Muwaqqar-chalk marl formation consists of soft, thick bedded chalky marl, marl and chalky limestone with bedded and nodules of microcrystalline limestone and chert. Some thin lenses (2-5 cm thick) of coarse grain granular phosphate are occasionally present. The hydraulic conductivity of this transformation ranges from 10^{-3} to 10^{-7} mm/s, which is low to very low permeability. This renders the Muwaqqar-chalk marl formation as an aquiclude. No major faults or cracks have been identified in the Project area and a homogeneous horizontal layering exist up to depth of 6 m (EcoConsult, 2008). From a hydrogeological point of view, the Muwaqqar chalk marl formation is considered as aquiclude with low permeability (10-2 to 10-4 mm/s) to very low permeability (10-4 to 10-6 mm/s). Some layers in the boreholes have permeability between 10-6 to 10-7 mm/s, which means impervious. The difference in permeability values is according to the difference of ground materials and occurrence of chert lenses through MCM stratum. It is also caused by the presence of fine and very fine materials mixed sometime with sand or silty sand (EcoConsult, 2008).

Generally, the Wadi As Sir/Amman Formation form the main aquifer (A7/B2) in the surrounding areas of the project. This aquifer system is well jointed and fissured and on a local scale exhibit solution channels and karstic features. Generally, the exposed Amman Formation (B2) north of WWTP site consists mainly of chert and limestone with phosphate beds while the Wadi As-Sir Formation consists mainly of highly fractured limestone, dolomitic limestone and some chert concretions.

Overall, there is no shallow groundwater present in the project area. Effluent water will flow for a short distance within the Muwaqqar Chalk-Marl formation which is an aquitard (B3). The first aquifer system expected to be encountered is the B2/A7 which is located at a depth of more than 40m m from the ground surface and separated from the surface by an aquitard (B3) of low vertical permeability. The general geology of the project shows that the WWTP is located within Muwaqqar Chalk-Marl and Pleistocene geologic formations. Wadi Al Mishgal passes through the proposed WWTP site trending towards the northeast direction then turns to the east to connect with Wadi Er Rucban. Water flowing in the northeastern part of the site will flow through the Muwaqqar Chalk-Marl for a distance of about 2 km then it will pass through the Amman Silicified Limestone (ASL) for about 3 km where it will continue through the Pleistocene and alluvial deposits. This renders the chances for groundwater pollutions as very low.

Moreover, as per the Ground water Vulnerability Map of Jordan issued as per the Amended Guideline of the Water Resources Protection for the year of 2019 (Official Gazette No. 5224), which calls for identifying and delineating zones for protecting groundwater resources (MWI, 2019), the Project area is located within a very low vulnerability zone.

Still, it is recommended to evaluate the existing water wells data to monitor the groundwater quality. There is one water well available at Al Ghabawi solid waste landfill site. The water from this well is pumped to control dust and to wash trucks, but not for drinking. Based on the geologic maps, other water wells available within a 6 km radius around the proposed WWTP site are presented in Table 6.6.

Table 6.6. Water wells available within a 6 Km radius around the proposed WWTP

Water Well No.	Location
AlGhabawi Landfill water well	Within Al Ghabawi solid waste landfill site
AL 1796	3 Km south of the WWTP
AL 1788	3.5 Km southwest of the WWTP
AL 1790	5 Km southwest of the WWTP
AL 1792	6 Km northwest of the WWTP
AL 1798	6 Km west- southwest of the WWTP
AL 1909	6 Km northeast of the WWTP

6.1.6 Landscape and Aesthetics

Area and its surroundings are characterized as barren land with almost no vegetative cover (Figure 6.10-a, b, and c). The site is adjacent to an existing solid waste landfill site. Due to the adjacent landfill and the prevalent wind direction at the area, trash bags can be found scattered within the Project site and mostly to the southern side (Figure 6.10-d). Accordingly, the planned project will have a high fence built to prevent/minimize the falling of trash bags from the landfill to the WWTP location.

The access road to the Project site is paved (Figure 6.10- e and f).

(a) Overview of the site

(b) Road to the eastern side of the land plot

(c) Barren surface of the site

(d) Trash bags scattered within the site

(e) Road towards the Project site

(f) Access way to the Project site

Figure 6.10. Group of pictures illustrating the Project site landscape

6.1.7 Climate Change

In Jordan, climate change studies indicate that the reduction in precipitation is the major factor that will negatively affect water resources availability, while temperature will play a minor role in changes in surface runoff amounts (Al Qatarneh et al., 2018). Under the influence of climate change during the "business-as-usual" RCP8.51 scenario (i.e., assuming a future with no policy action and increasing greenhouse gas concentrations), Jordan is expected to experience a 30% decline in annual winter

[1] The RCP database aims at documenting the emissions, concentrations, and land-cover change projections of the so-called "Representative Concentration Pathways" (RCPs). RCPs are consistent sets of projections of only the components of radiative forcing that are meant to serve as input for climate modeling, pattern scaling, and atmospheric chemistry modeling. They aim at providing a consistent analytical thread across scientific communities. The RCP 8.5 is characterized by increasing greenhouse gas emissions over time representative for scenarios in the literature leading to high greenhouse gas concentration levels.

precipitation and a 4.5°C increase in annual average temperature by 2071 - 2100. The effect of changes in precipitation and temperature will be further manifested in the form of changes in variables such as soil moisture and streamflow. Under RCP8.5, Jordan is also likely to experience a 28 and 58% decline in soil moisture and streamflow, respectively, resulting in agricultural and hydrologic droughts (Rajsekhar & Gorelick, 2017).

The frequency of drought occurrence, duration, and maximum severity show an increase from north to south. From north to south, the duration of meteorological drought events increases from 2 to 3 months, and meteorological drought severities increase from 26 to 37% (Rajsekhar & Gorelick, 2017). In addition to the expected increase in the future number of dry events, the number of wet events is also expected to decline during the 21st century. This is expected under RCP8.5 with a reported decline over time in all the wet event properties (duration, frequency of occurrence, and maximum severity of wet events), thus indicating a dual impact of climate change in simultaneously reducing the wet events and increasing the dry events. The sporadic wet events are likely to occur toward the end of the 21st century, with climate models predicting a likelihood of zero monthly occurrences of receiving "severe" or extreme rainfall based on the baseline period in the second half of the 21st century.

For Amman, the country's "Climate Change Policy for a Resilient Water Sector" indicates that by the end of the century Amman will witness an increase in dry years (years with <200 mm precipitation) from once every 3 years to once every 2 years, dry seasons that are longer by about 30 days, and a lower precipitation reduced by about 10-15% (MWI, 2016).

The likelihood of such increased incidence of droughts and an increasingly warmer, drier future have critical implications on the quantity and quality of Jordan's freshwater resources and aggravates its current challenges. In general, the water-related impacts would include (MWI, 2016; IWA, na):

- reduced total water availability with less rain reducing yields from surface water catchments;
- less reliable seasonal patterns;
- more extreme events where surface catchments are eroded with decrease in water quality;
- changed distribution of runoff which leads to slower, less reliable groundwater recharge;
- increasing intensity of droughts during which reservoirs are not refilled;
- increasing intensity of flood events during which water and other infrastructure experiences overflow and damages;
- higher temperatures leading to higher evaporative demand and hence higher irrigation water demand;
- increased evaporation through prolonged increase in temperature exacerbating water storage depletion;
- higher temperatures affecting the efficiency of wastewater treatment plants;
- increased agricultural and drinking water demands during heat waves and droughts which contributes to the country's water gap; and
- concern of future intensification of energy price shocks on international energy markets. Given that the Jordanian water sector is very energy intensive and dependent on fossil fuels, it becomes vulnerable to such energy price shocks.

Based on the above discussion and the Project overview, the potential climate change impacts foreseen for the proposed WWTP Project at Al Ghabawi include:

- Impact of rising temperature on the proposed WWTP particularly the anaerobic ponds in the primary and secondary treatment stages and the sludge treatment process.
- Impact of rising temperature on the per capita water demand during heat waves and implications of this seasonal increase on the WWTP capacity.
- WWTPs in Jordan are energy intensive and dependent on fossil fuels. As such, the likelihood of future intensification of energy price shocks on international energy markets will have implications on the operating cost of the WWTP.
- Increasing intensity of flood events may endanger WWTPs. However, no such threat exists within the Project site.

6.2 Biological Environment

The biological environment baseline conditions provide an overview of the following aspects:

- **Bio-geographical Zones** where the project area located.
- **Flora** of the project area.
- **Fauna** of the project area in terms of the following groups: mammals, birds (especially the conservation important resident species), and conservation important reptiles.
- **Sensitive Habitats** which includes areas with biological importance such as Protected Areas, Range land Reserves, and Important Bird Areas (IBA).

6.2.1 Bio-geographic Zones

Four biogeographical regions are recognized in Jordan: Mediterranean, Irano-Turanian, Saharo-Arabian and Sudanian (Al-Eisawi, 1996). Limits between regions are indicative only, and some species can be found across several regions.

The proposed project site is located in Irano-Turanian biogeographic zone (see Figure 6.11). The Irano-Turanian region surrounds the Mediterranean zone, forming a narrow strip of variable width, except in the north, where it extends eastwards along the Jordanian-Syrian border. Altitude typically ranges between 500-700 m above sea level. Precipitation is between 150 to 300 mm and mean minimum annual temperature 2-5°C and mean maximum annual temperature 15-25°C. Soils are mostly calcareous or transported by wind. This region is at the borders and below for rainfed agriculture, and predominantly used for grazing.

Dwarf shrubs are characteristic of this zone. Typical species include *Artemisia herba-alba*, which is considered more characteristic in the south, and *Noaea mucronata* in the north. Other common species include Retama raetam, *Salvia dominica, Ballota undulata*, *Anabasis syriaca*, and many grasses, bulb plants and herbs. Grasses such as *Stipa spp*. And *Festuca spp*. are the most common pasture and forage species. Bulbs include sea squill, *Urginea maritima* and *Asphodelus aestivalis*, among others (Al-Eisawi, 1996).

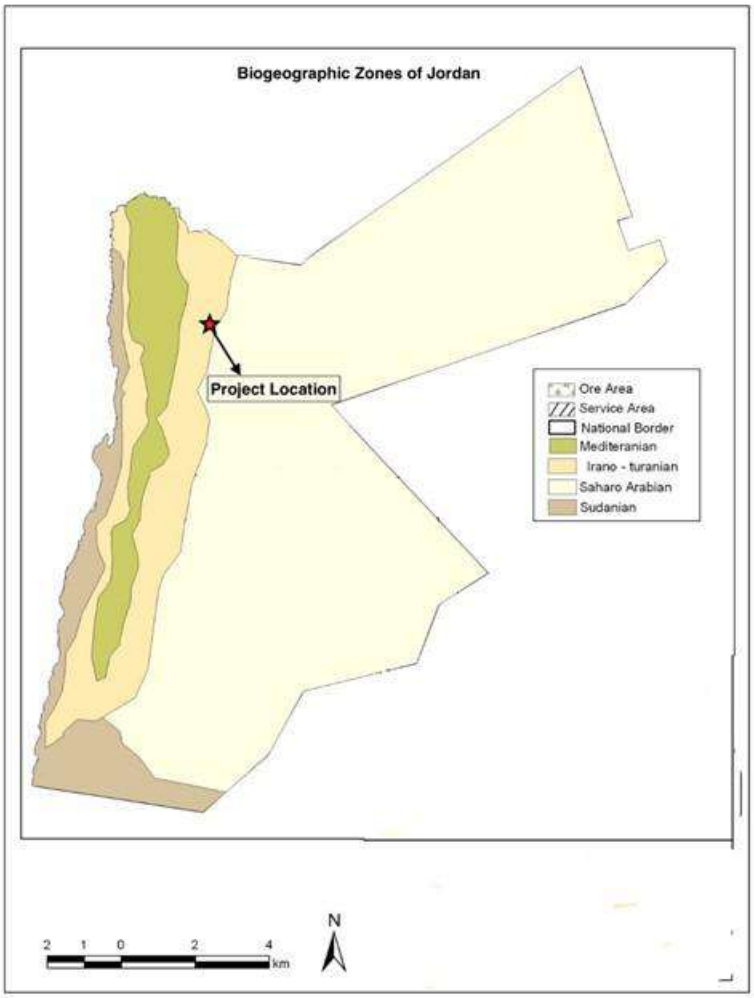


Figure 6.11. Biogeographic Zones of Jordan

6.2.2 Ecosystems

The proposed project area is represented by the Scrap and Highland Ecosystem. This ecosystem consists of escarpments and mountains, hills and undulating plateaus, which extend mainly from Irbid in the north to Ras Al Naqab in the south, and from Rift Valley region in the west to the Badia in the east.

The mountains in the southern of this zone are higher on average, and some range between 1200 m and 1600 m high. Mediterranean woodland of pine and oak, with juniper and cypress more locally is believed to have originally covered large tracts of the Jordanian highlands, but the human and climatic factors resulted in high deforestation and replacement of natural vegetation by secondary species.

The largest remaining areas of natural woodland occur in the highlands between Amman and North of Jordan, and are dominated by *Pinus halepensis* above 700 m, whilst mixed evergreen/deciduous oak woodland of *Quercus calliprinos* and *Q. ithaburensis* dominate at lower elevations where the original pine-dominated woodland has been degraded. Cultivation of rain fed wheat widespread on the

plateau between Madaba and Irbid, and olive groves cover a large part of the northwestern mountains above 700m. More than 80% of Jordan's cities and villages occur within this zone.

6.2.3 Vegetation Types

The project area is characterized by the vegetation type **Steppe Vegetation**. This vegetation is confined to the Irano-Turanian biogeographic zone and may intrude either into the Mediterranean as in the project area or into the Saharo-Arabian zone (Figure 6.12).

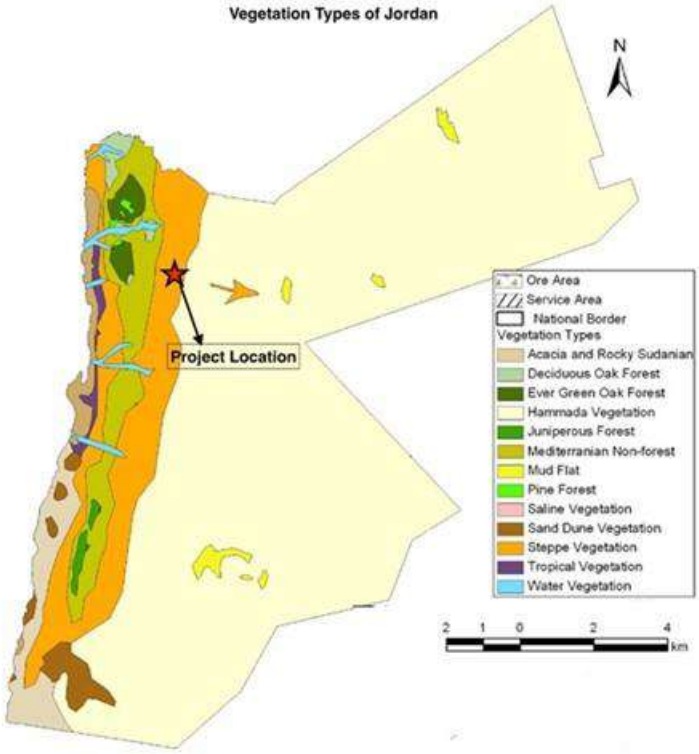


Figure 6.12. Vegetation Types of Jordan

The composition of this vegetation varies according to the soil and climatic differences depending on its location with respect to the Mediterranean zone. For example, the steppe vegetation in the Northern Ghor, which links with the Northern mountains, is dominated by *Retama raetam, Ziziphus lotus, Z. nummularia,* and *Ferula communis* with almost no *Artemizia herba-alba.* While the steppe vegetation in the North, East and South Mediterranean borders shows other elements like *Pistacia atlantica*, *Anabasis syriaca* and *Artemisia herba –alba*, which are not found in the western steppes. This might be due to the fact that the western steppes are more affected by the tropical conditions and vegetation in the Rift Valley, while the Eastern steppes are more affected by the Sahara conditions and vegetation. The common features of this type of vegetation are the presence of shrubs and bushes and the absence of tree vegetation. This vegetation type forms a strip surrounding the Mediterranean region. The common species in this type are: *Retama raetam Artemisia herba-alba Pistacia atlantica Noaea mucronata Ziziphus lotus Ziziphus nimmularia Asphodelus aestivus Urgiea maritime Anabasis syriaca Ferula communis Hammada spp. Gypsophila Arabica Salsola spp. Astragalus spinosus Tamarix spp. Crocus moabiticus.*

During the field assessment, it was noticed that the Project site is very degraded due to the impact of human activities. Vegetation cover is limited to small and narrow seasonal water courses while the most common species were *Anabasis syriaca* and *Malva spp*. The soil in the region is poor in organic content with low annual rainfall resulting in poor vegetative cover. The vegetation is mostly composed of fleshy and drought tolerant plants that can resist the conditions of hot and dry climate. Vegetation is restricted to the places close to the wadi systems where enough soil moisture exists.

Remnants of the natural vegetation cover were recorded in the Project site and the surrounding area giving a sign for a high degradation levels in the project area habitats. Only two species of natural plant (*Anabasis syriaca* and *Malva spp*) are found in the proposed site of this project and they are considered common vegetation of no conservation importance.

(a) Degraded project site

(b) Degraded project site

(c) *Malva spp*

(d) *Anabasis syriaca*

Figure 6.13. Selected pictures from the site

6.2.4 Zoogeographic

Reptiles

Irano-Turanian biogeographic zone is considered a transitional ecozone between Mediterranean and Saharo-Arabian biogeographic zones. This ecozone is typically represented by the presence of some herpetofauna elements such as *Trapelus ruderatus (Least Concern as per IUCN)* and *Acanthodactylus tristrami (Least Concern as per IUCN)* (Disi, 2002).

During the field visits no herpetofaunal species were recorded within the site which can be explained by the degraded vegetation cover but also the cold weather during the month of November which limits herpetofaunal activities.

Mammals

The project area belongs to the Saharo-Sindian Zone (also referred to as the Saharo-Arabian and Irano-Turanian phytogeographic region by Zohary 1973). This zone is located to the east of the mountain ranges, extending from south of Jordan to northeast of the country in Mafraq area. It is another sub-region within the Palearctic and includes the Sahara Desert and the Arabian Desert. The majority of the project's mammals belong to this zone.

No mammal species were recorded during the site visit. This is in line with the expectation that the project site is not suitable habitat for mammals due to the degraded habitat and high level of disturbance.

Birds

Jordan has a wide diversity of bird habitat types due to its varied topography and climate and its biogeographical location. 434 bird species have been recorded in Jordan, of which more than 141 species are breeding birds and this number might increase with the continuous research.

Jordan lies on the main route of bird's migration between Africa, Asia and Europe. Millions of birds are migrating over Jordan each year, to which the majority of the Jordanian avifauna belongs. The huge number of migrant birds that visit Jordan twice a year has made the country of a great importance for the global avifauna. According to BirdLife International, at least 500 million migratory birds of over 230 species pass through Jordan twice a year and rest in Important Bird Areas (IBAs). Jordan has 27 sites that are declared as Important Birds Areas (RSCN & Birdlife, 2000).

The project site does not have any significant habitat that is important for birds. Two bird species were recorded on the site: Crested Lark and House Sparrow, both Least Concern as per IUCN. These are common species with a wide range of distribution.

6.2.5 Sensitive Habitats

As discussed below, no sensitive or threatened habitats were identified to occur in close proximity of the Project's study area. The Project location relative to protected areas, rangeland reserves and important bird areas (IBAs) is discussed below.

Protected Areas

During the late seventies, an inventory was made by the Royal Society for Conservation of Nature (RSCN) upon which a network of sites where nominated as proposed protected areas (Clark, 1979). Some of these proposed protected areas were declared while others are still not. The protected areas illustrated in Figure 6.14 represent Jordan's important ecological systems. As can be noted, the

proposed project site is not close to any of the protected areas which would limit the impact of the project on this type of sensitive habitats.

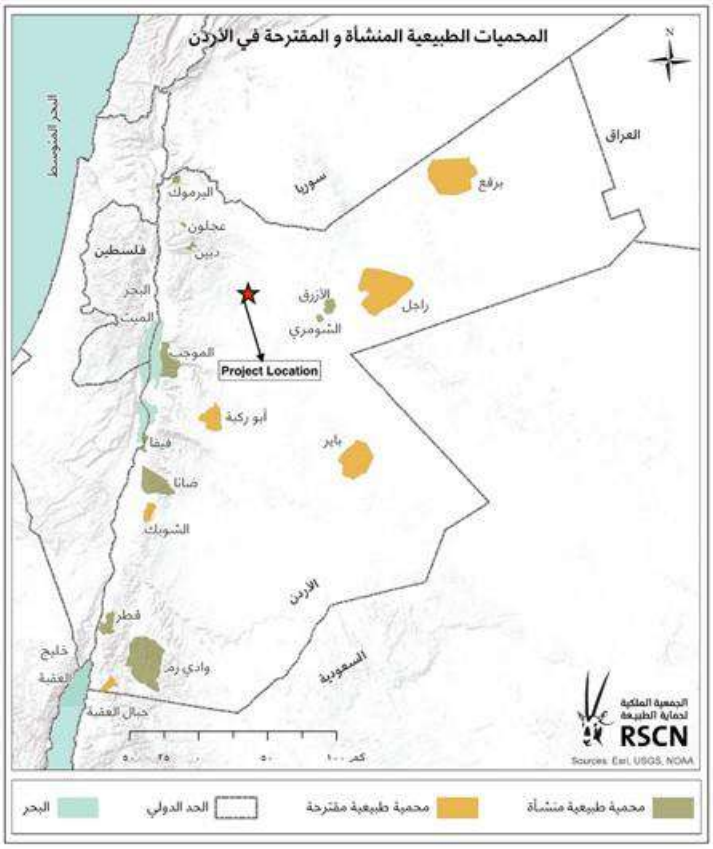


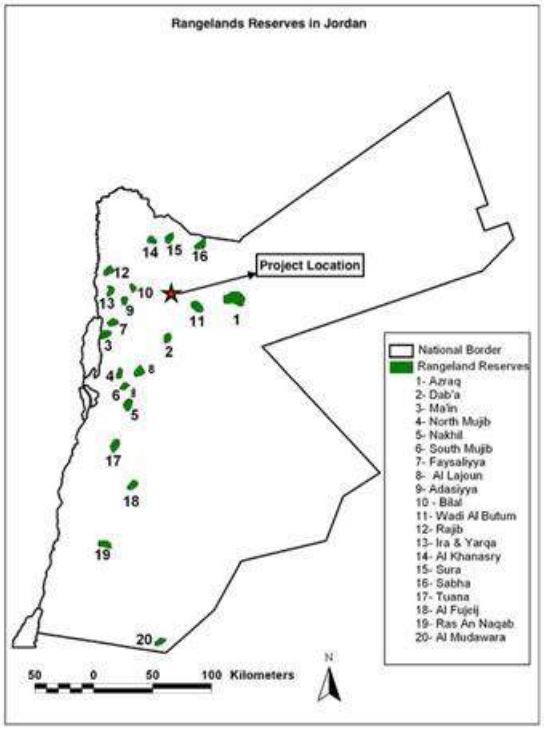
Figure 6.14. Established and Proposed Protected Areas in Jordan

Rangeland Reserves

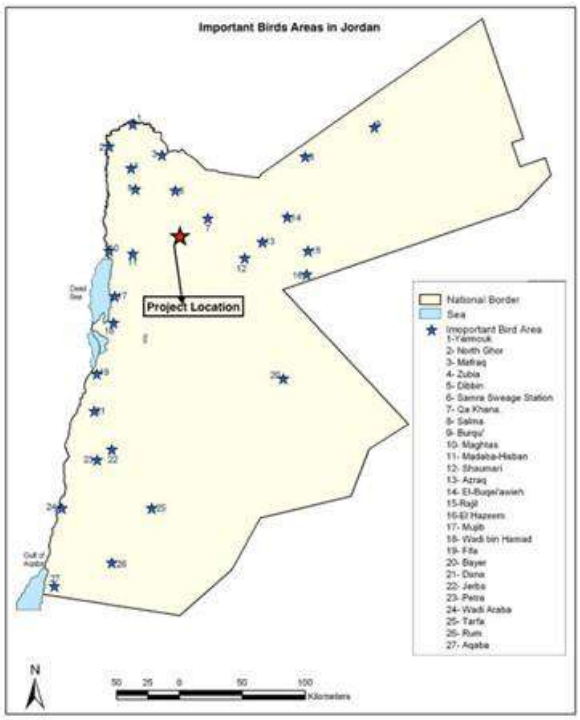
The closest rangeland reserve to the project site is Wadi Al Butum rangeland reserve, which is about 18 km from the site. It is not expected the project activities will have any negative impact on this reserve (Figure 6.15.a).

Important Birds Areas

As can be noted from Figure 6.15.b, the proposed project site is not within the 27 declared important bird areas in Jordan (RSCN & Birdlife, 2000). The proposed site is far from the closest IBA of Qa Khanna by 17km, which will reduce any potential negative impact of the project on this IBA.



(a) Rangelands Reserves in Jordan



(b) Important Birds Areas in Jordan

Figure 6.15. (a) Rangelands Reserves and (b) Important Birds Areas in Jordan

6.2.6 Priority Biodiversity Features

As required by EBRD PR6 the Project area and associated baseline conditions and features were evaluated against the criteria for "priority biodiversity features" in Table 6.7. Priority biodiversity features are a subset of biodiversity that is particularly irreplaceable or vulnerable, but at a lower priority level than critical habitats. PR6 defines specific conditions for project that could have significant, adverse and irreversible impacts to priority biodiversity features. Following the evaluation, it has been determined that there are no priority biodiversity features in the Project area.

Table 6.7. Evaluation of project area against the Priority Biodiversity Features criteria as per EBRD's PR6 and associated guidance

Criteria	Evaluation
Threatened habitats - For example (as per PR6 guidance): Habitats considered under pressure by national, regional or international assessments. These include natural and priority habitats identified under the EU Habitats Directive (Annex I).	Threatened habitats were not identified in the project area and its surrounds.
Vulnerable species - For example (as per PR6 guidance): Species listed by the International Union for Conservation of Nature (IUCN) or any other national/regional lists (such as national Red Lists) as Vulnerable (VU) or equivalent. These include animal and	All species recorded in the project area are common species in the country and have no significant conservation status. Those identified are Least Concern.

Criteria	Evaluation
plant species of community interest identified under the EU Habitats Directive (Annex II).	
Significant biodiversity features identified by a broad set of stakeholders or governments (such as Key Biodiversity Areas or Important Bird Areas) - For example (as per PR6 guidance): Key Biodiversity Areas and Important Bird and Biodiversity Areas; nationally and internationally important species or sites for conservation of biodiversity; many areas meeting natural habitat definitions of other international financial institutions.	These features have not been identified in the project area.
Ecological structure and functions needed to maintain the viability of priority biodiversity features. - For example (as per PR6 guidance): Where essential for priority biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.	Priority biodiversity features have not been identified as per the criteria above.

6.2.7 Critical Habitat

As required by EBRD PR6 the project area and associated baseline conditions and features were also evaluated against the criteria for "critical habitat" in Table 6.8. These are the most sensitive biodiversity features. Critical habitat must not be further fragmented, converted or degraded to the extent that its ecological integrity or biodiversity importance is compromised. In areas of critical habitat, PR6 defines a series of conditions for project activities. Following the evaluation it has been determined that critical habitat is not present in the project area.

Table 6.8. Evaluation of project area against the Critical Habitat criteria as per EBRD's PR6

Criteria	Evaluation
Highly threatened or unique ecosystems. - As per PR 6 Guidance: Ecosystems that are at risk of significantly decreasing in area or quality; have a small spatial extent; and/or contain concentrations of biome-restricted species. For example: - Ecosystems listed as, or meeting criteria for, Endangered or Critically Endangered by the IUCN Red List of Ecosystems - Areas recognised as priorities in official regional or national plans, such as National Biodiversity Strategy and Action Plans - Areas determined to be of high priority/significance based on systematic conservation planning carried out by government bodies, recognised academic institutions and/or other relevant qualified organisations (including internationally-recognised NGOs).	The project area does not include or close to areas classified as threatened habitats or unique ecosystems
Habitats of significant importance to endangered or critically endangered species.	All species recorded in the project area are common species in other

Criteria	Evaluation
- As per PR 6 Guidance: Areas supporting species at high risk of extinction (Critically Endangered or Endangered) on the IUCN Red List of Threatened species (or equivalent national/regional systems). For example: - Alliance for Zero Extinction sites. - Animal and plant species of community interest in need of strict protection as listed in EU Habitats Directive (Annex IV).	habitat in the country and have no significant conservation status.
Habitats of significant importance to endemic or geographically restricted species. - As per PR 6 Guidance: Areas holding a significant proportion of the global range or population of species qualifying as restricted-range under Birdlife or IUCN criteria. For example: - Alliance for Zero Extinction sites. - Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for restricted-range species	No endemic or geographically restricted species were recorded in the project area
Habitats supporting globally significant migratory or congregatory species. - As per PR 6 Guidance: Areas that support a significant proportion of a species' population, where that species cyclically and predictably moves from one geographical area to another (including within the same ecosystem, or areas that support large groups of a species' population that gather on a cyclical or otherwise regular and/or predictable basis. For example: - Global-level Key Biodiversity Areas and Important Bird and Biodiversity Areas identified for congregatory species. - Wetlands of International Importance designated under criteria 5 or 6 of the Ramsar Convention.	The project area does not have any significant habitat that is important for birds, all species recorded in the site are common and has no significant conservation status
Areas associated with key evolutionary processes. - As per PR 6 Guidance: Areas with landscape features that might be associated with particular evolutionary processes or populations of species that are especially distinct and may be of special conservation concern given their distinct evolutionary history. For example: - Isolated lakes or mountaintops. - Populations of species listed as priorities by the Edge of Existence programme.	None identified in project area.
Ecological functions that are vital to maintaining the viability of biodiversity features. - As per PR 6 Guidance: Ecological functions without which critical biodiversity features could not persist. For example: - Where essential for critical biodiversity features, riparian zones and rivers, dispersal or migration corridors, hydrological regimes, seasonal refuges or food sources, keystone or habitat-forming species.	The project site is very degraded due to human activities and its closeness to other development projects, in addition the project site does not have special ecological functions that are vital to maintaining the viability of biodiversity features.

6.3 Social Baseline Conditions

6.3.1 Surrounding Population and Communities

The project site is an unpopulated area with no communities within the direct vicinity of the project. The project area is also considered to be barren land that is unsuitable for agriculture or grazing. The project site is located directly to the east of Al Ghabawi municipal solid waste land fill site, which is owned and operated by the Greater Amman Municipality (GAM).

Accordingly, it can safely be said that no communities are found within at least a 5 km radius of the Project's boundary. The closest community surrounding the Project was identified as the population clusters which lie within a 7.5 - 13-km radius of the Project site. This included seven population clusters falling mostly within Uhud area under Sahab district, except for Mghayer Muhanna village which falls under Muwaqqar district. According to the Department of Statistics (DoS) projections for 2018, these communities are inhabited by 30,662 individuals. Table 6.9 shows the population size per cluster, the ratio of females in the population, and the average household size (DoS, 2019a).

Table 6.9. Population size in the targeted area (Source: DoS, 2019a)

Community	Approximate distance from project area	Population (# of individuals)[2]	% of females	Family size*
Al Baidah	13 km west of the site	12,142	47%	5.11
Khashafieh South	13 km west of the site	1,733	48%	4.08
Khashafieh North	13 km west of the site	8,531	49%	4.71
Al Madouneh	11 km west of the site	428	21%	4.65
Al Manakher	12 km south west of the site	3,496	41%	5.40
Qa'four	8 km south of the site	1,396	22%	4.81
Mghayer Muhanna	12 km west of the site	2,936	49%	5.13
Total		30,662	48%	4.93

* Source: Department of Statistics (DoS), 2015a.

Table 6.10 shows the distribution of the population by nationality. 85% of the population of the targeted communities are Jordanian. The largest migrant/refugee group was Egyptian nationals who constituted 6% of the population[2], followed by Syrian nationals who constituted 5% of the population. The ratio of migrants and refugees was highest in Al Madouneh and Qa'four, constituting 78% and 88% of the population respectively (DoS, 2019a). Those populations are, to a large extent, migrant workers in primary jobs which explains the high ratio of males to females in these two clusters (shown in Table 6.9) and the high ratio of individuals with low literacy (Table 6.11).

[2] Department of Statistics (DoS) 2018 projections based on the 2015 Population and Housing Census, DoS 2019.

Table 6.10: Distribution of residents by nationality per neighbourhood (Source: DoS 2019a)

Town / Nationality	Jordanian	Syrian	Iraqi	Palestinian	Egyptian	Other	Sum
Al Baidah	88.2%	3.6%	0.3%	5.8%	1.5%	0.6%	100.0%
Khashafieh South	91.7%	5.3%	0.0%	0.0%	3.0%	0.0%	100.0%
Khashafieh North	91.5%	3.0%	0.3%	2.8%	2.2%	0.2%	100.0%
Al Madouneh	22.0%	11.2%	0.0%	0.0%	50.0%	16.8%	100.0%
Al Manakher	78.5%	5.3%	0.0%	0.4%	15.8%	0.0%	100.0%
Qa'four	11.6%	40.1%	0.0%	0.0%	44.4%	3.9%	100.0%
Mghayer Muhanna	97.8%	1.8%	0.0%	0.0%	0.0%	0.5%	100.0%
All included communities	*84.7%*	*5.3%*	*0.2%*	*3.1%*	*5.9%*	*0.7%*	*100.0%*

6.3.2 Education level

Table 6.11 presents the distribution of residents aged 13 years and over according to their level of education as per the Population and Housing Census (DoS, 2015b). 14% of the residents hold a tertiary education degree and this ratio was highest in Mghayer Muhanna and Khashafieh South, with 25% and 20% of individuals above 13 years, respectively.

The illiteracy rate is 16% in the targeted communities, higher than the illiteracy rate on the national level (11%) and for Amman (10%) (DoS, 2015c). However, according to DoS (2015c), it is aligned with the illiteracy rate in rural areas (16%). Illiteracy is exceptionally high in Qa'four (42%), Al Madouneh (42%) and Khashafieh South (33%).

Table 6.11: Distribution of residents aged 13+ not enrolled in education by level of education per neighbourhood (Source: DoS 2015a)

Town / Educational Qualification	Illiterate	Read/ Write	Primary and below	Vocational Apprentice-ship	Secondary	College Diploma	Bachelor's degree and above
Al Baidah	12%	12%	35%	1%	25%	6%	8%
Khashafieh South	33%	2%	13%	0%	31%	5%	15%
Khashafieh North	14%	16%	23%	1%	32%	6%	8%
Al Madouneh	42%	32%	12%	0%	13%	0%	0%
Al Manakher	14%	6%	31%	11%	31%	3%	4%
Qa'four	42%	47%	3%	0%	5%	4%	0%
Mghayer Muhanna	12%	8%	21%	0%	33%	4%	21%
All targeted towns	*16%*	*14%*	*27%*	*2%*	*27%*	*5%*	*9%*

The community with the most educated population beyond primary schooling is Mghayer Muhanna with 58% educated beyond primary school. On the other hand, the community with the lowest educational level is Qa'four with only 9% educated beyond primary schooling.

6.3.3 Land Use

Based on the land use master plan adopted by GAM, GAM classifies the Project location under the "strategic services" area as shown in Figure 6.16. Hence, this area is suitable for industrial and infrastructural facilities as it is relatively far away from residential areas.

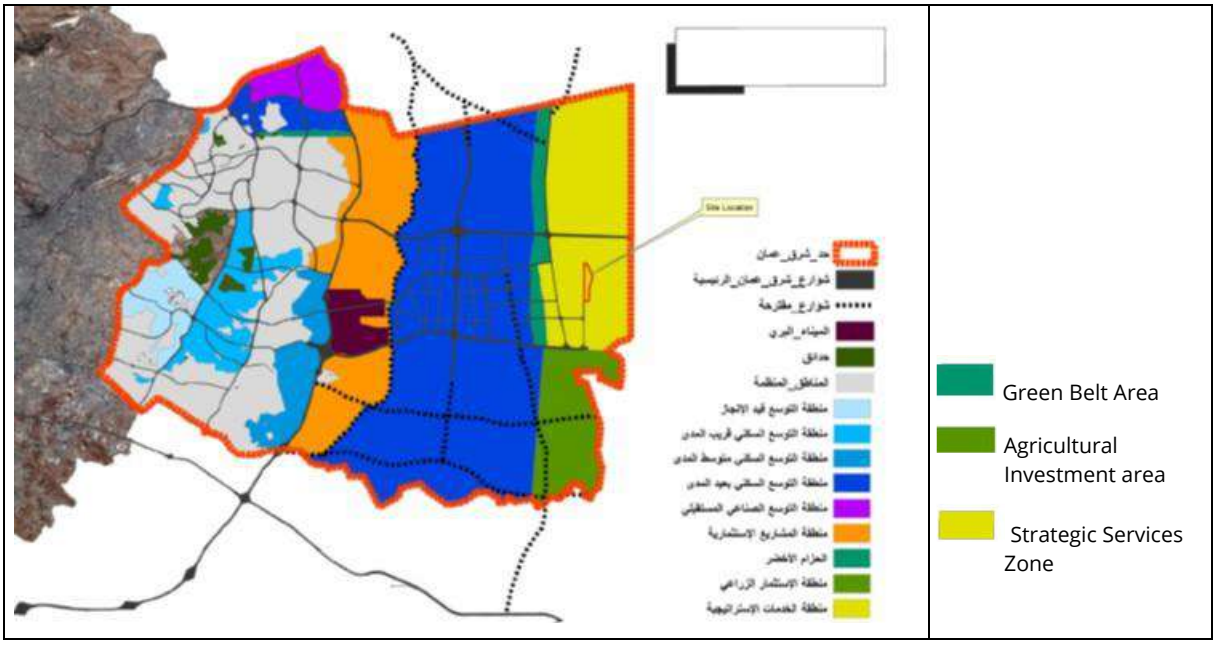


Figure 6.16. GAM Land Use Classification of East Amman Area

As mentioned before, the project will be constructed on Plot Number 63, Basin Number 1 of Al Ghabawi / Al Madouneh Area, where the plot is fully owned by WAJ (Annex 7 presents the Project's area registration certificate issued by the Department of Land and Survey).

6.3.4 Livelihood Conditions based on Household Survey

Sources of Income and Economic Activity

Based on the household survey conducted for this Project, 9 in 10 families reported relying on one source of income and 1 in 10 families (9%) reported income generated from two different sources. There is a high reliance on salaries from employment or pensions (39% and 27% of families, respectively) (Figure 6.17).

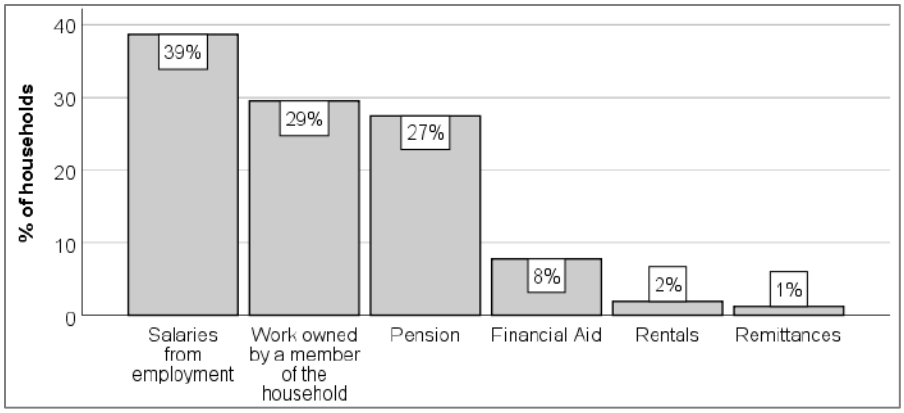


Figure 6.17. Sources of income reported by surveyed households
(Source: Household Survey, 2020)

The economic activity of all household members above the age of 15 years showed an economic rate among men that is close to the national numbers. This information is presented in Figure 6.18:

- 61% of males were reported economically active at the time of the data collection, the same ratio reported by DoS in the 2019 Employment and Unemployment Survey (DoS, 2019b).
- Unemployment among men was reported at 18%, closely aligned with the 16.8% reported by DoS in 2019 (DoS, 2019b).
- Females' reported economic activity rate was 11%, close to the national economic activity rate for women nationwide at 13% (DoS, 2019b).
- The unemployment rate among women was reported at 39.1%, almost 67% higher than women's unemployment rate on the national level which is 24.2% (DoS, 2019b).
- Youth unemployment (age 16-24 years) is at 39%, closely aligned with youth unemployment nationally of 41% for youth 15-24 years (DoS, 2019b).

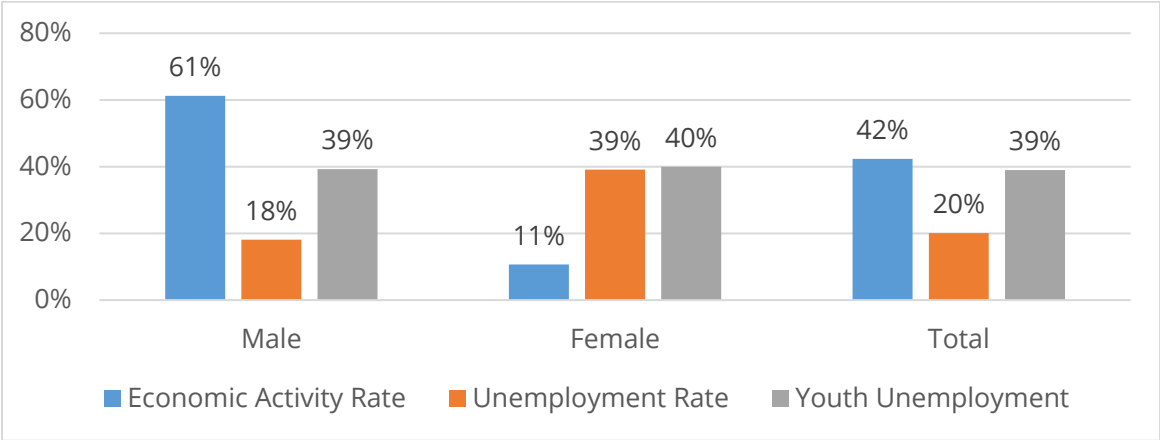


Figure 6.18. Economic activity rate, unemployment rate and youth unemployment, segregated by gender
(Source: Household Survey, 2020)

Sectors of Work

Table 6.12 and Figure 6.19 present the work sectors of working individuals above age of 15 years. The local community has high reliance on the public sector (including law enforcement and the Armed Forces) for employment. 37% of surveyed individuals were employed in the public sector and the armed forces, similar to the ratio of 40% reported on the national level (DoS, 2019c). Compared to the national average, a smaller ratio was reported to work in the private sector. 35% of working individuals in the targeted communities worked in the private sector, which is 9% lower than the ratio of 44% reported by DoS in 2019. On the other hand, the sample reported a higher inclination than the national average toward entrepreneurial activity where 29% of the households reported income from work owned by a member of the household.

Table 6.12. Sector of employment for working individuals above age 15
(Source: Household Survey, 2020)

Sector of work	% of working individuals above age of 15	Remarks
Self-employed	20%	Self-employment covers the following: - Car mechanic -Construction worker - Domestic housekeeper - Driver - Farmer - Livestock herder - Greengrocer -Primary worker
Business Owner	7%	Business ownership covers the following: - Barber - Contractor - Livestock breeder - Painter - Retail - Manufacturing (sponge)
Public Sector	19%	-
Private Sector	35%	-
Civic Sector	<1%	-
Law Enforcement / Armed Forces	18%	-
Total	**100%**	**-**

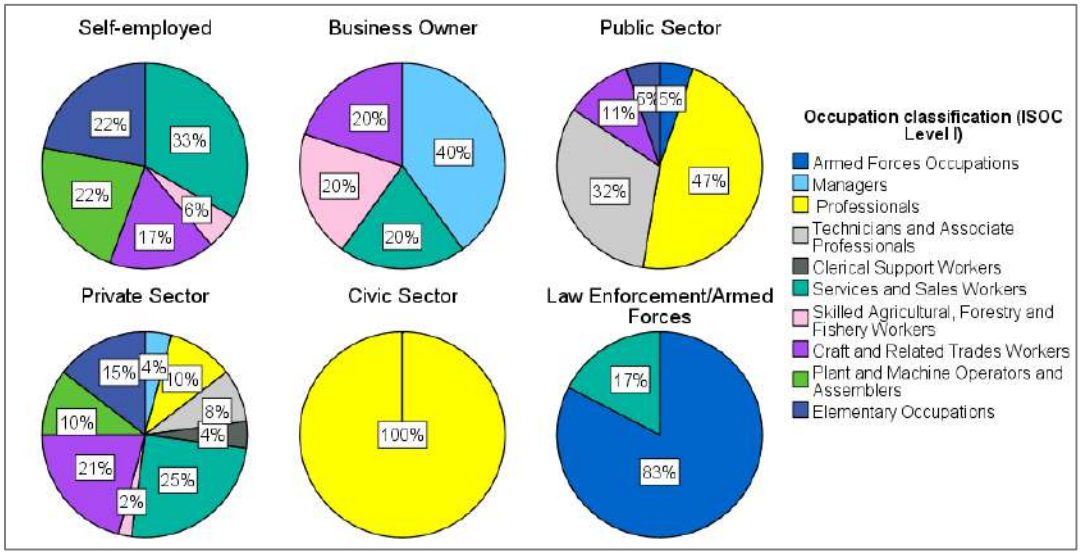


Figure 6.19. Main occupations of working individuals above 15, by sector of work
(Source: Household Survey, 2020)

General trends in women and men's main occupation is illustrated in Figure 6.20. It was found that 61% of the working women surveyed worked in education. For the remaining 39%, the occupations varied: tailors, domestic helpers, and other occupations in services and support. Men's employment, as shown in Figure 6.20, varied and distributed among most occupational classifications. Employment was reported the lowest in agriculture and clerical support (2% and 1%, respectively).

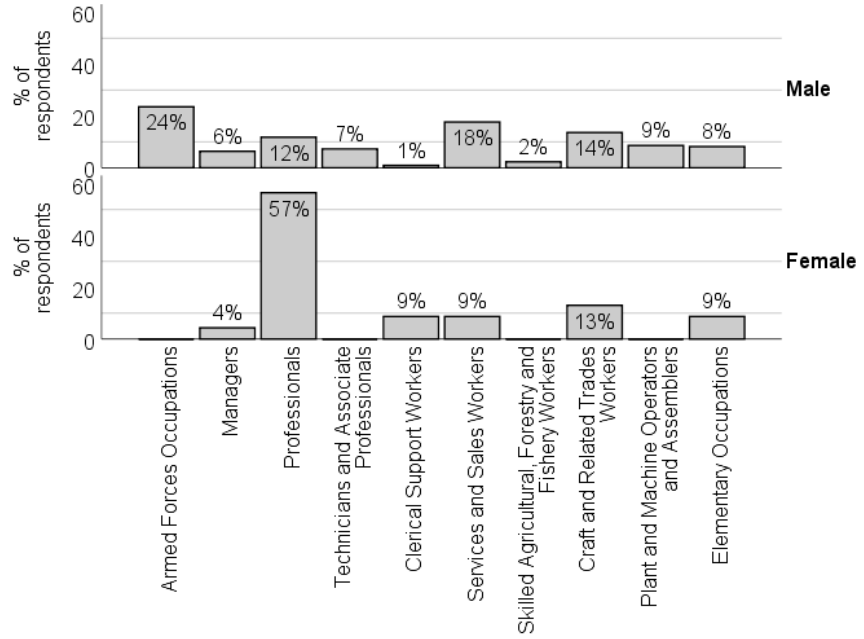


Figure 6.20. Occupations of working individuals above 15, by gender (Source: Household Survey, 2020)

Households Income

The monthly household income reported by the survey sample was JOD415.12 on average, with a standard deviation of JOD233. The lowest household income reported was JOD35 and the highest JOD1,500 per month.

As shown in Figure 6.21, 69% of respondents said their household income is usually or always insufficient in meeting the household needs. The income reported by the survey participants is lower than the average income reported by DoS in the 2017-2018 Households' Expenditure and Income Survey which is JOD1054.75 per month in Amman and JOD936.83 nationwide (DoS, 2018).

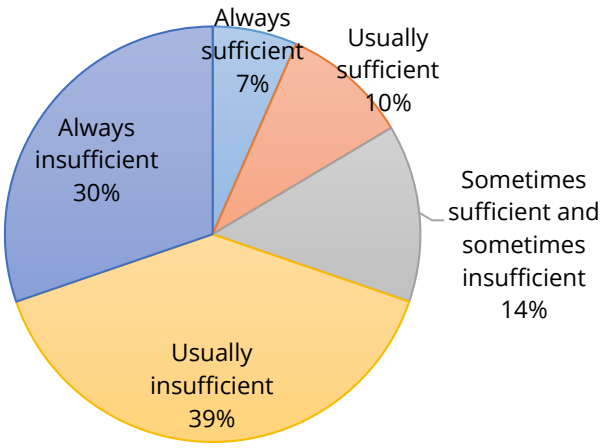


Figure 6.21. Sufficiency of household's income in covering the household's needs and expenses (Source: Household Survey, 2020)

Households Type and Ownership

All of the families interviewed (100%) lived in their home permanently. 93% of the households surveyed reported owning their home and 6% reported it was owned by a relative. 92% lived in detached houses, 7% in apartments, and 1% in temporary houses. Two cases described a different arrangement where one case was provided with accommodation for free and the other was given accommodation in return for work.

Livestock Breeding and Cultivation

Breeding livestock is considered by the local community as part of the local lifestyle and culture, a secondary occupation by a member of the household. 10% of the surveyed households have owned livestock in the past 12 months. 52% of those households owned goats/sheep, 13% owned camels, and 60% hens and other domesticated birds. Key information about the household's livestock activity are summarized in Table 6.13.

