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KHURMALA POWER PLANT-1000MW
ENVIRONMENTAL IMPACT ASSESSMENT

July 2013

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ENVIRONMENTAL IMPACT ASSESSMENT FOR
KHURMALA POWER PLANT-1000MW IN KHURMALA BLOCK/ ERBIL

"Khurmala Block, Erbil Province, Kurdistan of Iraq"

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"TABLE OF CONTENTS"

	Title	Page
Table of Contents		ii
List of Tables		v
List of Figures		vi
Abbreviations		vii
Unites and Glossary		viii
	EXECUTIVE SUMMARY	1
1.	**INTRODUCTION**	7
1.1	Project Background and Purposes	7
1.2	Purpose of the Environmental Assessment	8
2.	**REGULATORY FRAMEWORKS**	11
2.1	Institutional structure	11
2.2	Environmental Administration	12
2.3	Relevant Legislation, Standards and Guidelines	13
	2.3.1 The Iraqi Environment Protection Act	13
	2.3.2 International Standards	13
	2.3.2.1 Atmospheric Emissions	13
	2.3.2.2 Noise	13
	2.3.2.3 Drinking Water Quality	14
	2.3.2.4 Solid Wastes	14
	2.3.2.5 Contaminated Land and Ground Water	14
	2.3.3 Protected Areas and Biodiversity Protection	15
	2.3.4 Multilateral Environmental Agreements	16
3.	**DESCRIPTION OF THE PROPOSED PROJECT**	17
3.1	Introduction	17
3.2	Khurmala Power Plant-1000MW	17
3.3	Description, Activities and Design Basis	17
	3.3.1 Construction Phase	17
	3.3.1.1 Construction activities	17
	3.3.1.2 Construction Camp	18
	3.3.1.3 Construction Waste	19
	3.3.1.4 Accommodation and Offices	19
	3.3.2 Operation Phase	19
3.4	Transportation	21
3.5	Commissioning	21
3.6	Workforce and Working Hours	22
3.7	Operation (Sources of Pollution)	22
	3.7.1 Air Pollution	23
	3.7.2 Water Pollution	23
	3.7.3 Noise Levels	24
3.8	Health, Safety, and Environment	24
3.9	Social Action and Cultural Consciousness	24

3.10 Occupational Health and Safety 24
3.10.1 Hazard Assessment 24
3.10.2 Health and Safety Training 25

4. DESCRIPTION OF THE EXISTING ENVIRONMENT 26
4.1 **PHYSICAL ENVIRONMENT** 26
4.1.1 Methodology 26
4.1.2 Geology, Geomorphology and Topography 26
4.1.3 Hydrology and Hydrogeology 31
4.1.3.1 Surface Water 31
4.1.3.2 Groundwater 33
4.1.3.3 Conclusions 35
4.1.4 Land Use and Agriculture 37
4.1.5 Soil Characterization 40
4.1.5.1 Soil Types 40
4.1.5.2 Soil Chemistry 40
4.1.6 Climate and Meteorology 43
4.1.6.1 Kurdistan Region of Iraq 43
4.1.6.2 Erbil 43
4.1.7 Ambient Air Quality 45
4.1.8 Noise Levels and Traffic Density 48
4.1.8.1 Ambient Noise Levels 48
4.1.8.2 Traffic Density and Road Condition 50
4.2 **ECOLOGY AND BIOLOGICAL ENVIRONMENT** 52
4.2.1 Flora 53
4.2.1.1 Methodology 53
4.2.1.2 Vegetation Communities and their distribution 53
4.2.1.3 Stratification 54
4.2.1.4 Flora Spices 54
4.2.1.5 Forest Areas 56
4.2.2 Fauna 56
4.2.2.1 Methodology 56
4.2.2.2 Arthropods 57
4.2.2.3 Amphibians and Reptiles 59
4.2.2.4 Birds 59
4.2.2.5 Mammals 61
4.2.2.6 Conclusions 61
4.3 **SOCIAL, ECONOMIC AND CULTURAL ENVIRONMENT** 62

5. PREDICTION OF ENVIRONMENTAL IMPACT 63
5.1 Screening of the potential environmental impacts 63
5.2 Preliminary environmental impacts assessment and mitigation measures 63
5.3 General Impact During Construction Phase 63
5.4 General Impact During Operation Phase 65

6. ANALYSIS OF ALTERNATIVES 67
6.1 No Project Option 67
6.2 Conductance Of The Project 68

7. ENVIRONMENTAL MANAGEMENT PLAN 68
7.1 Preamble 68
7.2 Impact Mitigation During Construction Phase 68
7.2.1 Air Quality Management 68
7.2.2 Noise Level Management 69
7.2.3 Water Resource Management 69
7.2.4 Water Quality Management 69
7.2.5 Soil Quality Resource Management 70
7.2.6 Land Use Pattern and Ecology Management 70
7.2.7 Traffic Movement 70
7.2.8 Socio-Economic 70
7.3 Impact Mitigation During Operation Phase 71
7.3.1 Gas Emission 71
7.3.2 Fugitive Dust Emission 71
7.3.3 Emissions Monitoring Management Plan 71
7.3.4 Noise Level Management 72
7.3.5 Solid Waste Management 72
7.3.6 Solid Waste, Steel Structures, Empty Bags and Wood Trash 73
7.3.6.1 Oil Spillage and Lubricating Oil 73
7.3.6.2 Other Wastes Control 73
7.3.7 Water Pollution Managment 73
7.3.8 House Keeping 74

8. OCCUPATIONAL HEALTH AND SAFETY 74
8.1 Hazard Assessment 74
8.2 Health and Safety Training 74

9. CONCLUSION 75
10. RECOMMENDATION/ MITIGATION MEASURES 76
11. REFERENCES 80

12. APPENDICES 83
Appendix 1. *The Ministry of Environment (MOE)/ Erbil, Iraq* 83
Appendix 2. *Executive Summary In Kurdish Language* 87

"LIST OF TABLES"

Title	Page
Table (2.1): SO_2 Concentration Limitations Summary	14
Table (2.2): Ambient Noise Levels Standards	14
Table (2.3): Water Quality Standards	15
Table (4.1): Selected surface water locations within the survey area	32
Table (4.2): Surface water chemistry within survey area	33
Table (4.3): Selected groundwater locations within the survey area	33
Table (4.4): Groundwater chemistry within survey area	35
Table (4.5): Summary of land use within the survey area	39
Table (4.6): Soil sampling location descriptions	41
Table (4.7): Soil Analytical Results	43
Table (4.8): Summary of statistical analysis of meteorological data recorded for Erbil area during the last five years 2007 to 2011	44
Table (4.9): Location descriptions for ambient air quality assessment	46
Table (4.10): Gaseous pollutants and particulate matter recorded for the survey area	47
Table (4.11): Ambient Noise Levels	49
Table (4.12): Location description of the sites selected for traffic density in survey area	50
Table (4.13): Vegetation Communities and their Distribution in the survey area	53
Table (4.14): Vegetation structure and stratification in the survey area	54
Table (4.15): Inventory of flora species and related ecological parameters within the survey area	54
Table (4.16): Inventory of Arthropods for the survey area	57
Table (4.17): Inventory of amphibians and reptiles within the survey area	59
Table (4.18): Inventory of birds' characteristic of the survey area	60
Table (4.19): Inventory of mammals encountered within the survey area	61
Table (5.1): Activities, impact Identification, anticipated impact and category of Impact during construction phase	64
Table (5.2): Activities, impact Identification, anticipated impact and category of Impact during operation phase	66

"LIST OF FIGURES"

Title	Page
Figure (1.1): Concession Maps of Oil Exploration Blocks within Kurdistan of Iraq, Location of proposed Khurmala Power Plant-1000MW is indicated.	9
Figure (1.2): Proposed Khurmala Power Plant-1000MW survey area	10
Figure (2.1): the Kurdistan Region of Iraq – Political map	11
Figure (2.2): Approval procedures for an EIA study in Iraqi Kurdistan	12
Figure (4.1): Satellite image of the Khurmala Power Plant-1000MW Area	28
Figure (4.2): Topographic Map of the Khurmala Power Plant-1000MW Area	29
Figure (4.3): Geologic Map of the Khurmala Power Plant-1000MW Area	30
Figure (4.4): Map showing location of surface watercourses selected for water quality analysis within survey area.	32
Figure (4.5): Map showing location of groundwater selected for water quality analysis within survey area.	34
Figure (4.6): Pie presentation of land use patterns within survey area	39
Figure (4.7): Map showing location of soil sampling sites within survey area	41
Figure (4.8): Map showing sampling locations selected for ambient air quality assessment	46
Figure (4.9): Main Roads within the survey area	51

"ABBREVIATIONS"

ALARP	As Low As Reasonable Practicable
barg	bar (gauge)
bpd	barrel per day
BOD	Biological Oxygen Demand
COD	Chemical Oxygen Demand
EIA	Environmental Impact Assessment
EMMP	Environmental Management and Monitoring Plan
ESD	Emergency Shut-Down
ESHIA	Environmental, Social and Health Impact Assessment
EPA	Environmental Protection Agency (Us)
FWHP	Flowing well head pressure
GOR	Gas-Oil Ratio
HFO	Heavy Fuel Oil
HSE	Health, Safety, and Environment
KO drum	Knock Out drum
LFO	Light Fuel Oil
m.a.s.l	Meter Above the Sea Level
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
MMTPA	$10^6 tyr^{-1}$
MEK	Ministry Of Environment
MON	Ministry Of Natural Resources
MPN	Most Probable Number
NA	Not Applicable
NAAQS	National Ambient Air Quality Standard
NACE	National Association of Corrosion Engineers
N.A	Not Available
ND	No Detectable
NO_x	Nitrogen Oxides
NTU	Nephelometric Turbidity Units
OHSAS	Occupational Health & Safety Management System
RPM_{10}	Respirable Particulate Matter Of 10 Micron Dimension
psig	pounds per square inch (gauge)
RVP	Reid Vapour Pressure
SDV	Shut down Valve
SIWHP	Shut in well head pressure
SO_2	Sulphur Dioxide
SPM	Suspended Particulate Matter
SWI	Shannon's Weaver Index
TPH	Total Petroleum Hydrocarbons
UNDP	United Nations Development Program
VOC	Volatile Organic Compounds
WB	World Bank
WHO	World Health Organisation
WMP	Waste Management Plan

"UNITS"

°C	degree Celsius
µg/m^{-3}	microgram per norm cubic meter
d	day
dBA	decibel acoustic
ha	hectare
km	kilometer
l	liter
m	meter
m^3	cubic meter
mg/m^{-3}	milligram per norm cubic meter
NTU	nephelometric turbidity units
ppb	parts per billion or micrograms per liter (µg/l)
ppm	parts per million or milligrams per liter (mg/l)
t	metric tons

"GLOSSARY"

Ambient	Referring to existing or predominate conditions
Abundance	Total number of individuals of each species in the total area sampled.
Abundant	Species number = 30-60% of the total number of population
Biochemical Oxygen Demand	The amount of dissolved oxygen needed to decompose organic matter in wastewater
Biodiversity	An acronym for biological diversity and refers to the variety of living organisms that inhabit the earth.
Chemical Oxygen Demand	The amount of dissolved oxygen needed to oxidize organic matter in wastewater, under acidic conditions
Common	Species number = 10-30% of the total number of population
Dominance	Area a species occupies in a stand on a unit area basis. It is determined using either basal area or cover
Dominant	Species number = >60% of the total number of population
Flaring	Controlled disposal of surplus combustible vapour by igniting them in the atmosphere.
Frequency	Distribution of a species through the stand, i.e. percentage of quadrates in the sample area in which a given species occurs.
Frequent	Species number = 1-10%, of the total number population
Hazardous waste	Any industrial by-product, especially from the manufacture of chemicals, which is destructive to the environment or dangerous to the health of people or animals
Phytoplankton	Photosynthetic plankton
Plankton	Passively drifting or weakly swimming organisms in marine and fresh waters; members of this group range in size from microscopic plants to jellyfish measuring up to 2 meters across the bell, and include the eggs and larval stages of the nekton and benthos
Rare	Species number = 0.1-1% of the total number population
Relative Density	Density of one species relative to the density of all species
Relative Dominance	Area a species occupies relative to the total area occupied by all species (using basal area or cover)
Relative	Distribution of one species relative to the distribution of all species

Frequency	
Very Rare	Species number = <0.1% of the total number of population
Zooplankton	The animal forms of plankton

"EXECUTIVE SUMMARY"

- The Project

KAR Power, member of the **KAR Group** for General Contracting, Engineering Consultancy and Electrical, Mechanical Contracting Ltd, a company organized and existing under the laws of the Republic of Iraq, having its registered main office at Naz City, Building J, 1st Floor, Gulan Street, Erbil, Kurdistan Region, Iraq. **KAR Power** registered in the Companies Register under No. 6840 on 09 August 2012, with principal offices located at Khanzad, District 328, St 14 Erbil – Kurdistan Region - Iraq.

KAR Power intends to develop a Power Plant (**"Khurmala Power Plant-1000MW"**) (capacity = 1200MW) for electricity power generation at permitted area, Khurmala Block/Erbil, delimited by the following coordinates; Northing 36°07'58",60m and Easting 43°46′31",53m and 325m.a.s.l. **KAR Power** has commissioned MapCom, prior to the commencement of Khurmala Power Plant-1000MW development, to prepare an Environmental Impact Assessment (EIA) including the project Environmental Management and Monitoring Plan (EMMP). The Khurmala Power Plant-1000MW is a long term activity. This EIA relates specifically to the activities surrounding the Khurmala Power Plant-1000MW, and focuses on a circle centred at the Khurmala Power Plant-1000MW surface location with a radius of approximately 2.5km.

The activities relating to the Khurmala Power Plant-1000MW considered in this EIA include description, activities and design basis. Khurmala Power Plant-1000MW activity can have an impact on the surrounding environment. Possible impacts include the release of emissions and/or wastes into the environment in concentrations that are not naturally found.

This document sequentially reviews the planned work, the purpose of this EIA, the known environmental baseline, potential environmental and social impacts and mitigation measures for this project with the EMMP and WMP (Waste Management Plan) being key issues.

The study concludes that:

- The environmental impact of the activities is site specific and reversible, provided that the proposed mitigation measures are followed;
- It is not expected that the operations will cause any irreversible impacts, however, all precautions assumed to be considered;
- The activities associated with the project activity can be conducted with minimal impact to the environment and the lives of local people and their communities;
- Potential environmental impacts can be successfully mitigated thought the adoption of environmental operating standards based on the EMMP;

- The proposed activities would generate temporary/ permanent employment in the region during site preparation and project activities, supply of raw material, auxiliary and ancillary works.

- Typology of Environmental Impacts

Category of Impacts	Types of Impacts			
Type	biophysical	social	health	economic
	✔	✔	✔	✔
Nature	direct	indirect	cumulative	
			✔	
Magnitude or severity	high	moderate	low	
		✔		
Extent	local	regional	transboundary	global
	✔			
Timing	immediate term		long term	
			✔	
Duration	temporary		permanent	
			✔	
Uncertainty	low likelihood		high probability	
	✔			
Reversibility	reversible		irreversible	
	✔			
Significance	unimportant		important	
			✔	

The likely impacts of the proposed Khurmala Power Plant-1000MW during construction phase are assessed as (**SHORT-TERM, MITIGABLE/ MINOR NEGATIVE**) and operation phase as (**LONG-TERM, MAJOR POSITIVE / MINOR NEGATIVE**) impacts.

- Recommendation/ Mitigation Measure

1) Compliance to Alberta Ambient Air Quality Objective air quality limitations concerning (Stack and Green House Gas Emission Management).

2) As upper layer meteorological data is not available for Iraq. Even Stability class and mixing height for ground layer are not available. Hence **ISCST3** software is recommended to be used for dispersion modelling analysis, by using by default internationally available ground layer mixing height and stability class. Meanwhile, **ISCST3** is software of Industrial Sources Complex Short Term model version 3 (ISCST3) approved by Environment Protection Agency (EPA) USA.

3) For detection of destiny and fate of emissions, an Air Quality Management Plan should be put in place by **KAR Power** for the site prior to any production and flaring activities taking place. In this context MapCom Environmental Consultants have extensive experience working in such field.

4) Continuous online meteorological data (i.e. wind speed, wind direction, humidity, precipitation ...etc) should be monitored at project site;

5) Concerning abetment of atmospheric pollutants; the following should be followed carefully:

A. The main categories of CO_2 abatement potentials include:

- Stacks in the Khurmala Power Plant-1000MW shall be provided with automatic stack monitoring units (i.e. Equipped with online monitoring systems to control the emission of gases released).
- Energy efficiency: technical and operational measures to reduce fuel and power consumption per unit.

B. To control emissions (from flaring stack) the following measures shall be adopted from the proposed unit:

- The height of flaring stack should be more than 10m, for good dispersion of gaseous pollutants.
- On the site roads and approach roads shall be made of gravel/concrete
- Areas between various sections and truck parking area shall be made of gravel/concrete
- Open areas within the project premises and along the boundaries of the Khurmala Power Plant-1000MW premises shall be covered with a green belt.

6) Emission from Source;

Associated gas brought to the surface is sometimes disposed of at onshore facilities by venting or flaring to the atmosphere. However, flaring or venting are also important safety measures used on onshore oil and gas facilities to ensure gas and other hydrocarbons are safely disposed of in the event of an emergency, power or equipment failure, or other plant upset condition. Measures consistent with the Global Gas Flaring and Venting Reduction Voluntary Standard (part of the World Bank Group's Global Gas Flaring Reduction Public-Private Partnership (GGFR program3) is recommended. The following pollution prevention and control measures should be considered for gas flaring:

- Implementation of source gas reduction measures to the maximum extent possible;
- Use of efficient flare tips, and optimization of the size and number of burning nozzles;
- Maximizing flare combustion efficiency by controlling and optimizing flare fuel / air stream flow rates to ensure the correct ratio of assist stream to flare stream;
- Minimizing risk of pilot blow-out by ensuring sufficient exit velocity and providing wind guards;
- Use of a reliable pilot ignition system;

- Minimizing liquid carry-over and entrainment in the gas flare stream with a suitable liquid separation system;
- Operating flare to control odour and visible smoke emissions (no visible black smoke);
- Locating flare at a safe distance (i.e. at least one kilometre) from local communities (e.g. Helawa village) and the workforce including workforce accommodation units;
- Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency;
- Metering flare gas.

Flaring volumes for new facilities should be estimated during the initial commissioning period so that fixed volume flaring targets can be developed. The volumes of gas flared for all flaring events should be recorded and reported. Feasible alternatives should be evaluated for the recovery of hydrocarbon test fluids, while considering the safety of handling volatile hydrocarbons, for transfer to a processing facility or other alternative disposal options.

7) Ambient Air Quality;
Wherever hydrogen sulphide (H_2S) gas may accumulate the following measures should be considered:

- Development of a contingency plan for H_2S release events, including all necessary aspects from evacuation to resumption of normal operations;
- Installation of monitors set to activate warning signals whenever detected concentrations of H_2S exceed 7 milligrams per cubic meter (mg/m^3). The number and location of monitors should be determined based on an assessment of plant locations prone to H_2S emission and occupational exposure;
- Provision of personal H_2S detectors to workers in locations of high risk of exposure along with self-contained breathing apparatus and emergency oxygen supplies that is conveniently located to enable personnel to safely interrupt tasks and reach a temporary refuge or safe haven;
- Provision of adequate ventilation of occupied buildings to avoid accumulation of hydrogen sulphide gas;
- Workforce training in safety equipment use and response in the event of a leak.

8) Oil spillage and lubricating oil;
- Lubricating oil to be collected on a pit or drums then returned back to the supplier where it is recycled and reused again, the drums to be stored in special designated zone in the central stores area.

9) A Risk Assessment process will be developed and implemented, ensuring that all necessary control measure to eliminate or mitigate the risk is taken. The aim is to reduce the risks to ALARP - As Low As

Reasonable Practicable", and look for the following sources:

- All closed areas are equipped with the proper ventilation systems to ensure employee protection from suffocation, H_2S equipment, harmful gases and dust particles. All employees, regardless of their job description, are provided with the necessary personal protective equipment. Every employee is given safety shoes, a safety helmet, earplugs and safety goggles. Employees with specified jobs are given the necessary personal protective equipment for the job, such as heat-resistant gloves, heat-resistant jackets, earmuffs and respiratory equipment in dusty working places.
- All workers engaged in the operation of the Khurmala Power Plant-1000MW facility shall be regularly examined for lung diseases.
- All job activity will be controlled by Permit to Work System to make sure that risk assessment prior to work will be carried out.
- The SD & HSE Department ensures that monitoring of emissions and noise in all workplace areas. Portable measuring equipment is used to carry out measurements on a routine basis.

10) Noise Levels;

Some of the design features provided to ensure low noise levels shall be as given below:

- All rotating items shall be well lubricated and provided with enclosures as far as possible to reduce noise transmission. Extensive vibration monitoring systems will be provided to check and reduce vibrations. Vibration isolators will be provided to reduce vibration and noise wherever possible
- In general, noise-generating items such as fans, blowers, compressors, pumps, motors etc. will be so specified as to limit their speeds and reduce noise levels. Static and dynamic balancing of equipment will be insisted upon and will be verified during inspection and installation
- Provision of silencers shall be made wherever possible
- The insulation provided for prevention of loss of heat and personnel safety shall also act as noise reducers
- Layouts of equipment foundations and structures will be designed keeping in mind the requirement of noise abatement
- The Central Control Room(s) provided for operation and supervision of the project and equipment will be air-conditioned, insulated and free from project noise. Necessary enclosures will also be provided on the working platforms/areas to provide local protection in high noise level areas
- Proper lubrication and housekeeping of equipment to avoid excessive noise generation
- In cases where the operation of the equipment requires the presence of operators in close proximity to equipment, the operators will be provided with the necessary personal protective equipment such as ear muffs, ear plugs etc.

- By provision of the green belt in and around the project premises
- Occupational Health and Safety Administration System (OHSAS) for evaluation of exposure to noise pollution on the associated staff and comparing it with permissible exposure and subsequently taking corrective actions will be developed
- Regular noise surveys will be conducted to ensure the on-site and ambient maximum levels are not exceeded. By these measures, it is anticipated that the noise levels in the project will be maintained below 90 dB (A). Earth mounds and plantations in the zone between the project and the surrounding area would further attenuate noise in the residential area.

1. INTRODUCTION

1.1 Project Background and Purposes

Currently there is a power shortage throughout Iraq including Kurdistan Region of Iraq (KRI). Electricity power is among the major challenges facing all sectors including; citizen, businessman, stakeholder, factories and projects.

KAR Power, member of the **KAR Group** for General Contracting, Engineering Consultancy and Electrical, Mechanical Contracting Ltd, a company organized and existing under the laws of the Republic of Iraq, having its registered office at Naz City, Building J, 1st Floor, Gulan Street, Erbil, Kurdistan Region, Iraq. **KAR Power** registered in the Companies Register under No. 6840 on 09 August 2012, with principal offices located at Khanzad, District 328, St. 14 Erbil – Kurdistan Region - Iraq.

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This project addresses the necessity to decrease the power shortage in Kurdistan by a continuous expansion of the electrical power generation facilities. In this respect also the availability and accessibility of fuel resources becomes decisive:

- Natural gas – available on medium and long-term, gas processing plants and massive investment in gas pipelines are necessary. Available Gas will be used within Khormala Phase 1 (SCPP – with installed 640 MW, 4xSGT5-2000E) instead of being flared.
- LFO – currently the main fuel source for power generation in Kurdistan Region, also serves as backup fuel for Khormala Phase 1. Usage/availability is limited as there is a considerable demand from transportation sector and small decentralized generation units especially in the remote area of the Kurdish mountains.
- Crude/HFO – available in considerable quantities mainly originating from the oil fields directly (crude) and as a residue product from existing atmospheric refineries. Currently at KAR Group's Central Processing Station (CPS) a crude oil stabilization unit is under installation and will be in operation by middle of 2014. This CPS shall serve to process the crude oil and HFO in order to meet the World Bank Standards regarding emissions during the power production.

Furthermore it is worth to mention that due to the immediate availability of Crude/HFO, Phase 3 of the Khormala Power Plant is the fastest alternative to further increase the installed capacity for power generation

in Kurdistan. This supports the economic and structural development of the region and by this helps to further strengthen the political stability therefore must be classified as strategic project and hence it's regional rather than local impact on the environment has to be assessed.

All theactivities related to the mentioned project can have an impact on the surrounding environment. To mitigate any environmental disturbance from planned operations this EIA is prepared. The EIA identifies environmental and social aspects that may be affected. Mitigation and remedial measures to reduce the impacts are suggested.