Table 6.13. Summary of key information on households' livestock activity (Source: Household Survey, 2020)

Item	Mean	Median	Range
Number of livestock owned (unit: animal): - Sheep / goat - Cows - Camels - Hen Farm - Domesticated hens and other birds	 – 94.25 – 0.00 – 5.50 – 500.00 – 14.00	 – 22.00 – 0.00 – 5.50 – 500.00 – 10.00	 – 5 – 400 – 0 – 1 – 10 – 500 – 500 – 5 - 40
Value of the livestock-related activities in the past 12 months (JOD)	JOD 3,880.27	JOD 200.00	JOD 0 – 15,000
Costs of the livestock- related activities in the past 12 months (JOD)	JOD 946.92	JOD 110.00	JOD 0 – 6,000

Sheep and goat owners in the focus groups described a reliance on grazing during the spring and on wheat and barley which they cultivate every year to help maintain their livestock. The cultivation of wheat and barley is done on empty plots of land toward the East where areas of land needed for this cultivation are available. The high price of fodder was cited the main challenge by those who owned livestock.

Cultivating crops for sustenance and income by members of households beyond a home garden was reported by five households (3% of the sample). Four of those five households cultivate fodder foods – barley and wheat – which are rainfed. Two of the five households cultivate olives, and two cultivate vegetables and legumes. The lack of water is the main challenge cited by the farmers and the low quality of seeds was another cited reason. 27% of the households reported maintaining a home garden. Those who maintain a home garden reported cultivating olive trees (68%), vegetables & legumes (56%), fruit (12%), medicinal herbs (29%) and other unproductive trees (25%). All these households rely on privately purchased water for irrigating the home garden. Key information about the household's agricultural activity are summarised in Table 6.14 including: average area of cultivated land, value of agricultural produce in the past 12 months in JOD, and costs incurred to cover the expenses of agricultural activity. Those who farm in their houses mentioned dust and pests in addition to the lack of water as key challenges.

Table 6.14. Summary of key information on households' agricultural activity (Source: Household Survey, 2020)

Item	*Statistic*	Agriculture scale	
		In the vicinity of the house	Agricultural land
Number of households		41 (27%)	5 (3%)
Area of cultivated land	*Mean*	2.73 donums	59.50 donums
	Median	1.96 donums	29.51 donums
	Range	0 – 80 donums	4 – 120 donums
Estimated value of the agricultural produce produced in the past year regardless of whether it was consumed or sold	*Mean*	JOD 67.43	JOD 775.00
	Median	JOD 13.05	JOD 466.15
	Range	JOD 0 – 300	JOD 0 – 2000
Estimated value of the costs incurred on the family to cover the expenses of the family's agricultural activity in the last 12 months	*Mean*	JOD 364.46	JOD 620.00
	Median	JOD 140.38	JOD 334.89
	Range	JOD 0 - 4000	JOD 30 – 1200

6.3.5 Health Issues and Nuisances Reported by the Survey

Based on the household survey conducted in the target communities, 38% and 31% of the surveyed families reported frequent headaches and allergies, respectively, for at least one family member. Respiratory diseases were reported by 20% of households and gastrointestinal diseases by 14% of households. The reported prevalence of these health issues is illustrated in Figure 6.22.

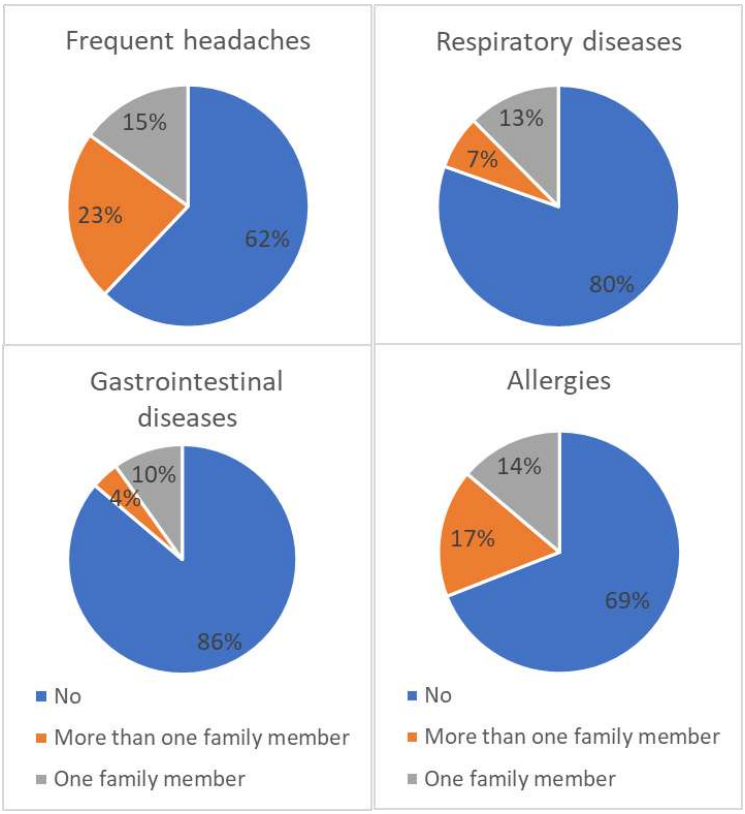


Figure 6.22. Health issues reported for at least one member of the surveyed households (Source: Household Survey, 2020)

Moreover, environmental nuisances were reported by a proportion of the households where noise and smoke were reported by 45% of the households, bad odors by 75%, and high levels of dust by 86%. The reporting of these nuisances is illustrated in Figure 6.23.

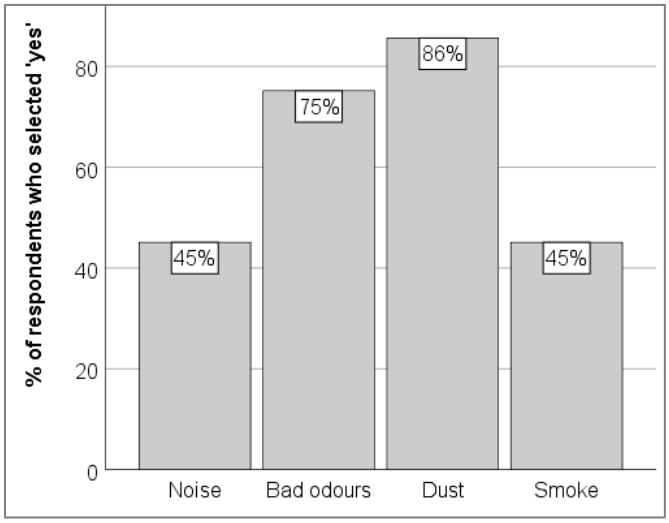


Figure 6.23. Nuisances reported by the surveyed households (Source: Household Survey, 2020)

6.3.6 Surrounding Facilities

Al Ghabawi is designated as a Strategic Services Zone. The surrounding facilities found to be within a close proximity to the proposed Project site include:

- Al Ghabawi solid waste landfill site that belongs to GAM which is located directly next to the project site.
- Amman Strategic Reserve Terminal for Petroleum Products that belongs to the Ministry of Energy and Minerals, is located 1.5 Km to the south of the site.
- There is a cow farm around 3 km south from the Project site.
- Amman Asia Electric Power, which is around 12 km south-west of the Project site.
- The project site is located at about 25 to 30 Km to the east-south direction from the AGTP depending on the route taken to reach the site.

These facilities were illustrated in Figure 2.2 under section 2.1.

At present, half of the local communities seem to be aware of the designation of Al Ghabawi as a Strategic Services Zone and expected further developments to take place in the area. The percentage found to be aware of this designation during the household survey is illustrated in Figure 6.24.

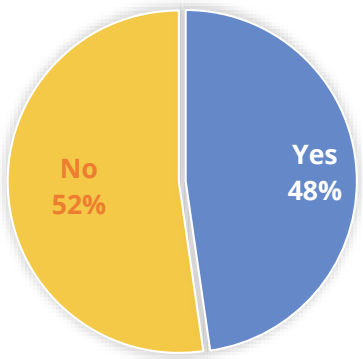


Figure 6.24. Community awareness of the designation of Al Ghabawi as a Strategic Services Zone (Source: Household Survey, 2020)

6.3.7 Infrastructure and Utilities

The Project site can be reached by existing roads from Zarqa and Amman (12 Km from Amman Development Corridor Road). The road leading directly to the project site is accessible through the main road that also leads to the adjacent Al Ghabawi landfill. However, necessary improvements to road infrastructure may need to take place to accommodate the project activities and needs.

Existing power lines (medium voltage) are also available on the main road. In addition, the project site already has communication/mobile network coverage.

6.3.8 Existing Transportation Network

A traffic assessment was conducted for the Project. Based on its findings, the following describes the current transportation network.

Amman Development Corridor

Amman Development Corridor, known as Road No. 45 or Road No. 100, is a major artery connecting the capital Amman with other governorates and rural areas. It is a four-lane divided highway with two lanes running on either side and a median separating both directions. It intersects with Al Madouneh interchange as shown in Figure 6.25. The total roadway width is 26 m, and the width of the separating median is 4.5 m. The Project, and other third-party facilities, is accessed by an existing, tarred two-lane road that extends east from the Al Madouneh Interchange.

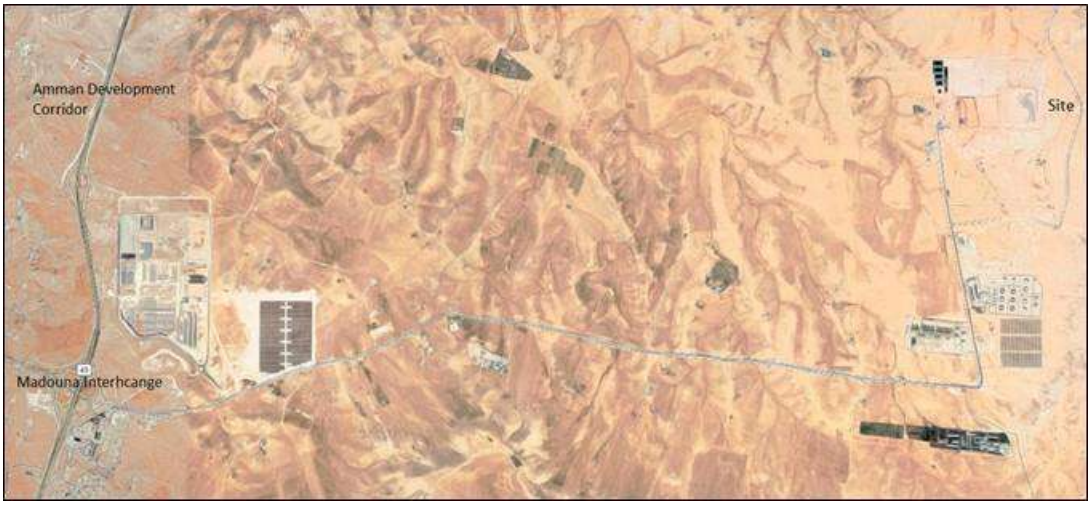


Figure 6.25. Amman Development Corridor and Al Madouneh interchange

Other Surrounding Roads

Al Ghabawi Wastewater Facility is surrounded by an existing undivided two-lane road on the eastern side of the project. The road runs in both directions with one lane of traffic in each direction. Figure 6.26 shows the project's site and the existing surrounding road.

Figure 6.26. Project site and surrounding road

Background Traffic Conditions

Background traffic conditions include traffic volumes that currently exist and would exist in the future without the project. Background traffic data are needed to isolate traffic that is generated from the Project from that which is not.

Even though very little traffic is expected to access the surrounding roads of the facility, Engicon has conducted a traffic count survey at two different stations near the project site. The coordinates of these two stations are listed Table 6.15 in and their locations are shown in Figure 6.27. Impact of the traffic potentially generated by the project is further assessed in section 8.3.3.

Table 6.15. Coordinates of traffic count stations

Station	Northing	Easting
1	31°54'11.85"	36°11'9.93"
2	31°55'32.18"	36°11'46.79"

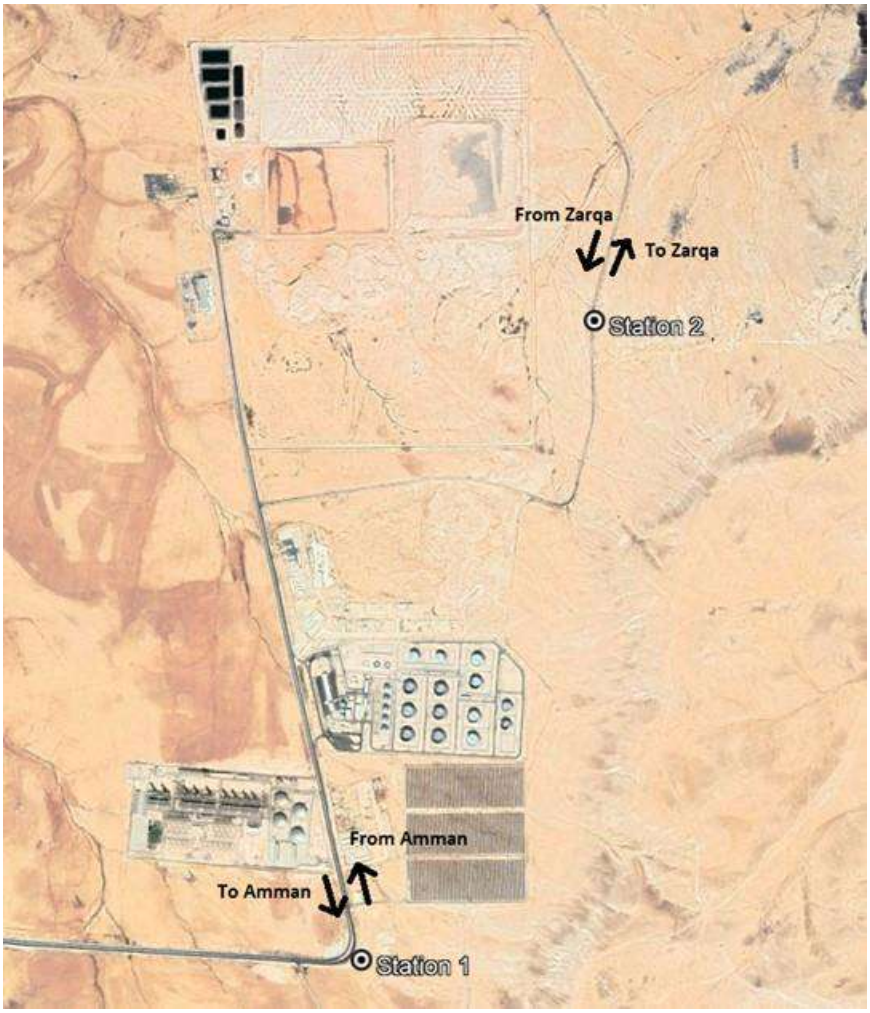


Figure 6.27. Traffic count stations

Existing Traffic Volume

Figure 6.28and Figure 6.29 show the total traffic volume and the peak hour volume (based on manual classified counts - MCCs) at two different stations (station 1 and station 2). Table 6.16 show the results of 12-hour MCCs conducted in the site.

(a) Total traffic volume at station 1

(b) Total traffic volume at station 2

Figure 6.28. Total traffic volume at (a) station 1 and (b) station 2

(a) Peak hour traffic volume at station 1

(b) Peak hour volume at station 2

Figure 6.29. Peak hour traffic volume at (a) station 1 and (b) station 2

Table 6.16. Results of 12 – hour manual classified counts on surrounding roads

Vehicle Class	Station 1				Station 2			
	To Amman		From Amman		To Zarqa		From Zarqa	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
Cars, 4-wheel drive, Jeeps, Taxis	274	33%	350	40%	109	59%	80	55%
Pick up/Van	227	27%	207	24%	40	22%	34	23%
Diana	35	4%	38	4%	13	7%	13	9%
Small Buses (up to 30 pax)	36	4%	25	3%	2	1%	0	0%
Buses	6	1%	4	0%	0	0%	1	1%
2-Axle Trucks	37	4%	28	3%	8	4%	5	3%
3-Axle Trucks	44	5%	55	6%	8	4%	7	5%
4-Axle Trucks	108	13%	103	12%	0	0%	1	1%
5-Axle and more trucks	69	8%	68	8%	4	2%	5	3%
Total	**836**	**100%**	**878**	**100%**	**184**	**100%**	**146**	**100%**

Future Traffic Projections

Figure 6.30 and Figure 6.31 present the total and peak hour projected background traffic volumes estimated using an equivalent growth rate of 3.7 %, obtained from the Jordan Highway Master Plan Study Estimates. The equivalent growth rate was determined by examining the traffic growth pattern of a road that is similar to the surrounding roads in the area. Table 6.17 shows the future traffic projections of the surrounding roads. The projection was made for 2030.

Table 6.17. Future traffic projections of the surrounding roads

Year	Future Traffic Projections			
	Station 1		Station 2	
	Total Projected Traffic			
	From Amman	To Amman	From Zarqa	To Zarqa
2030	1263	1202	210	265
	Peak Hour Projected Traffic			
	271	276	43	61

(a) Total projected traffic (Station 1, 2030)

(b) Total projected traffic (Station 1, 2030)

Figure 6.30. Total projected traffic (station 2, 2030)

(a) Peak hour projected traffic (station 1, 2030)

(b) Peak hour projected traffic (station 2, 2030)

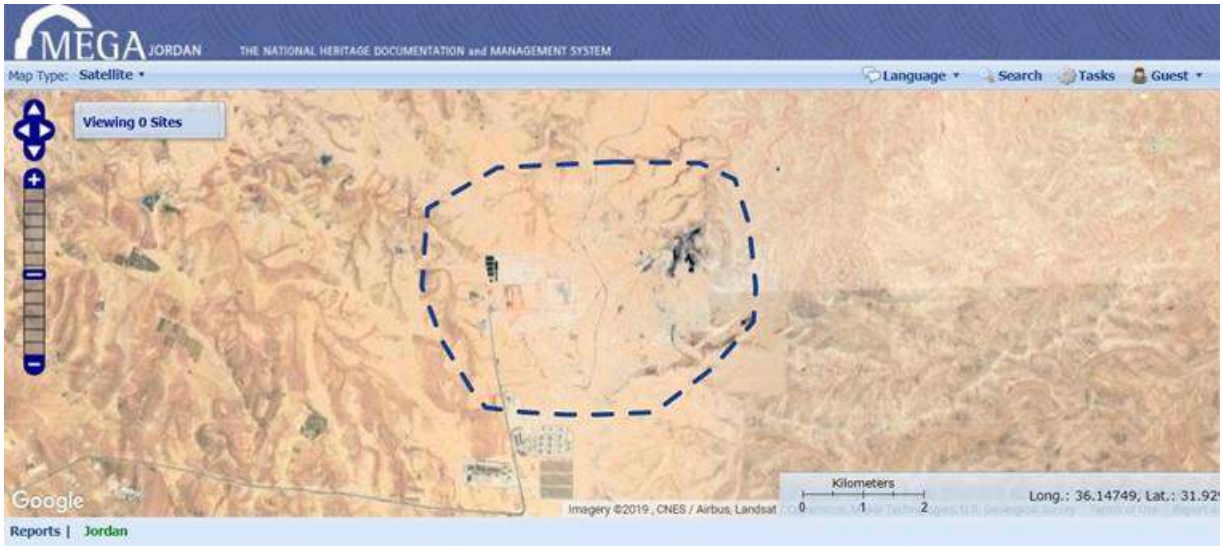
Figure 6.31. Peak hour 2030 projected traffic at (a) station 1 and (b) station 2

6.4 Cultural and Archaeological Conditions

The aim of describing the baseline situation for archaeology and cultural heritage is to identify and list potentially existing archaeological or cultural heritage sites available within the Project's area of influence. For this purpose, the research depended on searching the MEGA Jordan online system (MEGA Jordan, 2010) and on contacting the Department of Antiquities (DoA) to inquire about availability of archaeological or cultural heritage sites.

According to MEGA Jordan database, there are no potential archaeological sites that are close or available within the 1.5 km buffer zone for the Project area (MEGA Jordan, 2010). The absence of potential archaeological sites that within the project area of influence based on MEGA search is

illustrated in Figure 6.32 and has been confirmed by DoA letter indicating absence of any potential archaeological or cultural heritage sites within the Project area (see Annex 8). Although unlikely, in the case of any artefacts found on site during construction works or any other civil works related to the Project, chance find procedure is to be followed and DoA is to be informed.



Boundary of the search area

Figure 6.32. Absence of potential archaeological sites (within 1.5 km from the Project boundary) (source: website of MEGA Jordan, 2010)

7 PROJECT STAKEHOLDERS AND CONSULTATION

This section introduces the Project Stakeholders and provides the outcome of the public consultation session and follow-up meetings with stakeholders that were carried out as part of the Project's scoping process. It also provides the findings of the household survey with respect to the local community perceptions and concerns in relation to the Project and ends with the ESIA disclosure procedure.

7.1 Identified Project Stakeholders

Table 7.1 identifies stakeholder groups, their level of involvement and the extent of influence they may have on the Project.

Table 7.1. Stakeholder Identification and Potential Influence

Stakeholder Group	Identified Stakeholders	Level of Involvement in Project	Degree of Project Influence
Internal Stakeholders			
Project Owner	Ministry of Water and Irrigation (MWI) / Water Authority of Jordan (WAJ)	WAJ is the project owner and will be the prime stakeholder to make decisions on all aspects of project implementation.	High
Direct Workers/ employees	This includes WAJ male and female employees involved in this project. This includes temporary and part-time workers	Directly or Indirectly Affected by the Project during all phases. Direct workers are employed by WAJ who is has the primary responsibility to oversee the overall performance during all phases and will be responsible for overall performance of the project and compliance with regulatory requirements as well as EBRD requirements.	High
Contractors/ Sub-contractor workers	Contracted Workers and those employed by third parties such as the Contractor and/or sub-contractor. This includes temporary and part-time workers.	Directly or Indirectly Affected by the Project during Construction / Installation Phase. Contractor workers are responsible for complying with all construction activities as per the Contractor's agreement with WAJ	High
Operator's O&M Team and Project Implementation Unit (PIU) Consultant	Personnel responsible for the operation and maintenance of the septic tank facility during the operation phase of the project	Directly or Indirectly Affected by the Project during the Operation & Maintenance Phase.	High
Tanker operators/ owners	Tanker operators will be responsible to collect and transfer the septage from the unsewered areas of Amman and Zarqa Governorates, in addition	Directly affected by the project during the operation phase. Tanker drivers/tanker owners will be responsible to comply with MOENV online tracking system for wastewater tankers. Moreover, the proposed project facility shall	High

Stakeholder Group	Identified Stakeholders	Level of Involvement in Project	Degree of Project Influence
	to sludge from the treatment plants of Salt, Fuheis, and Baqa'a and will transport them to the septic tank facility at Al Ghabawi.	implement a regulated entrance and exit into the facility as a safety procedure.	
External Stakeholders			
Local Authorities	Ministry of Environment (MoEnv)	MoEnv will be responsible in influencing decisions pertaining to environmental permitting processes and environmental clearance for the project to ensure that all potential environmental, social and health & safety impacts are within the minimum acceptable limits in accordance with the mitigation and monitoring requirement discussed in the ESIA for the project.	High
	Ministry of Labor (MoL), Ministry of Transport (MoT), Ministry of Health (MoH), Ministry of Energy and Mineral Resources (MEMR). Ministry of Tourism and Antiquities (MoTA) and relevant municipalities	Regulatory role in the project.	Medium
	Greater Amman Municipality (GAM)	GAM is the responsible entity for Al Ghabawi landfill which is directly adjacent to the proposed project location.	Medium
	Civil Defence Authority	Review emergency response arrangements at septic tank facility with Civil Defence Authority (CDA).	Medium
	Miyahuna	Responsible for managing the wastewater services at Amman and Zarqa governorates, and currently operating the existing septic tank facility at Ain Ghazal septage receiving facility.	Medium to High
Members of the local community	Members of local communities and villages living within the project surroundings.	The project area is identified as a barren and empty land, with no current activities taking place, as no communities were seen to economically benefit from this land. The closest communities reside more than 5 km away from the project location. In addition, the Project area is a government owned land, particularly under WAJ's ownership. Therefore, no form of economic or physical displacement is triggered as a result this project.	Low

Stakeholder Group	Identified Stakeholders	Level of Involvement in Project	Degree of Project Influence
		There are no residential areas within at least 5km radius of the proposed project. The communities considered closest to the project fall mostly within Uhud area under Sahab district, these are: - Qa'four: 8 km south of the site - Al Madouneh: 11 km west of the site - Al Manakher: 12 km south west of the site - Mghayer Muhanna: 12 km west of the site and falls under Muwaqqar district. - Al Baidah: 13 km west of the site - Khashafieh South: 13 km west of the site - Khashafieh North: 13 km west of the site. The main interests and concerns of the local communities in the project are related to the following aspects: - Minimizing potential negative cumulative impacts that they perceive on the environment, public health and traffic due to the presence of different project facilities within the East Amman Area - Potential benefits from construction and operation phases, such as employment opportunities, to target local residents. - Suggests to implement corporate social responsibility interventions in East Amman area to benefit local communities (Detailed stakeholder issues of concern are presented in the following chapter of this SEP document).	
Vulnerable Groups	Women, youth, Syrian refugees	Those households consisting of vulnerable groups that will be served by the proposed project.	Low to medium
Local communities within the areas to be served	Local communities/households residing in areas that are un-sewered within Amman and Zarqa Governorates. These households are currently served by the existing septic tank facility at Ain Ghazal Treatment Plant, and will eventually be served by the proposed project.	Local communities to be served by the proposed project shall also pay for the transportation of their septage to the proposed septic tank facility at Al Ghabawi. Based on the affordability analysis conducted as part of the preliminary feasibility study, it was concluded that utility bills are affordable in both Amman and Zarqa Governorates.	Low

Stakeholder Group	Identified Stakeholders	Level of Involvement in Project	Degree of Project Influence
Non-Governmental Organizations (NGOs)/ Civil Society Organisations (CSOs)	The main identified CSOs within the project area and its surroundings are: - East Amman Society for Environmental protection - Roboua Al Manakher Society - Al-Bayida' Society (charity) - Maghayer Muhanna Society - Khashafiyeh Dabaybeh Society	They are stakeholders that are not considered directly affected or served as a result of the new project. However, they are involved through the engagement process and scoping session where they were able voice out their opinions or potential concerns on behalf of local communities during any phase of the project.	Low to Medium
Neighbouring facilities	The closest facilities surrounding Al Ghabawi septic tank facility project: - Al Ghabawi landfill - Electricity generating company Amman East - Reserve terminal for petroleum products - Cattle farm - Other facilities under construction	The closest involvement of neighbouring facilities will be from Al Ghabawi landfill, as it is situated adjacent to the project area. The project shall maintain an open dialogue with neighbouring facilities.	Low
International Financing Agencies/ Donors and International NGOs	International Donors or NGOs working in the infrastructure sector in Jordan.	Stakeholders who are not affected by the Project but may be potentially interested in the Project throughout any phase. Such stakeholders may be interested for research purposes or interested to fund a different component of this project or additional activities within the same target area in the future.	Low

7.2 Public Consultation

A public consultation session was held on the 5th of November 2019 at Bristol Hotel, Amman. The stakeholders were invited by MoEnv and the session was attended by 39 individuals as presented in Figure 7.1 and Annex 9. The session's communication language was in Arabic and all related handouts and presentations were prepared in Arabic. The overall aim of the session was to take into consideration issues of concern raised by stakeholders throughout different phases of the project, and where relevant, applicable and feasible, the study team assessed these concerns in this ESIA study

as part of the impact assessment process. Impacts and interests highlighted by stakeholders that needed special attention were further discussed with the project owner (WAJ), EBRD and the MoEnv.

In addition, a project-specific Stakeholder Engagement Plan (SEP) has been prepared in order ensure that identified stakeholders are appropriately engaged on all issues that potentially affect them and to maintain an ongoing relationship with them throughout the project.

Figure 7.1. Pictures from the scoping session

The scoping session started by opening words from the Project manager, representative of MoEnv, and representative of MWI. Following that, the E&S team made a presentation that addressed the following (see Annex 10):

- Project description
- Proposed ESIA study approach
- Stakeholders identified to date
- Overview of existing baseline conditions
- A preliminary evaluation of E&S impacts for discussion

After the presentation, the floor was open for discussions of potential impacts and the issues of concern as presented in Annex 10. Special attention was paid to points raised by the local communities and project-affected parties. Issues raised during the public consultation session are presented in Table 7.2.

Table 7.2. E&S Issues raised during the public consultation session

Entity Represented	Issues of Concern during Project Construction/Operation/Decommissioning	Response
Greater Amman Municipality (GAM)	- Incidence of stray dogs in the area of the project. - There are concerns for air quality and noise generation in the area due to the increase in movement of vehicles and septic tankers and thus requested that the traffic impacts be considered, especially that the area will continue growing as a strategic services zone. - Indicated that the 2018 ESIA study carried out for Al Ghabawi Landfill by EBRD indicated problem of odours. Accordingly, the WWTP need to identify its emission of odours in the area and present the odour control system to be adopted.	- The Consultant Engineering Team mentioned that issues will be taken into account in the ESIA, furthermore, a traffic impact assessment will be prepared as part of the ESIA. - As for odour, the plant will have an advanced odour control system to eliminate odour expected during the operation phase. Also, an option to set-up a committee from the local residents to monitor and manage odours in the area will be explored.
Environmental Rangers	- Emphasized the need for protection of ground water resources in the area due to scarcity of water resources in Jordan.	- The Consultant explained that ground water protection as well as flood protection measures will be taken into account in the design.
East Amman Society for Environmental Protection (EASEP) – (represented by Mr. Farhan Al Dboubi and Mr. Hakem AlDaajeh)	–Raised several issues of concern that are related to the development of this project and several other projects in the surrounding areas such as Al Ghabawi Landfill, Customs Depot, East Amman Power Generation Station and others. The concerns included: –Greenhouse gas emissions; –Requested resettlement of the nearby communities because of all the	–The Consultant Engineering Team stressed that there will be further communication with the local community to take their concerns into account in the ESIA where applicable, also developing a Stakeholder Engagement Plan is part of the project and will be prepared in both English and Arabic. –The Ministry of Environment expressed its understanding of the local

Entity Represented	Issues of Concern during Project Construction/Operation/Decommissioning	Response
	infrastructure projects being implemented in Al Ghabawi area. –Impacts from increased traffic due to increased vehicle movement. Also, the increased traffic will coincide with increased traffic movement due to the planned opening of the land port (Customs Depot). –Encouraged training and employment opportunities for the local community. –Requested that the SEP be developed in coordination with the local community. –Requested to have a monitoring plan for the influent septage delivered by the septic tanks to ensure that no unauthorized wastes are brought in with the septage. –Commented that AlBeidah and Wadi AlEish villages were not considered in the study area and that there could be agricultural and grazing activities. –Claimed that the project land plot historically belonged to the local community (as a tribal area) in the study area and was acquired by the military for public benefit (area had been designated as a military zone) but now should be given back to the local community after the military use has ended.	community concerns due to the increased traffic that will accompany the infrastructure projects in the study area. –The Ministry reminded that the septic tankers movement is being monitored through MoEnv Online Tracking System for Wastewater Tankers. –The Ministry emphasized that scoping sessions are being held and related stakeholders are invited to those scoping sessions in order to echo their concerns to be taken into consideration. –The Ministry also emphasized that all other projects in Al Ghabawi area have been implemented taking Jordanian regulations into consideration.
Ministry of Health	–Indicated that the treated wastewater effluent from the WWTP need to be tested for quality compliance. –Indicated that there is no need for disinfection system for the treated effluent as the water use in irrigation is just for trees and fodder plants like alfalfa. –Discussed that it is better to improve the treatment system of the sludge so that it can be used to improve the agricultural soil in the area.	–The Consultant Engineering Team responded that the treated WW should comply with the Jordanian Standard JS 893/2006.
Water Protection Society (represented by Dr. Nawaf Al Khawaldeh)	–Requested to consider any potential impacts on the groundwater aquifer in the study area. –Inquired about the how the treated wastewater effluent can be used to benefit the local community. –Asked about whether there are ways to sell the sludge to farmers and inquired of any proposed plan to handle the sludge after the 5-year period of storage.	–The Consultant Engineering Team emphasized that the WWTP design parameters need to comply with the Jordanian standard which requires the irrigation treated wastewater to be suitable to irrigate vegetables as well. –The Consultant also explained that ground water protection as well as flood protection measures will be taken into account in the design.

Entity Represented	Issues of Concern during Project Construction/Operation/Decommissioning	Response
	–Inquired about flood protection works for the WWTP as well as the odour control system. –Emphasized importance of having groundwater monitoring wells in the area.	
Jordan University – (represented by Dr. Ghada Kassab, Faculty of Engineering)	–Commented that the proposed WWT system is expensive and energy intensive. As she perceives that the WWTP will not be economically feasible, why not plan to have a lower quality effluent? –Why did the consultant select the aerated digestion? –Was mechanical treatment evaluated as an option?	– The Consultant Engineering Team responded that many technology alternatives were considered and discussed with EBRD, and finally reached to adopting the aerated digestion. Moreover, having a better-quality effluent will reduce any serious environmental issues if such effluent was ever discharged to Wadis.
Ministry of Tourism and Antiquities	–Ministry of Tourism and Antiquities is one of the ministries related to the Project as they should be contacted in case of chance finds, such as coming across artefacts during excavation works of the construction phase.	–The Consultant Engineering Team responded the ESIA Study shall consider the chance find procedure and incorporate it accordingly.

Moreover, a questionnaire was distributed to get the feedback from the participating stakeholders on what they perceive as the most and least significant E&S issues during the Project's construction and operation phases. The respondents indicated a group of E&S issues that they consider as significant and insignificant during the Project's implementation phases. According to their responses, these E&S issues include:

- Significant E&S issues during construction:
  - Occupational health and safety concerns.
  - Air quality concern due to dust and emissions from vehicles and equipment. Establish the air quality baseline to allow for a comparison during the operation phase.
  - Impact of high noise levels and vibrations on occupational health.
  - Soil pollution due to accidental leakage of oil and fuel.
  - Traffic accidents. Greater Amman Municipality has declared that it has assigned a budget of 30 Million JODs for the rehabilitation of Al Ghabawi highway over a period of three years.
  - Impact on land value for surrounding areas.
  - Work conditions for the labour force in terms of number of work hours and salary pay.
  - Positive impact of creating job opportunities to youth from surrounding communities.
- Least significant E&S issues during construction:
  - Aesthetics is not a perceived as a significant aspect during project construction.
  - Odour and noise levels.
  - Potential chance finds of archaeological artefacts.
- Significant E&S issues during operation:
  - Odour generation.

- Occupational health and safety concerns due to exposure to biological and mechanical hazards as well as physical hazards such as noise levels and heat.
- Impact on groundwater.
- Impact on air quality and their impact on health especially with respect to surrounding communities.
- How will the sludge be handled after the storage period of 7 years?
- Increase in traffic accidents and potential impacts on traffic due to movement of vehicles from Amman and Zarqa towards Al Ghabawi especially that the movement of septage tankers will coincide with the movement of garbage trucks to and from Ghabawi landfill.
- Potential change in the fees paid for transporting the septage to the new Al Ghabawi WWTP instead of Ain Ghazal receiving station.
- Monitoring of the septic tankers so they do not empty the septage illegally.
- Concern for potential of odour generation from the stored dried sludge.
- Cumulative impacts on air quality, odours and traffic due to availability of other infrastructure services within the area especially the future land port and slaughterhouse.
- Potential effect on land prices within the surrounding area.
- Work conditions for the labour force.
- Contribution of Al Ghabawi WWTP to greenhouse gas emissions.
- Cumulative impacts due to Al Ghabawi WWTP in relation to odour generation, air quality, soil and water quality.
- Potential to use Al Ghabawi WWTP to treat the leachate coming from Al Ghabawi landfill.

▪ Least significant E&S issues during operation:
- No potential impact on agricultural lands as the surrounding land plots are not suitable for agricultural purposes/use.
- Dust and noise levels.

The ESIA examined the above issues, and considered those that are applicable in the Impact Assessment and the Environmental and Social Management Plan (ESMP) accordingly.

7.3 Stakeholder Meetings

Stakeholder consultation meetings (on the 13th of November, 2018 and on the 17th and 27th of November, 2019) were carried out with local community stakeholders to engage them early on during the project and understand their concerns together with managing their expectations. The project team screened all comments and concerns accordingly during the ESIA process, and those that are realistic, feasible and applicable to this proposed project have been considered in this ESIA document. The detailed meeting outcomes, issues of concern and responses are provided in Annex 11 of this ESIA document.

In summary, the main interests and concerns of the local communities in the project are related to the following aspects:

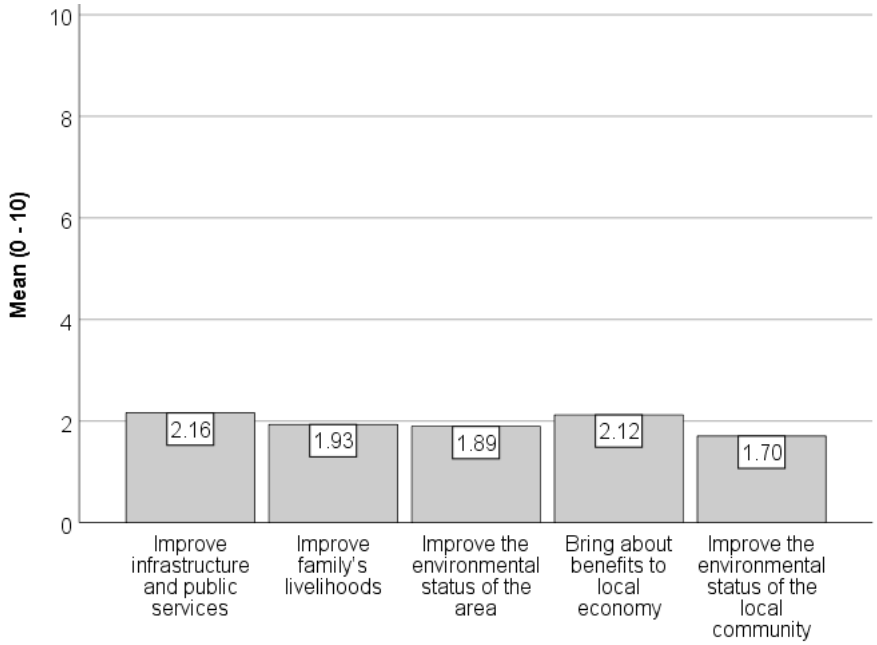
1. Potential negative cumulative impacts on the environment, public health and traffic due to the presence of different project facilities within the East Amman Area.

2. Potential nuisance resulting from the WWTP operations such as odour, and potential illegal discharge of wastewater by tankers
3. Potential reuse of wastewater effluent generated from the WWTP.
4. Potential benefits from construction and operation phases can such as employment opportunities.
5. Potential need of a committee from the local community to oversee the monitoring measures that will be taken during the operation phase of the plant (mainly for wastewater type and odours).
6. Supported the implementation of corporate social responsibility interventions in East Amman area to benefit local communities especially youth populations.

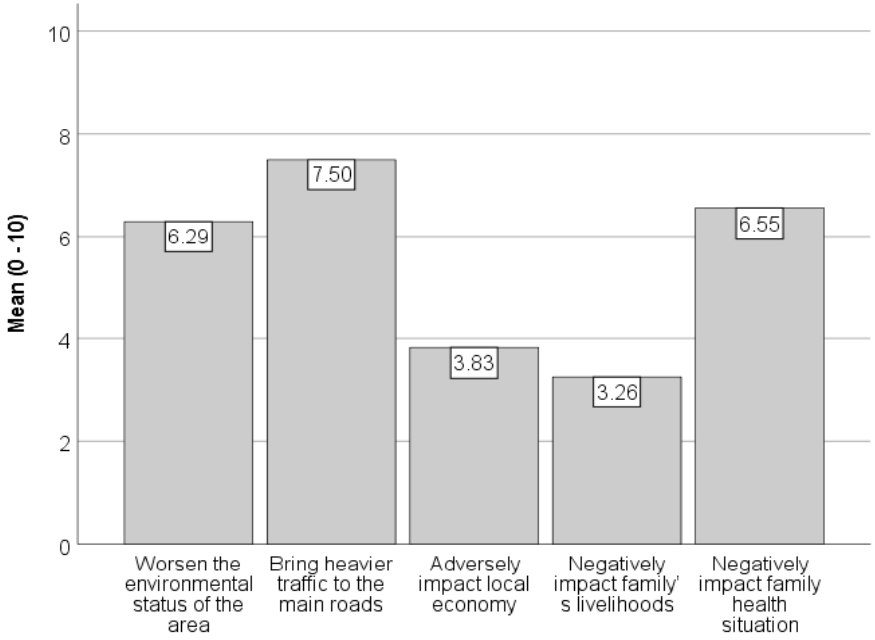
7.4 Household Survey: Findings on Local Community Main Concerns

Based on the household survey and the focus group discussions held in August and September 2020, concerns over the Project's were expressed by representatives of both genders who saw limited benefits in return. The low expectations for positive impact from the Project and high expectations for environmental risks are grounded in the experience with some of the other operating developments in the area, and a general lack of confidence in the implementation of the monitoring and mitigation processes.

The specific expectations of the Project's positive and negative impacts by the respondents are illustrated in Figure 7.2. Figure 7.2 (a) shows that the average expectations of a positive impact are low with an average of around 2 out of 10 on every item. This indicates that positive impacts were expected only to a limited extent among a limited portion of the population. Figure 7.2 (b) shows that, on average, expectations for the Project to negatively impact infrastructure, the environment and health were high. Adverse expected impacts on livelihoods and the local economy were, on average, moderate.



(a) Perceived possibility of the Project to improve overall conditions as the mean score of 0-10



(b) Perceived concern from Project the as the mean score of 0-10

Figure 7.2. (a) Perceived possibility of the Project to improve overall conditions as the mean score of 0-10, and (b) Perceived concern from the Project as the mean score of 0-10[3]
(Source: Household Survey, 2020)

Based on the household survey, 76% of respondents expect that the Project will have a negative impact on the environment: (50% a significant negative impact, and 26% to a smaller degree). These concerns of environmental pollution spill over to other domains and are related to impacts on human health and wellbeing, the health of animals and crops, daily lives, and the local economy including the social image of the area and land values. There are widely held expectations that the Project will increase odours and insects in the area. These are also a common grievance shared about Al Ghabawi municipal landfill, which already impacts the quality of life in the area. Though a high standard and measures to prevent pollution are expected, the lack of confidence toward the processes which protects the local environment and community has resulted in expectations of a negative impact on the environmental situation.

Moreover, illegal dumping of wastewater by septic tanks and the possibility of accidental leakage on the main roads was expressed as a concern. The increased traffic of wastewater septic tankers was also expected to impact air quality in the area, and thus it was suggested to mitigate their impact by assigning specific main roads which keep this traffic further away from residential areas and effectively monitor the septic tankers. Another major concern was related to the impact of the Project on the local economy due to the environmental pollution that was viewed as likely. There were concerns that the potential increase in bad odours and pests will adversely impact the quality of life in the area for all residents and reduce land values.

[3] Weights were given to each response as follows: 0 for "no impact", 5 for "small degree", and 10 for "large degree". The closer the number to ten, the more the positive or negative impact is expected. The closer the number is to 0, the lower the expectation of the positive or negative impact to take place as a result of the Project.

Still, 30% of the sample expected to have some positive impact on the environment. This is explained by expectations that the Project in the area would enhance environmental protection, monitoring, and wastewater services.

Additional anticipated positive impacts of the Project are the economic opportunities it may create for the local community. However, job creation, short-term demand on local services during construction, and the potential to benefit from opportunities along the value chain were believed to be limited as a result of the Project.

7.5 ESIA Disclosure

The ESIA disclosure approach has been described under section 5.11 and the approach details are also shared within the Stakeholder Engagement Plan (SEP) document.

8 ASSESSMENT OF ENVIRONMENTAL AND SOCIAL IMPACTS

This section identifies and assesses potential environmental and social impacts associated with the Project. It starts by listing the environmental and social components identified to be of value/significance and then discusses and assesses the potential impacts on them as well as the potential for any cumulative impacts. Necessary mitigation and management measures (chapter 9) are considered in the assessment to reduce the significance of impacts. Residual impact significance is presented.

8.1 Valued Environmental and Social Components

Based on the Project's E&S scoping report and on stakeholder meetings, the following were identified as Valued Environmental and Social Components (VESCs):

Construction phase:

- Air quality and noise
- Topography, soil and geology
- Job opportunities and impact on local communities
- Community health and safety
- Occupational health and safety
- Infrastructure utilities / Transportation
- Archaeology and cultural heritage

Operation phase:

- Air quality and noise
- Green House Gas emissions
- Water resources
- Biodiversity
- Local community
- Public health and safety
- Economy and employment
- Occupational health and safety
- Transportation

Decommissioning phase:

- Air quality and noise
- Topography, soil and geology
- Job opportunities and impact on local communities
- Community health and safety
- Occupational health and safety
- Infrastructure utilities

The impacts to these components along with impacts anticipated from unplanned events are evaluated in the following sub-sections along with the potential cumulative and residual impacts associated with the Project.

8.2 Construction Phase

8.2.1 Physical Environment

As discussed in the Project's scoping report, elements of the physical environment of concern during construction phase are limited to air quality and noise as well as topography and soil. These are discussed below.

Air Quality and Noise

During construction, the negative impact of increased levels of dust, exhaust gases and noise due to construction works is anticipated to affect the construction workers as well as the neighbouring

workers at Al Ghabawi landfill. Noise and vibration will arise from machinery operation and from on-site works and workers, whereas dust and exhaust gases (NOx, SO_2, VOCs) are expected to be generated by the following activities:

- Haulage activities
- Vehicles, machinery, and generators operations
- Materials handling
- Trenching and backfilling

Other than those, the closest facility is the Amman Strategic Reserve Terminal for Petroleum Products located at around 1.5 km south of the construction site and hence its employees and workers are not anticipated to be impacted by any increased levels of noise, dust or exhaust gas emissions.

The impacts on air quality and noise levels, though likely to occur, are considered to be site-specific, manageable and limited to construction phase. Management measures include:

- Ensuring vehicles and equipment are switched off when not in use.
- Using equipment and vehicles that are in appropriate technical conditions.
- Suppressing the scattering of dust occurring during excavation by sprinkling of water on as needed basis.
- Ensuring appropriate stockpile management (friable materials) and covering of truck loads to minimize dust generation.
- Conducting spot noise measurements to ensure to ensure compliance with Jordanian instructions for the Limitation and Control of Noise for the year 2003.

Accordingly, applying relevant mitigation measures renders the air quality and noise impacts of low consequence which results in it being of minor significance.

Topography, Geology and Soil

The construction phase will involve activities related to:

- Haulage activities
- Vehicles and machinery operations
- Materials handling
- Trenching and backfilling
- Solid waste and wastewater generation / disposal
- Chemical / fuel storage and hazardous chemical handling
- Equipment maintenance within construction site

These activities will break the top soil. However, given that the project site is already barren and it will be built into a WWTP involving buildings and paved roads, the consequence of this possible impact is considered to be negligible rendering the impact of minor significance.

Another concern is soil pollution that may result from the improper handling of the generated solid and liquid wastes, fuel and chemicals especially in case of accidental spill of chemicals/oils/fuels.

Though it is likely for such incidents to happen, they would be of medium consequence given that groundwater resources occur at very deep levels within the construction site and that no surface water resources exist. This also renders the impact of minor significance.

Still, mitigation measures to address handling of solid and liquid wastes as well as chemicals and fuels during construction phase are required as part of the Contractor's construction environmental and social management plan (CESMP). These mitigation measures include:

- Proper maintenance of machinery and vehicles.
- Ensuring immediate cleaning of any spills by having a spill response plan, to control any inadvertent leakage or spill and providing workers with proper spill response training and a spill kit for containment and clean-up of any accidental spills.
- Maintaining proper housekeeping on site.
- Collecting and segregating wastes as well as ensuring safe storage in line with legal requirements.
- Ensuring appropriate disposal of solid waste at approved disposal sites as per Solid Waste Management Regulation No. 27 of 2005.
- Ensuring proper collection and disposal of domestic wastewater generated from workers. Proper storage of domestic wastewater is in septic tanks and disposal should be at a designated WWTP in line with national requirements.

8.2.2 Biological Environment

Biological environment and biodiversity did not arise as issues of concern during the construction phase due to the following:

- The vegetation cover within and around the site is already degraded and high disturbance have been found due to proximity to AlGhabawi landfill. The recorded flora species at the proposed site are considered of common species at similar habitats in other parts of the country.
- Construction activities will be in a limited area and will not affect large number of fauna species since the area is already disturbed with no sensitive faunal species.
- The site is not located within or close to sensitive habitats (i.e., protected areas, IBAs, and rangeland reserves, priority biodiversity features, critical habitat).

However, in addition to the mentioned resident birds, Jordan is a passage for many types of migratory birds. Hence, it is possible that these birds could be at risk of being hunted by workers on the Project, especially during the migration period. Therefore, it is important to prohibit workers from hunting.

8.2.3 Socio-Economic Impacts

Employment Opportunities

Positive benefits of the Project may arise from short-term job opportunities during construction phase which is expected to last about 24 months. During the 4-month peak period during construction, an approximate 300 persons will be employed. The construction phase workforce shall comprise supervision team, project managers, engineers, specialists, Community Liaison officers (CLOs), technicians, project representatives, suppliers as well as unskilled construction workers. The

contractor will ensure that the majority of project's workers are Jordanian, with priority given to the local community for these job opportunities, should their qualification match the needed requirements.

In terms of gender issues, the job opportunities during construction are expected to be mainly limited to men due to required physical efforts and other cultural considerations. However, jobs available to local men can benefit women directly through support services such as renting homes and selling goods and products. It can also benefit women indirectly through income from the job provided for the spouse or head of the household. In addition to this, the construction phase workforce can hire women to undertake office-related activities such as engineering design, project management or administrative positions.

This is considered a short-term but positive impact during the construction period. Maximizing the benefits of this impact can be achieved by selecting staff from the surrounding local communities as much as possible or by sourcing goods and services from locals.

Potential Implications on Local Community Groups

The project area is owned by WAJ, which is a government entity as indicated in the land registration certificate (Annex 7). This land plot is almost a barren land and is unsuitable for cultivation or agriculture.

The potential impacts in relation to EBRD's Performance Requirement 5 (PR5) on Land Acquisition, Involuntary resettlement and Economic Displacement have been assessed via two main categories:

- **Physical Displacement:** No physical displacement will occur within the project area because the project will be developed inside a government land that is currently empty of any known use or residential dwellings. Moreover, this area has been designated as a strategic services area as per GAM's classification. In addition, a fence will be installed around the Project area prior to construction, which will not affect the access or mobility of any nearby activities or personnel.
- **Economic Displacement:** No economic displacement will be caused by the project as the location is currently not in any use, it does not support the livelihood of any community groups or provide any access to assets or income. In addition, and as previously emphasized the area is a government land, owned by WAJ. Therefore, there are no land ownership conflicts. As a result, the development of the project at the proposed location does not comprise any economic losses for the local community.

Accordingly, a Livelihood Restoration Plan (LRP) will not be required for this project as it is not expected to trigger physical or economic displacement and, therefore, EBRD PR 5: Land Acquisition, Involuntary Resettlement and Economic Displacement does not apply as there are no impacts associated with land acquisition, involuntary resettlement and/or economic displacement.

Community Health and Safety

Potential negative impacts to community health and safety are expected to be minimal given the following:

- the project site is currently vacant of any existing activities;
- no residential communities are present within a buffer of at least a 5 km; and
- the adjacent Al Ghabawi landfill is accessed through a separate entrance and exit that is designated only to permitted personnel.

Accordingly, no community residents, locals or vulnerable groups are expected to be directly affected by project activities. The nuisances that they may be exposed to on short-term basis during construction relate to traffic congestion at certain times and to transportation of construction materials. In case of any related nuisances or impacts, the local community will be able to file a grievance or compliant via the project's formal public grievance mechanism set out in the project-specific SEP.

Moreover, access to the site will be restricted to construction personnel, supervising engineer and project owner. As such, the potential for impacts to community members within the site is unlikely and would be of a medium consequence, which renders the potential impact as of minor significance.

Labour and Working Conditions

Common activities during construction will include hiring of site workers and personnel based on the agreed workforce plan of the contractor. Furthermore, construction activities will include but not limited to excavations, lifting, movement of heavy machinery, handling chemicals, electrical installations, building structures etc. Such activities etc. Such activities can introduce occupational health and safety (OHS) risks to workers. Other risks relating to labour and working conditions is the potential risk of child labour and forced labour.

Effective systems in line with EBRD's PR2 on Labour and Working Conditions, and good site practices in terms of site services and facilities will be designed and implemented to manage such potential risks. Such systems include incorporating applicable clauses of the EBRD Performance Requirement (2): Labour and Working Conditions into the Contract with the lead Contractor and ensuring that the selected contractor has a set of OHS policies and procedures and Human Resources (HR) policies in place that are relevant for its size and nature of its workforce and is compliant with Jordanian Labour Law and required international guidelines (i.e. EBRD).

In order to formalize such requirements, it is recommended to include requirements of having OHS Procedures and HR Policies in the tenders which will be included in the selection criteria of the Contractor. The contractor will also take reasonable steps to develop a workers' grievance mechanism to be implemented during construction to receive and follow up on worker grievances. A proposed employee/worker grievance procedure is available as part of the Project's SEP which can form a guidance for the contractor in applying the grievance mechanism.

The construction phase will be managed by the contractor and supervised by supervision engineer to ensure that such incidents do not take place. Such practice will not be limited to direct contractor staff only, it will also be applied to other employment relationships such as workers engaged by third parties and the supply chain (vendors/suppliers) that the contractor deals with.

With the implementation of an effective system, such as contracting suppliers / sub-contractors that satisfy EBRD requirements (including PR 2), it is considered unlikely to have risks associated with

labour and working conditions. Moreover, since construction duration is around 24 months, consequence is considered to be medium. This will reduce the risks of labour and working conditions throughout construction and the impact will be of minor significance.

Occupational Health and Safety

The construction activities include site preparation, earthworks, excavation and trenching, infrastructure utilities installation, building structures in addition to other physical works. As a result, potential impacts on workers' occupational health and safety are anticipated due to exposure to risks of injuries ad death through construction activities. The most frequent risks are:

- **Safety risks:** such as tripping; falling due to working at heights; working at confined spaces, potential fire due to hot work, smoking, failure in electrical installations; electric shocks.
- **Health risks and injuries:** such as lifting, lowering, pushing, pulling and carrying; temporary or hearing loss which usually comes from noise generated from machinery used for excavation or piling work and from compressors and concrete mixers etc.; heat stress and working during high temperatures; dermatitis that can arise from contact with substances that cause dermatitis such as wet cement, asphalt, solvents used in paints, glues or other surface coatings or chemicals…etc.

The Contractor will be committed to ensure all health and safety measures are in place to prevent accidents and\or reduce the consequences of non-conformance events. This is associated with the application of effective Environmental, Health and Safety (EHS) policies by the Contractor. Therefore, the contractor is expected to perform a risk assessment for construction activities and develop the occupational health and safety plan that ensures the mitigation measures are in place based. Moreover, measures will be adopted to ensure all workers during construction comply with the specified safety procedures through training, awareness and supervising in addition to the adherence to the Occupational, Health, and Safety & Environmental procedures and emergency response procedures on site and issuing relevant procedures for different types of work. A set of occupational health and safety mitigation measures are required as part of this ESIA and need to be taken into account when developing the construction environmental and social management plan and the related OHS plan.

It is worth noting that the Jordanian Labour Law No. 8 for the year 1996 and (its amendments) mentions that when an employee is stricken with one of the occupational diseases, disabilities or death due to working practices and a medical authority report is submitted stating the condition, the employer is then obliged to pay the compensation payment according to the law. Moreover, the provisions of the 'General Safety Code of Construction Projects Implementation', as part of the Jordanian National Building Law, and the fire protection code must be observed carefully by the assigned contractor. The occurrence of occupational health and safety (OHS) impacts such as death and serious injuries are considered irreversible and of critical consequence since human receptors are adversely affected. However, given that health and safety system and precautions are expected to be applied by the contractor in addition to being inspected by WAJ and the Supervision Engineer, the impact is considered likely with a high consequence, yielding a moderate impact significance.

Transportation System

During construction, light and heavy vehicles and construction equipment are expected to travel between the site and both Amman and Zarqa. As a result, traffic due to vehicle movement is expected to increase to a certain degree due to the nature of activities that will take place such as the transport of equipment and materials to and from the site through the surrounding road network. Additional traffic load will be evident at certain times during the day, especially if there are slow moving heavy vehicles transporting material to and from the site. This vehicle traffic can cause congestion on road networks around and within the site and thereby leading to potential accidents.

Traffic impacts during construction is likely to happen during the duration of construction, but is considered a short-term impact and not anticipated to cause any permanent effect on the receiving environment. Hence, the impact is likely with a low consequence which leads to it being assessed as being of minor significance.

8.2.4 Archaeological and Cultural Heritage Impacts

Based on documentation of baseline conditions, no potential archaeological sites were identified as close or available within the 1.5 km buffer zone for the Project area. Accordingly, no potential impacts are anticipated on archaeological and cultural heritage.

Though no potential impacts on cultural and archaeological resources during construction are anticipated to occur, care should be taken during excavation where if any remains or relics are observed. In case of coming across any cultural heritage or artefacts during excavation works, chance find procedure should be followed and the DoA should be notified to get the relevant expert assigned for further guidance on handling such relics while excavation work is stopped and contractor awaits instructions from DoA.

8.2.5 Impacts due to Unplanned Events and Emergencies

During Project construction phase, unplanned events relate mainly to health and safety aspects due to construction activities and movement of heavy machinery. These may vary from injury to site workers, soil pollution due to accidental oil/chemical spills, traffic accidents during movement of vehicles and machinery, fire accidents, etc. However, measures relating to emergency response plans and preparedness to address such incidents are addressed as part of the construction environmental and social plan (CESMP) under which OHS plans, traffic management plans, availability of firefighting extinguishers, etc. are required.

8.3 Operation Phase

8.3.1 Physical Environment

As discussed in the Project's scoping report, elements of the physical environment of concern during operation phase are limited to air quality, water resources, and sludge handling. These are discussed below. This section also provides below overview of the WWTP contribution to greenhouse gas (GHG) emissions.

Air Quality and Odour Nuisance

Most sewage treatment and disposal processes are a source of offensive odour. In general, ammonia (NH_3) and hydrogen sulphide (H_2S) are expected to be emitted to the ambient air from the proposed WWTP facility. It should be noted that these gases are also being contributed by the neighbouring Al Ghabawi solid waste landfill. For the Project site, the ambient air quality measurements discussed under baseline conditions (section 6.1.2) indicate that the levels of H_2S are already elevated within the Project site. The prevalent wind direction within the study area is westerly with the wind blowing from the west downwards towards the south end of the Project site. Most probably, these elevated levels of H_2S are caused by the nearby Al Ghabawi municipal solid waste landfill which implies that measures are needed to mitigate this odour nuisance to the WWTP employees during operation. Such mitigation measures are needed to ensure a suitable and nuisance free work environment especially for employees working in open space within the WWTP facility.

Given that H_2S will be generated at the proposed WWTP, the issue of odour will be of concern. The potential for odour nuisance would be from the septage discharge channel, headworks, treatment ponds, sludge digesters/thickeners as well as the sludge dewatering building and to a lesser extent from small emissions from the stabilized sludge. This odour nuisance will impact the Project workers, workers available at surrounding facilities, and nearby communities. With respect to surrounding facilities, and given that the prevailing wind direction is westerly and would blow the odour downwards towards the south-west, the facilities of Amman Strategic Reserve Terminal for Petroleum Products facilities may be impacted the odour generated from the WWTP. But since it is not known that such complaints have been received due to Al Ghabawi landfill, it is not anticipated that the odour from the WWTP will reach the Amman Strategic Reserve Terminal for Petroleum Products especially that odour control systems will be adopted.

With respect to odour nuisance to nearby communities from the WWTP, the closest local community is around 7.5 km to the west of the Project site. No residential communities were identified within a range of up to 20 km to the north and east of the Project site. Since the local communities are located at far enough distance to allow for odour dilution, and they are located opposite to the prevailing wind direction, and given the odour mitigation measures to be adopted at the WWTP, the likelihood of odour nuisance to local communities is considered unlikely and of minor significance.

With the unlikely potential for occurrence and medium consequence in case of occurrence, the impact of odour nuisance is considered to be of minor significance to the surrounding institutional facilities and local communities. However, the potential for odour nuisance is likely for the WWTP employees, which necessitates the need for adoption of mitigation and monitoring measures that address the potential for odour nuisance from Al Ghabawi landfill to the WWTP employees.

On the other hand, the Project operation has a positive impact with respect to odour nuisance at the old project site of the septic tankers receiving facility at Ain Ghazal. The operation of the Project implies that operation of the septic tankers receiving facility at Ain Ghazal will cease, and this will lead to a significant reduction in the odour problem the Ain Ghazal septic tankers receiving facility.

With respect to emission of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), the WWTP will be connected to the national electricity grid and therefore will not be burning diesel on site and

thus will not be emitting these gases directly onsite. As for the septic tankers, their exhaust emissions will be reduced by having the tankers switch their engines off and by the fact that the facility is designed to limit queuing of the tankers. Moreover, the WWTP is located next to a solid waste landfill site which is a greater source of emission for those gases. As per overview presented below on Green House Gas Emissions, the GHG contribution by the proposed WWTP will be minimal compared to Al Ghabawi solid waste landfill.

Green House Gas Emissions

According to EIB Project Carbon Footprint Methodologies (2018), municipal WWTP are among projects that will not require GHG assessment. However, as an overview, the Project's contribution to GHG emissions is anticipated from processes related to the anaerobic ponds, the sludge drying, and the emissions resulting from the traveling distance of the septage tankers. Major GHG contributed directly by WWTPs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The indirect emissions of GHG result from energy generated to be used by the WWTP. Jordan's contribution to GHG emissions as Gigagrams (Gg) of CO_2eq for the years 2010 and 2012 based on Jordan's Biennial Updated Report (2017) for different sectors are summarized in Table 8.1. These contributions presented by Jordan's Biennial Updated Report (BUR) to the UNFCCC (2017) show that WWTPs contribute less than 1% of the national GHG emissions.

Table 8.1. Jordan's contribution to GHG production for years 2010 and 2012 (source: UNDP, 2017)

Sector	2010		2012	
	Giga Grams of CO_2eq	Percentage from Total Emissions	Giga Grams of CO_2eq	Percentage from Total Emissions
Country Level	23,140.0	100.00	27,997.0	100.00
Energy	19,410.9	83.90	22,756.8	81.30
Industrial Processes	1,982.0	8.60	3,368.5	12.00
Agriculture, Forestry and other land uses (including livestock)	180.5	0.80	237.3	0.90
Waste Sector	1,567.5	6.70	1,635.1	5.80
Solid Waste Disposal	*1,391.8*	*6.00*	*1,488.1*	*5.30*
Incineration and Open Burning	*4.0*	*0.02*	*4.7*	*0.02*
Wastewater Treatment and Discharge	*171.7*	*0.68*	*142.4*	*0.48*

On the other hand, an estimation of the GHG emissions associated with the operation of the WWTP and its electricity consumption were carried based on EIB calculation methods (EIB, 2018). For a WWTP, sources of GHG emission by type include (EIB, 2018):

- CH_4 from degradation of organic material in the wastewater under anaerobic conditions.
- CO_2 emissions from the consumption of electricity in the treatment process.
- N_2O as an intermediate product from the degradation of nitrogen components in the wastewater.

For an estimation of GHG estimation by the WWTP (for scope 1 and 2)[4], the emissions factors provided by EIB (2018) for wastewater and sludge treatment are used. These emission factors depend upon the waste water and sludge treatment method and have been calculated by the EIB based on the IPCC 2006 Good Practice Guide. Using EIB (2018) estimation approach, a comparison of greenhouse gas emissions (GHG) was carried out between the two cases of:

- having the septage transported by tankers to Ain Ghazal (AGTP) receiving facility for the subsequent conveyance by pipeline and treatment at As-Samra wastewater treatment plan (WWTP); and
- having the septage transported for treatment at the proposed Ghabawi WWTP.

This comparison was based upon the following:

- **GHG due to transportation of the septage by tankers** to AGTP or to Ghabawi WWTP. Transportation is not anticipated to have a significant change in GHG emissions between to the two locations of AGTP and Al Ghabawi. Although the travel distance will increase for transferring the septage to Al Ghabawi from some households, the travel distance will decrease for transporting the septage from other households. Accordingly, we can assume that the difference in GHG emission for the transport of septage to either location will not be significant.
- **GHG due to wastewater treatment**:
  - At AGTP: Since no treatment of the septage occurs at AGTP as the septage is treated at As-Samra WWTP, it is assumed that no GHG emissions would occur at AGTP due to wastewater treatment and all GHG emissions will be generated from septage treatment at As-Samra WWTP. At As-Samra, the wastewater treatment is aerobic wastewater treatment, with anaerobic digestion of the sludge.
  - At Ghabawi: the wastewater treatment is considered to be aerobic wastewater treatment without anaerobic digestion of the sludge.

  For an estimation of GHG estimation by the WWTP (for scope 1 and 2), the emissions factors provided by EIB (2018) for wastewater and sludge treatment are used. These emission factors depend upon the waste water and sludge treatment method and have been calculated by the EIB based on the IPCC 2006 Good Practice Guide. As per the default emissions calculation methodology #7 included in Annex 1 of EIB (2018), the following calculation methods were used:

  For Ghabawi WWTP: **CO_{2e} (t/y) = PE * 0.10**
  For As-Samra WWTP: **CO_{2e} (t/y) = PE * 0.06**

  where, PE is population equivalent, and 1 PE equals 54 grams of BOD per 24 hours.

[4] As per EIB (2018):
Scope 1: Direct GHG emissions. Direct GHG emissions physically occur from sources that are operated by the project. For example, emissions produced by the combustion of fossil fuels, by industrial processes and by fugitive emissions, such as refrigerants or methane leakage.
Scope 2: Indirect GHG emissions. It accounts for indirect GHG emissions associated with energy consumption (electricity, heating, cooling and steam) consumed but not produced by the project. These are included because the project has direct control over energy consumption, for example by improving it with energy efficiency measures or switching to consume electricity from renewable sources.

- **GHG due to power consumption**:
  - **Power consumed at AGTP Receiving Facility:** This power is supplied from electricity grid via 4 stepdown transformers. For year 2019, the average monthly consumption is 167 MWh/month.
  - **Power consumed by the wastewater conveyor pipeline from AGTP to As-Samra WWTP:** The wastewater is transferred from AGTP receiving facility to As-Samra WWTP by gravity without a need for pumping processes. The power consumed is for the service of isolation valves stations, cathode protection stations, tunnel's lighting…etc. and is around 1500 KWh/month supplied from the gird by separate stepdown transformers located at each station along the pipeline.
  - **Power consumed at As-Samra WWTP:** As-Samra WWTP consumes around 222,734.1 kw/day (average of 2017, 2018, and 2019). Around 20% of the power is from the national grid and 80% is from renewable energy. The 80% is further broken down as follows: around 20% of the energy comes from the 2 inlet turbines, around 20% of the energy comes from the 3 outlet turbines, and around 60% is generated from bio gas.
  - **Power estimated for Ghabawi WWTP:** Ghabawi WWTP will consume 63,000 kw/day (2020). All the power will be purchased from the national grid.

The CO_2 equivalent due to power consumption is estimated as:

CO_2 (t) = Energy use * Country Specific Emissions Factor for Electricity Consumption

Where, Emissions Factor for hydropower: 0 (t CO_2/GWh)
Emissions Factor for engine combustion using natural gas: 457 t CO_2/GWh = 457 g CO_2/kWh
Country Specific Emissions Factor for electricity grid for Jordan: 706 g CO_2/kWh

Given the above, the Population Equivalent for the wastewater received by the WWTPs, the WWTPs electricity consumption from the grid, the estimated CO_2e (tonnes/year) are presented in Table 8.2.

As per the results presented in Table 8.2, the GHG emissions associated with scope 1 and scope 2 emissions of the proposed Ghabawi WWTP are around 99,889 CO_2e tonnes/year in 2020. The majority of the emissions (around 84%) is attributed to the treatment process, and a smaller percentage (around 14%) is attributed to energy consumption from the grid. Comparing these GHG emissions of Ghabawi WWTP and those of the septage receiving at AGTP and subsequent treatment at As-Samra WWTP show an increase of around 42,567 CO_2e tonnes/year. This increase implies that the treatment of the septage at Ghabawi WWTP will increase GHG emissions by around 74% compared to the current practice of receiving it at AGTP and its subsequent treatment at As-Samra WWTP. Moreover, since the estimation exceeds the 25K CO_2e tonnes/year limit indicated by EBRD's PR3, the WWTP operator will have to conduct an annual quantification of these emissions in accordance with EBRD Methodology for Assessment of Greenhouse Gas Emissions. The GHG assessment needs to include all direct emissions from the facilities, activities and operations that are part of the Project, as well as indirect emissions associated with consumption of electricity from the national grid by the Project. This quantification of GHG emissions should be reported to the EBRD.

Table 8.2. Estimation of the WWTP GHG emissions

Source of GHG emission	Unit	Ghabawi WWTP (2020 estimates)	As-Samra WWTP total estimated emissions (based on average of 2017, 2018, 2019)	Estimated GHG emission at As-Samra WWTP due to septage received by tankers at AGTP
Emission due to transportation of Septage by tankers	-	The difference in GHG emission due is assumed to be insignificant.		
Total Consumed Power by the WWTP	KWh/day	63,000.0	222,734.6	-
Power consumed at AGTP Pre-Treatment Facility	KWh/month	-	167,000.0	-
Power consumed by the conveyor Pipeline from AGTP to As-Samra WWTP	KWh/month	-	1,500.0	-
Scope 1 emissions				
Septage quantity transported by tankers	m^3/day	16,731.0	329,763.3	-
BOD_5	g/m^3	2,700.0	591.1	-
Total Population Equivalent to be served by the WWTP based on BOD_5 of wastewater and (1 PE = 54 g BOD/day)	PE	836,550.0	3,609,686.8	836,550.0
Percentage of PE of As-Samra attributed to septage received at AGTP	%	-	-	23.2
GHG Emissions from WWT process: i) Ghabawi: CO2e (tonnes/year) = Pop. Eq. * 0.10 ii) As-Samra: CO2e (tonnes/year) = Pop. Eq. * 0.06	tonnes/year	83,655.0	216,581.2	50,193.0
Consumed Power generated within the WWTP: i) Ghabawi: None. ii) As-Samra: 48% from bio gas.	KWh/day	0.0	106,912.6	24,777.1
Power consumption Emission Factors	g CO_2/kWh	-	Bio gas: 457	-
GHG emission as CO_{2e} due to power generated within the WWTP: i) Ghabawi: None. ii) As-Samra WWTP: (106,912.6*457*10-6) *365	tonnes/year	0.0	17,833.6	4,133.0

Source of GHG emission	Unit	Ghabawi WWTP (2020 estimates)	As-Samra WWTP total estimated emissions (based on average of 2017, 2018, 2019)	Estimated GHG emission at As-Samra WWTP due to septage received by tankers at AGTP
Scope 2 emissions				
Power Consumption from the Grid: i) Ghabawi: 100% from the national grid => (63,000*365*706*10^{-6})	KWh/day	63,000.0	-	-
ii) As-Samra WWTP: 20% from the national grid.		-	44,546.9	10,323.8
iii) AGTP Pre-Treatment Facility.		-	(167,000.0/30)= 5,566.7	38,702.5
iv) Conveyor Pipeline from AGTP to As-Samra WWTP.		-	(1,500.0/30)/30= 50.0	347.6
Power consumption Emission Factors	g CO_2/kWh	706.00	Grid: 706	-
Power Consumption from the grid as CO_2e: i) Ghabawi: (63,000*365*706*10^{-6})	tonnes /year	16,234.0	-	-
ii) As-Samra: (44,546.9*706*10^{-6})*365		-	11,479.3	2,660.3
iii) AGTP Pre-Treatment Facility: (5,566.7*706*10-6)*365		-	1,434.5	9,973.2
iv) Conveyor Pipeline from AGTP to As-Samra WWTP: (50*706*10-6)*365		-	12.9	89.6
Total of Scope 1 and 2 emissions				
Total Emissions as CO_2e	tonnes/year	99,889.0	247,341.4	57,321.7
Percentage Contribution by WWTP process	%	83.7	87.6	87.6
Percentage Contribution by electricity consumption	%	16.3	12.4	12.4

* Assumed that the quantity of electricity consumed is proportional to the ratio of population equivalent, which is 23.2%. That is, using the percentage of PE to be transferred to Gahabwi and multiplying it by the total energy consumption of As-Samra WWTP.

Water Resources

From the information included in section 6.1.5, the risk to groundwater resources within the Project area is considered to be low as the WWTP facility is designed so as is to prevent influent getting into contact with bare soil. Moreover, there is no shallow groundwater present in the project area and groundwater resources within the Project area occur within aquifers at very deep levels. Accordingly, any effluent will flow for a short distance within the Muwaqqar Chalk-Marl formation, which is an aquitard (B3). The first aquifer system expected to be encountered is the B2/A7 which is separated from the surface by an aquitard (B3) of low vertical permeability. Though any groundwater pollution is considered to be of high significance, the possibility for occurrence of groundwater pollution is considered unlikely, rendering it as a minor significance impact. Still, it is required to implement groundwater quality monitoring from an existing well that is nearest to the Project site in order to ensure the protection of groundwater sources. Table 6.6 provides a list of available wells within a 6 km radius around the Project location.

On the other hand, the treated effluent will have the positive impact of enhancing irrigation water supply within the Project study area. As discussed in section 3.2 of this ESIA, the default option for this stage of the Project is discharge into the nearby wadi. This discharge has not been related to potential environmental or social impacts because the treated effluent will meet the required standards for discharge into wadis (less stringent that Class A irrigation water to which the influent will be treated) and most of the water is expected to evaporate before eventually reaching the Zarqa river or infiltrating into groundwater resources.

Sludge Handling

The sludge will be thickened, dewatered and dried. The dried sludge will be stored onsite over a period of 7 years. This sludge treatment will result in stabilized sludge that does not cause insect breeding, or act as source of pathogens as well as reduce odour. Accordingly, under proper O&M procedures, the stabilized sludge is unlikely to be a source of odour nuisance, fly or insect breeding, or pathogens. Moreover, the consequence of any odour potential is low since it will be confined to vicinity of the stockpiling area which renders this impact of minor to negligible significance. Still, monitoring measures for sludge stockpiling are required to ensure it will not become a source of nuisance.

As discussed before, the sludge will be mechanically dewatered to reduce the sludge volume and increase its dryness to around 22% dry matter content. This will be followed by greenhouse drying technology to further dry the dewatered sludge up to 50% dry matter content, which will greatly reduce the sludge volume. Still, the current approach of onsite stockpiling is temporary. A long-term national strategy in terms of sludge management is required. This may include disposal into Al Ghabawi solid waste landfill or may require investing in new incineration facilities, new landfills, or even changes in legislations so that the generated sludge can be used as fertilizers. These long-term management options necessitate investment in a long-term strategy at the national level.

Climate Change Risks

In general, climate change may impact WWTPs efficiency due to changes in climate factors such as extreme temperatures, precipitation and floods. In general, anticipated increases in ambient temperatures can potentially improve the performance of water treatment plants (WERF, 2009). However, the increase in temperature also increases the potential for hydrogen sulfide odour

problems as well as reduces dissolved oxygen and alters concertation of water quality parameters, potentially increasing power requirements to operate aeration equipment (WERF, 2009).

Another implication of climate change on WWTPs is the increased risk of flood damage to facilities. Wastewater facilities are typically sited in low-lying areas within watersheds, which creates vulnerability to flooding (WERF, 2009).

For this Project, considering the potential implications of climate change on WWTPs, the assessment of the most climate resilient option for wastewater treatment for an area where annual temperature and evapotranspiration are expected to increase and rainfall to decrease, revealed that activated sludge, despite its high energy requirement, is the most climate resilient wastewater treatment option (Adonadaga, 2014). The potential climate change risks/challenges foreseen for the proposed WWTP at Al Ghabawi include:

- **Increased flood and risk of damage to WWTP facilities:** However, no such threat exists within the Project site since the catchment area from which the flood would be generated is the land area of the WWTP itself. Given that precipitation level at the WWTP location is low and the catchment area is small, the generated flash floods are considered very low and do not pose a threat of asset damage to the facilities of the WWTP.
- **Potential for changes in water demand:** Implication of rising temperature on the per capita water demand during heat waves usually increases water consumption and consequently affects the WWTP capacity. However, given that per capita water availability in Jordan is limited and that precipitation is anticipated to decrease, potential for increase in per capita water consumption is unlikely.
- **Potential for challenges to treatment process due to increase in temperature:**
  - Implication of change in temperature on the operation of the WWTP. However, this will be a positive implication since a rise in temperature will have a positive impact on the efficiency of conventional activated sludge treatment. The anticipated increase in temperature will increase fermentation, which implies enhanced biodegradation at the sludge digestion.
  - Implication of rising temperature on increased generation of hydrogen sulphide. With higher temperatures, the potential for hydrogen sulphide generation will most likely increase. However, as the wastewater is septage that was kept in underground septic tanks, the potential for increased odour generation due to increase in temperature is considered to be low. This remains to be of low concern at the WWTP headworks as well as the sludge drying beds.
  - Implication of change in temperature on sludge dewatering. However, anticipated increase in temperature will enhance drying of sludge.
- **Implications of increase in energy prices:** The likelihood of future intensification of energy price shocks to raise the operating cost of WWTPs especially those adopting biological-mechanical treatment processes. Moreover, as the septage is transported to the WWTP via tankers, the increase in energy prices may encourage illegal dumping of the septage by the wastewater tanker's drivers to save on their cost of transportation.

A vulnerability analysis of the Project was carried out to determine any needed climate change adaptation needs. The assessment and the prioritization of the impacts depended on determining the impact significance in terms of likelihood of occurrence and consequence (in terms of threshold of challenge level) on the Project as presented in Table 20.

For the Project's climate resilience, adaptation measures to reduce vulnerability over the lifetime of the project and the remaining risks with respect to critical climate hazards were identified for challenges assessed to be of moderate to major significance. As per Table 20, the majority of the

potential impacts posed by climate change on the planned WWTP are either positive or of negligible significance. Only three issues were considered of minor to major significance and these include:

- Minor significance challenge of potential increase in odour caused by enhanced generation of hydrogen sulphide at the headworks and hydrogen sulphide at the sludge dewatering due to increased temperatures.
- Minor significance challenge of increase in WWTP operating cost due to energy price shocks.
- Major significance challenge of potential increase in illegal dumping of transported septage due to the increase in fuel price and consequently increase in transportation cost.

These impacts are expected to arise gradually over time, which provides an opportunity to have the adaptative response as part of the routine rehabilitation/replacement cycles rather than identifying them as additional capital demands (WERF, 2009). Accordingly, the adaptation measures identified with the technical assessment team were operational based measures and include:

- **Proper operation and maintenance (O&M) of the WWTP odour control system:** The proposed odour control system is designed to meet the current conditions over the lifetime of the project (i.e., year 2045). The potential increase in temperature is not anticipated to significantly increase odour generation due the fact that the WWTP will receive septage that was stored in septic tanks below ground level and has limited potential for further emitting hydrogen sulphide. Moreover, the capacity of the odour control system can be increased on a need basis.
- **Monitoring of the movement of wastewater tankers**: The transportation of wastewater by tankers is already being monitored as part of the Ministry of Environment's (MoEnv) Online Tracking System for Wastewater Tankers. Any illegal dumping of septage by the wastewater tankers will be detected by MoEnv and, hence, the challenge is considered to be under control.

Table 8.3. The Project's vulnerability assessment to climate change

Project Components and Related Activities (Where?)	Potential Threat(s) due to Climate Change (How and Why?)	Significance			Risk Characterization (Tangible/Intangible)
		Likelihood	Consequence	Significance	
Preliminary Treatment					
Influent septage quantity	Potential increase in influent septage into the WWTP due to increase in per capita water consumption during heat waves. However, given that per capita water availability in Jordan is limited and that precipitation is anticipated to decrease, potential for increase in per capita water consumption is considered unlikely.	Unlikely	Low	Negligible	-
Sand and rock traps and screening Aerated grit and FOG removal	Potential threat of damage due to flash floods. However, the catchment area from which the flood would be generated is the land area of the WWTP itself. Given that precipitation level is low and the catchment area is small, the generated flash floods are considered negligible. Thus, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
Odour control units	With higher temperatures, the potential for hydrogen sulphide generation will most likely increase and consequently increase the odour problem. However, as the wastewater is septage that is kept in underground septic tanks and transported to the WWTP in closed tankers, the potential increase in generated odour due to increase in ambient temperature is anticipated to be low.	Possible	Low	Minor	-
Primary Treatment					
Equalization tank Primary settling tanks	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
Secondary Treatment - Conventional Activated Sludge					
Aeration tank, and Anoxic Tanks	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
	Increased temperature would accelerate the reaction thus increase treatment capacity at the aeration and anoxic tanks.	Likely	Positive	Positive	-
Secondary settling tank	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
Tertiary Treatment					
	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-

Project Components and Related Activities (Where?)	Potential Threat(s) due to Climate Change (How and Why?)	Significance			Risk Characterization (Tangible/Intangible)
		Likelihood	Consequence	Significance	
Slow Sand Filters as rectangular sand beds	Potential increase in temperature enhances microbiological activity and hence enhances filtration.	Likely	Positive	Positive	-
Chlorination via chlorine gas injection	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
Effluent Reuse Tank	Potential threat of damage due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
Sludge Treatment					
Gravity thickened aerobic digester	Potential increase in temperature would increase the digestion.	Possible	Positive	Positive	-
Sludge Dewatering using centrifuges	Increased temperature may increase odour problems due to increased fermentation.	Possible	Low	Minor	-
Greenhouse Sludge Drying Beds	Potential threat of damage due to flash floods. But as discussed before, flash floods are likely to be generated, but will be negligible.	Likely	Negligible	Negligible	-
	Increased temperature would increase drying of sludge.	Possible	Positive	Positive	-
Onsite stockpiling	Potential threat on stockpiled sludge due to flash floods. As discussed before, flash floods are likely to be generated, but will be negligible.	Unlikely	Low	Negligible	-
	The anticipated decrease in precipitation and increase in temperature are not anticipated to impact stockpiled dried sludge.	Unlikely	Negligible	Negligible	-
Related Activities					
Treated effluent reuse	Wastewater reuse will become more necessary as climate change accelerates and water scarcity aggravates.	Possible	Positive	Positive	-
ENERGY cost for WWTP operation	Future energy price shocks are likely to occur and raise WWTP operating cost. However, climate change is not the only factor affecting energy prices and hence potential impact due to climate change is of medium effect.	Likely	Medium	Minor	-
Septage tankers traffic movement	Potential increase in fuel price would increase the cost of transportation and consequently increase the potential for illegal dumping.	Possible	High	Major	Tangible

8.3.2 Biological Environment

During operation phase, the site will have open wastewater tanks that may attract some faunal species such as mammals and birds. Although these ponds may act as a man-made habitat for waterbirds and a source of food, pathogens and pollutants may also negatively affect mammals and birds. The occurrence of this impact is possible, however, with a low consequence given low prevalence of bird species and mammals in the area which renders it of minor significance and can be mitigated by fencing the site and using proper means to prevent waterfowls from landing on open influent wastewater tanks. In addition, hunting by the Project workers should be prohibited.

8.3.3 Socio-Economic Impacts

Local Community Perceptions

Throughout the stakeholder engagement process, local stakeholders (primarily those residing closest to the project area in East Amman) expressed some concerns from the operation of this Project as summarised in section 7 of this ESIA (more details are included as part of the Stakeholder Engagement Plan (SEP) prepared for this project). They stated that their concerns stem from the fact that previous projects / facilities in the East Amman area did not sufficiently integrate the local community into their projects. They have concerns from the potential escalation of public health issues in the area due to potential pollution from several project facilities. The ESIA team together with MWI/ WAJ conducted stakeholder engagement meetings to understand the local community concerns that are related specifically to this project, in addition to managing their expectations and concerns to what can be done to protect their well-being within the Project's scope and feasibility.

The project design and ESIA phases, including the preparation of the SEP, have taken applicable measures to address the local community's concerns to reduce any potential impacts that would affect stakeholders' perceptions to the project. It is worth mentioning that the WWTP design parameters have taken into account advanced sludge treatment technologies to minimize odour and ensure best practice for environmental protection, furthermore, flood protection and groundwater protection measures have been integrated into the design. Concerns from the treated effluent are expected to be minimal as it will comply with Jordanian standards which requires the treated wastewater to be suitable to irrigate non-cooked vegetables, consequently, locals or any other entity can potentially benefit from.

Traffic safety measures are introduced in the ESIA to minimize any potential impacts to local residents travelling throughout the road network.

The SEP also include measures to engage the local community throughout project phases giving them the chance to file grievances and voice out their concerns through multiple formalized channels, which is backed-up by appointing a Community Liaison Officer during operation as well to manage this process.

As local community concerns have been addressed, it is expected that additional concerns are unlikely to occur, however, if occurred, they will have a high consequence and will need further management. Although the overall impact significance is assessed as minor; this still necessitates appropriate management measures to be implemented during the operation phase to allow the local community

to file complaints through a formalized grievance mechanism, in addition to enforcing the mitigation measures set-out in the ESIA to minimize potential environmental impacts.

It is the responsibility of the operator during the operation phase to implement social responsibility initiatives in line with WAJ social responsibility strategy. The detailed activities shall be coordinated between WAJ and the operator at a later stage.

Community Health and Safety

During the operation phase, the main personnel expected to be within the direct vicinity of the Project operations are the project operator team, project owner team and tanker drivers. Moreover, the site will be fenced and appropriate security measures applied to restrict entry to the site for unauthorized individuals. The entry and exit of any personnel in addition to the tanker drivers will be controlled as part of enforcing the health and safety procedures on site to avoid safety hazards during the septage discharge into the septic tank facility. Though health and safety concerns are of high consequence, it is unlikely that members of local community would be exposed to health and safety risks from the WWTP operations due to the distance of such communities as the closest community is located more than 5 km away resulting in an overall impact of minor significance.

Still, the household survey revealed that 78% of the respondents in the household survey (who are available at distances exceeding 7.5 km from the Project site) have concerns over the Project negatively impacting their family's health. These concerns were related to increased odours in the atmosphere leading to reduced quality of life and to chronic health conditions to the respiratory system, skin, and even cancer. Therefore, the presence of effective and transparent accountability mechanisms, particularly on the issues of environmental pollution and possible health impacts, were viewed crucial elements for increasing community confidence toward the environmental and social commitment of the Project.

Livelihood and Employment Opportunities

The household survey revealed that the local community perception is that job creation as a result of the Project is limited. The scarcity of economic opportunities in the area, according to the residents, make jobs which are locally available attractive opportunities for young men and women. Based on the household survey, only 29% of respondents expect the Project to have a positive impact on their families' livelihoods. These expectations were associated with job creation. Respondents associated these potential benefits with a commitment by WAJ to provide the job opportunities at the Project to local residents and to future potential benefits in using treated wastewater to support agricultural activities and allowing land use for cultivating fodder crops. On job opportunities, the local community believe the Project would have a meaningful impact if the local community were to occupy technical and professional vacancies.

With respect to the future potential benefit of providing the treated effluent for use by the local community, this was perceived as one measure to mitigate the impact of the Project on their livelihoods. Still, awareness needs to be raised regarding the permitted and safe use of the treated effluent.

Still, 44% of respondents expect a negative impact of some degree to local livelihoods especially to livestock-related livelihoods. One reason was the potential impact of pollution on the wellbeing of the livestock.

Overall, the long-term operation of the Project will provide specialized employment and training for a small workforce (up to 30 people including project manager, engineers, operators, technicians, administrative personnel, drivers and labourers) to be hired as part of the operation and maintenance team. This potential for employment is assessed as a positive impact. However, and as perceived by the local community, these opportunities are limited in number and require people with certain technical qualifications. Therefore, to manage local community expectations and to maximize the benefit from this impact, the operator will ensure that any needed qualifications available within the local community will be hired in the project should the qualifications match.

Affordability of Communities Potentially to-be-Served

A concern associated with the Project operation is the concern for the ability of users to pay the septage transportation fees. Since the project will serve unsewered areas in Amman and Zarqa, the Project's draft preliminary feasibility report (dated December 2019) assessed the affordability of households within Amman and Zarqa governorates. As per EBRD's general framework of affordability analysis, affordability is the share of monthly household income/expenditure spent on utility bills. It is the actual financial ability of households to pay for utility services. The affordability assessment focused on several variables to determine affordability of tariffs, among these are:

- Income of households
- Level of consumption
- Tariffs
- Collection rates
- Inflation
- Income growth

Affordability ratios were calculated by dividing household utility expenditure by the total household expenditure (or by total income where data is unavailable). Utility bills are considered "unaffordable" when they exceed the pre-set threshold, which in the context of this project is 5% for water and wastewater.

To carry out the assessment, the feasibility study conducted for the project agreed on several assumptions with EBRD, which include:

- Size of the household;
- Tariffs and average consumption per household;
- Average household expenditure; and
- Inflation.

The affordability analysis concluded the following:

- **Affordability in Amman:** The combined water and sewer bills in Amman account to ca. 1.6%

of the total annual household expenditure. On the other hand, it accounts to ca. 4.7% of the total annual household expenditure for the lowest decile. Both of which are below the affordability threshold of 5%, which indicates that utility bills are affordable.

- **Affordability in Zarqa:** In Zarqa governorate, the combined water and sewer bills account to ca. 2.4% of the total annual household expenditure. While, it accounts to ca. 4.4% of the total annual household expenditure for the lowest decile. Both of which are below the affordability threshold of 5%, which indicates that utility bills are affordable.

Based on the above conclusion where utility bills are affordable within both Amman and Zarqa governorates, and the concern for ability to pay will not arise implying no impact with respect to affordability. It is worth mentioning that the proposed project may cause a two-way effect; where some households served by the project will witness an increase in transportation cost due to a longer distance travelled from the tankers transporting the septage as a result of the new project location compared to AGTP, on the other hand other households end up being closer to the project location, and will witness a decrease in transportation costs.

Occupational Health and Safety

During the household survey, the respondents indicated that the work environment will pose possible risks to the workforce. Therefore, the respondents expressed concern that the Project requires strict health and safety measures to protect workers from adverse short and long-term health impacts.

In fact, the operation and maintenance of the wastewater treatment plant will involve a range of activities that are potentially unsafe for workers. The specific hazards associated with working in at the WWTP can be categorized into physical, chemical, and biological hazards. The result of an encounter with these hazards can often be immediate, severe, and irreversible, even fatal. The potential impacts for each category are presented in Table 8.4.

Table 8.4.Hazard categories and potential impacts during construction and operation

Hazards	Potential Impacts
Physical Hazards	**Entry and work at Confined Space** - Potential of serious injury or death due to decreased oxygen levels. - Potential damage to living tissue, the central nervous system, severe illness, or even death due the presence of toxic gases (i.e., H_2S) - Potential of drowning, suffocation, burns and other injuries due to liquids or solids flowing into the confined space. - Increased risks of heat stroke or collapse from heat stress. **Working with inadvertent energizing of machines or machine parts** - Exposure to an electric shock or create an arcing fault that results in an arc flash. - Cuts and pricks by sharp tools sharp edges of articles to be plated sharp deposits on jigs, etc. **Slipping and falling curing the working activities** - Falls into ponds, pits, clarifiers or tanks causing injuries or drowning. - Blows and contusions caused by falling heavy articles, including containers of chemical reagents, e.g., from overhead conveyors, or by contact with moving machinery or vehicles.
Chemical Hazards	- Chronic poisoning by inhalation or ingestion of many of the chemicals used in the treatment plant such as chlorine. - Dermatoses caused by exposure of the skin to the septic, cleaning formulations, acid, and alkaline solutions, etc. - Irritation of mucous membranes (in particular of the respiratory tract) by acid or alkaline vapors or aerosols, by hydrogen sulfide, and other substances. - Latex allergy caused by the use of latex gloves
Biological Hazards	- Diseases caused by infectious agents (bacteria, viruses, protozoa, helminths and fungi present in the raw wastewater). - Diseases caused by contact with the toxins released by the infectious Agents. - Diseases caused by insects or rodents proliferating in the sludge during the sludge greenhouse drying process.

The prevention of occupational accidents on-site and the harmful health impacts in its vicinity requires the operator to undertake compliance and monitoring measures in line with the requirements of Jordanian and international health and safety laws and guidelines during the operation phase. If control measures are not correctly applied, the impacts can be severe. Therefore, it is essential to ensure that the operation and maintenance personnel operating the facility and carrying out the regular technical checks are made aware of potential health effects that could occur on site. This can be done through proper training and capacity building on handling potential site emergencies and dangers. Given that WAJ's operator (Miyahuna) has an existing OHS policy, adherence to the OHS policy and the health and safety procedures on site during O&M activities will significantly reduce the potential for occupational health and safety impacts on workers. However, OHS risks remain likely to occur with a high consequence which renders the impact of major significance.

Transfer of Skills

This project is anticipated to have benefits to society since it will contribute to transfer of skills in wastewater treatment technologies to operator staff as well as project owner. This impact is assessed as positive.

Infrastructure Improvement

The operation of the proposed Project is expected to solve an existing infrastructure issue that has been present at AGTP, thereby minimizing the current load and operational burden, and improving wastewater treatment capacity. Thus, it is considered to be a positive impact in terms of infrastructure services since it will help in maintaining better sanitation and living conditions for served communities as well as enhanced environmental protection in the served area. Not to mention that the project may potentially serve more households.

However, and as illustrated in Figure 8.1, the local community held varying expectations to the impact of the Project on infrastructure in the area. Only around one third of the respondents in the household survey believed the Project could potentially bring about an improvement in infrastructure and public services in the area. The expectations of positive impacts were based on the expectation that these developments are likely to result in increased spending on infrastructure services in the area such as utilities, a wastewater networks, better roads and maintenance, and higher monitoring of environmental penalties.

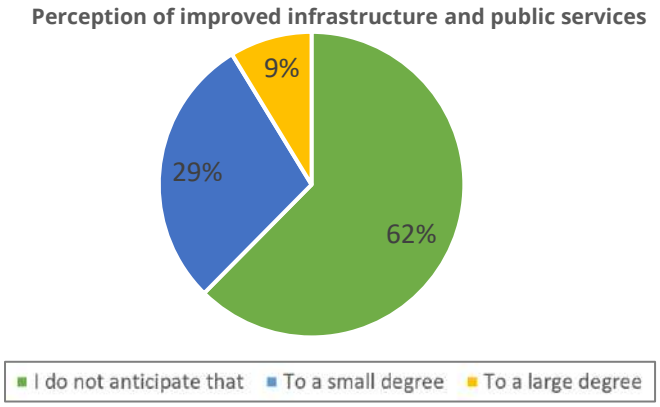


Figure 8.1. Local community perception of the Project impact on local infrastructure (Source: Household Survey, 2020)

Transportation

During operation phase, risks are anticipated from transportation activities and to the transportation system due to the trips to be carried by the hauling trucks and septic tankers. The risk anticipated from the transportation activities by the hauling trucks and septic tankers relate to the illegal dumping of septage. This issue is of concern now during operations at AGTP and is expected to be of concern during the operation of Al Ghabawi WWTP. The travelling distance for the tankers coming from Zarqa Governorate to Al Gabawi WWTP will be reduced. However, the traveling distance will increase for the tankers coming from Amman Governorate. It is anticipated that with the increase in traveling distance, the potential for illegal dumping of the transported septage will increase as well. This issue of illegal

dumping by septic tankers is being monitored by MoEnv Online Tracking System for Wastewater Tankers. which was found to be applicable for this project where tankers can be equipped with tracking devices to monitor their location as the system will send notifications when a septic tanker's valve has been opened for the disposal of wastewater if it is at an undesignated site. Information of tanker owners and drivers involved in the project will be added into MoEnv's existing database Where Information of their location and route are entered to be tracked and undergo review for any violations i.e. illegal dumping. MoEnv requires that all licensed septic tankers to have a GPS monitoring device and MoEnv monitors their movement online.

Still, the illegal dumping is likely to occur and is of high consequence making the risk of moderate significance and emphasizes the importance of the Online Tracking System of wastewater tankers adopted by MoEnv.

On the other hand, risk to the transportation system is anticipated due to the expected increase in traffic loads especially from hauling trucks and septic tankers during operation. This risk is also perceived by the local community where around 66% of the surveyed households perceived that the Project will lead to negative impact on traffic in the area and the state of roads. They believe that the daily septic tankers traffic to Al Ghabawi, if passing near residential areas, will pose risks to the safety of children in particular and to other commuters in the area. There are worries about the tankers' overflow or leakage to cause slippage on the roads, similar to the concerns raised by the current traffic to Al Ghabawi municipal landfill, which is resulting in spread of litter in the area along the route. Local community are to be encouraged to report any noticed incidents on septic tankers leakage using the Project grievance mechanism.

A traffic assessment was undertaken describing the trip generation and trip distribution of Al Ghabawi Wastewater Facility. Previously, under baseline conditions (section 6.3.7) the basic parameters regarding existing conditions and current and future non-site traffic were determined. Below, the core traffic analysis is done. It starts by presenting the amount of generated traffic, trips distribution, and a general review of the site's traffic circulation and access points, after which the impact on the surrounding road network is presented.

Trip Generation

The description of the trip generation of Al Ghabawi Wastewater Facility demonstrates the amount of generated traffic and the projected number of trips that are expected to access the facility in 2030. Trips generated by the project are those that would not have taken place had the project not been in place.

During operation of the facility, workers' light vehicles in addition to around 920 sludge hauling trucks trips are expected to travel daily between the site and both Amman and Zarqa. Yet, the projected number of trips is expected to increase gradually to reach 1250 daily trips in the year 2045.

The estimation of the amount of generated traffic was done using the average monthly trips to Ain Ghazal in 2018. By assuming that the average monthly daily flow is directly proportional to the average monthly trips, increasing trips by the same proportion as quantities produce the amount of generated traffic.

Regarding future traffic projections, the expected number of trips in the year 2045 was determined using an equivalent growth factor of 1.4%. Table 8.5 shows the daily trips to Ain Ghazal and Al-Ghabawi Wastewater Facility.

Table 8.5. Expected amount of generated traffic

Item	Monthly Quantity	Daily Trips
Trips to Ain Ghazal (2018, assuming 11,315 m^3/day)	18,859	630
Trips to Al Ghabawi Facility (assuming 16,500m^3/day)	27,500	920
Projected Trips in 2045 (assuming 22,500 m^3/day)	37,501	1250

Trips Distribution

According to the data obtained from the AGTP office, the origin of trips is categorized according to major areas, minor areas, governmental authorities, and different wastewater treatment plants as shown in Figure 8.2.