KAR Power has retained **MapCom** Environmental Consultants to undertake Environment, Social and Health Impact Assessment study and prepare an Environmental Management Plan (EMP) for the proposed project. The study has been carried out within the framework of national, local, international regulation, the World Bank, Alberta Guidelines and **KAR Power** Regulations and Standard.

1.2 Purpose of the Environmental Assessment

In order to assess the baseline environmental status in the studied area, site visits were made and a comprehensive data program was undertaken during the study period October 2012. The environmental components considered include:

1) Physical and chemical components: soil, surface/ground water resources, water/air quality, noise, and climatology.
2) Land use, vegetation, forestry, wildlife and archaeology.
3) Biological environment: which include flora i.e. trees and grasses; fauna i.e. insects, birds, hyper fauna, mammals, threatened and/or endangered species (plants/animals).
4) Socio-economic components: distribution economic indicative of human welfare i.e. education system, public services-security, fire protection and medical facilities and health impact.
5) Develop an Environmental Management Plan to be implemented during the Project implementation, taking into account the following considerations:

    a. Protect the surrounding during operation of the Khurmala Power Plant-1000MW with appropriate environmental safeguards.
    b. Protect native flora and fauna.
    c. Protect quality of local surface and groundwater.
    d. Minimize public health risks.
    e. Ensure that ecological balance of the area is not adversely affected by air pollutants.
    f. Minimize noise and vibration impacts on surroundings.

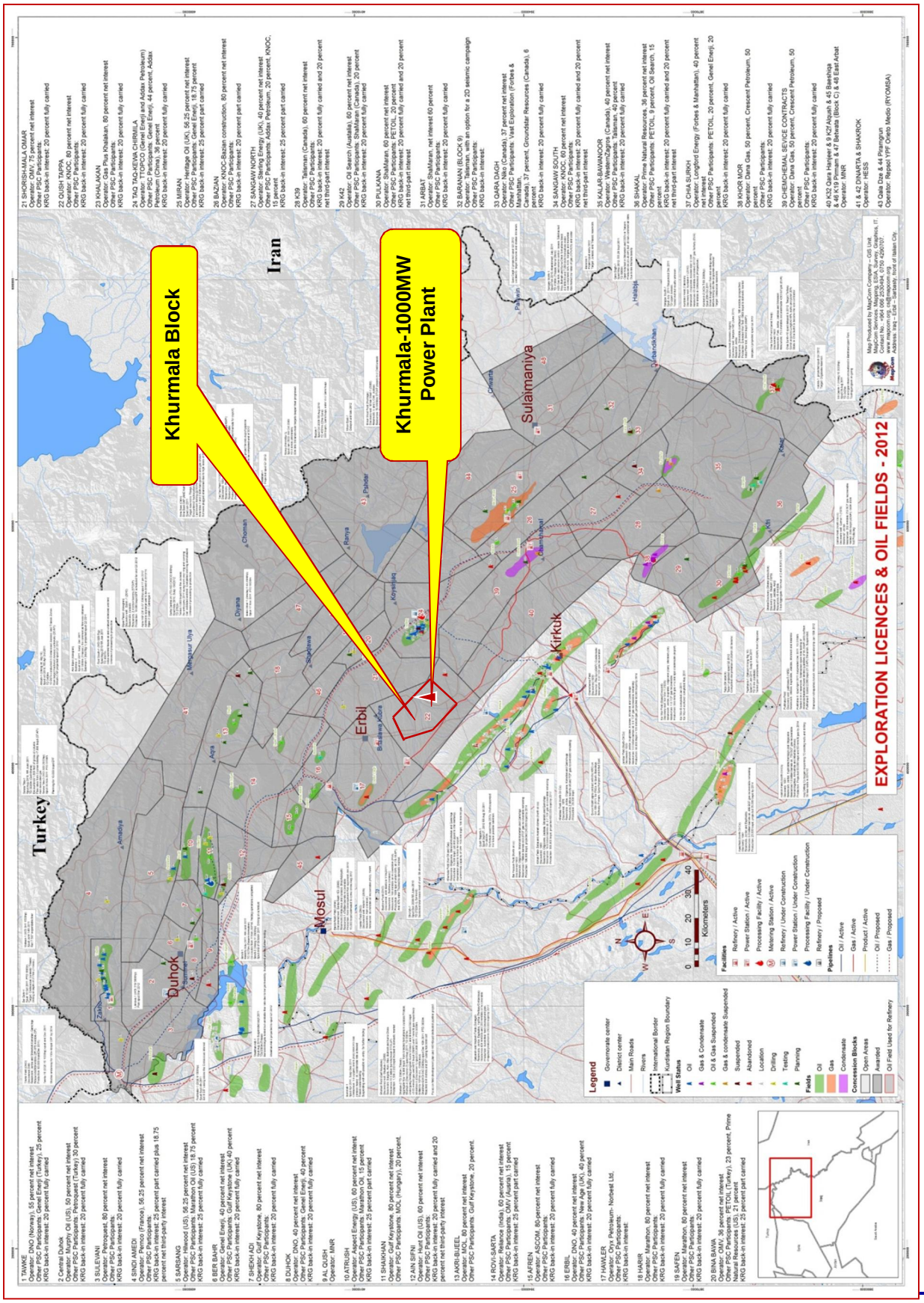

Figure 1.1 Concession Maps of Oil Exploration Blocks within Kurdistan of Iraq, Location of Block Khurmala and proposed Khurmala Power Plant-1000MW is indicated.

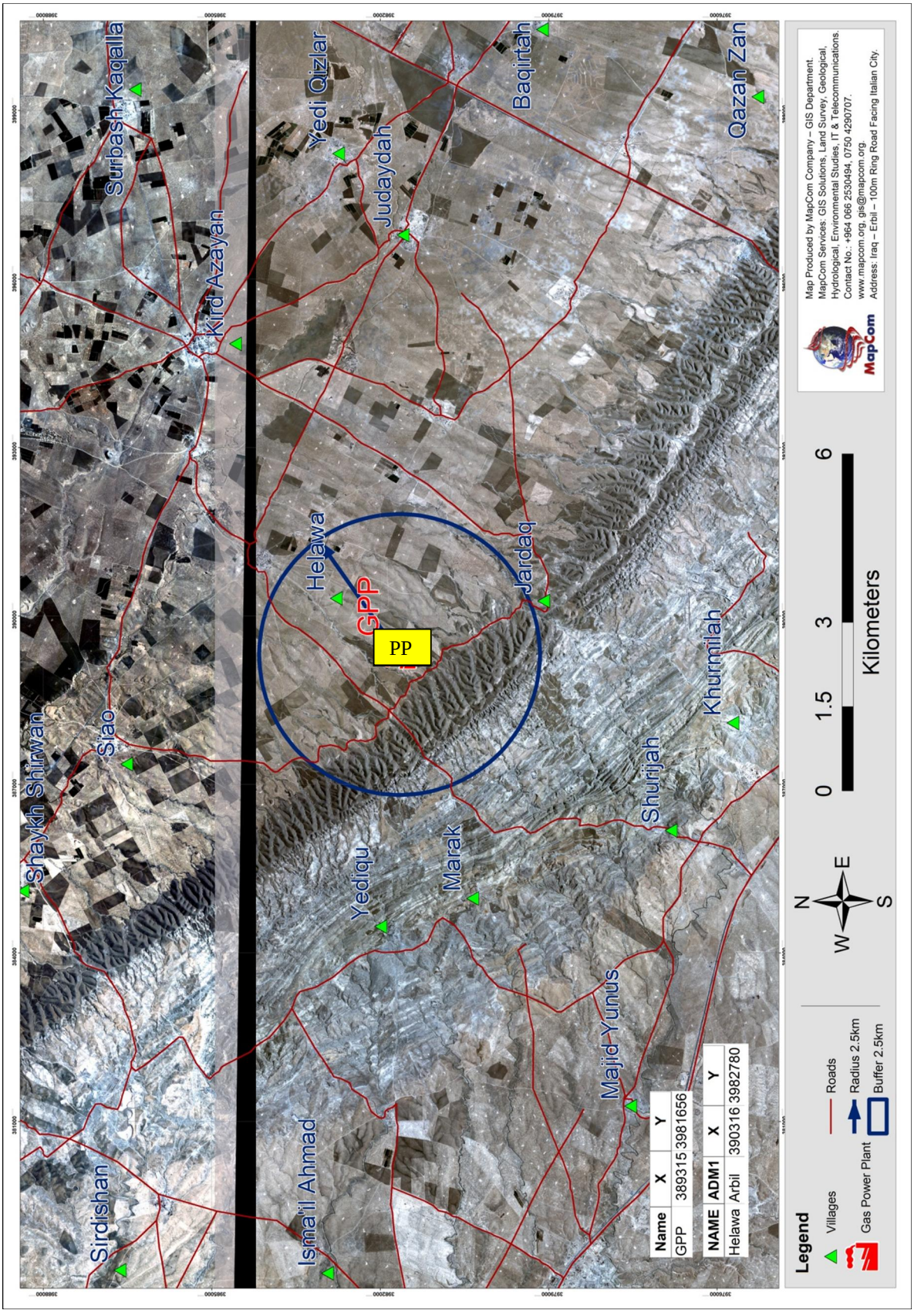

Figure 1.2 Proposed Khurmala Power Plant-1000MW Survey Area

2. REGULATORY FRAMEWORK

2.1 Institutional Structure

The Kurdistan Region ***Figure 3.1*** occupies the north and north-eastern portions of Iraq. It borders Iran to the East, Turkey to the North, Syria to the west, and the rest of Iraq to the South. Iraqi Kurdistan, also known as South Kurdistan, covers an area of 40,643 square kilometres, with a population of 3,757,058. Its capital is the city of Erbil.

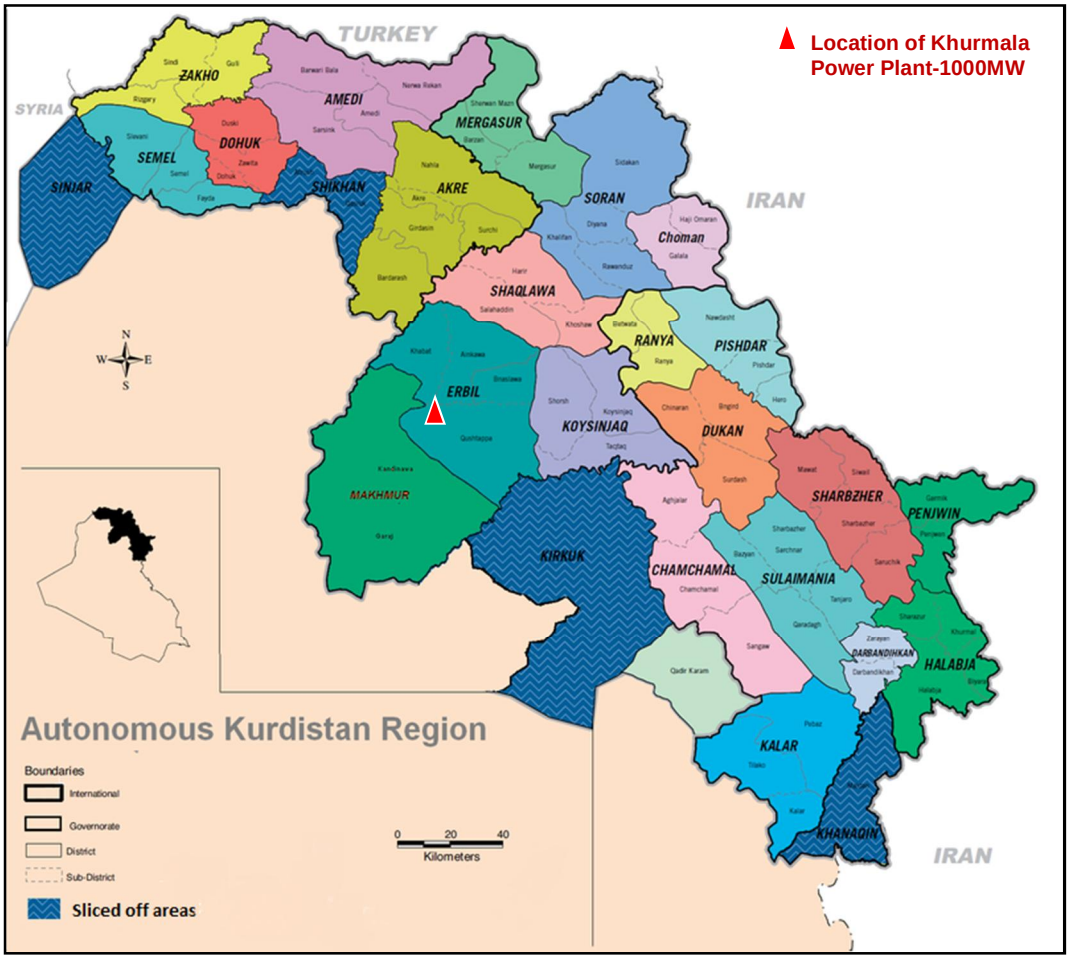

Figure 2.1 the Kurdistan Region of Iraq – Political map

Iraqi Kurdistan is recognized by the 2005 Iraq Federal Constitution as an autonomous, political, ethnic and economic region of Iraq. It has been governed since 1992 by the Kurdistan Regional Government (KRG). It is divided into six governorates, three of which (Erbil, Sulaimaniya and Dohuk) are entirely controlled by, and the remainder are partially controlled by, the KRG. Iraqi's constitution recognizes the Kurdistan Regional Government, the Kurdistan National Assembly and the Peshmerga guard as the legitimate regional forces.

In 2006, the KRG established the Ministry of Natural Resources (MNR) to administer all operations regarding the petroleum industry activities, and the Ministry of the Environment (MOE) to define environmental standards specific for the sustainable development of Iraqi Kurdistan in line with international global targets.

Both the MNR and MOE are actively involved in the review and approval of EIA studies regarding the petroleum industry EIAs. The following diagram ***Figure 3.2*** outlines the processes of the EIA reviews and approvals in the KRG.

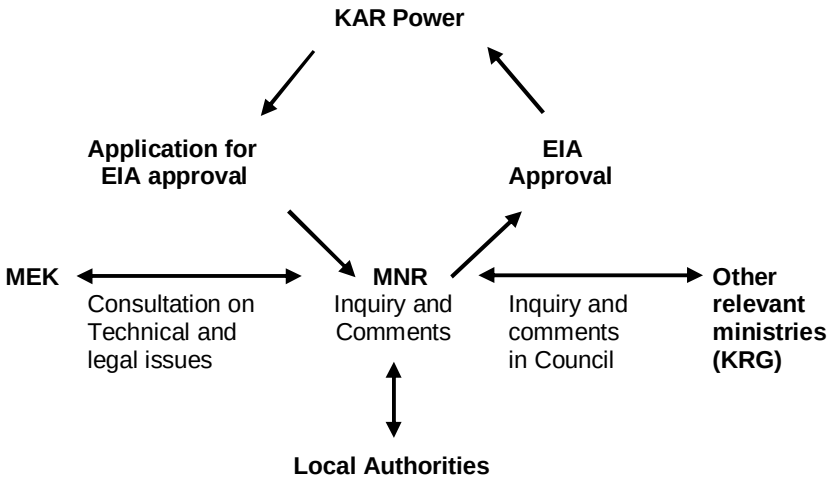

Figure 2.2 Approval procedures for an EIA study in Iraqi Kurdistan

2.2 Environmental Administration

The Ministry of the Environment of Kurdistan (**MEK**) was established in May 2006 with the objective to *"… set the region with environmental standards applicable locally and in line with global targets for sustainable development and to commit itself to the integration of its principles and tackling climate change, and ….to protect and enhance the environment and natural resources locally and as capacities develop regionally and internationally"* (*Appendix 1 – Underpinnings of the Ministry of the Environment*). The **MEK** is in the early stages of its legislative programme. Current development is based on the legal framework of the Ministry of the Environment of the central Iraqi Government. The specific aims of the **MEK** as established by the KRG are, in conformation with international agreements, conventions and protocols, to:

- develop policies and short-term and long-term strategic plans for the protection and the improvement of the environment;
- issue guidelines to control environmental health problems and developing safety standard through monitoring;
- establish an environmental monitoring programme incorporating collection, quality control and dissemination of data;
- administer activities associated with development in the region (including preparation of Strategic Environmental Assessments);
- Evaluate and assess reports produced by local authorities, industry and academic bodies, including EIAs.

2.3 Relevant Legislation, Standards and Guidelines

2.3.1 The Iraqi Environment Protection Act

The relevant environmental laws included in the Iraqi Environmental Protection Act are:

- Environment Protection and Improvement Law (Law No.3), 1997. This law outlines the responsibility in case of pollution of the environment, monitoring and assessments of impacts, and the restriction concerning any activities which can potentially cause pollution. Articles 16 and 17 prescribe that all the development projects shall be implemented with the appropriate countermeasures and monitoring systems for the mitigation of environmental impacts. Article 18 shows the contents to be included in the EIA and prescribes that an EIA has to be carried out in a feasibility study in all the development projects in spite of the category.
- System No. (25) 1967 - Maintenance of rivers and public water from pollution. This system contains instructions concerning the quantity of chemicals and material allowed to be discharged into a water body.
- Standard specification No. 417 - Drinking water and standard methods for testing and analysis. It includes requirements on natural characteristics, chemical characteristics, bacteriological characteristics, and radiant characteristics.
- Public Health Act No. (89) 1981, Chapter (V) - specifications for healthy burial of waste. This chapter indicates five fundamentals concerning determination of site selection, methods of burial, machinery required, staff involved and other requirements.
- Environmental Instructions for Industrial, Agricultural and Service Projects, 1990. The document includes explanation of site determinations, environmental requirements, master plan outlines, classifications of pollution sources and activities.

2.3.2 International Standards

Where national environmental guidelines have not been set, international standards from the World Bank, the World Health Organization or other developed countries are commonly required by the KRG.

2.3.2.1 *Atmospheric Emissions*

There are no known applicable ambient air quality standards for the region. As a substitute the Alberta Environment (AENV)/ Alberta Ambient Air Quality Objective air quality limitations[1] are recommended by MNR/KRG ***Table 2.1***.

2.3.2.2 *Noise*

Limits for ambient noise as specified by WHO[2] is presented in ***Table 2.2*** for the present project, within a primarily rural residential area, noise limits of maximum 55 dB(A) during daytime and 45 dB(A) during night time at the nearest habitation and/or the immediate vicinity (i.e. 10m log equivalent) is considered.

Table 2.1 SO_2 Concentration Limitations Summary

Organization	Limits	
Alberta Environment (AENV)	1-hour Average	450 µg/m^3
	24-hour Average	125 µg/m^3
	30-day Average	30 µg/m^3
	Annual Average	20 µg/m^3

[1] *Alberta Environment – Alberta Ambient Air Quality Objectives and Guidelines Summary – April 2011.*

Table 2.2 Ambient Noise Levels Standards

Receptor	Maximum allowable log equivalent in dB(A)	
	Day (07:00 – 22:00 hr)	Night (22:00 – 07:00 hr)
Residential, Institutional, Education	55	45
Industrial, Commercial	70	70

[2] *Sources: Guidelines for Community Noise, WHO, 1999.*

2.3.2.3 *Drinking Water Quality*

Because the Standard Specification No 417 from the Iraqi Environmental Protection Act is not strict enough, the guidelines typically used for drinking water quality assessment are those defined by the World Health Organization in "Guidelines for Drinking Water Quality", 4th edition, 2011 ***Table 2.3***.

2.3.2.4 *Solid Wastes*

Because the Iraqi Environmental Protection Act does not provide strict guidelines for waste in general, World Bank standards are used in this case.

2.3.2.5 *Contaminated Land and Groundwater*

Kurdistan has not yet adopted any environmental quality standards for the characterization and remediation procedures for contaminated soil and groundwater, nor do international institutions (UN, World Bank) provide any quantitative guideline. It is recommended to refer to guidelines that were developed for the United State Environmental Protection Agency. These guidelines take into account the planned use of impacted land (e.g. residential, agricultural, natural or industrial). They are constantly reviewed and updated with new research results, to ensure that human health and environment are safely protected.

2.3.3 Protected Areas and Biodiversity Protection

Traditional methods for protection of rangeland are being continued by local communities in KRG's rural areas and under the jurisdictions of local Mukhtars or administrators, there have been cases of local bans on de-forestation, cutting trees and restricted entry into certain areas to protect the environment. Since 2003, the KRG has also put a ban on cutting trees in the Kurdistan Mountains. Though there is no particular legislation in regard to biodiversity protection, it is prohibited to construct establishments, buildings or roads, or to perform any commercial or industrial activity unless permission has been obtained from competent authority.

Table 2.3 Water Quality Standards

Parameter	Unit	WHO Standards (Desirable)
pH	Units	7.0 to 8.5
Total Dissolved Solids	mg/L	500
Sulphate as SO_4	mg/L	200
Chloride	mg/L	200
Calcium	mg/L	75
Nitrates as NO_3	mg/L	45
Magnesium	mg/L	30
Manganese	mg/L	0.05
Cyanide	mg/L	0.05
Iron as Fe	mg/L	No health concern
Mercury	mg/L	0.006
Arsenic	mg/L	0.01
Zinc	mg/L	5
Selenium	mg/L	10
Cadmium	mg/L	10
Copper	mg/L	50
Lead	mg/L	0.01
Chromium	mg/L	50
Faecal Coliforms	Number per 100ml	Zero
E. coli	Number per 100ml	Zero

2.3.4 Multilateral Environmental Agreements

International Environmental Agreements already ratified by the Federal Government of Iraq, which are relevant to the project, are:

- Kyoto Protocol (Green House Gases Emissions) on Climate Change, 1997.
- Basel Convention on the Control of the Transboundary Movement of Hazardous Wastes and their Disposal, 1989.
- Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemical and Pesticides in International Trade, 1998.
- 1987 Montreal Protocol on Substances the Deplete the Ozone Layer, 1987.
- Stockholm Convention on Persistent Organic Pollutants (POPs) especially as it concerns dioxins emission and the management of polychlorinated Biphenyl's (PCBs), 2001.

3. DESCRIPTION OF THE PROPOSED PROJECT

3.1 Introduction

Currently there is a power shortage throughout Iraq including Kurdistan Region of Iraq (KRI). Electricity power is among the major challenges facing all sectors including; citizen, businessman, stakeholder, factories and projects. **KAR Power,** member of the **KAR Group** intends to develop a Power Plant (**"Khurmala Power Plant-1000MW"**) (product capacity = 1200MW) for electricity power generation, proposed to be located at Northing 36° 07′ 58, 60m and Easting 43° 46′ 31,53m and 325m.a.s.l.

3.2 Khurmala Power Plant-1000MW

The Khurmala Power Plant-1000MW will include; Combined Cycle Power Generation Plant, time Frame is 01-06-2013 Open Cycle and 01-06-2015 Combined Cycle. Technical Details; Phase I: 4 simple cycle, 160MW GTs, Phase II: 4 HRSC plus 2, 160MW each steam turbines and Phase III: installation of (2) additional Gas turbines (2 x 160 MW) using HFO as primary fuel. Prime Fuel; flare Gas from Khurmala Field and other sources and liquid fuel oil, storage, utilities and process support systems. Modular fabrication of the processing plant is being undertaken out of country and the components brought in and assembled on-site.

3.3 Description, Activities and Design Basis

3.3.1 Construction Phase

The following sequences of activities are being undertaken during the construction phase:

- Site clearance;
- Excavation activities;
- Levelling;
- Site roads and foundations;
- Installation of power and utilities;
- Main Camp and Security Camp erection: People will live and work in cabins: Construction;
- Khurmala Power Plant-1000MW Facility installation;
- Gathering system installation; and
- Access roads.

3.3.1.1 Construction activities

- Construction vehicles and mobile / fixed construction plant (e.g. rock crushers):
    - Trucks during the construction phase:
        - Access road renewing (stone, gravels and concrete transport);
        - Site construction (stone, gravels, soil, metal, equipment, pipe transport);
    - Special machines:
        - Excavators;

- Dozers;
- Crane;
- Welding machine;
- Forklifts; and
- Front end Loader.

- Estimate of water use, source & method of transportation
  - Water for the construction phase is by truck from the closest water well; and
  - Will be stocked in the open air water pit and water tanks at the site.

3.3.1.2 Construction Camp

- Power supply for the construction camp – number & size of generators:
  - 2 pcs. generator;
  - driven by diesel fuel; and
  - Capacity at each 300 kVA.

- Fuel storage (number & size of tanks, frequency of refuelling, secondary protection):
  - 10 m^3 diesel oil tank;
  - refuelling is scheduled on every 10^{th} day; and
  - berm is erected around the diesel generator and Diesel tank concrete pads.

- Solid waste management:
  - **KAR Power** has a contract to transport the waste to the waste deposit point.