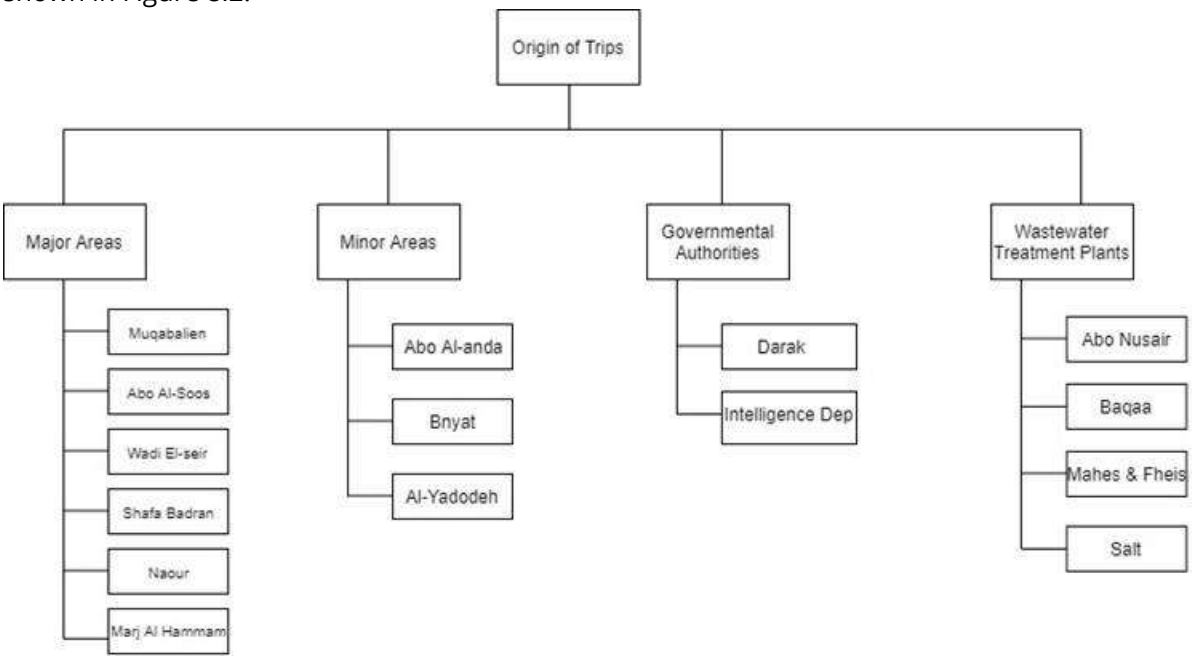


Figure 8.2. Origin of Trips

Review of Access Points and Circulation

The project is designed to allow access for trucks and admins' vehicles via two different access points. The first point is assigned for truck entry and exit, while the second point is designated access for admin entry and exit. Figure 8.3 shows the path of trucks and vehicles in black and green respectively.

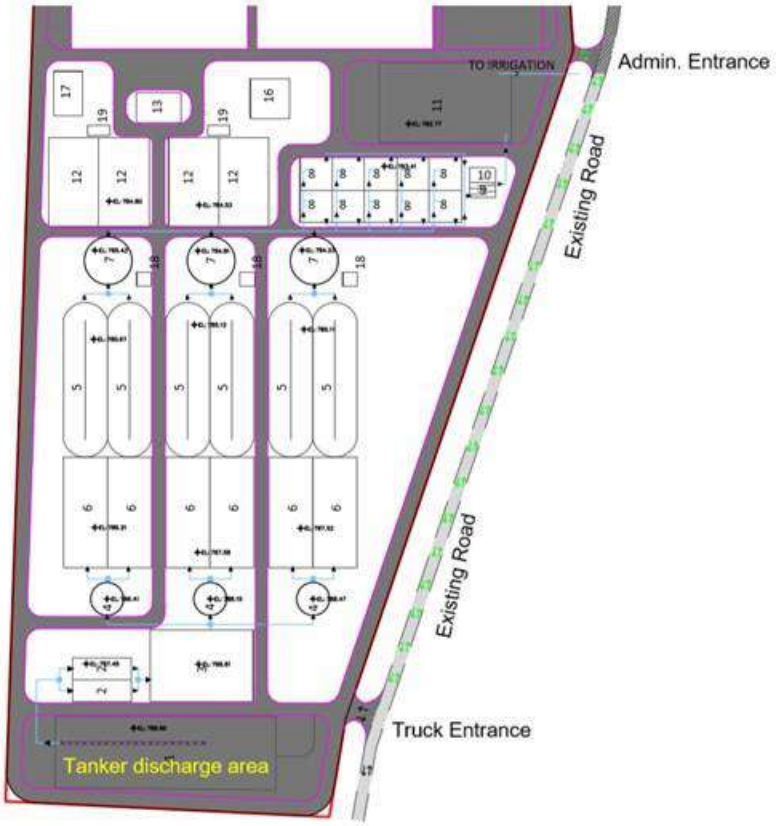


Figure 8.3. Traffic circulation and the facility's access points

Outcome

To assess the impact of the project on traffic conditions on the surrounding road network, the site-generated traffic was added onto the background traffic and the resulting changes were analysed for changes in certain parameters, such as volume-to-capacity ratio (v/c ratio) and level of service (LOS). To do that, the Highway Capacity Manual (HCS 2000) was used to determine the level of service at which the road may operate. The purpose of this analysis is to assess the need for any potential upgrading of the surrounding roads, if necessary.

The HCS 2000 manual presents many ways to determine the LOS and v/c ratio. In this traffic impact assessment (TIA), two different methodologies were used. Table 8.6 shows the methodologies used, input parameters, and the outcomes obtained in this analysis.

Table 8.6. Methodologies adopted in the analysis

Road Name	Methodology Used	Input Parameters	Outcome
Road adjacent to station 2	Two-lane Highway	Roadway dimensions, highway class, terrain, two-way hourly volume, directional split of traffic, peak hour factor (PHF), percentage of trucks and buses, percentage of no passing zones, and number of access points per km.	Average Travel Speed, and percent time spent following.
Road adjacent to station 1	Multilane Highway	Roadway dimensions, median type, lateral clearance, number of access points per km, peak hour factor (PHF), terrain, percentage of trucks and buses, and driver population factor.	Average passenger car speed, and the flow rate.

Table 8.7 and Table 8.8 present the results of the level of service and capacity analysis results of each road. Note that the estimation of the amount of generated traffic during the peak hour was done by calculating the ratio of the 15 minutes peak-hour traffic volume to the total peak-hour traffic volume. The ratio obtained was multiplied by the generated traffic that is expected to access the two roads.

Table 8.7. LOS and Capacity analysis of the road adjacent to station 1

Traffic Composition					
Type of traffic		Peak Hour			
Background Traffic					
From Amman to Al Ghabawi (veh/hr)		188			
From Al Ghabawi to Amman (veh/hr)		192			
Trips Generated					
From Amman to Al Ghabawi (veh/hr)		125			
From Al Ghabawi to Amman (veh/hr)		147			
Future Background Traffic (Year 2030)					
Year		Volume (Veh/hr)			
From Amman to Al Ghabawi (veh/hr)		271			
From Al Ghabawi to Amman (veh/hr)		276			
Capacity Analysis					
Year	Direction	Without the project		With the project	
		LOS	v/c	LOS	v/c
2020	From Al Ghabawi to Amman	A	11.4%	B	18.3%
	From Amman to Al Ghabawi	A		B	
2030	From Al Ghabawi to Amman	A	15.6%	B	22.0%
	From Amman to Al Ghabawi	A		B	

Table 8.8. LOS and capacity analysis of the road adjacent to station 2

Traffic Composition					
Type of traffic		Peak Hour			
Background Traffic					
From Al Ghabawi to Zarqa (veh/hr)		42			
From Zarqa to Al Ghabawi (veh/hr)		30			
Trips Generated					
From Al Ghabawi to Zarqa (veh/hr)		170			
From Zarqa to Al Ghabawi (veh/hr)		230			
Future Background Traffic (Year 2030)					
Year		Volume (Veh/hr)			
From Al Ghabawi to Zarqa (veh/hr)		61			
From Zarqa to Al Ghabawi (veh/hr)		43			
Capacity Analysis					
Year	Direction	Without the project		With the project	
		LOS	v/c	LOS	v/c
2020	From Al Ghabawi to Zarqa	B	8.4%	C	55.2%
	From Zarqa to Al Ghabawi	B		C	
2030	From Al Ghabawi to Zarqa	B	12.6%	C	58.9%
	From Al Ghabawi to Zarqa	B		C	

The analysis shows that LOS will be reduced from A to B at Station 1 and from B to C at Station 2. This is not considered a significant impact and is well within the acceptable range for level of service. No interventions are necessary in terms of increasing road capacity at Al Ghabawi Road or the access road. Still, GAM has announced that it has allocated a budget of 30 million Jordanian Dinars over a three years period in order to upgrade Al Ghabawi Road. Thus, though the increased traffic load during the operation phase of the project is certain, it will be of low consequence yielding an overall moderate impact significance.

8.3.4 Impacts due to Unplanned Events and Emergencies

During the Project's operation phase, unplanned events and emergencies related to improper operation and maintenance or accidents may lead to:

- Treated effluent discharged into the wadi does not meet the Jordanian and EU standards for discharge into wadi due to a process malfunction;
- Overflow of untreated wastewater from the WWTP into the adjacent wadi;
- Accidental chlorine gas release from the chlorination unit;
- Receipt of industrial wastewater by the septic tankers transporting the wastewater;
- Fire hazards; and
- Power supply failure.

The impact assessment of such unplanned events is discussed in Table 8.9.

Table 8.9. E&S impact assessment of unplanned event and emergencies associated with WWTP operation

Unplanned Event and/or Emergency	E&S Impact Assessment
Treated effluent does not meet the Jordanian and EU standards for discharge into wadi due to a process malfunction	Unplanned events could result in a process malfunction where treatment efficiency is reduced and the treated effluent discharged into the wadi does not meet the indicated Jordanian and EU standards. Though the sensitivity of the study area in terms of water resources pollution or biodiversity impacts is low, the impact is of medium consequence. Given that such an event is possible to occur the significance of this unplanned event is considered to be moderate. Accordingly, WAJ should have a monitoring program for the treated effluent to ensure that it is in line with the indicated Jordanian Standard JS 893/2006 for reuse of treated wastewater and the EU Urban Waste Water Directive.
Overflow of untreated wastewater into the adjacent wadi in case of malfunction at the WWTP	The wastewater to be received at AlGhabawi WWTP will be transported by tankers. Hence, in case of an operational emergency, the discharge of wastewater from the tankers can be stopped. In addition, the design for the WWTP has accounted for a large capacity equalization tanks that has the capacity to take additional wastewater inflow. Therefore, risk of overflow of untreated wastewater is unlikely. In case of untreated wastewater flow, there are no near sensitive ecological habitats or surface water resources that may be contaminated. Groundwater resource surrounding the Project site is considered to be confined in an aquitard and therefore at no risk of pollution. Thus, the overall consequence of a wastewater overflow event is low resulting in a negligible impact significance. Still, the Operator should maintain a record of occurrence of any such emergency situations so that WAJ could review the records of such documented incidences and evaluate the extent of exceedance of the equalization tank capacity.
Risk of chlorine gas release at the chlorination unit	Accidental chlorine gas release from the chlorination unit poses occupational health risk to workers at the facility. The likelihood of accidental chlorine gas release is likely and the consequence is high given the high sensitivity of workers at the facility. This implies that the overall risk significance of chlorine gas release is moderate. This requires that the operator to have leak detection sensor for chlorine gas at the chlorine gas storage room along with a system that treats the released gas. The operator is also required to maintain Material Safety Data Sheet (MSDS) information on chlorine gas. Also, the operator should place a sign indicating “DANGER CHLORINE GAS” on the exterior side of a chlorine gas feed room door. The sign shall contain a telephone number to be used in the event of an emergency at the facility. The operator needs to develop safety protocols for chlorine gas, including staff training, in case of hazardous release.

Unplanned Event and/or Emergency	E&S Impact Assessment
Receipt of industrial wastewater by the septic tankers transporting the wastewater	There is a risk that the septic tankers may bring industrial wastewater into the WWTP. However, the likelihood of such risk is considered to be unlikely since AlGhabawi should be receiving licensed municipal septage transport tankers. The municipal septage transport tankers have the standard orange colour. Accordingly, the operators would notice if a non-municipal septic taker entered the WWTP facility. Moreover, all the received septage is directed towards the equalization tank. The mixing of all received wastewater at the equalization tank is expected to dilute any accidentally received industrial wastewater. However, if industrial wastewater concentrations were high, this will affect the efficiency of the treatment process. Though the likelihood of occurrence is considered unlikely, the consequence of such a risk is considered to be severe, resulting in an overall significance of major. Accordingly, the operator is required to receive transported wastewater from licensed municipal septic tankers.
Fire hazards	Fire hazards can occur at WWTP especially in case of chlorine, ammonia, methane and hydrogen sulphide build up in confined spaces. Methane accumulation can be explosive. Such fire hazards are likely to occur and would pose high risk to individuals available within the Project site. Accordingly, the impact significance of fire hazards is considered to be moderate. The Operator should have a firefighting plan and system for the facility including planned fire drills with evacuation procedures. Also, the operator is to have regular inspections and maintenance for the firefighting system. It is recommended to carry fire drills with WAJ representative attending the fire drills at least once annually.
Power supply failure	The WWTP receives its power requirements from the national electricity grid. Incidences of power failure are extremely remote and are usually fixed within short time durations. Thus, no disruptions to the wastewater treatment process is anticipated due to power failure. Moreover, as discusses previously, AlGhabawi WWTP receives its inflow by tankers and has a large capacity equalization tank that results in a low consequence. Thus, no wastewater overflow is anticipated due to power failure and the overall impact is evaluated to be of negligible significance.

Response to such emergency situations or unplanned events need to be part of the emergency operating plans of the WWTP. Such plans should clearly indicated actions to be taken, entities to be contacted and their contact information, assignments, and responsibilities. All the staff at the WWTP need to be trained on emergency plans and periodic training exercises need to be carried to ensure adequate preparation of the staff.

8.4 Decommissioning Phase

Depending on decommissioning approach to be adopted, the potential impacts during decommissioning are anticipated to be similar to those discussed for the construction phase.

The aspect that will require further evaluation and management measures is waste management in terms of approach of handling, transporting and disposing of the demolition waste and decommissioned equipment.

8.5 Cumulative Impacts

Cumulative impact is the potential effect on receptors from environmental and social impacts caused by the combined influence of more than one project operating in the study area of the Project. This area is overall planned as an area of strategic services such as Al Ghabawi municipal solid waste landfill and nearby petroleum reserve facility.

During stakeholder consultations, concerns were raised over the current environmental state driven by the current Landfill in the Strategic Services Zone and the other facilities in the area, and the accumulative impact of the upcoming Project and other planned developments in the area. The household survey revealed a great concern by the local communities that the developments being attracted into the Strategic Services Zone and the surrounding area are negative and are likely to result in pollution and pose risk to residents' health and wellbeing.

Salient and non-salient factors were found behind these concerns and the expressed dissatisfaction. The local community expressed a negative experience with existing facilities in the area in terms of environmental impacts, which are sensed at varying degrees across the area. The landfill was considered to have the most negative impact as the odour has reached many areas and garbage which flies off trucks or fly-dumping are visually apparent. Moreover, the landfill being in the Strategic Services Zone adjacent to the site of the planned Project - and the fact that the Project deals with sewage – leads residents to believe the Project will impact the area in a similar manner and add to the nuisances already caused by the existing facilities. Besides Al Ghabawi Municipal Landfill, the area included other developments including Amman Strategic Reserve Terminal for Petroleum Products, a cow farm, and Amman Asia Electric Power, and the East Amman livestock market. This Project is perceived by the local communities as another unwanted development with a high likelihood of causing additional pollution. Moreover, there is the additional concern that the Strategic Services Zone will continue to bring in development viewed unwanted by the local community, adding to an already vulnerable environmental situation.

Moreover, dissatisfaction with the environmental management of the existing facilities and the processes for environmental monitoring, protection and community engagement has contributed to a level of distrust in the seriousness of facilities' environmental and social commitments. Accordingly, expectations of a negative impact were expressed more strongly, especially with respect to negative impact on the environment and public health, road traffic, and consequently land values. The high percentage of property owners, coupled with the urban crawl and the moderate prevalence on activities for sustenance which depend on the private land ownerships raises economic concerns among many in the local community as a result of the cumulative impacts. Currently, there are some planned developments that are of medium to large scale such as the land port and the

slaughterhouse. These are likely to have a cumulative effect on any of the resources and receptors within the area of influence.

However, the proposed Project is relatively a small scale one with its potential adverse cumulative impacts considered as negligible and confined to odour nuisance, increase in traffic, and potentially increased local community perception of risk overtime if the commitments set-out in the ESMP or ESAP are not met. It is therefore important for the project to engage stakeholders as needed and to communicate clearly the proposed measures that are feasible, applicable and in-line with project scope. One important measure to be emphasized is the need that future developments employ the technicians and university-educated local community members who may qualify for such jobs and provide low-skill primary jobs to the local community. Moreover, clear communication with the local community, and making available an accessible and receptive grievance mechanism are recommended measures to maintaining positive relations with the local community.

However, in order to better assess potential cumulative impacts within the bigger picture of the project area and its surroundings, it is recommended that the future planning of the infrastructure services area of East Amman to have a separate "Cumulative Impact Assessment (CIA)" to quantify the impacts that are likely to persist in the area, and to what degree they can be managed. The CIA can be initiated with dialogue between surrounding projects and facilities as well as relevant government authorities, in addition to future projects developers that are likely to operate in the area within the next few years.

8.6 Residual Impacts

Residual impacts are those environmental and social impacts that remain following the implementation of the required mitigation measures. Given that the majority of the identified impacts on physical environment are of minor significance and manageable through adoption of proper environmental management measures, the residual impact of concern is anticipated on the working conditions due to prevalence of odour nuisance from the neighbouring Al Ghabawi solid waste facility. As discussed, this impact requires adoption of mitigation measures for minimizing impact of the prevalent nuisance on the WWTP employees.

Moreover, once operational, the number of daily trips generated will result in increasing the used capacity of the road from around 11 to 16% without the Project to around 18-22% with the Project. This increase is not expected to significantly affect the level of service and, therefore, no residual impacts are anticipated from the Project on the area's traffic system.

8.7 Summary of E&S Impacts

A summary of the evaluated significance of the anticipated environmental and social impacts is provided in Table 8.10.

Table 8.10. Summary of the E&S impacts and their significance

No.	Aspect	Potential Impact / Risk	Magnitude	Sensitivity	Consequence	Likelihood	Significance
Construction/Decommissioning Phase							
1.	Air Quality and Noise	- Air pollution due to exhaust gas from construction machinery and vehicles. - Dust due to excavation works and machinery movement over unpaved roads. - Nuisance to surrounding workers due to noise and vibration from construction machinery and vehicles movement.	**Low**	**Medium**	**Low**	**Likely**	**Minor**
2.	Topography, Geology and Soil	- Soil Pollution resulting from potential leakage of small amounts of oil from construction machinery and vehicles. - Improper handling of solid and/or liquid waste.	**High**	**Low**	**Medium**	**Likely**	**Minor**
3.	Biodiversity	- Birds exposed to risk of hunting by Project workers, especially during the migration season.	**Medium**	**High**	**Severe**	**Likely**	**High**
4.	Employment Opportunities	- Generation of employment opportunities to local community during construction phase.	**Positive**	**-**	**Positive**	**Possible**	**Positive**
5.	Potential Implications on Local Community Groups	- The project as it is not expected to trigger physical or economic displacement and, therefore, there are no impacts associated with land acquisition, involuntary resettlement and/or economic displacement.	**No Impact**	**-**	**None**	**-**	**None**
6.	Community Health and Safety	- Disturbance to local community caused by project construction activities including transporting of construction materials.	**Medium**	**Medium**	**High**	**Unlikely**	**Minor**
7.	Labour and Working Conditions	- Occupational Health & Safety risks to labour working in the project site. - Potential employment of child labour or forced labour.	**Medium**	**Medium**	**High**	**Unlikely**	**Minor**
8.	Occupational Health and Safety	- Potential exposure of construction personnel and site workers to injuries and safety events such as tripping, working at height activities, fire from hot	**Medium**	**Medium**	**High**	**Likely**	**Moderate**

No.	Aspect	Potential Impact / Risk	Magnitude	Sensitivity	Consequence	Likelihood	Significance
		works, smoking, failure in electrical installations, mobile plant and vehicles, and electrical shocks.					
9.	Transportation	- Temporary increase in traffic load due to light and heavy vehicles and construction equipment travelling to and between the site and both Amman and Zarqa.	**Low**	**Medium**	**Low**	**Likely**	**Minor**
10.	Archaeological and Cultural Heritage	- Potential for accidental encounter of archaeological remains or relics during excavation.	**High**	**Low**	**Medium**	**Extremely Remote**	**Negligible**
Operation Phase							
11.	Air Quality and Odour Nuisance	- Odour nuisance due to WWTP operations.	**Medium**	**Medium**	**High**	**Unlikely**	**Minor**
12.	Green House Gas Emissions	- In general, WWTPs contribute less than 1% of the national GHG emissions in Jordan and accordingly the operation of the WWTP is not expected to contribute significantly to GHG emissions. However, estimates reveal emissions to exceed 25K CO_2e tonnes/year mainly due to electricity consumption from the national grid.	**Low**	**Low**	**Negligible**	**Certain**	**Minor**
13.	Water Resources	- Positive impact of securing additional irrigation water supply within the project area.	**Positive Impact**	**-**	**Positive**	**Certain**	**Positive**
14.	Sludge Handling	- Potential for odour and/or insect nuisance from onsite sludge stockpiling.	**Medium**	**Medium**	**High**	**Unlikely**	**Minor**
15.	Biodiversity	- Potential attraction of birds and/or mammals to open wastewater tanks.	**Medium**	**Low**	**Low**	**Possible**	**Minor**
16.	Local Community Perceptions	- Potential community concerns from environmental impacts and public health impacts from the project, especially with respect to odour.	**High**	**Medium**	**Severe**	**Likely**	**Major**
17.	Community Health and Safety	- Potential safety hazards on tanker drivers entering and exiting the site.	**Medium**	**Medium**	**High**	**Unlikely**	**Minor**
18.	Employment Opportunities	- Potential positive impact of employment opportunities for local community.	**Positive Impact**	**-**	**Positive**	**-**	**Positive**

No.	Aspect	Potential Impact / Risk	Magnitude	Sensitivity	Consequence	Likelihood	Significance
19.	Affordability	- Concerns for ability of users to pay septage transportation fees. However, the affordability assessment indicated that utility bills are affordable within both Amman and Zarqa governorates.	**Low**	**Low**	**Negligible**	**Will not occur**	**No Impact**
20.	Occupational Health and Safety	- Potential occupational health and safety impacts on workers associated with working at the WWTP.	**Medium**	**High**	**Severe**	**Likely**	**Major**
21.	Infrastructure	- Solving an existing infrastructure issue that has been present at AGTP, thereby minimizing the current load and operational burden, and improving wastewater treatment capacity.	**Positive Impact**	**-**	**Positive**	**-**	**Positive**
22.	Transfer of Skills	- The Project will contribute to transfer of skills in wastewater treatment technologies to operator staff as well as project owner.	**Positive Impact**	**-**	**Positive**	**-**	**Positive**
23.	Transportation	- Potential increase in illegal dumping of transported septage due to the increase in transportation cost.	**Medium**	**Medium**	**High**	**Likely**	**Moderate**
		- Increase in traffic load within the surrounding road network during operation.	**Low**	**Medium**	**Low**	**Certain**	**Moderate**
24.	Treated effluent does not meet standards	- Unplanned events could result in a process malfunction where treatment efficiency is reduced and the treated effluent discharged into the wadi does not meet the indicated Jordanian and EU standards.	**High**	**Low**	**Medium**	**Possible**	**Moderate**
25.	Potential for overflow of untreated wastewater into the adjacent wadi in case of malfunction at the WWTP	- As the wastewater is transported by tankers to the WWTP and the WWTP has large capacity equalization tanks, no incidences of untreated wastewater overflow are anticipated.	**Low**	**Low**	**Negligible**	**Unlikely**	**Negligible**

No.	Aspect	Potential Impact / Risk	Magnitude	Sensitivity	Consequence	Likelihood	Significance
26.	Risk of chlorine gas release at the chlorination unit	- Accidental chlorine gas release from the chlorination unit posing occupational health risk to workers at the facility.	**Medium**	**Medium**	**High**	**Likely**	**Moderate**
27.	Receipt of industrial wastewater by the septic tankers transporting the wastewater	- Risk that the septic tankers may bring industrial wastewater into the WWTP.	**Medium**	**High**	**Severe**	**Unlikely**	**Major**
28.	Fire hazards during operation	- Risk to individuals available within the Project site in case of fire accidents.	**Medium**	**Medium**	**High**	**Likely**	**Moderate**
29.	Power supply failure	- Disruption to the wastewater treatment process in case of power failure.	**Low**	**Low**	**Low**	**Unlikely**	**Negligible**

9 MITIGATION MEASURES

Mitigation measures have been developed to avoid, minimize, or compensate for the potentially identified adverse future impacts, issues and/or risks. Measures have also been included to enhance Project benefits. Adopting those measures is needed for to achieve best results, eliminate or minimize risks and to achieve overall compliance with the relevant national regulations, EBRD requirements and introduce best practices.

9.1 Mitigation Measures during Construction/Decommissioning Phase

The mitigation measures needed during the Project's construction/decommissioning phases are presented in Table 9.1. The implementation of these measures is the responsibility of the Project's contractor and WAJ.

Table 9.1. Mitigation measures during construction/decommissioning phases

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
1.	Air Quality	- Odour and dust due to activities carried at the neighbouring Al Ghabawi landfill.	- Conduct a 24-hour air quality measurements for $PM_{2.5}$, H_2S, NH_3 each month.
		- Air pollution due to exhaust gas from construction machinery and vehicles.	- Ensure vehicles and equipment are switched off when not in use. - Use equipment and vehicles in appropriate technical conditions.
		- Dust due to excavation works and machinery movement over unpaved roads.	- Suppress the scattering of dust occurring during excavation by sprinkling of water on as needed basis. - Ensure appropriate stockpile management (friable materials) to minimize dust blow. - Cover truck loads with canvas to avoid dust blow.
2.	Noise and Vibrations	- Nuisance to employees/workers at surrounding facilities due to noise and vibration from construction machinery and vehicles movement.	- Conduct spot noise measurements to ensure to ensure that noise levels do not exceed the day-time limit of 70 dBA and night-time limit of 65 dBA as an industrial area. - Ensure vehicles and equipment are switched off when not in use.
3.	Topography, Geology and Soil	- Soil Pollution resulting from potential leakage of small amounts of oil from construction machinery and vehicles. - Improper handling of solid and/or liquid wastes.	- Proper maintenance of machinery and vehicles. - In case of having temporary fuel tanks onsite, use secondary containment tanks to control accidental leakages. - Develop a spill response plan, to control any inadvertent leakage or spill. - Provide workers with proper spill response training and a spill kit for containment and clean-up of any accidental spills.

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			- Ensure immediate cleaning of any spills and remediation of contaminated areas after construction. - Maintain proper housekeeping on site. - Collect and segregate wastes and ensure safe storage and in line with legal requirements. - Ensure appropriate disposal of solid waste at approved disposal sites where solid waste is disposed of at approved disposal landfills and hazardous waste at Swaqa hazardous waste landfill. - Ensure proper collection and disposal of domestic wastewater generated from workers. Proper storage of domestic wastewater is in septic tanks and disposal should be at a designated WWTP in line with national requirements.
4.	Biodiversity	Since Jordan is a migratory passage for many types of migratory birds, in addition to the mentioned resident birds, it is possible that these birds may be at risk of hunting by workers on the project, especially during the migration period.	- Prohibit workers from hunting.
5.	Community Health, Safety and Security	Disturbance to local community caused by project construction activities.	- WAJ, through the contractor to appoint two Community Liaison Officers (CLOs) whose responsibility shall include the management of all community related matters for the project and well as managing the community grievance mechanism. The CLO role is also reflected in the project-specific SEP. - Implementation of appropriate security management on site (such as appropriate fencing, entry and exit controls, cameras and sensor systems where applicable).
6.	Labour & Working Conditions	Potential employment of child labour of forced labour.	- Ensure that all national legislation on labour and health and safety, the requirements of EBRD Performance Requirement 2 are in compliance. This includes ensuring that applicable clauses relating to labour and working conditions requirements that are in line with local Jordanian standards and EBRD requirements are incorporated into the agreement with the contractor, such as requirements for having a relevant HR policy and OHS policies and procedures in place. - Provide a Grievance Mechanism for all workers and employees. The Contractor will ensure that all workers are informed about the Grievance

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			Mechanism and that information about the mechanism is posted in relevant areas of the project site. - Appoint competent persons on site to oversee all activities and carry out relevant audits and inspections. - Ensure that hiring, recruitment and training plans satisfy the requirements of the provisions of Performance Requirement 2, and the HR procedures are well tailored to comply with local Jordanian Laws and EBRD requirements. - Ensure that a safe and healthy working environment is provided for all workers on site and that good international practice on occupational health and safety is followed in line with policies developed by the Contractor. - Child labour is not allowed and it is not allowed under any circumstance to employ workers under age of 18. - Ensure that there shall be no use of forced or compulsory labour as part of this project.
7.	Occupational Health and Safety Risks	Occupational Health & Safety risks to labour working in the project site including potential exposure of construction personnel and site workers to injuries and safety events such as tripping, working at height activities, fire from hot works, smoking, failure in electrical installations, mobile plant and vehicles, and electrical shocks	- Develop an Occupational Health and Safety (OHS) Plan that comply with Jordanian and EBRD OHS related policies and procedures that is based on a risk assessment prepared prior to commencement of work. - - Allocate specific personnel responsible for health & Safety management on site. - Adequate and appropriate training of all workers of the contractor's OHS policies and procedures before they are permitted to undertake a task. - Appropriate PPE and safety clothing shall be used during construction work, especially when handling chemicals and entering confined locations. - As per the Instructions for the Protection of Workers against the Risks of the Work Environment No. 8 of 1996. If noise levels exceed the 85 dBA limit for workers in an 8-hour work shift, hearing protection equipment are required for workers exposed to such noise levels. - All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - A Risk assessment shall be prepared and communicated prior to commencement of work for all types of work activities on site.

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			- Provide a separate storage area for hazardous materials and chemicals. The hazardous materials/products must be labelled with proper identification of its hazardous properties. - Storage of chemicals shall be performed in accordance with MSDS's. - The contractor shall ensure that all equipment and machinery are turned off, unplugged, and properly stored when not in use. - Avoid work at height where it reasonably practicable to do so, e.g. by assembly at ground level. - Prior to entry to any confined space, the following shall be followed at a minimum: 1) ensure proper ventilation is in place; 2) necessary precautions to be taken to isolate any flows, turn off electric equipment; 3) atmosphere inside the confined space has been examined for safe entry; 4) ensure that emergency plans and risk assessment prepared by contractor include precautions for confined spaces that are in-line with WAJ safety requirements. - Prohibit smoking in areas identified as a fire hazard. - Formally alert civil defense prior to start of activities with potential fire hazards. - The fire protection program shall comply with the requirements of the appropriate Local Standards for Construction. - Carry out fire risk assessment for the construction areas, identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire. - Ensure all plant machines and vehicles are regularly inspected, serviced and maintained; ensure all staff assigned is trained and competent to operate plant machines and vehicles. - Ensure clear signage is in place, such as Warning of speed limits, obstructions, allowable widths/heights…etc. - Electrical equipment must be safe and properly maintained; works shall not be carried out on live systems. - Ensure all equipment are suitable for jobs (safety, size, power, efficiency, ergonomics, cost, user acceptability

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			etc), provide the lowest vibration tools that are suitable and can do the works. - Only competent authorised persons shall carry out maintenance on electrical equipment, adequate Personal Protective Equipment (PPE) for electrical works must be provided to all personnel involved in the tasks. - First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site. - Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills.
8.	Transportation	Temporary increase in traffic load due to light and heavy vehicles and construction equipment travelling to and between the site and both Amman and Zarqa	- Ensure that all trucks and vehicles accessing the facility are operated by licensed operators. - Ensure adequate maintenance and inspection of vehicles. - Presence of flagman at the entrance and exit of the project site in order to control vehicles and truck movement. - Every employee working at the project site shall make sure that all needed signs and preventive measures are implemented when starting any activity. - Number of traffic signs, their characteristics and distance among them will be placed according to local legal requirements. - Vehicle transit across any restricted area and/or limited to working activities is prohibited.
9.	Archaeology and Cultural Heritage	- Potential for accidental encounter of archaeological remains or relics during excavation.	- Have a chance find procedure in case of coming across any cultural heritage or artefacts (e.g. graves, old ceramic, old building fragments) during excavation works. These procedures should require that excavation works are stopped, report those immediately to DoA, and contractor awaits instructions from DoA.

9.2 Mitigation Measures during Operation Phase

The mitigation measures needed during the Project's operation phase are presented in Table 9.2. The implementation of these measures is the responsibility of WAJ.

Table 9.2. Mitigation measures during operation phase

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
1.	Air Quality including Odour	- Odour nuisance due to WWTP operations	- Have in place an odour control system and monitoring scheme. - Monthly, carry out one day (24hours) of air quality monitoring to measure $PM_{2.5}$, H_2S, and NH_3 and report on instances of exceeding the limits set by JS 1140/2006 and by EU Directive 96/62/EC - Air quality framework directive. - Reduce the work hours for workers in exposed areas. - Develop an Odour Monitoring Committee to check on odour within the WWTP. The committee is recommended to consist of five members as follows: one representing the WWTP operator, one representing WAJ, one representing MoEnv, one representing local community, and one representing nearby establishments. - Have a green barrier around the Project to assist in reducing odours and emissions.
2.	GHG Emissions	- GHG emissions mainly contributed by electricity consumption from the national network grid.	- Consider energy efficiency in Project design to reduce energy demand (already considered but to be refined)
3.	Water Resources	- Positive impact of securing additional irrigation water supply within the project area.	- Encourage reuse of treated effluent for restricted irrigation purposes especially by the local community. - Prepare a plan to develop the infrastructure needed to deliver the treated wastewater to target users.
4.	Sludge Handling	- Potential for odour and/or insect nuisance.	- Ensure proper stabilization of the treated sludge. - Review records of odour and/or insect complaints. - Develop a long-term strategy for handling the treated sludge. - Prepare a long-term plan for sludge disposal as sludge stockpiling is planned for the first 7 years.
5.	Biodiversity	- Potential attraction of birds and/or mammals to open wastewater tanks.	- Fencing the site and using proper means to prevent waterfowls and/or mammals from landing on open influent wastewater tanks. - Prohibit workers from hunting.
6.	Employment Opportunities	Potential positive impact of employment opportunities for local community.	- Operator to ensure that any needed qualifications available within the local community will be hired in the project should the qualifications match.
7.	Local Community Perceptions	Potential community concerns from environmental impacts and public health impacts from the project.	To help change local community perception in the area and manage their expectations as well as ensuring safe project practices, the project owner i.e. Ministry of Water and Irrigation/WAJ, together with the project operator

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			will implement a number of measures throughout the project such as: - Appointing two CLOs during construction, and continuing within this mechanism throughout the operation phase by keeping one CLO to continue managing the grievance mechanism and continuous engagement with the local community, as previously mentioned the CLOs will be selected only from the local communities and start their commission during the contractor mobilization period. - Implementation of WAJ's existing Grievance Mechanism during the project implementation (Please refer to SEP for more details on the mechanism process). - WAJ Social Responsibility Strategy shall be taken into account during project implementation by the operator to maximize the communication and involvement of stakeholders and support in decreasing environmental and socio-economic negative impacts resulting from the project where applicable. Exact initiatives related to maintaining social responsibility with the local community shall be determined by the operator in coordination with WAJ. Local community proposed measures that include greening the area, establishing parks, maintaining roads and extending a wastewater network in the area. - The project will have a strict monitoring system to ensure the quality and type of the septic received. In addition, the plant will have an advanced odour control system to eliminate odour expected during the operation phase. Moreover, an Odour Monitoring Committee will be set-up to check on odour within the WWTP. - Allow only septage tankers that are tracked electronically by MoEnv and MoEnv will monitor any potential violations of these tankers in the case of illegal discharge of wastewater.
8.	Community Health and Safety	Potential safety hazards on tanker drivers entering and exiting the site.	- The site to be fenced and appropriate security measures applied to restrict entry to the site for unauthorized individuals. - The project facility shall implement a regulated entrance and exit into the facility as a safety procedure. - Specific Occupational Health and Safety procedures shall be applied during the transportation of septage and its discharge on site.

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
9.	Occupational Health and Safety	Potential occupational health and safety impacts on workers associated with working in the treatment plant.	- Develop an Occupational Health and Safety (OHS) Plan that complies with OHS related policies and procedures complying to local Jordanian requirements, as well as EBRD requirements where applicable. - Operation and maintenance works shall be conducted by authorized/certified personnel only. - Compliance with project's OHS Policy and procedures to manage and control the activities with regard to occupational health and safety. - All workers should undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies and provide worker immunization (e.g. for Hepatitis B and tetanus). - Workers to wear personal protective equipment (PPE) and chemical resistant clothing to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapors. - Obey all safety-instructions regarding the storage, transport, handling or pouring of chemicals. - Obey all safety instructions concerning entry into confined spaces, e.g., check atmosphere for oxygen or for poisonous gases, use respiratory protection equipment if needed, have a co-worker stand guard in case of need for help, etc. - Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. to minimize chemical and radionuclide exposure. - First aid kits should be available at the project site and easily accessible to all workers. In addition, workers must be educated in the use of first aid kits; and informed of their location within the project site. - Hazardous chemical assessments and Material Safety Data Sheets (MSDS) are required for the hazardous substances used on site. All hazardous chemicals used on site must be placed in a designated and secure area to avoid accidental human contact. - Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE. - Plant operators are to have a recognized qualification for the operation they will be performing in the plant. - Locking out (de-charging and leaving open with a controlled locking device) and tagging-out (warning sign placed on the lock) devices during maintenance.

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
			- Double insulating / grounding all electrical equipment used in environments that are, or may become, wet; using equipment with ground fault interrupter protected circuits. - Fall prevention and protection measures should be implemented whenever a worker is exposed to the hazard of falling more than two meters. - Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. - Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills. - Carry out fire risk assessment for the operation areas, identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire.
10.	Transportation	Increase in traffic load within the surrounding road network during operation.	The number of daily trips generated by the project is relatively small compared to the roadway capacity and is not expected to significantly affect the level of service on surrounding roads. Since the composition of generated traffic will comprise mostly of sludge hauling trucks, certain traffic safety measures can be introduced to reduce speeds. These include, but are not limited to: - Adding cautionary/advisory signage for truck drivers and others using the road - Potentially introducing enforcement measures such as cameras to monitor speed and the proper entry/exit of trucks into and out of the facility - Building awareness among drivers by providing material or potentially holding an awareness session - Engineering treatments such as speed humps or rumble strips, especially in section of potential conflict with entering/exiting vehicles
11.	Emergency / Unplanned Events	Risk that the treated effluent discharged into the wadi does not meet the Jordanian and EU standards for discharge into wadi/irrigation due to a process malfunction	- Have WWTP Design controls. - Prevent discharge (operating procedures) unless quality standards are achieved.

No.	Area of Potential Risk	Potential E&S Impact	Mitigation Measures
		Potential for overflow of untreated wastewater into the adjacent wadi in case of malfunction at the WWTP	- Maintain a record of occurrence of any such emergency situations so that WAJ could review the records and evaluate the equalization tank capacity.
		Risk of chlorine gas release at the chlorination unit	- Have leak detection sensor for chlorine gas at the chlorine gas storage room along with a system that treats the released gas. - Maintain Material Safety Data Sheet (MSDS) information on chlorine gas. - Place a sign indicating "DANGER CHLORINE GAS" on the exterior side of a chlorine gas feed room door. The sign shall contain a telephone number to be used in the event of an emergency at the facility. - Develop safety protocols for chlorine gas, including staff training, in case of hazardous release.
		Receipt of industrial wastewater by the septic tankers transporting the wastewater	- Transported wastewater is to be received only from licensed municipal septic tankers.
		Fire hazards	- Have a firefighting plan and system for the facility including planned fire drills with evacuation procedures. - Have regular inspections and maintenance for the firefighting system. - Carry fire drills.

10 MONITORING MEASURES

Monitoring measures are presented here to indicate how the identified impacts and their mitigation measures will be monitored and reported on.

10.1 Monitoring Measures during Construction/Decommissioning Phase

The monitoring measures needed during the Project's construction/decommissioning phases are presented in Table 10.1. The implementation of these measures is the responsibility of WAJ through a supervision consultant.

Table 10.1. Monitoring measures during construction/decommissioning phases

No.	Area of Potential Risk	Monitoring Measures
1.	Air Quality	- Review the results of the air quality measurements. - Observations and site inspection for dust and odour. - Review complaints records for number of complaints recorded.
2.	Noise and Vibrations	- Review the results of the noise level measurements. - Review complaints records for number of complaints recorded.
3.	Topography, Geology and Soil	Site inspection and observations including: - Checking for oil leakage from construction machinery and vehicles. - Checking on status of repairs condition of locations where soil is affected by oil leakage. - Review waste manifests and the permit of approved disposal sites. - Checking the availability of a spill response plan and related toolkits. - Check the availability of septic tanks on site and records of wastewater disposal that prove the safe disposal of the wastewater.
4.	Biodiversity	- Carry out site visits to check that no hunting incidents carried out by the workers.
5.	Community Health, Safety and Security	- Ensure project area is secure and access is well monitored and controlled through cameras / automated systems where applicable and visual monitoring. - Monitor grievance log and ensure all complaints are addressed in accordance with the public grievance mechanism.
6.	Labour & Working Conditions	- Ensure that systems are in place to monitor compliance with labour and health and safety standards. - Appointment of a manager on site to be responsible for ensuring that labour and health and safety legislation is complied with, and for monitoring supplier and sub-contractor performance. This shall be conducted through Internal audits and/or inspections to monitor compliance. - Employee grievance log sheets to be regularly monitored in addition to the time taken to resolve them.
7.	Occupational Health and Safety	- Daily site inspection and auditing to check for compliance with OHS procedures.

No.	Area of Potential Risk	Monitoring Measures
		- Monthly records of inspection and auditing reports documented and sent to WAJ. - Inspection on reported injuries or accidents to personnel and the corrective action taken to ensure compliance with the health and safety procedures. - Inspection on trainings conducted to contractor personnel documented and maintained. - Evidence and records of mock up drills on site.
8.	Transportation	- Maintain open dialogue with Al Ghabawi landfill personnel as it is located adjacent to the project area. - Monitor vehicle movement to and from the Project area.
9.	Archaeology and Cultural Heritage	- Observations on existence of remains and relics at construction site. - Records of coordination with DoA.

10.2 Monitoring Measures during Operation Phase

The monitoring measures needed during the Project's operation phase are presented in Table 10.2. The implementation of monitoring is the responsibility of WAJ through the operator.

Table 10.2. Monitoring measures during operation phase

No.	Area of Potential Risk	Monitoring Measures
1.	Air Quality/ Odour	- Odour control system and monitoring scheme where weekly monitoring of H_2S and NH_3 gas concentrations at various locations within the plant. - Ensure that the Odour Monitoring Committee meet and document the odour at the WWTP. - Have sensors for chlorine gas detection along with gas release treatment system.
2.	GHG Emissions	- Prepare an annual estimation of GHG emissions by the WWTP.
3.	Water Resources	- Ensure that the plan to develop the infrastructure needed to deliver the treated wastewater has been prepared. - Ensure that a record proving the safe disposal of waste in approved landfills and hazardous waste in the Swaqa hazardous waste landfill is maintained. - Ensure the implementation of a groundwater quality program from the nearest existing water well.
4.	Sludge Handling	- The long-term plan for sludge handling has been prepared.
5.	Biodiversity	- Observe availability of fencing and control measures (such as closed tanks) that limit accessibility of mammals and birds to wastewater.
6.	Employment opportunities	- Review employment records to check for local community employment.
7.	Local Community Perceptions	Ensure the implementation of the SEP throughout the project operation phase such as: - Maintain records of stakeholder consultation meetings (where needed);

No.	Area of Potential Risk	Monitoring Measures
		- Maintain records of grievance logging and reporting are regularly maintained. - Maintain records of any reporting by local community about spillage from the septic tankers along the roads.
8.	Community Health and Safety	- Ensure project area is secure and access is well monitored throughout all project phases.
9.	Occupational Health and Safety	- Regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. - Regular audits on the compliance with OHS procedures, and audit reports to be sent to WAJ. - Surveillance of workers' health through periodic clinical and/or physiological assessment of individual workers. - Inspection on reported injuries or accidents to personnel and the corrective action taken to ensure compliance with the health and safety procedures. - Inspection on trainings conducted to operator staff documented and maintained. - Evidence and records of mock-up drills and emergency exercises on site.
10.	Transportation and Traffic System	- Coordinate with MoEnv to check for violations noted by the MoEnv Online Tracking System for Wastewater Tankers. WAJ and the operator to coordinate with MoEnv to add the location and route information of the tanker owners and drivers involved in the project operation phase to the MoEnv's database to be tracked and undergo review for any violations done by the wastewater tankers using the WWTP. - Monitoring of access roads around site. - Monitor the documentation of Incident reports. - Monitor the records for any reporting of spillage from the septic tankers along the roads.
11.	Risk of treated wastewater not meeting the standards for discharge into wadis	- Have a monitoring program for the treated effluent to ensure that it is in line with Jordanian Standard JS 893/2006 for reuse of treated wastewater and the EU Urban Waste Water Directive.
12.	Overflow under emergency operation conditions at the WWTP	- Review the records on documented such incidences and evaluate the extent of exceedance of the equalization tanks capacity.
13.	Risk of chlorine gas release at the chlorination unit	- Check for availability of safety protocols and warning signs.
14.	Risk of industrial wastewater at the WWTP	- Monitor the WWTP records for influent quality monitoring and to check that wastewater tankers are licensed as municipal wastewater septic tankers.
15.	Fire hazards	- WAJ representative attending the fire drills at least once annually.

11 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

This sub-section outlines the main roles and responsibilities during the Project implementation followed by the Environmental and Social Management Plan (ESMP) needed to ensure that all relevant stages of the Project are covered to meet the applicable requirements.

11.1 The Project Implementing Unit (PIU)

The Project Implementing Unit (PIU), which is WAJ for this Project, with support from the Supervision Engineer/ the Plant Operator has the overall responsibility for environmental and social management of the Project during implementation and operation.

WAJ Current Environmental, Social, Health and Safety Performance

As part of the E&S assessment process, the E&S team conducted an E&S audit on AGTP facility to check WAJ operational compliance with EBRD's ESP and PRs. Outcomes of the E&S audit on WAJ current environmental, social, health and safety Performance are explained below.

Environmental Performance

In general terms, the level of compliance with EBRD PRs at WAJ facility was found to be not adequate. WAJ and its operator do not have an environmental and social management system and policies that manage E&S principles to achieve sound environmental and social performance at the inspected facility. In the meantime, WAJ fully complies with national legislation to obtain environmental permits from the MoEnv and conduct necessary impact assessment studies and environmental management plans for its projects.

In terms of the E&S monitoring processes, WAJ assigns a qualified Supervision Engineering Firm that is responsible for ensuring contractor compliance with all statuary requirements, including the proper implementation of environmental mitigation measures during the construction phase of its projects. For the operating activities, the responsibilities of monitoring the environmental performance lie under the operators that produce periodic operation and maintenance reports that present results of all required monitoring programs, including those related to the EMP. Furthermore, WAJ has the right to access and inspect or audit any premises or operations, even without prior notice to the operator.

Social Performance

WAJ has a well-organized Human Resources (HR) directorate that has adequate capacity to manage all aspects relevant to its employees and workers according to the Civil Service Regulation No. 82 for the year 2013 and amendments thereof. Also, WAJ's operator has an HR Department to perform human resource management and oversee various aspects of employment according to the operator Miyahuna HR policy. However, WAJ and the operator of the project should have policies that reflect the requirements of the PR2 and improve the efforts to ensure compliance with EBRD PR2 requirements for supply chain requirement to consider the risks associated with child labour and forced labour being used in WAJ supply chains and accordingly adopt adequate measures.

Also, WAJ has a well-established and readily accessible grievance system in place that helps to respond to stakeholders' concerns, complaints, and suggestions on time. As part of the grievance system, WAJ has a call centre to receive complaints and suggestions from all governorates in Jordan.

Due that WAJ's day-to-day activities have direct interaction with citizens and local communities, WAJ developed in 2012 a Social Responsibility Strategy according to ISO 26000: Social Responsibility to maximize WAJ contribution to sustainable development. The strategy identified and prioritized all WAJ stakeholders based on their influence and found out that the local community involvement should be improved to reflect their expectations, interests, rights, and concerns.
Health and Safety Performance

Current WAJ's Operator at the inspected facility has an Occupational Health and Safety (OHS) Policy that defines the framework of health and safety management, addresses key OHS issues, and provides required procedures and actions. Also, Miyahuna has an OHS committee that is responsible for developing, implementing, and monitoring relevant OHS policies and procedures at all levels. Detailed procedures for all activities associated with Miyahuna activities are established. These procedures take into consideration all safety measures that should be in place to ensure workers' safety and to eliminate or reduce the hazards associated with the operational activities. However, a lack of commitment towards OHS among Miyahuna workers was noticed during the visits, the basic practices according to Miyahuna OHS policy were missing, and using of Personal Protective Equipment (PPE) is not enforced.

WAJ Roles and Responsibilities during the project

- WAJ as the PIA will be responsible for overall project management, planning and implementation of activities. The key roles and responsibilities of WAJ include the following: Ensure that the implementation of construction activities is conducted in a manner that protects the environmental and social components;
- Formally review and approve Construction Environmental and Social Management Plan (CESMP) that will be prepared by the contractor prior to commencement of the construction activities;
- Ensure compliance with all relevant national and international legislation and requirements;
- Ensure compliance with ESMP during the construction period and maintain close co-ordination with the site engineer and the Environmental focal point of the contractor;
- Ensure stakeholder grievance mechanisms are followed and that public complaints relating to nuisance and inconvenience caused by the Project implementation are addressed with corrective action and adequately documented;
- Conduct periodic site Environmental, Social, Health and Safety (ESHS) supervision. The purpose of the supervision is to verify that the ESMP is being effectively implemented; and
- Ensure that the ESMP for the operation phase of the Project is implemented.
- Prepare an environmental and social report as well as a status update on the implementation of the project ESAP to the EBRD on an annual basis.