- Liquid waste; grey and black water treatment and disposal:
  - Communal waste water goes throw the Septic Field and the treated water goes into the creek.

- Hazardous camp wastes; segregation, storage and disposal:
  - Separate completion process.

- Site Plan:
  - The same actions and methods functioning as in the Construction Camp.

- Medical facilities:
  - Will be in function from the Main Camp Commencement. The wastes to be gathered separately and handled by Certificated Contractor.

- Kitchen and canteen facilities:
  - There is separate waste collection system will be in function; and
  - Wastes to be transported and collected by an entitled Contractor.

3.3.1.3 Construction Waste

Construction waste will be currently transported by waste management contractor.

- Breakdown of waste materials and quantities:
  - construction wastes (concrete, contaminated ground, metal pieces, contaminated rags, electrodes, cable pieces, lubricating oils, greases;
  - packaging wastes (plastic bottles, plastic cover cups from the flanged ends, packages, wood and plastic pallets); and
  - Test fluids.

3.3.1.4 Accommodation and Offices during Operation Period

(a) Details of accommodation on site are given below:

- Operator container (with air-condition) ;
- Supervisor container (with air-condition);
- Main camp, living containers, fully furnished and equipped with HVAC, shower, toilet, TV and internet connection., kitchen, dining container; and
- Clinic Container/Medical Centre
- Socializing rooms
- Mosque
- Indoor and outdoor sport facilities
- Diesel powered generators
- Guarded security fence around the living camp

(b) Area of offices on site – size, number of floors, location on site plan is:

- 40 feet container;
- 2 pcs; and
- One floor containers.

(c) Proportion of workers are:

- 120 persons in average
- 500 persons at peak times

(d) Water and power supply to accommodation and offices are described below:

- The plant will have a simple water treating unit for everyday use but not for potable water. Potable water will be provided as bottled mineral waters.
- Water is supplied from the closest water well
- Power supplied will be through the diesel generators.

(e) Kitchen/canteen facilities will be located at Main Camp with two dining rooms that serve different food; the separate cabin provides the dining and rest room at the Power Plant facility.

(f) Separate disposal of domestic waste will be in containers.

(g) Clinical waste will be disposed in container(s) nearby the Clinic Container.

(h) Cleaning and Laundry Service are available to the people on site

3.3.2 Operation Phase

- Power Plant Capacity:
  - Maximum capacity of the facility shall be 1200MW after implementation of all three phases..

- Water Consumption:
  - Sanitary water and building heating systems: filling up the heating system with water and periodically make up the loss from the balance tank;
  - Potable water: 240 l/day bottled water;
  - Sanitary consumption: 1000 l/day; and
  - Maintenance and cleaning: 200 l/day.

- Discharge points to air – number & height of stacks, air emission monitoring data:
  - Generators powered by Diesel engine 425 kVA, 2 pcs (one in function and one in standby), height of chimney approximately 3 m from the ground level;
  - Auxiliary boilers heated by Diesel Oil, 2 pcs, height of chimney approximately 5 m from the ground level;
  - Cold vent, 40 feet height; and
  - Flare, 60 feet height.; Maximum flared quantity on the flare head is not calculated yet.

- Flare data – stack height, burner spec, throughput, hours of usage, shut down procedures etc.
  - Height is 60 feet, **KAR Power** has not got information at this moment about the burner but the basic technical parameters are the followings:
    - Above ground vertical gas flare system,
    - Continuous propane pilot system,
    - Flame arrestor, and
    - Emission monitoring system.

- Noise output figures from items of plant:
  - The sources will be the followings;
    - Power Generators,
    - Loading and manipulating pumps,
    - Auxiliary boilers,
    - Flare,
    - Cold vent,
    - Trucks (HFO/LFO transportation),

  - Vehicles (maintenance, crew change, material supply), and
  - Alarm system.

- Effluent discharges:
  - Sewage water approximately 1200 l/d; and
  - Residual sludge from process water treatment approx. 20 t/d .

- Waste production; types, segregation, treatment, quantities and end disposal route:
  - Produced water contaminated by scavenger goes to the open air water pit;
  - Communal wastes storage in the separate waste containers depend on their type;
  - Flared gas will be treated by scavenger during the Power Plant;
  - Hazardous materials will be stocked in the special container;
  - Communal waste fluids gathered and treated by the Septic Field method; and
  - Medical waste.

3.4 Transportation

- Number of vehicles used for the Khurmala Power Plant-1000MW; cars, tankers, heavy plant, forklifts etc:
  - At least 6 vehicles and during normal operations.

- Number of tanker journeys made for supply and product delivery:
  - In case of full production capacity then it will be around 60 for a return journey as a super Maximum but most probably around 35 in average as a return journey.

- Fuel types used and on-site refuelling facilities:
  - Fuel for the diesel generators is diesel,
  - Fuel for the auxiliary boilers is diesel, and
  - Cars will be most probably filled in the filling stations.

3.5 Commissioning

The pre-commissioning and commissioning stages are likely to involve cleaning, pressure testing, flaring, gauging etc.

- Cleaning chemicals and quantities / discharge points
  - Laundry service will be in function after the Main Camp is finished. Washing chemicals will be used. The normal operation is expected to require 4 package of washing detergents/day.

3.6 Workforce and Working Hours

During peak civil, erection and commissioning times there will be > 500 worker on site for a limited period of time. Approximately 70% of the construction workers are local; the remaining 30% are sourced internationally. International workers are based at a construction camp located approximately 300-400 meters from the Khurmala Power Plant-1000MW site, within the security fence.

In average approximately 120 workers will be employed for the operation of the Power Plant Facility for all three phases. During normal plant operation of Khormala Phase 1 and 3 a total of approx. 65 full time employees are expected to be at site. This work force consists of 4 international experts (O&M managers) and 61 local workers (27 operators, 30 maintenance engineers and 4 administrative staff). Detailed Workforce for phase 2 has not been defined yet. Additional partially and third party service workforce will be necessary for scheduled outages and revisions.

Operating hours of the power plant:
The facility is working continuously 24hrs/day, 7 days/week, 52 weeks/year.

Working hours:
The regular working time in Iraq is 8 hours per day, 6 days per week and shall apply also for the project. For the peak period of the construction phase temporary shift work of 12 hours per day may be implemented in order to meet the tight project time schedule. The workers will be compensated for the additional overtime.

3.7 Operation (Sources of Pollution)

The various types of pollution from the proposed drilling operations are categorized under the following types:

- Air pollution;
- Water pollution;
- Solid waste generation; and
- Noise pollution.

Exhaust gases from DG sets, wastewater and noise from the drilling operations are the major sources of the pollutants generated during the proposed drilling operations. The quantities and the composition of the gaseous, liquid and solid waste that are generated during the proposed operation will be regulated such that their final disposal into the environment meets all the statutory requirements and the environmental impacts are minimized. Noise attenuation measures are expected to be marginal and well within the ambient noise level standards.

3.7.1 Air Pollution

During routine operation, air pollutants are emitted by the large diesel engines that power the equipment. These engines create some amounts of particulate matter, Sulfur dioxide, oxides of Nitrogen. The air pollution associated with operation can be increased by long-term multi disciplinary activities. The vehicular movement associated with the operation activities will be also an important cause for the dust pollution. The predominant air emissions from the proposed operations are gaseous emissions *viz.* Sulfur dioxide, Oxides of Nitrogen and Hydrocarbons. Each power generator will have the adequate stack height for easy dispersion of gaseous emissions.

3.7.2 Water Pollution

Operation sites will have adequate drainage system so that all wastewater are contained and disposed of in accordance with local regulations. Means will be provided to trap any escape of oil before it can leave the site. Drains and skimmer tanks are sized so that they can contain two to three times the maximum storm rainfall expected over any two-hour period, plus the liquid inventory they are designed to contain. Surface drains are adequately graded and kept debris free to ensure quick discharge of their contents. Spilled fuel oil within the fuel unloading, treatment and storage facilities as well as waste oil from pumps or other machinery is trapped, collected and disposed of properly. All potential sources of spillage are equipped with drainage facilities or drip pans in order to contain spills. The waste pit is collecting all the wastewater fluids, which come from the diverse operational water with a 0.5m freeboard to be maintained in the water storage and waste pits. The final mode of surface water disposal after separation of the spilled oil or waste oil would be discharged as “usable” water into a creek close to the power plant without any impact on the land.

Sanitary waste water will be collected within septic tanks and trucked off site for final disposal in accordance with local sanitary regulations.

Waste water from the process will be treated in a mechanical waste water treatment facility in accordance with local environmental requirements and World Bank Effluent Guidelines. The remaining concentrated sludge will be discharged e.g. in an evaporative pond or similar facility that can be emptied and cleaned regularly. The dried sludge will be trucked off site for final disposal in accordance with local environmental requirements and World Bank guidelines.

For the open cycle as well as for the combined cycle process only closed loop cooling systems with water/air fin fan coolers or air cooled condensers will be used. This will have no impact on the surrounding environment.

The water used for the Khormala power plant will be from Greater Zab River approx. 50 km West from the site. A dedicated water pipeline with pumping stations will be installed also for operation of the CPS. This water pipeline will be built next to the existing KAR oil pipeline. This measure will have no impact on the

ground water level in the region. Due to the relatively small amount of water extracted from the river this will also have no impact on the water used for irrigation.

3.7.3 Noise Levels

The major noise generating sources are DG sets where noise is continuously generated. Typically, the noise generating sources are provided below (in the immediate vicinity)

Diesel Generator	:	90 to 95 dB (A)
Pumps	:	85 to 90 dB (A)
Miscellaneous	:	80 to 85 dB (A)
Control Room & Quarters	:	50 to 60 dB (A)

Noise is not considered to be a potential threat since the Power Plant sites will be selected keeping in view that there are no settlements in close proximity to the site.

3.8 Health, Safety, and Environment

The importance of HSE program is paramount to the success of any operation conducted by executive project agency and its sub-contractors. The **KAR Power** as a normal part of its operations have a dedicated HSE department to ensure the highest level of safety awareness and environmental compliance is achieved at all times during the operation phase. However, the responsibility for Safety does not lie solely with the HSE Department but rather with every employee in the workplace.

3.9 Social Action and Cultural Consciousness

KAR Power and other subcontractor are working closely with a view to present both companies to the local community in a positive frame to achieve the above objectives. There are some social benefits that the locals are employed during the site preparation, up gradation of the site for Power Plant foundation, approach road if any, and ancillary jobs such as canteen, vehicle hire, labor used for clearing of a Right Of Way (ROW) generally 10–30m wide, this for heavy truck transporting during construction activities and subsequently operation processes.

3.10 Occupational Health and Safety

3.10.1 Hazard Assessment

A hazard assessment is a formalization of what is done whenever personal protective equipment is selected based on the hazards of the job. During the hazard assessment of each task to select the proper P.P.E., inspect the layout of the work place and look for the following hazardous source:

- All closed areas are equipped with the proper ventilation systems to ensure employee protection from suffocation, harmful gases and dust particles. All employees, regardless of their job description, are provided with the necessary personal protective equipment. Every employee is given safety shoes, a safety helmet, earplugs and safety goggles. Employees with specified jobs are given the necessary

personal protective equipment for the job, such as heat-resistant gloves, heat-resistant jackets, earmuffs and respiratory equipment in dusty working places

- All workers engaged in the material handling system will be regularly examined for lung diseases
- Any worker found to develop symptoms of toxic gases related diseases should be immediately changed over to another job in a cleaner environment within the project
- All job activity will be controlled by work permit system to make sure that risk assessment prior to work will be carried out.
- The OHS & E Department carries out constant monitoring of emissions, radiation and noise in all workplace areas. Portable measuring equipment is used to carry out measurements on a routine basis. Stacks are equipped with online monitoring systems to control the emission of dust and gases released.

3.10.2 Health and Safety Training

To ensure a high level of competency and awareness in the area of occupational health and safety, training will be provided in all relevant areas. This training will be integrated with the creative LEARNING program, and place a strong emphasis on risk assessment and management. **KAR Power** will train its employees in health and safety in a manner that is consistent with the **KAR Power** Safety Manual. Training will also comply with any legislative requirements.

Formal training for all employees (including contractors) at all levels within **KAR Power** will be provided, and shall address the following:

- Health and safety awareness
- Risk assessment principles
- Principles and practice in health and safety
- Induction for new employees and transferred personnel (general and specific safety procedures required by the job)
- Changes to project, equipment or processes
- Personal Protective Equipment use and care as required.
- Training records are to be made and maintained in a corrective manner. Such records will relate to training, competence, licenses, certificates and operating authorizations.

4. ENVIRONMENTAL BASELINE CHARACTERIZATION

4.1 Physical Environment

4.1.1 Methodology

The proposed area for Khurmala Power Plant-1000MW survey area ***Figure 4.1*** was screened for physical environment survey in October 2012. Data was collected on Geology and Geomorphology, Hydrology and Hydrogeology, Land Use and Agriculture, Soil Characterization, Climate and Meteorology, Ambient Air Quality and Noise Levels and Traffic Density.

Physical parameters presented in this section were primarily based on direct field survey, carried out by the field survey team. Additional information was obtained from the related Directorates/ Centres of Dashty Hawler and Erbil, direct interview from local residents, textbook references (scientific publications referred to in the bibliography) and the University of Salahaddin-Erbil.

4.1.2 Geology, Geomorphology and Topography

Based on available maps and satellite imagery (Quick Bird/ Res. = 0.6m) of the environmental baseline survey area, the following observations about structure, stratigraphy, lineaments and slopes can be made; the Khurmala Power Plant-1000MW area is located in the Zagros Fold belt of Kurdistan, within the Low Folds with wide synclines Zone of Iraq, and stratigraphically part of the Tertiary Foreland Basin. The following structure, lineaments and slopes can be drowning; the area is generally formed of long extended hills/ mountains dominated by Zurgah Ziraw Mountain (490m), valleys, hills and flat plains. The elevation is quite different, ranging from 300 to more than 490 meter above the sea level. Topographic features are highly affected by lithology and structure ***Figure 4.2***.

Geology of the Khurmala Power Plant-1000MW area ***Figure 4.3*** is located at the Zurgah Ziraw Mountain, which is geologically anticline located within the simple folds zone of the Iraqi territories. Synclinal areas between the folded anticlines create broad NW-SE trending valleys. Stream erosion has cut some canyons through some of the anticlines resulting in additional, though generally smaller valleys that trend at right angles to the topographic highs. Rocks exposed at the surface of the Zurgah Ziraw feature are as old as Neogene/ Miocene and represented by massive limestone. Progressively younger rocks are exposed on the flanks of the Zurgah Ziraw anticline and are represented by the Bai Hassan Formation (conglomerates, sandstone and claystone), Mukdadiya Formation (pebbly sandstone, claystone and sandstone) and Injana Formation (sandstone interbedded with claystone). Both the stream eroded valleys as well as the synclinal valleys are filled by modern and ancient clastic sediments represented by Miocene and Pliocene-Recent sediments of the Fars and Bakthtiari Formations. These sediments generally consist of varying proportions of conglomerate, sandstone and mudstone.

General Topography of Khurmala Power Plant-1000MW Area

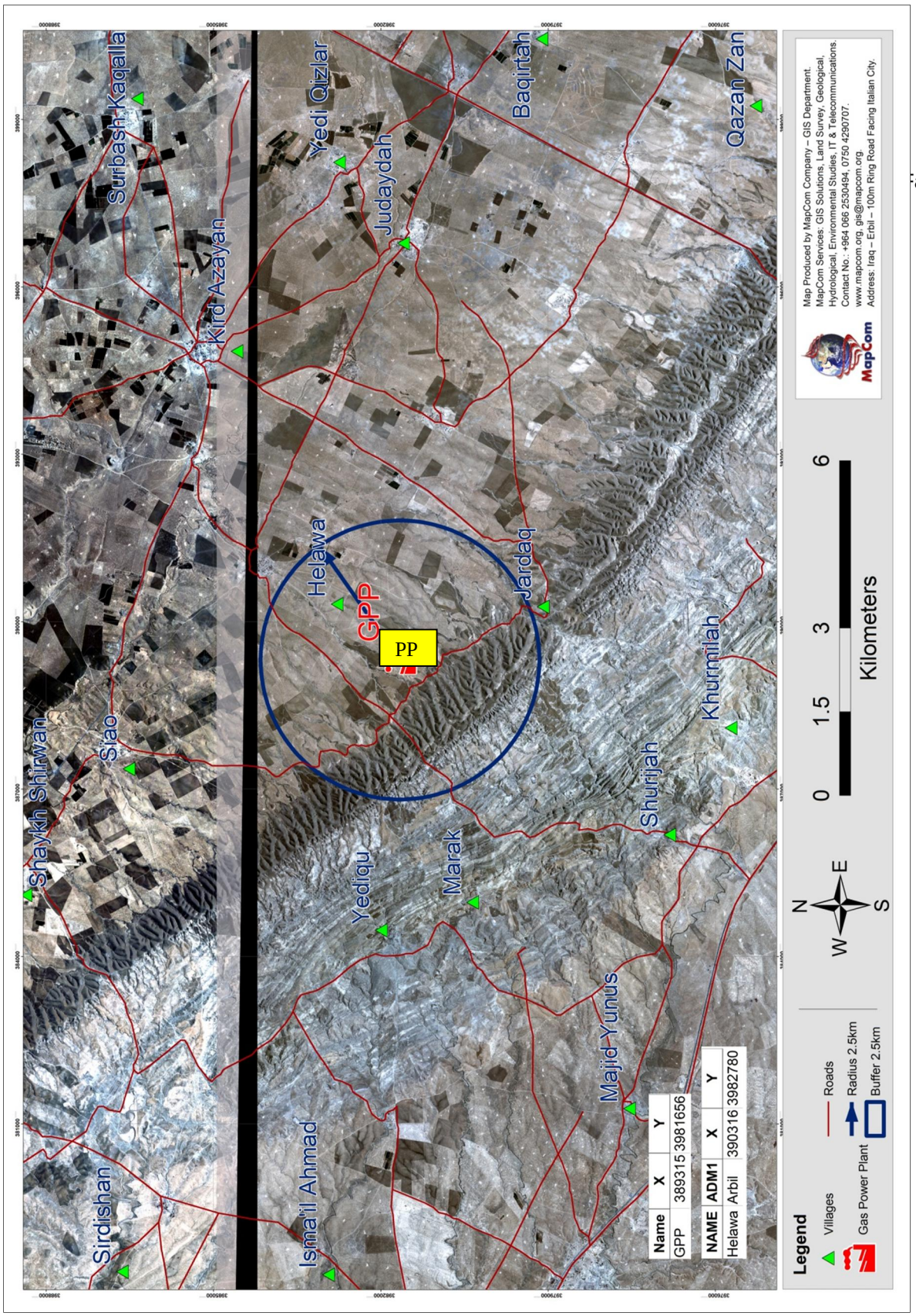

Figure (4.1): Satellite image of the Khurmala Power Plant-1000MW Area.

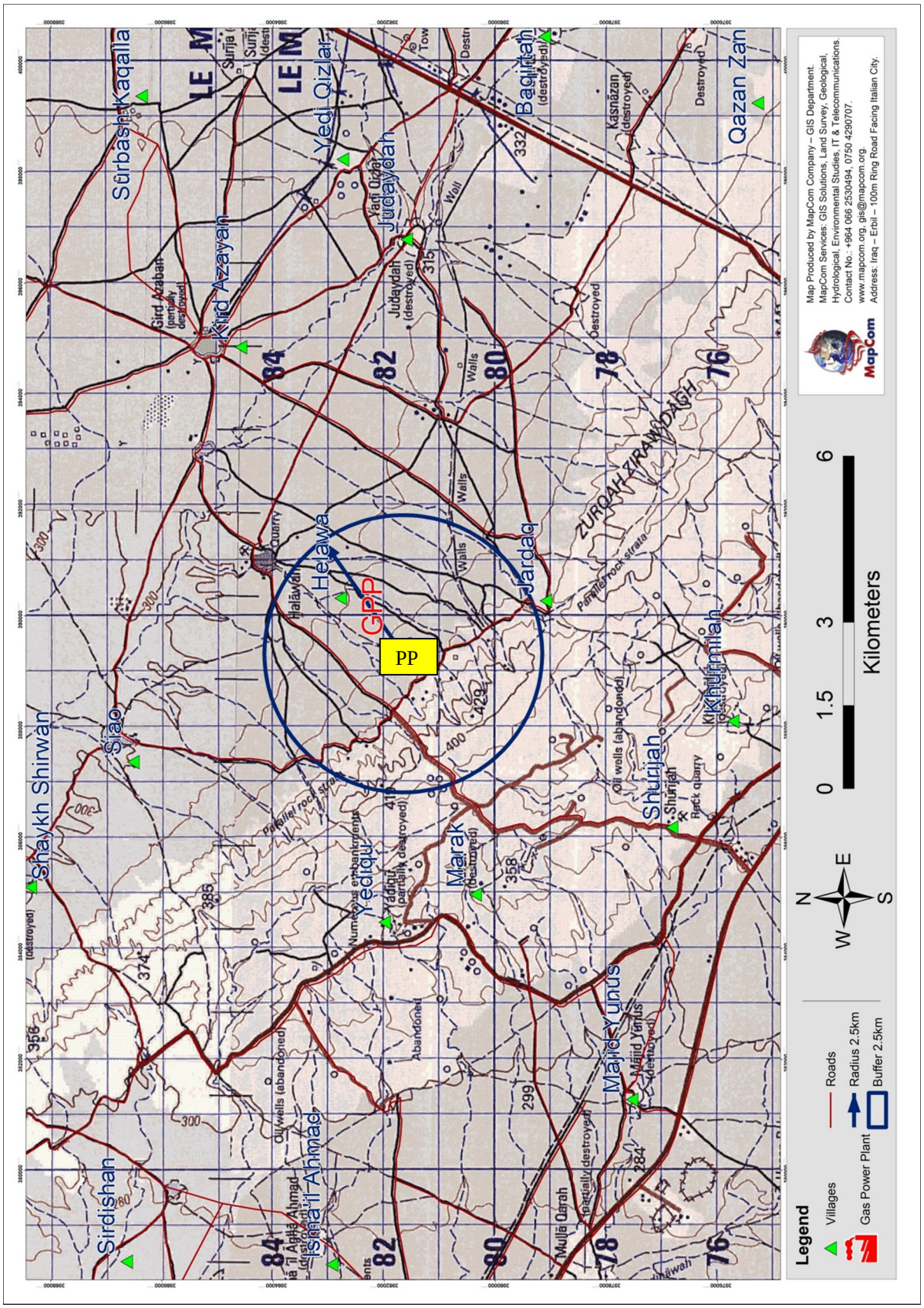

Figure (4.2): Topographic Map of the Khurmala Power Plant-1000MW Area.

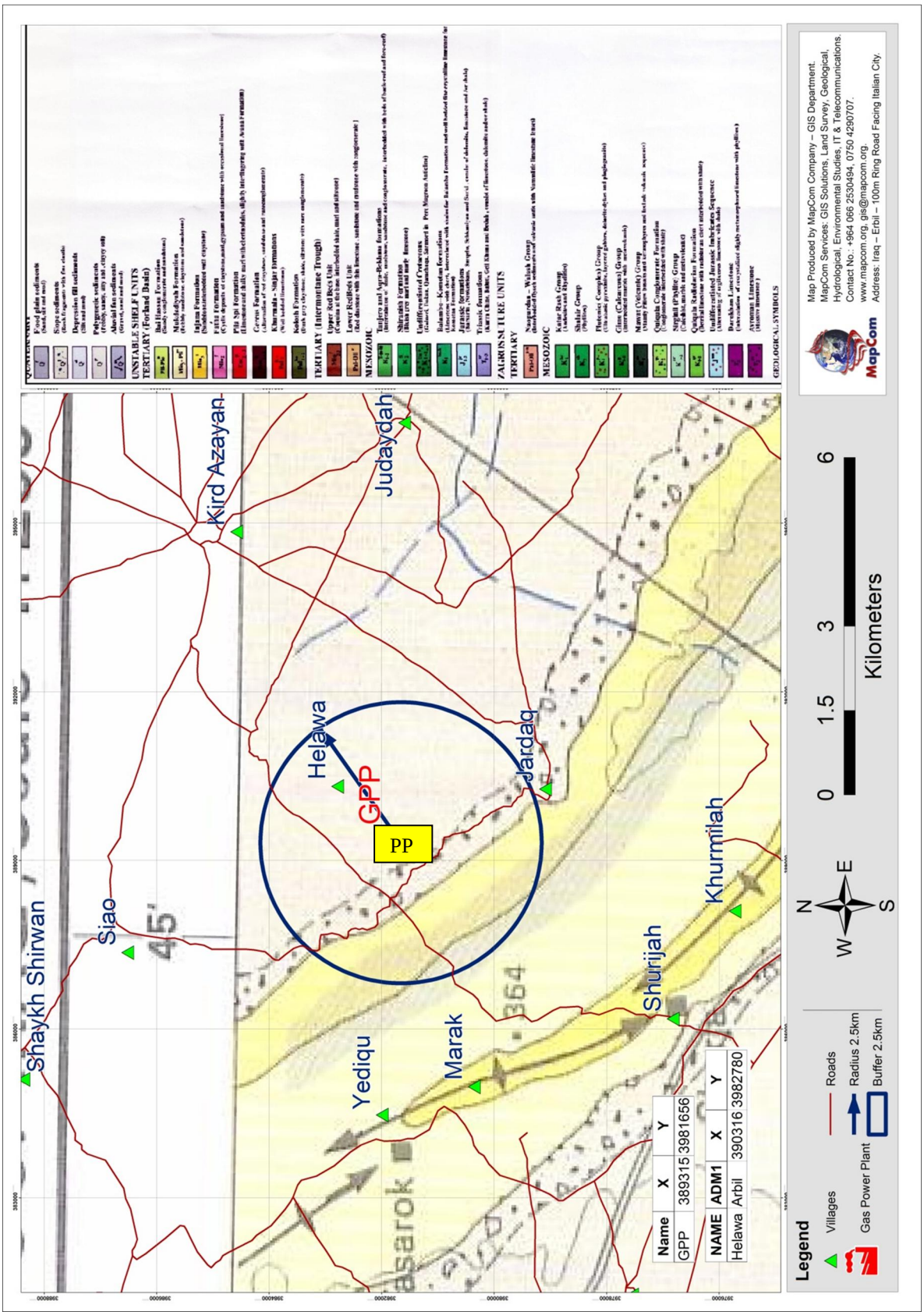

Figure (4.3): Geologic Map of the Khurmala Power Plant-1000MW Area.

Key Issues;

- The Khurmala Power Plant-1000MW & camp sites are restricted access area and must be fenced all round with round the clock watch & ward facility.
- Entry of vehicles into the Khurmala Power Plant-1000MW site area is prohibited except for material movement. Adequate parking facilities must be provided outside the Khurmala Power Plant-1000MW location.
- Land clearance for site construction at the Khurmala Power Plant-1000MW site will be kept to a minimum practicable in order to safely accommodate the facilities.
- The site will be strengthened for the Khurmala Power Plant-1000MW.
- Ensure natural drainage channels are avoided or drainage channels rerouted to ensure unhindered flow of rain / flood water.
- For prevention in slope frailer (e.g. camps and Khurmala Power Plant-1000MW) always stay back safe distances from the rocky edges.

4.1.3 Hydrology and Hydrogeology

4.1.3.1 Surface Water

No surface water systems were found in and around the Khurmala Power Plant-1000MW survey area, the exceptions were groundwater fed ponds and handmade irrigation canals, which are used for irrigation. Water samples collected from the above water sources at indicated locations were analyzed for physical, chemical, and biological parameters. With the exception of BOD_5 and MPN for bacteria, all other parameters were analyzed with portable field equipment, using a portable Spectrophotometer DR/ 2400 (HACH)/ USA, and Orion Star Series Meter/ Thermo Electron Corporation, Beverly, MA 01915 USA. BOD_5 and MPN were estimated following Standard Methods recommended by W.H.O. (1997) and A.P.H.A. (1989). The water quality was assessed in comparison with the World Bank norms.

Field water sampling/ analysis methods

Portable Spectrophotometer DR/2400 (HACH)/ USA (left) & Orion Star Series Meter (right)

The photographs below show two selected watercourses for water sampling and chemical analyses throughout the Khurmala Power Plant-1000MW survey area. Their locations/ coordinates and types and elevations are shown in the ***Table 4.1*** and ***Figure 4.4***. Water Chemistry is given in the ***Table 4.2.***

Table (4.1): Selected surface water locations within the survey area

S.N.	Location (Village Name)	Code	Coordinates		Type and Source of Water	Altitude (m.a.s.l)
			Lat.	Long.		
1	Helawa	W2	36° 0'20.21"N	43°48'49.94"E	Pond (groundwater fed)	318
2	Siao (Siaw)	W1	36° 1'18.88"N	43°46'8.58"E	Pond (groundwater fed)	323

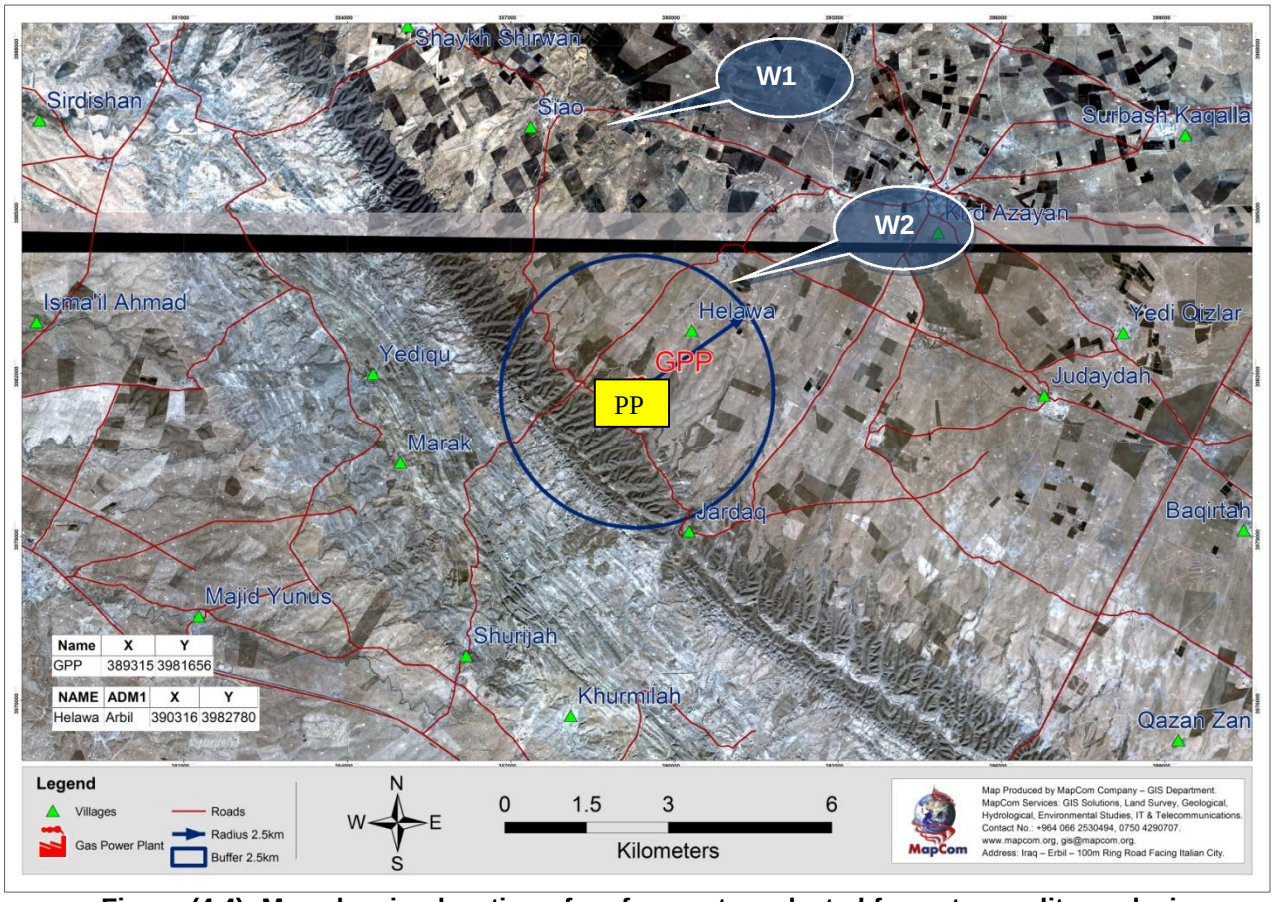

Figure (4.4): Map showing location of surface water selected for water quality analysis

Photos of selected surface water resources within the Khurmala Power Plant-1000MW survey area

Table (4.2): Surface Water Chemistry within Khurmala Power Plant-1000MW Survey Area[1]

S.N	Parameter (units)	Locations		WB Norms
		W1	W2	
1.	Temp. (^{o}C)	12.3	12.4	-
2.	pH	8.4	8.3	**6.5 - 8.5**
3.	EC (µs.cm^{-1})	712	538	**400-600**
4.	T.D.S. (ppm)	410	328	**250**
5.	D.O. (mg.l^{-1})	5.5	6.1	**7.0**
6.	B.O.D$_5$ (mg.l^{-1})	>5	>5	**0.0-1.0**
7.	C.O.D. (mg.l^{-1})	18	22	**10-20**
8.	$SO_4^{=}$ (mg.l^{-1})	373	309	**200-400**
9.	NO_3 (mg.l^{-1})	38	42	**45**
10.	MPN (Cells. 100 ml^{-1})	2.2	2.2	**0.0**

4.1.3.2 Groundwater

Surface manifestations of groundwater aquifers are mainly represented by drilled wells. The groundwater occurrence and quality within the block strongly depends on the geology of the area. The photographs below show six groundwater locations selected for groundwater analyses throughout the Khurmala Power Plant-1000MW survey area. Their locations/ coordinates, nature and elevations are shown in the ***Table 4.3*** and ***Figure 4.5***. Groundwater chemistry is given in ***Table 4.4.***

Table (4.3): Selected groundwater locations within the Khurmala Power Plant-1000MW survey area

S.N.	Location (Village Name)	Code	Coordinates		Type and Source of Water	Altitude (m.a.s.l)
			Lat.	Long.		
1	Helawa	G1	35°59'48.97"N	43°47'30.08"E	Well	325
2	Helawa	G2	35°59'47.58"N	43°47'18.25"E	Well	322
3	Helawa	G3	36° 0'20.21"N	43°48'49.94"E	Well	318
4	Siao (Siaw)	G4	36° 1'18.88"N	43°46'8.58"E	Well	323

[1] WB= World Bank, Temp. = Temperature, ^{o}C = degree Celsius, NTU = Nephelometric Turbidity Unit, pH = potential of hydronium, EC = Electrical Conductivity, µs.cm^{-1} = microsimense per centimetre, mg.l^{-1} = milligram per litre, T.D.S = Total Dissolved Solids, D.O. = Dissolved oxygen, B.O.D$_5$ = Biological Oxygen Demand of five day incubation time, C.O.D. = Chemical Oxygen Demand, $SO_4^{=}$ = Sulphate, NO_3 = Nitrate, MPN = Most Probable Number of Faecal coliform bacteria.

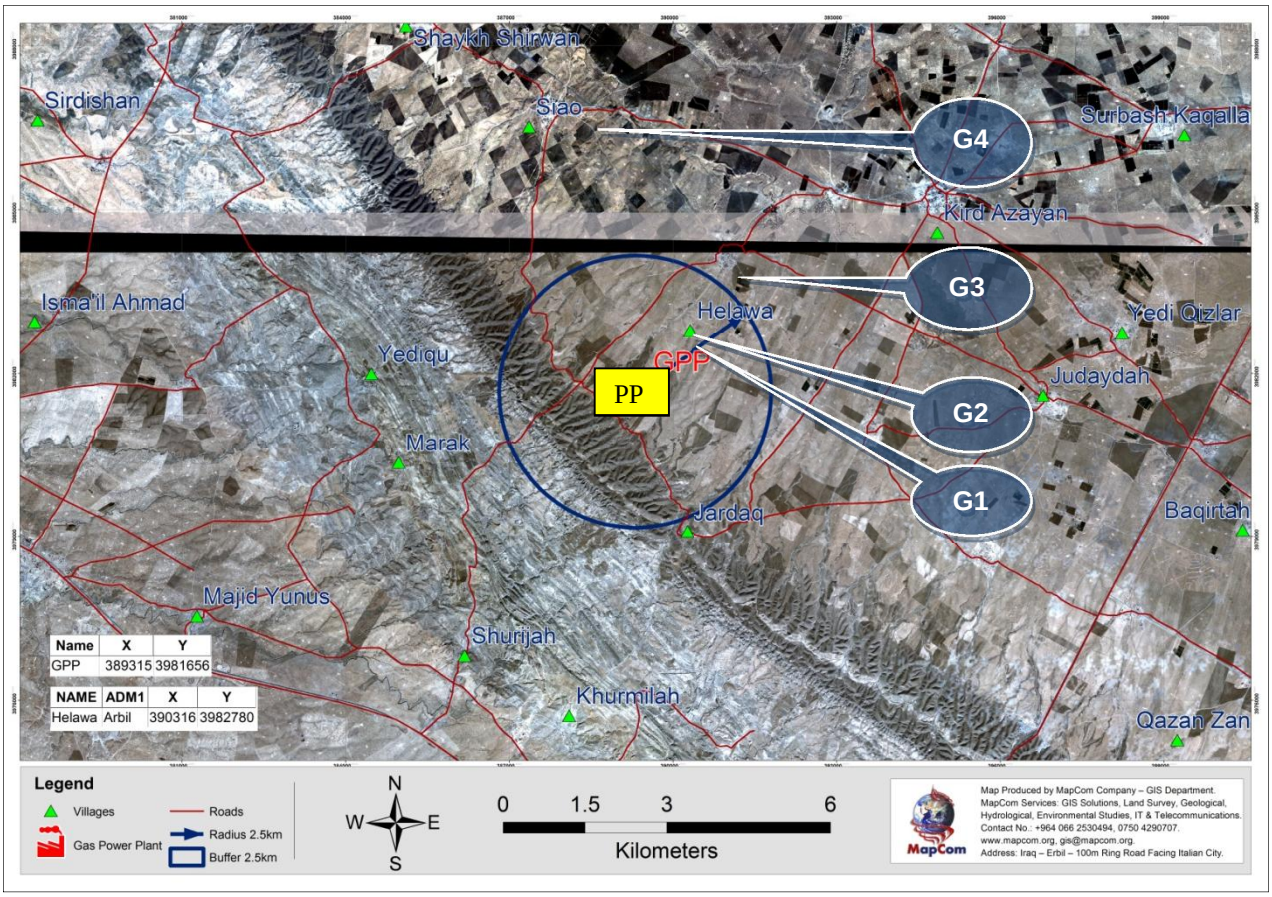

Figure (4.5): Map showing location of groundwater selected for water quality analysis.

Photos of selected groundwater resources within the survey area

Table (4.4): Groundwater chemistry within Khurmala Power Plant-1000MW survey area[2]

S.N	Parameter (unit)	Locations				WB Norms
		G1	G2	G3	G4	
1.	Temp. (^{o}C)	13.1	12.8	12.7	12.6	-
2.	Turbidity (NTU)	6	4	4	4	**5**
3.	pH	7.9	7.8	8.1	8.2	**6.5 - 8.5**
4.	EC (µs.cm^{-1})	412	422	482	431	**400-600**
5.	T.S.S. (ppm)	0.0110	0.0134	0.0138	0.0172	**0.0100**
6.	D.O. (mg.l^{-1})	4.4	4.6	4.3	4.8	**0.0-7.0**
7.	B.O.D$_5$ (mg.l^{-1})	1.0	1.0	1.1	1.1	**0.0-1.0**
8.	C.O.D (mg.l^{-1})	13	16	24	31	**10-20**
9.	Chlorides (mg.l^{-1})	288	294	286	323	**250**
10.	Total Hardness (mg CaCO$_3$.l^{-1})	286	347	322	312	**300**
11.	Ca. H. (mg.l^{-1})	108	187	168	176	**75**
12.	Mg. H. (mg.l^{-1})	62	66	72	80	**30**
13.	Sodium (mg.l^{-1})	8	8	9	9	**6-10**
14.	Potassium (mg.l^{-1})	0.22	0.23	1.1	1.2	**0.5-2.5**
15.	Alkalinity (mg CaCO$_3$.l^{-1})	188	191	206	256	**200**
16.	Acidity (mg CaCO$_3$.l-^{1})	Nil	Nil	Nil	Nil	**0.20**
17.	$SO_4^{=}$ (mg.l^{-1})	278	279	252	266	**250**
18.	NO_3 (mg.l^{-1})	22	24	31	18	**45**
19.	MPN Bacteria (Cells/ 100ml)	0.0	0.0	2.2	0.0	**0.0**
20.	Water Table (m)	55	65	50	35	-
21.	Well depth (m)	83	110	120	110	-

4.1.3.3 Conclusions

The occurrence of water within the block is intimately connected with the geology of the area. Most of the streams and creeks at north and northwest originate from the Pilaspi limestone formation which forms the core of Mountains. Conversely, the north-western portion of the block is occupied by claystone and sandstone

[2] WB= World Bank, Temp. = Temperature, ^{o}C = degree Celsius, NTU = Nephelometric Turbidity Unit, pH = potential of hydronium, EC = Electrical Conductivity, µs.cm^{-1} = microsimense per centimetre, mg.l^{-1} = milligram per litre, T.D.S = Total Dissolved Solids, D.O. = Dissolved oxygen, B.O.D$_5$ = Biological Oxygen Demand of five day incubation time, C.O.D. = Chemical Oxygen Demand, $SO_4^{=}$ = Sulphate, NO_3 = Nitrate, MPN = Most Probable Number of Faecal coliform bacteria, Un = unknown.

layers of the Mukdadiyah and Injana formations is fairly dry with no springs and intermittent watercourses void of water. The drainage of the block operates through small streams which collect into larger creeks and streams parallel to the general geological structure NW-SE direction. The surface water can be considered as poor quality, besides some significant elevated values typically for total dissolved solids, nitrates and sulphates. The cause of these elevated parameters may be of natural origin, local domestic sources and/or from upstream inputs. Groundwater is readily available at shallow depth in areas located within the Pilaspi limestone formation which forms the core of Zurgah Ziraw Mountain. Most of the villages within the limestone area rely on drilled wells; although the water may contain elevated dissolved solids. Groundwater wells within limestone aquifers are generally shallow, typically less than 50-120m deep. Chloride levels were found to be generally elevated throughout the area. Sodium remained low and has likely no connection to elevated chlorides. The cause of these elevated parameters may be of natural origin or from local domestic sources. The western area within claystone and sandstone layers of the Mukdadiyah and Injana formations has little or no springs, with deep and low yield groundwater wells. The water quality is poor with elevated salt content, as recorded from most of the villagers. Drinking water is trucked from other locations. Reliable groundwater aquifers are generally over 100m deep, although shallow and perched water wells may be found in some ravines and valleys at northern portions.

Key Issues;

- Wastewater generated from Khurmala Power Plant (e.g. cooling systems and domestic usages), the hot water and wastewaters shall be treated in an effluent treatment plant (ETP). ETP shall consist of primary to tertiary treatment and treated water shall be used for dust suppression, green belt development and in the power plant operation to the possible extent. Regular monitoring shall be carried out to assess any adverse impact
- Ensure natural drainage channels are avoided or drainage channels rerouted to ensure unhindered flow of rain / flood water. In this contents two options are suggested;
    A. Construction of small dam/barrier front of the flood inlet(s).
    B. Reroute the flood drainage channels out of the Khurmala Power Plant-1000MW site.
- The study has indicated that aquifer depth around the Khurmala Power Plant-1000MW site is >150m, while the water table is 40m.
- The intermittent water either in or around the Khurmala Power Plant-1000MW site is not yield a reliable water supply to the project. Thus, it would be preferred option to;
    A. Drill bore wells (Ideally two) close to the well sites to tap groundwater from aquifer to meet the water requirement,
    B. Tap closest well water using tankers and/or water pipeline.
- Khurmala Power Plant-1000MW site and camp will have an adequate drainage and wastewater will be treated in an environmental friendly method.
- Waste oil from Khurmala Power Plant-1000MW or other machinery will be trapped and manually collected and stored in a paved dedicated waste oil storage area.

- The storage area will be provided with paved flooring and containment bunding.
- Containment systems and oil traps will be provided to trap any escape of oil before it can leave the Khurmala Power Plant-1000MW site.
- All potential sources of spillage will be equipped with drainage facilities or drip pans in order to contain spills.
- Lubricating Oil to be collected on a pit or drums then returned back to the supplier where it is recycled and reused again, the drums to be stored in special designated zone in the central stores area.

4.1.4 Land Use and Agriculture

The satellite image of the study area was analyzed to determine the land classification within the concession and the project influence area. The project influence area is considered as a 20km^2 buffer from either the Khurmala Power Plant-1000MW site boundary or the extreme, whichever is the farthest. A desktop exercise for classification of the area into the major land use types (for 20km^2 area around the well site) such as agricultural land, barren land, range land, built-up area and water bodies was undertaken.

The classification map was then used during the site visits to corroborate and validate the findings. The land here is rain-fed agricultural land yielding one crop per year. Generally, the land of Khurmala Power Plant-1000MW area consists of restricted cultivated areas but non inhabited hillsides used for occasional livestock grazing. Crops found in the area include wheat and barley, along with summer and winter vegetables. Results are tabulated in ***Table 4.5*** and ***Figure 4.6***.

The land classification provided in this section is expected to provide a 95% confidence level based on the observation collected during the site visit. The land in Khurmala Power Plant-1000MW area is generally rural residential with limited suburban areas. The largest suburban area is Sub-District of Dashty Hawler 14km to the south. Out of the 20km^2 of land screened at and around the Khurmala Power Plant-1000MW area, approximately 14.4km^2 are family-owned and 5.6km^2 is government-owned land.

Different land use categories around the proposed power plant

Table (4.5): Summary of land use within the survey area[3]

S.N.	Type of Land	Area (sq km)	% of Total Area
1	Agricultural Land/ Fields	6.6	33
2	Forest Land	0.0	0.0
3	Barren Land	7.1	35.5
4	Built-up Land	2.2	11
5	Range Land	4.1	20.5
6	Water	0.0	0.0
TOTAL		~ 20	100

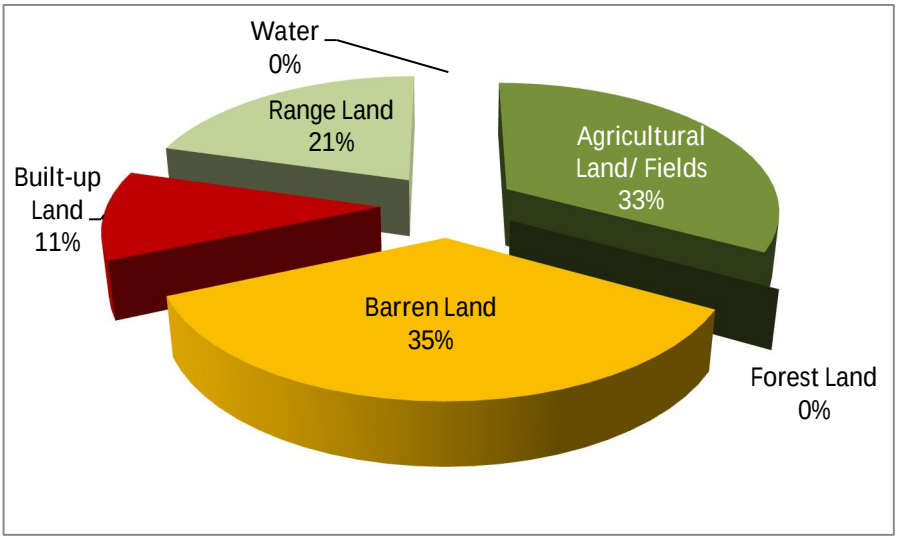

Figure (4.6): Pie presentation of land use patterns within survey area

Key Issues;

Although the land use pattern will not effect as approximately an area of ~20km^2 required for Khurmala Power Plant-1000MW activity, nevertheless, the following is the major issues for the proposed activity:

- The land will be acquired from private / government lands as per the government procedure for this type of activity.
- Damages / lease land will compensate according to practice in Kurdistan.

[3] Data on land use in the area was collected by MapCom based on topography and satellite maps in addition to the survey carried out by FAO coordination in northern Iraq/Sulaimani Sector in 2000 and information provided by agricultural centre at Erbil & Dashty Hawler. Collected data were crosschecked through visual observations during field trips and interviews with farmers.