11.2 The Contractor

The Contractor is fully responsible to comply with the commitments as set out in this ESMP and to ensure that all involved sub-contractors comply with the provisions of the ESMP. For this purpose, the contractor must prepare a CESMP prior commencement of the construction activities containing plans and procedures to protect public health, safety and security. The Contractor shall define in the CESMP the number, the locations and the type of project area and establish site specific management strategies and implementation and monitoring plans to manage and monitor ESHS risks. The CESMP shall include the following sub-plans:

- Occupational Health and Safety Plan;
- Traffic Management Plan (to ensure safety of surrounding institutions as well as local communities from construction traffic and maintain accessibility);
- Boundary Marking and Protection Strategy (for mobilization and construction to prevent offsite adverse impacts);
- Worksite Management Plan;
- Site Emergency and Evacuation Plan; and
- Waste Management Plan.

The E&S roles and responsibilities of the contractor personnel, at a minimum, are outlined below.

Project Manager (PM)

- Ultimate responsibility for the implementation of the CESMP and the contractor's HS policies and rules on site;
- Ensure all required resources including manpower are in place to maintain full compliance with ESHS requirements of the project are in place;
- Ensure compliance with applicable national and international legislation and requirements; and
- Ensure that all levels of staff receive adequate and appropriate training.

ESHS Manager

- Implement the CESMP during construction activities;
- Review sub-contractors environmental protection/mitigating measures to verify compliance with the CESMP;
- Complete regular checks of impact mitigation measures (as listed in Table 9.1 and Annex 12);
- Report any CESMP non-compliances to the PM;
- Carry out environmental awareness and training sessions;
- Conduct environmental surveying and monitoring programs and periodic ESHS audits and reviews; and
- Issue to the PIA a monthly ESHS report containing a description of ongoing activities and details of ESHS inspection, control and monitoring programs.

ESHS Supervisors

The ESHS supervisors will provide technical support and work with the ESHS Manager to identify potential activities, which may not be adequately addressed by proposed mitigating measures by subcontractors. The ESHS supervisors will conduct regular field inspections, monitoring and participate in audits to ensure compliance with ESHS requirements and shall notify any deviation or incident to the management and call for rectification. The ESHS supervisors will supervise regularly ESHS training sessions and shall assist any third party that would audit the construction site.

Sub-Contractors

The 'Sub-contractor' is any company hired directly or indirectly by 'The Contractor' to carry out project related tasks including the construction works.

All Sub-contractors that have at least one interface activity with identified key environmental aspects are responsible to comply with the requirements of this ESMP. The Sub-contractors are called to demonstrate a proactive behaviour towards environmental and social concerns. It is their responsibility to provide information requested by 'The Contractor' with regard to their scope of activities and to demonstrate compliance with the applicable environmental and social requirements and particularities.

11.3 Training Requirements

The ESMP will not be effectively implemented unless all staff are aware of their specific responsibilities and required actions, as specified by this ESMP. Therefore, the PIA shall provide an induction training to its employees and Contractor personnel working on the project prior commencement of the construction activities. At a minimum, the induction training shall cover:

- ESMP objectives and approach;
- Roles and responsibilities for ESMP implementation;
- Committed impact mitigation and environmental monitoring program; and
- ESMP procedures including the environmental and social monitoring, incident reporting and corrective actions.

The ESMP training shall be carried in the presence of WAJ engineers and shall be provided for at least 3 of WAJ engineers.

The Contractor shall prepare a detailed training plan for all construction workers and this plan needs to be approved by the PIA / WAJ /Supervision Engineer. The ESHS manager shall provide an overview level of training to all staff. The objective will be to highlight the environmental sensitivity of the working area and ensure that all staff are aware of environmental and social mitigation commitments. The training will be based on project environmental and social standards / requirements, the environmental and social management commitments and procedures. It will include:

- Occupational Health and Safety rules at the construction site;
- Dust control efforts;
- Spill prevention and response;

- Project's Grievance Mechanism and the basic worker's rights; and
- Interaction rules with the local communities and how to deal with unauthorized visitors to the site.

In addition to all staff, all temporary visitors to the site will be required to undergo an abbreviated version of environmental awareness training/induction to ensure they too are aware of environmental requirements.

The ESHS Manager shall maintain records of trainings properly. These records should be reviewed periodically by the PIA and the Contractor.

11.4 E&S Commitments and Monitoring Measures

The E&S commitments and monitoring required for the project implementation are presented as a tabulated ESMP under Annex 12.

12 CONCLUSION

The Project of Al Ghabawi Septic tank facility is designed to receive influent wastewater from tankers transferring septage from the unsewered areas of Amman and Zarqa Governorates, in addition to sludge transported from the treatment plants of Salt, Fuheis, and Baqa'a. The proposed wastewater treatment process is a Conventional Activated Sludge process followed by sludge treatment using aerobic digestion. The WWTP will be designed to treat a future inflow of approximately 22,500 m^3/day up to the year 2045.

Based on the ESIA study outcomes, the Project will resolve issues of odour and traffic around the existing tanker receiving facility at Ain Ghazal as well as reduce the biological loading for AlSamra WWTP. At the Al Ghabawi, the Project will allow for availability of treated wastewater suitable for restricted irrigation purposes within the study area.

However, the EISA has identified a number of potentially significant risks associated with the operation of the proposed Al Ghabawi WWTP. These included risks to occupational health and safety, increase in traffic load within the surrounding road network, increase in illegal dumping of transported septage, and unplanned events related to chlorine gas release and fire hazards. These risks are considered to be manageable given the environmental and social management measures provided by the ESMP are followed. However, the remaining social impact of concern relates to the local community perceptions and their concerns from environmental impacts and public health impacts due to the implementation of the Project within the infrastructure services area and cumulative impacts on air quality and transportation and the increased local community perception of risk overtime if E&S management measures are not adopted.

At this stage of the Project the treated effluent is planned to be discharged into the nearby wadi. However, given the scarcity of water resources in Jordan and that the country's water strategy requires treating wastewater for reuse in irrigation, it is recommended that an irrigation reuse plan be prepared and adopted early on during the Project's operation phase. This is currently under consideration.

Overall, the Project implementation is not associated with any high E&S risk impacts and all identified E&S impacts were considered to be manageable with the adoption of the required mitigation and monitoring measures set out in the ESMP. But due to the local community perceptions and their concerns from the cumulative environmental and public health impacts, it is recommended that the future planning of the infrastructure services area of East Amman have a separate "Cumulative Impact Assessment" to quantify the impacts that are likely to persist in the area, and the degree to which they can be managed.

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Annex 1. ESIA Study Team

The ESIA study team members, their positions, educational qualifications and years of experience are presented in Table A1.1.

Table A1.1. ESIA team members

No.	Position	Name	Qualifications	Years of Experience
1.	Project Manager and ESIA Expert	Rola Quba'a	–PhD: Environmental and Water Resources Management –MSc: Environmental Technology –BSc: Environmental Health	20
2.	ESIA Specialist, Legislative and HSE Expert	Nazih Bandak	–MSc: Environmental Engineering –BSc: Civil Engineering	> 25
3.	Social and Gender Expert	Rasha Tomaira	–MBA: Management Emphasis –BSc: Environmental Health	13
4.	Social/ESIA/Land Acquisition and Resettlement Expert	Ashraf Maani	–BE: Civil and Environmental Engineer	13
5.	Biodiversity Expert	Anwar Halah	–BSc: Rangeland & Forestry, Natural Resources & Environment	19
6.	Social Researcher	Noora El Wer	- MSc, Applied Social Psychology - BSc, Psychology, emphasis in Social Psychology	13

Annex 2. Jordanian Standard JS 1145/2016 on Sludge

Table A11.1 Maximum Allowable Concentration Limits of Various Parameters in Sludge

Parameters and other conditions		Symbol		Concentration/Sludge type mg/kg dried weight (except mentioned)
		Class # 1	Class # 2	Class # 3
Arsenic	As	41	75	75
Cadmium	Cd	40	40	85
Chromium	Cr	900	900	3000
Copper	Cu	1500	3000	4300
Mercury	Hg	17	57	57
Molybdenum	Mo	75	75	75
Nickel	Ni	300	400	420
Selenium	Se	100	100	100
Lead	Pb	100	840	840
Zinc	Zn	2800	4000	7500
Moisture level	-	10*	40*	-
Total Faecal coliform	TFCC	1,000**	2,000,000**	-
Salmonella	-	3***	-	-
Nematode	-	1***	-	-
Virus	-	1****	-	-

Source: JS 1145: 2016

* Percentage

** Most probable number/gm or CFU/gm

*** one/4gm dry

**** unit/gm dry

Based on the classification of the treated sludge, the applications "reuse and disposal" are defined as follows:

- Class #1 and #2: sludge can only to be used to improve the soil quality in rangelands or disposed to landfills.
- Class #3: sludge is only allowed to be disposed to landfills.

Annex 3. Crop Water Requirements

Table A3.1 Crop water requirements for the green belt area

Month	ET0 (mm/day)	Kc	CWR (l/m^2)
Jan	1.5	0.5	0.75
Feb	2.1	0.5	1.05
Mar	3.1	0.5	1.55
Apr	4.6	0.5	2.3
May	6.2	0.5	3.1
Jun	7.3	0.5	3.65
Jul	7.6	0.5	3.8
Aug	6.9	0.5	3.45
Sep	5.5	0.5	2.75
Oct	3.8	0.5	1.9
Nov	2.5	0.5	1.25
Dec	1.6	0.5	0.8

CROP WATER REQUIREMENTS

ETo station: ZERQA
Rain station: ZERQA

Crop: Barley
Planting date: 15/10

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Oct	2	Init	0.30	0.93	5.6	0.1	5.5
Oct	3	Deve	0.31	0.84	9.2	1.9	7.3
Nov	1	Deve	0.54	1.26	12.6	4.0	8.6
Nov	2	Deve	0.87	1.68	16.8	5.7	11.1
Nov	3	Mid	1.11	1.91	19.1	6.7	12.4
Dec	1	Mid	1.11	1.72	17.2	8.1	9.1
Dec	2	Mid	1.11	1.50	15.0	9.4	5.6
Dec	3	Mid	1.11	1.48	16.3	9.2	7.1
Jan	1	Mid	1.11	1.47	14.7	8.9	5.8
Jan	2	Late	1.01	1.31	13.1	8.9	4.3
Jan	3	Late	0.71	1.06	11.7	9.1	2.6
Feb	1	Late	0.41	0.69	6.9	9.6	0.0
Feb	2	Late	0.25	0.47	0.5	1.0	0.5
					158.6	82.5	79.8

CROP WATER REQUIREMENTS

ETo station: ZERQA
Rain station: ZERQA

Crop: ALFALFA-perennial
Planting date: 01/01

Month	Decade	Stage	Kc coeff	ETc mm/day	ETc mm/dec	Eff rain mm/dec	Irr. Req. mm/dec
Jan	1	Init	0.40	0.53	5.3	8.9	0.0
Jan	2	Init	0.40	0.52	5.2	8.9	0.0
Jan	3	Init	0.40	0.60	6.6	9.1	0.0
Feb	1	Init	0.40	0.68	6.8	9.6	0.0
Feb	2	Init	0.40	0.75	7.5	9.9	0.0
Feb	3	Init	0.40	0.87	7.0	9.0	0.0
Mar	1	Init	0.40	0.99	9.9	8.2	1.7
Mar	2	Init	0.40	1.11	11.1	7.5	3.6
Mar	3	Init	0.40	1.27	13.9	5.5	8.4
Apr	1	Init	0.40	1.42	14.2	3.0	11.2
Apr	2	Init	0.40	1.58	15.8	1.0	14.8
Apr	3	Init	0.40	1.73	17.3	1.0	16.3
May	1	Init	0.40	1.88	18.8	1.2	17.6
May	2	Init	0.40	2.03	20.3	1.0	19.3
May	3	Deve	0.40	2.17	23.8	0.7	23.2
Jun	1	Deve	0.52	2.95	29.5	0.1	29.4
Jun	2	Deve	0.70	4.20	42.0	0.0	42.0
Jun	3	Mid	0.88	5.31	53.1	0.0	53.1
Jul	1	Mid	0.94	5.75	57.5	0.0	57.5
Jul	2	Mid	0.94	5.79	57.9	0.0	57.9
Jul	3	Mid	0.94	5.59	61.4	0.0	61.4
Aug	1	Mid	0.94	5.39	53.9	0.0	53.9
Aug	2	Mid	0.94	5.19	51.9	0.0	51.9
Aug	3	Mid	0.94	4.91	54.0	0.0	54.0
Sep	1	Mid	0.94	4.62	46.2	0.0	46.2
Sep	2	Mid	0.94	4.34	43.4	0.0	43.4
Sep	3	Mid	0.94	3.87	38.7	0.1	38.6
Oct	1	Mid	0.94	3.39	33.9	0.1	33.9
Oct	2	Mid	0.94	2.92	29.2	0.1	29.1
Oct	3	Mid	0.94	2.55	28.1	1.9	26.1
Nov	1	Mid	0.94	2.18	21.8	4.0	17.8
Nov	2	Mid	0.94	1.82	18.2	5.7	12.5
Nov	3	Late	0.94	1.63	16.3	6.7	9.6
Dec	1	Late	0.92	1.42	14.2	8.1	6.1
Dec	2	Late	0.90	1.21	12.1	9.4	2.8
Dec	3	Late	0.88	1.17	12.9	9.2	3.6
					959.7	129.8	846.9

Annex 4. MoEnv Response and Approval Letters on the Project's Permit Application

وزارة البيئة

الرقم ٩،٢٣١٥/٤
التاريخ
الموافق ١٥/١٠/٢٠١٩م

معالي وزير المياه والري

تحية طيبة وبعد،،

إشارة لكتابكم رقم BOT/19/945 تاريخ 2019/9/9 المتضمن طلب الموافقة البيئية على موقع مشروع محطة معالجة مياه صهاريج النضح في الغباوي على قطعة الارض رقم (63) حوض رقم (1) من اراضي الماضونة/عمان .

أرجو العلم بأنه قد تم عرض الموضوع على لجنة التراخيص المركزية بتاريخ 2019/10/14 حيث أوصت اللجنة بالطلب من اصحاب العلاقة تقديم دراسة تقييم اثر بيئي شامل للمشروع قبل البدء بأي نشاط يتعلق بالمشروع علما بأن قائمة بالمكاتب الاستشارية المعتمدة لاجراء دراسات تقييم الاثر البيئي موجودة على موقع الوزارة:

www.moenv.gov.jo

وتفضلوا بقبول فائق الاحترام،،،

وزير الزراعة
ووزير البيئة

المهندس ابراهيم الشحاحدة

المهندس أحمد القطارنه
الأمين العام

المملكة الأردنية الهاشمية
هاتف: ٥٥٦٠١١٣ ٦ ٩٦٢+ فاكس: ٥٥١٦٣٧٧ ٦ ٩٦٢+ ص.ب: ١٤٠٨ عمان ١١١٩٤١ الأردن . الموقع الإلكتروني: www.moenv.gov.jo

وزارة البيئة

الرقم ٤/٧/٢٨٦٣
التاريخ
الموافق ١٨/٥/٢٠٢٠

السادة شركة المستشار للهندسة

تحية طيبة و بعد،،

إشارة لكتابكم رقم ت م/2020/886/1833 تاريخ 2020/5/10 ومرفقه تقرير دراسة تقييم الأثر البيئي لمشروع انشاء محطة معالجة صهاريج النضح العائد للسادة سلطة المياه على قطعة الأرض رقم (63) حوض (1) من أراضي الغباوي- الماضونة/ محافظة العاصمة.

أوافق على تقرير الدراسة اعلاه شريطة الالتزام بالاجراءات الوقائية الواردة في الدراسة و ذلك استناداً إلى توصية اللجنة الفنية لمراجعة دراسات تقييم الأثر البيئي للمشاريع.

وتفضلوا بقبول فائق الاحترام،،،

وزيـــــــــر البيئـــــــة
ووزيـــــر الزراعـــــة المكلف

د. صالـــــح الخرابشـــــة

المهندس احمد القضاة
الأمين العام

المملكة الأردنية الهاشمية
هاتف: ٠٦٥٥٦٠١١٣ +٩٦٢ فاكس: ٠٦٥٥١٦٣٧٧ +٩٦٢ ص.ب: ٢٤٠٨ عمان ١١١٩٤١ الأردن . الموقع الإلكتروني: www.moenv.gov.jo

Annex 5. Air Quality Measurement Results as part of this ESIA study

Hima حمى
Hima Laboratory for Environmental Testing
مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

Test Report

Customer Name: Sustainable Alternatives
Customer Address: Amman
Phone: 06 5527742

Hima Laboratory for Environmental Testing
Al-Fuhais – Shaker Circle/ Al Fares complex
06 4721230

Description of Service(s): Ambient air monitoring
Monitoring Site(s): Al Ghabawi
Number of Locations: 1- location
Date of Intervention: 01-08/12/2019

Date / Time	Parameter	Result							Legal Limits JS 1140:2006	Test Method
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7		
01 – 08/12/2019	$PM_{2.5}$ ($\mu g/m^3$)	44.42	13.91	17.90	28.63	23.89	7.45	10.47	65 $\mu g/m^3$	JS 1140:2006
	H_2S (ppm)	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.01 ppm	
	NH_3 ($\mu g/m^3$)	253.21	254.60	240.74	235.77	246.21	250.90	256.95	270 $\mu g/m^3$	
	TVOCs ($\mu g/m^3$)	3.53	2.84	3.37	2.88	2.95	2.50	2.18	---	Photo Ionization Detection (PID)

The measurements started at 2:00 pm on December 01, 2019.

Form No. QF5.10-1 Rev. 1.1

Page 1 of 13

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Noise Measurements (Daytime Average)

Date / Time	Result (dBA)	Legal Limits [1]	Test Method
01/12/2019	51.27	65.0 dBA	ANSI S1.13
02/12/2019	56.71		
03/12/2019	52.61		
04/12/2019	54.45		
05/12/2019	55.66		
06/12/2019	56.35		
07/12/2019	56.09		
08/12/2019	---		

[1] Jordanian Guidelines for Prevention of Noise, 2003

Noise Measurements (Nighttime Average)

Date / Time	Result (dBA)	Legal Limits [1]	Test Method
01/12/2019	---	55.0 dBA	ANSI S1.13
02/12/2019	38.77		
03/12/2019	34.40		
04/12/2019	38.08		
05/12/2019	38.21		
06/12/2019	44.56		
07/12/2019	40.35		
08/12/2019	37.76		

[1] Jordanian Guidelines for Prevention of Noise, 2003

H_2S Hourly Average Measurements

Date / Time	Hour	H_2S Result (ppm)	Legal Limits JS 1140:2006	Test Method
01/12/2019	2:00 PM	0.030	0.03	JS 1140:2006
	3:00 PM	0.026		
	4:00 PM	0.010		
	5:00 PM	0.020		
	6:00 PM	0.030		
	7:00 PM	0.018		
	8:00 PM	0.020		
	9:00 PM	0.010		
	10:00 PM	0.032		
	11:00 PM	0.026		
02/12/2019	12:00 AM	0.024		
	1:00 AM	0.021		
	2:00 AM	0.030		
	3:00 AM	0.023		

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مختبر حمى للفحوصات البيئية

	4:00 AM	0.030		
	5:00 AM	0.018		
	6:00 AM	0.020		
	7:00 AM	0.016		
	8:00 AM	0.038		
	9:00 AM	0.046		
	10:00 AM	0.020		
	11:00 AM	0.034		
	12:00 PM	0.020		
	1:00 PM	0.029		
	2:00 PM	0.030		
	3:00 PM	0.023		
	4:00 PM	0.028		
	5:00 PM	0.022		
	6:00 PM	0.042		
	7:00 PM	0.030		
	8:00 PM	0.029		
	9:00 PM	0.029		
	10:00 PM	0.018		
	11:00 PM	0.020		
03/12/2019	12:00 AM	0.019		
	1:00 AM	0.021		
	2:00 AM	0.031		
	3:00 AM	0.023		
	4:00 AM	0.026		
	5:00 AM	0.030		
	6:00 AM	0.031		
	7:00 AM	0.020		
	8:00 AM	0.040		
	9:00 AM	0.036		
	10:00 AM	0.038		
	11:00 AM	0.039		
	12:00 PM	0.034		
	1:00 PM	0.024		
	2:00 PM	0.021		
	3:00 PM	0.022		
	4:00 PM	0.035		
	5:00 PM	0.026		
	6:00 PM	0.024		
	7:00 PM	0.037		
	8:00 PM	0.027		
	9:00 PM	0.024		

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	10:00 PM	0.016
	11:00 PM	0.028
04/12/2019	12:00 AM	0.034
	1:00 AM	0.026
	2:00 AM	0.022
	3:00 AM	0.020
	4:00 AM	0.025
	5:00 AM	0.027
	6:00 AM	0.026
	7:00 AM	0.030
	8:00 AM	0.027
	9:00 AM	0.018
	10:00 AM	0.010
	11:00 AM	0.012
	12:00 PM	0.028
	1:00 PM	0.019
	2:00 PM	0.024
	3:00 PM	0.024
	4:00 PM	0.016
	5:00 PM	0.011
	6:00 PM	0.037
	7:00 PM	0.024
	8:00 PM	0.033
	9:00 PM	0.031
	10:00 PM	0.030
	11:00 PM	0.025
05/12/2019	12:00 AM	0.026
	1:00 AM	0.030
	2:00 AM	0.020
	3:00 AM	0.017
	4:00 AM	0.019
	5:00 AM	0.010
	6:00 AM	0.008
	7:00 AM	0.014
	8:00 AM	0.019
	9:00 AM	0.010
	10:00 AM	0.017
	11:00 AM	0.011
	12:00 PM	0.020
	1:00 PM	0.016
	2:00 PM	0.015
	3:00 PM	0.013

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	4:00 PM	0.009
	5:00 PM	0.008
	6:00 PM	0.020
	7:00 PM	0.007
	8:00 PM	0.002
	9:00 PM	0.001
	10:00 PM	0.024
	11:00 PM	0.051
06/12/2019	12:00 AM	0.042
	1:00 AM	0.021
	2:00 AM	0.015
	3:00 AM	0.018
	4:00 AM	0.019
	5:00 AM	0.014
	6:00 AM	0.018
	7:00 AM	0.014
	8:00 AM	0.026
	9:00 AM	0.019
	10:00 AM	0.010
	11:00 AM	0.018
	12:00 PM	0.001
	1:00 PM	0.014
	2:00 PM	0.012
	3:00 PM	0.013
	4:00 PM	0.020
	5:00 PM	0.014
	6:00 PM	0.016
	7:00 PM	0.021
	8:00 PM	0.020
	9:00 PM	0.018
	10:00 PM	0.027
	11:00 PM	0.022
07/12/2019	12:00 AM	0.024
	1:00 AM	0.025
	2:00 AM	0.021
	3:00 AM	0.015
	4:00 AM	0.019
	5:00 AM	0.010
	6:00 AM	0.022
	7:00 AM	0.006
	8:00 AM	0.006
	9:00 AM	0.023

Form No. QF5.10-1 Rev. 1.1

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	10:00 AM	0.015		
	11:00 AM	0.015		
	12:00 PM	0.010		
	1:00 PM	0.007		
	2:00 PM	0.020		
	3:00 PM	0.010		
	4:00 PM	0.010		
	5:00 PM	0.003		
	6:00 PM	0.006		
	7:00 PM	0.004		
	8:00 PM	0.011		
	9:00 PM	0.022		
	10:00 PM	0.002		
	11:00 PM	0.030		
08/12/2019	12:00 AM	0.019		
	1:00 AM	0.020		
	2:00 AM	0.018		
	3:00 AM	0.012		
	4:00 AM	0.015		
	5:00 AM	0.015		
	6:00 AM	0.010		
	7:00 AM	0.007		
	8:00 AM	0.023		
	9:00 AM	0.010		
	10:00 AM	0.020		

Legal Limits are the maximum allowable limits
The test results relate only to the items tested

Hima Lab
For Environmental Testing

Lab Manager: Eng. Sana Allabadi

Signature:

Form No. QF5.10-1 Rev. 1.1

Hima حمى
Hima Laboratory for Environmental Testing
مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

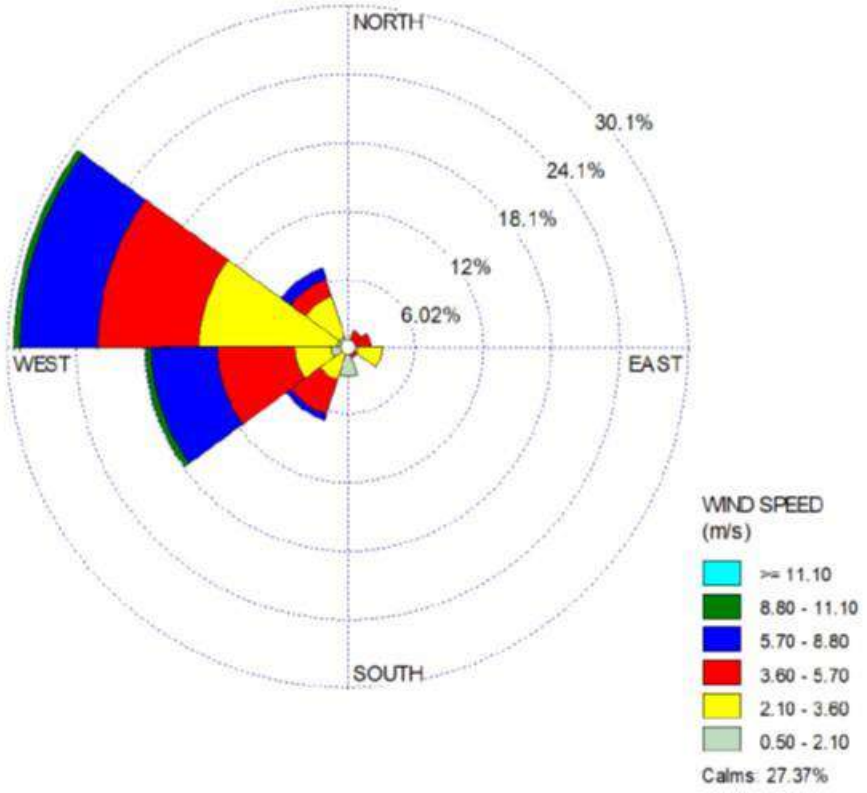

Figure 1 Wind Rose During Measurement Period

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Report Number: 257/2019
Issue Date: 09/12/2019

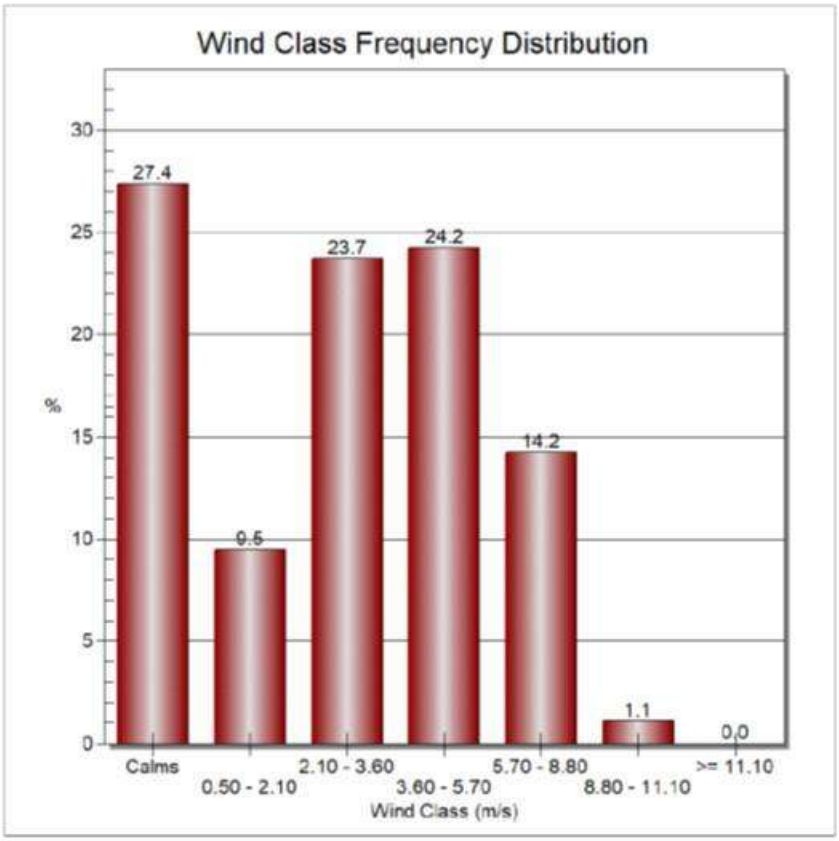

Figure 2 Wind Class Frequency Distribution

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Hima حمى
Hima Laboratory for Environmental Testing
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Report Number: 257/2019
Issue Date: 09/12/2019

Air Quality Monitoring Results (Dec. 01 – Dec. 08, 2019)

Date	Hour	$PM_{2.5}$	H_2S	NH_3	VOCs	Noise
		µg/m³	ppm	µg/m³	µg/m³	dBA
01/12/2019	2:00 PM	82.59	0.030	265.8	5.24	54.89
	3:00 PM	70.45	0.026	267.2	7.52	55.29
	4:00 PM	53.98	0.010	264.6	4.83	58.24
	5:00 PM	58.31	0.020	258.3	3.54	54.54
	6:00 PM	53.59	0.030	284.3	3.32	56.69
	7:00 PM	48.06	0.018	262.7	2.62	55.69
	8:00 PM	43.06	0.020	243.5	6.82	53.74
	9:00 PM	47.31	0.010	299.1	2.42	35.54
	10:00 PM	64.87	0.032	236.7	2.42	36.79
	11:00 PM	120.44	0.026	253.3	2.64	37.69
02/12/2019	12:00 AM	111.56	0.024	262.3	2.26	36.29
	1:00 AM	34.65	0.021	288.6	2.42	36.09
	2:00 AM	14.32	0.030	276.5	2.42	32.59
	3:00 AM	27.26	0.023	218.4	2.64	33.84
	4:00 AM	28.87	0.030	282.4	2.42	38.04
	5:00 AM	24.94	0.018	263.3	2.42	35.74
	6:00 AM	35.55	0.020	268.4	1.54	48.39
	7:00 AM	28.68	0.016	246.8	2.86	50.24
	8:00 AM	27.03	0.038	228.3	3.64	59.39
	9:00 AM	18.81	0.046	227.7	2.67	62.84
	10:00 AM	19.97	0.020	217.6	2.48	57.39
	11:00 AM	18.89	0.034	224.3	7.04	56.11
	12:00 PM	18.26	0.020	213.2	4.84	59.34
	1:00 PM	14.56	0.029	223.7	3.74	58.24
	2:00 PM	13.85	0.030	225.4	3.42	59.8
	3:00 PM	12.96	0.023	271.7	2.61	58.87
	4:00 PM	13.99	0.028	235.4	2.88	57.45
	5:00 PM	13.56	0.022	278.3	2.69	56.15
	6:00 PM	10.71	0.042	258.2	2.74	58.1
	7:00 PM	3.57	0.030	248.6	2.84	57.5
	8:00 PM	5.37	0.029	253.2	2.32	57.4
	9:00 PM	4.26	0.029	261.4	1.92	55.65
	10:00 PM	14.22	0.018	255.4	2.72	36.35
	11:00 PM	15.15	0.020	262.6	1.94	33.15
03/12/2019	12:00 AM	18.68	0.019	234.3	1.52	35.1

Form No. QF5.10-1 Rev. 1.1

Hima حمى
Hima Laboratory for Environmental Testing
مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

Date	Hour	$PM_{2.5}$	H_2S	NH_3	VOCs	Noise
		µg/m³	ppm	µg/m³	µg/m³	dBA
	1:00 AM	19.77	0.021	283.7	1.38	31.65
	2:00 AM	16.47	0.031	268.7	4.62	34.45
	3:00 AM	12.15	0.023	262.7	1.76	33.65
	4:00 AM	12.71	0.026	233.5	1.54	36.67
	5:00 AM	13.34	0.030	244.5	7.48	35.52
	6:00 AM	12.68	0.031	279.2	2.86	35.3
	7:00 AM	16.77	0.020	236.4	5.08	34.1
	8:00 AM	15.59	0.040	224.5	3.28	53.11
	9:00 AM	17.68	0.036	227.8	1.32	45.15
	10:00 AM	19.34	0.038	248.8	1.58	51.24
	11:00 AM	19.48	0.039	235.3	3.22	58.35
	12:00 PM	17.79	0.034	279.4	3.12	53.25
	1:00 PM	13.79	0.024	301.4	3.26	57.35
	2:00 PM	12.78	0.021	236.7	3.16	57.98
	3:00 PM	13.11	0.022	293.6	3.74	55.35
	4:00 PM	18.81	0.035	280.1	3.96	57.43
	5:00 PM	15.47	0.026	254.4	2.86	56.65
	6:00 PM	9.57	0.024	262.4	2.64	54.51
	7:00 PM	9.22	0.037	278.5	4.62	55.95
	8:00 PM	14.26	0.027	289.4	3.24	56.17
	9:00 PM	17.94	0.024	228.6	2.62	39.05
	10:00 PM	28.26	0.016	293.3	2.46	37.65
	11:00 PM	26.74	0.028	248.9	3.76	36.53
04/12/2019	12:00 AM	25.13	0.034	243.3	2.34	34.46
	1:00 AM	17.47	0.026	187.6	2.38	32.27
	2:00 AM	9.55	0.022	198.3	3.63	35.35
	3:00 AM	7.26	0.020	173.2	2.64	31.45
	4:00 AM	10.71	0.025	168.1	3.59	32.35
	5:00 AM	10.15	0.027	221.9	4.27	32.25
	6:00 AM	11.59	0.026	224.2	3.74	54.54
	7:00 AM	13.85	0.030	241.3	2.33	53.55
	8:00 AM	19.15	0.027	244.9	4.47	53.55
	9:00 AM	22.77	0.018	236.4	4.72	54.55
	10:00 AM	21.81	0.010	263.8	3.79	54.35
	11:00 AM	20.52	0.012	249.9	2.68	53.35
	12:00 PM	23.15	0.028	243.6	2.69	54.42
	1:00 PM	30.79	0.019	215.4	4.43	55.25

Hima حمى
Hima Laboratory for Environmental Testing
مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

Date	Hour	$PM_{2.5}$	H_2S	NH_3	VOCs	Noise
		µg/m³	ppm	µg/m³	µg/m³	dBA
	2:00 PM	33.81	0.024	266.8	3.06	54.05
	3:00 PM	40.29	0.024	188.5	4.64	54.01
	4:00 PM	21.66	0.016	104.2	3.51	54.35
	5:00 PM	15.77	0.011	225.28	3.44	55.23
	6:00 PM	13.22	0.037	261.3	1.21	55.45
	7:00 PM	9.74	0.024	274.1	2.62	56.73
	8:00 PM	12.45	0.033	243.3	2.46	52.98
	9:00 PM	20.61	0.031	218.7	2.68	43.45
	10:00 PM	30.12	0.030	215.7	3.39	35.01
	11:00 PM	56.77	0.025	148.5	3.3	32.25
05/12/2019	12:00 AM	71.03	0.026	167.1	2.2	37.8
	1:00 AM	54.19	0.030	258.2	2.42	34.93
	2:00 AM	24.67	0.020	231.1	5.94	41.22
	3:00 AM	10.09	0.017	238.3	2.42	36.65
	4:00 AM	9.16	0.019	281.2	2.86	34.84
	5:00 AM	8.58	0.010	282.6	1.08	36.85
	6:00 AM	13.38	0.008	255.5	2.86	42.49
	7:00 AM	18.41	0.014	304.6	2.42	46.87
	8:00 AM	21.93	0.019	237.2	2.86	48.44
	9:00 AM	24.35	0.010	286.2	2.42	54.64
	10:00 AM	42.41	0.017	252.5	2.42	55.65
	11:00 AM	51.61	0.011	208.2	2.86	57.76
	12:00 PM	42.22	0.020	296.1	1.52	59.78
	1:00 PM	40.66	0.016	213.3	4.62	62.55
	2:00 PM	44.19	0.015	261.7	2.64	67.54
	3:00 PM	35.16	0.013	265.4	3.74	51.15
	4:00 PM	34.9	0.009	251.3	4.62	59.22
	5:00 PM	32.25	0.008	265.8	1.42	56.48
	6:00 PM	23.19	0.020	263.7	2.86	57.1
	7:00 PM	20.93	0.007	275.4	3.96	53.25
	8:00 PM	19.14	0.002	267.9	1.86	58.91
	9:00 PM	21.45	0.001	225.3	2.42	48.85
	10:00 PM	26.29	0.024	223.6	2.64	43.6
	11:00 PM	51.9	0.051	255.8	1.53	49.7
06/12/2019	12:00 AM	43.25	0.042	247.8	3.55	49.24
	1:00 AM	22.9	0.021	251.6	2.56	39.75
	2:00 AM	27.74	0.015	235.3	3.78	35.85

Hima حمى
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مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

Date	Hour	$PM_{2.5}$	H_2S	NH_3	VOCs	Noise
		µg/m³	ppm	µg/m³	µg/m³	dBA
	3:00 AM	18.93	0.018	266.7	3.36	39.76
	4:00 AM	12.87	0.019	212.5	3.55	36.69
	5:00 AM	20.8	0.014	257.6	3.24	44.86
	6:00 AM	18.58	0.018	239.3	3.13	46.32
	7:00 AM	17.29	0.014	249.5	3.28	58.88
	8:00 AM	17.71	0.026	223.2	2.32	58.28
	9:00 AM	12.22	0.019	219.1	2.56	54.55
	10:00 AM	12.51	0.010	231.5	3.14	59.76
	11:00 AM	11.19	0.018	222.4	2.16	57.38
	12:00 PM	15.77	0.001	227.3	3.16	58.68
	1:00 PM	12.25	0.014	269.3	3.23	54.35
	2:00 PM	14.09	0.012	304.2	3.44	54.6
	3:00 PM	5.03	0.013	247.4	3.66	57.11
	4:00 PM	2.36	0.020	231.2	3.53	56.87
	5:00 PM	1.81	0.014	309.3	5.46	55.94
	6:00 PM	2.61	0.016	301.2	2.52	57.17
	7:00 PM	3.71	0.021	238.1	3.84	59.29
	8:00 PM	3.94	0.020	252.8	2.36	59.72
	9:00 PM	4.78	0.018	227.6	4.28	52.71
	10:00 PM	6.85	0.027	254.4	2.24	48.91
	11:00 PM	3.49	0.022	204.5	1.86	40.71
07/12/2019	12:00 AM	5.22	0.024	244.6	1.3	39.44
	1:00 AM	7.39	0.025	264.5	1.3	34.05
	2:00 AM	6.43	0.021	212.5	2.86	36.75
	3:00 AM	8.66	0.015	215.3	1.96	38.75
	4:00 AM	9.97	0.019	255.6	1.18	33.67
	5:00 AM	8.25	0.010	249.5	2.74	39.61
	6:00 AM	9.16	0.022	246.2	1.84	48.88
	7:00 AM	8.75	0.006	291.1	2.18	51.25
	8:00 AM	10.21	0.006	251.6	1.74	55.29
	9:00 AM	9.52	0.023	254.3	2.62	60.52
	10:00 AM	10.25	0.015	239.5	1.64	63.04
	11:00 AM	16.23	0.015	233.6	2.64	58.32
	12:00 PM	10.71	0.010	259.3	1.82	56.47
	1:00 PM	9.37	0.007	233.4	1.08	58.77
	2:00 PM	8.39	0.020	245.2	1.64	56.67
	3:00 PM	6.76	0.010	221.8	3.16	54.64

Hima حمى
Hima Laboratory for Environmental Testing
مختبر حمى للفحوصات البيئية

Report Number: 257/2019
Issue Date: 09/12/2019

Date	Hour	$PM_{2.5}$	H_2S	NH_3	VOCs	Noise
		µg/m³	ppm	µg/m³	µg/m³	dBA
	4:00 PM	5.64	0.010	270.8	3.24	54.03
	5:00 PM	7.93	0.003	259.5	3.31	56.65
	6:00 PM	3.95	0.006	275.6	2.86	59.74
	7:00 PM	4.71	0.004	261.3	3.74	56.86
	8:00 PM	8.09	0.011	237.9	1.74	58.15
	9:00 PM	11.26	0.022	296.4	1.96	51.23
	10:00 PM	16.45	0.002	300.3	1.08	41.01
	11:00 PM	12.65	0.030	304.2	2.6	36.87
08/12/2019	12:00 AM	17.23	0.019	235.7	2.62	34.73
	1:00 AM	17.44	0.020	264.3	1.86	35.62
	2:00 AM	11.54	0.018	263.5	1.62	31.92
	3:00 AM	10.51	0.012	223.7	2.08	32.87
	4:00 AM	11.39	0.015	247.3	2.3	36.63
	5:00 AM	9.48	0.015	201.2	1.52	35.13
	6:00 AM	13.61	0.010	207.5	1.42	39.83
	7:00 AM	10.17	0.007	265.7	1.64	56.26
	8:00 AM	11.21	0.023	275.5	1.64	55.53
	9:00 AM	9.19	0.010	270.3	1.86	54.33
	10:00 AM	12.23	0.020	268.32	1.94	58.36

Annex 6. Air Quality data from Previous Measurements by Al Ghabawi Landfill Project and the Ministry of Environment

This annex presents the air quality and noise level measurements from the following sources:

- Air quality and noise measurement results carried out by Al Rawabi at GAM solid waste landfill site.
- Air quality data for Ghabawi area obtained from the Directorate of Monitoring and Environmental Assessment at the MoEnv.

Air Quality and Noise Level data from Previous Measurements by Al Ghabawi Landfill Project

REEC

Al RAWABI Environment & Energy Consultancies

الروابي لإستشارات البيئة و الطاقة

Test Report No.(15 / 2018)

Client Name: ECO Consult	No. Pages : 14
Client Address: Shmeisani - Amman	Location : Ghabawi
Date of Testing : Sep./2018	Date :23/9/2018
No. of samples : 5 sites	Methodology of Test: JS 1140/2006
	conditions : Temp.26 C° ,Humidity : 54%

Attached you will find the results of Gaseous Emissions (SO2, NH3, H2S, VOC, NO2) and Dust Emissions (TSP, PM10, PM2.5) Measurements conducted at Ghabawi on Sep.2018.

Please See Attached Results

Notes:

-Test Report is only valid with the division stamp and signature.

-The test results relate only to the items tested.

Test Report No.(15 /2018)

Ghabawi - Air Data/ Gaseous Emissions Results

Locations 1 to 5

Monitoring period: 16 Augest - 2018 – 31 Augest - 2018

Jordanian Standard for Ambient Air Quality No. 1140, Year 2006 (JS 1140/2006):

Parameter	Maximum Allowable Limit (1hour)	Maximum Allowable Limit (24hour)
SO2	0.30 ppm	0.14 ppm
NH3	Not available	0.388 ppm
H2S	0.03 ppm	0.01ppm
VOC	Not available	Not available
NO2	0.21 ppm	0.08 ppm

REEC

Al RAWABI Environment & Energy Consultancies

الروابي لإستشارات البيئة و الطاقة

Location 1																									
Date & Time	Day 1					Day 2					Day 3					Day 4					Day 5				
	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2
8-9 AM	0.073	0.2	0.0028	0.1	0	0.09	0	0.0025	0.1	0.01	0.089	0	0.0028	0	0.01	0.101	0.1	0.0005	0.1	0	0.094	0.3	0.00273	0.2	0
9-10 AM	0.087	0.1	0.00283	0	0	0.078	0.4	0.0005	0	0	0.077	0.1	0.0004	0.1	0	0.077	0.4	0.0011	0.2	0.01	0.056	0.3	0.00113	0.1	0.01
10-11 AM	0.059	0.2	0.00205	0.2	0.01	0.065	0.4	0.0019	0.2	0.02	0.061	0.1	0.0019	0.1	0.01	0.061	0.4	0.0019	0	0	0.11	0.5	0.00276	0.3	0
11-12 PM	0.101	0.3	0.00005	0.1	0	0.1	0.2	0.0007	0	0	0.023	0.2	0.0015	0.2	0	0.092	0.2	0.0006	0.1	0.02	0.097	0.1	0.00171	0	0.01
12-1 PM	0.127	0.1	0.00173	0	0.01	0.127	0.3	0.0024	0	0.01	0.115	0	0.0009	0	0.02	0.096	0.3	0.0004	0	0	0.103	0.2	0.00056	0	0
1-2 PM	0.159	0.1	0.00005	0.1	0	0.143	0.2	0.0009	0.3	0	0.106	0.4	0.0009	0.4	0	0.101	0.2	0.0005	0.2	0	0.1	0.3	0.00036	0.2	0.02
2-3 PM	0.127	0.2	0.0017	0	0.01	0.09	0.3	0.0003	0.1	0.02	0.143	0.2	0.0008	0.2	0	0.094	0.4	0.0003	0.1	0.01	0.096	0.3	0.0019	0.1	0
3-4 PM	0.159	0.1	0.0022	0.2	0.02	0.045	0.5	0.0013	0.2	0.02	0.111	0.1	0.0011	0.1	0	0.048	0.2	0.0015	0	0	0.085	0.5	0.0015	0	0
4-5 PM	0.025	0.2	0.0018	0.2	0	0.073	0.1	0.0029	0.3	0	0.09	0.3	0.0012	0.3	0.01	0.037	0.1	0.003	0	0.01	0.039	0.4	0.003	0.1	0.01
5-6 PM	0.033	0.3	0.00006	0.1	0	0.036	0.4	0.002	0.1	0.01	0.087	0.3	0.0015	0.3	0	0.039	0.3	0.0026	0.2	0	0.101	0.1	0.0025	0.3	0
6-7 PM	0.014	0.1	0.0011	0.2	0.01	0.11	0.2	0.0018	0	0.02	0.06	0.1	0.0023	0.1	0.01	0.115	0.2	0.0018	0	0.01	0.134	0.3	0.0017	0.1	0.02
7-8 PM	0.009	0.1	0.0008	0.2	0	0.037	0.1	0.0017	0	0	0.025	0.2	0.0028	0.2	0.02	0.038	0.3	0.0014	0.1	0	0.052	0.2	0.0012	0	0
8-9 PM	0.063	0.2	0.0009	0.3	0	0.101	0.3	0.0007	0	0	0.115	0	0.003	0	0	0.11	0.3	0.0009	0.1	0	0.013	0.1	0.0018	0	0
9-10 PM	0.12	0.1	0.0021	0.1	0.01	0.128	0.1	0.0028	0.1	0	0.1	0.2	0.0015	0.2	0	0.14	0.1	0.0026	0.1	0	0.087	0.3	0.0026	0.2	0.03
10-11 PM	0.111	0.2	0.0023	0.2	0	0.033	0.3	0.0004	0.2	0	0.014	0.1	0.0029	0.1	0.01	0.037	0.2	0.00099	0	0.02	0.037	0.4	0.00086	0	0
11-12 AM	0.093	0.3	0.0018	0.1	0.01	0.065	0.2	0.0007	0.3	0	0.11	0	0.0026	0	0.01	0.066	0.3	0.0021	0.3	0	0.06	0.3	0.00213	0.2	0
12-1 AM	0.077	0.1	0.0013	0.3	0	0.127	0.3	0.0015	0.3	0.01	0.07	0.3	0.0005	0.3	0	0.11	0.5	0.0022	0.1	0	0.114	0.2	0.00155	0.1	0.01
1-2 AM	0.083	0.2	0.0017	0.2	0	0.131	0.4	0.0014	0.1	0	0.06	0.2	0.0013	0.2	0	0.067	0.3	0.0016	0.2	0	0.093	0.3	0.00178	0.2	0
2-3 AM	0.123	0.5	0.0025	0.1	0.01	0.114	0.5	0.0025	0.1	0	0.065	0.1	0.0012	0.1	0.02	0.14	0.1	0.0007	0.1	0.01	0.13	0.1	0.0006	0.3	0
3-4 AM	0.066	0.3	0.0028	0	0	0.111	0.1	0.0028	0.3	0.02	0.111	0	0.0021	0	0	0.087	0.2	0.0004	0	0	0.084	0.3	0.00067	0	0.01
4-5 AM	0.043	0.3	0.0014	0.2	0	0.108	0.2	0.0014	0	0.01	0.108	0	0.0025	0	0	0.099	0.4	0.0018	0.1	0	0.077	0.2	0.00185	0.2	0
5-6 AM	0.011	0.4	0.0009	0.3	0.02	0.103	0.3	0.0021	0	0	0.103	0.3	0.0026	0.3	0.01	0.09	0.5	0.0026	0.2	0	0.034	0.1	0.0025	0.1	0
6-7 AM	0.032	0.3	0.001	0.1	0	0.093	0.1	0.0007	0.1	0	0.093	0.1	0.0006	0.1	0	0.091	0.4	0.0007	0.1	0.2	0.105	0.3	0.00076	0.3	0.03
7-8 AM	0.145	0.1	0.0021	0.2	0	0.019	0.2	0.0017	0.2	0	0.054	0	0.0026	0	0	0.02	0.5	0.0019	0.2	0	0.023	0.2	0.00187	0.1	0.01
Max Hou	0.159	0.5	0.00283	0.3	0.02	0.143	0.5	0.0029	0.3	0.02	0.143	0.4	0.003	0.4	0.02	0.14	0.5	0.003	0.3	0.2	0.134	0.5	0.003	0.3	0.03
24 hr avg	0.081	0.208	0.00158	0.146	0.005	0.089	0.254	0.0016	0.125	0.006	0.083	0.138	0.0017	0.138	0.005	0.0815	0.287	0.0014	0.104	0.0121	0.0801	0.279	0.00167	0.129	0.007