4.1.5 Soil Characterization

4.1.5.1 Soil Types

The general soil characteristics within the Khurmala Power Plant-1000MW survey area vary with the location (plains, surface drainage channels and mountainous areas) and underlying geological formations (limestone, marl, claystone and sandstone). In plains and mountain foothills, leaching and accumulation of lime is seen in surface cracks within swelling and shrinking clay, resulting in the build-up of internal pressures in the soil leading to varying, but usually mitigated, degrees of slickenside (sliding pressure faces) formation. Leaching and accumulation of lime within swelling and shrinking clay cracks is generally more pronounced in southern areas, specially river/ stream banks, where the lime accumulation horizon tends to start slightly deeper (typically between 35 and 50cm) than in the plains and foothills. In the south, the organic matter content of the soil is generally high with enough topsoil to qualify as a mollic horizon. The combination of a mollic horizon and lime accumulation (Calcic horizon) points to the Kastanozem group. If the topsoil does not qualify as a mollic horizon, the soil will be classified as a Calcisol. In northern parts of Khurmala Power Plant-1000MW survey area, the soil is mainly alluvial type (gravel and sand). Fluvic soil material with visible stratification and irregular decrease of organic matter content is often present. These soils are classified as Fluvisols. The organic matter tends to decrease due to the current land use (i.e. grazing and burning of crop residues). Soil crusting occurs probably due to low organic matter contents. The vertical properties are mostly not sufficiently developed for a true Vertisol.

4.1.5.2 Soil Chemistry

Fourteen soil samples collected from different locations within the Block were selected for baseline chemistry characterization. Hand augers and / or scoops were used to collect approximately 1kg of soil sample from an approximate depth of 0.3m at each location. The samples were obtained from areas representative of the general environmental conditions of the Khurmala Power Plant-1000MW survey area. They excluded incidental local influences from existing activities (e.g. manure, minor spills, etc.). The soil samples were analyzed at the ecology laboratory of Salahaddin University for metals and TPH (total petroleum hydrocarbons). Agricultural and residential CCME (Canadian Council of Ministers of the Environment) guidelines were adopted for the evaluation of the soil chemistry. The ***Table 4.6*** and ***Figure 4.7*** show sampling locations and a summary of analytical results along with selected guidelines given in ***Table 4.7***. Photographs illustrating the soil sampling and the laboratory of the Salahaddin University are also displayed.

Table (4.6): Soil sampling location descriptions

Sn	Location (Name of Village)	Code	Coordinates	
			Lat.	Long.
1	Khurmala Power Plant-1000MW Site	S1	35°58'7.22"N	43°46'33.26"E
2	East of Power Plant	S2	35°58'6.43"N	43°48'20.43"E
3	South of Power Plant	S3	35°57'10.88"N	43°46'33.41"E
4	West of Power Plant	S4	35°58'26.28"N	43°44'53.63"E
5	North of Power Plant	S5	36° 0'6.64"N	43°46'41.70"E

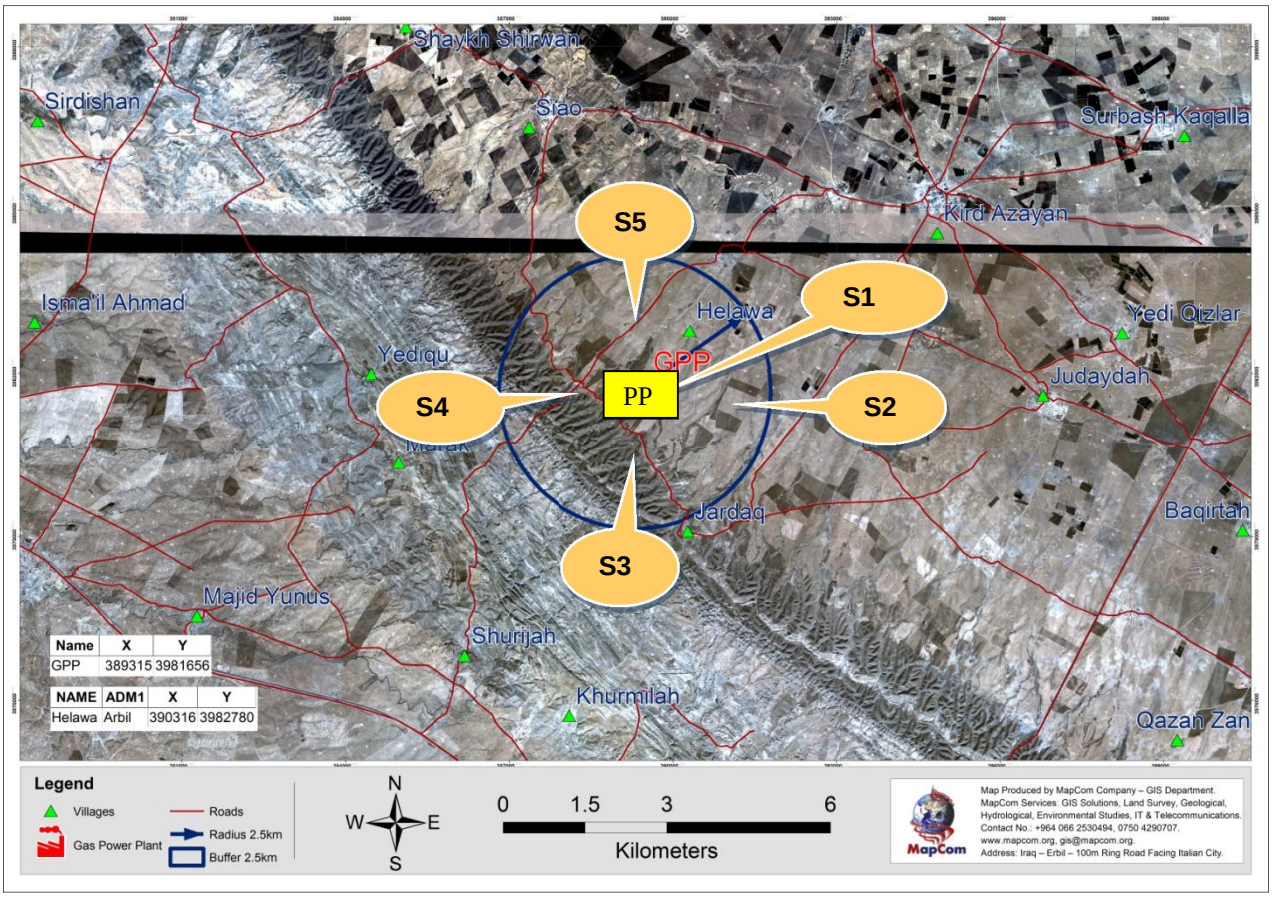

Figure (4.7): Map showing location of soil sampling sites within Power Plant survey area.

Soil colour and texture at and around the project site

Steps of soil sample collection

Ecology laboratory at the University of Salahaddin-Erbil

Table (4.7): Soil Analytical Results[4]

S.N.	Parameter	Locations					CCME	
		S1	S2	S3	S4	S5	Agr.	Res.
1	Mercury	BDL	BDL	BDL	BDL	BDL	6.6	6.6
2	Arsenic	1.43	1.78	1.11	2.09	1.34	12	12
3	Zinc	18.6	34.0	37.4	33.8	14.9	-	-
4	Cyanide	BDL	BDL	BDL	BDL	BDL	-	-
5	Cadmium	BDL	0.5	0.7	BDL	BDL	1.4	10
6	Chromium	28	37	26	31	31	64	64
7	Manganese	245	209	276	236	185	-	-
8	Magnesium	55.2	38.1	44.7	45.7	33.7	-	-
9	Copper	39.6	44.7	38.4	35.9	29.9	-	-
10	Lead	18.6	16.8	9.5	23.5	17.7	70	140
11	Nickel	24	33	26	42	37	50	50
12	Iron	34.1	78.4	74.0	63.7	67.0	-	-
13	TPH	1.5	1.9	1.8	1.1	5.2	-	-

4.1.6 Climate and Meteorology

4.1.6.1 Kurdistan Region of Iraq

Generally, the climate of Kurdistan Region of Iraq (KRI) is described as continental and subtropical semi-arid type, characterized by wide diurnal and annual ranges of temperature, low relative humidity, cloudless summer months and northwest prevailing wind directions (Guest 1966). Since the Block Khurmala is close to Erbil, meteorological data for Erbil district is used for this study.

4.1.6.2 Erbil

Climate of Erbil (including Khurmala Block) is most closely approaches Irano-Turanian type, characterized by cold winters, mild-growing period of springs and hot summers. It locates in semi-arid zone. The higher altitude parts of the area (Zurgah Ziraw Mountain) have colder winters and receive more precipitation than the areas of lower elevations (Erbil plain). As described by Guest (1966) and Rzoska (1980) rainfall and humidity play a great role on the climate altogether with temperature. Erbil City has rainfall average of 425.83 mm. $year^{-1}$ and the annual range between 188.1 to 739.7 mm. $year^{-1}$, while in summer months the precipitation become very rare and often absent (Nabi, 2005). Humidity varies from 50-75% in winter and falls below 30% from May to October, generally strong winds occur here may turn into dust storms. Compared to the other regions of Iraq; North-west is the predominant wind direction in Erbil (Haddad *et al.,* 1974). Summary of statistical analysis of meteorological data recorded for Erbil during the last five years 2007 to 2011 is provided at the ***Table 4.8***.

[4] All units are in mg/kg, except for TPH which given in µg/kg.
- Correction factor for Iron values is 1000 and for Magnesium is 100.
- CCME Guidelines is Canadian Council of Ministers of Environment (2001),
- Agr. = Agricultural, Res. = Residential
- BDL means Below Detection Limit.

Table (4.8): Summary of statistical analysis of meteorological data recorded for Erbil during the last five years 2007 to 2011.

Source: Erbil International Airport[5]

S.N.	Description	Monitoring Period (2007 to 2011)
1	Wind Speed ($m.sec^{-1}$)	
	Maximum	13.20
	Minimum	1.32
	Average	7.28
2	Distribution of Wind Speed (%)	
	Calm	64.22
	1.6 to 5 $m.sec^{-1}$)	07.22
	5 to 10 ($m.sec^{-1}$)	10.35
	10 to 15 ($m.sec^{-1}$)	01.14
3	Temperature (°C) (Dry Bulb)	
	Maximum	45.30
	Minimum	-5.10
	Average	22.61
4	Monthly Relative Humidity (%)	
	Maximum	92.30
	Minimum	18.25
	Average	32.40
5	Daily Average Relative Humidity (%)	
	Maximum	50.22
	Minimum	14.40
6	Precipitation	
	Average (mm)	310 Per Year
	Number of Rainy days	235 Days Per Five Years
7	Cloud Cover (Oktas)	Total average = 0.54
8	Predominant Wind directions (from)	SW in Dry Seasons SE in Wet Seasons

[5] Meteorological data was collected from secondary sources, and direct communication with closer meteorological centres. Field interviews with indigenous peoples for assessment of the climatic conditions of the area under study were undertaken.
The purpose of climatic parameters, land use categories and vegetation cover of the areas under study enables to understand the following aspects:

- Date of wilting of grasses (loss of freshness) in rangelands.
- Date of wheat harvesting.
- Date of planting tomato seedling in the spring.
- Date of coming people out of building (out of doors) in the late spring season.
- Date of coming people inside building (within doors) in autumn.
- Date of operating of heating apparatus (stove) of burning tree branches for heating room.
- The extent of farmer need to operate air cooler and fan.
- The feeling of people about the coldness of water of spring and stream in July and October and the need of ice for cooling drinking water.
- Rate of snow melting and duration of snow cover in the spring season.
- The actual irrigation interval for vegetables in days.
- The latest possible date for swimming in water.
- The possible date of plowing land in spring.

Key issues;

Climate change is affected by emissions from flaring stack, vehicles, and generators and from clearing vegetation for power Plant/ building construction. That will be limited and will not adversely contribute to regional characteristics. Therefore there is no impact envisaged outside the project location.

4.1.7 Ambient Air Quality

Based on the field survey, there are several major industrial activities within the concession area (e.g. Khurmala Central process Facility, road construction, camp ...etc). The general area varies from; rural to residential setting. The ambient air quality is expected to represent the general area type. Five locations were selected within the Khurmala Power Plant-1000MW survey area for ambient air quality measurements. Results were evaluated in comparison with the guidelines prescribed by the World Bank (WB) Ambient Air Quality Norms.

Descriptions of sampling locations, photographs of field equipment and analytical results are provided in ***Tables 4.9*** and ***4.10*** and ***Figure 4.8*** below. Generally, the results show that all air quality parameters, gaseous pollutants SPM, RPM_{10}, SO_2, NO_x and CO were within the limits prescribed by the World Bank (WB) Ambient Air Quality Norms, and the exceptions were the AQ1 and AQ5 sites, close to the operation area and Khurmala Central Process Facility.

Gas analyzer Drager-Multiwarn/ Germany

Measurement of particulate matters (left)

Measurement of wind direction and speed (right)

Table (4.9): Location descriptions for ambient air quality assessment

S.N.	Location	Code	Coordinates	
			Lat.	Long.
1	Khurmala Power Plant-1000MW Site	AQ1	35°58'7.22"N	43°46'33.26"E
2	East of Power Plant	AQ2	35°58'6.43"N	43°48'20.43"E
3	South of Power Plant	AQ3	35°57'10.88"N	43°46'33.41"E
4	West of Power Plant	AQ4	35°58'26.28"N	43°44'53.63"E
5	North of Power Plant	AQ5	36° 0'6.64"N	43°46'41.70"E

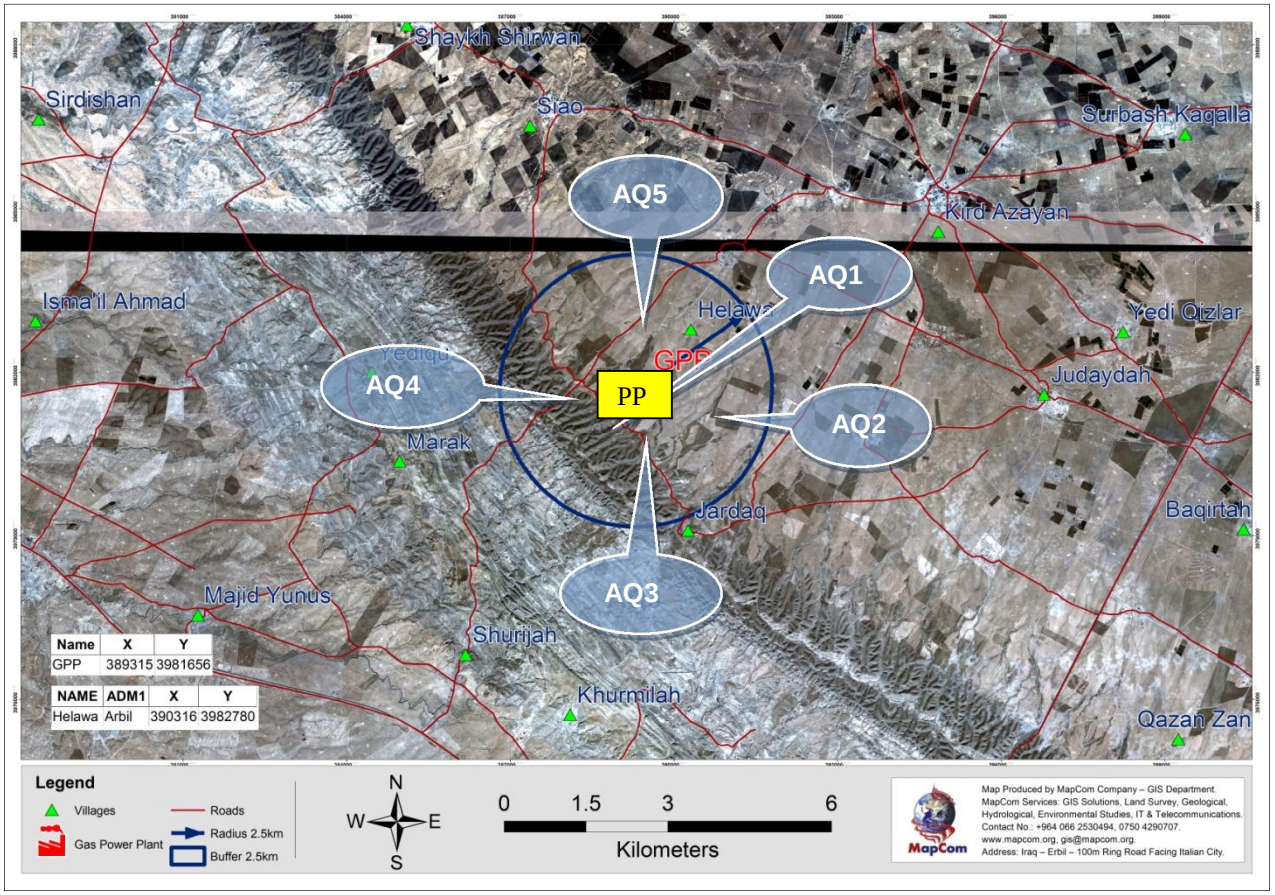

Figure (4.8): Map showing location of selected sites for ambient air quality analysis

Methodology and Instruments

Gaseous pollutants including SO_2, NO_x, CO, and HC were analyzed directly at the field using a portable gas analyzer Drager-Multiwarn/ Germany. The instrument was calibrated against high purity standard gases, following the instrument instruction manual given by Drager laboratories. The 24 hour average concentrations of gaseous pollutants were estimated from measurements conducted for about 15 minutes at each location. Weather conditions were normal and there was no excess wind during the measurements. The measured

values were logged into the instrument memory, and subsequently downloaded. Ambient suspended particulate matters were measured using a direct particulate matter (PM_{10}) monitor manufactured by Thermo Electron. The instrument is a handheld dust monitor and draws air passively through the sensor, which works following a relationship between particulate concentration and attenuation of light transmittance. The instrument covers a measurement range of 0.001 mg/m^3 to 400 mg/m^3.

Table (4.10): Gaseous pollutants and particulate matter recorded for the Khurmala Power Plant-1000MW survey area

S.N.	Location	Concentration (mg/m^3)		Concentration (µg/m^3)		
		SPM	RPM_{10}	SO_2	NO_2	O_3
1	AQ1	0.159	0.152	84.06	106.05	155.07
2	AQ2	0.107	0.113	62.33	74.23	131.17
3	AQ3	0.109	0.113	58.73	64.05	121.56
4	AQ4	0.107	0.114	62.01	84.22	117.23
5	AQ5	0.153	0.154	81.54	101.85	157.09
Limits/ Norms		0.15[1]		80[2]	100[3]	157[4]

[1]*USEPA NAAQ Standards, 24 hour average* [2]*USEPA NAAQ Standards, Annual arithmetic mean*
[3]*USEPA NAAQ Standards, Annual arithmetic mean* [4]*USEPA NAAQ Standards, 8 hour average*

The currently relatively high baseline values are due to the adjacent oil field operations, mainly flaring of the associated gas and diesel powered generators. By installing this power plant the emissions resulting from the currently operated emergency diesel generators in this region will be eliminated.

The flare gas will be purified, desulfurized and used for power generation in phase 1. Therefore also this source of air pollution will be eliminated.

Key Issues and Measures

1) Expected Stack emissions from the Khurmala Power Plant-1000MW are;
   - Sulphur Oxides (SO_X),
   - Nitrogen Oxides (NO_X),
   - Others, process request
   - Hydrocarbons (C_xH_y),
   - Heavy Metals.
   - Respirable Particulates (PM_{10}),
   - Carbon Monoxide (CO),
   - Other, Process request

2) NO_x gases are generated at high temperature in the flaring stack.
3) Traces of SO_2 will be emitted.
4) In view of the firing technique of keeping a positive oxygen balance, emission of carbon monoxide (CO) shall be minimal.
5) The main categories of CO_2 abatement potentials include:
   - Energy efficiency: technical and operational measures to reduce fuel and power consumption per unit;
   - Increasing Alternative Fuel and Raw material AFR thermal substitution is also fairly effective.

6) To control fugitive emissions (from flaring stack) the following measures shall be adopted from the proposed unit:
   - The height of flaring stack must be more than 10m, for good dispersion of gaseous pollutants.
   - Jet Pulse bag filter at all dry transfer points
   - Refinery roads and approach roads shall be made of bitumen/concrete
   - Areas between various sections and truck parking area shall be made of bitumen/concrete
   - Open areas within the Khurmala Power Plant-1000MW premises and along the boundaries of the Khurmala Power Plant-1000MW premises shall be covered with a green belt
7) The thermal NOx emissions resulting from the air bound nitrogen will be minimized by applying an optimized gas turbine combustion process including water injection to reduce the flame temperatures (instead of burning the fuel in inefficient Diesel engines). Further emissions are mainly driven by the respective fuel, wherefore a fuel treatment / blending is applied as far as the reasonably possible for the available HFO or Diesel. Based on this treatment / blending and depending on the fuel composition the environmental standards of the World Bank for Particulate Matter, Sulfur and NOx can be achieved.
8) All small combustion facilities e.g. black-start and emergency diesel generators and aux. heaters will run on LFO and meet the World Bank emission requirements.

4.1.8 Noise Levels and Traffic Density

4.1.8.1 Ambient Noise Levels

The ambient noise levels within the Khurmala Power Plant-1000MW survey area were recorded as a part of the field baseline study, at the same locations as the ones used for air quality measurements. The noise level measurements were conducted using Integrating and Logging Sound Level Meter (SLM), Quest, Model 2900 UL. The instrument has capabilities to measure equivalent continuous noise levels (Leq.) with standard measurement settings conforming to regulatory requirements.

Noise levels were measured at five sensitive significant and residential areas for about 10-15 minutes at each location during daytime. Weather conditions were normal and there was no excessive wind during the measurements. The ambient noise levels presented in the ***Table 4.11*** shows that noise levels in sampled areas are below WHO standards and the exception was the AQ5 site, close to the Khurmala Central Process

Facility. It is likely that air and noise pollution in this area may be related to Central Process Facility and incidental local traffic during measurements.

Table (4.11): Ambient Noise Levels[6]

Location	WHO Standard (rural /residential)	Leq	L5	L10	L50	L90
AN1	55	38.5	32.7	30.4	28.6	20.7
AN2		45.2	44.3	42.6	35.8	30.6
AN3		50.8	50.3	40.2	45.2	40.7
AN4		52.3	52.4	50.3	45.3	42.8
AN5		55.0	50.0	45.3	40.5	35.5

The main sources for noise in this area are currently the operating flare and the diesel powered generators. Both sources will be eliminated once the power plant will be operational which will result in a significant reduction of the baseline values given in table 4.11. The noise levels for the residential and industrial receptors after implementation of all three phases are expected to be below the noise guidelines shown in chapter 2.3.2.2 table 2.2.

Key Issues;

Some of the design features provided to ensure low noise levels shall be as given below:

- All rotating items shall be well lubricated and provided with enclosures as far as possible to reduce noise transmission. Extensive vibration monitoring systems will be provided to check and reduce vibrations. Vibration isolators will be provided to reduce vibration and noise wherever possible
- In general, noise-generating items such as fans, blowers, compressors, pumps, motors etc. will be so specified as to limit their speeds and reduce noise levels. Static and dynamic balancing of equipment will be insisted upon and will be verified during inspection and installation
- Provision of silencers shall be made wherever possible
- The insulation provided for prevention of loss of heat and personnel safety shall also act as noise reducers
- Layouts of equipment foundations and structures will be designed keeping in mind the requirement of noise abatement
- The Central Control Room(s) provided for operation and supervision of the refinery and equipment will be air-conditioned, insulated and free from refinery noise. Necessary enclosures will also be provided on the working platforms/areas to provide local protection in high noise level areas
- Proper lubrication and housekeeping of equipment to avoid excessive noise generation

[6] All Values are in **dB (A)**

- In cases where the operation of the equipment requires the presence of operators in close proximity to equipment, the operators will be provided with the necessary personal protective equipment such as ear muffs, ear plugs etc.
- By provision of the green belt in and around the refinery premises
- Occupational Health and Safety Administration System (OHSAS) for evaluation of exposure to noise pollution on the associated staff and comparing it with permissible exposure and subsequently taking corrective actions will be developed
- Regular noise surveys will be conducted to ensure the on-site and ambient maximum levels are not exceeded. By these measures, it is anticipated that the noise levels in the refinery will be maintained below 90 dB (A). Earth mounds and plantations in the zone between the refinery and the surrounding area would further attenuate noise in the residential area.

4.1.8.2 Traffic Density and Road Condition

The existing road network at Khurmala Power Plant-1000MW survey area is the principal mean of transporting personnel and equipment to the project site. The condition of existing roads varies significantly throughout the block from good asphalt paved highway (e.g. Erbil-Helawa main road), to high grade and low grade gravel roads, and downs to dirt roads in poor conditions. The traffic density and bad road condition calls for special safety considerations for the seismic crew. Four locations were selected for traffic density count on major roads, as shown on ***Figure 4.9*** and the ***Table 4.12***. Traffic on those points was counted for 60 minutes with distinction between light cars and heavy trucks.