All above concentrations are in ppm

Location 2																										
Date & Time	Day 1					Day 2					Day 3					Day 4					Day 5				
	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2
8-9 AM	0.11	0.4	0.0005	0	0	0.1	0.3	0.0023	0	0	0.01	1.2	0.003	0	0.02	0.07	0.3	0.00133	0.2	0.01	0.1	0.3	0.0017	0.1	0.01
9-10 AM	0.102	0.5	0.0009	0	0.01	0.073	0.2	0.0015	0.2	0.01	0.094	1.2	0.002	0.2	0.01	0.103	0.3	0.00254	0.1	0.02	0.1	0.2	0.0009	0.2	0
10-11 AM	0.01	0.8	0.0013	0.1	0	0.063	0.7	0.0013	0.1	0	0.034	0.9	0.003	0	0.01	0.065	0.4	0.00167	0	0	0.07	0.4	0.0021	0	0.02
11-12 PM	0.056	0.4	0.0004	0	0.03	0.096	0.3	0.0009	0	0.01	0.022	0.2	0.003	0.1	0.03	0.14	0.3	0.00033	0.2	0.01	0.025	0.1	0.0016	0.1	0.01
12-1 PM	0.023	0.9	0.0025	0.1	0	0.101	0.9	0.0003	0.2	0.02	0.028	1.3	0.002	0	0.02	0.105	0.1	0.00176	0	0.02	0.1	0.3	0.0008	0	0.01
1-2 PM	0.101	0.4	0.0006	0.2	0	0.105	0.3	0.0013	0.1	0.01	0.106	1.1	0.001	0.4	0	0.09	0.3	0.00032	0	0.01	0.104	0.4	0.0014	0.3	0
2-3 PM	0.098	0.5	0.0015	0	0.01	0.092	0.2	0.0002	0.1	0	0.14	1.5	0.002	0.2	0.01	0.025	0.4	0.00132	0.1	0	0.1	0.6	0.0017	0.1	0.02
3-4 PM	0.023	0.8	0.0025	0.4	0.01	0.063	0.9	0.0016	0	0.02	0.123	0.7	0.001	0.1	0.01	0.04	0.3	0.0021	0.3	0.01	0.056	0.4	0.0021	0.4	0.01
4-5 PM	0.078	0.3	0.0013	0.1	0	0.045	0.8	0.003	0	0.03	0.098	1.3	0.002	0.1	0	0.104	0.4	0.0016	0.4	0.01	0.094	0.9	0.0023	0.1	0
5-6 PM	0.103	0.4	0.002	0.2	0	0.083	0.7	0.0016	0.2	0	0.034	0.8	0.002	0.3	0.03	0.089	0.4	0.00033	0.1	0	0.09	0.2	0.0016	0	0.01
6-7 PM	0.101	0.2	0.0014	0	0.02	0.1	0.6	0.0012	0	0.01	0.065	0.9	0.002	0.2	0.01	0.03	0.3	0.00122	0	0.03	0.054	0.5	0.0023	0	0.02
7-8 PM	0.097	0.3	0.0013	0	0.01	0.045	0.1	0.0017	0.1	0	0.12	1.2	0.003	0.1	0	0.05	0.4	0.00098	0	0	0.12	0.7	0.0013	0	0
8-9 PM	0.102	0.3	0.0005	0	0	0.107	0.2	0.0002	0.2	0	0.157	0.5	0.002	0	0.01	0.07	0.3	0.00094	0.2	0.02	0.1	0.3	0.0015	0.2	0.01
9-10 PM	0.115	0.3	0.0023	0	0	0.103	0.3	0.0026	0	0	0.107	1.4	0.003	0.4	0.02	0.103	0.3	0.0023	0.1	0	0.09	0.9	0.0021	0.1	0
10-11 PM	0.035	0.9	0.0005	0.2	0.01	0.074	0.4	0.001	0	0.03	0.025	1.5	0.002	0.1	0.01	0.115	0.1	0.0021	0.3	0.02	0.056	0.8	0.0026	0.2	0.02
11-12 AM	0.072	0.8	0.0003	0.3	0.02	0.079	0.4	0.0021	0.3	0.01	0.13	0.4	0.002	0	0	0.05	0.2	0.0025	0.1	0	0.102	0.4	0.0014	0.1	0
12-1 AM	0.12	0.3	0.0013	0.2	0	0.115	0.9	0.0027	0.2	0	0.077	1.3	0.001	0.4	0.02	0.08	0.3	0.0012	0.2	0.03	0.08	0.5	0.0009	0.2	0.01
1-2 AM	0.134	0.8	0.0012	0.3	0.01	0.043	0.7	0.0016	0.1	0.01	0.054	1.1	0.003	0.1	0	0.1	0.4	0.0019	0	0	0.067	0.6	0.0015	0.1	0.01
2-3 AM	0.106	0.9	0.0023	0.1	0	0.1	0.8	0.0004	0.3	0.02	0.058	1.1	0.002	0	0	0.055	0.2	0.0024	0.3	0.02	0.05	0.9	0.0023	0.3	0
3-4 AM	0.066	0.9	0.0012	0.3	0	0.087	0.2	0.0003	0	0.03	0.123	1.2	0.002	0.3	0.03	0.045	0.3	0.0021	0.1	0	0.113	0.4	0.0024	0	0.02
4-5 AM	0.089	0.9	0.0019	0	0.02	0.098	0.7	0.0013	0.1	0	0.132	0.9	0.003	0.2	0	0.101	0.4	0.0014	0.3	0	0.109	0.9	0.0013	0.1	0
5-6 AM	0.104	0.6	0.0024	0	0	0.067	0.4	0.0023	0.2	0.01	0.07	0.7	0.002	0.1	0.02	0.103	0.4	0.0009	0.4	0.01	0.137	0.3	0.0024	0	0.03
6-7 AM	0.11	0.2	0.0005	0.1	0.01	0.092	0.5	0.0006	0	0.01	0.043	0.7	0.002	0	0	0.04	0.3	0.0012	0	0	0.098	0.8	0.0009	0.2	0
7-8 AM	0.025	0.5	0.0012	0.2	0	0.045	0.7	0.0014	0.1	0	0.02	1.1	0.001	0	0.01	0.13	0.2	0.0021	0.1	0	0.06	0.9	0.0025	0.1	0
Max Hour	0.134	0.9	0.0025	0.4	0.03	0.115	0.9	0.003	0.3	0.03	0.157	1.3	0.003	0.4	0.03	0.14	0.4	0.00254	0.4	0.03	0.137	0.9	0.0026	0.4	0.03
24 hr avg.	0.082	0.554	0.0013	0.117	0.007	0.082	0.508	0.0014	0.112	0.009	0.078	1.162	0.002	0.138	0.011	0.0792	0.304	0.00152	0.156	0.0092	0.0864	0.529	0.00173	0.132	0.009

All above concentrations are in ppm

Location 3																										
Date & Time	Day 1					Day 2					Day 3					Day 4					Day 5				
	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2
8-9 AM	0.11	0.3	0.0017	0	0.02	0.098	0.2	0.0017	0	0.01	0.115	0.4	0.0028	0	0.01	0.1	0.5	0.00133	0	0.01	0.101	0.6	0.0011	0.1	0.01
9-10 AM	0.087	0.2	0.00005	0.1	0.01	0.107	0.3	0.0013	0.1	0.02	0.123	0.5	0.00005	0.1	0	0.104	0.3	0.00032	0.1	0.01	0.11	0.4	0.0007	0.2	0.02
10-11 AM	0.106	0.3	0.00123	0.2	0.01	0.104	0.4	0.0021	0.3	0	0.045	0.4	0.0017	0.3	0.01	0.07	0.5	0.00023	0	0.02	0.076	0.9	0.0021	0.3	0
11-12 PM	0.12	0.4	0.00087	0	0	0.045	0.3	0.0009	0	0.02	0.023	0.3	0.0003	0	0.01	0.095	0.2	0.0002	0.3	0.01	0.023	0.3	0.0013	0	0.01
12-1 PM	0.083	0.5	0.0014	0	0.02	0.111	0.4	0.0023	0.1	0	0.112	0.4	0.0021	0.1	0.02	0.11	0.1	0.00133	0	0.01	0.11	0.9	0.0009	0.1	0.03
1-2 PM	0.11	0.3	0.002	0.1	0.01	0.023	0.4	0.0008	0.1	0.01	0.109	0.5	0.0015	0.4	0	0.098	0.2	0.00034	0.1	0	0.145	0.6	0.0015	0.2	0
2-3 PM	0.027	0.3	0.00066	0.2	0	0.045	0.5	0.0015	0.2	0.01	0.119	0.5	0.0018	0.1	0.01	0.125	0.3	0.00123	0.3	0	0.123	0.3	0.0015	0.1	0
3-4 PM	0.098	0.4	0.00043	0	0.02	0.065	0.5	0.0016	0.3	0	0.067	0.4	0.0023	0.3	0.03	0.043	0.3	0.0023	0.2	0	0.024	0.2	0.0012	0.4	0
4-5 PM	0.046	0.5	0.0021	0.3	0.01	0.047	0.4	0.003	0.1	0.02	0.145	0.5	0.0021	0	0	0.114	0.2	0.00134	0.3	0.01	0.094	0.3	0.0019	0.3	0
5-6 PM	0.1	0.3	0.00156	0.1	0	0.112	0.3	0.00005	0.2	0.01	0.065	0.3	0.0025	0.1	0.01	0.09	0.1	0.00043	0.4	0.01	0.09	0.2	0.0016	0	0
6-7 PM	0.11	0.4	0.00132	0.2	0.02	0.123	0.4	0.00156	0.3	0	0.15	0.4	0.0019	0.3	0	0.034	0.3	0.00133	0	0	0.054	0.3	0.0023	0.1	0
7-8 PM	0.058	0.3	0.0021	0.3	0	0.145	0.3	0.00145	0	0	0.11	0.5	0.0021	0	0	0.056	0.2	0.00023	0	0.02	0.123	0.4	0.0015	0	0
8-9 PM	0.12	0.4	0.00078	0.1	0.01	0.11	0.4	0.002	0	0	0.134	0.3	0.0009	0	0.01	0.078	0.3	0.00089	0.1	0.02	0.11	0.3	0.0014	0.1	0
9-10 PM	0.113	0.3	0.0023	0	0	0.145	0.3	0.0025	0	0.01	0.024	0.4	0.003	0.2	0	0.109	0.1	0.0021	0.2	0	0.067	0.4	0.0023	0.3	0
10-11 PM	0.067	0.4	0.00098	0.2	0.01	0.15	0.4	0.001	0.1	0.01	0.123	0.2	0.00005	0.1	0.02	0.134	0.2	0.0023	0.1	0.01	0.087	0.5	0.0026	0.1	0.01
11-12 AM	0.087	0.4	0.0021	0.1	0.02	0.045	0.5	0.0013	0.2	0	0.159	0.3	0.0008	0.1	0	0.067	0.3	0.0015	0.2	0	0.102	0.2	0.0013	0.2	0
12-1 AM	0.1	0.5	0.0023	0.2	0.01	0.023	0.5	0.0021	0.1	0.01	0.025	0.4	0.0016	0.1	0.01	0.089	0.1	0.002	0.3	0.02	0.087	0.3	0.00067	0.1	0
1-2 AM	0.067	0.4	0.0017	0	0	0.123	0.4	0.0015	0.1	0	0.087	0.4	0.0021	0.2	0	0.134	0.3	0.0019	0	0	0.056	0.3	0.00156	0	0.02
2-3 AM	0.054	0.5	0.0021	0	0	0.123	0.3	0.0025	0.4	0.01	0.073	0.3	0.0028	0.3	0.01	0.123	0.2	0.0023	0.4	0.01	0.076	0.4	0.0023	0.3	0
3-4 AM	0.098	0.2	0.00098	0.3	0.02	0.124	0.2	0.0016	0.2	0	0.123	0.4	0.0024	0.4	0	0.067	0.3	0.0023	0	0	0.113	0.3	0.0021	0	0
4-5 AM	0.123	0.4	0.00134	0.1	0	0.045	0.2	0.0021	0	0	0.11	0.3	0.0015	0	0.02	0.11	0.2	0.0014	0	0.01	0.107	0.3	0.0018	0.2	0.01
5-6 AM	0.1	0.3	0.00233	0.3	0.01	0.1	0.2	0.002	0.1	0.02	0.105	0.3	0.0021	0	0	0.123	0.3	0.0007	0.3	0	0.134	0.4	0.002	0	0
6-7 AM	0.067	0.4	0.00078	0.1	0	0.093	0.1	0.0007	0	0	0.096	0.4	0.0007	0.2	0	0.046	0.4	0.0016	0	0.02	0.1	0.4	0.0019	0.1	0
7-8 AM	0.123	0.5	0.00133	0.2	0	0.02	0.3	0.0014	0	0.01	0.02	0.4	0.0004	0.2	0	0.123	0.2	0.0013	0.1	0	0.067	0.3	0.0024	0.2	0
Max Hour	0.123	0.5	0.00233	0.3	0.02	0.15	0.5	0.003	0.4	0.02	0.159	0.5	0.003	0.4	0.03	0.134	0.5	0.0023	0.4	0.02	0.145	0.9	0.0026	0.4	0.03
24 hr avg.	0.091	0.37	0.00144	0.136	0.008	0.088	0.3	0.0016	0.1	0.007	0.094	0.38	0.0016	0.156	0.008	0.093	0.254	0.00128	0.152	0.0079	0.0908	0.416	0.00166	0.152	0.004

All above concentrations are in ppm

Location 4																										
Date & Time	Day 1					Day 2					Day 3					Day 4					Day 5				
	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2
8-9 AM	0.103	0.4	0.0005	0	0.01	0.11	0.4	0.0016	0	0.001	0.101	0.4	0.0013	0.2	0.01	0.105	0.5	0.0013	0	0	0.1	0.2	0.0013	0	0.01
9-10 AM	0.086	0.3	0.0015	0.1	0	0.103	0.5	0.0021	0.3	0	0.093	0.2	0.0017	0.1	0	0.103	0.3	0.00056	0.1	0	0.089	0.1	0.0012	0.1	0
10-11 AM	0.065	0.2	0.002	0.2	0	0.089	0.1	0.0019	0.2	0	0.067	0.4	0.002	0	0.02	0.076	0.1	0.0023	0.3	0	0.065	0.3	0.002	0.1	0.02
11-12 PM	0.09	0.3	0.0014	0	0	0.092	0.2	0.0005	0	0.01	0.054	0.3	0.0021	0.1	0	0.023	0.1	0.0018	0	0	0.045	0.1	0.0009	0	0
12-1 PM	0.123	0.1	0.0012	0	0	0.104	0.3	0.0024	0.1	0	0.11	0.4	0.0019	0	0	0.11	0.2	0.0006	0.1	0	0.109	0.4	0.0003	0.1	0.01
1-2 PM	0.11	0.2	0.0005	0.1	0.02	0.026	0.4	0.0005	0.1	0.02	0.106	0.2	0.0013	0.1	0.01	0.102	0.3	0.0013	0	0.01	0.108	0.5	0.0014	0.1	0
2-3 PM	0.09	0.6	0.0002	0	0	0.048	0.1	0.0013	0.2	0	0.098	0.3	0.0009	0.2	0	0.12	0.3	0.0021	0.1	0	0.034	0.1	0.0017	0.2	0.01
3-4 PM	0.04	0.3	0.0013	0.1	0	0.076	0.2	0.002	0.1	0	0.12	0.3	0.0018	0	0	0.125	0.4	0.0014	0.2	0	0.12	0.2	0.0018	0	0
4-5 PM	0.036	0.1	0.0013	0	0	0.046	0.1	0.0018	0	0	0.113	0.4	0.003	0.1	0	0.067	0.2	0.0021	0.3	0	0.067	0.1	0.003	0	0.01
5-6 PM	0.112	0.2	0.0011	0	0.01	0.103	0.2	0.0028	0	0.01	0.12	0.4	0.0023	0	0	0.086	0.2	0.0019	0	0	0.095	0.3	0.0029	0.1	0
6-7 PM	0.13	0.3	0.002	0.2	0	0.109	0.3	0.002	0.2	0	0.106	0.4	0.002	0	0	0.056	0.3	0.0024	0.1	0	0.102	0.2	0.002	0.1	0
7-8 PM	0.045	0.1	0.0013	0.3	0	0.14	0.3	0.0028	0	0.02	0.036	0.5	0.0015	0.1	0	0.12	0.2	0.002	0	0.02	0.034	0.1	0.0015	0	0
8-9 PM	0.107	0.3	0.001	0.4	0	0.115	0.2	0.0014	0.1	0	0.102	0.3	0.0021	0.2	0	0.103	0.1	0.0016	0	0.03	0.109	0.2	0.0017	0	0
9-10 PM	0.045	0.4	0.0021	0	0	0.109	0.4	0.003	0	0	0.104	0.2	0.0024	0	0.01	0.067	0.3	0.0025	0.2	0	0.102	0.1	0.0028	0	0
10-11 PM	0.035	0.3	0.0012	0	0	0.054	0.2	0.0014	0.2	0.01	0.103	0.1	0.0015	0	0	0.089	0.2	0.0028	0.1	0	0.1	0.2	0.0016	0.1	0.01
11-12 AM	0.067	0.4	0.0021	0.1	0.01	0.078	0.1	0.0013	0.3	0	0.054	0.4	0.002	0.3	0.02	0.102	0.1	0.0018	0.1	0	0.102	0.1	0.0021	0.4	0
12-1 AM	0.103	0.4	0.002	0.2	0	0.123	0.2	0.0023	0	0	0.109	0.1	0.0021	0.1	0.03	0.103	0.3	0.0009	0.1	0	0.102	0.1	0.0013	0.2	0
1-2 AM	0.068	0.2	0.0014	0	0	0.109	0.3	0.002	0.1	0.01	0.067	0.3	0.0015	0	0	0.067	0.1	0.0014	0	0	0.1	0.2	0.002	0.1	0.2
2-3 AM	0.134	0.3	0.0013	0.1	0.01	0.1	0.2	0.0021	0.1	0	0.103	0.2	0.0009	0.4	0	0.086	0.2	0.0018	0.2	0	0.14	0.3	0.0009	0.1	0
3-4 AM	0.098	0.4	0.0006	0	0	0.103	0.1	0.0017	0.3	0.01	0.087	0.3	0.0006	0	0	0.102	0.1	0.002	0	0	0.103	0.1	0.0013	0	0
4-5 AM	0.076	0.2	0.0016	0.3	0	0.056	0.1	0.0012	0	0	0.1	0.2	0.0015	0.3	0	0.12	0.2	0.0019	0.4	0	0.1	0.2	0.0019	0.2	0.01
5-6 AM	0.045	0.2	0.0023	0.4	0.02	0.034	0.2	0.0019	0.2	0	0.098	0.3	0.0023	0.2	0.01	0.13	0.1	0.0023	0	0.02	0.056	0.1	0.0025	0.1	0
6-7 AM	0.076	0.1	0.0009	0	0	0.103	0.3	0.0008	0	0	0.056	0.3	0.0009	0.1	0	0.123	0.2	0.0024	0.2	0	0.058	0.2	0.0015	0.2	0
7-8 AM	0.054	0.2	0.002	0.2	0	0.12	0.1	0.002	0	0	0.024	0.4	0.0014	0	0	0.07	0.3	0.0012	0.1	0.01	0.023	0.2	0.002	0.3	0
Max Hour	0.134	0.6	0.0023	0.4	0.02	0.14	0.5	0.003	0.3	0.02	0.12	0.5	0.003	0.4	0.03	0.13	0.5	0.0028	0.4	0.03	0.14	0.5	0.003	0.4	0.2
24 hr avg.	0.081	0.271	0.00136	0	0	0.090	0.229	0.0018	0.104	0.004	0.089	0.304	0.0018	0.104	0.004	0.0939	0.221	0.00176	0.108	0.0037	0.0859	0.192	0.00173	0.104	0.012

All above concentrations are in ppm

Location 5																										
Date & Time	Day 1					Day 2					Day 3					Day 4					Day 5				
	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2	SO2	NH3	H2S	VOC	NO2
8-9 AM	0.125	0.3	0.0009	0.1	0.01	0.101	0.2	0.0011	0.1	0.01	0.123	0.1	0.0029	0	0.01	0.122	0.3	0.0004	0.2	0.01	0.1	0.1	0.00199	0	0.001
9-10 AM	0.128	0.9	0.0015	0.2	0	0.076	0.3	0.0009	0.2	0	0.114	0.2	0.0012	0.1	0	0.067	0.2	0.0003	0.1	0	0.109	0.2	0.00145	0.1	0
10-11 AM	0.078	0.5	0.0021	0	0.01	0.043	0.1	0.0021	0.4	0.01	0.065	0.3	0.0016	0.2	0.02	0.091	0.4	0.0021	0	0.01	0.102	0.3	0.0023	0	0
11-12 PM	0.09	0.4	0.0028	0	0	0.11	0.2	0.0013	0.1	0	0.078	0.5	0.0001	0.1	0	0.065	0.1	0.0019	0	0	0.034	0.3	0.00123	0	0.02
12-1 PM	0.056	0.8	0.00088	0.4	0	0.093	0.3	0.0008	0	0	0.09	0.4	0.0021	0	0	0.12	0.2	0.0013	0.4	0.02	0.101	0.1	0.00078	0	0
1-2 PM	0.049	1.1	0.00275	0.1	0.02	0.023	0.3	0.0012	0	0	0.157	0.3	0.0001	0.2	0	0.134	0.3	0.0014	0.1	0.02	0.15	0.2	0.0013	0.3	0.01
2-3 PM	0.092	1	0.0014	0.2	0.01	0.103	0.1	0.0013	0.1	0.02	0.123	0.2	0.0021	0	0.01	0.076	0.4	0.0009	0.2	0	0.12	0.3	0.002	0.1	0
3-4 PM	0.111	0.9	0.0023	0	0	0.124	0.2	0.0023	0.2	0	0.09	0.1	0.0025	0.3	0	0.086	0.1	0.0013	0	0.01	0.121	0.2	0.0015	0	0.02
4-5 PM	0.083	0.5	0.0014	0.1	0	0.092	0.3	0.0015	0.1	0.02	0.088	0.1	0.0023	0.1	0	0.13	0.2	0.0029	0	0.01	0.098	0.1	0.002	0	0
5-6 PM	0.072	1	0.00278	0	0.02	0.081	0.2	0.0025	0.1	0	0.043	0.2	0.0001	0	0.02	0.129	0.3	0.003	0.1	0	0.095	0.4	0.0018	0.4	0
6-7 PM	0.113	0.9	0.003	0.1	0	0.093	0.2	0.0014	0.4	0.03	0.065	0.1	0.0023	0	0	0.025	0.1	0.0013	0.3	0	0.045	0.2	0.0029	0.3	0.01
7-8 PM	0.155	0.6	0.0024	0	0	0.12	0.3	0.0017	0.2	0	0.087	0.2	0.0008	0	0	0.087	0.2	0.0023	0.4	0	0.12	0.3	0.0023	0	0
8-9 PM	0.134	0.5	0.00145	0.2	0	0.109	0.1	0.003	0	0.01	0.009	0.3	0.0013	0.1	0	0.098	0.3	0.0015	0.1	0.02	0.1	0.4	0.003	0	0
9-10 PM	0.109	1.1	0.0024	0.4	0	0.043	0.3	0.0013	0	0	0.12	0.1	0.0023	0.2	0.03	0.034	0.2	0.0021	0	0	0.09	0.2	0.002	0.1	0.03
10-11 PM	0.065	1.2	0.0015	0.1	0.01	0.02	0.2	0.0021	0.1	0	0.109	0.3	0.0011	0.1	0	0.12	0.3	0.0017	0	0.02	0.123	0.1	0.0016	0	0
11-12 AM	0.053	0.5	0.0019	0.3	0	0.101	0.3	0.0024	0	0.01	0.065	0.2	0.0024	0.4	0	0.076	0.4	0.0023	0.3	0	0.09	0.4	0.0026	0	0
12-1 AM	0.102	1.2	0.00077	0	0	0.123	0.3	0.0013	0.1	0	0.034	0.4	0.0014	0.3	0.03	0.109	0.4	0.0017	0.1	0.03	0.067	0.2	0.0006	0.3	0.02
1-2 AM	0.108	1.1	0.0024	0.1	0	0.067	0.4	0.0015	0.4	0	0.023	0.3	0.0023	0.1	0	0.076	0.3	0.002	0.2	0	0.045	0.3	0.0011	0.2	0
2-3 AM	0.12	0.3	0.00065	0.2	0.01	0.023	0.4	0.0023	0.3	0.03	0.109	0.2	0.0019	0	0	0.15	0.2	0.0019	0.1	0	0.111	0.2	0.0018	0	0
3-4 AM	0.13	0.3	0.0023	0.3	0	0.123	0.2	0.0015	0	0	0.076	0.3	0.0013	0.2	0	0.109	0.3	0.0023	0	0	0.12	0.1	0.0023	0	0.01
4-5 AM	0.102	0.5	0.0019	0	0	0.1	0.1	0.0026	0.1	0	0.045	0.3	0.0007	0	0.01	0.108	0.4	0.0015	0	0.03	0.076	0.3	0.0021	0	0
5-6 AM	0.105	0.3	0.002	0.2	0	0.1	0.2	0.0013	0	0.02	0.12	0.2	0.0003	0.1	0	0.056	0.4	0.0023	0	0	0.054	0.2	0.0018	0.3	0
6-7 AM	0.099	1.1	0.0004	0	0	0.076	0.3	0.0009	0.4	0	0.1	0.4	0.0021	0.2	0	0.045	0.2	0.0012	0.1	0	0.067	0.1	0.0019	0.2	0
7-8 AM	0.081	1.2	0.0007	0	0	0.1	0.2	0.0005	0	0	0.097	0.3	0.0017	0.4	0	0.023	0.3	0.0011	0.2	0.01	0.034	0.2	0.0023	0.1	0.02
Max Hour	0.155	1.2	0.003	0.4	0.02	0.124	0.4	0.003	0.4	0.03	0.157	0.5	0.0029	0.4	0.03	0.15	0.4	0.003	0.4	0.03	0.15	0.4	0.003	0.4	0.03
24 hr avg	0.098	0.758	0.00177	0.125	0.004	0.085	0.237	0.0016	0.137	0.007	0.085	0.25	0.0015	0.129	0.005	0.089	0.271	0.00169	0.121	0.0079	0.0905	0.225	0.00186	0.1	0.006

All above concentrations are in ppm

REEC

Al RAWABI Environment & Energy Consultancies

الروابي لإستشارات البيئة و الطاقة

Test Report No. (15/2018)

Ghabawi - Air Data/ Dust Emissions Results

Locations 1 to 5

Monitoring period: 16 Augest 2018 – 31 Augest 2018

Jordanian Standard for Ambient Air Quality No. 1140, Year 2006 (JS 1140/2006):

Parameter	Maximum Allowable Limit (1hour)	Maximum Allowable Limit (24hour)
PM10	Not Available	120 µg/m³
PM2.5	Not Available	65 µg/m³
TSP	Not Available	260 µg/m³

REEC

AL RAWABI Environment & Energy Consultancies

الروابي لإستشارات البيئة و الطاقة

Location 1															
Date & Time	Day 1			Day 2			Day 3			Day 4			Day 5		
	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
8-9 AM	231.57	49.9	420.9	245.2	77.5	390.7	120.4	75.2	439.2	67.8	70.3	229.5	118.4	67.8	224.8
9-10 AM	225.3	46.589	435.1	140.9	74.2	228.4	94.5	73.2	420.1	99.8	59.9	233.8	114	100.3	226.9
10-11 AM	227.1	46.482	427.4	155.7	75.8	230.5	97.7	70.1	338.5	90.4	63.2	230.7	100.7	101.2	221.5
11-12 PM	225.6	59.158	431.8	169.3	72.5	224.2	110.3	69.8	350.7	112.4	67.7	231.9	121	78.4	276.9
12-1 PM	343.2	68.898	337.9	146.6	70.3	231.1	112.5	72.4	364.3	113	65.5	259.9	98.7	76.2	266.5
1-2 PM	225	44.7	352.8	117.3	74.2	250	99.4	67.8	372.1	100.6	63.3	267.8	115.2	60.3	264.1
2-3 PM	340.7	54.3	320.1	121.7	64.4	257.6	92.7	74.5	355.8	120.7	70.1	283.8	99.8	68.4	259.4
3-4 PM	339.7	67.164	326.8	92.7	62.2	265.3	110.5	70.3	340.2	513.2	67.4	280.7	100.7	79.9	261.3
4-5 PM	72.998	43.235	329.9	120.4	67.7	266.8	99.9	65.5	289.5	424.7	60.5	278.9	120.3	73.8	263.8
5-6 PM	62.739	48.291	318.9	321.7	57.8	267.8	111.7	61.1	238.7	150.7	61.1	279.4	119.8	76.3	259.8
6-7 PM	130.46	54.313	330.7	422.3	73.2	234.3	78.3	57.8	209.4	143	62.3	281.3	99.6	80	258.7
7-8 PM	120.5	59.716	337.5	355	43.4	228.9	93.5	68.8	220	122	60.9	276.2	100.2	83.1	255.9
8-9 PM	227.9	77.3	328.4	103.4	101.3	239.9	99.3	59.7	231.2	121	63.3	255.8	113	88	257.2
9-10 PM	339	52.4	476.8	424	96.3	347.6	120.1	60.3	248.9	117	62.8	247.3	117.2	79.3	266.3
10-11 PM	321	51.8	470.6	111	89.3	344.9	88.9	61.2	278	113	65.5	251.1	121	109	258.7
11-12 AM	225.5	57.9	468.9	123	75.7	339.8	93.9	70.3	269.5	120.3	62.1	257.7	116	127	254.1
12-1 AM	119	67.8	446.7	143	68.3	342.7	99.6	73.4	275.4	129.7	67.8	258.2	99.5	99.4	257.7
1-2 AM	226.9	72.1	437.9	115	75.4	357.2	113.8	75.5	233.3	325.1	65.7	259.4	98.3	87.3	258.8
2-3 AM	120.3	77.7	409.1	127	89.7	367.9	120	71.2	215.4	220	62.3	258.8	98.9	66.9	262.3
3-4 AM	121.6	79.8	369.5	113.8	77.2	377.8	77.9	69.4	229.4	221	59.9	257.7	110.7	73.7	259.9
4-5 AM	200.3	72.3	370.8	390	75.2	382.1	84.5	68.8	230.1	125	57.8	256.9	117.3	56.7	257.7
5-6 AM	159.8	62.5	259.8	120.3	83.2	333.8	89.2	65.9	233.8	117	61.5	254.4	123	86.9	259.8
6-7 AM	222.8	77.9	332.7	122	72.1	409.4	100.3	63.6	234.9	119	60.4	250.9	120.8	79.6	262.7
7-8 AM	271.5	78.4	295.6	137	74.5	445.2	90.8	60.4	235.8	120	63.8	258.4	99.6	55.7	260.5
Max Hour	**343.2**	**79.8**	**476.8**	**424**	**101.3**	**445.2**	**120.4**	**75.5**	**439.2**	**513.2**	**70.3**	**283.8**	**123**	**127**	**276.9**
24 hr avg	**209.8**	**63.0**	**369.4**	**191.6**	**74.3**	**312.1**	**99.4**	**67.0**	**274.7**	**183.0**	**63.5**	**261.6**	**110.1**	**81.25**	**259.9**

All above concentrations are in µg/m³

Location 2															
Date & Time	Day 1			Day 2			Day 3			Day 4			Day 5		
	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
8-9 AM	235.9	55.5	339	129.8	68.9	388.5	128.8	63.1	430.3	125.5	68.8	236.8	125.5	67.7	268.5
9-10 AM	233.8	59.9	347	144.3	73.8	374.2	129	70.4	427.7	122.2	74.3	390	124.2	68.4	274.4
10-11 AM	239.1	56	414.3	138.8	74.4	379.9	133.7	68.8	430.1	135.8	75.5	387.5	119.8	77.1	268.8
11-12 PM	122	67.7	378.2	129.4	71.9	365.2	134.8	67.7	425.5	136.6	71.8	294.4	121.6	76.6	287.1
12-1 PM	128.7	69.9	360.3	128.2	75.5	347.7	133.6	70.3	342.1	131.23	73.4	303.7	125.5	73.2	338.8
1-2 PM	125.4	73	407.5	127.7	70.8	407.6	131.1	69.9	330.6	120.9	70.9	340.7	127.8	68.3	303.9
2-3 PM	127.6	70.8	395.1	123.3	72.6	350.8	137.8	70.3	331.7	122.7	72.2	256.8	134.4	66.4	309.4
3-4 PM	129.9	71.1	384.6	129	68.8	468.8	137.9	71.4	275.9	127.6	69.8	338.8	122.8	65.5	335.6
4-5 PM	123.6	66.7	355.9	122	67.7	423.1	233	66.8	432	126.9	64.4	367.8	143.7	63.3	332.1
5-6 PM	127.6	69.9	347.6	126.6	63.9	457.7	204.3	64.7	416.7	119	67.7	355.8	122.1	67.8	309
6-7 PM	128.8	56.9	359.9	121.6	68.8	368.9	158.8	60.9	335.2	127.7	68.8	398.8	119.9	70.3	305.6
7-8 PM	130	58.8	341.8	128.4	70.3	397.7	143.5	64.4	341.1	134.4	63.9	404.7	121.7	69.9	295.5
8-9 PM	133.5	66	395.5	124.2	69.4	343.2	133	77.8	336.7	144	69.9	395.5	123.8	74.1	287.7
9-10 PM	134.2	66.5	448.1	126.6	68.1	341.1	132.2	75.2	229.9	147.6	70.3	332.1	122.9	73.6	290.4
10-11 PM	129.8	67.7	469.7	166.9	73.4	335.5	121.1	74.4	243.3	154.7	71.1	375.5	125.5	88.9	340.7
11-12 AM	127.7	68.1	471.1	165.8	69.9	347.1	128.8	78.1	257.7	155.5	68.8	340.8	128.8	74.3	320.1
12-1 AM	109.9	69.5	456.8	125.2	68.8	350.5	122.7	72.2	313.8	156.9	69.2	309.9	127	75.5	297.7
1-2 AM	128.7	68.4	430.8	121	69.9	357.1	129.6	75.5	357.7	132.2	74.2	295.5	129.8	68.8	285.5
2-3 AM	127.5	70.3	411.7	128.5	77.1	365.8	127.6	74.8	329.5	115.9	77.5	288.7	132.6	67.7	307.7
3-4 AM	124.5	71.1	397.5	122.2	70.3	366.6	128.8	70.7	408.5	128.7	68.8	307.7	136.8	70.3	390.3
4-5 AM	144.6	76.6	333.1	120.9	68.9	384.4	122.9	65.5	375.5	132.8	72.3	319.9	122.1	67.8	384.4
5-6 AM	132.8	77.5	460.7	125.3	66.9	322.7	121.4	73.2	367.7	145.5	67.7	356.4	126.5	74.1	350.7
6-7 AM	154.4	74.3	469.9	125.6	83.2	343.7	122.5	70.2	374.1	123.3	65.9	330.5	121.7	65.5	289.9
7-8 AM	176.7	66.8	475.1	121.1	77.8	328.8	124.4	65.4	358.4	127.7	64.4	368.1	119.8	68.9	277.7
Max Hour	**239.1**	**77.5**	**475.1**	**166.9**	**83.2**	**468.8**	**233**	**78.1**	**432**	**156.9**	**77.5**	**404.7**	**143.7**	**88.9**	**390.3**
24 hr avg	**136.6**	**69.3**	**410.4**	**130.7**	**71.7**	**374.9**	**143.8**	**70.8**	**349.8**	**134.9**	**70.0**	**342.4**	**127.3**	**71.8**	**317.3**

All above concentrations are in µg/m³

Location 3															
Date & Time	Day 1			Day 2			Day 3			Day 4			Day 5		
	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
8-9 AM	251	57.8	457	203.7	74.3	327.5	209.8	79.2	384.4	88.9	73.8	308.7	121.4	70.2	275.5
9-10 AM	234.1	58.4	499.3	233.1	70.5	318.9	234.7	80.3	385.5	126.5	66.9	315.7	127.6	72.2	284.3
10-11 AM	220	59.1	485.5	267.7	71.4	227.7	117.9	81.9	393.2	130.8	64.8	295.5	138.4	73.8	293.4
11-12 PM	212.2	58.3	487.1	289.9	76.3	230.5	120.8	73.3	390.4	137.6	61.8	284.3	144.3	75.5	277.8
12-1 PM	245.6	57.9	467.7	218.7	78.9	238.4	189.7	75.5	394.1	134.4	67.7	277.9	173	71.3	279.1
1-2 PM	190.6	63.2	492.2	243.5	77.5	241.5	157.8	71.2	396.7	135.5	64.4	278.4	178.8	67.8	284.4
2-3 PM	198.3	68.8	478.9	276.7	64.2	260.3	129.9	73.3	358.9	127.7	71.8	280.3	179.9	69.9	287.9
3-4 PM	178.5	69.9	485.4	244.1	65.3	261.7	134.7	69.9	344.5	142.7	68.8	284.3	178.8	72.1	257.8
4-5 PM	184.9	56.8	497.5	235.5	69.4	267.8	120.6	66.8	294.4	137.6	65.5	277.8	184.4	70.7	266.9
5-6 PM	188	57.4	394.3	206.4	73.1	278.2	129.7	64.2	307.6	134.4	63.3	276.3	187.7	75.5	274.1
6-7 PM	187.8	67.8	387.6	257.7	76.9	240.5	133.8	63.9	334.8	120.3	69.9	280.1	185.3	73.2	283.3
7-8 PM	190.3	61.2	348.1	250.9	59.8	323.3	135.8	60.4	260.4	125.7	77.6	391.4	121	80.3	274.4
8-9 PM	197.6	70.9	407.9	207.7	66.8	409.5	147.7	58.8	274.1	146.6	74	377.6	128.7	81.2	270.5
9-10 PM	202	77.3	405.8	365.5	74.2	388	155.8	64.3	309.6	144.3	71.1	374.8	136.5	75.3	277.8
10-11 PM	209.4	75.4	396.7	247.1	83.6	380.4	143.3	62.8	312.7	140.7	78.8	320.3	138.8	74.8	280.9
11-12 AM	234.1	66.9	387.8	244.3	76.7	390.6	120.7	69.7	270.5	137.8	74.4	335.7	140.6	133	305.7
12-1 AM	222.2	64.3	335.6	240.6	70	385.5	133.6	70.3	281.4	136.5	72.2	294.4	136.9	101.9	288.4
1-2 AM	257.6	70.2	417.7	251.1	73.1	347.7	135.5	71.4	285.3	135.8	64.1	287.6	129	119.8	274.6
2-3 AM	278.9	71.6	423.6	222.7	74.8	381.7	127.7	69.5	294.1	118.6	65.7	290.4	137.6	128.8	277.8
3-4 AM	243.4	74.4	368.2	265.6	72.1	290.8	137.8	64.1	309.5	137.6	68.4	302	141.6	77	309.8
4-5 AM	255.8	75.8	375.5	219	77.7	295	125.6	63.1	244.6	134.8	67	319.2	140.8	69.8	228.8
5-6 AM	190.9	73.9	307.8	216.8	81.4	309.8	137.8	67.7	247.5	119.7	68.8	288.3	139.9	87.4	239.9
6-7 AM	189.8	76.6	314.5	202.7	80.3	307	121.5	65.4	409.8	126.4	64.5	274.8	146.8	79.9	241.1
7-8 AM	200.5	78.8	325.7	209.9	77.9	369.2	132.1	62.8	320.4	135.1	61.1	280.4	156.7	80.1	268.8
Max Hour	**278.9**	**78.8**	**499.3**	**365.5**	**83.6**	**409.5**	**234.7**	**81.9**	**409.8**	**146.6**	**78.8**	**391.4**	**187.7**	**133**	**309.8**
24 hr avg.	**215.5**	**68.5**	**412.6**	**250.0**	**74.1**	**314.5**	**140.2**	**68.4**	**323.7**	**134.2**	**68.9**	**307.1**	**153.6**	**85.7**	**276.2**

All above concentrations are in $\mu g/m^3$

Location 4															
Date & Time	Day 1			Day 2			Day 3			Day 4			Day 5		
	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
8-9 AM	241.7	53.8	409.4	156.6	74.6	409.6	120.4	68.3	354	125.5	64.3	258.8	129.9	68.8	255
9-10 AM	246.3	56.6	427.3	142.2	77.9	337	94.5	70.2	357.7	127.7	67.5	266.9	137.7	76.3	275.5
10-11 AM	229.1	57.8	430.5	140.7	74.6	349.9	97.7	69.4	340.4	135.5	63.1	267.4	139.5	74.2	273.3
11-12 PM	234.8	52.9	427.5	138.7	70.9	355.8	110.3	66.5	320.8	138.8	62.8	284.4	141	78.3	271.9
12-1 PM	240.5	67.9	423.8	135.8	71.1	270	112.5	71.1	340.9	140.9	60.4	280.8	146.5	79.1	276.5
1-2 PM	239.8	80.5	420.9	142.2	75.6	274.4	99.4	64.3	357.7	138.8	65.5	285.5	122.8	67.3	277.8
2-3 PM	217.9	75.6	376.5	140.6	79.3	276.8	92.7	65.5	322.2	142.2	73.4	288.9	101	69.4	279.2
3-4 PM	223.1	94.3	377.9	136.8	85.5	284.3	110.5	67.7	228.9	148.8	70.1	285.4	119	71.2	285.1
4-5 PM	236.9	90.6	284.8	128.9	81.6	281.1	99.9	64.1	307.9	155	63.3	259.9	128.8	70.4	280.3
5-6 PM	241.7	88.7	235.5	133.9	82.2	279.9	111.7	79.4	255.4	147.7	60.2	267.7	132.9	77.9	279.4
6-7 PM	258.3	87.4	241.4	127.8	74.4	268.8	78.3	73.2	267	143.3	61.1	289.9	142.7	75.5	277.6
7-8 PM	271.4	89.2	335.7	147.3	71.1	270.9	93.5	70.4	284.4	140.7	69.9	290.3	140.9	80.3	231.8
8-9 PM	270.5	79.8	309.7	152.2	76.4	275.5	99.3	78.1	288.9	138.9	68.4	287.6	125.5	76.5	249.5
9-10 PM	338	81.3	355.5	146.3	73.1	308.9	120.1	74.2	283.3	127.7	67.3	269	127.7	73.4	247.1
10-11 PM	261.1	79.9	348.7	138.8	68.4	328	88.9	66.7	270.7	134.5	68.8	273.3	148.8	68.5	240
11-12 AM	246.5	66.8	309.8	141.7	69.9	299.3	93.9	63.3	279.9	129.8	65.9	270.5	153.7	65.4	277.3
12-1 AM	234.6	64.9	422.7	147	72.8	284.4	99.6	68.4	281.3	137.6	64.4	275	150	63.8	290.9
1-2 AM	235.8	83.6	428.9	138.8	74.5	290.7	113.8	66.1	280.9	142	68.8	277.8	129.8	66.9	307
2-3 AM	209.8	80.9	427.7	135.5	73.8	294.3	120	68.4	279.9	142.6	69.3	274.4	128.4	68.9	326.8
3-4 AM	210.7	81.4	387.8	139.7	71.1	387.7	77.9	73.4	277.7	148.7	73.1	275.8	133	69.2	377.9
4-5 AM	205.8	83.5	375.6	128.8	70.3	380.9	84.5	70.2	280.4	152.4	70.6	277.8	137.8	64.1	386.4
5-6 AM	215.5	84.9	408.8	125.3	74.8	379.9	89.2	71.2	285.5	128.8	73.3	274.4	136.4	73.7	387.8
6-7 AM	253.8	80.3	411.3	121.7	79.9	385.5	100.3	68.4	284	133.7	64.3	278.4	138.2	69	409.1
7-8 AM	225.4	88.2	375.3	120.4	80.3	388.4	90.8	65.5	279.4	138.8	61.8	270	117.8	68.8	436.2
Max Hour	**338**	**94.3**	**430.5**	**156.6**	**85.5**	**409.6**	**120.4**	**79.4**	**357.7**	**155**	**73.4**	**290.3**	**153.7**	**80.3**	**436.2**
24 hr avg.	**245.9**	**80.8**	**371.6**	**137.5**	**75.6**	**318.5**	**100.3**	**69.8**	**293.7**	**141.2**	**67.1**	**278.0**	**134.4**	**71.7**	**308.9**

All above concentrations are in $\mu g/m^3$

Location 5															
Date & Time	Day 1			Day 2			Day 3			Day 4			Day 5		
	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP	PM10	PM2.5	TSP
8-9 AM	209.9	58.5	419.9	209.9	79.8	397.6	137.5	72.1	420.3	217.6	75.5	395.4	195.4	79.9	364.4
9-10 AM	205.1	59.9	430	255	84.3	340.7	134.4	70.8	339.9	215.3	77	397.6	199.3	84.4	382.1
10-11 AM	184.3	67.7	438.7	257.7	80.3	236.6	182.2	73.3	397.5	218.9	79.3	416.5	191.6	77.5	295.7
11-12 PM	180.5	69.8	429.5	254.4	81.2	238.8	180.3	74.4	377.8	226.4	80.7	320	187.7	78.4	290.4
12-1 PM	184.4	69.9	433.7	238.8	87.5	241.7	184.2	75.6	409.5	209.6	87.7	357.2	185.5	69.9	286.7
1-2 PM	179.9	84.5	388.8	309.7	88.3	244.5	173.3	69.9	417.2	237.5	86.6	359.1	182.3	66.3	280.1
2-3 PM	175.4	40.1	394.1	224.7	87.4	236.7	170.4	72.6	422.2	124.3	85.3	364.4	101.7	64.7	284.4
3-4 PM	168.4	49.9	398.5	118	86.9	267.8	143.6	77.8	420.5	129.9	76.8	377.6	116.8	68.8	289.9
4-5 PM	160.3	57.6	409.2	190	79.4	294.3	140.4	73.4	384.8	226.6	72.3	374.4	122.4	75.4	307
5-6 PM	163.5	59.8	476.3	179.3	91.7	289.9	146.7	75.5	390.5	227.7	70.4	382.4	123.6	70.3	312.8
6-7 PM	179.3	55.8	477.2	177.6	88.7	287.6	153.8	71.7	392.3	228.8	83.3	380.3	119.4	76	420.9
7-8 PM	175.4	69.9	458.7	187.6	80.6	234.4	155.7	72.3	397.6	187.8	80.6	376.4	120.8	87.8	433.6
8-9 PM	170.3	79.9	439.2	188.4	84.1	235	158.9	70.9	396.5	157.7	81.1	370.5	122.4	85.4	427.6
9-10 PM	207.6	75.5	440.7	177.9	83.3	227.9	147.7	69.9	394.1	162.2	78.7	277.5	132.7	89.3	440.9
10-11 PM	251.1	89.9	426.8	184.4	79.1	226.9	151.8	68.3	407.9	168.8	75.5	294.4	118.8	88.4	448.7
11-12 AM	243.3	87.3	430.7	155.6	77	234.1	150.8	73.3	409.2	155.5	73.8	299.3	127.8	87.4	340.2
12-1 AM	237.7	84.5	428.8	147.9	79.8	244.5	147.6	72.6	337.6	152.1	75.5	290.6	129.4	86.6	337.7
1-2 AM	228.8	88.8	433.8	156.8	84.3	248.8	143.2	77.8	348.4	225.6	77.7	288.4	109	84.4	329.9
2-3 AM	243.7	87.6	451.5	163.2	85	257.5	140.7	79.9	366.6	209.8	73.3	284.6	139.9	74.4	370.4
3-4 AM	238.1	84.4	467	144.8	81.7	364.1	85.7	80.3	248.9	218.3	75.6	280.3	219.8	77.8	355.7
4-5 AM	238.8	80.3	440.3	147.7	82.9	366.6	87.7	85.7	255.7	215.5	70.8	281.7	212.4	69.9	370.3
5-6 AM	222.1	82.1	446.7	166.5	84.3	367.7	89.3	87.7	280.4	209.9	74.7	284.4	220.3	73.3	369.8
6-7 AM	227.4	79.9	428.8	159.8	88.4	395.3	93.2	89.9	274.5	218	69.9	288.7	219.8	75.5	370.4
7-8 AM	230.8	89.6	430.3	208.5	85.4	387.9	91.7	90.5	276.7	118	76.5	279.5	100.4	74.8	375.5
Max Hour	**251.1**	**89.9**	**477.2**	**309.7**	**91.7**	**397.6**	**184.2**	**90.5**	**422.2**	**237.5**	**87.7**	**416.5**	**220.3**	**89.3**	**448.7**
24 hr avg	**207.2**	**75.3**	**436.7**	**190.5**	**84.5**	**285.9**	**141.9**	**77.3**	**365.1**	**193.1**	**77.9**	**328.5**	**151.5**	**77.9**	**358.7**

All above concentrations are in $\mu g/m^3$

Noise Measurement Data at the southern end of the Ghabawi Landfill

REEC
Al RAWABI Environment & Energy Consultancies
الروابي لإستشارات البيئة و الطاقة

Test Report No. (24 / 2018)

Table A6.1. Results of the noise measurement data at the southern end of the Ghabawi Landfill (source: Al Rawabi, 2018)

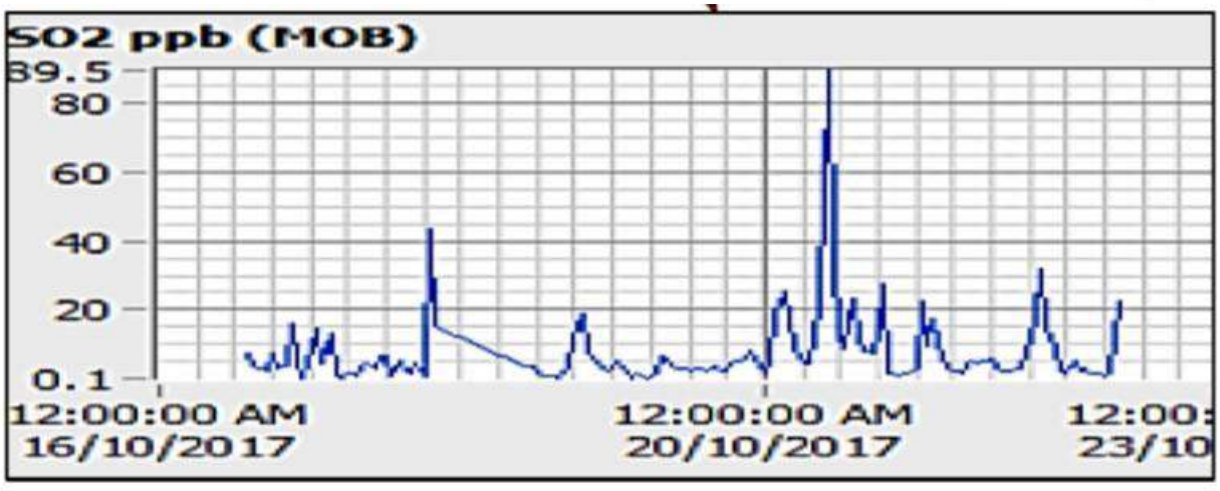
Time	Day 1 (16-17/8/2018)			Day 2 (17-18/8/2018)			Day 3 (18-19/8/2018)			Day 4 (19-20/8/2018)			Day 5 (20-21/8/2018)		
	Max (dBA)	Min (dBA)	Avg (dBA)	Max (dBA)	Min (dBA)	Avg (dBA)	Max (dBA)	Min (dBA)	Avg (dBA)	Max (dBA)	Min (dBA)	Avg (dBA)	Max (dBA)	Min (dBA)	Avg (dBA)
11 am-12 pm	72.5	55.3	63.9	67.3	45.6	56.45	67.3	35.5	51.4	72.6	33.7	53.15	73.5	40.1	56.8
12-1 pm	71.1	48.7	59.9	72.5	46.3	59.4	69.3	47.2	58.25	73.3	34.6	53.95	74.4	42.7	58.55
1-2 pm	70.2	46.5	58.35	70.4	43.2	56.8	72.4	44.3	58.35	74.5	36.1	55.3	73.2	42.5	57.85
2-3 pm	65.2	47.7	56.45	69.3	40.1	54.7	73.2	41.5	57.35	70.3	37.6	53.95	72.7	42.7	57.7
3-4 pm	69.9	43.8	56.85	71.1	39.8	55.45	70.3	43.7	57	68.5	36.8	52.65	67.5	40.4	53.95
4-5 pm	73.1	46.5	59.8	70.2	42.1	56.15	67.8	44.1	55.95	69.7	33.7	51.7	73.9	40.9	57.4
5-6 pm	70.4	41.8	56.1	72.8	43.4	58.1	69.1	45.5	57.3	68.8	38.2	53.5	68.7	42.2	55.45
6-7 pm	68.8	47.7	58.25	69.8	45.2	57.5	70.3	42.8	56.55	74.2	36.4	55.3	66.7	43.5	55.1
7-8 pm	67.3	47.2	57.25	68.5	46.3	57.4	71.4	46.8	59.1	72.1	42.6	57.35	69.1	46.2	57.65
8-9 pm	66.5	43.3	54.9	67.2	44.1	55.65	72.7	47.2	59.95	70.3	43.7	57	71.3	42.7	57
9-10 pm	37.1	33.1	35.1	42.2	28.5	35.35	66.8	43.5	55.15	69.9	41.4	55.65	68.4	41.8	55.1
10-11 pm	36.6	30.1	33.35	34.3	32	33.15	35.5	32.6	34.05	35.4	31.7	33.55	42.2	30.8	36.5
11 pm-12 am	42.2	36.3	39.25	35	31.2	33.1	36.8	34.2	35.5	34.4	33.6	34	47.1	35.1	41.1
12-1 am	37.6	34.1	35.85	37.8	33.5	33.35	37.4	35.2	36.3	36.5	30.8	33.65	45.3	33	39.15
1-2 am	38.8	36.5	37.65	34.4	31.7	33.05	35	30.2	32.6	35.4	31.6	33.5	42.2	32.7	37.45
2-3 am	36.1	31.3	34.15	36.2	30.8	33.5	34.2	29.2	31.7	34.7	33.5	34.1	45.6	32.9	39.25
3-4 am	36.4	34.4	35.4	32	31.4	31.7	35.1	31.4	33.25	35.2	32.1	33.65	44.6	31.6	38.1
4-5 am	35.1	32.1	33.6	31.7	30.3	31	34.2	32.1	33.15	34.8	31.1	32.95	46.1	30.8	38.45
5-6 am	37.3	33.5	32.3	34	32.6	33.3	33.6	30.6	32.1	33.6	32.7	33.15	42.2	31.5	36.85
6-7 am	49.5	36.4	42.95	37.5	30.7	34.1	36.4	34.2	35.3	32.9	29.8	31.35	40.7	32.7	36.7
7-8 am	53.8	49.8	51.8	57.4	48.6	53	66	46.2	56.1	44.7	42.2	43.45	67.8	44.3	56.05
8-9 am	58.9	57	57.95	49.8	42.1	45.95	65.2	40.7	52.95	65.2	42.1	53.65	73.4	42.2	57.8
9-10 am	66.5	58.3	62.4	57.6	43.1	50.35	63.1	41.4	52.25	57.7	40.7	49.2	72.4	40.3	56.35
10-11 am	67	48.9	57.95	67.3	42.6	54.95	64.7	43	53.85	65.7	42.1	53.9	74.1	41.1	57.6
Max.	**73.1**	**58.3**	**63.9**	**72.8**	**48.6**	**59.4**	**73.2**	**47.2**	**59.95**	**74.5**	**43.7**	**57.35**	**74.4**	**46.2**	**58.55**
Min.	**35.1**	**30.1**	**32.3**	**31.7**	**28.5**	**31**	**33.6**	**29.2**	**31.7**	**32.9**	**29.8**	**31.35**	**40.7**	**30.8**	**36.5**
Average	**55.33**	**42.51**	**48.81**	**53.56**	**38.55**	**45.98**	**56.16**	**39.23**	**47.73**	**55.43**	**36.2**	**45.82**	**60.96**	**38.53**	**49.75**

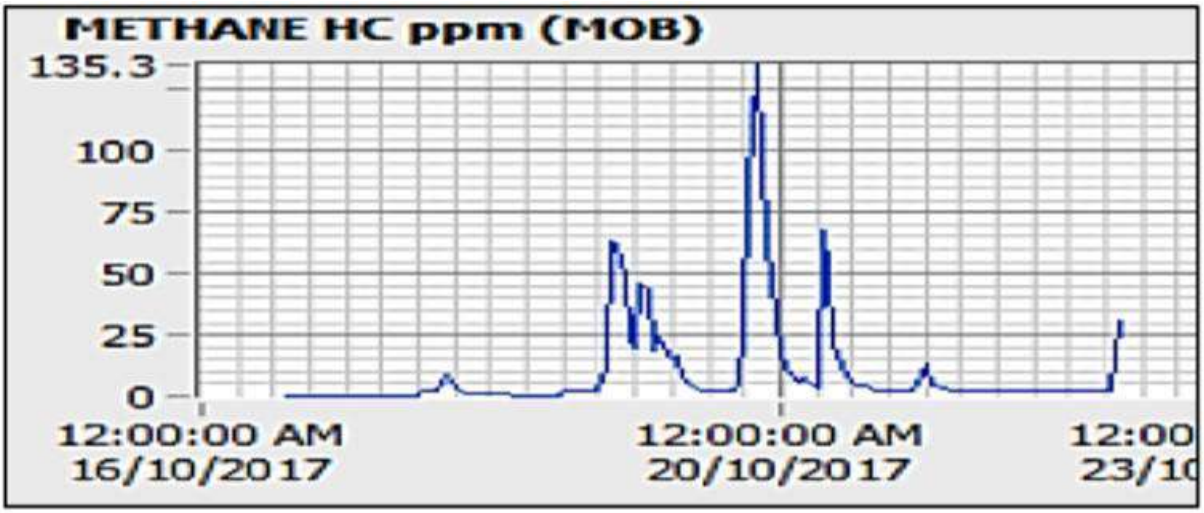
Air Quality data from Previous Measurements by Ministry of Environment

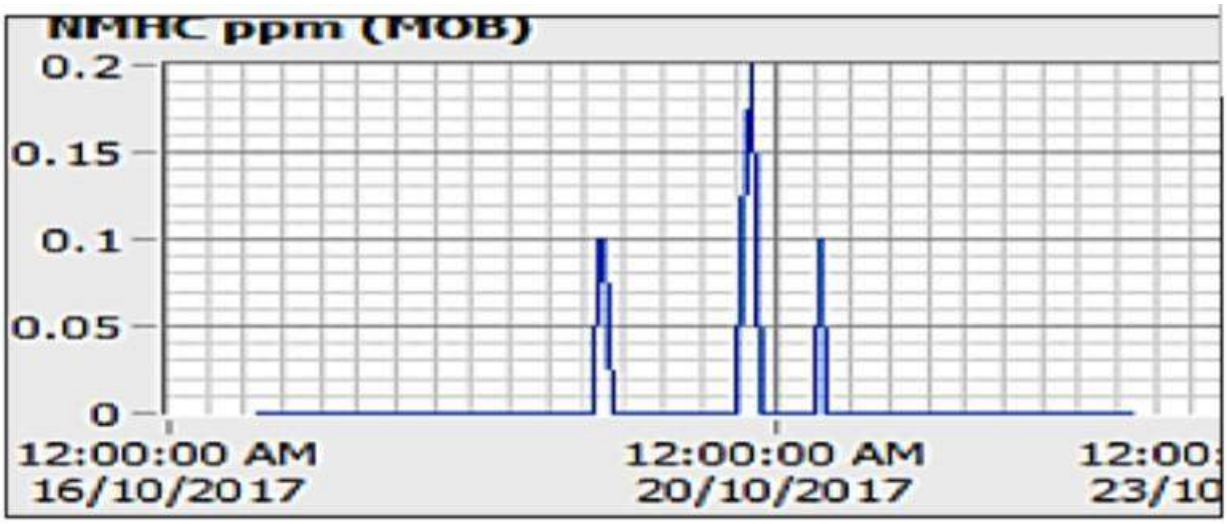
Table A6.1. Daily averages of air quality measurements near the health care waste incinerator at Al Ghabawi Landfill site

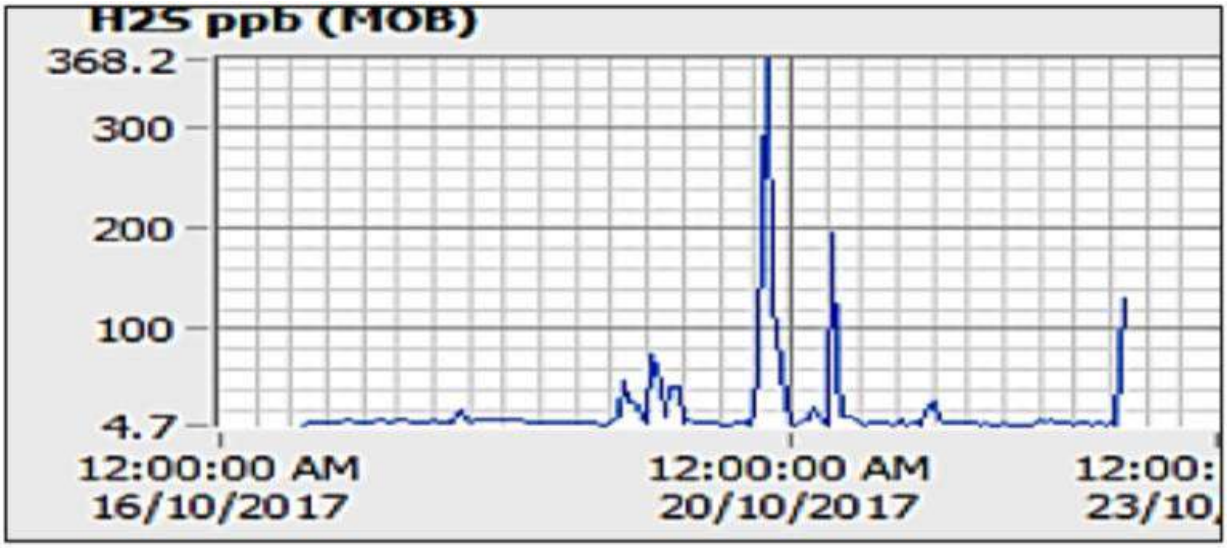
Time	PM_{10}	$PM_{2.5}$	O_3	CO	SO_2	H_2S	NO_2	NH_3	METHANE	NMHC
	µg/m³	µg/m³	ppb	ppb	ppb	ppb	ppb	µg/m³	ppb	ppb
المواصفة الأردنية 2006/1140	120	65	-	-	140	10	80	270	-	-
16/10/2017	28.8	12.8	45.9	2757	39.4	7.72	9.68	27.39	0	0
17/10/2017	141	26.9	42.9	1983	23.3	9.19	7.47	16.2	1.33	0
18/10/2017	421	26	34.9	2442	5.84	13.2	16.8	4.06	16.2	0.013
19/10/2017	400	39.4	35.5	2082	10.3	42.4	11.1	7.16	28.1	0.017
20/10/2017	246	46.9	36.4	2338	30.9	19.9	13.8	21.48	10.6	0.0042
21/10/2017	81.7	29.1	41.6	2435	46.1	7.05	9.58	32.05	2.13	0
22/10/2017	74	26.7	21.7	2489	34.7	21.8	19.1	24.13	5.51	0

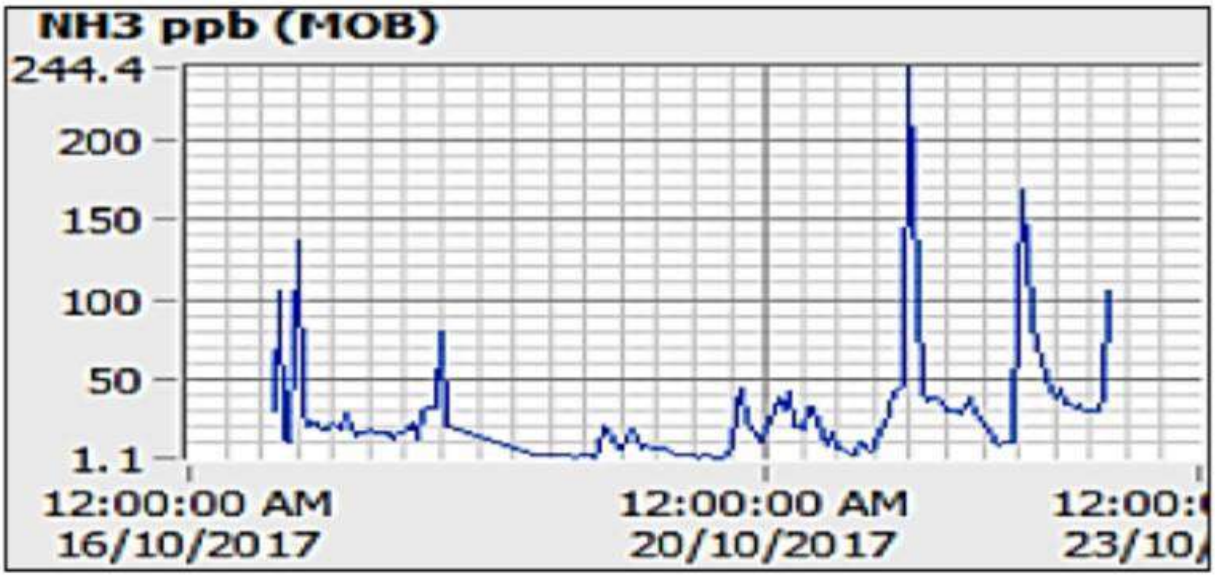
Figure A6.1. Representation of the results of the air quality measurements near the health care waste incinerator at Al Ghabawi Landfill site (source: MoEnv)

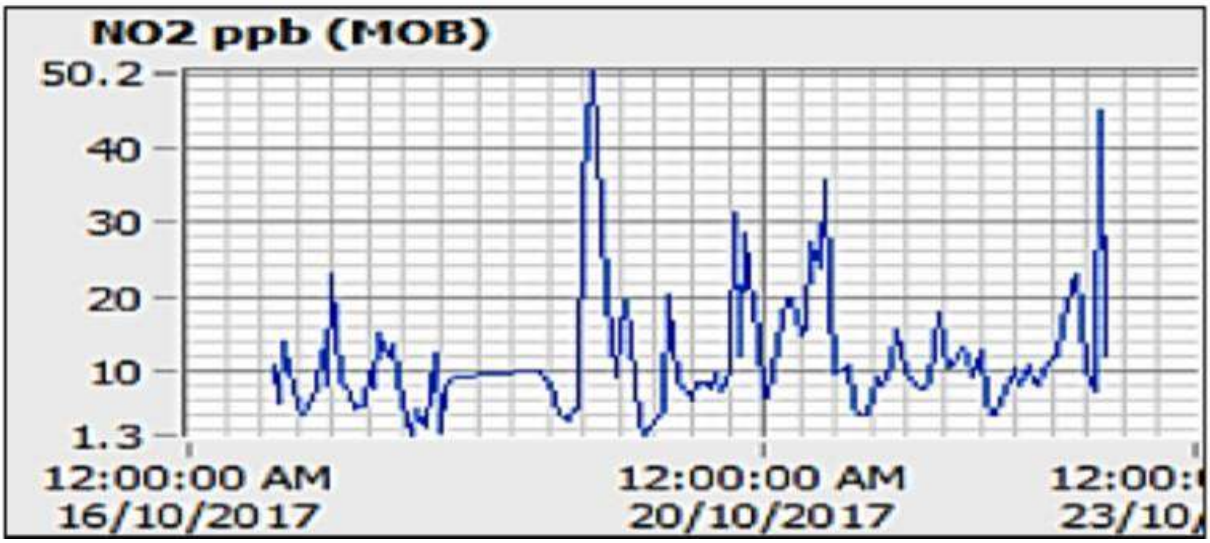


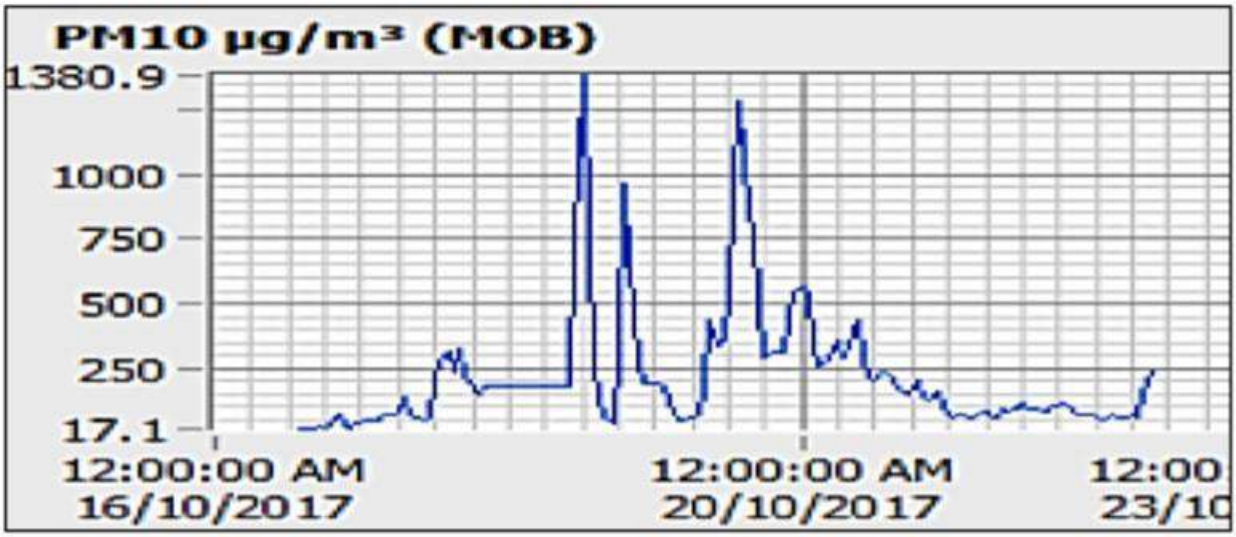

METHANE HC ppm (MOB)
135.3
100
75
50
25
0
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00
23/10

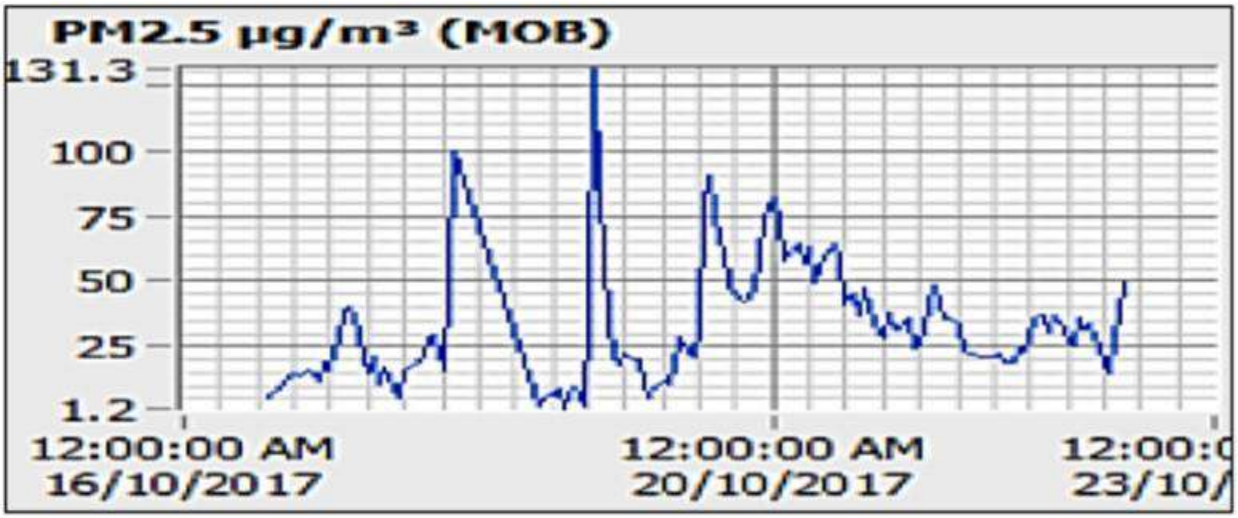

NMHC ppm (MOB)
0.2
0.15
0.1
0.05
0
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00
23/10

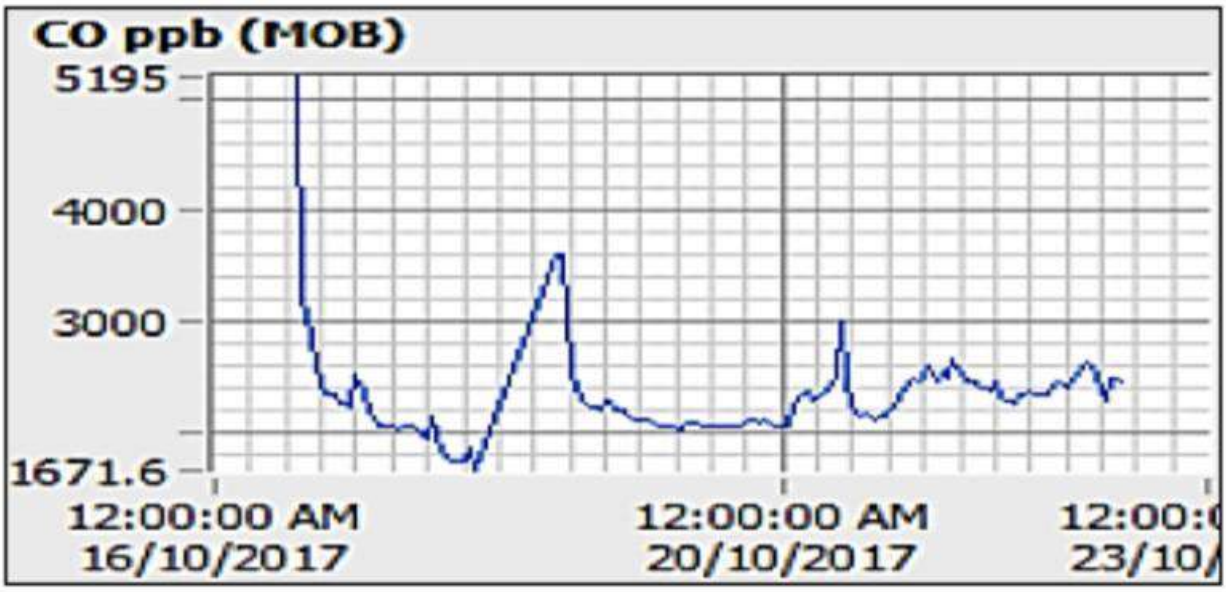

H2S ppb (MOB)
368.2
300
200
100
4.7
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00:
23/10

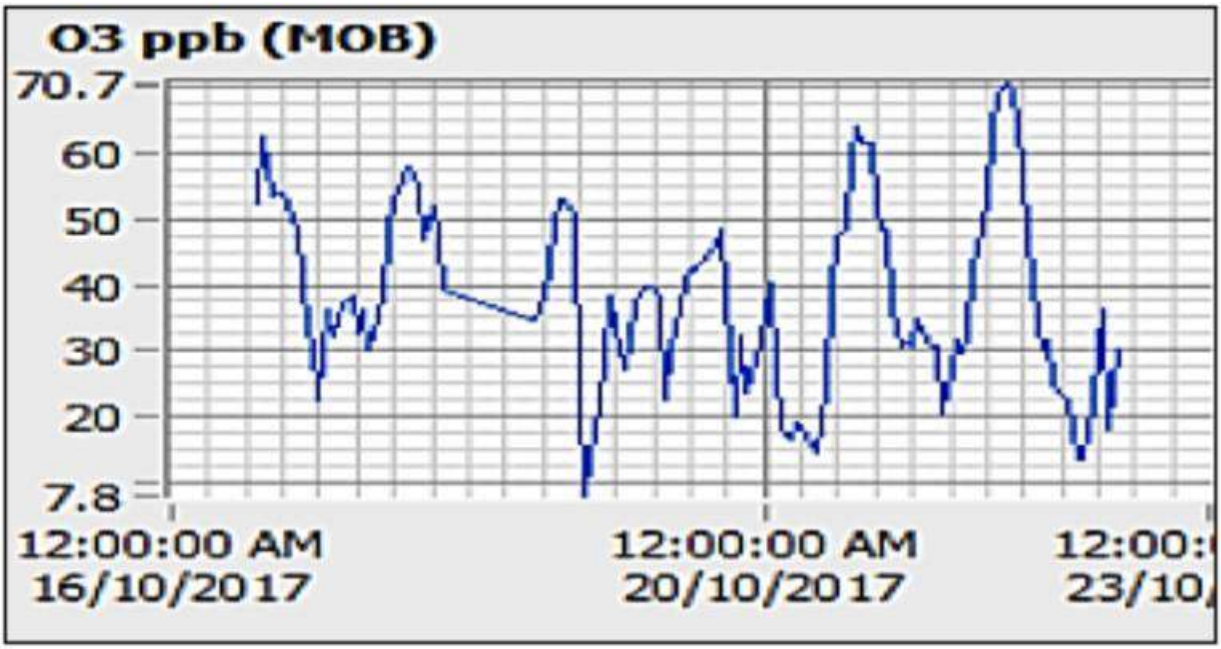

NH3 ppb (MOB)
244.4
200
150
100
50
1.1
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00:00 AM
23/10/


NO2 ppb (MOB)
50.2
40
30
20
10
1.3
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00:00 AM
23/10/

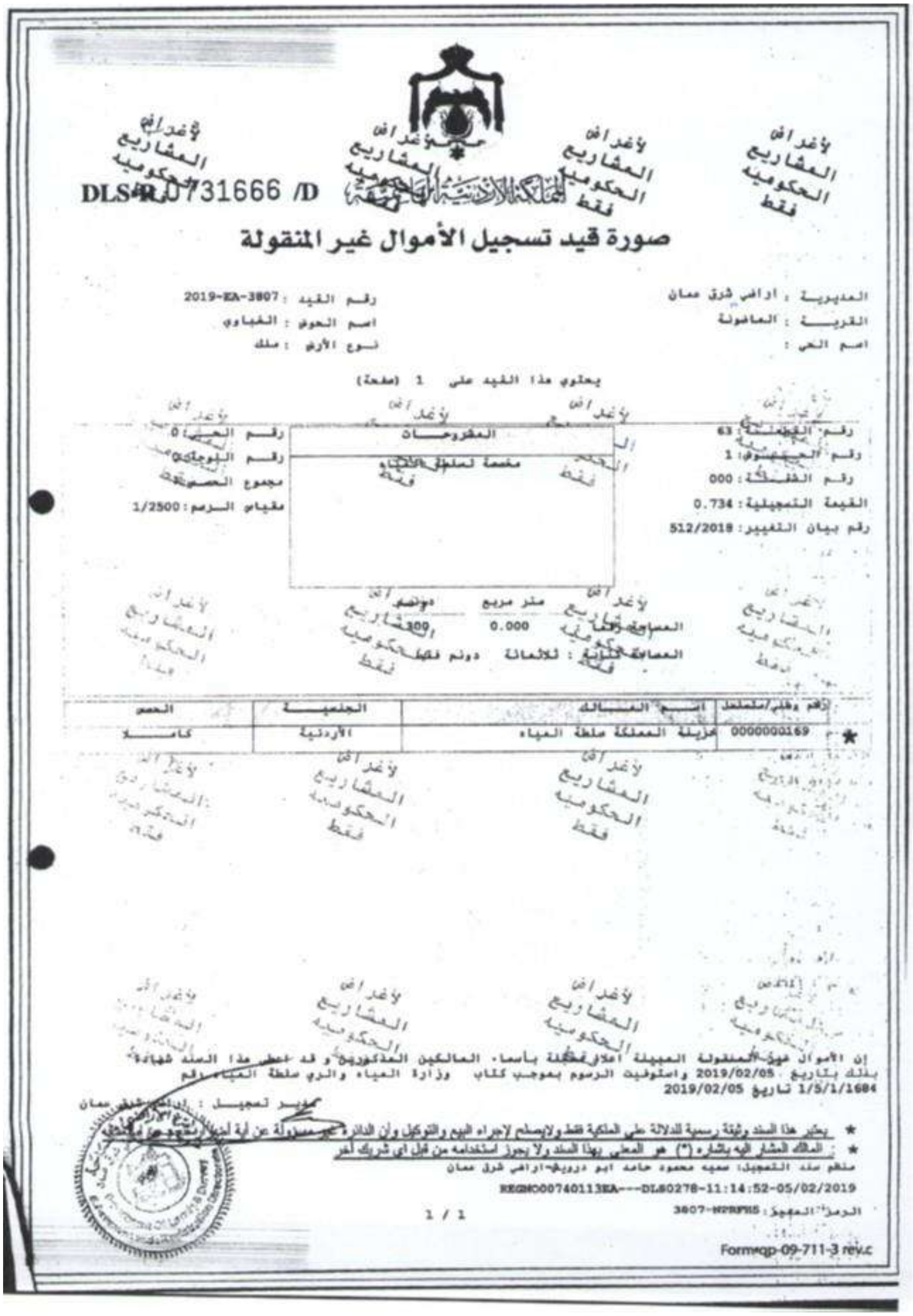

PM10 µg/m³ (MOB)
1380.9
1000
750
500
250
17.1
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00
23/10


PM2.5 µg/m³ (MOB)
131.3
100
75
50
25
1.2
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017
12:00:0
23/10/


CO ppb (MOB)
5195
4000
3000
1671.6
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017


O3 ppb (MOB)
70.7
60
50
40
30
20
7.8
12:00:00 AM
16/10/2017
12:00:00 AM
20/10/2017

Annex 7. Project's land registration certificate issued by the Department of Land and Survey



DLS-R.D731666 /D

المملكة الأردنية الهاشمية

صورة قيد تسجيل الأموال غير المنقولة

المديرية : اراضي شرق عمان

القرية : الماضونة

اسم الحي :

رقم القيد : 2019-EA-3807

اسم الحوض : الغباوي

نوع الأرض : ملك

يحتوي هذا القيد على 1 (صفحة)

رقم القطعة : 63

رقم الحوض : 1

رقم الشقة : 000

القيمة التحليلية : 0.734

رقم بيان التغيير : 512/2018

رقم الحي : 0

رقم اللوحة : 0

مجموع الحصص :

مقياس الرسم : 1/2500

المفروحات
مخصصة لمشروع الغباوي

	دونم	متر مربع
المساحة رقماً	300	0.000

المساحة كتابة : ثلاثمائة دونم فقط

رقم وطني/متسلسل	اسم المالك	الجنسية	الحصص
★ 0000000169	خزينة المملكة سلطة المياه	الأردنية	كاملا

إن الأموال غير المنقولة المبينة أعلاه مسجلة بأسماء المالكين المذكورين و قد أعطي هذا السند شهادة بذلك بتاريخ 2019/02/05 واستوفيت الرسوم بموجب كتاب وزارة المياه والري سلطة المياه رقم 1/5/1/1684 تاريخ 2019/02/05

مدير تسجيل : اراضي شرق عمان

★ يعتبر هذا السند وثيقة رسمية للدلالة على الملكية فقط ولا يصلح لإجراء البيع والتوكيل وإن الدائرة غير مسؤولة عن أية أخطاء

★ المالك المشار إليه بإشارة (*) هو المعطى بهذا السند ولا يجوز استخدامه من قبل اي شريك آخر

منظم سند التسجيل: سميه محمود حامد ابو درويش-اراضي شرق عمان

REGMO0074O113EA---DL80278-11:14:52-05/02/2019

الرمز المعمم : 3807-HPRFHS

1 / 1

Form#qp-09-711-3 rev.c

Annex 8. Letter of reply by Department of Antiquities (DoA)

وزارة السياحة والآثار
دائرة الآثار العامة

الرقم ٤٢٧٠١١٥
التاريخ ٢٠١٩/١٠/١٤
الموافق

السادة شركة المستشار للهندسة

اشاره إلى كتابكم رقم ت م/2019/1772/1833 تاريخ 2019/9/3م بخصوص طلبكم بيان وجود أي مواقع أو أيّة لُقى أثرية موجودة في المنطقة المقترحة لمشروع إنشاء محطة معالجة صهاريج مياه النضح في الغباوي/ محافظة العاصمة.

اعلمكم انه وبعد القيام بإجراء أعمال المسح الأثري لمنطقة المشروع المقترحة وبناءً على الكشف الميداني الذي تم على الموقع المقترح للمشروع من قبل كادر مديرية آثار محافظة العاصمة وحسب كتابهم رقم 386/7/1 تاريخ 2019/9/29م، فإنه لا مانع لدينا من القيام بتنفيذ أعمال المشروع أعلاه، وذلك بعد أن تبين خلو المنطقة المقترحة للمشروع من اية لُقى او معالم اثرية على السطح، مع ضرورة التوقف عن العمل في حال العثور على اية معالم او لقى اثرية اثناء تنفيذ المشروع وابلاغ دائرة الاثار العامة بذلك.

و اقبلوا الاحترام

يزيد عليان

مدير عام دائرة الآثار العامة

نسخة/ مديرية التنقيبات الاثرية
نسخة/ مديرية آثار محافظة العاصمة
ض ح

Annex 9. Attendance Record of the Public Scoping Session held on November 5th, 2019

الرقم	الأسم	الجهة الممثلة	المسمى الوظيفي	الهاتف	E-mail	الامضاء
1						
2						
3		PMU	P.M. Expert	0795586888		
4						
5						
6						
7						
8						
9				0796521170		
10						
11				0796090636		
12						

الرقم	الأسم	الجهة الممثلة	المسمى الوظيفي	الهاتف	E-mail	الامضاء
1				0799054175		
2				0798774684		
3				0799891484		
4				0779201207		
5						
6						
7						
8				0799733316		
9				0776346300		
10				0795597927		
11						
12		Engicon				

الرقم	الأسم	الجهة الممثلة	المسمى الوظيفي	الهاتف	E-mail	الامضاء
1					Chairman_fadi@easep-jo.org	
2						
3						
4		Engicon		0796985942		
5		Engicon	ESIA Team	0795522868	abdak	
6		Engicon	E&S Team	0775527742		
7		Engicon	E&S Team	06-4602120		
8		Engicon	Project Eng	0795744068		
9				0772246788		
10						
11		Engicon	Env Engineer			
12		MEMR				

الرقم	الأسم	الجهة الممثلة	المسمى الوظيفي	الهاتف	E-mail	الامضاء
1				0797145616	ghrayyeh.maha@yahoo.com	
2						
3				0777423143		
4						
5						
6						
7						
8						
9						
10						
11						
12						

Annex 10. Scoping Session Agenda and Presentation

دراسة تقييم الأثر البيئي والاجتماعي
لمشروع انشاء محطة معالجة مياه صهاريج النضح في الغباوي، الأردن

فندق بريستول – الدوار الخامس

عمان – الأردن

5 تشرين الثاني 2019

10:00 – 9:45	تسجيل المشاركين
10:10 – 10:00	كلمة افتتاحية - وزارة البيئة - سلطة المياه
11:10 – 10:10	عرض المشروع ومراحل الدراسة البيئية والاجتماعية
11:30 – 11:10	استراحة
12:00 – 11:30	عرض السجل الأولي للآثار المحتملة لأنشطة المشروع
12:45 – 12:00	مناقشة الأثار البيئية والاجتماعية المحتملة وتلك ذات الأهمية لمراحل المشروع
13:45 – 12:45	غداء


وزارة المياه والري
سلطة المياه
البنك الأوروبي لإعادة الاعمار والتنمية
European Bank
الحلقة التشاورية الخاصة
بدراسة تقييم الأثر البيني والاجتماعي لمشروع انشاء
محطة معالجة مياه صهاريج النضح في الغباوي، الأردن
الفندق بريستول – الدوار الخامس
عمان – الأردن
5 تشرين الثاني 2019
ankura
engicon

1


جدول العمل
10:00 – 9:45 تسجيل المشاركين
10:10 – 10:00 كلمة افتتاحية
- وزارة البيئة
- سلطة المياه
11:10 – 10:10 عرض المشروع ومراحل الدراسة البيئية والاجتماعية
11:30 – 11:10 استراحة
12:00 – 11:30 عرض السجل الأولي للآثار المحتملة لأنشطة المشروع
12:45 – 12:00 مناقشة الآثار المحتملة و ذات الأهمية خلال مراحل المشروع
13:45 – 12:45 غداء

2


جدول المحتويات
• نبذة عن المشروع
• أهداف الدراسة والجلسة التشاورية
• وصف المشروع
• الحاجة الى المشروع
• البيئة المحيطة بالمشروع
• مراحل ومنهجية دراسة تقييم الأثر البيني والاجتماعي
• تحديد أصحاب العلاقة حتى تاريخه
• السجل الأولي لآثار أنشطة المشروع

3


نبذة عن المشروع
• الجهة الممولة
- البنك الأوروبي لإعادة الاعمار والتنمية (EBRD)
• مالك المشروع
- وزارة المياه والري / سلطة المياه
• فريق الدراسة
- يتم تنفيذ الدراسات المتعلقة بالمشروع من قبل شركة «المستشار» (ENGICON) الأردنية وشركة ANKURA البريطانية
- فريق الدراسة هو من شركة «المستشار» (ENGICON) الأردنية

4


الأهداف
• أهداف الدراسة
- تقييم الأثر البيني والاجتماعي للمشروع وفقا الى:
- متطلبات نظام تقييم الاثر البيني الأردني رقم 37 لعام 2005
- تحديد الآثار البيئية والاجتماعية السلبية المحتملة، وتحديد التدابير اللازمة لمنع هذه الآثار أوتخفيفها
- تحديد الفرص البيئية والاجتماعية التي من شأنها تحسين الاستدامة البيئية والاجتماعية للمشروع
• أهداف الجلسة التشاورية
- تقديم المشروع لأصحاب العلاقة والجهات المعنية
- الاطلاع على آراء المشاركين
- العمل مع المشاركين لتحديد الآثار البيئية والاجتماعية والمخاوف المتوقعة خلال مراحل المشروع
- التأكد من اتباع المنهجية المناسبة خلال عملية التقييم

5


وصف المشروع
• أهداف المشروع:
- انشاء محطة الغباوي لمعالجة مياه صهاريج النضح لاستبدال مرافق استقبال الصهاريج والمعالجة الأولية الموجودة في عين غزال
• سيخدم المشروع المناطق والأحياء غير المخدومة بشبكة الصرف الصحي في عمان والزرقاء، والتي يتم خدمتهم حاليا من خلال محطة معالجة مياه صهاريج النضح في عين غزال القائمة
• وسيقوم المشروع أيضا باستقبال الحمأة الناتجة من محطات المعالجة في السلط والفحيص والبقعة

6


منطقة المشروع
• المشروع يقع في منطقة الغباوي على بعد ~20 كم شرق عمان على قطعة أرض مخصصة لسلطة المياه الأردنية
• الموقع هو:
• مباشرة إلى الشرق من موقع مكب الغباوي للنفايات الصلبة التابع لأمانة عمان
• على بعد 1.5 كم شمالاً من موقع محطة عمان للاحتياطي الاستراتيجي للمنتجات البترولية التابعة لوزارة الطاقة والمعادن
• يمكن الوصول إلى الموقع من الزرقاء وعمان عبر الطرق الحالية
Zarqa
Amman
Karak
Tafiela
Ma'an
Aqaba
حدود المحافظات

7


وصف المشروع
عناصر المشروع
• استقبال صهاريج النضح التي تنقل مياه الصرف الصحي من المناطق غير المخدومة بشبكة صرف صحي
• محطة معالجة مياه الصهاريج
• معالجة الحماة
كمية الصرف الصحي للمعالجة
الصرف الصحي عبر صهاريج النضح
الكمية (م³ / يوم)
الصرف الصحي الذي يتم استلامه في عين غزال لعام 2018
11,180
تدفق مستقبلي الى محطة الغباوي لعام 2045
~22,500

8


وصف المشروع
نظام معالجة المياه العادمة
مرحلة المعالجة
هدفها
مكوناتها
المعالجة الأولية
المعالجة الابتدائية
إزالة غالبية المواد الصلبة العالقة في المياه العادمة
أحواض الترسيب الأولية
معالجة ثانوية
conventional activated sludge
أحواض الترسيب الثانوية
المعالجة الثالثة
توفير مياه معالجة ذات جودة عالية

9


وصف المشروع
معالجة الحماة
• سيتم معالجة الحماة لتصبح:
• مستقرة ويتم منع انبعاث الرائحة وتقليل مسببات الأمراض وتقليل الحجم
• سيتم استخدام الأسرة الدفينة لتجفيف الحماة حتى نسبة 50٪ محتوى كمواد جافة
• طريقة المعالجة:
• التكثيف والتخمير الهوائي ومن ثم التجفيف ثم طمرها وتخزينها داخل الموقع
• سوف تطابق الحماة الناتجة للمعايير الأردنية للحماة JS 1145/2016 الفئة 3

10


وصف المشروع
جودة مياه الصرف الصحي المعالجة
(BOD5) 30 30 2,700
(COD) 100 100 5,950
(DO) <2
(TSS) 50 50 3,300
pH 6-9 6-9 6-9
NTU 10 10
(NO3) 30 30
(TN) 45 45 220
(E. Coli) 100 100
≤ 1 ≤ 1
(FOG) 8 8

11


الحاجة الى هذا المشروع
• ايجاد حل لمشكلة الروائح التي تسببها محطة عين غزال لاستقبال صهاريج النضح
• زيادة القدرة على تلبية الطلب المتزايد لمعالجة الصرف الصحي
• تخفيف عن التحميل البيولوجي العالي القادم من مياه الصرف الصحي على السعة التصميمية لمحطة السمرا لمعالجة الصرف الصحي

12

البيئة المحيطة بالمشروع

البيئة الفيزيائية - المناخ

مناخ متوسطي بارد

العامل	القيمة
معدل الحرارة	~19 °C
متوسط درجة الحرارة الدنيا	~12 °C
متوسط درجة الحرارة القصوى	~25 °C
متوسط الرطوبة	~62%
متوسط هطول الأمطار السنوي	~ 84 mm/year

13

البيئة المحيطة بالمشروع

- البيئة الفيزيائية – التضاريس والتربة
  - المنطقة شبه مسطحة مع انحدار نحو الشمال الغربي
  - السطح عبارة عن مارل طباشيري ناعم وسيلت وحجر جيري طباشيري، يعمل كحاجز غير نافذ أمام تدفق المياه

- البيئة الفيزيائية – مصادر المياه
  - لا توجد مياه سطحية في منطقة الغباوي باستثناء مجاري الفيضانات المؤقتة التي تظهر أثناء هطول الأمطار
  - توجد مياه جوفية ولكنها شديدة العمق
  - يوجد بئر واحد في موقع الغباوي للتقنيات الصلبة يتم ضخ المياه منه للتحكم في الغبار وغسل الشاحنات وليس للشرب
  - لا توجد أي آبار أخرى على مسافة قريبة من الموقع

14

البيئة المحيطة بالمشروع

- البيئة البيولوجية
  - منطقة المشروع هي منطقة ذات تنوع منخفض للغاية في أنواع النباتات والغطاء النباتي:
  - النباتات في الغالب هي مقاومة للجفاف يمكنها مقاومة ظروف المناخ الحار والجاف
  - يقتصر الغطاء النباتي على الأماكن القريبة من نظام الوادي حيث توجد رطوبة تربة كافية
  - لم يتم تسجيل أي نوع من الحيوانات في الموقع حيث موقع المشروع :
  - ليس موطنًا مناسبًا للثدييات ولا يحتوي على أي موائل مهمة للطيور
  - تم تسجيل نوعين من الطيور شائعة التوزيع: القبرة الشائع (Crested Lark) و عصفور الدوري (House Sparrow)

15

البيئة المحيطة بالمشروع

الموقع المقترح ليس قريبًا من أي مناطق محمية أو محميات رعي أو مناطق طيور هامة

16

البيئة المحيطة بالمشروع

- البيئة الاجتماعية
  - لا يوجد تحديدًا أي تجمعات سكانية أو أي أنشطة اقتصادية مباشرة ضمن الموقع
  - التجمعات السكانية الأقرب إلى منطقة المشروع تقع أغلبها من ضمن منطقة أهد التابعة إلى لواء سحاب ما عدا منطقة مغاير مهنا والتي تقع من ضمن لواء الموقر:

التجمع السكاني	البعد عن موقع المشروع	عدد السكان
زملة العليا	7.5 كم جنوب-شرق موقع المشروع	حوالي 136 نسمة
قفور	8 كم جنوب موقع المشروع	حوالي 700 نسمة
المغاسوبة	11 كم غرب موقع المشروع	حوالي 215 نسمة
المناخر	12 كم الى غرب موقع المشروع	حوالي1,750 نسمة
مغاير مهنا	12 كم الى غرب موقع المشروع	حوالي 3,000 نسمة

  - من الجدير بالذكر أن المناطق أعلاه لا ترتبط بمنطقة تأثير المشروع من ناحية توفير الخدمات المحددة تقديمها بواسطة المشروع

17

البيئة المحيطة بالمشروع

- ملكية الأرض
  - الأرض مخصصة لسلطة المياه لذلك لا يوجد أثار متوقعة من استملاك الأراضي
  - ومن الجدير بالذكر أن منطقة الغباوي كانت في السابق أراضي عسكرية وبالتالي كانت خالية وغير مستخدمة اقتصاديا أو سكنيا

18

19

20

21

22

23

24

الإطار القانوني والتنظيمي ذو الصلة بالمشروع

- الأنظمة
  - نظام الصرف الصحي رقم 66 لعام 1994 ونظام الصرف الصحي، وقانون تزويد المياه لعام 1988
  - نظام تقييم الأثر البيئي رقم 37 لعام 2005
  - نظام حماية الهواء رقم 28 لعام 2005

25

الإطار القانوني والتنظيمي ذو الصلة بالمشروع

- التعليمات
  - تعليمات إدارة النفايات الصلبة رقم 27 لعام 2005
  - تعليمات منع النفايات البيضة ورسوم جمع النفايات الصلبة داخل حدود البلدية رقم 1
  - تعليمات للحد من الضوضاء ومنعها لعام 2003
  - تعليمات إدارة المواد الضارة والخطرة ونقلها ومعالجتها رقم 24 لعام 2005
  - تعليمات الفحص الطبي الأولي للعاملين في المؤسسات عام 1999
  - تعليمات لحماية العمال من مخاطر بيئة العمل رقم 8 لسنة 1996
  - اللائحة التنفيذية لتشكيل اللجان والمشرفين على السلامة والصحة المهنية رقم 7 لعام 1998
  - اللائحة رقم 42 لعام 1998 بشأن الرعاية الطبية الوقائية والعلاج للعاملين في المؤسسات
  - اللائحة رقم 43 لعام 1988 بشأن الحماية والسلامة من الآلات والمعدات الصناعية في مواقع العمل
  - أمر الدفاع المدني رقم 1: حماية الغابات في الأردن لعام 1993

26

الإطار القانوني والتنظيمي ذو الصلة بالمشروع

- المعايير
  - المواصفة الأردنية لمياه الصرف الصناعي - JS 202/1991
  - المواصفة القياسية الأردنية للمياه العادمة المستصلحة - JS 893/2006
  - المواصفة القياسية الأردنية لمياه الصرف الصناعي المستصلحة - JS 202/2007
  - المواصفة القياسية الأردنية بشأن المتطلبات الوقائية العامة لتخزين المواد الخطرة - JS 432/1985
  - المواصفة القياسية الأردنية لمعايير جودة الهواء المحيط - JS 1140/2006
  - الماء - الحمأة - استخدامات الحمأة المعالجة والتخلص من الحمأة - JS 1145: 2006
  - المواصفة القياسية الأردنية لمستويات الحرارة في بيئة العمل - JS 525/1987
  - المواصفة القياسية الأردنية لمستويات الإضاءة في بيئة العمل - JS 524/1987

27

الإطار القانوني والتنظيمي ذو الصلة بالمشروع

- السياسات
  - السياسة الوطنية لتغير المناخ 2013-2020

28

الإطار القانوني والتنظيمي ذو الصلة بالمشروع

- الاتفاقيات والبروتوكولات الدولية
  - بروتوكول كيوتو بشأن تغير المناخ، 2003
  - اتفاقية رامسار (RAMSAR) للأراضي الرطبة ذات الأهمية الدولية، 1971
  - اتفاقية فيينا وبروتوكول مونتريال لحماية طبقة الأوزون
  - اتفاقية بازل بشأن التحكم في نقل النفايات الخطرة والتخلص منها عبر الحدود، 1992
  - اتفاقية الأمم المتحدة لمكافحة التصحر 1996 - (UNCCD)
  - بروتوكول قرطاجنة للسلامة البيولوجية
  - on اتفاقية حماية الطيور المائية الأفريقية - الأوروبية الأسيوية
  - اتفاقية حفظ أنواع الحيوانات البرية المهاجرة، 1979
  - بروتوكول استكهولم بشأن الملوثات العضوية الثابتة، 2004
  - اتفاقية التنوع البيولوجي 1994 - (CBD)