Table (4.12): Location description of the sites selected for traffic density in survey area

Sn	Location	Code	Coordinates		Traffic Count/ hr.		Type of Area
			Lat.	Long.	Light Cars	Heavy Trucks	
1	Gird Azaban	TD1	36° 0'30.47"N	43°50'4.42"E	18	14	Erbil–Helawa road
2	Helawa	TD2	35°59'33.30"N	43°47'17.30"E	10	9	Helawa-Operation road
3	Siao	TD3	36° 1'9.52"N	43°46'8.54"E	6	4	Helawa-Siao road
4	Operation	TD4	35°57'52.55"N	43°47'13.12"E	0	4	Operation road

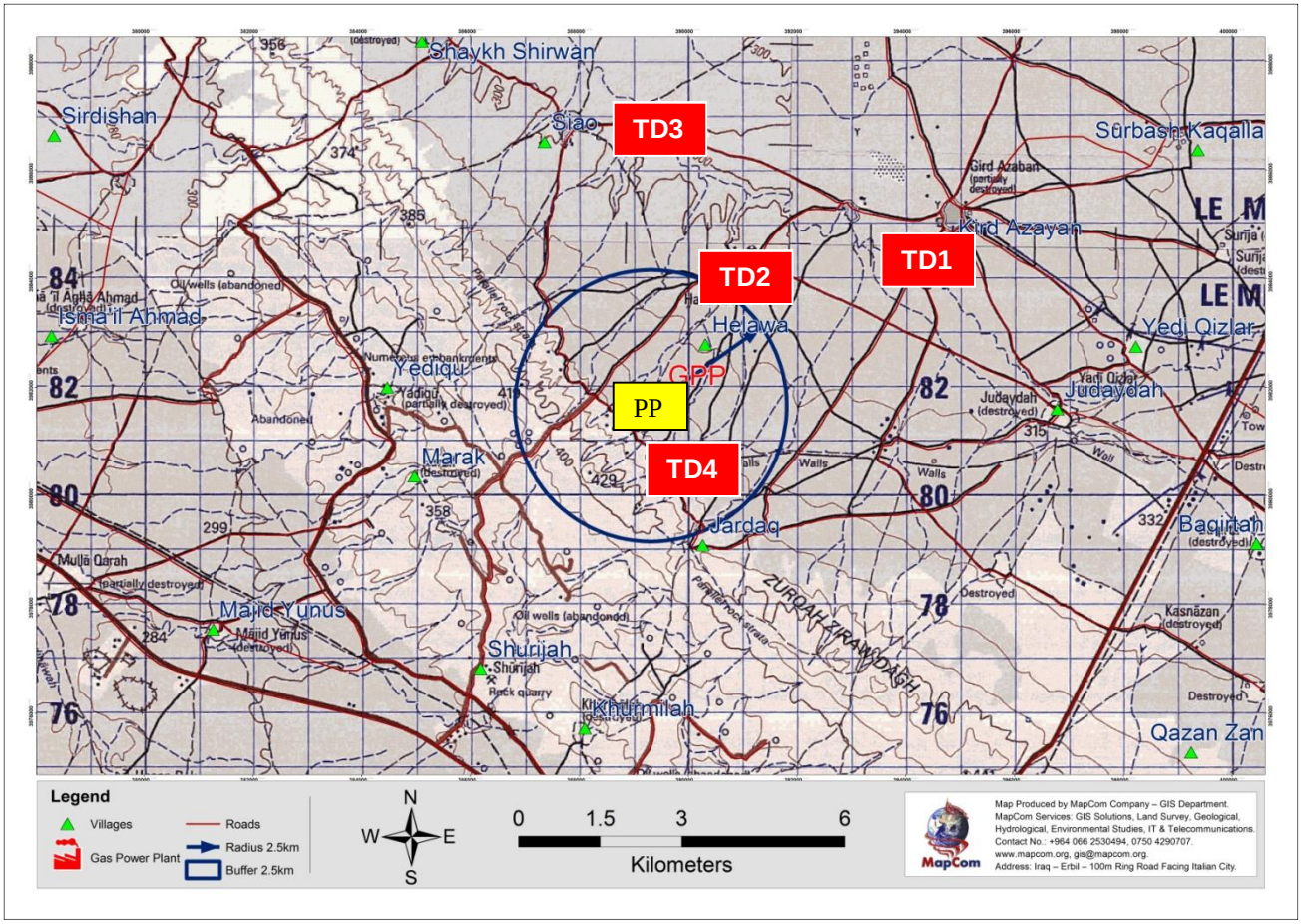

Figure (4.9): Main Roads within the proposed Khurmala Power Plant-1000MW survey area

The traffic count was done in the TD1 close to Gird Azaban village, where the traffic is high and good paved road used mainly for access from Erbil to Helawa village. The TD2 is extension of TD1 from Helawa to operation area (i.e. Khurmala Power Plant-1000MW) is paved road in good condition assessed as moderate traffic density road. The road TD3 was assessed as low density road. The TD4 was assessed as very low traffic density road.

Roads watched for traffic density at proposed Khurmala Power Plant-1000MW survey area

Key Issues;

During the site preparation earth moving equipment will be working on the access road and the well location. Prior to and after the operation, when building the power Plant or move, some heavy transport is envisaged. During the operation there would be supply truck movements and small vehicles movements which are used mainly for transport of personnel;

- The project will also possibly require the upgrade of many unsealed local roads to allow for the transportation of heavy equipment and trucks to and along the proposed project.
- The operational team must pay an extra attention when passes TD2, because the road is heavily used by the public, along with school children and cattle.
- Dust and the increased number of heavy vehicles are potential hazards that need to be managed.
- **KAR Power** will consider the acceptable safe workloads capacity when crossing bridges with heavy loads because the maximum load of bridges are not identified or marked.

4.2 Ecological and Biological Environment

The power plant site or any associated facility is not located in or nearby any sensitive area (= national parks and other protected areas identified by national or international law, and other sensitive locations of international, national or regional importance, such as wetlands, forests with high biodiversity value etc.). Nevertheless the impact on the ecological and biological environment has been assessed.

4.2.1 Flora

4.2.1.1 Methodology

The proposed area for seismic survey (Khurmala Power Plant-1000MW survey area) was screened for ecological field survey in October 2012. Data was collected on forests, crops, plantations, natural vegetation, rare and endangered species, endemic species, medicinal species, rangelands, and land use. Ecological parameters presented in this section were primarily based on direct field survey carried out by a botanical specialist (plant taxonomist). Additional information was obtained from the Agriculture Directorate centre of Dashty Hawler, and Erbil, direct interview from local residents, textbook references, and the herbarium of College of Science/ Biology Department and Salahaddin-Erbil University.

4.2.1.2 Vegetation Communities and their Distribution

The Khurmala Power Plant-1000MW survey area belongs to a semi arid climate, according to the amount of precipitation during the wet season. During the dry season, the climate is characterized by moderately hot and dry weather conditions, which result in a very low capacity to support vegetation, vegetation communities and their distribution in the Khurmala Power Plant-1000MW survey area is given in ***Table 4.13***.

Table (4.13): Vegetation Communities and their Distribution in the survey area

Type of Vegetation	Distribution in comparison with total vegetation	Description
Crops	35%	wheat, barley, lentil, chickpea, dry onion, tomato, cucumber, egg plants, gourd, okra, bean, sunflower, sesame, alfalfa, cauliflower, potato, cow pea, water melon, pepper, grapes.
Plantations	35%	See below (flora species)
Natural Vegetation	30%	See below (flora species)
Rare species	0%	-
Endangered species	0%	-
Endemic species	100%	See below (flora species)
Medicinal species	0%	-

The flora of the region consists of a group of annual vegetation, with perennial shrubs and trees of different kinds, characteristic of plain and low mountain formations. Most of the vegetation is of winter habitat, and its life cycle finishes at the end of the wet season in June. Cool season Mediterranean weeds are common in cultivated winter fields. The project region is sub marginal for sustaining economical agricultural production. The soil is brown, cultivated through rain fed during the wet season from October- June, mostly with common wheat (***Triticum aestivum***), durum wheat (***T. durum***), barley (***Hordeum vulgare***), chickpea (***Cicer arietinum***), lentil (***Lens culinare***), and sunflower (***Helianthus annus***). During summer vegetables are cultivated in small farms. Part of the vegetation is pasture suitable for grazing. Herding small groups of

animals such as sheep and goats are common in the vicinity of the region. Vegetation communities considered for the Khurmala Power Plant-1000MW survey area are: crops, plantations, natural vegetation, rare species, endangered species, endemic species, and medicinal species. The following table shows their description and distribution within the Khurmala Power Plant-1000MW survey area.

4.2.1.3 Stratification

The vegetation structure and stratification in the Khurmala Power Plant-1000MW survey area includes grasses, herbs, shrubs, and trees, distributed as referred to in the ***Table 4.14*** below;

Table (4.14): Vegetation structure and stratification in the survey area

Stratum 1	Grasses	70%
Stratum 2	Herbs	28%
Stratum 3	Shrubs	1.5%
Stratum 4	Trees	0.5%

4.2.1.4 Flora Species

The inventory of flora species in the Khurmala Power Plant-1000MW survey area and related ecological parameters are presented in the ***Table 4.15***.

Table (4.15): Inventory of flora species and related ecological parameters within the survey area

sn	Common Name (Scientific Name)	Order Family	Type		
			Naturalized Plant	Endemic Plant	Medicinal Plant
1	Common hawthorn *(Crataegus azarolus)*	Rosales Rosaceae	○	○	-
2	Judas tree or red bud *(Cerceis siliquastrum)*	Fabales Fabiaceae	○	-	-
3	Oat grass *(Avena spp.)*	Poales Geamenaceae	○	-	-
4	Rye grass (*Lolium spp.)*	Poales Geamenaceae	○	-	-
5	Reed canary grass *(Phalaris spp.)*	Poales Geamenaceae	○	-	-
6	Brome grass *(Bromus spp.)*	Poales Geamenaceae	○	-	-

7	Mustache grass, goat grass *(Aegilops spp.)*	Poales Geamenaceae	○	-	-
8	Alfalfa or Lucerne *(Madicago spp.)*	Fabiales Leguminosa	○	○	○
9	Clover *(Trifolium spp)*	Fabiales Leguminosa	○	-	-
10	Vetches *(Vicia spp.)*	Fabiales Leguminosa	○	-	-
11	Pea *(Lathyrus spp.)*	Fabiales Leguminosa	○	-	-
12	Meliot or Loco *(Astragalus spp.)*	Fabiales Leguminosa	○	-	-
13	Wart reed. sun spurge *(Euphorbia helioscopia)*	Euphorbales Euphorbaceae	○	-	-
14	Common nut grass *(Cyperus rothundus)*	Caperales Caperaceae	○	-	-
15	Common licorice *(Glycyrrhiza glabra)*	Fabiales Leguminosa	○	-	-
16	Worm wood, sage brush *(Artemisia absentium)*	Astrales Compositae	○	-	-
17	Mint or Menthe *(Mentha logifolia)*	Lamiales Labiateae	○	○	○
18	Vervain *(Verbena officinalis)*	Verbenales Verbenaceae	○	-	-
19	Bur weed, sheep bur *(Xanthium strumarium)*	Astrales Compositae	○	-	-
20	Marigold *(Calendula paiaestina)*	Astrales Compositae	○	-	-
21	Field horse tail *(Equisetumarvense)*	Equisetales Equisetaceae	○	-	-
22	Eucalyptus *Eucalyptus camaldulensis*	Rosales Rosaceae	○	-	-

Note: Some other minor weeds exist in the area.

"○ " means yes and "-" means no.

4.2.1.5 Forest Areas

No natural and/or artificial forests were found within the Khurmala Power Plant-1000MW survey area.

Flora status at and around Khurmala Power Plant-1000MW survey area

4.2.2 Fauna

4.2.2.1 Methodology

Ecological parameters of available fauna species in the Khurmala Power Plant-1000MW survey area were assessed based on direct field survey carried out by an ecology specialist and supplemented by a zoologist. The observations were based on visual observations, hearing, and interviews with local farmers and collected sample pictures. Pictures of unknown species were taken to the lab for identification in reference to recognized textbooks. Additional information was obtained from other scientific publications referred to in the bibliography.

4.2.2.2 Arthropods

Characteristics of insects within the Khurmala Power Plant-1000MW survey area are detailed in the ***Table 4.16***.

Table (4.16): Inventory of Arthropods for the survey area[7]

S.N.	Common Name	Scientific Name	Type	Status	Land	Aquatic	Plankton
1.	Sugar beet Armyworm■	*Spodoptera exigua*	Insect	Common	o	-	-
2.	Small white butterfly ■	*Piers rapae*	Insect	Common	o	-	-
3.	Large white butterfly ■	*Piers braccicae*	Insect	Common	o	-	-
4.	Silver Moth ●	*Autographa gamma*	Insect	Common	o	-	-
5.	Death's head hawk moth	*Ascheronita atropos*	Insect	Common	o	-	-
6.	Bean Butterfly▲	*Lampides baeticus*	Insect	Frequent	o	-	-
7.	Swallow tail Butterfly▲	*Papilio machaon*	Insect	Frequent	o	-	-
8.	Wire worm ▲	*Julius* sp.	Insect	Abundant	o	-	-
9.	Chilopoda ▲	*Scolopendra* sp.	Centipedes	Abundant	o	-	-
10.	Yellow scorpions■	*Leiurus quinquestrainus*	Scorpion	Abundant	o	-	-
11.	Black Scorpion ●	*Androctonus crassicauda*	Scorpion	Abundant	o	-	-
12.	Crab ▲	*Daphnia* sp.	Crustaceans	Common	-	-	o
13.	Hover fly ■	*Syrphus corollae*	Insect	Common	o	-	-
14.	Yellow Jacket wasp ▲	*Polistes watti*	Insect	Dominant	o	-	-
15.	Yellow wasp ▲	*Vespa orientalis*	Insect	Dominant	o	-	-
16.	Housefly ■	*Musca domestica*	Insect	Dominant	o	-	-
17.	Seven spot ladybird ■	*Coccinella septempunctata*	Insect	Common	o	-	-
18.	Eleven spot ladybird ■	*Coccinella undecimpunctata*	Insect	Common	o	-	-
19.	Large bean seed beetle ■	*Bruchus rufimanus*	Insect	Common	o	-	-
20.	cotton aphid ▲	*Aphis gossypi*	Insect	Dominant	o	-	-
21.	The Lentil aphid▲	*Aphis craccivora*	Insect	Dominant	o	-	-

[7] Very Rare = < 0.1% Rare = 0.1 - 1% Frequent = 1-10% Common = 10 - 30% Abundant = 30 - 60% Dominant = >60%:
■ Direct identification by the survey team.
● Identified through interview with local farmers
▲ Identified through interview with government officials
"o" means yes "-" means no

22.	Black bean aphid▲	*Aphis fabae*	Insect	Dominant	o	-	-
23.	*Green* peach aphid▲	*Myzus persicae*	Insect	Abundant	o	-	-
24.	Mealy plum aphid▲	*Hyalopterus pruni*	Insect	Abundant	o	-	-
25.	Peach stem aphid▲	*Pterochlorus persicae*	Insect	Abundant	o	-	-
26.	Apple aphid▲	*Aphis pomi*	Insect	Abundant	o	-	-
27.	Cabbage aphid▲	*Brevicoryne bmssicae*	Insect	Abundant	o	-	-
28.	Corn leaf aphid ▲	*Rhopalosiphum maidis*	Insect	Dominant	o	-	-
29.	Pomegranate aphid ▲	*Aphis punicae*	Insect	Dominant	o	-	-
30.	The brown soft scale ■	*Coccus hesperidium*	Insect	Dominant	o	-	-
31.	Olive scale ■	*Parlatoria oleae*	Insect	Common	o	-	-
32.	Cotton whitefly ▲	*Bemisia tabaci*	Insect	Rare	o	-	-
33.	The Whiteflies ■	*Trialeurodes sp.*	Insect	Common	o	-	-
34.	Lace bug ■	*Stephanotis pyri*	Insect	Common	o	-	-
35	Bugs ■	*Apodiphus amegdali*	Insect	Abundant	o	-	-
36.	Sun pest ■	*Eurygaster integriceps*	Insect	Abundant	o	-	-
37.	Olive spilled ▲	*Eupphyllura straminea*	Insect	Abundant	o	-	-
38.	Confused flour beetle ■	*Tribolium confusum*	Insect	Abundant	o	-	-
39.	Rust-red flour beetle ■	*Tribolium castaneum*	Insect	Abundant	o	-	-
40.	Khabra beetle ■	*Trogoderma granarium*	Insect	Common	o	-	-
41.	Dragon fly■	*Helocordulia uhleri*	Insect	Common	-	o	-
42.	Freshwater Midge ■	*Chironomus* sp.	Insect	Common	-	o	-
43.	Mosquito ■	*Culex pipiens*	Insect	Common	-	o	-
44.	Beats ■	*Ecdyonurus* sp	Insect	Common	-	o	-

4.2.2.3 Amphibians and Reptiles

The details of amphibians and reptiles reported within the studied sites are given in the ***Table 4.17*** below.

Table (4.17): Inventory of amphibians and reptiles within the survey area[8]

S.N.	Common Name	Scientific Name	Status
1.	Kurdistan viper snake ■	*Vipera raddei*	Frequent
2.	Black rat Snakes ■	*Elaphe obsoletaobsoleta*	Frequent
3.	Lizard ■	*Teratoscincus keyzerlingi*	Frequent
4.	Frog, canyon tree frog ■	*Hyla arenicolor* Cope	Frequent
5.	Lizard- banded gecko ■	*Coleonyx variegatus* Baird	Frequent
6.	Desert iguana ●	*Dipsosaurus dorsalis* Baird and Girard	Very Rare
7.	Gila monster ●	*Heloderma suspectum* Cope	Very Rare
8.	Salamander, tiger ●	*Ambystoma tigrinum* Green	Very Rare
9.	Snake- blind snake, western ●	*Leptotyphlops humilis* Baird and Girard	Frequent
10.	Bullsnake (or gopher snake) ●	*Pituophis melanoleucus* Daudin	Rare
11.	Burrowing snake, banded ●	*Chilomeniscus cinctus* Cope	Rare
12.	Whipsnake (or coachwhip) ●	*Masticophis flagellum* Shaw	Rare
13.	Whipsnake, striped ●	*M. taeniatus* Hallowell	Frequent
14.	Great Plains toad ■	*Bufo cognatus* Say	Frequent
15.	Spade foot toad, Couch's ■	*Scaphiopus couchi* Baird	Frequent
16.	Spade foot toad, western ■	*S. (Spea) hammondi* Baird	Frequent
17.	tortoise, desert ■	*Gopherus agassizi* Cooper	Frequent

4.2.2.4 Birds

Iraq is the paradise of birds. However, nearly all known local and other migratory birds pass through different paths in Iraq, including the Khurmala Power Plant-1000MW survey area, for different purposes (e.g. nesting, food, weather, ….etc). During February till March, several species of birds transit through the Khurmala Power Plant-1000MW survey area. Although no paper has yet been published on this migratory path, it is known that these birds come from the Iranian Territory and migrate towards the south. They stay within the survey area for a short period of time. The details on birds reported within the Khurmala Power Plant-1000MW survey area are provided in the ***Table 4.18*** below.

[8] Very Rare = < 0.1% Rare = 0.1 - 1% Frequent = 1-10% Common = 10 - 30% Abundant = 30 - 60% Dominant = >60%:
■ Direct identification by the survey team.
● Identified through interviews with local farmers

Table (4.18): Inventory of birds' characteristic of the survey area[9]

S.N.	Common Name	Scientific Name	Status
1.	Hooded Crow ■	*Corvus corone cornex*	Dominant
2.	Brown-necked Raven ■	*Corvus ruficollis*	Dominant
3.	Alpine Chough ■	*Pyrrhocorax graculus*	Frequent
4.	Dove- Mourning ■	*Zenaida macroura* (Linnaeus)	Dominant
5.	White-winged Dove ■	*Z. asiatica* (Linnaeus)	Dominant
6.	Golden Eagle ■	*Aquila chrysaetos* (Linnaeus)	Frequent
7.	Gnatcatcher, Blue-gray ■	*Polioptila caerulea* (Linnaeus)	Frequent
8.	Grosbeak, Blue ■	*Guiraea caerulea* (Linnaeus)	Frequent
9.	Grouse, Blue (or Dusky)	*Dendragqpus obscurus* (Say)	Rare
10.	Hawk- Cooper's ■	*Accipiter cooperii* (Bonaparte)	Rare
11.	Pin-tailed Sand grouse	*Pterocles alchata*	Frequent
12.	Kestrel ●	*Falco sparverius* Linnaeus	Rare
13.	Owl- Elf ●	*Micrathene whitneyi* (Cooper)	Frequent
14.	Pigeon, Band-tailed ■	*Columba fasciata* Say	Frequent
15.	Quail- Bobwhite ●	*Colinus virginianus*	Frequent
16.	Quail ●	*Coturnix coturnix*	Frequent
17.	Scaled Quail●	*Callipepla squamata* (Vigors)	Frequent
18.	Sparrow- Chipping ■	*Spizella passerina* (Bechstein)	Dominant
19.	Vesper Sparrow ■	*Pooecetes gramineus* (Gmelin)	Dominant
20.	Frequent BUZZARD ■	*Bueto bueto*	Frequent
21.	Hoopoe ■	*Upupa epops*	Very Rare
22.	European Bee-eater ●	*Merops apiaster*	Rare (immigrated)
23.	Common Swift ■	*Apus apus*	Rare (immigrated)

[9] Very Rare = < 0.1% Rare = 0.1 - 1% Frequent = 1-10% Common = 10 - 30% Abundant = 30 - 60% Dominant = >60%:
■ Direct identification by the survey team.
● Identified through interviews with local farmers

24.	Eagle Owl ●	*Bubo bubo*	Frequent
25.	Collared Dove ■	*Streptopelia decacota*	Abundant
26.	Griffon Vulture ■	*Gyps fulvus*	Frequent
27.	Rock Dove ■	*Columba livia*	Frequent
28.	Black Francolin ■	*Francolinus francolinus*	Frequent
29.	Sparrow hawk ■	*Accipiter nisus*	Frequent
30.	Black Vulture ■	*Aegypius monachus*	Frequent
31.	Red Kite ●	*Milvus milvus*	Rare
32.	Crested Lark ●	*Galerida cristata*	Frequent
33.	Barn Swallow ■	*Hirundo rustica*	Rare (immigrated)
34.	House Sparrow ■	*Passer domesticus*	Dominant

4.2.2.5 Mammals

The details of mammals, excluding domestic animals (cows, goats and sheep), that were reported within the Khurmala Power Plant-1000MW survey area are given in the ***Table 4.19*** below:

Table (4.19): Inventory of mammals encountered within the survey area[10]

Sn	Common Name	Scientific Name	Status
1.	Bats (free-tailed) ■	*Tadarida spp.*	Common
2.	Fox- gray ● ■	*Urocyon cinereoargenteus (Shreber)*	Dominant
3.	Kit Fox●	*Vulpes macrotis Merriam*	Dominant
4.	Mouse- Cactus ▲ ●	*Peromyscus eremicus (Baird)*	Dominant
5.	Porcupine ▲ ●	*Erethizon dorsatum Linnaeus*	Dominant
6.	Gray Wolf ▲ ●	*Cannas spp.*	Abundant

4.2.2.6 Conclusions

The main conclusions deducted from the ecology and biological environment study can be summarized along these points:

- the proposed project traverses diverse terrestrial habitats;
- no endangered habitats are expected;
- endemic habitats are not affected by the proposed project;

[10] Very Rare = < 0.1% Rare = 0.1 - 1% Frequent = 1-10% Common = 10 - 30% Abundant = 30 - 60% Dominant = >60%
■ Direct identification by the survey team.
● Identified through interview with local farmers
▲ Identified through interview with government officials.

- no rare species fauna/ flora are encountered;
- no endangered species of fauna/ flora are encountered;
- No specified natural habitat of reptiles, particularly snakes and/or scorpions are expected;
- The area is a migratory path for birds, especially in February – March

Key Issues;

- **KAR Power** would engage professional watch & ward services to safe guard the decommissioned Power plant site and prevent man and animal entry.
- The **KAR Power** and other subcontractor as a normal part of their operations will have a dedicated **HSE** department to ensure the highest level of safety awareness and environmental compliance is achieved at all times during the Power Plant operation.

4.3 Social, Economic and Cultural Environment

The site of the power plant is not located in any disputed area. The nearest residential area is Helawa village which is approx. 3 km away from the power plant site. Before it was decided to build the power plant the area was wasteland/semi-desert land with very little vegetation (small grass and bushes only).
The land is owned by the Kurdish government since it falls within the whole Khormala oil field. Farmers were allowed to cultivate this land when it was not used for oil related activities. KAR were granted the right to use the land for the power station purposes under the regional investment law and KAR compensated the farmers as per local customs which is the value of similar size land with equivalent annual yield. It is important to mention that no involuntary physical or economical resettlement was exercised or contemplated since this could lead to security problems.

Currently the main socio-economic challenges within the area are low living standards, high rate of illiteracy, poor health condition and malnutrition, lack of capital to conserve soil and water, difficulties in transportation of people and materials especially during winter months due to lack of good roads between the villages. These conditions will be substantially improved by the project implementation as local infrastructure will be built up and local jobs are being created.

Kurds are the majority of people living within the boundaries of the area. There are several Kurdish clans “Siyan, Dzayee, Hormiziyar ... etc" living within the Project area, all of which follow the Iraqi laws in their entire lifestyle. The dominant religion is Islam/ Sunni.

The project area does not contain any sites, structures or resources having archaeological, paleontological or historical significance. If any “chance findings” occur during the current activities, the Project Manager shall immediately report to the Ministry of Tourism and Antiquities or any relevant governmental department of the finding(s) in order to advise on measures to be taken to ensure their preservation.

5. PREDICTION OF ENVIRONMENTAL IMPACT

5.1 Screening of the potential environmental impacts

The purpose of this section is to examine the potential impacts of the Project on the biophysical and socio-economical environments in the project area.

5.2 Preliminary environmental impacts assessment and mitigation measures

Both beneficial as well as potential adverse impacts may be expected on the environment from the proposed Khurmala Power Plant-1000MW activities. The impacts may be direct or indirect, short or long term and reversible or irreversible.

For the purposes of the assessment, the following categories of impacts have been developed:

(a) **NO IMPACT**: The potential impact of the project is assessed as **NO IMPACT** if the impact is so small as to be un-measurable (i.e. negligible).

(b) **MINOR IMPACT (POSITIVE OR NEGATIVE)**: If an impact occurs but does not meet the criteria for a Major Impact it is assigned the category **MINOR**.

(c) **MITIGABLE IMPACT**: The potential impact of the project on an environmental component is said to be **MITIGABLE** if there is potential for a major negative impact to occur but there is a proposed mitigation measure that will prevent the impact or reduce the impact to acceptable levels.

(d) **MAJOR IMPACT (POSITIVE OR NEGATIVE)**: If an impact occurs and meets the criteria for a Major Impact it is assigned the category **MAJOR**.

(e) **UNKNOWN IMPACT**: The potential impact of the project will be assessed as being **UNKNOWN** if the magnitude of the effect cannot be predicted for any of the following reasons:

(i) The nature and location of the project activity are unknown
(ii) The occurrence of the environmental component within the Block K-10 is unknown
(iii) The time scale of the effect is unknown
(iv) The special scale over which the effect may occur is unknown

5.3 GENERAL ENVIRONMENTAL IMPACTS DURING CONSTRUCTION PHASE:

Construction activities will include preconstruction, preparatory construction, machinery installation, commissioning stages, and induction of manpower and start up. The impact due to construction phase would be regarded as temporary or short term. Each activity during this phase has the potential for a variety of positive and negative environmental and social impacts. The details of activities and their impacts during construction phase are summarized in the ***Table 5.1*** below;

Table (5.1): Activities, impact Identification, anticipated impact and category of Impact during construction phase

Component	Activities	Impacts
1. Movement of manpower, machinery and material	• Increase in traffic movement • Encroachment of area of parking and camping • Washing and maintenance of vehicles	• Potential health and safety risk due to increase in traffic and access to the construction site • Dust, gaseous pollutants emissions like SO_2, NO_x, CO_2, CO, VOC, HC • Noise and ground vibration, dust and dirt, visual effects • Soil contamination from fuels, oil, and other hazardous materials • Nuisance to cultural and aesthetic features • Job creation and business opportunities to local residents
2. Site clearing, levelling & excavation	❖ Heavy machinery & ❖ equipment operation ❖ Removal of vegetation at site ❖ Piling of soil ❖ Storage of soil ❖ Disturbance to ground water	❖ Disturbance to native vegetation and habitats ❖ Change in land use pattern ❖ Noise and ground vibration, dust and dirt, visual effects ❖ Dust, gaseous pollutants emissions like SO_2, NO_x, CO_2, CO, VOC, HC ❖ Nuisance from solid waste, soil contamination, and wastewater ❖ Job creation and business opportunities to local residents
3. Civil Construction	✓ Construction materials ✓ transportation and storage ✓ Oil storage ✓ Construction machinery and equipment operation ✓ Waste materials storage ✓ Water resources usage	✓ Noise and ground vibration, dust and dirt, visual effects ✓ Dust, gaseous pollutants emissions like SO_2, NO_x, CO_2, CO, VOC, HC ✓ Nuisance from solid waste, soil ✓ contaminations, and wastewater ✓ Job creation and business opportunities to local residents

4. Mechanical construction	➢ Transportation of equipment, metal sheets etc. ➢ Cutting and welding works ➢ Oil storage ➢ Waste material storage	➢ Dust, gaseous pollutants emissions like SO_2, NO_x, CO_2, CO, VOC, HC ➢ Noise and ground vibration, dust and dirt, visual effects ➢ Nuisance from solid waste, soil ➢ contaminations, and wastewater ➢ Job creation and business opportunities to local residents
5. Camp	• Temporary accommodation construction • Supply of fuel and other material • Supply domestic water • Storage of domestic waste • Medical facilities • Supply the electricity	• Disturbance to existing nearby land users creating visual impact in vegetated area • Dust, gaseous pollutants emissions like SO_2, NO_x, CO_2, CO, VOC, HC • Nuisance of solid waste, soil contaminations, and wastewater • Nuisance to cultural and aesthetic features • Job creation and business opportunities to local resident

5.4 GENERAL ENVIRONMENTAL IMPACTS DURING OPERATION PHASE:

Operation phase of the proposed Khurmala Power Plant-1000MW mainly comprises of the following:

- Transportation of crude oil
- Transportation of other additives to Khurmala Power Plant-1000MW site
- Cooling
- Emissions from flaring stack
- Operation of generators

The detailed activities and their impacts during operation phase are summarized in the ***Table 5.2*** below:

Table (5.2): Activities, impact Identification, anticipated impact and category of Impact during operation phase

Component	Activities	Impacts
1. Transportation of personnel and materials	❖ Increase the traffic movement ❖ Washing and maintenance of vehicles	❖ Potential health and safety risk due to increase in traffic ❖ Dust generated during transportation, ❖ Gaseous pollutants, ❖ Soil contamination from fuels, oil, and other hazardous materials ❖ Nuisance to cultural and aesthetic features ❖ Job creation and business and ❖ opportunities to local residents
2. Operation of Khurmala Power Plant-1000MW	o Transportation of crude oil o Transportation of other additives to the site o Cooling o Emissions from flaring stack o Operation of captive power generator(s) o Payment of taxes and royalty	o Dust generated during transportation o Traffic disturbance o Gaseous pollutants, the air emitted from the flaring stack contains SO_2, NO_x, CO_2, CO, and HC o Solid waste from wastewater o treatment plant as dry sludge o Oil from machinery and equipment o Dirt Oil from petroleum residuals o Waste from domestic usages o Accidental oil spillage o Regional development o Saving of foreign exchange

6. ANALYSIS OF ALTERNATIVES

In assessing the environmental impact of this project and given the size of the project in terms of electricity it will generate (almost 30% of the region's demand) it must be classified as strategic project and hence it's regional rather than local impact on the environment has to be assessed, more specifically its environmental impact shall not be viewed on standalone basis but should be compared with the environmental impact of the existing alternative industries and practices, e.g.

a) Fuels that will be burned in this power plant are currently being burned in small, less efficient, and very polluting plants.
b) Electricity generated by the power plant will be a stimulus for numerous other smaller businesses that will employ tens of thousands of persons.
c) Relatively large compensations and/or income allow the local inhabitants to invest in more modern living and farming practices. Example: approx. 25 clay houses in the nearest village to the site (Helawa) are already replaced by 60 modern built new houses, new water wells are being drilled for irrigation instead on relying fully on the highly scarce, unreliable, and seasonal rain water.

The introduction of this power plant and the ensuing social intercourse between the local inhabitants and the plant workers will improve the cultural and educational environment in the region especially since the planned housing complex for the permanent power plant staff (built primarily as an incentive to the work force) to be constructed adjacent to the nearest major town (Shamanek) will provide the above mentioned social intercourse.

Two options were examined and reviewed before taking the decision of conducting construction of the proposed project. These options were:

a) No project option
b) Conductance of the proposed project

6.1 NO PROJECT OPTION

No project option and lack in electricity power, is not a viable alternative due to the vital importance of electricity power for all community levels. The Kurdistan Government wants to be self-reliant in their power supply to sustain its development program. In terms of the global environment, liquid gas (LPG) as a fuel for the Khurmala Power Plant-1000MW would avoid the environmental impacts of the project in Kurdistan, and emissions would be lower and/or absent. The no project option would involve failure to rationalize the use of natural resource available in the project area (i.e. natural gas), which can be used to electricity generation. This option may result in loss of opportunity to create direct employment for hundreds of citizens and loss of several socio-economic benefits and improvement in the living conditions of local population in the project area.

6.2 CONDUCTANCE OF THE PROJECT

The Khurmala Power Plant-1000MW will make good use of the local natural gas and promote industrialization of surrounding areas. Strong demand for electricity power is expected to continue throughout the country. Surveys have not found an acceptable alternative location. The proposed Khurmala Power Plant-1000MW will be almost dustproof, and other pollutants such as gasses and wastewater will be controlled at acceptable levels. A small number of transport equipment would be used which would lead to lower risks of accidents and lower air pollution from traffic movement and vehicular emissions. Thus the alternative of establishing Khurmala Power Plant-1000MW is the best available option.

7. ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

7.1 PREAMBLE

The management plan for construction and operation phases of the Khurmala Power Plant-1000MW includes measures that minimize adverse impacts to the environment and ensure no long lasting evidence of activities. The Environmental Management and Monitoring Plan (EMMP) have been designed within the framework of various regulatory requirements on environmental and socio-economic aspects aiming at the following:

- Minimize disturbance to native flora and fauna
- Prevent air, water, soil and noise pollution
- Avoid sites of historical, cultural and archaeological significance
- Encourage the socio-economic development

Khurmala Power Plant-1000MW is committed to maintaining the highest standards of environmental protection. Compliance with relevant legislations shall be targeted as a minimum objective. In particular, environmental management activities include but are not limited to the compliance with the environmental requirements applicable to the project, such as:

- International Conventions/Guidelines and Agreements to which Kurdistan is a signatory
- World Bank Guidelines on the Environment

7.2 IMPACT MITIGATION TECHNIQUES DURING CONSTRUCTION PHASE

Environment protection measures/precautions shall be adopted to minimize the impacts due to activities related to pre-construction, preparatory construction, machinery installation and commissioning stages and end with the induction of manpower and start up. The impacts during the construction phase on the environment would be basically of transient nature and are expected to reduce gradually on completion of construction activities.

7.2.1 AIR QUALITY MANAGEMENT

During the construction phase, certain amount of dust shall be generated due to the transportation of men, machinery and materials, land clearing and levelling of land, operation of construction machinery/equipment,

construction of foundations, buildings and other requisite infrastructure etc. closed to the construction site. The impacts shall be temporary in nature and shall marginally deteriorate the ambient air quality. However, the following measure shall further reduce the dust generation:

- Land clearing for construction site will be kept at the absolute minimum practicable
- Construction site would be designed to minimize the removal of soil and vegetation
- Topsoil removed will be preserved for later reinstatement purposes by piling it along a boundary of the site
- Dust suppression systems (water sprays) shall be used as per requirement at the construction site

7.2.2 NOISE LEVEL MANAGEMENT

The noise shall be generated mainly due to operations of machinery/equipment used for construction and transportation of materials to the sire. The measures described below shall be able to mitigate the noise levels generated at the site:

- Provision of rubber padding/noise isolators
- Provision of silencers to modulate the noise generated by machines
- Provision of protective devices such as ear muffs/plugs to the workers

7.2.3 WATER RESOURCE MANAGEMENT

The following measures shall be adopted:

- Continuous attempt shall be made to optimize/reduce the use of water
- Continuous attempt shall be made to avoid wastage and leakage of water

7.2.4 WATER QUALITY MANAGEMENT

The proper drainage system shall be constructed at site on temporary basis at an early stage. Salient features of water quality management comprise the following:

- Raw water quality shall be checked on regular basis for essential parameters as per World Health Organization (WHO) guidelines (i.e. **pH, Total Dissolved Solids, Sulphate as SO_4, Chloride, Calcium, Nitrates as NO_3, Magnesium, Manganese, Cyanide, Iron as Fe, Mercury, Arsenic, Zinc, Selenium, Cadmium, Copper, Lead, Chromium, Faecal Coliforms and E. coli)**.
- All the waste from the site shall be treated in a simple water treating unit for everyday use but not for potable water.
- All the debris resulting from the site shall be isolated from the waste water and disposed of separately.
- A sediment trap shall be provided to prevent the discharge of excessive suspended solids.
- An oil trap shall be provided in the drainage line to prevent contamination by accidental spillage.
- Wash down area for cleaning of vehicles wheels shall be provided and wheel wash waste shall be drained properly.

- To prevent contamination from accidental spillage of oil, the storage areas will be bonded and will be inspected and cleaned at regular intervals.

7.2.5 SOIL QUALITY MANAGEMENT

The following measure shall be adapted to prevent/reduce the soil contamination:

- Litter, fuel, oil drums, used grease cartridges will be collected and removed properly
- Dust bins shall be placed at requisite locations
- Lubrication waste oil shall be collected separately in drums and shall be disposed of as per standard practice

7.2.6 LAND USE PATTERN AND ECOLOGY MANAGEMENT

Disturbance during the construction phase shall be confined to the land acquired for the proposed Khurmala Power Plant-1000MW only. To keep the disturbance at a minimum, the following measures are recommended:

- Land clearing for the construction site will be kept at the absolute minimum practicable
- Construction site will be designed to minimize the removal of soil and vegetation
- Topsoil will be cleared and stored for later reinstatement purposes by piling along the boundary of the site

7.2.7 TRAFFIC MOVEMENT

- Minimize use of roads by planning vehicle movements
- Advise traffic police of activities
- Road crossings to be used shall be well marked
- Spray down dirt roads if too dusty

7.2.8 SOCIO-ECONOMIC

- Adequate dialogue with the local population and the authorities while designing compensation packages and close monitoring on the type of land and crop loss
- Regular meeting with the local community and the local authorities.
- The feedback and comments will be taken into serious consideration and will be documented.
- Protection of traditional water structures
- Provision of health and education services
- Provide temporary employment generation opportunities

7.3 IMPACT MITIGATION TECHNIQUES DURING OPERATION PHASE

7.3.1 GAS EMISSION

Environment protection measure/precautions will be adopted to minimize the impacts due to operation of the Khurmala Power Plant-1000MW, which mainly includes stack and fugitive emissions. Gaseous pollutant emission is the main pollutant emitted from various stacks in a Khurmala Power Plant-1000MW. Other emissions include SO_2, H_2S, NO_X, CO_2 and CO.

- Khurmala Power Plant-1000MW settled a strict control and monitoring systems to minimize the air emissions from its operations either dust or gaseous emissions. Stacks in the Khurmala Power Plant-1000MW shall be provided with stack monitoring units
- In the event of failure of any pollution control equipment, automatic tripping in the control system shall be provided to ESP operations, interlocking shall be provided with supply to an electrode, which means that any disruption in the power supply to the electrode will result in the switch-off of the entire unit
- The impact of CO emission is negligible in view of the firing technique of keeping a positive oxygen balance. However, regular monitoring and continuous auto regulation of fuel and air by an automatic combustion control system is proposed to be installed
- Heavy and light vehicles are the other major sources of CO. All vehicles and their exhausts will be well maintained and regularly tested for emission concentration
- Regular preventive maintenance of pollution control equipment shall be carried out
- H_2S and SO_2 concentrations should be followed up where is possible.

7.3.2 FUGITIVE DUST EMISSION

The following measures shall adopt from the proposed unit:

- Khurmala Power Plant-1000MW roads and approach roads shall be made of gravel/concrete
- Areas between various sections and truck parking area shall be made of gravel/concrete
- Open areas within the Khurmala Power Plant-1000MW premises and along the boundaries of the Khurmala Power Plant-1000MW premises shall be covered with a green belt.

7.3.3 EMISSIONS MONITORING MANAGEMENT PLAN

Khurmala Power Plant-1000MW is committed to comply with the local authorities, and WB guidelines and regulations concerning air emission monitoring program. The monitoring activities taking place by Khurmala Power Plant-1000MW is carried out internally through the online analyzers provided to the main stacks at the Khurmala Power Plant-1000MW operations facilities as well as the portable equipment for checking and calibration purposes.

The monitoring of the fuel will be done already before the unloading. From each fuel truck two samples will be pulled and analysed at site as the emissions mainly result from the fuel composition. In addition the values for SO2, NO2, PM10, PM2.5 and Ozone will be monitored after project implementation in the averaging periods

given in the WHO Ambient Air Quality Guidelines. A detailed monitoring plan will be developed during the early project execution phase

7.3.4 NOISE LEVEL MANAGEMENT

Some of the design features provided to ensure low noise levels shall be as given below:

- All rotating items shall be well lubricated and provided with enclosures as far as possible to reduce noise transmission. Extensive vibration monitoring systems will be provided to check and reduce vibrations. Vibration isolators will be provided to reduce vibration and noise wherever possible
- In general, noise-generating items such as fans, blowers, compressors, pumps, motors etc. will be so specified as to limit their speeds and reduce noise levels. Static and dynamic balancing of equipment will be insisted upon and will be verified during inspection and installation
- Provision of silencers shall be made wherever possible
- The insulation provided for prevention of loss of heat and personnel safety shall also act as noise reducers
- Layouts of equipment foundations and structures will be designed keeping in mind the
- requirement of noise abatement
- The Central Control Room(s) provided for operation and supervision of the Khurmala Power Plant-1000MW and equipment will be air-conditioned, insulated and free from Khurmala Power Plant-1000MW noise. Necessary enclosures will also be provided on the working platforms/areas to provide local protection in high noise level areas
- Proper lubrication and housekeeping of equipment to avoid excessive noise generation
- In cases where the operation of the equipment requires the presence of operators in close proximity to equipment, the operators will be provided with the necessary personal protective equipment such as ear muffs, ear plugs etc.
- By provision of the green belt at and around the Khurmala Power Plant-1000MW premises
- Occupational Health and Safety Administration System (OHSAS) for evaluation of exposure to noise pollution on the associated staff and comparing it with permissible exposure and subsequently taking corrective actions will be developed by these measures, it is anticipated that the noise levels in the Khurmala Power Plant-1000MW will be maintained below 90 dB (A). Earth mounds and plantations in the zone between the Khurmala Power Plant-1000MW and the surrounding area would further attenuate noise in the residential area.

7.3.5 SOLID WASTE MANAGEMENT

With the adoption of sustainable development as an approach to manage the environment, quality waste management techniques is essential. The principle aim of waste management is to sustain the environment by ensuring that waste does not contaminate the environment at such a rate or in such a form or quantity as to overload natural assimilative processes and cause pollution. Eliminating or

minimizing waste generation is becoming crucial, both environmentally and economically, for reducing waste-related liabilities and costs.

7.3.6 SOLID WASTE, STEEL STRUCTURES, EMPTY BAGS & WOOD TRASH

- Solid waste, steel structures, and empty bags & wood trash ...etc shall be managed by contract on waste management.

7.3.6.1 OIL SPILLAGE AND LUBRICATING OIL

- Waste oil from Khurmala Power Plant-1000MW or other machinery will be trapped and manually collected and stored in a paved dedicated waste oil storage area.
- The storage area will be provided with paved flooring, containment bundling and covered roofing.
- Containment systems and oil traps will be provided to trap any escape of oil before it can leave the Khurmala Power Plant-1000MW site.
- All potential sources of spillage will be equipped with drainage facilities or drip pans in order to contain spills.
- Lubricating Oil to be collected on a pit or drums then returned back to the supplier where it is recycled and reused again, the drums to be stored in special designated zone in the central stores area.

7.3.6.2 OTHER WASTES CONTROL

- The solid waste generated as municipal waste (Garbage & Households) will be collected and segregated along with the domestic waste generated from the Khurmala Power Plant-1000MW and will be sent to a municipal waste disposal site allocated by local administrative authorities.
- Water Resource/Quality Management

The following measure shall be adopted:

- Continuous attempt shall be made to optimize/reduce the use of water in the Khurmala Power Plant-1000MW
- Continuous attempt shall be made to avoid wastage and leakage of water
- A regular record of water tables shall be maintained
- Raw water quality shall be checked on a regular basis for essential parameters as per WHO guidelines before use
- The drainage system that shall be used for carrying the wastewater to storage tanks shall be periodically checked for any leakage

7.3.7 WATER POLLUTION MANAGEMENT

Wastewater generated from Khurmala Power Plant-1000MW operation, which shall be mainly from domestic usages, the water treatment and blow downs shall be treated in a simple effluent treatment plant (ETP). ETP shall consist of primary to tertiary treatment and treated water shall be used for dust suppression, green belt

development and in the Khurmala Power Plant-1000MW operation to the possible extent. Regular monitoring shall be carried out to assess any adverse impact.

7.3.8 HOUSEKEEPING

The significant features of the practices adopted for the proposed Khurmala Power Plant-1000MW shall be:

- Mechanized cleaning of roads and floor areas inside the Khurmala Power Plant-1000MW premises by using a road sweeper and mobile vacuum cleaner on a regular basis
- Training shall be given on a regular basis to all workers regarding awareness on the importance of cleanliness
- Careful garbage transportation to dumping site and disinfection of the transport vehicle's body
- Construction of suitably designed drains all along the roads and boundary of the Khurmala Power Plant-1000MW premises

8. OCCUPATIONAL HEALTH AND SAFETY

8.1 HAZARD ASSESSMENT

A Risk Assessment process will be developed and implemented, ensuring that all necessary control measure to eliminate or mitigate the risk is taken. The aim is to reduce the risks to ALARP-As Low As Reasonable Practicable" and look for the following hazardous source:

- All closed areas are equipped with the proper ventilation systems to ensure employee protection from suffocation, harmful gases and dust particles. All employees, regardless of their job description, are provided with the necessary personal protective equipment. Every employee is given safety shoes, a safety helmet, earplugs and safety goggles. Employees with specified jobs are given the necessary personal protective equipment for the job, such as heat-resistant gloves, heat-resistant jackets, earmuffs and respiratory equipment in dusty working places
- All workers engaged in the material handling system shall be regularly examined for lung diseases
- Any worker found to develop symptoms of toxic gases related diseases should be immediately changed over to another job in a cleaner environment within the Khurmala Power Plant-1000MW
- All job activity will be controlled by work permit system to make sure that risk assessment prior to work will be carried out.
- The SD & HSE carries out constant monitoring of emissions and noise in all workplace areas. Portable specific measuring equipment will be used to carry out measurements on a routine basis. Stacks are equipped with online monitoring systems to control the emission of dust and gases released.

8.2 HEALTH AND SAFETY TRAINING

To ensure a high level of competency and awareness in the area of occupational health and safety, training will be provided in all relevant areas. This training will be integrated with the creative LEARNING program,

and place a strong emphasis on risk assessment and management. **KAR Power** will train its employees in health and safety in a manner that is consistent with the **KAR Power** Operation regulation. Training will also comply with any legislative requirements.

Formal training for all employees (including contractors) at all levels within Khurmala Power Plant-1000MW will be provided, and shall address the following:

- Health and safety awareness
- Risk assessment principles
- Principles and practice in health and safety
- Induction for new employees and transferred personnel (general and specific safety procedures required by the job)
- Changes to Khurmala Power Plant-1000MW, equipment or processes
- Personal Protective Equipment use and care as required.
- Training records are to be made and maintained in a corrective manner. Such records will relate to training, competence, licenses, certificates and operating authorizations.

9. CONCLUSION

The study concludes that:

- The environmental impact of the activities is site specific and reversible, provided that the proposed mitigation measures are followed;
- It is not expected that the operations will cause any irreversible impacts, however, all precautions assumed to be considered;
- The activities associated with the project activity can be conducted with minimal impact to the environment and the lives of local people and their communities;
- Potential environmental impacts can be successfully mitigated thought the adoption of environmental operating standards based on the EMMP;
- The proposed activities would generate temporary/ permanent employment in the region during site preparation and project activities, supply of raw material, auxiliary and ancillary works.

10. RECOMMENDATION/ MITIGATION MEASURES

1) Compliance to Alberta Ambient Air Quality Objective air quality limitations concerning (Stack and Green House Gas Emission Management).