29

توثيق الوضع البيئي والاجتماعي القائم

- البيئة الفيزيائية
  - بما في ذلك الدراسات الكمية والتي تشمل قياس جودة الهواء في محيط موقع المشروع
- البيئة البيولوجية
  - بما فيها تقدير الحد الأدنى من تدفق المياه المطلوب لغايات إستدامة الخدمات الإيكولوجية اللازمة
- الظروف الاجتماعية والاقتصادية
  - بما في ذلك التجمعات السكانية والأنشطة الاقتصادية والبنية التحتية
- المواقع الأثرية والتراث الثقافي
  - بما في ذلك المواقع ذات الأهمية التراثية والثقافية

30

تحديد أصحاب العلاقة والجهات المعنية بالمشروع

- سيقوم المشروع بإعداد خطة مفصلة لإشراك أصحاب العلاقة والجهات المعنية بالمشروع
- تعتبر هذه المرحلة عنصرا أساسيا لبناء الإستراتيجية المناسبة لإشراك أصحاب العلاقة والجهات المعنية بالمشروع
- يتطلب تحديدهم ما يلي:
  - تحديد المجال الجغرافي لتأثير المشروع
  - تحديد المتأثرين بشكل مباشر وغير مباشر
  - تصنيف أصحاب العلاقة والجهات المعنية إلى فئات على شكل جدول وبناء على كيفية تأثير المشروع عليهم

31

أصحاب العلاقة والجهات المعنية الخاصة بالمشروع (2\1)

الجهة	ملاحظات
الجهات الحكومية	✓ وزارة المياه والري/سلطة المياه، وزارة البيئة، وزارة الشؤون البلدية، وزارة الصحة، وزارة العمل، وزارة النقل، وزارة الأشغال العامة والإسكان، وزارة الزراعة ووزارة التخطيط والتعاون الدولي
الجهات الحكومية المحلية	✓ أمانة عمان الكبرى، بلدية الزرقاء
شركة مياهنا	✓ المسؤولة عن إدارة خدمات الصرف الصحي في عمان والزرقاء بما فيها محطة عين غزال والمشروع المقترح
الموظفين والعمال	✓ الموظفين والعمال بالإضافة الى المتعاقدين
المقاولين	✓ المقاول والمقاولين الفرعيين
الممولين والمنظمات الدولية	✓ البنك الأوربي لإعادة الإعمار والتنمية (المسول للمشروع) وكالات ومنظمات التمويل الدولية التي تعمل/تمول مشاريع ضمن منطقة المشروع أو في مناطق مجاورة خلال تمويل مشاريع البنية التحتية

32

أصحاب العلاقة والجهات المعنية الخاصة بالمشروع (2\1)

الجهة	ملاحظات
المنظمات غير الحكومية	✓ -
منظمات المجتمع المحلي في منطقة المشروع	✓ جمعية شرق عمان للحماية البيئية، جمعية ريوع المناخير الخيرية، جمعية البيضاء الخيرية، جمعية سفاير جهة الخيرية وغيرها
الفئات المهمشة	✓ اللاجئين السوريين، النساء، الأطفال والشباب
سائقي ومالكي صهاريج التفريغ	✓ -
السكان المحليين	✓ السكان المحليين في المناطق المجاورة التي تم تحديدهم ✓ سكان المناطق التي سيتم خدمتها من خلال المشروع (مناطق عمان والزرقاء الغير مخدومة بشبكة الصرف الصحي)
المنشآت الصناعية	✓ المنشآت الصناعية القريبة من المشروع

33

منهجية تقييم الآثار البيئية والاجتماعية

- سيتم مراعاة الآثار خلال مراحل البناء والتشغيل للمشروع :
  - المباشرة وغير المباشرة
  - الناتجة عن أنشطة المشروع المخطط لها أو غير المخطط لها (العرضية)
  - آثار متبقية (أي آثار تبقى بعد التدابير التخفيفية)
  - آثار تراكمية محتملة
- سنحدد عملية التقييم:
  - الجوانب البيئية للمشروع (أي الأنشطة التي تتفاعل مع البيئة وتحتوي على مصدر التأثير)
  - المستقبلات (أي المستقبلات البيئية والاجتماعية التي يتم التأثير عليها من تلك الجوانب)
  - ما يترتب على ذلك من آثار

34

منهجية تقييم الآثار البيئية والاجتماعية

- سيتم تقييم التأثيرات المحتملة كالتالي: شدة العاقبة × الاحتمالية = حدة التأثير

شدة العاقبة	احتمالية الحدوث 5	4	3	2	1	0	حدة التأثير
	مؤكد	محتمل جدا	محتمل	من غير المرجح	بعيد لكافية	لن يحدث	
كبيرة (5)	25	20	15	10	5	0	كبيرة
مرتفعة (4)	20	16	12	8	4	0	كبيرة
متوسطة (3)	15	12	9	6	3	0	معتدلة
منخفضة (2)	10	8	6	4	2	0	ثانوية
تأثير ضئيل (1)	5	4	3	2	1	0	ضئيلة
لا يوجد (0)	0	0	0	0	0	0	لا تأثير
ايجابي (+)							تأثير إيجابي

35

تحليل البدائل

- سيتناول تحليل البدائل:
  - استمرار الوضع القائم كما هو
  - المشروع المقترح
- تحليل البدائل قبل بدء أنشطة المشروع سيساهم في:
  - تحديد امكانية زيادة الفوائد البيئية والاجتماعية للمشروع
  - تحديد التحديات المحتملة ومعالجتها

36

اعداد خطة الإدارة البيئية والاجتماعية

- الهدف:
  - تحديد أهمية تأثير القضايا البيئية والاجتماعية التي تم التوصية بها
  - ادراج التدابير الموصى بها للإدارة والتخفيف من الآثار المتوقعة
  - ادراج برامج الرصد المقترحة خلال تقييم الأثر البيئي والاجتماعي

- سيتم تنظيم الخطة لتشير بوضوح خلال مرحلتي الانشاء والتشغيل الى الأمور التالية:
  - الآثار المحتملة
  - تدابير التخفيف
  - معايير الرصد المحددة وتيرة الرصد
  - الجهة المسؤولة عن تنفيذ التدابير والجهة التي يتم إبلاغها عن التدابير التي يتم تطبيقها

38

تحديد التوصيات للتدابير التخفيفية

- سيتم وضع توصيات لتدابير تخفيفية لكل أثر من الآثار المحتملة
  - ستكون إما عبارة عن حلول هندسية أو إجراءات مختلفة
  - يجب أن تكون فعاله واقتصادية من حيث التكلفة، معمول بها وسهلة التنفيذ

37

السجل الأولي للآثار البيئية لأنشطة المشروع

المتلقيات	التفاعلات المحتملة من الأنشطة مرحلة التشغيل	حدة التأثير
الضوضاء	✓ حدوث الضوضاء بسبب حركة مرور الآليات	ضئيلة
المياه	✓ سيؤدي الفشل في التحكم في الرائحة في محطة معالجة مياه الصرف الصحي إلى إزعاج للمنشآت المحيطة	معتدلة
التربة	✓ لا يوجد	لا تأثير
المنظر العام	✓ لا يوجد	لا تأثير
المصادر المائية	✓ تغير نظام التدفق الهيدرولوجي ✓ ويعتبر خطر تلوث المياه الجوفية منخفضا على افتراض الإدارة الجيدة للمادة المرتشحة	معتدلة
التنوع البيولوجي	✓ قد يحتوي الموقع على برك مياه الصرف الصحي المقترحة التي قد تجذب بعض أنواع الحيوانات مثل الثدييات والطيور. على الرغم من أن هذه الأحواض يمكن أن تكون جذابًا للغاء، فقد تحتوي أيضًا على ملوثات التي يمكن أن تؤثر سلبًا على الثدييات والطيور المائية	ضئيلة

40

السجل الأولي للآثار البيئية لأنشطة المشروع

المتلقيات	التفاعلات المحتملة من الأنشطة مرحلة الانشاء	حدة التأثير
الضوضاء	✓ الضوضاء والاهتزازات الناتجة عن الآلات العاملين في الموقع	ضئيلة
المياه	✓ الانبعاثات من المولدات الكهربائية وحركة وتشغيل الآليات / المركبات ✓ الغبار الناتج عن الأعمال الأرضية وانبعاثات الغازات المتطايرة	معتدلة
التربة	✓ تضرر التربة السطحية وانضغاط التربة بسبب حركة المركبات ✓ تلوث التربة (بسبب امكانية تسرب الوقود / الزيوت والنفايات)	معتدلة
المنظر العام	✓ تشير المنطقة والمناطق المحيطة بها بأنها ارضي جرداء ومحاورة لموقع مكب النفايات الصلبة الحالي، ولذا الآثار البصري لعمليات المنطقة ضئيل	ضئيلة
المصادر المائية	✓ تتواجد موارد المياه الجوفية داخل منطقة الدراسة في مستويات عميقة للغاية، ولذا تلوث المياه بسبب الرواسب والوقود والزيوت والنفايات ضئيل	ضئيلة
التنوع البيولوجي	✓ لا يوجد تأثير كبير على الحيوانات أو الأنواع النباتية • تشير منطقة المشروع بالتنوع المنخفض في أنواع النباتات والعشاء النباتي حيث أن النباتات في الغالب تقتصر على الأماكن القريبة من نظام الوادي حيث توجد رطوبة تربة كافية • الموقع ليس موئلا مناسبا للثدييات • الموقع ليس قريباً من أي مناطق محمية أو موائل مهمة للطيور	ضئيلة

39

السجل الأولي للآثار الاجتماعية لأنشطة المشروع

المتلقيات	التفاعلات المحتملة من الأنشطة مرحلة التشغيل	حدة التأثير
الوضع الاجتماعي-الاقتصادي	✓ تعزيز مستويات خدمات الصرف الصحي نتيجة المشروع، بالإضافة الى تخفيف الأعباء التشغيلية المالية والآثار البيئة الناتجة من سحطة عين غزال ✓ من غير المتوقع أن يكون هناك ازدحام في حركة المرور نتيجة تواجد عدد قليل من العمال أو الموظفين في الموقع عند التشغيل ✓ من المحتمل أن يتم توفير فرص عمل متخصصة وفرص تدريب في مرحلة التشغيل لعدد محدود من الموظفين لأعمال التشغيل والصيانة ✓ كلف نقل المياه العادمة من خلال صهاريج التصح الشرائية على سكان المناطق التي سيخدمها المشروع في عمان والزرقاء (سلبا أو ايجابيا أو قد تبقى كما هي حسب الموقع)	ايجابي ضئيلة الى معتدلة
الصحة والسلامة العامة	✓ مخاوف الصحة والسلامة المهنية المحتملة على سائقي الصهاريج التصح اثناء نقل المياه العادمة والحمأة ✓ مخاطر الصحة والسلامة المحتملة لموظفي التشغيل والصيانة في الموقع في حال عدم تدريبهم بشكل صحيح	ضئيلة الى معتدلة

42

السجل الأولي للآثار الاجتماعية لأنشطة المشروع

المتلقيات	التفاعلات المحتملة من الأنشطة مرحلة الانشاء	حدة التأثير
الوضع الاجتماعي-الاقتصادي	✓ زيادة في حركة المرور بشكل مؤقت نظرا لطبيعة الأنشطة خلال مرحلة الإنشاء مثل نقل المعدات والمواد ✓ انبعاثات الغبار والضجيج نتيجة الأعمال الانشائية والتي من المحتمل أن تشكل الإزعاج لموظفي مكب العلوي المجاور لموقع المشروع ✓ فرص العمل أثناء مرحلة الانشاء (إيجابية)	معتدلة
الصحة والسلامة العامة	✓ الآثار المحتملة على الصحة والسلامة المهنية أثناء الأعمال الإنشائية وما يترتب من حوادث وإصابات محتملة	معتدلة

41

شكراً

43

للمناقشة مع المشاركين في الجلسة

- ما هي التاثيرات السلبية / المخاوف والتأثيرات الايجابية من المشروع على البيئة الفيزيائية /البيولوجية /الاجتماعية والتراثية؟
  - خلال مرحلة الانشاء
  - خلال مرحلة التشغيل

- ما هي الآثار ذات الأهمية القصوى؟
- ما هي التاثيرات الأقل أهمية؟

44

Annex 11. Record of Meetings with Local Community

Meeting with Tanker Drivers on November 13th, 2018

Introduction

Early on in the project, the E&S team conducted a quick meeting with the existing tanker drivers currently operating at AGTP in order to gather some information on their opinion about the proposed. The below is an interesting insight on what their general view is on the project.

Location	Ain Ghazal Treatment Plant
Participants	Septic Tank Drivers
Entity Represented	**Opinion about the Proposed Project**
Septic Tank Drivers currently transporting the septage/wastewater) from households to AGTP	– AGTP is located in the middle of Amman. The government should transfer the facility from the current location to a new place due to traffic congestion and time spent to reach it, especially during peak hours. – Some of the drivers who were interviewed consented with the proposed location in Al Ghabawi considering it a good selection and away from traffic congestion. On the other hand, few other drivers welcomed the idea to move Ain Ghazal Facility to a new location, but not to the Al Ghabawi area due to long distance from Amman and issues that they will face with citizens because of the expected fees increase. – The trip to the Al Ghabawi area will increase the fuel cost on the drivers, which will lead to an increase of septic transfer fees on the citizens. – The expected increase of the septic transfer fees from North or West Amman is an average of 30-40 JOD and depends on fuel prices in the market. – It was mentioned that there would be different effects on the septic transfer fees depending on the location. The septic transfer fees from West or North Amman will be increased as the distance to the new plant will be increased. While the fees from the south Amman or Zarqa may decrease as the new location will be closer than the current facility in Ain Ghazal.

Meeting on November 17th, 2019

Introduction

As part of the public consultation process with the local communities for the purpose of preparing the ESIA study, the E&S team conducted a meeting with a selected group of individuals from the local community that represent some tribes and civil society organizations in the area of the project. This meeting followed the scoping session held on the 5th of November, 2019, and aimed at better understanding the issues raised by the local communities in the project area and learning more about their concerns towards the proposed project. The discussions during this meeting helped guide the E&S team to realistically assess the impacts of the project and the needed mitigation and monitoring measures. Also, it helped in establishing a base for future stakeholder engagement activities to be implemented throughout the project lifecycle.

Meeting Details		
Day and Date	Sunday, 17 November 2019 (10:00 AM – 12:15 PM)	
Location	Uhud District Municipal Directorate / GAM	
Participants	– Mr. Saad Fahad Al-Dabaibh, (Local Municipal Committee Head / GAM) – Eng. Farhan Al-Dabobi, (Chairman, East Amman Society for Environmental Protection) – Mr. Yousef Al-Daejuh, (Head of Al-Bayidah Charity Society – Mr. Eid Al-Dabobi, (Head of Al-Khashafiyyah Society) – Mr. Ayed Al-Dabobi, Local community representative – Eng. Ahmad Al-Awamlah, (Ministry of Water and Irrigation) – Eng. Sultan Mashagbeh, PMU, Private Projects Unit- Ministry of Water and Irrigation) – Ashraf Ma'ani, (Engicon – Environmental & Social Specialist) – Eng. Nazih Bandak, (Engicon – Environmental & Social Expert)	
Entity Represented	**E&S issues of Concern discussed/raised during the meeting**	**Ministry of Water and Irrigation – PMU (Private Projects Unit) Response**
Local Community Representatives	– Raised several issues of concern that are related to the development of this project and several other projects within the same area such as the Ghabawi Landfill, power generating station, Customs Depot, etc.. – Mentioned that the EIA studies that were prepared previously for other projects in the area were theoretical and did not involve the local communities. Furthermore, the projects' owners did not implement the monitoring measures included in those EIAs. They now have a concern that the same issue will be repeated for the proposed project. – Expressed concerns from tankers discharging the septage illegally in nearby Wadies due to the absence of enforcement and monitoring measures by the local authorities. There are many Wadis on the way to the project's proposed location where the tankers can discharge the septage and this where their sheep graze. – Explained that they believe there would be a significant impact of increased traffic due to increased vehicle movement of septic tankers when added to the traffic that is generated from other existing and planned industries and businesses in the area. Also, the increased traffic will coincide with increased traffic movement due to the planned opening of the land port (Customs Depot). Therefore, the participants suggested alternative roads to be used by the septic tankers instead of the existing road to avoid congestion expected during the operation phase.	– Explained the strategic importance of this project for the Ministry of Water and Irrigation. – Mentioned that the Ministry worked hard with the Consultant to ensure that the plant design will be according to the best international standards. – Explained that the Ministry understands all concerns raised by local communities towards the proposed project, especially that the Ministry has previous experience in different locations in Jordan with similar treatment plants. (i.e., Al Samra WWTP. The Ministry is working closely with the local communities around Al-Samra WWTP and has formed a committee from the local residents to monitor and manage odours in the area. – The Ministry will oblige the contractor to secure a certain percentage for employment from the local community and allocate a budget for this purpose in the contract. – Mentioned that the Ministry during the project implementation will establish a committee from the local community to monitor compliance with the ESMP, this committee will be linked directly to the Ministry. – Explained that the Plant will have strict performance and monitoring measures at the entrance to ensure the proper wastewater type received at the plant. – Mentioned that the Ministry will encourage the local communities to

	– There is a lack of trust in the government promises for employment opportunities and improved livelihoods. – The participants expressed their concerns from the wastewater type that will be conveyed by septic tanks, especially the industrial, hazardous and toxic wastewater. Therefore, the participants requested to have a strict monitoring procedure to ensure that the wastewater that will enter the plant will be strictly domestic wastewater. – The participants emphasized that there should be a continuous stakeholder engagement process with the local communities and CSOs during the project lifecycle. – The participants expressed their demand to be served with a wastewater collection network as the government had promised them on many occasions. – Discussed that WAJ should demonstrate social responsibility towards the area and allocate a budget for this purpose. – There are concerns that the value of land will drop due to the project. They reported that it had dropped due to establishing the Ghabawi landfill nearby. – The participants requested to have another meeting with more representatives from nearby local communities to discuss the project and listen to their concerns relevant to the proposed project.	utilize the treated wastewater from the plant for agricultural purposes.

Meeting on November 27th, 2019

Introduction

As part of the public consultation process with the local communities for the purpose of preparing the ESIA study, the E&S team conducted a second meeting with representatives from the local community that represent resident tribes, municipal government and civil society organizations in the area of the project. This meeting followed the meeting with Mr. Saad Al-Dabaibh, the Local Municipal Committee Head / GAM, representatives from the local communities, and the Private Project Units (PMU) at the Ministry of Water and Irrigation (MWI) held on 17 November 2019. The meeting aimed to further interact with members from the local communities to learn more about their concerns towards the proposed project. The invitations were sent by the Local Municipal Committee Head / GAM to different groups in the local communities such as Women NGOs, disabled groups, and youth centers.

Meeting Details		
Day and Date	Wednesday, 27 November 2019 (10:00 AM – 12:30 PM)	
Location	Uhud District Municipal Directorate / GAM	
Participants	This meeting was organized through Mr. Saad Fahad Al-Dabaibh, (Local Municipal Committee Head / GAM) and attended by Eng. Sultan Mashagbeh, PMU, Head of Private Projects Unit- Ministry of Water and Irrigation). The Signed attendance sheets are attached as follows).	
Entity Represented	**E&S issues of Concern discussed/raised during the meeting**	**Ministry of Water and Irrigation – PMU (Private Projects Unit) Response**
Local Community Representatives	– East Amman area is a polluted region. The development of this project will increase the pollution in the area. – There is a concern from unauthorized discharge of the wastewater from tankers carrying the septage in nearby Wadies. – A cumulative impact assessment study for East Amman should have been conducted by the government which would take account of the sum of all development planned in the area. Based on this study's outcomes, the decision to develop this project should have been taken. – There should be an alternative special road to be used by tankers instead of using the existing road that passes between the villages. – There should be a system to examine the type of wastewater received at the entrance of the treatment plant to avoid bringing in hazardous or toxic wastewater. – The treated wastewater should be tested before discharging it to the Wadis or using it for any other purpose.	– Provided an overview of the proposed project and explained its strategic importance to wastewater sector in Jordan. – Emphasized that the project location was selected to be away from dense urban communities. The project location should be reasonably located to avoid a significant increase in septic transportation fees on the citizens. – The Ministry is in the process to obtain the required permits from the Ministry of Environment. – Emphasized that the Ministry will not implement the project if there are major and reasonable objections from the local communities. – The Ministry is keen to include all anticipated negative environmental and social impacts and concerns that will be raised by the local communities in the

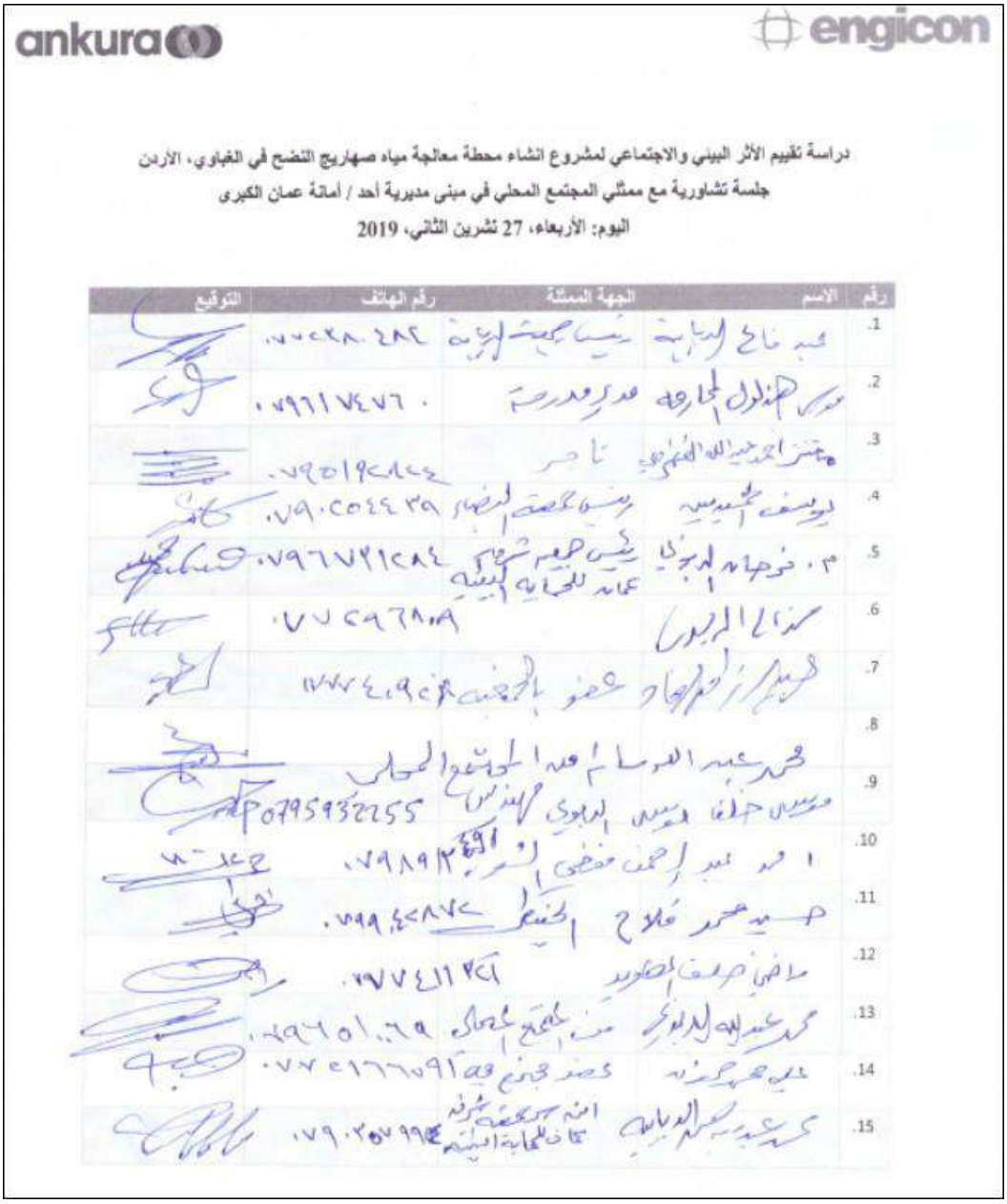
Entity Represented	E&S issues of Concern discussed/raised during the meeting	Ministry of Water and Irrigation – PMU (Private Projects Unit) Response
	– Stockpiling of the sludge at the treatment plant site will result in severe impacts on the environment and nearby villages. It was suggested that the sludge should be treated to be utilized as fertilizers by local communities. – There should be a committee from the local community to oversee the monitoring measures that will be taken during the operation phase of the plant (mainly for wastewater type and odours). – The proposed project does not correspond to Jordan's Sustainable Development Goals. – There will be adverse impacts during operation phase on public health and will increase the number of deaths due to diseases. – There is a concern that the proposed project is an initial stage of having a larger wastewater treatment plant set up at this location in the future. – The Ministry of Water and Irrigation as the owner of the project should allocate a certain amount from the tanker's fees during the operation phase (10 JD per tanker was suggested) to support programs for youth in the local communities. – The EIA studies that were prepared previously for other projects in the area were theoretical and did not involve the local communities in consultations as this project is currently doing. The monitoring measures included in those EIAs were not implemented. – Raised several issues of concern that are related to the development of this project and several other projects within the same area such as the Ghabawi Landfill, power generating station, Customs Depot, etc. which would have a cumulative impact. – There is a lack of trust in the government promises for employment opportunities and improved livelihoods – The stakeholder engagement process with the local communities and CSOs should be continuous during the project lifecycle. – The health facilities within the area are not sufficient to deal with the anticipated	EIA report. The Ministry will work with the EIA consultant to include adequate mitigation and monitoring measures in the Environmental Management Plan. – Explained that the proposed plant will have a strict monitoring system to ensure the quality and type of the septic received. Also, the plant will have an advanced odour control system to eliminate odour expected during the operation phase. The Ministry is applying these systems at other plants that meet local and international effluent standards. – Explained that the Ministry is working closely with the Consultant to ensure that the plant design will be according to the best international standards. – The Ministry will oblige the contractor to secure a certain percentage for employment from the local community and allocate a budget for this purpose in the contract. – Mentioned that the Ministry during the project implementation will establish a committee from the local community to monitor compliance with the ESMP, this committee will be linked directly to the Ministry. The same system is followed at As Samra Wastewater Treatment Plant. – Suggested to establish an NGO from local community to utilize the treated wastewater from the plant for agricultural purposes. The Ministry will support the NGO technically to ensure the maximum benefits from using the treated wastewater effluent. – Mentioned that the plant will be dedicated to receiving the septic

Entity Represented	E&S issues of Concern discussed/raised during the meeting	Ministry of Water and Irrigation – PMU (Private Projects Unit) Response
	problems that are caused by the polluting projects in the area. – The Ministry of Water and Irrigation should comply with the WB and the EBRD E&S requirements on this project. – The employment opportunities should consider the vulnerable groups in the local communities, especially the persons with disabilities. – There are four monitoring wells in the area. The Ministry of Water and Irrigation should use the information obtained from these wells to monitor the groundwater pollution that might occur during the operation phase. – A livelihood Restoration Plan should be prepared to compensate the local communities affected form the existing projects and the proposed project. – The ESIA study should consider the GHG emissions. – The proposed project area of influence should be expanded to include additional villages, at least 10 villages will be affected by the project. – Explained that they believe there would be a significant impact of increased traffic due to increased vehicle movement of septic tankers when added to the traffic that is generated from the other existing and planned industries and businesses in the area. Also, the increased traffic will coincide with increased traffic movement due to the planned opening of the land port (Customs Depot). Therefore, the participants suggested an alternative road to be used by the septic tankers instead of the existing roads to avoid congestion expected during the operation phase. – The Ministry should demonstrate social responsibility towards the area and allocate a budget for this purpose. – The participants expressed their demand to be served with a wastewater collection network as the government had promised them on many occasions in the past. – There are concerns that the value of land will drop due to the project. They reported	from tankers only. The design lifetime of the proposed WWTP will be 25 years. After that, it is expected that the treatment plant will be demolished unless other plans come up by then. – Clarified that the Ministry cannot be responsible for adverse environmental impacts generated from other projects in the area (i.e., Power plants and Al Ghabawi Landfill). However, the Ministry will work jointly with other governmental authorities to resolve/reduce these adverse impacts and will ensure that anticipated impacts from the proposed project will be minimized. – The Ministry suggested that the local community formally request from the Ministry to serve their villages and towns with a wastewater collection network so the Ministry can process this request and approach international donors to fund this project.

Entity Represented	E&S issues of Concern discussed/raised during the meeting	Ministry of Water and Irrigation – PMU (Private Projects Unit) Response
	that it had dropped when establishing the Ghabawi landfill nearby. – Requested to conduct a comprehensive socio-economic field survey to generate data on the social, health and economic conditions of the local communities and establish a database for the future. Based on the survey results, the Ministry should take the decision whether to implement the proposed project. – The Ministry should provide free land to local farmers to plant fodder crops irrigated by the treatment plant effluent. – The local communities should be represented within the management/administration of the future wastewater treatment plant. – They expressed doubts that the wastewater treatment plant will be operated efficiently and cited examples of other treatment plants in the country. – Emphasized the "polluter pays" principle, strong Corporate Social Responsibility (CSR), and protecting the human rights of the local people. – Suggested to search for alternative site for the wastewater treatment plant. – The local communities were not consulted by the government when preparing the East Amman Master Plan. – There are no community recreational facilities in the area especially for the youth. – The project should allocate in its budget funds for CSR, supporting youth, training and rehabilitation. – Contractual conditions should be included in the agreement with the construction contractor to employ local residents. – Representatives of the local communities expressed their appreciation to EBRD for consulting with them and involving them at this early stage of the project. They mentioned that among all the other industries and facilities that had been established in their areas, this is the first time they are engaged in this manner.	




Pictures from the meeting



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جلسة تشاورية مع ممثلي المجتمع المحلي في مبنى مديرية أحد / أمانة عمان الكبرى

اليوم: الأربعاء، 27 تشرين الثاني، 2019

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Annex 12. Environmental and Social Management Plan (ESMP)

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
Construction / Decommissioning Phase						
Air Quality	- Odour and dust due to activities carried at the neighbouring Al Ghabawi landfill. - Air pollution due to exhaust gas from construction machinery and vehicles. - Dust due to excavation works and machinery movement over unpaved roads.	- Conduct 24-hour air quality monitoring for $PM_{2.5}$, H_2S, and NH_3 each month. - Ensure vehicles and equipment are switched off when not in use. - Use equipment and vehicles in appropriate technical conditions. - Suppress the scattering of dust occurring during excavation by sprinkling of water on a as needed basis. - Ensure appropriate stockpile management (friable materials) to minimize dust generation. - Cover truck loads with canvas to avoid dust generation.	Contractor	- Observations and site inspection for dust. - Review the results of the one day of air quality monitoring for $PM_{2.5}$, H_2S, NH_3. - Review complaints records for number of recorded complaints.	Once/month	WAJ supported by Supervision Engineer
Noise and Vibration	- Nuisance to employees/workers at surrounding facilities due to noise and vibration from construction machinery and vehicles movement.	- Conduct spot noise measurements to ensure that noise levels do not exceed the day-time limit of 70 dBA and night-time limit of 65 dBA as an industrial area. - Ensure vehicles and equipment are switched off when not in use.	Contractor	- Review the results of the one day of noise level measurements. - Review complaints records for number of recorded complaints.	Once/month	WAJ supported by Supervision Engineer

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
Soil	- Soil Pollution resulting from potential leakage of small amounts of oil from construction machinery and vehicles. - Improper handling of small amounts of solid and/or liquid waste.	- Proper maintenance of machinery and vehicles. - In case of having temporary fuel tanks onsite, use secondary containment tanks to control accidental leakages. - Develop a spill response plan, to control any inadvertent leakage or spill. - Provide workers with proper spill response training and a spill kit for containment and clean-up of any accidental spills. - Ensure immediate cleaning of any spills and remediation of contaminated areas after construction. - Maintain proper housekeeping on site. - Collect and segregate wastes and ensure safe storage and in line with legal requirements. - Ensure appropriate disposal of solid waste at approved disposal sites. - Proper storage of domestic wastewater from workers on site in septic tanks and disposing them at designated WWTP in line with national requirements.	Contractor	Site inspection and observations including: - Check oil leakage from construction machinery and vehicles. - Check status of repairs condition of locations where soil is affected by oil leakage. - Review waste manifests and the permit of approved disposal sites to ensure safe disposal of the waste. - Check for availability of a spill response plan. - Check the availability of septic tanks on site and records of wastewater disposal.	Once/week	WAJ supported by Supervision Engineer

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
Biodiversity	- Birds exposed to potential risk of being hunted by Project workers, especially during the migration season.	- Prohibit workers from hunting.	Contractor	- Carry out site inspection and observations.	Once per month	WAJ supported by Supervision Engineer
Community Health and Safety	- Disturbance to local community caused by project construction activities.	- WAJ, through the contractor to appoint two Community Liaison Officers (CLOs) whose responsibility shall include liaising between the PIA and local communities as well as managing the community grievance mechanism. The CLOs role is also reflected in the project-specific SEP. - Implementation of appropriate security management on site (such as appropriate fencing, entry and exit controls, cameras and sensor systems where applicable).	Contractor / CLOs	- Ensure project area is secure and access is well monitored and controlled through cameras / automated systems where applicable and visual monitoring. - WAJ, with the assistance of the CLOs shall monitor grievance log and ensure all complaints are addressed in accordance with the public grievance mechanism.	Continuous	Contractor / CLOs
Labour and Working Conditions	- Potential employment of	- Ensure that all national legislation on labour and health and safety, the requirements of EBRD Performance Requirement 2 are in compliance.	Contractor and Supervising Engineer	- Ensure that systems are in place to monitor	Continuously	Contractor, Supervising

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
	child labour or forced labour.	This includes ensuring that applicable clauses relating to labour and working conditions requirements that are in line with local Jordanian standards and EBRD requirements are incorporated into the agreement with the contractor, such as requirements for having a relevant HR policy and OHS policies and procedures in place. - Have a Grievance Mechanism for all workers and employees and ensure that all workers are informed about the Grievance Mechanism and that information about the mechanism is posted in relevant areas of the project site. - The hiring, recruitment and training plans should satisfy the requirements of the provisions of Performance Requirement 2, and the HR procedures are well tailored to comply with local Jordanian Laws and EBRD requirements. - Ensure that a safe and healthy working environment is provided for all workers on site and that good international practice on occupational health and safety is followed in line with policies developed by the Contractor. - Child labour is not allowed and it is not allowed under any circumstance		compliance with labour and health and safety standards. - Appointment of a manager on site to be responsible for ensuring that labour and health and safety legislation is complied with, and for monitoring supplier and sub-contractor performance. This shall be conducted through Internal audits and/or inspections to monitor compliance. - Employee grievance log sheets to be regularly monitored in addition to the		Engineer and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		to employ workers under the age of 18. - Ensure that there shall be no use of forced or compulsory labour as part of this project.		time taken to resolve them.		
Occupational Health and Safety Risks	- Occupational Health & Safety risks to labour working in the project site including potential exposure of construction personnel and site workers to injuries and safety events such as tripping, working at height activities, fire from hot works, smoking, failure in electrical installations, mobile plant and vehicles, and electrical shocks	- Develop an Occupational Health and Safety (OHS) Plan that complies with Jordanian and EBRD OHS related policies and procedures that is based on a risk assessment prepared prior to commencement of work. - Allocate specific personnel responsible for health & Safety management on site. - Adequate and appropriate training of all workers of the contractor's OHS policies and procedures before they are permitted to undertake a task. - Appropriate PPE and safety clothing shall be used during construction work, especially when handling chemicals and entering confined locations. - All construction equipment used for the execution of the project works shall be fit for purpose and carry valid inspection certificates and insurance requirements. - Prepare a risk assessment and communicate it prior to commencement of work for all types of work activities on site.	Contractor and Supervising Engineer	- Site inspection and auditing to check for compliance with OHS procedures. - Records of inspection and auditing reports documented and sent to WAJ. - Inspection on reported injuries or accidents to personnel and the corrective action taken to ensure compliance with the health and safety procedures. - Inspection on trainings conducted to contractor personnel	Daily Monthly Every 6 months (or as deemed necessary).	Contractor, Supervising Engineer and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		- Provide a separate storage area for hazardous materials and chemicals. The hazardous materials/products must be labeled with proper identification of its hazardous properties. - Storage of chemicals shall be performed in accordance with MSDS's. - Ensure that all equipment and machinery are turned off, unplugged, and properly stored when not in use. - Avoid work at height where it reasonably practicable to do so, e.g. by assembly at ground level. - Prior to entry to any confined space, the following shall be followed at a minimum: 1) ensure proper ventilation is in place; 2) necessary precautions to be taken to isolate any flows, turn off electric equipment; 3) atmosphere inside the confined space has been examined for safe entry; 4) ensure that emergency plans and risk assessment prepared by contractor include precautions for confined spaces that are in-line with WAJ safety requirements. - The contractor shall prohibit smoking in areas identified as a fire hazard.		documented and maintained - Evidence and records of mock up drills on site.		

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		- Formally alert civil defense prior to start of activities with potential fire hazards. - The fire protection program should comply with the requirements of the appropriate Local Standards for Construction. - Carry out fire risk assessment for the construction areas, identify sources of fuel and ignition and establish general fire precautions including, means of escape, warning and fighting fire. - Set up a system to alert workers on site. This may be temporary or permanent mains operated fire alarm. - Fire extinguishers should be located at identified fire points around the site. The extinguishers shall be appropriate to the nature of the potential fire. - Ensure all plant machines and vehicles are regularly inspected, serviced and maintained; ensure all staff assigned is trained and competent to operate plant machines and vehicles. - Ensure clear signage is in place, such as Warning of speed limits, obstructions, allowable widths/heights...etc. - Electrical equipment must be safe and properly maintained; works				

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		shall not be carried out on live systems. - Ensure all equipment are suitable for jobs (safety, size, power, efficiency, ergonomics, cost, user acceptability etc.), provide the lowest vibration tools that are suitable and can do the works. - Only competent authorised persons shall carry out maintenance on electrical equipment, adequate Personal Protective Equipment (PPE) for electrical works must be provided to all personnel involved in the tasks. - First aid kit with adhesive bandages, antibiotic ointment, antiseptic wipes, aspirin, non-latex gloves, scissors, thermometer, etc. shall be made available by the contractor on site. - Emergency evacuation response shall be prepared by the contractor and relevant staff shall be trained through mock-up drills.				
Transportation	- Temporary increase in traffic load due to light and heavy vehicles and construction equipment travelling to and between the site and both Amman and Zarqa	- Ensure that all trucks and vehicles accessing the facility are operated by licensed operators. - Pedestrians Safety: All project vehicles and trucks shall comply with the proposed speed limits - Ensure adequate maintenance and inspection of vehicles - Presence of flagman at the entrance and exit of the project site in order	Contractor	- Maintain open dialogue with Al Ghabawi landfill personnel as it is located adjacent to the project area. - Monitor vehicle movement to	Continuous	Contractor

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		to control vehicles and truck movement. - Every employee working at the project site shall make sure that all needed signs and preventive measures are implemented when starting any activity. - Number of traffic signs, their characteristics and distance among them will be placed according to local legal requirements. - Vehicle transit across any restricted area and/or limited to working activities is prohibited.		and from the Project area.		
Cultural Heritage	- Potential for accidental encounter of archaeological remains or relics during excavation.	- Have a chance find procedure in case of coming across any cultural heritage or artefacts (e.g. graves, old ceramic, old building fragments) during excavation works. These procedures should require that excavation works are stopped, report those immediately to DoA, and contractor awaits instructions from DoA.	Contractor	- Observations on existence of remains and relics at construction site. - Records of coordination with DoA.	Once/month and on need basis in coordination with MoTA/DoA	MoTA/DoA
Operation Phase						
Air Quality/ Odour	- Odour nuisance due to WWTP operations	- Have in place an odour control system and monitoring scheme. - Monthly, carry out one day (24hours) of air quality monitoring to measure $PM_{2.5}$, H_2S, and NH_3 and report on instances of exceeding the limits set by JS 1140/2006 and by EU Directive 96/62/EC - Air quality framework directive.	Operator	- Odour monitoring scheme where results of monitoring of H_2S, NH_3, and VOCs concentrations at various	- Once per week	WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		- Reduce the work hours for workers in exposed areas. - Develop an Odour Monitoring Committee to check on odour within the WWTP. The committee is recommended to consist of five members as follows: one representing the WWTP operator, one representing WAJ, one representing MoEnv, one representing local community, and one representing nearby establishments. - Have a green barrier around the Project to assist in reducing odours and emissions.		locations within the plant are reviewed. - Have the Odour Monitoring Committee check the odour at the WWTP every three months. - Have sensors for chlorine gas detection along with gas release treatment system.	- Once every three months	
GHG Emissions	- GHG emissions mainly contributed by electricity consumption from the national network grid.	- Consider energy efficiency in Project design to reduce energy demand (already considered but to be refined).	Design Team	- Prepare an annual estimation of GHG emissions by the WWTP.	- Annual	Operator
Water Resources	- Positive impact of securing additional irrigation water supply within the project area.	- Encourage reuse of treated effluent within the green belt and the agricultural investment land use areas. - Prepare a plan to develop the infrastructure needed to deliver the treated wastewater to the green belt and agricultural investment land use areas.	WAJ/WWTP Operator	- Ensure that the plan to develop the infrastructure needed to deliver the treated wastewater has been prepared. - Ensure that a record proving the safe	- Prior to commencement of WWTP operation.	WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
				disposal of waste in approved landfills and hazardous waste in the Swaqa hazardous waste landfill is maintained. - Ensure the implementation of a groundwater quality program from the nearest existing water well.		
Sludge Handling	- Potential for odour and/or insect nuisance from onsite sludge stockpiling.	- Ensure proper stabilization of the treated sludge. - Review records of odour and/or insect complaints. - Develop a long-term strategy for handling the treated sludge. - Prepare a long-term plan for sludge disposal as sludge stockpiling is planned for the first 7 years.	Operator WAJ and Operator	- A plan for the long-term handling of sludge is prepared.	- Within the first 5 years of WWTP operation.	WAJ
Biodiversity	- Potential attraction of birds and/or mammals to open wastewater tanks.	- Fencing the site and using proper means to prevent waterfowls and/or mammals from landing on open influent wastewater tanks. - Prohibit hunting by Project workers.	Operator	- Observe availability of fencing and control measures to limit accessibility of	Quarterly	WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
				mammals and birds to wastewater.		
Local Community Perceptions	- Potential community concerns from environmental impacts and public health impacts from the project	- To help change local community perception in the area and manage their expectations as well as ensuring safe project practices, the project owner i.e. Ministry of Water and Irrigation/WAJ, together with the project operator will implement a number of measures throughout the project such as: - Appointing one CLO during the operation phase to continue managing the grievance mechanism and manage the continuous engagement with the local community. The CLO will be selected only from the local community. - Implementation of WAJ's existing Grievance Mechanism during the project implementation (Please refer to SEP for more details on the mechanism process). - WAJ Social Responsibility Strategy shall be taken into account during project implementation by the operator to maximize the communication and involvement of stakeholders and support in decreasing environmental and socio-economic negative impacts resulting from the project where applicable. Exact initiatives related to maintaining social responsibility	Project Operator (including CLOs) and WAJ	- Ensure the implementation of the SEP throughout the project operation phase such as: - Records of stakeholder consultation meetings (where needed); - Records of grievance logging and reporting are regularly maintained.	Continuously	Project Operator and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		with the local community shall be determined by the operator in coordination with WAJ. - The project will have a strict monitoring system to ensure the quality and type of the septic received. In addition, the plant will have an advanced odour control system to eliminate odour expected during the operation phase. Moreover, an Odour Monitoring Committee will be set-up to check on odour within the WWTP. - Allow only septage tankers that are tracked electronically by MoEnv and MoEnv will monitor any potential violations of these tankers in the case of illegal discharge of wastewater.				
Employment Opportunities	- Potential positive impact of employment opportunities for local community.	- Ensure that any needed qualifications available within the local community will be hired in the project should the qualifications match.	Operator	- Review employment records to check for local community employment.	Annually	WAJ
Community Health and Safety	- Potential safety hazards on local communities and tanker drivers entering and exiting the site.	- Fence the site and apply appropriate security measures to restrict entry to the site for unauthorized individuals. - Tanker and exit into the facility should be regulated as a safety procedure. - Specific Occupational Health & Safety procedures shall be prepared to be followed during the	Project Operator and WAJ	- Ensure project area is secure and access is well monitored throughout all project phases.	Continuously	Project Operator and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		transportation of septage and its discharge on site.				
Occupational Health and Safety	- Potential occupational health and safety impacts on workers associated with working at the WWTP.	- Develop an Occupational Health and Safety (OHS) Plan that complies with OHS related policies and procedures complying to local Jordanian requirements, as well as EBRD requirements where applicable. - Operation and maintenance works shall be conducted by authorized/certified personnel only. - Compliance with project's OHS Policy and procedures to manage and control the activities with regard to occupational health and safety. - All workers should undergo periodic examinations by occupational physician to reveal early symptoms of possible chronic effects or allergies .and provide worker immunization (e.g. for Hepatitis B and tetanus). - Workers to wear personal protective equipment (PPE) and chemical resistant clothing to avoid exposure of skin or eyes to corrosive and/or polluted solids, liquids, gases or vapours. - Obey all safety-instructions regarding the storage, transport, handling or pouring of chemicals. - Obey all safety instructions concerning entry into confined spaces, e.g., check atmosphere for	Operator	- Regular inspection on the compliance with OHS procedures, and monthly reports to be sent to WAJ. - Ensure health and safety procedures are followed during inspection and maintenance works - Inspection on reported injuries or accidents to personnel and the corrective action taken to ensure compliance with the health and safety procedures. - Inspection on trainings conducted to operator staff	Continuously Monthly Every 6 months (or as deemed necessary)	Operator and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		oxygen or for poisonous gases, use respiratory protection equipment if needed, have a co-worker stand guard in case of need for help, etc. - Provide areas for workers to shower and change clothes before leaving work and provide laundry service for work clothes. to minimize chemical and radionuclide exposure. - First aid kits should be available at the project site and easily accessible to all workers. In addition, workers must be educated in the use of first aid kits; and informed of their location within the project site. - Hazardous chemical assessments and Material Safety Data Sheets (MSDS) are required for the hazardous substances used on site. All hazardous chemicals used on site must be placed in a designated and secure area to avoid accidental human contact. - WWTP operators to have a recognized qualification for the operation they will be performing at WWTP.		documented and maintained - Evidence and records of mock up drills on site.		

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
Transportation	- Potential increase in illegal dumping of transported septage due to the increase in transportation cost.	- Allow only septage tankers that are electronically tracked by MoEnv Online Tracking System for Wastewater Tankers.	MoEnv	- Coordinate with MoEnv to review the occurrence of any violations by the wastewater tankers using the WWTP. - Monitoring of access roads around site. - Monitor the documentation of Incident reports. - Monitor the records for any reporting of spillage from the septic tankers along the roads.	Monthly	WAJ
	- Increase in traffic load within the surrounding road network during operation.	- Add cautionary/advisory signage for truck drivers and others using the road. - Potentially introduce enforcement measures such as cameras to monitor speed and the proper entry/exit of trucks into and out of the facility. - Build awareness among drivers by providing material or potentially holding an awareness session.	Project Operator and WAJ	- Monitoring of access roads around site - Monitor the documentation of Incident reports.	Daily	Project Operator and WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
		- Adopt engineering treatments such as speed humps or rumble strips, especially in section of potential conflict with entering/exiting vehicles.				
Treated effluent not meeting the standards	- Treated effluent discharged into the wadi does not meet the Jordanian and EU standards for discharge into wadi/irrigation due to a process malfunction	- Have WWTP Design controls. - Prevent discharge (operating procedures) unless quality standards achieved.	WAJ/Design Team/Operator	- Monitor the treated effluent to ensure that it is in line with Jordanian Standard JS 893/2006 for reuse of treated wastewater and the EU Urban Waste Water Directive.	Weekly	WAJ
Risk of untreated wastewater overflow under emergency operation conditions at the WWTP	- As the wastewater is transported by tankers to the WWTP and the WWTP has large capacity equalization tanks, no incidences of untreated wastewater overflow are anticipated.	- Maintain a record of occurrence of such emergency situations.	Operator	- Review the records on documented such incidences and evaluate the extent of exceedance of the equalization tanks capacity.	Annually	WAJ
Risk of chlorine gas release at the	- Accidental chlorine release from the chlorination unit poses occupational health risk to	- Have leak detection sensor for chlorine gas at the chlorine gas storage room along with a system that treats the released gas.	Operator	- Check for availability of safety protocols	Quarterly	WAJ

Component	Potential Impact	Mitigation Measure(s)	Mitigation Responsibility	Monitoring Measure	Frequency	Monitoring Responsibility
chlorination unit	workers at the facility.	- Material Safety Data Sheet (MSDS) information on chlorine gas. - Place warning signs and develop safety protocols, including staff training.		and warning signs.		
Risk of industrial wastewater at the WWTP	- Receipt of industrial wastewater by the septic tankers transporting the wastewater.	- To receive wastewater from licensed municipal wastewater septic tankers. - To have a separate tank to empty tankers suspected of carrying industrial wastewater. - To adopt an influent wastewater quality monitoring program.	Operator	- Monitor the WWTP records for influent quality monitoring and to check that wastewater tankers are licensed as municipal wastewater septic tankers.	Quarterly	WAJ
Risk of Fire incidents as unplanned events	- Risk to individuals available within the Project site in case of fire accidents.	- Have a firefighting plan and system for the facility including planned fire drills with evacuation procedures. - Have regular inspections and maintenance for the firefighting system.	Operator	Review available firefighting plan and a representative to attend the firefighting drills at least once annually.	Annually	WAJ