2) As upper layer meteorological data is not available for Iraq. Even Stability class and mixing height for ground layer are not available. Hence **ISCST3** software is recommended to be used for dispersion modelling analysis, by using by default internationally available ground layer mixing height and stability class. Meanwhile, **ISCST3** is software of Industrial Sources Complex Short Term model version 3 (ISCST3) approved by Environment Protection Agency (EPA) USA.

3) For detection of destiny and fate of emissions, an Air Quality Management Plan should be put in place by **KAR Power** for the site prior to any production and flaring activities taking place. In this context MapCom Environmental Consultants have extensive experience working in such field.

4) Continuous online meteorological data (i.e. wind speed, wind direction, humidity, precipitation ...etc) should be monitored at project site;

5) Concerning abatement of atmospheric pollutants; the following should be followed carefully:

C. The main categories of CO_2 abatement potentials include:

- Stacks in the Khurmala Power Plant-1000MW shall be provided with automatic stack monitoring units (i.e. Equipped with online monitoring systems to control the emission of gases released).
- Energy efficiency: technical and operational measures to reduce fuel and power consumption per unit.

D. To control emissions (from flaring stack) the following measures shall be adopted from the proposed unit:

- The height of flaring stack should be more than 10m, for good dispersion of gaseous pollutants.
- On the site roads and approach roads shall be made of gravel/concrete
- Areas between various sections and truck parking area shall be made of gravel/concrete
- Open areas within the project premises and along the boundaries of the Khurmala Power Plant-1000MW premises shall be covered with a green belt.

6) Emission from Source;

Associated gas brought to the surface is sometimes disposed of at onshore facilities by venting or flaring to the atmosphere. However, flaring or venting are also important safety measures used on onshore oil and gas facilities to ensure gas and other hydrocarbons are safely disposed of in the event of an emergency, power or equipment failure, or other plant upset condition. Measures consistent with the

Global Gas Flaring and Venting Reduction Voluntary Standard (part of the World Bank Group's Global Gas Flaring Reduction Public-Private Partnership (GGFR program3) is recommended. The following pollution prevention and control measures should be considered for gas flaring:

- Implementation of source gas reduction measures to the maximum extent possible;
- Use of efficient flare tips, and optimization of the size and number of burning nozzles;
- Maximizing flare combustion efficiency by controlling and optimizing flare fuel / air stream flow rates to ensure the correct ratio of assist stream to flare stream;
- Minimizing risk of pilot blow-out by ensuring sufficient exit velocity and providing wind guards;
- Use of a reliable pilot ignition system;
- Minimizing liquid carry-over and entrainment in the gas flare stream with a suitable liquid separation system;
- Operating flare to control odour and visible smoke emissions (no visible black smoke);
- Locating flare at a safe distance (i.e. at least one kilometre) from local communities (e.g. Helawa village) and the workforce including workforce accommodation units;
- Implementation of burner maintenance and replacement programs to ensure continuous maximum flare efficiency;
- Metering flare gas.

Flaring volumes for new facilities should be estimated during the initial commissioning period so that fixed volume flaring targets can be developed. The volumes of gas flared for all flaring events should be recorded and reported. Feasible alternatives should be evaluated for the recovery of hydrocarbon test fluids, while considering the safety of handling volatile hydrocarbons, for transfer to a processing facility or other alternative disposal options.

7) Ambient Air Quality;

Wherever hydrogen sulphide (H_2S) gas may accumulate the following measures should be considered:

- Development of a contingency plan for H_2S release events, including all necessary aspects from evacuation to resumption of normal operations;
- Installation of monitors set to activate warning signals whenever detected concentrations of H_2S exceed 7 milligrams per cubic meter (mg/m^3). The number and location of monitors should be determined based on an assessment of plant locations prone to H_2S emission and occupational exposure;
- Provision of personal H_2S detectors to workers in locations of high risk of exposure along with self-contained breathing apparatus and emergency oxygen supplies that is conveniently located to enable personnel to safely interrupt tasks and reach a temporary refuge or safe haven;

- Provision of adequate ventilation of occupied buildings to avoid accumulation of hydrogen sulphide gas;
- Workforce training in safety equipment use and response in the event of a leak.

8) Oil spillage and lubricating oil;

- Lubricating oil to be collected on a pit or drums then returned back to the supplier where it is recycled and reused again, the drums to be stored in special designated zone in the central stores area.

9) A Risk Assessment process will be developed and implemented, ensuring that all necessary control measure to eliminate or mitigate the risk is taken. The aim is to reduce the risks to ALARP - As Low As Reasonable Practicable", and look for the following sources:

- All closed areas are equipped with the proper ventilation systems to ensure employee protection from suffocation, H_2S equipment, harmful gases and dust particles. All employees, regardless of their job description, are provided with the necessary personal protective equipment. Every employee is given safety shoes, a safety helmet, earplugs and safety goggles. Employees with specified jobs are given the necessary personal protective equipment for the job, such as heat-resistant gloves, heat-resistant jackets, earmuffs and respiratory equipment in dusty working places.
- All workers engaged in the operation of the Khurmala Power Plant-1000MW facility shall be regularly examined for lung diseases.
- All job activity will be controlled by Permit to Work System to make sure that risk assessment prior to work will be carried out.
- The SD & HSE Department ensures that monitoring of emissions and noise in all workplace areas. Portable measuring equipment is used to carry out measurements on a routine basis.

10) Noise Levels;

Some of the design features provided to ensure low noise levels shall be as given below:

- All rotating items shall be well lubricated and provided with enclosures as far as possible to reduce noise transmission. Extensive vibration monitoring systems will be provided to check and reduce vibrations. Vibration isolators will be provided to reduce vibration and noise wherever possible
- In general, noise-generating items such as fans, blowers, compressors, pumps, motors etc. will be so specified as to limit their speeds and reduce noise levels. Static and dynamic balancing of equipment will be insisted upon and will be verified during inspection and installation
- Provision of silencers shall be made wherever possible
- The insulation provided for prevention of loss of heat and personnel safety shall also act as noise reducers

- Layouts of equipment foundations and structures will be designed keeping in mind the requirement of noise abatement
- The Central Control Room(s) provided for operation and supervision of the project and equipment will be air-conditioned, insulated and free from project noise. Necessary enclosures will also be provided on the working platforms/areas to provide local protection in high noise level areas
- Proper lubrication and housekeeping of equipment to avoid excessive noise generation
- In cases where the operation of the equipment requires the presence of operators in close proximity to equipment, the operators will be provided with the necessary personal protective equipment such as ear muffs, ear plugs etc.
- By provision of the green belt in and around the project premises
- Occupational Health and Safety Administration System (OHSAS) for evaluation of exposure to noise pollution on the associated staff and comparing it with permissible exposure and subsequently taking corrective actions will be developed
- Regular noise surveys will be conducted to ensure the on-site and ambient maximum levels are not exceeded. By these measures, it is anticipated that the noise levels in the project will be maintained below 90 dB (A). Earth mounds and plantations in the zone between the project and the surrounding area would further attenuate noise in the residential area.

Respectfully submitted to;

KAR Power, Member of KAR Group

MapCom

D Ganjo

July 2013

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Some Times a Photo Speaks More Than A Thousand of Words!

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12. APPENDICES

"Appendix 1"

1. The Ministry of Environment (MOE)/ Erbil, Iraq.

1.2 Underpinnings for the Establishment of the Ministry of Environment (A Synopsis of Duties):

Kurdistan has always been known for its pure nature and environment until the destruction that the former government of government of Iraq inflicted on the area. Years of displacement, massacres, destruction and chemical attack on villages, led to urbanization and subsequent decline in environmental standards among other social and economical changes in the Kurdistan region.

After gaining autonomy in 1992, the Kurdistan region slowly resuscitated itself with the aid of the international community as well as the willingness of the people to develop. This has not necessarily been done in a well designed pattern. Until recently development and construction programs in the cities, towns and villages of Kurdistan lacked environmental protection measures during the planning and implementation processes. Acknowledging this issue, the environment became an important agenda for the Kurdistan Regional Government in Iraq. Subsequently, the government established the Ministry of Environment1 on May 2006 to establish regional environmental standards applicable locally and in line with global targets for sustainable development; and to commit itself to the integration of its principles and tackling climate change.

The President and the Prime Ministers' offices of Kurdistan pay a great deal of support to the ministry. The latter however is at its infancy stage and environmental policies are yet to be crystallized and implemented. Legislation development benefits from those existing in the central Iraqi government Ministry of Environment. These are being reformed to adapt to the Kurdish regions. The duties, responsibilities, objectives and the components of the ministry are however reasonably established. The Kurdistan National Assembly nominated Mr. Dara Mohamed Ameen to be the first Minister of Environment in Kurdistan to lead, develop and expand the ministry mission.

The strategic planning of the ministry sets measurable targets, including those related to waste management, water and river management, capacity building and institutional development and environmental, social and health impact assessments. GIS is already being used to assess the region to help guide the authorities with the decision making process to improve water and land management.

1.3 Aims, Objectives and the Duties of the Ministry of Environment:

The aim of the ministry is to protect and enhance the environment and natural resources locally and as capacities develop regionally and internationally. The duties of the ministry are evolving as lessons being learned from the experiences of the region. It is also the aim of the ministry to learn from the experiences of other countries and regions, both those with similar conditions to those of Kurdistan and developed countries.

1.4 Immediate and specific targets set and active by the ministry are:

First: Developing and proposing overall policies and short-term and long-term strategic plans for the protection and the improvement of the environment.

Second: Proposing policies for the protection of the environment to control and tackle pollution issuing guidelines for controlling environmental health problems and developing safety standard through monitoring.

Third: promoting coordination and collaboration between the ministry and government and non-governmental organizations and institutions as well as the private sector to mobilize human and material resources for promoting and enhancing the environment.

Fourth: Striving to abide by international agreements, conventions and protocols on the environment.

Fifth: Setting measures to follow-up monitor and assess polluters and the factors that affect the uptake of safety measures in coordination with the relevant stakeholders including government and public and private sectors. The ministry is in the process of developing appropriate policies to use economic instruments and polluter- pays principles in its long-term strategic planning.

Sixth: Conducting environmental surveys and impact assessments in coordination with relevant authorities. In its long-term strategic planning, the ministry will require from developers with major projects to undergo environmental, social and health impact assessments to be granted with planning permission.

Seventh: Investing in appropriate technology for efficient and accurate data collection and establishing and conducting lab tests for environmental samples.

Eighth: Strengthening the media and communication department and publishing of research studies about the environment, and dissemination of environmental awareness and engaging the civil society in this field.

Ninth: Coordination with the Ministry of Higher Studies and Scientific Research for promoting and conducting research studies on environment. This will help with efficient and accurate data collection and analysis for use by managers and policy makers.

Tenth: monitoring and evaluating of published reports presented by the local authorities on environmental impact of proposed, ongoing and completed projects. The ministry also assesses these projects for permission (approving or refusal) of such projects for implementation. The ministry is developing guidelines for industries and sectors.

Eleventh: Hazardous waste management through impact assessment, remediation and rehabilitation of chemical and nuclear weapons in coordination with relevant authorities and the private sector. Application of

appropriate methods those protect human beings from harmful radiation. Finding safe and appropriate methods for waste management such as garbage disposal and treatment and containing hazardous waste.

Twelfth: Improving the institutional capacity of the ministry and its cadre through capacity building workshops, training and investing in research and developing expert specialties.

Thirteenth: Developing policies and guidelines on water treatment and management including sustainable drainage systems.

Fourteenth: Networking locally, regionally and internationally with and participation in world conference on the protection of the environment.

Fifteenth: Promoting sound forest and agricultural management practices in the region so that we minimize the use of chemicals (including pesticides and herbicides) in agriculture and also to help minimize land degradation, Stalinization and floods.

Sixteenth: Developing sustainable tourism policies in collaboration with government authorities, the civil society and the private sector.

1.5 Ministry Structure- Divisions of the Ministry:

In addition to its main office in Dohuk, the ministry has directories in Erbil, Sulaimaniya and Dohuk that report to the main office. The attachment shows the organizational structure of the ministry in detail. In summary the ministry consists of the following divisions, which is in continual reform, development and restructuring:

1. The Minister's Office
2. The Deputy Minister's Office
3. Consultants
4. The General Directorate of the Ministry Office (Diwan): Its duty is the management and organization of the Ministry Office administratively, financially, and legally. It also undertakes planning, follow-up, and ministry development.
5. The General Directorate of Environmental Awareness and Information: Its duty is environment awareness rising by conducting seminars, training courses, and advertisement as well as establishing environmental media channels to deliver the activities of the ministry and containing environmental threats. This office publishes posters and magazines for both children and adult and in collaboration with ministry of education attempts to integrate the environment in school curriculum.
6. The General Directorate of Technical Affairs and Protection from Radiation: Its duty is the establishing an overall system for remediation and protection of land, water and air from chemical radiation and hazardous substances. It also formulates plans and programs for this purpose. Furthermore, it is directly involved in undertaking research studies in coordination with the universities

and the scientific canters inside and outside of Kurdistan. The Directorate monitors the companies and provides them with what is known as Standard Operation Procedures (SOP).

This directorate supervises the changes in natural resources including information gathering and protection of designated sights, and safeguarding, birds, animals and plant species. It develops and establishes central labs for analyzing environmental and gradually develops special instructions about protection and nurturing such resources.

In collaboration with the Ministry of Natural Resources, the Ministry of Environment addresses environmental concerns arising from oil extraction in the region. By doing so, it alerts and provides guidance to the relevant stakeholders on environmental protection measures that are necessary to control over-extraction and land and water pollution that may arise from such businesses.

1.6 The Council of Environment Protection and Improvement:

The minister is the chairperson of this council and the deputy minister is the vice-chairman. The members consist of the general directors of each directorate of the ministry of environment, in addition to a member from the Ministry of Municipality, Higher Studies and Scientific Research, Planning, Water Sources, Interior, Agriculture, Health, Industry, Natural Resources, Tourism, Electricity, Commerce, Transportation, and an appointed member by the Minister himself who is expert in the field of environment. The minister has also the authority to appoint other experts and competent representatives from other ministries when needed for the protection and improvement of Kurdistan environment.

1.7 The Council of Environment Protection and Improvement of the Governorate:

The Governorate Council is formed in each governorate of Kurdistan. The governor or his representative is the chairperson. His/her duties will be the protection and improvement of the environment within the boundaries of the governorate and will inform the Ministry of Environment and the relevant authorities about any developments that concern the environment.

"Appendix 2"

Executive Summary in Kurdish Language

ثرِؤذةى دامةزراندنى ويَزطةى طازى خورمةلَة "1000 ميَطاوات" بؤ بةرهةمهيَنانى وزةى كارةبا لة ناوضةكة, ئةمةش بةمةبةستى دابينكردنى وزةى كارةباى و ثتر بةهيَزكردنى بارى ئابورى كوردستان, هةروةها بةمةبةستى راكيَشكردنى كؤمثانيكانى دةرةوةى هةريَم بؤناو كوردستان و دابينكردنى وزة, كؤمثانياى " **KAR Power**" ئةم ثرِؤذةى ثيَستيَردرا. ئةمةش لة ناوضةى بلؤكى (خورمةلَة) كة سةر بة ثاريَزطاى هةوليَر ئةنجام دةدريَت. بؤ ئةوةى ئةم ثرِؤذةش بةطؤيَرةى ياساو بنةماسةركةشةكانى ذينطةثاريَزى و ثيَوةرةكانى نيَودةولَةتى هةروةها رِيَنماييةكانى وةزارةتى ذينطة و وةزارةتى سامانة سروشتييةكانى كوردستان بيَتة دامةزراندن ئةم رِاثؤرتة كة بريتية لة ثوختى ثرِؤسةى كاريطةرى ثرِؤذةكة لةسةر ذينطةى دةوروبةر لةلايةن كؤمثانياى (ماثكؤم) هاتة ذيَر تويَذينةوة بة طويَرةى ستاندةرى بانكى نيَودةولَةتى و ياساى ضاككردن و ثاراستنى ذينطةى كوردستان (ذمارة 8 لة سالَى 2008). ئةم ثرِؤسةى بةردةستيش تةواوى لايةنةكانى ثيَوةست بة ذينطةى خستة ذيَر ثشكنين و ليَكؤلَينةوة كة ئةمانةى خوارةوة دةطريَتةوة:

- ثشكنينى ثيَكهاتةى فيزياوى و كيمياوى خاكى ناوضةكة, جيؤلؤجيا, سةرضاوةكانى ئاوى رِؤيشتو, ئاوى ذيَر زةوى, جؤرى ئاوةكان, ذاوةذاوى دةنط, هاتو ضؤ, هةروةها بارى ئاو و هةواى ثانتايى بلؤكةكة.
- زةوى و بةكارهيَنانى, رِوةكى ناوضةكة, دارستانةكان, طياندارانى كيَوى, ثاشماوة ديَرينةكانى ناوضةكة.
- زيندة ذينطةى ناوضةكة, كة ئةمانة دةطريَتةوة: شيَوازةكانى رِوةك, وةك دار و دةوةن و طذ وطيا, جؤرةكانى طياندارانى وةك: ميَرو و بالَندة, ماسى, شيردةرةكان, وة جةختيش كرا لةسةر زيندةوةرة دةطمةنةكان وة ئةوانةى لةذيَر مةترسى فةوتانن, سةرةراى هةمةضةشنى شيَوازةكانى ذيان لة ناوضةكة.
- بارى ئابورى و كؤمةلاَيةتى طوند و ديَهاتى ناوضةكة, وةك قوتابخانة و فيَركردن, تةندروستى و نةخؤشخانةكان, ضالاكيةكان, ئايين, هةروةها بارى كؤمةلاَيةتى ناوضةكة.
- ثيَشنياركرن و ئةنجامدانى ثلانيَكى تؤكمة بؤ كؤمثانياى ناوبراو وةك رِيَنمايى شياو بؤ ئةوةى هيض سامانيَكى سروشتى و ثيَكهاتة بنةرِةتييةكانى ذينطةى كوردستان زةرةرمةند نةبن لة ئةنجامدانى ثرِؤذةكة. ئةمةش بة طويَرةى رِيَنماييةكانى وةزارةتى ذينطةى كوردستان و ستاندةرةكانى بانكى نيَودةولَةتى.

دةكريَت ئةنجامى ئةم تويَذينةوةى بةردةستيش لةم ديَرانةى خوارةوة ضرِ بكريَتةوة:

1. بةطشتى وة بةطويَرةى نةخشةكانى ئاسمانى دةركةوت كةوا ناوضةى ثرِؤذةكة (بلؤكى خورمةلَة) كة رِوبةرى نزيكةى 370 كم^2 دةكةويَتة ناوضةى دارايى ثاريَزطاى هةوليَر, رِةقى بةرداوى و طرد و دؤلَ و دةشتى ثان و ثؤرة هةنديَك ناوضةى بةرزة 300 بؤ 429 م لةسةر ئاستى دةريا, جيولؤجياى ناوضةكة دةطريَتةوة بؤ ضةرخى زؤر كؤنى مايؤسين, بةرزاييةكان لة باكورى رِؤذاوا بةرةو خواروو رِؤذهةلات لاردةبيَتةوة.
2. دةرئةنجامى ثلةى طةرمى سالأنةى ناوضةكة 25 بؤ 40 ثلةى سةدية, ئاو و هةواى ناوضةكة بةطشتى لة هاويندا طةرم و سارد لة زستاندا.لة هاويندا رِةنطة ثلةى طةرمى بطاتة 45 ثلةى سةدى و لة زستاندا -2) ثلة.
3. خةلَكى ناوضةكة بةطشتى خةريكى مةرِداري و ضاندنن,
4. ضالاكى ثيشةسازى قورس لة ناوضةكةدا هةية (وةك كارطةى ثالأوتنى نةوتى خاو, كارطةى طةضكارى ....هتد), سةرضاوةى ئاو بة ثلةى يةكةم ئاوى بارانة, هةروةها ئاوى بيرى ئيرتيوازى بة هةلَمة بةكارديَت بؤ هةمان مةبةست.
5. زيندة ذينطةى ناوضةكة: ئةنجامى طةرِان و ثشكنينى ئةم ثرِؤسةى بن دةست ئةوانةى خوارةوةى دةستكةوت:
   - ثرِؤذةكة جؤرةها ذينطةى جياوازى ثان و ثؤر دةطريَتةوة (ئاوى و وشكانى),
   - هيض ذينطةيةكى ناوضةكة لةذيَر هيض كاريطةريةكى ثيسبوندا نين,
   - ضالاكيةكانى ئةم ثرِؤذة هيض كاريطةريةكى نابيَت لةسةر ذينطةكانى ناوضةكة (ئةطةر هةشبيَت كاتية),
   - هيض جؤريَك لة شيَوازى ذيانة بةدةطمةنةكان لة ناوضةكة نةبينرا,

- هیض شیَوازیَکی ذیان (ئەوانەی خەریکة قەلاضۆ دەبن) لة ناوضەکة نەبینرا,
- هیض دارستانی ضرِ و ثرِی سروشتی لة ناوضەکەدا نیة,
- ناوضەی ثرِۆژەکة تەنیا ثیَرِەویَکی بالَندة کیَویەکانة.
- ناوضەکة بة طشتی شویَنیَکی دیاركراو/تایبەتمەند نیة بۆ رِوەك یان طیاندارة دەطمەنەکانی كوردستان. بەطشتی مار, دوثشك, مشك,بەرازی كیَوی, رِیَوی, طورط لة ناوضەکەدا هەن, هەمو رِوەکەکانی ناوضەکة خۆمالَین.

6. سەرضاوەئاوییەکانی ناوضەکة (سەر زەوی/ ذیَر زەوی), تا رِادەیەك ثیسبون, هەندیَکیان طران (ناساز) بوون, تفت, برِی خویَی تواوة مامناوەندی, هەندیَکیشیان ثیسبون بة بەکتریا, قولَی /ئاستی ئاوی ذیَر زەوی 50 بۆ 75 مەترة. ئاوی بیرەکان بەطشتی باشة دەشیَت بۆ خواردنەوة و ئاودیَری و بەکارهیَنانی ناومالَ.
7. لەثشکنینی ماددة ثیسکەرەکانی هەوا دەرکەوت کەوا رِیَذەی هەردوو طازی طۆطرد و هایدرۆکاربۆنیەکان لة ناوضەکة کەمیَك بەرزی بەخۆوة دەبینیَت! هۆکاری ئەوەش رِەنطة بطەرِیَتەوة بۆ شیَوازی کۆنی بەکارهیَنانی دار و خەلَوز و قیرتاو نەکردنی رِیَطاوبانەکان بوونی کارطەی ضیمەنتۆی تاسلوجة و بازیان, کارطەی طەضکاری لة ناوضەکة.
8. ناوضەی ثرِۆژەکَة ذاوەذاوی تیَدا نیة (کثة بیَ دەنطة). هاتوضۆش لة ناوضەکة بەطشتی بة تایبەتی رِیَطای سەرەکی هەولیَر – سلَیمانی وة سلَیمانی- کەرکوك لة نیَوان مامناوەندی بۆ بەرزة.
9. خۆلَی ناوضەکة ماددەی هایدرۆکاربۆنی زۆرة, ئاسن و کانزاکانی زۆرة, ئۆرطانەماددەی تیَدایة برِی لم کەمیَ بەرزة تیَیدا, بۆ ضاندن و باغداری دەشیَت.
10. ناوضەکة هیض ثاشماوەی دیَرینی کۆنی تیَدا نیة.
11. لەم تویَذینەوة دەرکەوت کەوا خەلَکی ناوضەکة هیض لاریەکیان نیة لة سەر ئەنجامدانی ئەم ثرِۆژة, ضونکة دەبیَتة مایەی دابینکردنی کار و داهاتی باش و رِیَطاوبان بۆیان,
12. تیمی ئسثۆری ذینطة کۆمەلَیَك خالَ ثیی◌ٍشنیار دەکات وەك هیَورکردنەوة بۆ وەلاوەنانی کاریطەریەکانی ثرِۆژەکة لەسەر ذینطەی ناوضەکة.

تاکة خالَ کة لة ئەنجامی ئەم ثرِۆسەیة (ئەم ثشکنینة) کة دەکریَت بطوتریَت ئەوەیة کەوا ئەم ثرِۆژة/ ضالاکیة هیض کاریطەرییَکی خراثی دریَذخایەن ناکاتة سەر ذینطەی ناوضەکة, بەلاَم مەرجة ثیَشنیارەکانی تیمی ئسثۆر کة لەم رِاثۆرتەدا هاتووة بەهەند وەرطیریَت لة لایەن کۆمثانیای **"KAR Power"** بۆ بنبرِکردن و هیَورکردنەوەی کاریطەریة خراثەکان.